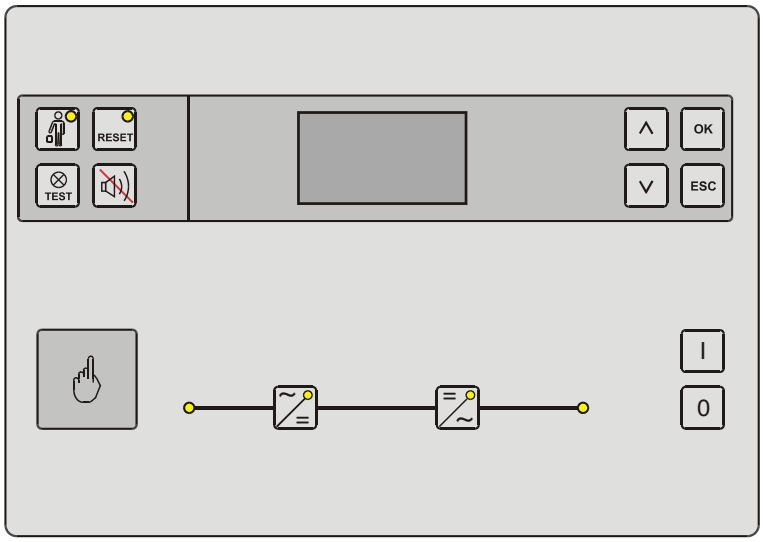
PILLER

Power Systems

Operating manual

APOCONV AC

100 – 500kVA



A Langley Holdings Company

The descriptions and specifications in this operating manual are dated 29.02.2023.
We reserve the right to change without notice!

2 INTRODUCTION

Many systems and devices require a voltage having a frequency that is not directly supplied by the mains supply. To supply the load, transformers are used which, on the one hand, deliver the required voltage and frequency and, on the other hand, to a certain extent smooth out irregularities in the mains supply.

This manual describes the following converter system:

- APOCONV 100 – APOCONV 500

When you have read the explanations you will know how to handle the equipment and make use of all of its advantages.

NOTE Naturally, an operating manual cannot cover every conceivable installation, operating, maintenance or servicing situation.
Should problems arise, or if the data in the manual is not sufficiently detailed or you require further information, please contact our representatives who will be pleased to give you further assistance.

Fig. 2-1 General view APOCONV 100/120 kVA and APOCONV 160/200 kVA

Fig. 2-2 General view APOCONV 300 kVA and APOCONV 400/500 kVA

2.1 Information about the operating instructions

These operating instructions provide important advice about handling the plant. Adherence to all stated safety instructions and operating instructions is a prerequisite for safe working.
In addition, the local accident prevention regulations in force for the area of application of the system, and general safety requirements, shall be followed.
All the operating instructions, particularly the chapter dealing with safety, and the respective safety instructions, must be read prior to starting all work on the system. The operating instructions are an integral part of the product and must be kept in the immediate vicinity of the system and made accessible to the personnel at all times.

2.2 Limitation of liability

The relevant standards and regulations, state of the art, as well as our knowledge and experience accumulated over many years, have been taken into account in the compilation of the details and statements in these operating instructions.

The manufacturer bears no responsibility for damage due to:

- Non-observance of these operating instructions
- Improper use
- Employment of untrained personnel
- Unauthorized modifications

In the case of special versions, the actual scope of delivery, the taking up of additional order options or the latest technical modifications can deviate from the explanations and representations described here.

2.3 Protection of copyright

The operating instructions should be treated confidentially. They are exclusively intended for use by personnel dealing with the system. The transmission of the operating instructions to third parties is not permitted without the manufacturer's written permission.

The contents, texts, drawings, images and other representations are protected by copyright and subject to industrial property rights. Any misuse is punishable in law.

2.4 Guarantee conditions

The guarantee conditions are in the form of a separate document in the sales documentation.

2.5 Customer service

Technical information is available from our Customer Service Department.
The relevant contacts can be reached at any time by telephone, fax, email or the Internet, details of which can be found under the manufacturer's address.

3 SAFETY NOTES

IMPORTANT SAFETY INSTRUCTIONS SAVE THESE INSTRUCTIONS

This manual contains important instructions for all models of the APOCONV converter system.

3.1 General warn and safety notes

The converter system APOCONV is a piece of electrical equipment which carries voltages and currents that are hazardous to personnel. You must therefore observe the following points.

1. Installation, operation and maintenance of the converter system must only be carried out according to the instructions in this manual.
2. Provide suitable measures to ensure that only operating and maintenance personnel have access to the room.
3. Ensure that the equipment is handled only by well-trained and authorised personnel.
4. The installation of the converter system, as well as the maintenance and repair operations, must only be carried out by personnel with specialist electrical training.
5. When working around the converter system, do not step onto the roof or place any objects on it!
6. All personnel who have to work on the equipment should be familiar with first-aid procedures relating to electrical accidents.
7. The doors of the control cabinets should be kept closed while the converter system is operating. With the doors open there is a risk of contact with "live" parts.
8. Even when the converter system is completely switched off, a few internal parts are "live" while they are connected to the AC supply network, the battery or other converter sets connected in parallel.
9. Work on the converter system must only take place with the equipment switched off. A warning notice should attached at the disconnection point or points to prevent unintentional switch-on.

   Do not switch on
   Work in progress at
   Site.....
   Panel to be removed only by
   .....

10. Ensure all -pole disconnection of system components after switching off the supply and before starting work on the system.
11. Built-in capacitors can remain charged up, even when the complete system is "dead". They should be suitably discharged by trained personnel before contact is made with the connections.
12. Fuses must not be rewired or shorted out and rewired fuses must not be used.
13. When replacing fuses, only the same or lower current ratings and types (slow-blow, quick-acting, very quick-acting) should be used.

14. To buffer important adjustment parameters a built-in Lithium battery is used. The minimum operating life time of this battery is about 5 years. After this time the battery must be exchanged to avoid loss of data respectively malfunctions. Exchange of battery see chapter 10.2.
15. The environment of the converter system must be kept as clean as possible and always be free of aggressive agents. Particular care must be taken to prevent metallic or other electrically-conducting dust particles from being sucked in through the air inlet.
16. Non-compliance with the climatic conditions can impair operation and cause the converter system to malfunction.
17. The local electricity supply company's current regulations and other safety instructions (e.g. VDE 0100) must be observed.
18. Warning signs bearing the following wording must be attached to all disconnecting switches of the primary supply located outside the system:

    Disconnect converter system before working on this electric circuit!
    To inform electrical personnel that the relevant circuit supplies a converter system.
19. Warning - high leakage currents! Install earth connection before connecting supply circuit!
20. A remote emergency switching device for the converter system shall be installed at a suitable location (e.g. in the distribution system). Interfaces for this are provided in the converter system. Activating this emergency switching device blocks further supply to the load in this operating state.

3.2 Explanation of symbols and notes

Special instructions are highlighted in the text by warning symbols and notes. The various symbols have different meanings:

WARNING

appears alongside all instructions which must be followed exactly in order to eliminate personal injury and corruption/destruction of data.

IMPORTANT appears alongside all instructions which must be followed in order to eliminate damage to equipment and/or malfunctions.

NOTE indicates instructions which must be followed during installation, operation or maintenance/repairs.

Warning signal: danger of electric shock

3.2.1 Labelling

Warning: Risk of electric shock
Only trained electrical personnel may operate in work areas showing this warning.
Unauthorized persons must not enter such work areas or open cabinets bearing these labels.

3.2.2 Circuit-breaker symbols

Off (colour: black)

On (colour: black)

3.3 Basic hazards

DANGER!
Dangerous electric current!
Immediate danger to human life through contact with 'live' parts. Possible danger due to damaged insulation or individual components.

- In the case of damaged insulation, disconnect the power immediately and arrange repairs.
- Only trained electrical personnel should be permitted to work on electrical equipment.
- Before working on the electrical equipment check that it is isolated and made 'dead'.
- Disconnect the power supply and secure against reconnection before carrying out maintenance, cleaning or repairs.
- Do not bypass fuses or otherwise render them unserviceable.

3.4 Intended use

The converter system is designed and constructed exclusively for the specified application described here.
The UPS system is designed and constructed exclusively for the specified application described here.
The frequency converter system is exclusively used to convert an AC voltage into an, in the specification defined, AC voltage, and, with appropriate energy storage equipment, to bridge mains outages, short breaks, voltage distortion, voltage and frequency deviations.
The frequency converter system is provided exclusively for commercial use.

WARNING

Danger due to misuse!
Any use over and above that which is stipulated and/or different use of the system can lead to hazardous situations.

- Do not subject the system to loads exceeding those specified in the technical data.
- Do not connect the system to mains voltages other than those specified in the technical data.

Claims of any kind arising from misuse are excluded.

3.5 Operator's responsibility

The system is used in the commercial/industrial field. The operator of the system is therefore subject to the legal obligations relating to safety at work.
In addition to the references to safety at work in these operating instructions, the relevant safety, accident prevention and environmental regulations relating to the field of application of the system must be observed. The following apply in particular:

- The operator must familiarize himself with the relevant safety at work regulations and in a risk assessment also determine hazards which arise from the special working conditions at the location of the system. He must translate these into the form of operating instructions for the operation of the system.
- During the entire period of use of the system, the operator must check whether the operating instructions drawn up by him meet the latest regulations, and adapt these instructions if necessary.
- The operator must ensure that all employees who deal with the system have read and understood these instructions. In addition, he must instruct the personnel at regular intervals and inform them of the dangers.
- The operator must provide the necessary personal protective equipment.

3.6 Personnel requirements

WARNING

Risk of injury due to inadequate qualifications!

Improper handling can result in serious personal injury and damage to property.

- Only persons named in the respective chapters of these instructions are permitted to carry out particular tasks.
- Keep unqualified personnel away from hazardous areas

The operating instructions list the following qualifications that are required for various fields of activity:

- Operator's personnel
  have, under instruction by the operator, been informed of the tasks assigned to them and the possible dangers of improper action.
- Manufacturer's and technical service personnel
  Due to their specialist training, knowledge and experience, as well as knowledge of the relevant standards and regulations, these personnel are able to work on the system and independently recognize and avoid possible dangers.
  The manufacturer's personnel and technical service engineers are trained for the special environment in which they operate and are familiar with the relevant standards and regulations.
- Skilled electrical personnel
  Due to their specialist training, knowledge and experience, as well as knowledge of the relevant standards and regulations, these personnel are able to work on electrical equipment and independently recognize and avoid possible dangers.

3.7 Procedure in hazardous situations and in the event of accidents

3.7.1 Preventive measures

- Always be prepared for accidents or fire!
- Keep first-aid equipment (first-aid box, blankets, etc.) and fire extinguishers ready to hand.
- Familiarize personnel with accident alarm, first-aid and rescue facilities.

3.7.2 In the event of an accident

- Immediately shut down the system via the emergency-stop facility.
- Clear personnel from the danger zone when any threat to personal safety has been eliminated.
- Initiate first-aid measures.
  - If the victim has suffered an electric shock, obtain immediate medical assistance **even if the victim shows no signs of visible injury**. There is quite often a delayed reaction to electrical shocks which may not show up for several hours following the accident.
  - Electrical burns always require medical attention even if the victim otherwise feels quite well.
- Alert doctor and/or fire service.
- Inform responsible persons at the site.
- Make access routes free for rescue vehicles.
- Ensure that all accidents and injury to personnel are recorded in the Site Safety Book.

5 TECHNICAL DATA

5.1 Output

Type AC	100
Converter- Nominal power (cos φ = 0,9)	100 kVA
Nominal voltage 3ph	208 V[1] / 380 V / 400 V / 415 V / 440 V[1] / 480 V[1]
Nom. current cos φ = 0,9 ind.	
208 V[1]	278 A
380 V	152 A
400 V	144 A
415 V	139 A
440 V[1]	131 A
480 V[1]	120 A
Voltage deviation	± 5%
Waveform	sinusoidal
Voltage tolerance	
static	± 1 %
at 50% / 100% load unbalance	± 1 % / ± 1 %
dynamic at 100% load change	± 3 %
Settling time	< 10 ms
Frequency	50 Hz / 60 Hz ± 1%
Distortion factor, linear load	< 1 %
Overload	
60 s (3-phase, 1-phase)	180%
10 min (3-phase, 1-phase)	140%
Max. crestfactor	3

5.2 Input

Type AC	100
Nominal power	
380 V	95 kVA
400 V	95 kVA
415 V	95 kVA
480 V	97 kVA
Nominal voltage 3 phase	
380 V	-20% / +15%
400 V	± 15%
415 V	± 15%
480 V	± 15%
Nominal frequency	50 – 60 Hz ± 10%
Current harmonic distortion	< 3%
Input power factor	cos φ 0,99
Input current	
380 V	144 A
400 V	137 A
415 V	132 A
480 V	116 A

[1] with output transformer, see chapter 5.5.

5.3 General Data

Type AC	100
Efficiency at[1] cos φ 0,9 ind.	94,1%
Power dissipation[1] cos φ 0,9 ind.	5,7 kW
Noise level m[1] (distance 1m)	68 dB(A)
Permiss. ambient temperature	43áG - 215áG00 – 40°C (daily average ≤ : 5°G0≤ 35°C)
Relative humidity	5 – 95 % without condensation
Dimensions: Width Depth Height	 42/6 jo 0800 mm 42/6 jo 0800 mm 86 jo 01900 mm
Weight	2566 mt / 0660 kg
Floor loading capacity	322 mt 0g² 01031 kg/m²
Dimensions ext. Transformer cabinet Width Depth Height	 42/6 jo 0800 mm 42/6 jo 0800 mm 86 jo 01900 mm
Weight Output transformer in cabinet	2566 mt / 0660 kg
Colour Cabinet / Side cover	RAL 7035 / RAL 7035
Protection acc. to IEC 60529:1989	IP20

[1] 100% Load

5 CONSTRUCTION AND MODE OF OPERATION

5.1 General

The converter system described below is manufactured using the latest state-of-the-art technology. New trends in the power electronics field and in digital control technology have been implemented to offer an optimum solution to power supply problems.
The power supplied to the connected critical loads is stabilised within specific voltage and frequency tolerances.

Under normal conditions (public mains supply available) the rectifier converts the a.c. mains voltage to a d.c. voltage and supplies this to the inverter.
The inverter again converts the d.c. voltage to an a.c. output voltage with stabilised frequency and amplitude, which is fed to the critical load.
Both the rectifier and the inverter are monitored and controlled by their respective control and monitoring units, which ensures an accurate supply at all times, even when changes occur at the load.

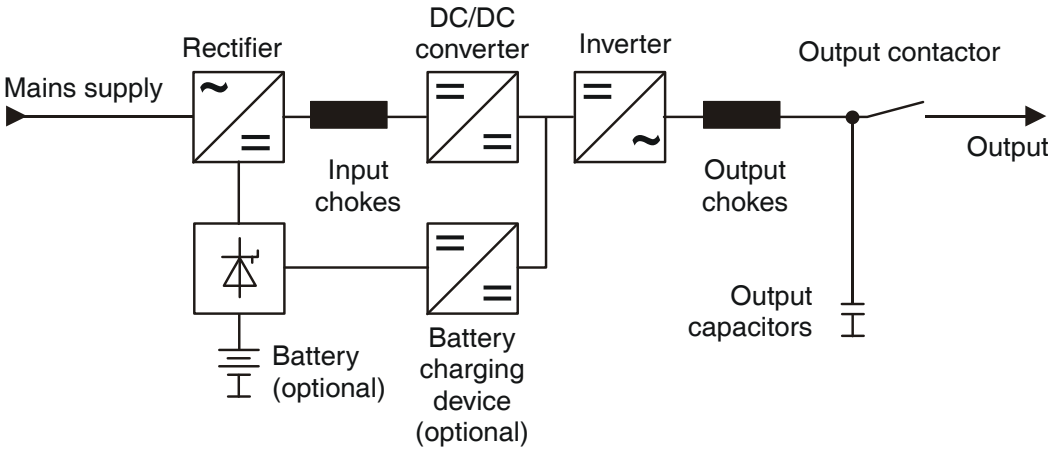


Fig. 5-1 Block diagram APOCONV

5.2 Performance under special operating conditions

5.2.1 Overload

The inverter can supply its rated power for 60 seconds with at least a 150% overload and for 10 minutes with at least a 125% overload. For higher overloads the output current is limited to at least 150%. If the output voltage falls below the permissible tolerance, the inverter switches off after five seconds.

5.2.2 Short-circuit on load busbar

The system cannot be started if the mains supply is out of tolerance. In this case, the mains input LED on the mimic display is off. If the system is running and the mains voltage goes out of tolerance, the system is switched off after a maximum delay of 50ms. With the battery option, the system transfers to the battery mode in the event of a mains failure.

5.2.3 System malfunctions

If one or both fans malfunction, the system continues to operate normally until the over-temperature protection is activated. An over-temperature warning is initially output and the system is shut down shortly after this when the maximum temperature is reached.

- Rectifier
  In the event of and depending on the type of rectifier malfunction, the system first switches to battery operation and when the final discharge voltage is reached it changes over without a break to bypass or directly to bypass, again without a break.
- DC/DC converter
  If the DC/DC converter is faulty, the system immediately switches to the bypass without a break.
- Inverter
  If the inverter is faulty, the system immediately switches to the bypass without a break.
- Battery
  Faults in the battery circuit are only indicated, switching operations are not implemented.

5.3 Description of rectifier

The operation of the rectifier is automated. Control is digital.
When the system starts the rectifier initially ramps up the pre-charging of the link circuit. The mains thyristors are triggered accordingly.
On completion of pre-charging of the link circuit, in mains operation the rectifier thyristors are continuously triggered so that power can flow at any time.

5.4 Description of the DC/DC converter

The operation of the DC/DC converter is automated. Regulation and control are performed digitally.
The DC/DC converter of the APOCONV operates as a step-up converter. At system start and after the pre-charging of the link circuit by the rectifier, the DC/DC converter acts to increase the link circuit voltage. This voltage is ramped up to the required nominal value. Using its link circuit voltage regulator the task of the DC/DC converter is to maintain the link circuit voltage at its nominal value during the operation of the system.

5.5 Output transformer

An external output transformer is available in order to supply loads with voltages other than the standard voltages (above 415 V and below 380 V), or to achieve electrical isolation. The transformer can be supplied in an optional auxiliary cabinet. The dimensions of this cabinet are matched to the size of a transformer with natural cooling. If electrical isolation is not required, an autotransformer is also available.
It should be noted that the transformer generates additional losses which result in a reduced overall efficiency of the frequency converter system. These losses are transformer-specific and are not and are not considered in chapter 4 Technical Data.

5.6 Battery charger regulator, option

The APOCONV operates with a battery, which is not directly connected to the converter link circuit. Battery operation involves the rectifier and the DC/DC step-up converter as described in chapter 5.3. Battery charging is carried out via a separate battery charger. This acts as a DC/DC step-down converter and charges the battery from the converter link circuit. The battery charging mode is always available when mains infeed is present.

The battery charger regulator operates according to the DIN 41773-1:1979-02 IU characteristic. The maximum charging power is 17 % of the nominal active output power.

There are two operating modes for the battery charging current, which can be selected via the menu. These are the so-called normal and high-rate charging currents. The charging currents are calculated according to battery type. The normal charging current is I_{10}, e.g. for a 70 Ah battery = 7 A. The value of the high-rate charging current I_5 is twice that of the normal charging current.
The final charging voltage is adjustable between 2.23 V/cell and 2.3 V/cell (default 2.27 V/cell). The final discharge voltage is adjustable and is set at 1.65 V/cell (1.65 V/cell – 1.8 V/cell adjustable). The maximum equalizing charge voltage is 2.4 V/cell (2.3 V/cell – 2.5 V/cell adjustable).

5.6.1 Automatic battery test / fuse test, option

The converter system continuously monitors the voltage at the battery terminals.
If no battery is connected or a battery fuse is faulty, the system immediately detects this fault by means of the voltage measurement and signals it via the red battery LED.
When the system is running or when the outgoing contactor is ON, in such a fault scenario the converter system also generates an acknowledgement event to point to any installation problems. The battery LED then flashes red.

5.6.2 Protection against exhaustive battery discharge, option

A battery turn-off characteristic has been built into the APOCONV to prevent exhaustive discharges at very small battery currents. Two limits for the battery current and two limits for the battery voltage are entered. The voltage limits are the turn-off points for small battery currents and for heavy discharges. These points are set at 1.8 Volts per cell and 1.65 Volts per cell, respectively.
The current limits depend on capacity. For a “5-10 Minute-Battery” they are set at the factory to approximately 10% current for the low value and 50% current for the high value. Fig. 5-2 shows the function of the curve. At currents <10% I_n (rated current) turn-off occurs at 1.8 Volts per cell and at currents ≥50% I_n it occurs at 1.65 Volts per cell. The curve gives a turn-off point for currents anywhere between these two values. The disconnection point is indicated on the measured value page “battery parameter” (see section 8.3.1).

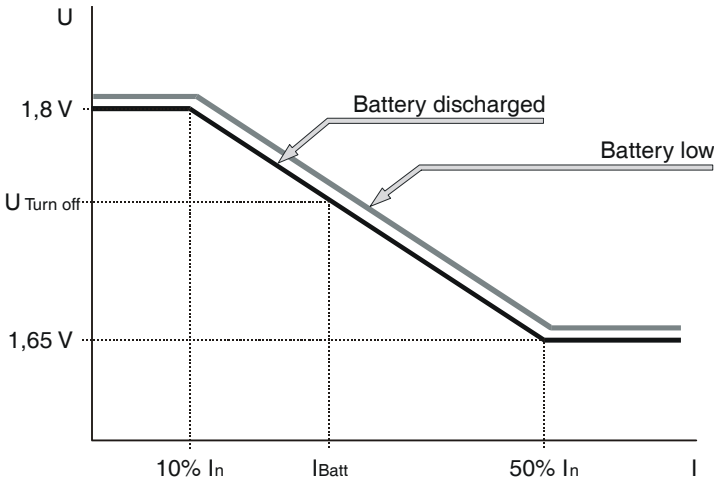


Fig. 5-2 Turn-off voltage versus DC

5.6.3 Temperature-dependent final charge voltage, option

To ensure optimum battery life it is necessary to reduce the final charge voltage of the battery if the ambient temperature in the battery compartment exceeds 25°C. The ambient temperature of the battery room can be measured via an external temperature sensor. The necessary software is already installed in the APOCONV, so that it is only necessary to fit the temperature-measuring device (two-wire temperature sensor) and an additional cable. The final charge voltage can then be reduced according to the temperature by means of a curve stored in the microcomputer. The temperature is shown in the Display on the operator control panel.

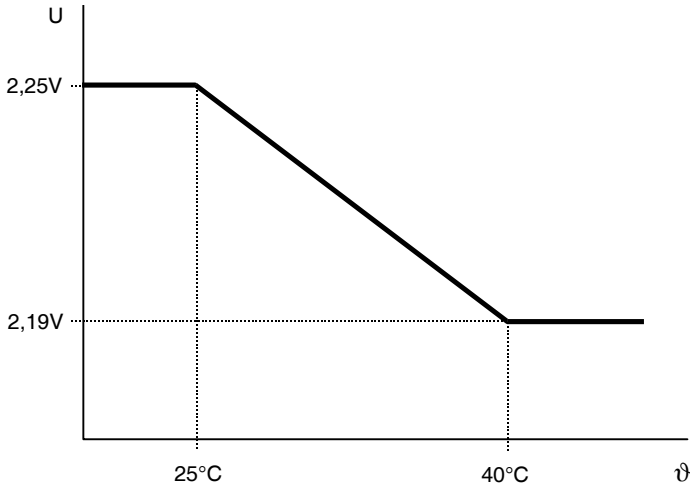


Fig. 5-3 Final charge voltage versus ambient temperature

5.6.4 Battery monitor, option

The battery monitor calculates the remaining battery life while the battery is being charged and discharged. To do this, the battery performance is simulated by means of a discharge/charge characteristic curve. The battery discharge curve can be entered by Piller service personnel at the factory or on site during commissioning.

The remaining battery life can be called up at the control panel of the converter system or on the remote panel. It can also be continuously displayed by means of a digital minute indicator. An event message and a general alarm is triggered if the remaining battery runtime falls below a programmable value.

NOTE In addition to the ambient temperature and load at the converter system, the residual battery runtime also depends on the state (age) of the cells. For this reason the displayed value can deviate from the actual residual runtime.

5.7 Description of the inverter

The operation of the inverter is automated. Regulation and control are performed digitally.
The functions of the main components of the inverter are as follows:
The IGBT inverter converts the link circuit voltage into the AC voltage required at the output of the converter system.
Together with the output capacitors the output chokes form an LC filter, which minimises the switching frequency component of the AC voltage.
The output contactor switches the AC output voltage of the inverter to the load or, in the bypass mode (service mode, fault in the DC/DC converter, inverter, …), isolates the inverter's output from the output voltage.
The inverter controller controls and monitors the operation of the inverter and ensures that the output voltage and frequency are stabile, irrespective of loading. To achieve this, inverter current, inverter voltage, bypass current and, for synchronisation the bypass input voltage, are measured and evaluated.
The inverter's output voltage can be adjusted within a range of ± 5%, via the settings menu in the display.

5.8 Parallel operation of converter systems

5.8.1 General

A special controller in each set ensures uniform distribution of load current. Outside the tolerance the units are self-commutating and synchronise themselves to the signal of the synchronisation master.

Converter systems are connected in parallel for the following reasons:

1. To increase the power (power-parallel). .
2. To increase the reliability (redundant parallel).
   In this operating mode, at least one more set is used than is necessary to cover the power requirement.

Parallel operation is possible with a maximum of eight systems which can be subdivided into a maximum of four groups.

NOTE If an external outgoing disconnector is connected in series with the outgoing contactor K600, this must send an appropriate check-back signal to the paralleling board. This will then clearly indicate that the system is actually connected to the converter-busbar.

5.8.2 Additional equipment for parallel operation

The following components are additional required for parallel operation:

- three one-phase paralleling chokes
- three current transformer for the output current
- one Parallel- Interface Board AC

At least one CAN-Bus and one Current bus connection are required for communication between the systems.

5.8.2.1 Parallel - Interface Board (PIB)

The parallel - interface board is plugged directly into the controller board via its plug connector X1. All data and signals go to the controller board via this plug connector.

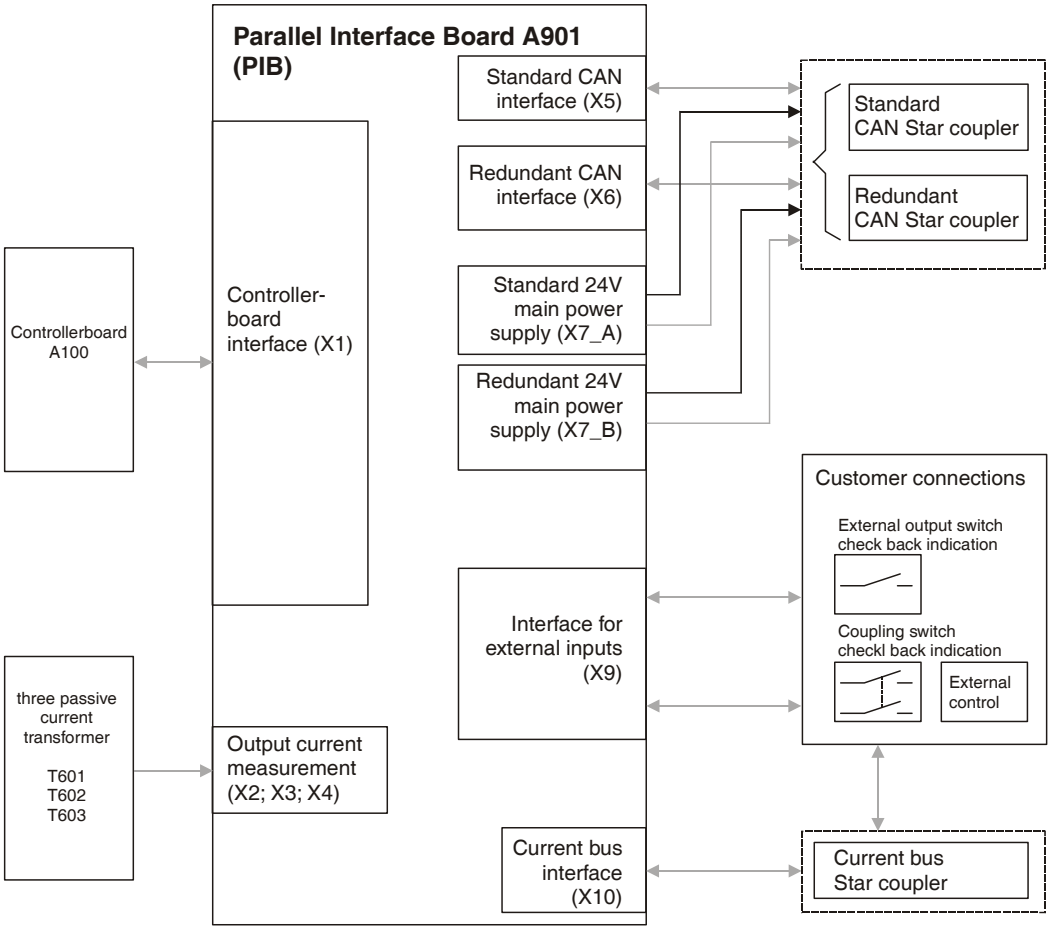


Fig. 5-4 Parallel – Interface Board (PIB) interfaces

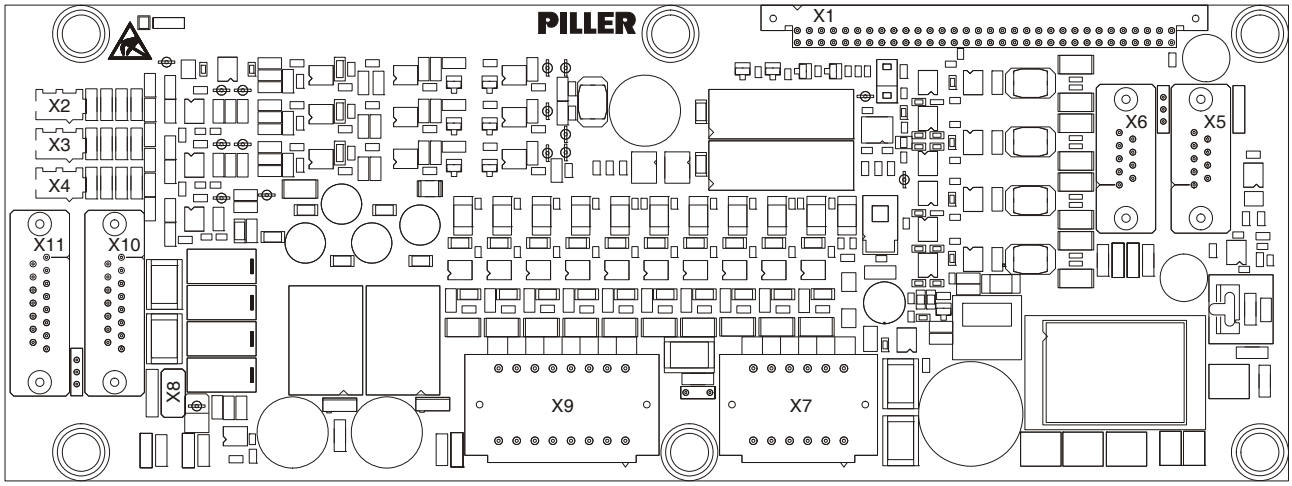


Fig. 5-5 Configuration of the components on the Parallel – Interface Board

5.8.2.2 Configuration of the input-Interface X9

A 1x2 screened twisted pair cable should be used for these interfaces if just the signal of the external outgoing disconnector is connected.
A 5x2 screened twisted pair cable should be used if just the group preselection is used (group parallel operation).
The screen of the conductor at terminal strip A should be connected to Pin A8. The screen of the conductor at terminal strip B should be connected to Pin B8.

Signal	Pin No.	Description
Input external output isolator	A1	Status signal of the external outgoing disconnector via a normally-closed contact (signal status HIGH = outgoing disconnector is open).
24 V	A2	Voltage supply 24 V
Group selection input 1	A3	Group selection group 0
24 V	A4	Voltage supply 24 V
Group selection input 2	A5	Group selection group 1
24 V	A6	Voltage supply 24 V
GND	A7	Ground
Shield	A8	Shield connection
Group selection input 3	B1	Group selection group 2
24 V	B2	Voltage supply 24 V
Group selection input 4	B3	Group selection group 3
24 V	B4	Voltage supply 24 V
Free input	B5	Reserve
24 V	B6	Voltage supply 24 V
GND	B7	Ground
Shield	B8	Shield connection

5.8.2.3 Current transformer

Regulation to the average output current requires the particular output current to be measured. Three current transformers are connected to the Parallel - Interface Board (X2 – X4) for this purpose.

5.8.2.4 CAN-Bus cable

The CAN bus cable is connected to X5 and connects two Parallel - Interface Boards or one parallel - interface board to the star coupler (required when running more than two systems in parallel see chapter 5.8.4). The lines for the CAN communication, the synchronisation pulse and a 24V signal for the common bypass changeover go via this cable. Since there is no CAN bus line structure, but only one connection between two subscribers, the terminating resistor is permanently installed on the parallel board and the star coupler.
A redundant CAN bus cable can be optionally connected to X6. Data are sent to X5 as well as to X6. The software can change over the receiving channel in the event of a fault.

The CAN bus cables are pre-assembled in various lengths:

0043360867	CAN-Bus-cable AP Type 2 10 m
0043360868	CAN-Bus-cable AP Type 2 20 m
0043360869	CAN-Bus-cable AP Type 2 40 m
0043360870	CAN-Bus-cable AP Type 2 60 m

5.8.2.5 Current Bus cable

For each phase, current signals whose amperage is proportional to the output current are fed to the Current bus via the Current bus cable (connection to X10). Each system participating in parallel operation connects both its current signal and its measuring shunt when K600 (outgoing contactor) is switched ON. The same voltage that is proportional to the average output current is therefore dropped across each measuring shunt. The deviation between the particular output current and the average output current is passed to the controller board. The system can thus vary its output voltage so that it approaches the average output current.
Optionally, a redundant Current bus cable can also be connected to X10 by means of an adapter.
The Current bus cables are pre-assembled in various lengths:

0043360871	Current bus - cable AP Type 2 10 m
0043360872	Current bus - cable AP Type 2 20 m
0043360873	Current bus - cable AP Type 2 40 m
0043360874	Current bus - cable AP Type 2 60 m

5.8.3 Parallel operation of two converter sets

Where two APOCONV sets are operated in parallel, the CAN and the Current bus connections can be made directly between the Parallel - Interface Boards of both systems.

5.8.4 Parallel operation of three or more converter sets

Where three or more APOCONV sets are operated in parallel, additional software is required for setting up a star-type parallel group.

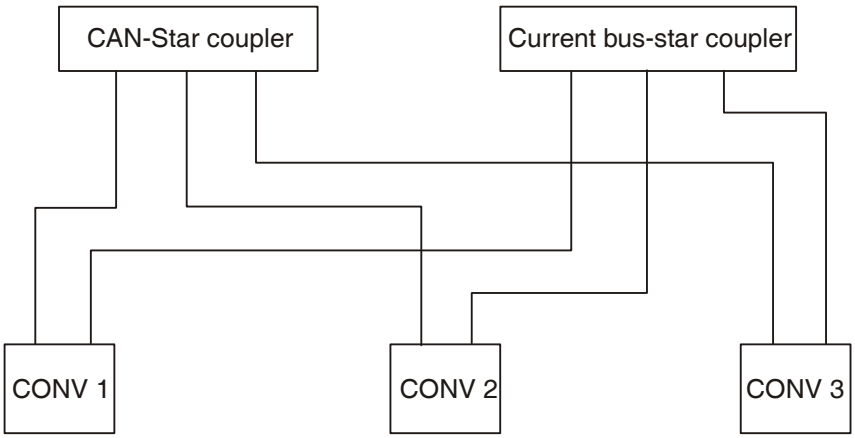


Fig. 5-6 Parallel operation of three or more sets

5.8.4.1 CAN star coupler

The CAN star coupler provides the star structure for the CAN parallel communication. Up to four systems can be connected to it. If a group of more than four systems is to be constructed, two CAN star couplers can be directly plugged into each other.
For group parallel operation the link between the CAN star couplers can be opened or closed via an external signal. For this type of parallel operation the systems of one group always have to be connected to a CAN star coupler. The star coupler is designed for mounting on a supporting rail. This supporting rail is not included in the APOCONV and should be installed at a location outside the converter system, e.g. in a distribution cabinet or in a separate enclosure. If a central control is provided for the converter system, this is a suitable location for the CAN star coupler.
In addition to the CAN bus cable, each system delivers a 24 volt voltage supply for the CAN star coupler via an additional line. This can also be a redundant line as required.

0043360738	Cable 24V-external, Power-Supply 10m
0043360739	Cable 24V-external, Power-Supply 20m
0043360740	Cable 24V-external, Power-Supply 40m

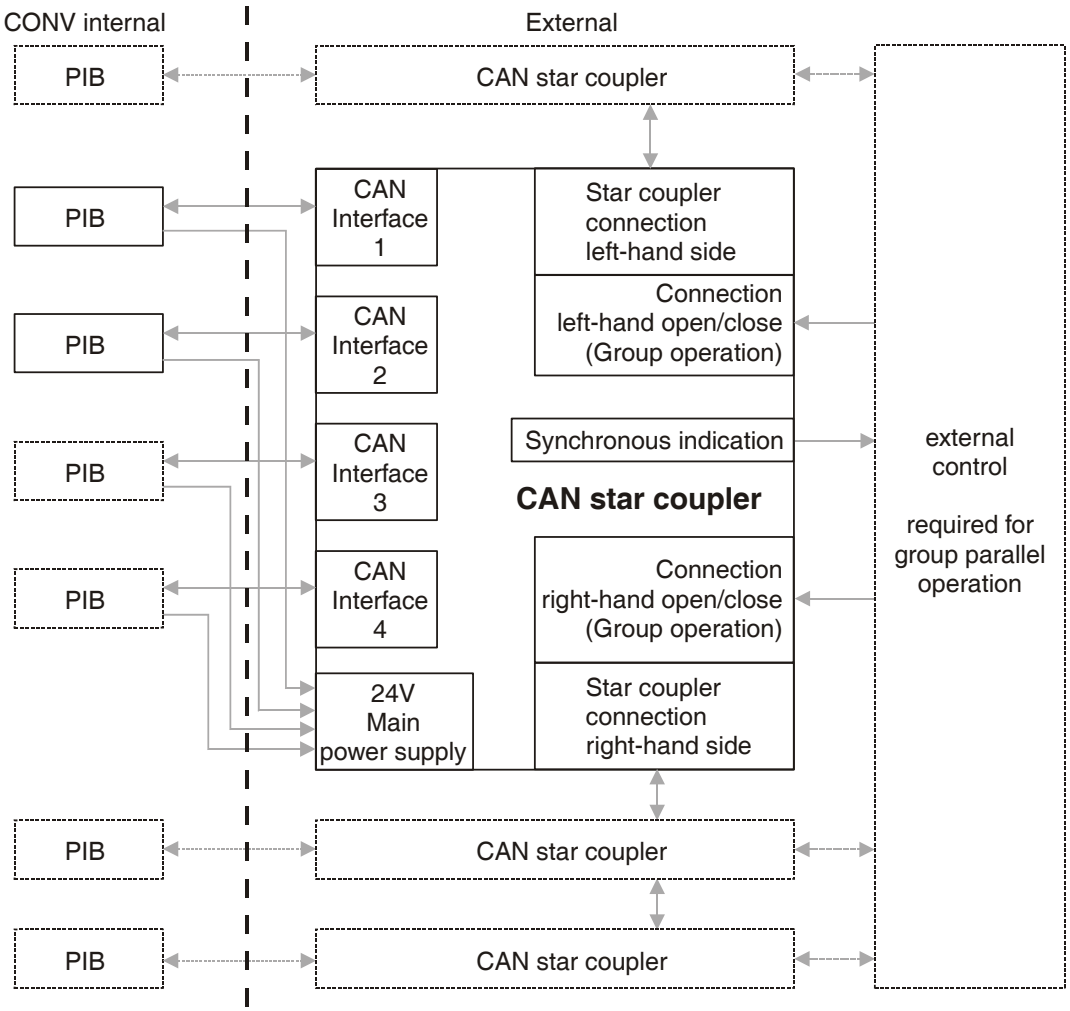


Fig. 5-7 CAN star coupler interfaces

5.8.4.2 Current bus star coupler

The Current bus star coupler provides the star structure for the Current bus parallel communication. Up to four systems can be connected to it. If a group of more than four systems is to be constructed, two Current bus couplers can be directly plugged into each other.
For group parallel operation the link between the Current bus star couplers can be opened or closed via an external signal. For this type of parallel operation the systems of one group always have to be connected to a Current bus star coupler. The star coupler is designed for mounting on a supporting rail. This supporting rail is not included in the APOCONV and should be installed at a location outside the converter system, e.g. in a distribution cabinet or in a separate enclosure. If a central control is provided for the converter system, this is a suitable location for the Current bus star coupler.

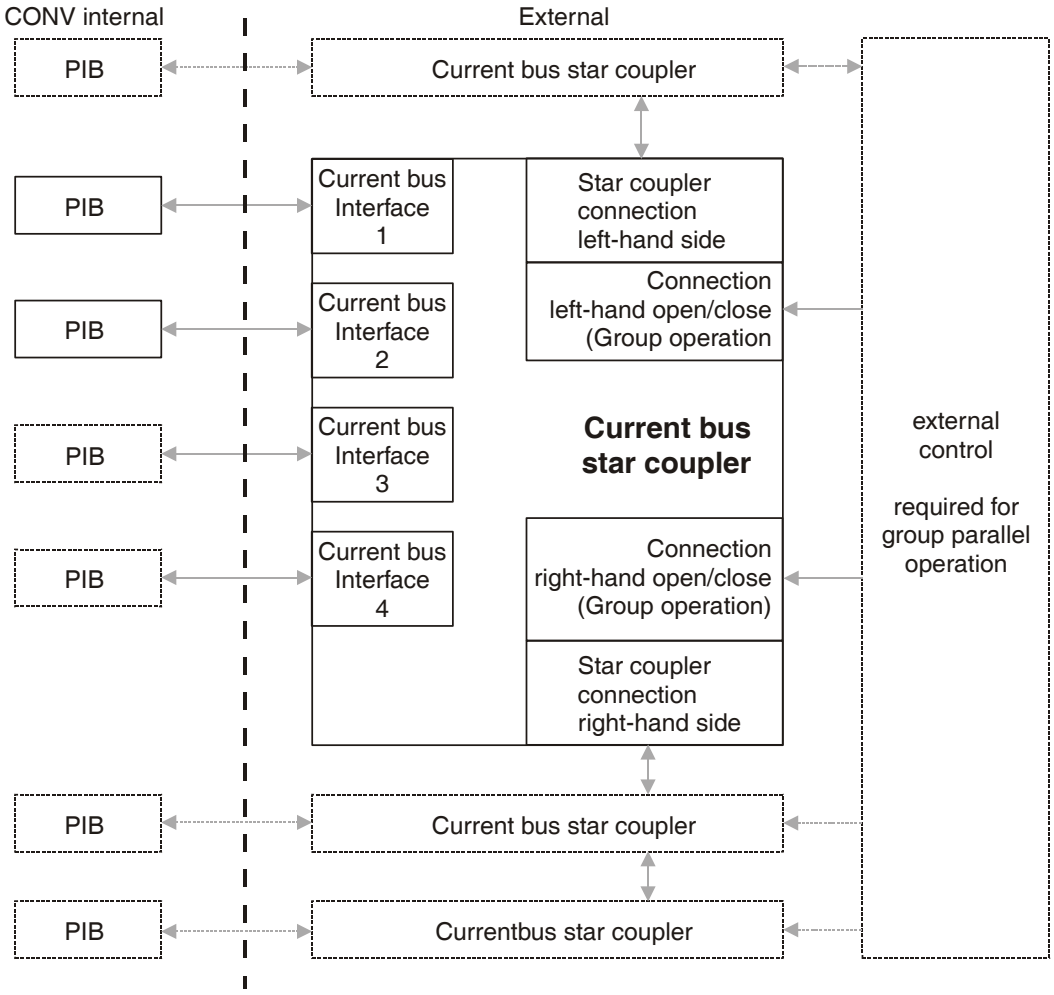


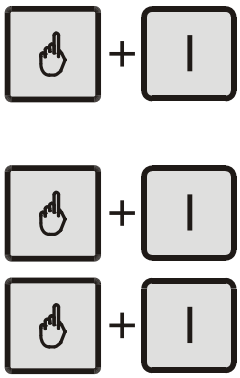
Fig. 5-8 Current bus star coupler interfaces

5.8.5 Operating the parallel configuration

5.8.5.1 Switching on the parallel configuration

IMPORTANT The starting cycle of all units forming part of the parallel group should be completed within two minutes, otherwise the units are disconnected again automatically.

1. Switch on all rectifiers:
   Press the „Hand“ and „I“ buttons simultaneously on each system.
2. Engage the battery isolators. (Battery option)
3. Switch on all inverters:
   Press the „Hand“ and „I“ buttons simultaneously on each system.
4. Switch on all output contactors:
   Press the „Hand“ and „I“ buttons simultaneously on each system.



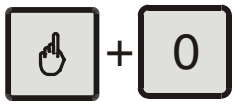
The availability of the output contactor of each system is indicated by a flashing LED. Power parallel systems and redundant parallel systems differ in in the switching operation of the contactors.

- Power parallel:
  The available units wait until the last unit of the group is ready. Only now do all units of the group switch on outgoing contactor.
- Redundant parallel:
  The available units wait until the redundancy condition is met or the set minimum number of units is ready. All units of the group now switch on outgoing contactor. Any other unit in the group that has still not closed the outgoing contactor can now be switched on.

5.8.5.2 Switching off the parallel connection

Switch off all systems:
Press the „Hand“ and „0“ buttons simultaneously on each system.

If necessary, the external battery isolators should also be opened during prolonged shut-down periods.



Every system can be disconnected separately. In this case the load is supplied from the other parallel unit without a break.

ATTENTION Depending on the size of the load, systems overload can occur.

5.8.5.3 Load-dependent paralleling concept

The philosophy of automatic load-dependent paralleling is to obtain optimum system efficiency and a maximum possible interference-free supply for the entire system. At the same time, only so many sets are run in parallel as are required to supply the load. If the load increases, the next set is started, and one set is stopped if the load decreases. For this to happen, the interconnected group must be running in the redundant-parallel mode and load management must be activated (see chapter 8.3.3 Menu „Settings“). The sets must be interference-free and their rectifiers must at least be started.
For special applications in the parallel mode, it is also possible to connect one or more sets in addition to the calculated number of required sets (load-dependent, redundant-parallel mode). The number of additional operational sets can be set in the "Parallel operation" menu on the display (see chapter 8.3.3 Menu „Settings“).
Threshold values which generate the next set "on" or "off" signal are programmed in the system software. Each set knows the total load of the system and calculates the switching thresholds using the following method:

Reserve of the system or of the group in % =
maximum load of the system (100% multiplied by the number of operational sets) minus the existing load of the system in % minus the redundancy (100% multiplied by the number of redundant sets).

The next set is connected if the reserve is < 45% of the nominal power of one set (equivalent to a threshold of 55%).

The next set is disconnected if the reserve minus 100% is > 65% of the nominal power of one set (equivalent to a threshold of 35%).

In order to accommodate short-term load peaks and to limit the starting cycles of the sets accordingly, two further delays come into effect. The "next set on" signal is delayed by 30 seconds and the "next set off" signal is delayed by 1 minute.

In order to achieve maximum possible uniform distribution of the numbers of operating hours, each time a set is started the set with the lowest number of operating hours is always automatically started first. The second set is then the one with the second-lowest number of hours. The reverse procedure is followed when individual sets are switched off. Basically, the set with the highest number of hours is switched off first. If one set is to be run in a continuous operating mode for a prolonged period of time, the operational sets are changed over after a stipulated time. This concept ensures uniform distribution of the operating hours. The necessary adjustments and monitoring operations can then be implemented for all sets at a particular time.

5.9 Description of system control

System control operates centrally via a controller board. In this case the control functions are handled by a 16-bit single chip microcontroller. The precise, fast-acting and fully digital control system is based on two 32-bit single chip DSPs and two FPGAs.
Further peripheral units are connected to the controller board via a field bus conforming to the CAN industry standard. The operator control unit is the user interface. It accepts control commands via its membrane keyboard and visualises the system’s operating state on the mimic diagram and the LC display.

5.10 Standard I/O Board A900

For communication with the converter system, the standard I/O board offers various connectivity options for linking the converter system to external operator controls and annunciators, other converter systems, etc., to exchange operational messages or fault messages with the outside world. Here is an overview of the various functions of the standard I/O board:

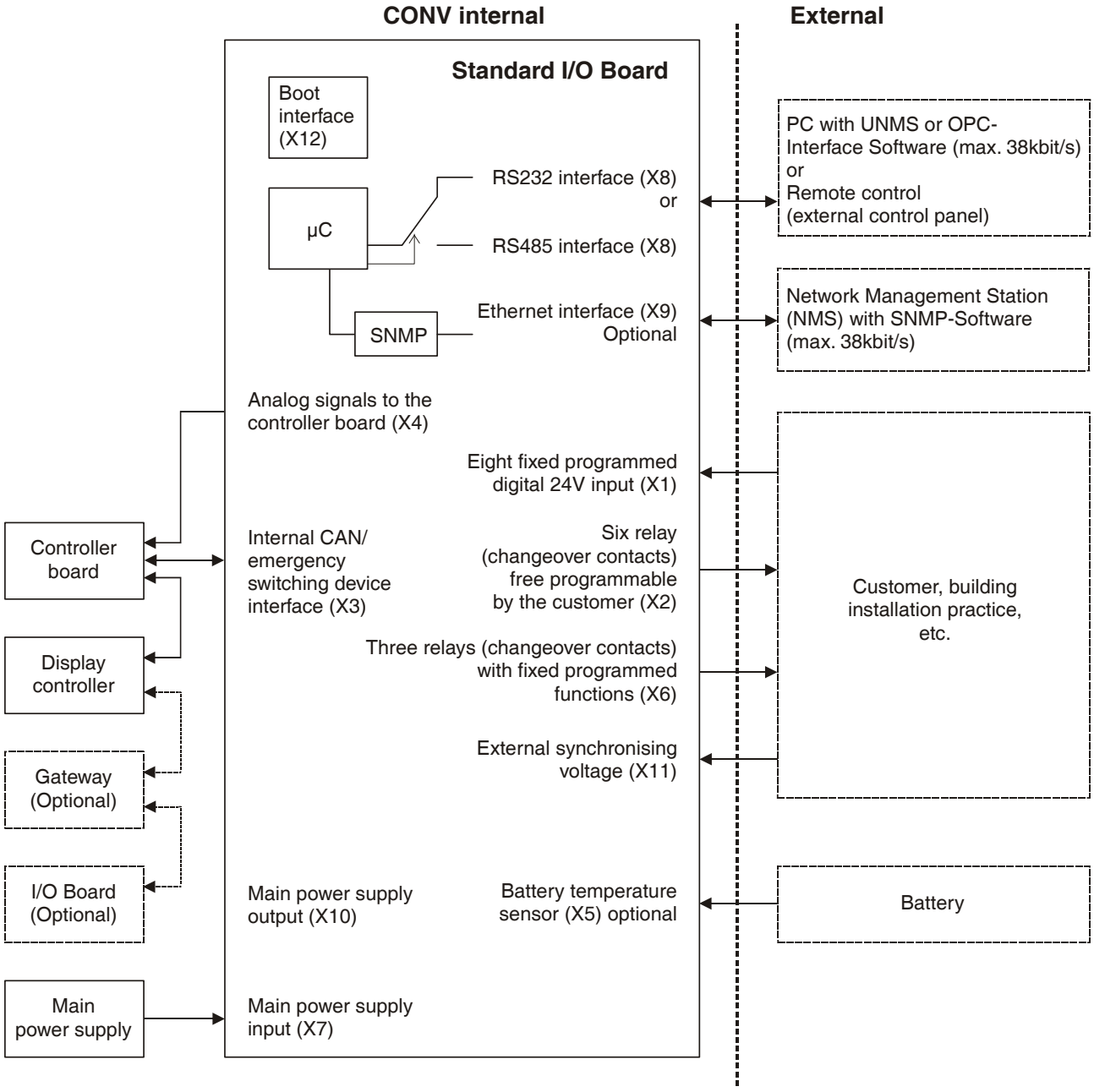


Fig. 5-9 I/O Board A900

5.10.1 Terminal X1 (digital inputs)

The following interfaces are available at terminal strip X1:

- eight digital inputs
- four terminals for 24 V DC
- four terminals for frame / ground
- two terminals for screen connections
- two terminals for an emergency switching device

The digital inputs of terminal strip X1 can be activated with an internal 24 V DC voltage and a potential-free contact, as well as with an external 24 V DC voltage. The following two figures (Fig. 5-10 and Fig. 5-11) show an example of both variants. A mixture of both variants is permissible.

NOTE If possible, when an external 24 V DC voltage is employed only one source should be used. If a supply from several sources is necessary, suitable equipotential bonding must be provided between these sources.

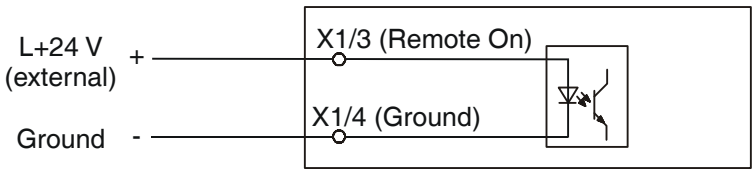


Fig. 5-10 Example of digital input connections using an external 24 V DC voltage.

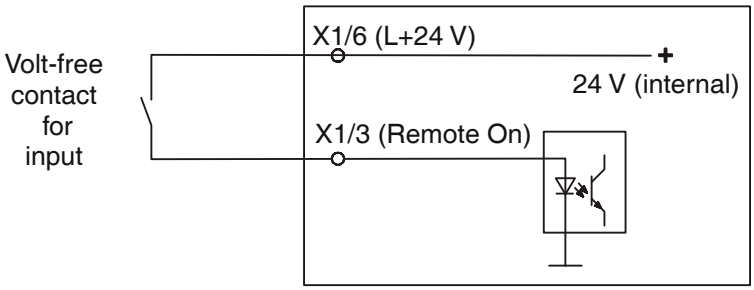


Fig. 5-11 Example of digital input connections using an internal 24 V DC voltage.

NOTE The functions of the digital inputs are permanently assigned. Reprogramming is not possible. An extended interface is required for digital inputs having other functions. For this, up to an additional I/O board (A911, see chapter 5.11) with 12 digital inputs, are available for use with the APOCONV.

The 24 V DC terminals are provided with potential-free contacts to activate the digital inputs. The voltage at these terminals is always between + 21.6 V and + 26.4 V.

When an external 24 V DC supply is used, the available voltage must always be between + 19.2 V and + 30 V.

The current of the digital inputs in the ON state is less than or equal to 20 mA.

The screens of the cables for the digital inputs should be connected to the screen connection terminals.

In order to use the emergency switching device, the link between X1.1 and X1.2 should be removed. In this case, a switch with an N/C contact should be connected.

WARNING

Note No. 20 in chapter 3.1 must be complied with when setting up emergency switching devices.

NOTE

A further option for connecting an emergency switching device is located on the optional extension interface I/O board A911, between X1.1 and X1.2.
It is preferable to use interface X1 on the standard I/O board A900.

Fixed programmed functions of the digital inputs:

Terminal No.	Input	Function
1		Emergency switch device
2		Emergency switch device
3	1	Remote on
4		Ground
5	2	Remote off
6		24 V
7	3	Remote bypass on
8		Ground
9	4	Diesel operation
10		24 V
11	5	Battery fuse tripped
12		Ground
13	6	External bypass
14		24 V
15	7	Start synchronising at external source
16		Ground
17	8	not used
18		24 V
19		Shield
20		Shield

5.10.2 Terminal X2 (potentialfree contacts, freely programmable)

Six potential-free changeover contacts are available at interface X2. Each of these contacts is brought out to two terminals. These six relay outputs have a pre-programmed function.

NOTE Chapter 5.11.2.2 provides a list for entering new relay assignments.

Relay No.	Function
K1	Mains operation
K2	Battery operation
K3	Bypass operation
K4	Battery voltage low
K5	Battery failure
K6	General failure

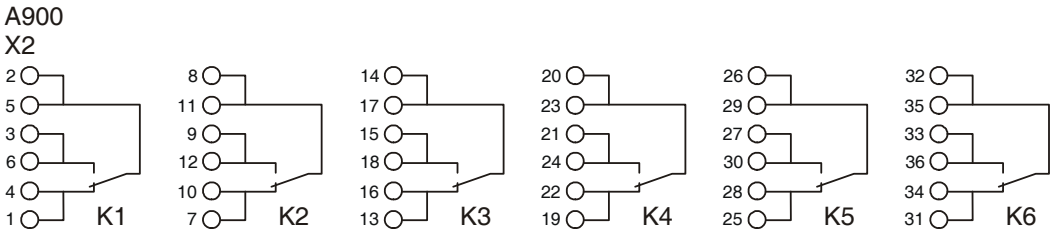


Fig. 5-12 relay pin assignment K1 – K6

Contact loading:
– max. 120 V AC, 6 A
– max. 120 V DC, (0-30 VDC 6 A; >30 VDC 50 W)

5.10.3 Terminal X5 (Battery-Temperature sensor, optional)

The optional temperature sensor for recording the temperature of the battery room or battery cabinet can be connected to interface X5. The sensor is connected to X5.1 and X5.2, the screen of the cable should be connected to X5.3.

Signal	Terminal No.	Description
Battery temperature	1	Temperature signal
Ground	2	GND for temperature sensor
Shield	3	A filter connects the cable shield with the PE.

5.10.4 Terminal X6 (potentialfree contacts, fixed programmed)

Three potential-free changeover contacts are available at interface X6. Each of these contacts is brought out to two terminals.

NOTE The functions of these relay outputs are permanently assigned and no reprogramming is possible. The six relay outputs of terminal strip X2 are available for potential-free changeover contacts having other functions. An interface extension is required for any additional ones. For this, one further I/O board (A911, see chapter 5.11), with 12 potential-free changeover contacts, are available for use with the APOCONV.

Relay No.	Function
K7	Battery isolator normally closed (Permanently assigned)
K8	Battery isolator normally closed (Permanently assigned)
K9	Mains isolator normally closed (Permanently assigned)

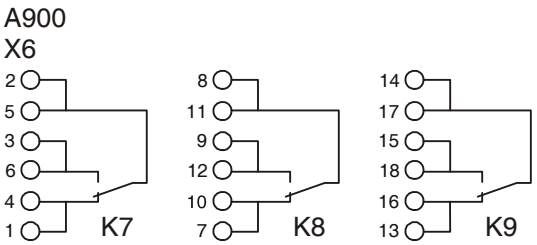


Fig. 5-13 relay pin assignment K7 – K9

Contact loading:
– max. 120 V AC, 6 A
– max. 120 V DC, (0-30 VDC 6 A; >30 VDC 50 W)

5.10.5 Terminal X11 (external synchronising source)

A single-phase (phase to neutral conductor) AC voltage can be applied at interface X11. The APOCONV uses the voltage connected to this point as a synchronisation source in accordance with the configuration set in the menu (see chapter 8.3.3.2 point 10).

Signal	Terminal No.	Description
L1	1	Connection for L1 (phase 1) of ext. synchronising source
N	2	Connection for N (neutral conductor) of ext. synchronising source

5.10.6 Pin assignment X8 (RS232 or RS485 – interface)

Signal	Pin No.
RS485 +	1
RS485 -	2
RS232 TX	3
RS232 RX	4
GND	5
24V	6
Free	7
Shield	8

5.10.7 Pin assignment X9 (Ethernet / SNMP – Option)

RJ45 – socket 8-pole

5.10.8 Connections standard I/O Board A900

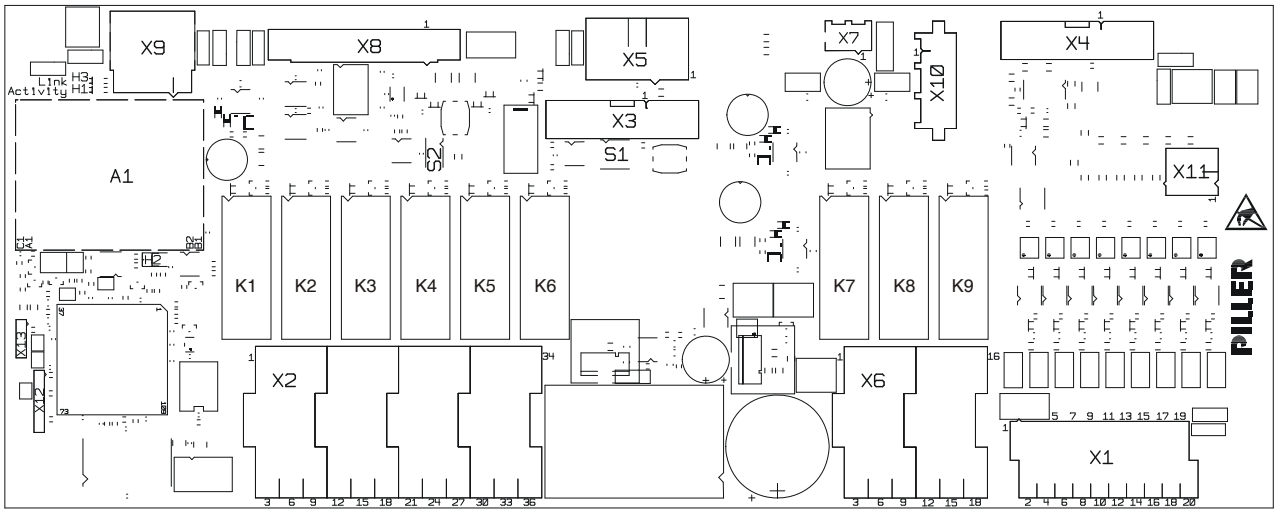


Fig. 5-14 Standard I/O Board A900

5.11 I/O Board A911/A912, optional

In addition to the standard I/O board, the I/O Board (Fig. 5-15) is used to extend the communication facilities by means of operator controls and annunciators.

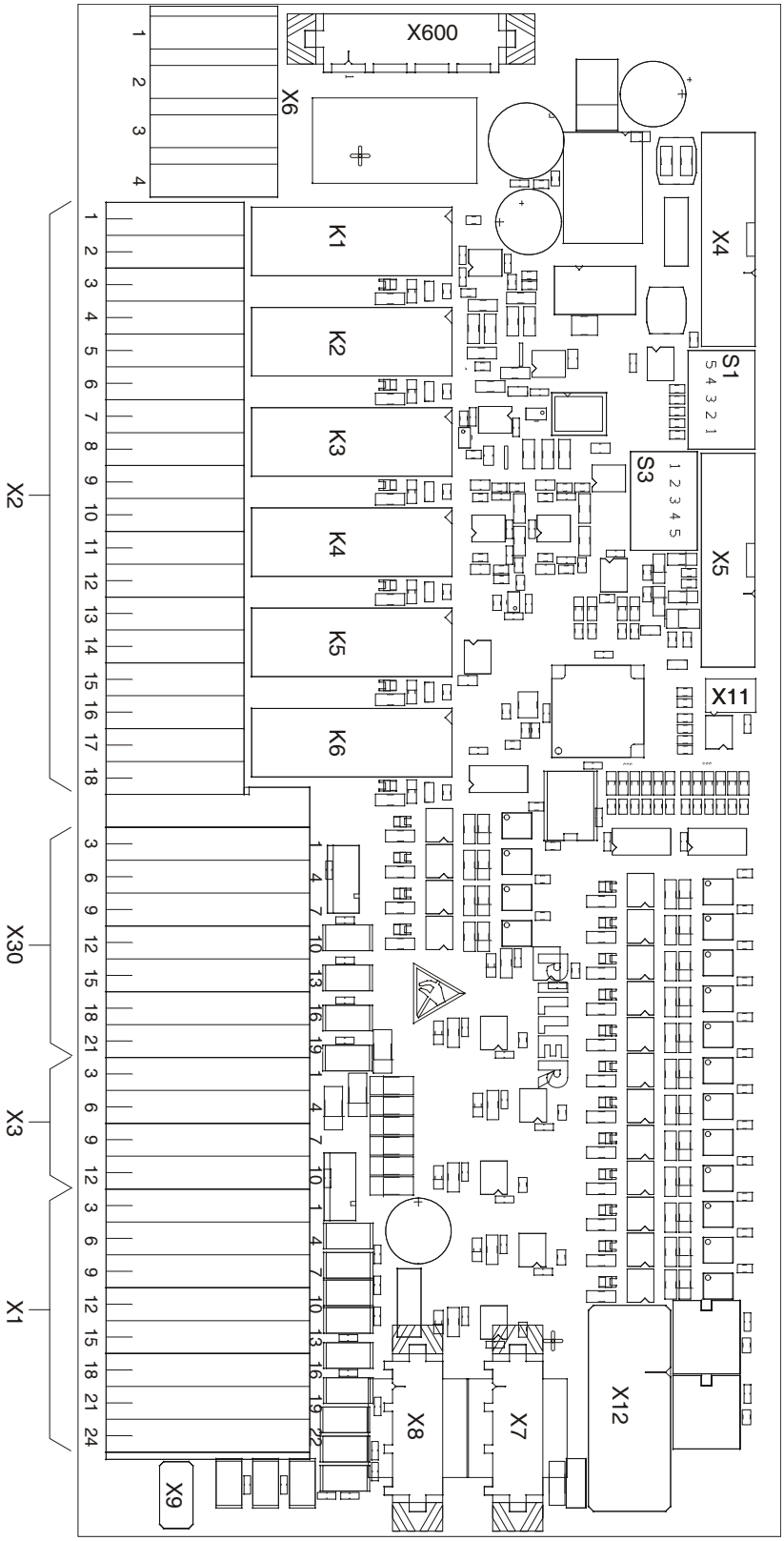


Fig. 5-15 I/O Board

The terminals of the I/O Boards are divided into three functions:

- Terminal strip X1, connection of digital inputs
- Terminal strip X2, connection of customer relays
- Terminal strip X30, connection of digital outputs

5.11.1 Terminal Strip X1 and X30

The inputs that are connected to terminal strip X1 can be implemented with internal 24 V DC and a potential-free contact, or with an external 24 V signal (see example in Fig. 5-16). The load current is 13 mA.

IMPORTANT The remote control functions can be operated per potential group only with internal 24 V DC and potential-free contacts or only with external 24 V DC.

Example:

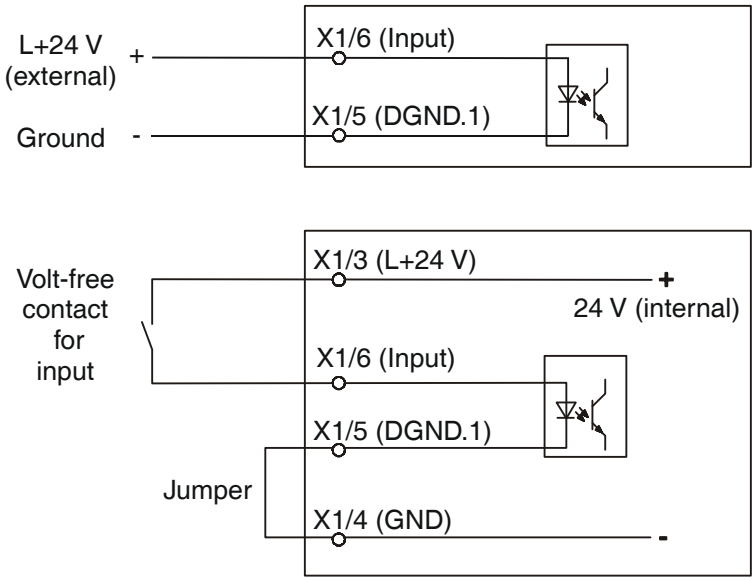


Fig. 5-16 Example for indication via external and internal signal

The inputs of the remote control functions are combined in two groups, each group having its own external ground connection (DGND.1 res. DGND.2 ...). When an external 24 V DC voltage is used, the external earth must be connected to the external ground connection of the respective group.
Likewise, when the 24 V supply from the system is used (see Fig. 5-16, terminal 3/L+24 V), the external ground connection (DGND.1 res. DGND.2...) of the respective group must be connected via a jumper to an earth terminal (GND).

The terminal assignment of terminal strip A911 X1 is shown in the table below.

Terminal No.	Description	Function
1 – 2		
3	L+24V.2	
4	GND	Ground
5	DGND.1	external ground
6-17	-	free programmable from the event list (chapter 5.13)
18	DGND.2	external ground
19	GND	Ground
20	L+24V.2	

The terminal assignment of terminal strip A911 X30 is shown in the table below.

Terminal No.	Description	Function
1-6	-	free programmable from the event list (chapter 5.13)
7	GND	Ground
8	GND	Ground
9	GND	Ground
10	L+24V.2	
11	L+24V.2	
12	L+24V.2	

5.11.2 Terminal strip A911 X2

Six programmable relays with changeover contacts are located on each of the I/O Boards. The relay contacts are connected to terminal strip X2.

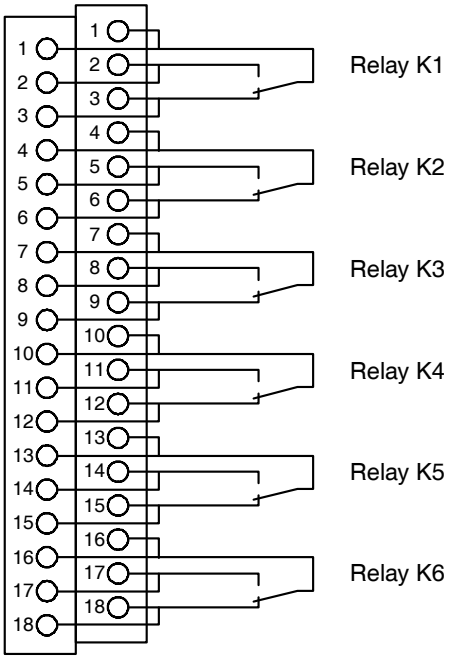


Fig. 5-17 Contact assignment of Terminal Strip X2

Contact loading:
- max. 120 V AC, 6 A
- max. 120 V DC, (0-30 VDC 6 A; >30 VDC 50 W)

WARNING

Adjacent relays may only be used for the same voltage level. Especially SELV circuits and circuits with higher voltage (>30 VAC / 60 VDC) must not be routed via adjacent contacts.

Section 5.11.2.1 describes the mode of operation of the relays.

5.11.2.1 Programmable relays

Six programmable relays are fitted as standard in each converter set on the standard I/O board A900. With the additional installed optional I/O Board (A911) up to nine relay outputs are available, which allow simple information exchange with the converter set. From a large number of available events, the desired information can be routed to a potential-free contact by means of internal logic operations. The events which can be displayed on the operator control panel of the set are described in section 5.13. They give an initial idea of the wide variety of data that can be exchanged. Please contact Piller Service if further data are to be exchanged with the set.

5.11.2.2 Standard relay pin assignment

New application-specific assignments, as well as the assignment of additional I/O Boards, can also be entered here.

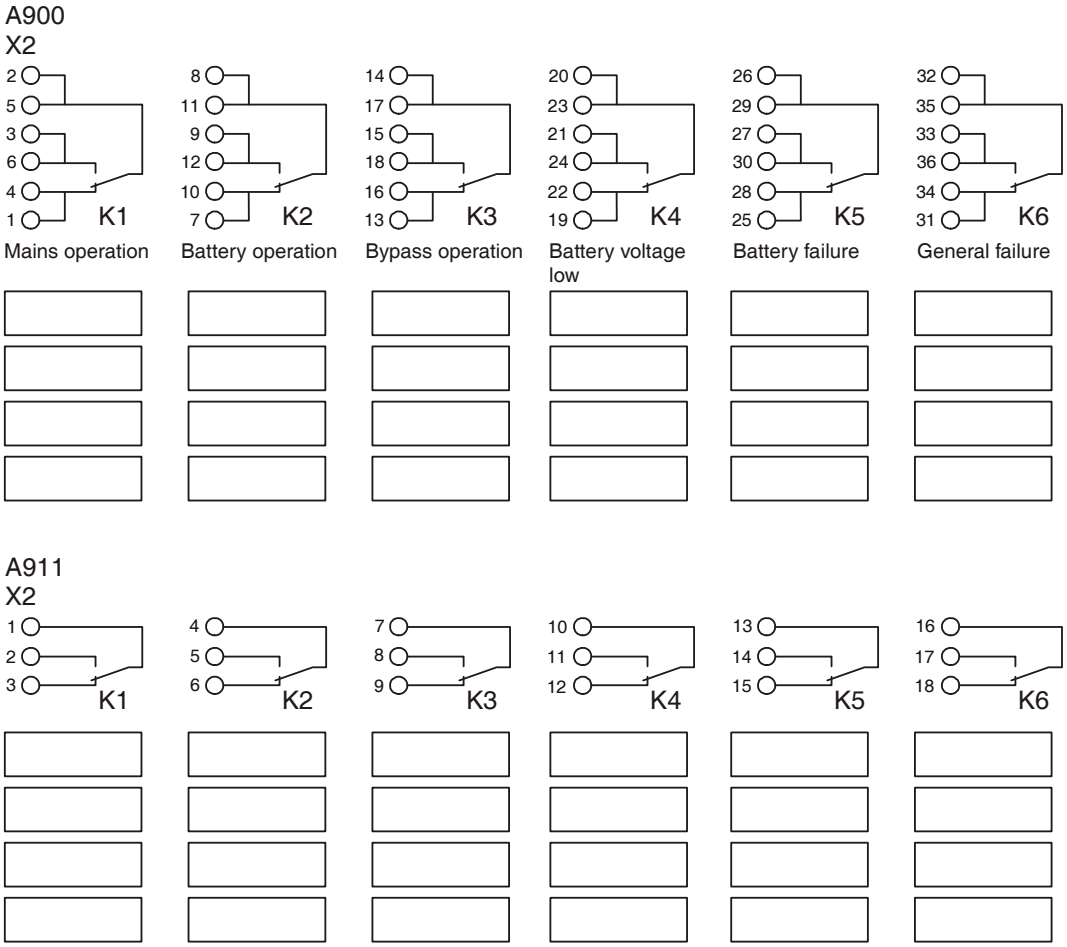


Fig. 5-18 Customer relay pin assignment

5.12 Protocol gateway A921 / A922, optional

The protocol gateway card (Fig. 5-19) is used to connect a remote control and APOCONNECT+ for example. Up to two protocol gateway cards can be fitted in the APOCONV.

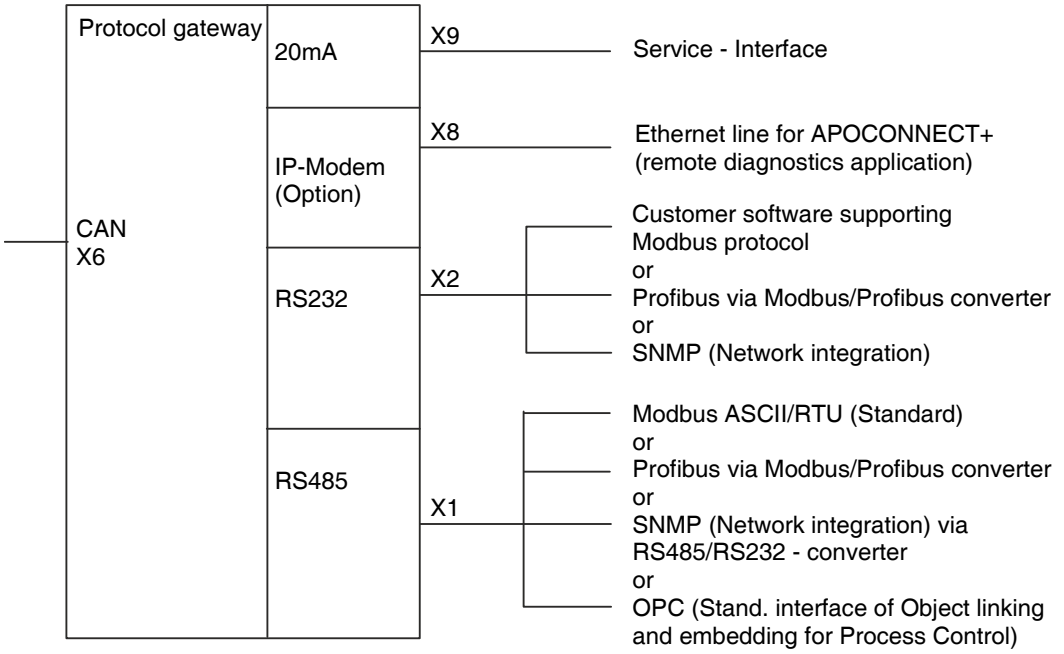


Fig. 5-19 Protocol gateway with connectivity options

The protocol gateway card provides connectivity via two interfaces - RS232 and RS485 - which communicate via the Modbus protocol.

The RS232 interface enables to connect a SNMP adapter or special software (customer software), which controls the Modbus software.

The display controller can be connected as a remote control to the RS485 interface, or an SNMP adapter via an RS485/RS232 converter, also special software (customer software) which supports the Modbus protocol.
It is also possible to connect a modem for the optional APOCONNECT+ remote diagnostics application.

Limitation:
The APOCONNECT+ application can only be connected to the first protocol gateway board (A921).

5.12.1 Pin assignment Terminal X1 (RS485 interface)

Signal	Pin No.
RS-485A	1
RS-485B	2
TE A	3
TE B	4
DGND.1	5
L+24.1	6
DGND.1	7
Shield	8

5.12.2 Pin assignment Terminal X2 (RS232 interface)

Signal	Pin No.
DCD	1
RXD	2
TXD	3
DTR	4
DGND.1	5
DSR	6
RTS	7
CTS	8
RI	9
Shield	10

5.12.3 Network management with SNMP

The current operating data of the system are transmitted on the network for evaluation by means of SNMP (Simple Network Management Protocol).
Thereby UPS can be integrated into existing network management systems.

5.12.4 Profibus-DP

Open bus standard in the field range according to IEC 61158.
The connection of the field bus will be made on the Profibus-DP converter.

5.12.5 OPC (Object linking and embedding for Process Control)

OPC is a standardized interface (under windows) for the access of process datas. OPC is established as standard data interface in the automation technology. With the **Piller** OPC-server UPS data can be retriered for visualization purposes.

5.13 Event recorder (event memory)

The event recorder in the APOCONV stores every event that occurs (key press, switching operation, faults) along with the date and time. Up to 1199 entries can be stored. With more than 1199 events the event recorder always stores the last 1199 events in accordance with the FIFO (first in, first out) principle.

The following are displayed:

- date and time
- description of event (e.g. Button ON pressed)
- event code and event number

The event code signifies the following:

Exxx / Elxxx	A non-acknowledged event has occurred.
*xxx	An event which must be acknowledged has occurred but has still not been acknowledged.
Rxxx	An event which must be acknowledged has been acknowledged.
Axxx	The time of the acknowledgement is being recorded.

NOTE xxx stands for a three-digit decimal number.

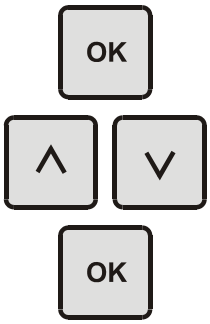
All events still in the memory can be shown in the LC display. The event recorder is reached via the selection menu of the APOCONV.

5.13.1 Call up the eventrecorder

Call up the menu selection with the „OK“ key.

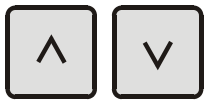
Select the „events“ with the „Arrow keys“.

Confirm the choice with the „OK“-key.



5.13.2 Scrolling / acknowledgement in the event recorder

The "arrow" keys are used for moving around the event recorder. The right-hand scroll bar indicates the position in the event recorder (start, middle, end). In addition, the number of events that are stored and are being currently displayed is indicated in the display at the bottom right:
e.g. 13 / 254 -> Event 13 from 254 is shown.



When event entries which have to be acknowledged are present, this is indicated by the red "Reset" LED.

Press the "Reset" key to go directly to the acknowledgement event.

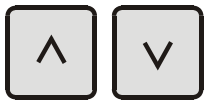
To acknowledge events (identified by *xxx) press the "Reset" key while the event is being displayed. The identification of the event then changes from *xxx to Rxxx and an additional event is generated that records the time of acknowledgement (Axxx).

If further acknowledgement events are present ("Reset“ LED stays red), press the "Reset" key again to now go to the event to be acknowledged next.

5.13.3 Quitting the event recorder

Quit the event recorder by means of the "ESC" key and return to the selection menu.

You can now select another list entry with the "arrow" keys or change to the standard display by pressing the "ESC" key again.



5.13.4 Event list

Event No.	Event
001	Button on pressed
002	Button off pressed
003	Button bypass on pressed
004	Button bypass off pressed
007	Battery charger overcurrent
008	Converter system output is on
009	Converter system output is off
010	Precharge voltage ok
011	Equalize charging off
012	Rectifier ready for start_up
013	Battery charger on
014	Battery charger off
015	Boost charging on
016	Equalize charging on
017	'Fast off' switch pressed
020	Inverter current > 100%
021	Maximum inverter current
022	Manual bypass switch Q500 closed
023	Manual bypass switch Q500 opened
024	Parallel operation
025	Single operation
026	Battery charger activated
027	Battery charger deactivated by menu
029	Bypass mains ok
030	Bypass mains out of tolerance
034	External output breaker opened
035	External output breaker closed
037	Inverter overload protection active
038	Output overload protection active
039	Output voltage high
040	Output voltage low
041	Output voltage low -30%
042	Mains 1 rotation fail
045	Battery completely discharged
046	Converter system maintenance required
054	Battery voltage low
055	General failure
056	General failure acknowledged
057	Overvoltage mains 1
058	Undervoltage mains 1
059	Overfrequency mains 1
060	Underfrequency mains 1
061	Overvoltage bypass
062	Undervoltage bypass
063	Overfrequency bypass

Event No.	Event
064	Underfrequency bypass
065	Output frequency failure
070	Fast bypass on
074	Ups synchronizes to external source
075	Synchronization to external source off
081	Input current > 100%
082	Maximum input current
083	Bypass current >100%
084	Rectifier synchronises to mains 1
085	Power supply error controllerboard
086	Bypass blocked
091	External sync source available
096	Rectifier mains ok
097	Rectifier mains out of tolerance
100	Precharging on
101	Precharging off
102	Mains thyristors on
103	Mains thyristors off
104	Battery thyristors on
105	Battery thyristors off
106	DCDC converter on
107	DCDC converter off
108	Inverter on
109	Inverter off
110	Converter system output on
111	Converter system output off
112	Inverter is on
116	DCDC converter is on
117	Not enough converter system available for parallel operation
118	Charger switched off due to diesel operation
119	Diesel operation
120	Red. cable connected without selected option
128	Supply air overtemperature
129	Supply air temperature ok
130	Battery overtemperature
131	Battery temperature ok
132	Battery rest time threshold 1 underrun
133	Battery rest time threshold 2 underrun
134	Battery rest time threshold 3 underrun
135	Battery rest time threshold 4 underrun
144	DC link overvoltage
146	DC link undervoltage
148	Output measurement board failure
150	Battery is not connected
153	Output voltage failure in bypass operation
159	Rectifier disabled in diesel operation
171	'Fast off' switch is off

Event No.	Event
176	Converter system load requires redundant converter system
177	Converter system load limit exceeded
178	Minimum number of converter system sufficient for load
179	Converter system load remain under limit
181	Inverter FPGA failure
182	Rectifier FPGA failure
183	Battery charger FPGA failure
184	Redundant parallel wiring enabled
185	Redundant parallel wiring disabled
200	Temperature warning DCDC converter
202	Temperature warning inverter
204	Temperature warning battery charger
205	Temperature warning mains and battery thyristors
207	Temperature warning bypass
272	Start Converter system because of increasing load
273	Stop Converter system because of decreasing load
278	Bsafe battery failure detected
402	Precharge failure
403	DCDC voltage ramp failure
404	Fan connection at X22 on A100 not ok
406	Voltage failure of power supply A305
407	Inverter measurement board failure
408	Rectifier measurement failure
409	Overtemperature battery charger
411	Overtemperature input thyristors
412	Overtemperature inverter
413	Overtemperature DCDC converter
414	Overtemperature battery charger choke
415	Actual speed signal of converter fans not ok
418	Parallel connection defective
419	Battery failure
422	Actual speed value of bypass fans not ok
423	Output contactor failure
424	Overtemperature inverter chokes
425	Overtemperature rectifier chokes
426	Inverter voltage ramp failure
427	DSP boot failure
429	Battery overvoltage at battery charging
432	Hardware failure of DC measurement board A100 X39
433	Inverter failure
434	Hardware failure battery charger
435	Hardware failure DCDC converter
436	Hardware failure of rectifier firing at A100 X15
437	Hardware failure inverter
438	Hardware failure of battery firing at A100 X16
440	Hardware watchdog triggered
441	Overtemperature input trafo

Event No.	Event
442	Overtemperature output trafo
443	Parallel connection redundancy fail
444	Tempsensor failure air inlet
445	Tempsensor failure battery
446	Can sync pulse failure counter rate high
447	Can communication of active parallel Converter system lost
448	Battery voltage unsymmetrical
449	Battery charger fuse blown
485	Converter system output failure
555	Horn off
666	Horn on
900	'Remote on' pressed
902	'Remote off' pressed
904	'Remote bypass on' pressed
908	Blown battery fuse
910	External bypass is on

6 INSTALLATION AND CONNECTIONS

6.1 Installation notes

6.1.1 Goods inwards inspection

Final inspection ensures satisfactory mechanical and electrical condition before that APOCONV leaves the factory. Immediately after the equipment arrives, please check whether any freight damage has occurred and if necessary, bring this to the attention of the freight operator. In no circumstances put a damaged APOCONV into service before you have consulted us!

6.1.2 Transport

If required, the APOCONV and the optional cabinets can be moved by means of a fork-lift or lift truck. Moving by crane should only be used in exceptional circumstances and only after consulting us. Ensure that the equipment is only transported upright and not tilted or turned over. Please note the centre-of-gravity stickers affixed to the external panels of the APOCONV. Always avoid sharp impacts. Where possible leave the equipment in its original packing when moving it. This provides the best possible protection against damage. It is important to ensure that the APOCONV, including packing and transportation means, does not exceed the permissible floor loading over any part of the transport route. The permissible carrying capacity of lifts and elevators must be observed.

6.1.3 Storage

The equipment should be stored in a dry, well-ventilated room that is free of aggressive materials. Where possible, the original packing should not be removed during storage. In no circumstances must the APOCONV be left stacked or stored outside!

6.1.4 Choice of installation site

The APOCONV can be installed with the rear side against a wall. The following criteria should be observed when selecting the installation site:

a. Floor loading capacity
The weight of the equipment is distributed over a relatively small area; care must therefore be taken to ensure that the floor loading capacity is adequate. The exact value can be obtained from chapter 4 Technical Data. If necessary, the support area can be increased by interposing a suitable load distribution rack. Please consult your architect, the site management or us if you require assistance.

b. Baseframe
Baseframe are available on request. If questions appear please do not hesitate to contact us.

c. Installation of several APOCONV systems
If several APOCONV units are placed side by side (e.g. on a common baseframe), the internal side panels (side panels between cabinets) can be removed and replaced by side panels having suitable openings for the cable runs.
It is also possible to bolt the cabinets to each other and to the base.
Hereby the operation of the APOCONV will not be impaired.

d. Space requirements

The APOCONV can be installed with the rear side against a wall, a clearance of at least 10 mm will be recommended. About a metre clearance should be left in front of the unit to provide unimpeded access to the cubicle. Local or general safety regulations, e.g. escape routes as per VDE 0100, part 729, should also be observed. A clearance of at least 50 cm should be left above the APOCONV to allow the warm air to be freely exhausted.

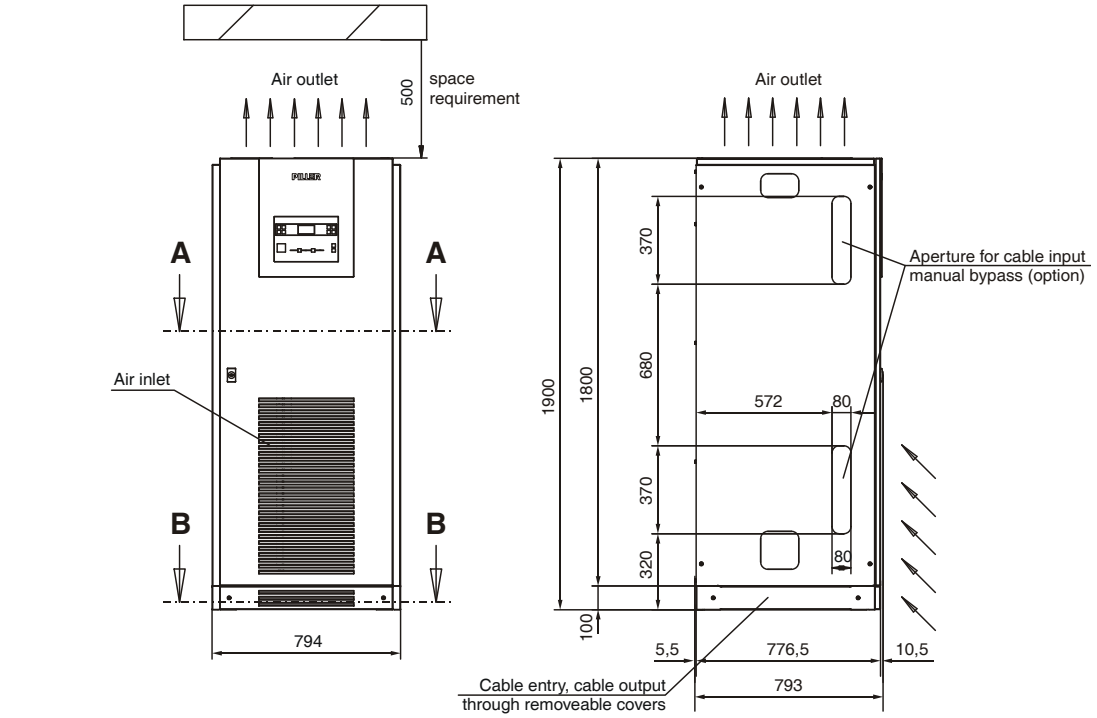
In no circumstances must the air inlets (front, bottom cover and front door) and air outlet (top) be covered or blocked, there is a risk of overheating of the system. Further information are given in chapter 6.2 Dimensions.

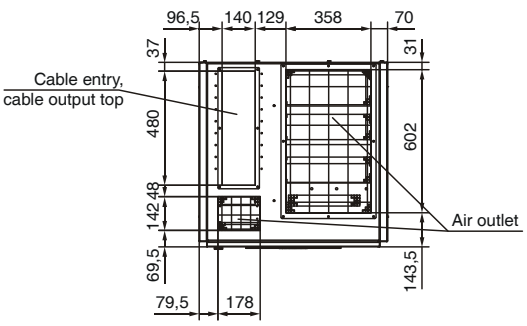
e. Installation altitude, temperature and humidity

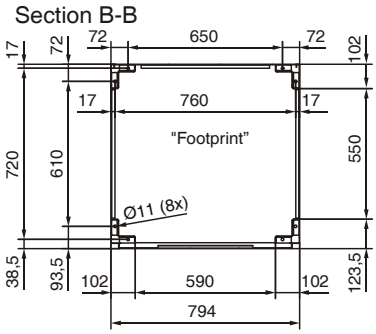
The APOCONV is designed for an installation altitude of up to 2000 metres above mean sea level, an ambient temperature of 0 to 40°C (daily average ≤ 35°C) and a relative humidity of up to 95% without condensation. The optimum temperature is around 20°C. Please consult us if planning an installation above 2000 metres. Please ensure that any existing air-conditioning plant meets these conditions and is also able to remove the unit's dissipated heat. Details are shown in the technical data (chapter 4). The cooling air must always be free of aggressive agents.

6.2 Dimensions

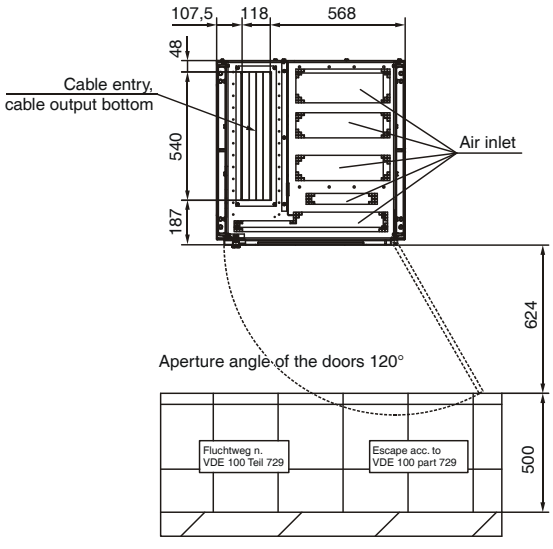
6.2.1 APOCONV 100 – 120 kVA







Section A-A
(also showing the space requirement)



All dimensions in mm

Fig. 6-1 APOCONV 100-120 kVA dimensions and space requirements

6.2.2 APOCONV 160 – 200 kVA

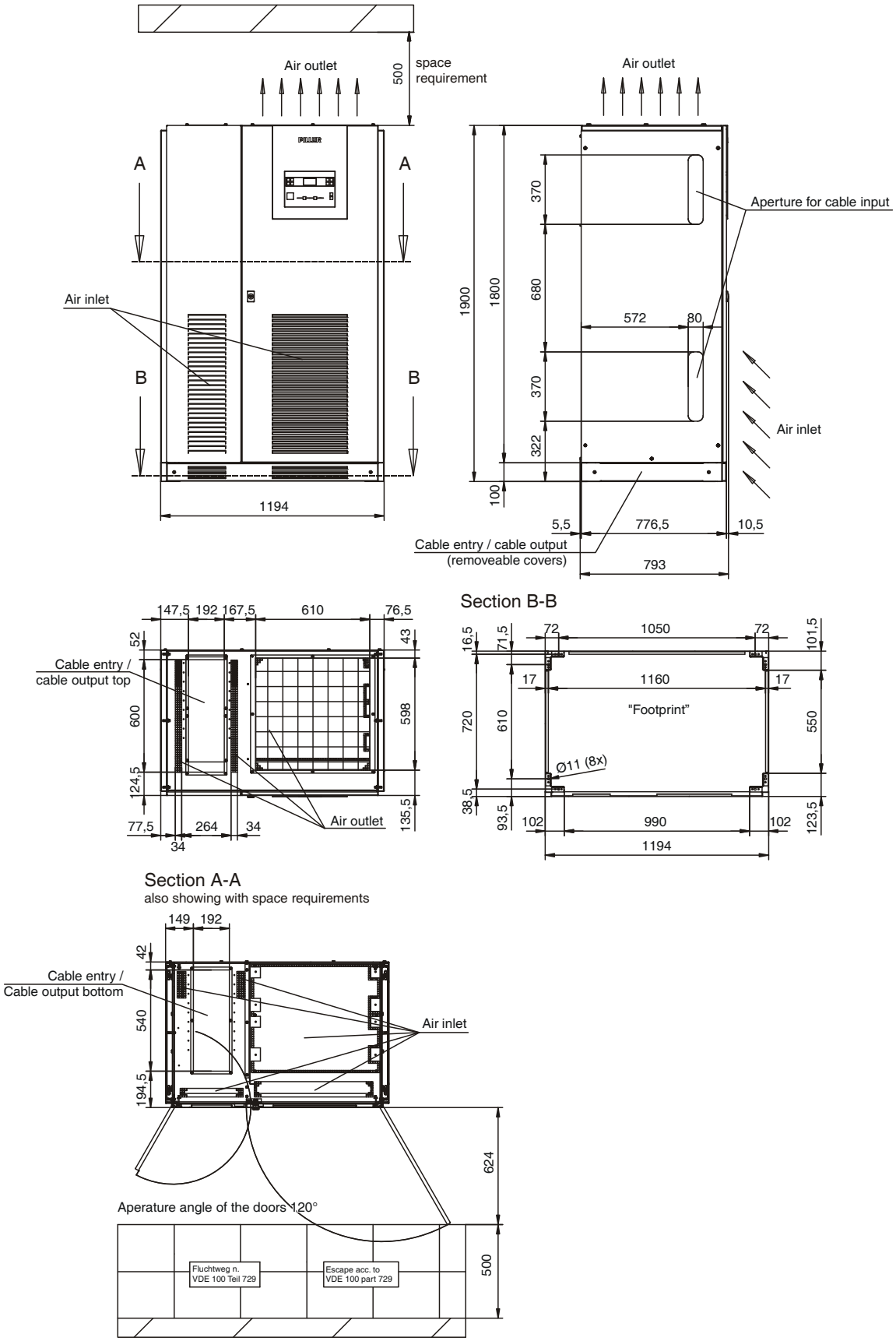


Fig. 6-2 APOCONV 160-200 kVA dimensions and space requirements

6.2.3 APOCONV 300 kVA

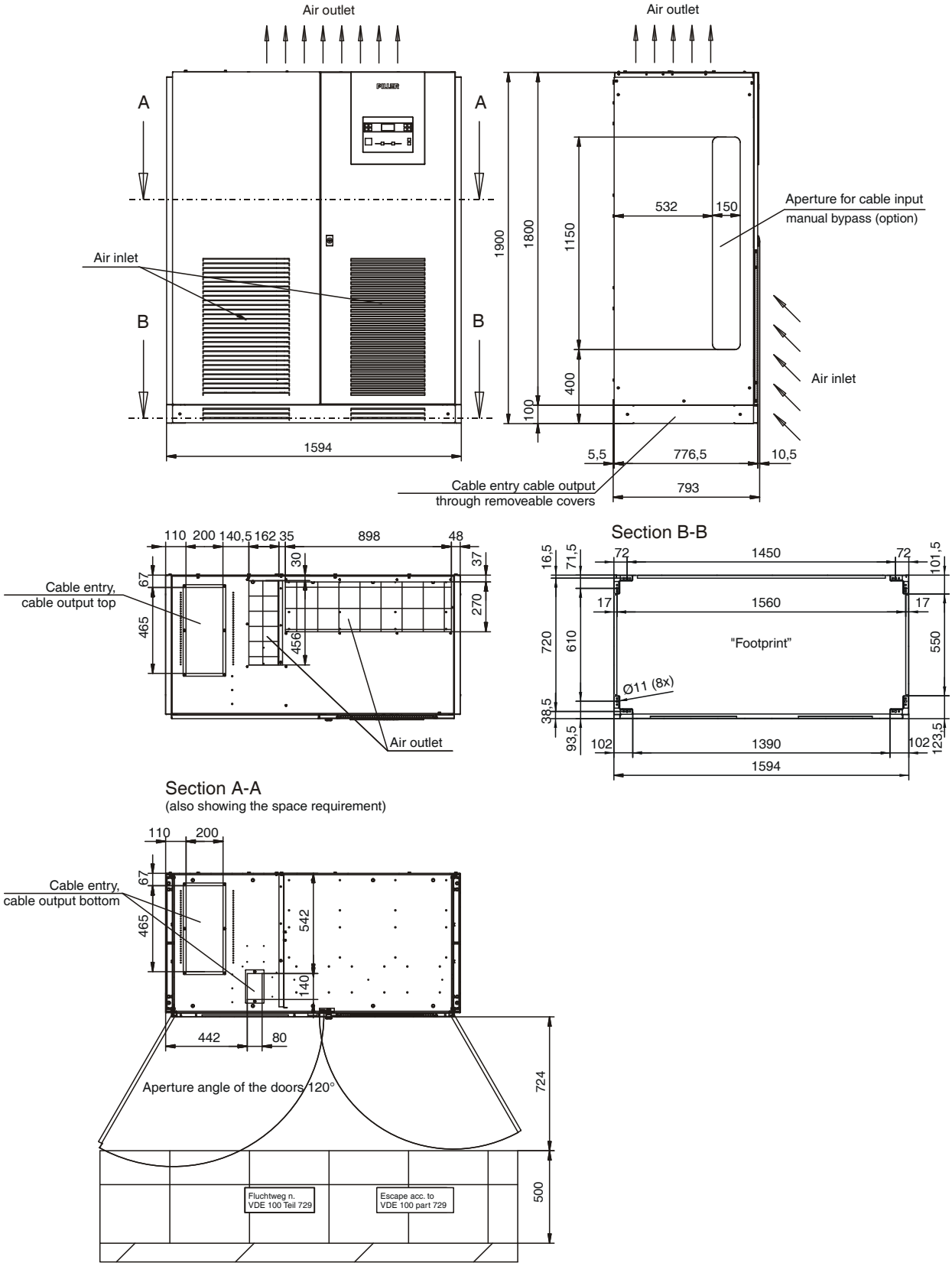


Fig. 6-3 APOCONV 300 kVA dimensions and space requirements

6.2.4 APOCONV 400 kVA

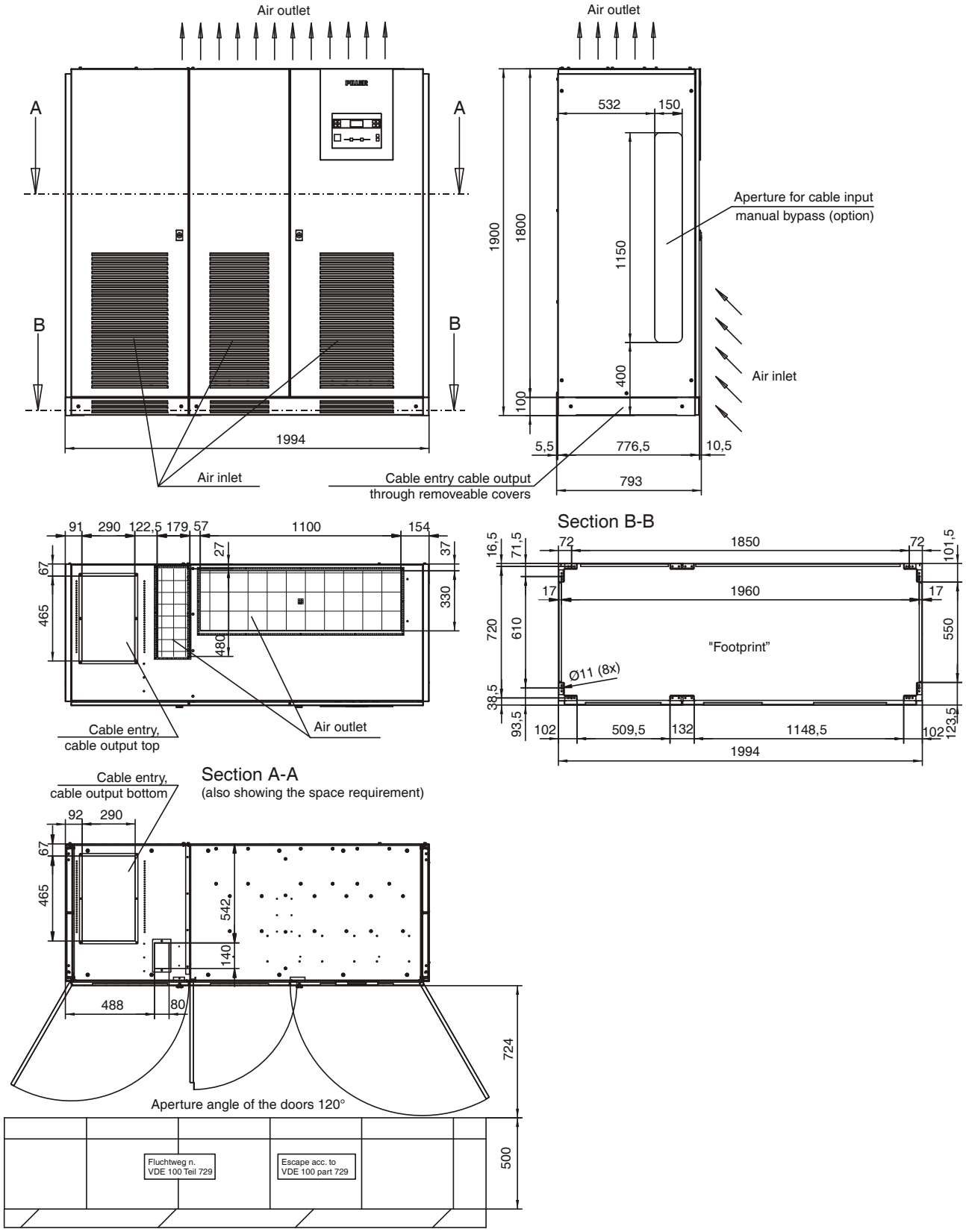


Fig. 6-4 APOCONV 400 kVA dimensions and space requirements

6.2.5 Auxiliary cabinet APOCONV 100 – 200kVA (Option)

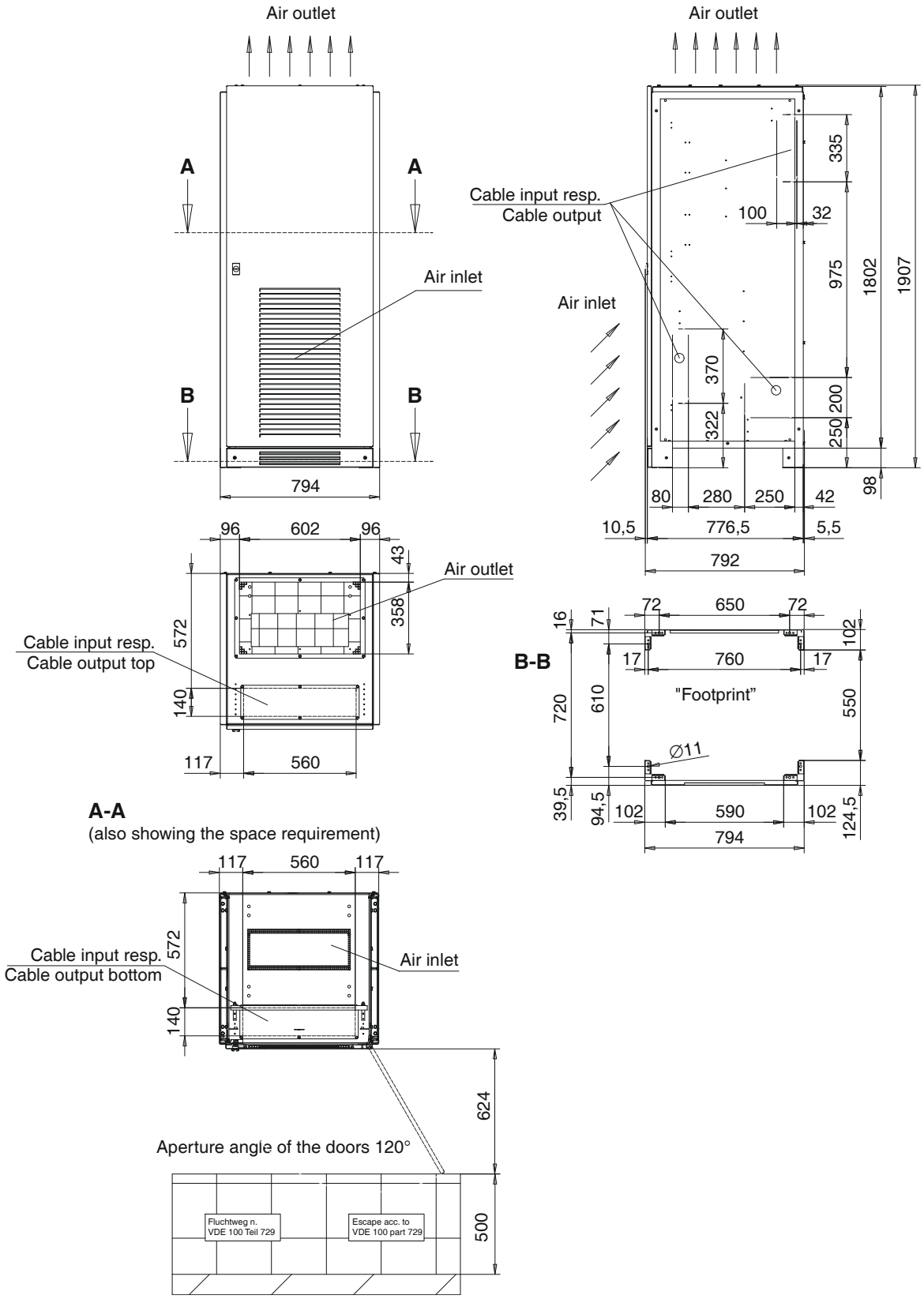


Fig. 6-5 Auxiliary cabinet APOCONV 100-200 kVA dimensions and space requirements

NOTE The auxiliary cabinet is installed on the left-hand side of the basic unit.

6.2.6 Auxiliary cabinet APOCONV 300 – 500kVA (Option)

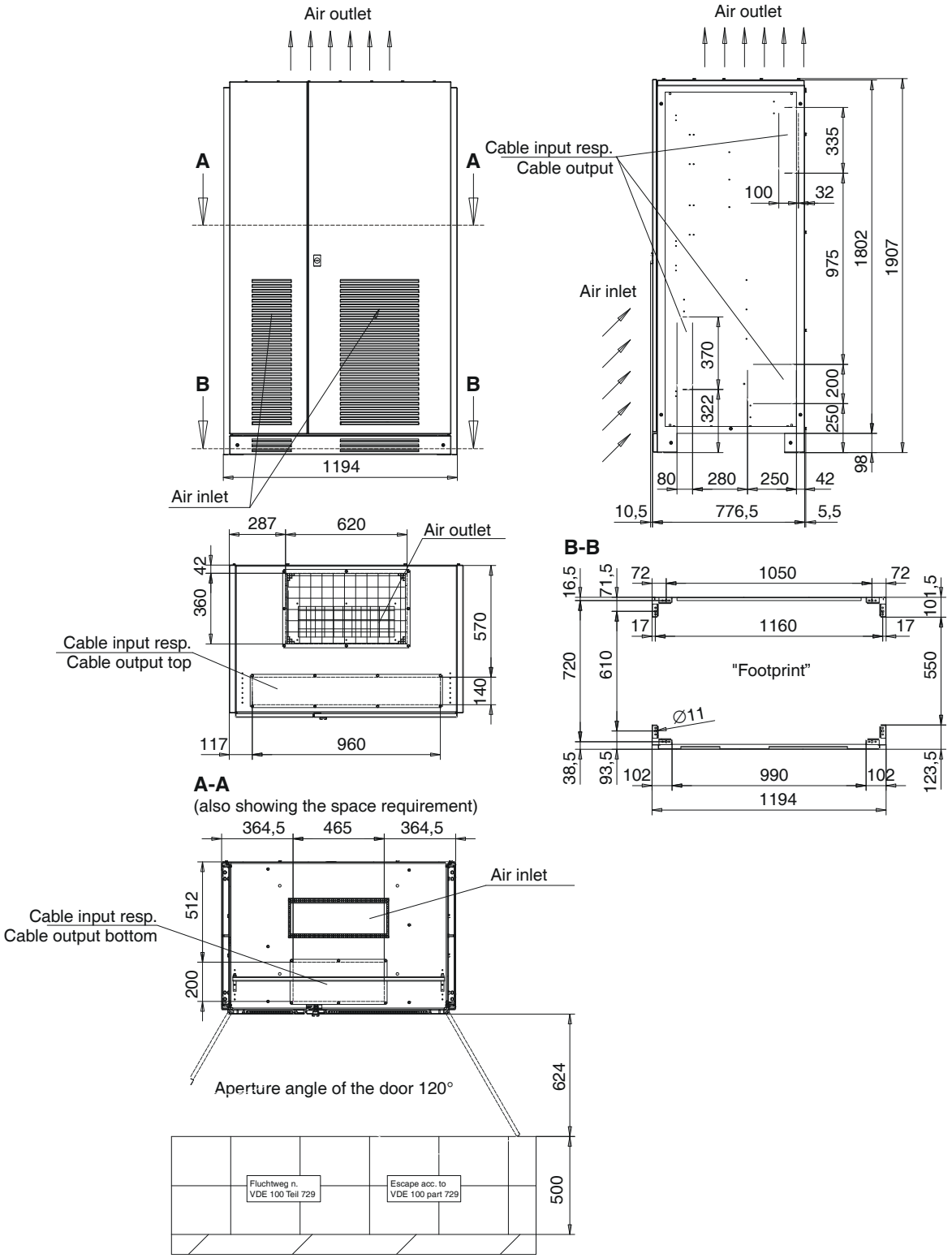


Fig. 6-6 Auxiliary cabinet APOCONV 300-500 kVA dimensions and space requirements

NOTE The auxiliary cabinet is installed on the left-hand side of the basic unit.

6.3 Fuses

6.3.1 APOCONV fuse protection

The fuses are shown in the following tables.

We recommend l.v.h.b.c. type fuses with gL/gG tripping characteristic.

Type	Fuses
AC 100	200 A
AC 120	250 A
AC 160	315 A
AC 200	355 A
AC 300	500 A
AC 400	800 A
AC 500	1000 A

IMPORTANT If the fuse rating is reduced in relation to the table given above, operating states can occur in which the fuse is tripped unintentionally (e.g. during mains voltage fluctuations).

IMPORTANT In the case of installations with continuous undervoltages, the fuse rating of the incoming supply and associated cable should be checked. In individual cases it may be necessary to increase the value of the incoming supply fuse.

6.3.2 Battery protection

The battery fuse should be matched to the respective, planned battery installation. In this case, apart from the current, both the capacity and the number of battery cells influence the rating. This results in a large number of possible fuses. For these reasons they are not listed here. Further information is shown in the technical data of the battery or contact the battery manufacturer resp. supplier or us.

6.3.3 Load protection

The load fuse is the fuse that is fitted directly after the output. The maximum permissible load fuses are listed in the table below.
We recommend l.v.h.b.c. type fuses with gG tripping characteristic.

IMPORTANT The fuses listed here correspond to the rated output current of the converter system (see chapter 4.1) and are not selective for the recommended incoming supply fuse stated in chapter 6.3.1.

Type	Fuses
AC 100	160 A
AC 120	200 A
AC 160	250 A
AC 200	315 A
AC 300	425 A
AC 400	630 A
AC 500	800 A

6.4 Connection cables

The cables in the tables 6.4.1 - 6.4.3 are applicable to the following ambient conditions:

- Use of the backup fuses listed in chapter 6.3.1
- Cable type NYY resp. NYCWY according to VDE 0276-603:2010-03
- Permanent installation in buildings
- Ambient temperature 30°C
- Horizontal or vertical cable runs in perforated cable trays
- Wall clearance of at least 0.3 x cable diameter
- Bundling of multicore cables according to number of parallel cables in the table

6.4.1 Connection cables of mains supply

The cables required for connecting the APOCONV to the supply mains are listed in the table below. The data are apply to the input fuses from chapter 6.3.1 and the ambient conditions in chapter 6.4.

NOTE Where ambient conditions differ, the choice of cable should comply with the appropriate regulations.

NOTE The quoted cable cross-sections allow for increased currents in the neutral conductor.

Type	Connection cable of mains supply L1, L2, L3, N, PE
AC 100	1x NYCWY 4x70SM35
AC 120	1x NYCWY 4x95SM50
AC 160	2x NYCWY 4x70SM35
AC 200	2x NYCWY 4x70SM35
AC 300	2x NYCWY 4x120SM70
AC 400	3x NYCWY 4x150SM70
AC 500	4x NYCWY 4x150SM70

6.4.2 Connection cables of battery (option)

The cables required for connecting the APOCONV to the battery are listed in the table below. The data are applicable to the following ambient conditions.

NOTE Where ambient conditions differ, the choice of cable should comply with the appropriate regulations.

WARNING

Take measures in the battery unit for protection against direct and indirect contact, acc. DIN EN 50272-2 VDE 0510-2:2001-12.

NOTE The voltage drop across the battery cables should not exceed 1.5 %. When using the cables specified in this chapter, the total length of the outgoing and return conductors of the battery cable should not exceed 60 m. The necessary cable lengths within the system should also be taken into account during project planning.
Cable lengths may also be limited by the battery or battery protection unit. These can be found in the battery manufacturer's technical data.

Type	Battery current[5]	Connection cable of battery[6]
AC 100	320 A	1 x NYY-O 1x95RM
AC 120	384 A	1 x NYY-O 1x120RM
AC 160	514 A	2 x NYY-O 1x70RM
AC 200	643 A	2 x NYY-O 1x95RM
AC 300	967 A	3 x NYY-O 1x95RM
AC 400	1289 A	3 x NYY-O 1x150RM
AC 500	1589 A	4 x NYY-O 1x150RM

[5] Max. battery discharging current of APOCONV.
[6] The technical data apply to connection at one battery pole.

6.4.3 Connection cables to the load

The cables required for connecting the APOCONV to the load bar are listed in the table below. The data are applicable to the following ambient conditions. The data are apply to the input fuses from chapter 6.3.3 and the ambient conditions in chapter 6.4.

NOTE Where ambient conditions differ, the choice of cable should comply with the appropriate regulations.

NOTE The quoted cable cross-sections allow for increased currents in the neutral conductor.

WARNING

In order to ensure line protection in this operating mode, these cables are connected to the infeed fuse protection of the converter. Overloading of the cables can occur if the conductor cross-section is reduced to the current loading based on the output current of the system.

Type	Connection cable of the load L1, L2, L3, N, PE
AC 100	1 x NYCWY 4x95SM50
AC 120	1 x NYCWY 4x120SM70
AC 160	2 x NYCWY 4x70SM35
AC 200	2 x NYCWY 4x95SM50
AC 300	2 x NYCWY 4x150SM70
AC 400	3 x NYCWY 4x150SM70
AC 500	4 x NYCWY 4x150SM70

6.5 Converter electrical connections

WARNING

Generally we recommended following the SAFETY NOTES of chapter 3.

For the connection of the APOCONV, terminals are provided in the left-hand area of the cabinet (cable compartment) for the power connections (infeed converter, load and battery). The interfaces for the control and communications cables are located behind the door on a hinged bay in the right-hand area of the system. Cables can be routed into the cabinet from all four sides and introduced through the floor of the cabinet and/or the roof. A false floor is not required at the installation site. The following describes how the cables selected in chapter 6.4 should be installed in the system and where these are to be connected.

IMPORTANT Please ensure that the phase of AC connections and the polarity of the battery connection are correct since incorrect connections can cause damage to the system. (Direction of rotation of MG-set: counter clockwise).

6.5.1 Installation and cable entry on AC 100 – 200 kVA

NOTE The Figures included in this chapter show the cable routing for the AC 100 – 120 kVA. The principle of the cable routing for the AC 160 – 200 kVA is identical.

6.5.1.1 Installation with cable entry from below

Cables should be led through the floor panel into the left-hand part of the cabinet (cable compartment) and attached to the supporting rails provided for this purpose.

The load connecting cables should be installed first. As shown in the illustrations in chapter 6.5.4, the load terminals (X6) are located in the upper part of the cable compartment. The associated connecting cables should be routed to the terminals through the cable duct in front of the rear panel. The cables are attached to supporting rails provided for this purpose.

The infeed cables should be installed next. The sequence of connections for X1 and X4 is optional. The mains input and battery terminals are located in the lower part of the cable compartment. The described cable routing is shown in the following figure.

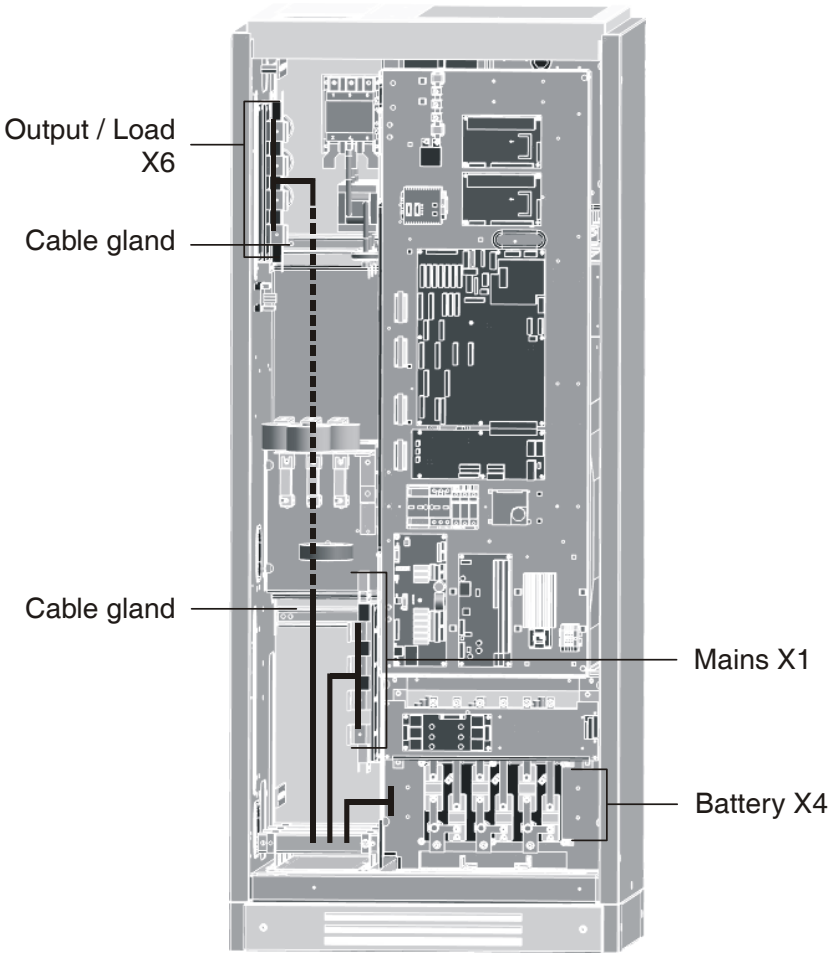


Fig. 6-7 Routing of cables into the cable compartment where cable entry is from below; AC 100 – 200 kVA, as shown on the AC 100 – 120 kVA

NOTE All power cables should be attached with standard tubular cable lugs or crimp-type cable lugs with a hole for M12 bolts.

6.5.1.2 Installation with cable entry from above

Cables should be routed into the inside of the unit through the cable entry panel in the roof; left-hand part of the cabinet (cable compartment). A supporting rail is provided for this purpose. The panel should be adapted to the particular requirements prior to installation, e.g. by fitting screwed glands.

The infeed cables should be installed first. As shown in the illustrations in chapter 6.5.4, the converter system (X1) and battery terminals (X4) are in the lower part of the cable compartment. The associated connecting cables are routed to the terminals through the cable duct in front of the rear panel. The sequence of connections for X1 and X4 is optional. The cables are attached to supporting rails provided for this purpose.

The load connecting cables are installed next. The load terminals (X6) are located in the upper part of the cable compartment. The described cable routing is shown in the following figure.

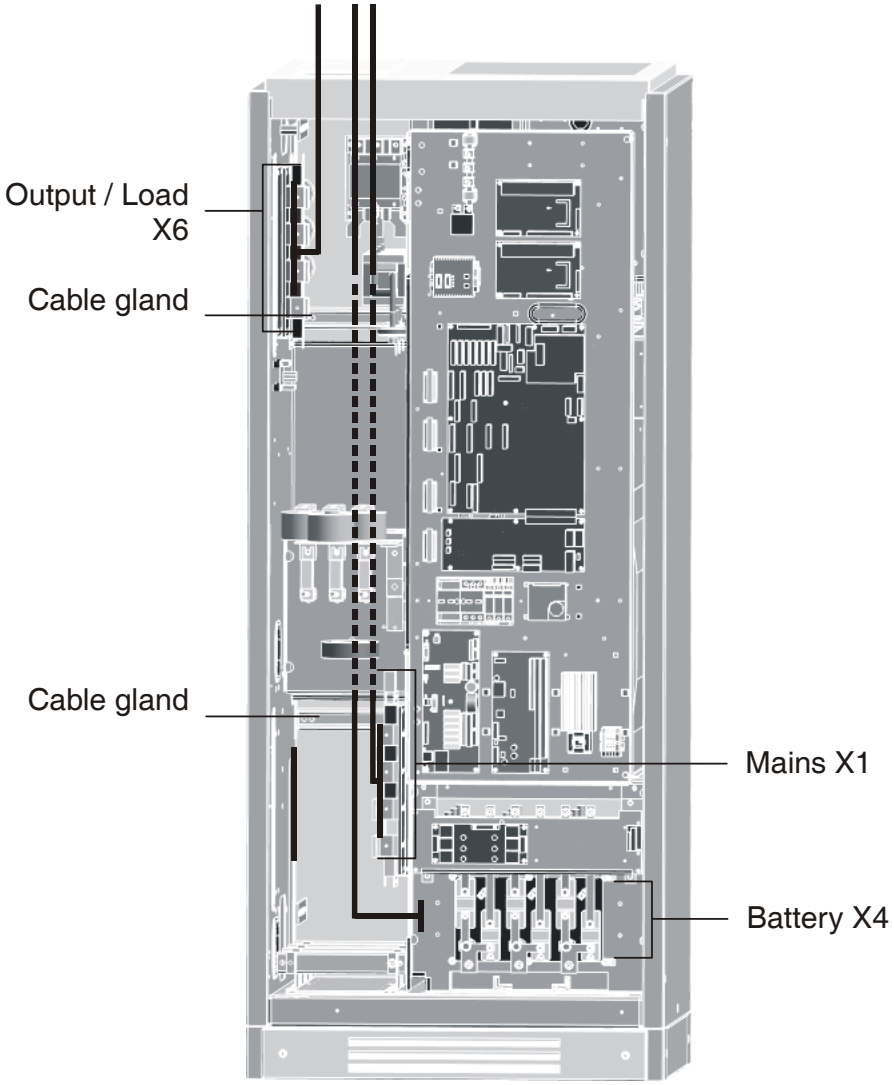


Fig. 6-8 Routing of cables into the cable compartment where cable entry is from top; AC 100 – 200 kVA, as shown on the AC 100 – 120 kVA

NOTE All power cables should be attached with standard tubular cable lugs or crimp-type cable lugs with a hole for M12 bolts.

6.5.1.3 Cable installation for control and communications cables

A number of interfaces is available to the APOCONV for control or communication with external devices. These are located on some optional circuit boards on the hinged bay behind the door. The following circuit boards with interfaces to external devices are mounted on the hinged bay:

- Standard I/O-Board (A900)
- I/O-Boards (A911), optional
- Protocol Gateways (A921, A922), optional
- Parallel - Interface Board (A901), optional

The cable routing to these circuit boards is the same as that for the power cables via the floor panel (cable entry from below) or via the cable entry panel in the roof (cable entry from above) in the left-hand part of the cabinet (cable compartment). With cable entry from below, the control cables should be routed upwards via the cable duct in the rear part of the cable compartment and attached to the supporting rails provided for this purpose. The cables should be led forward and attached to clips on the central panel directly below the roof. This route forward towards the hinged bay should also be used for cable entry from above. The cables should then be led through a 90° elbow to the upper left-hand corner of the hinged bay. The described cable installation can be seen in the following figure.

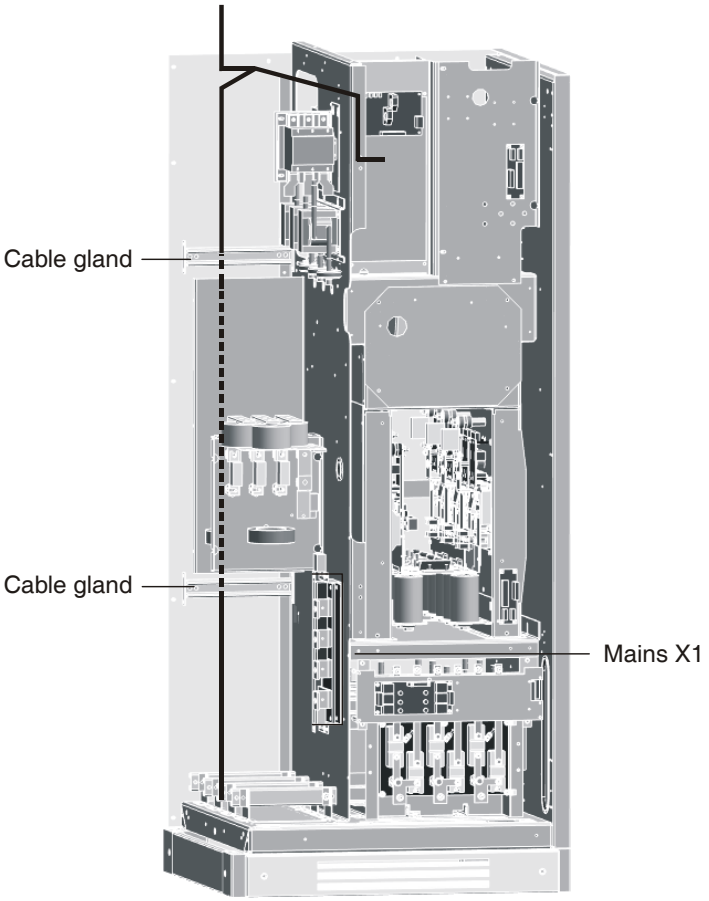


Fig. 6-9 Routing of control and communications cable into the cable compartment; AC 100 – 200 kVA, as shown on the AC 100 – 120 kVA

The so-called shield buses are located on the hinged bay close to the cable entry area. The screens of all communications cables should be connected to these shield buses.

The remaining cable installation in the cable trunking up to the respective circuit boards is shown in the following figure. Here the inner cable duct (Fig. 6-10/a) should be used for the more sensitive communications cables. These cables include data exchange cables such as CAN or Current bus, for example. The less sensitive cables should be routed in the outer cable duct (Fig. 6-10/b). These include potential-free control cables to the I/O Boards, for example.

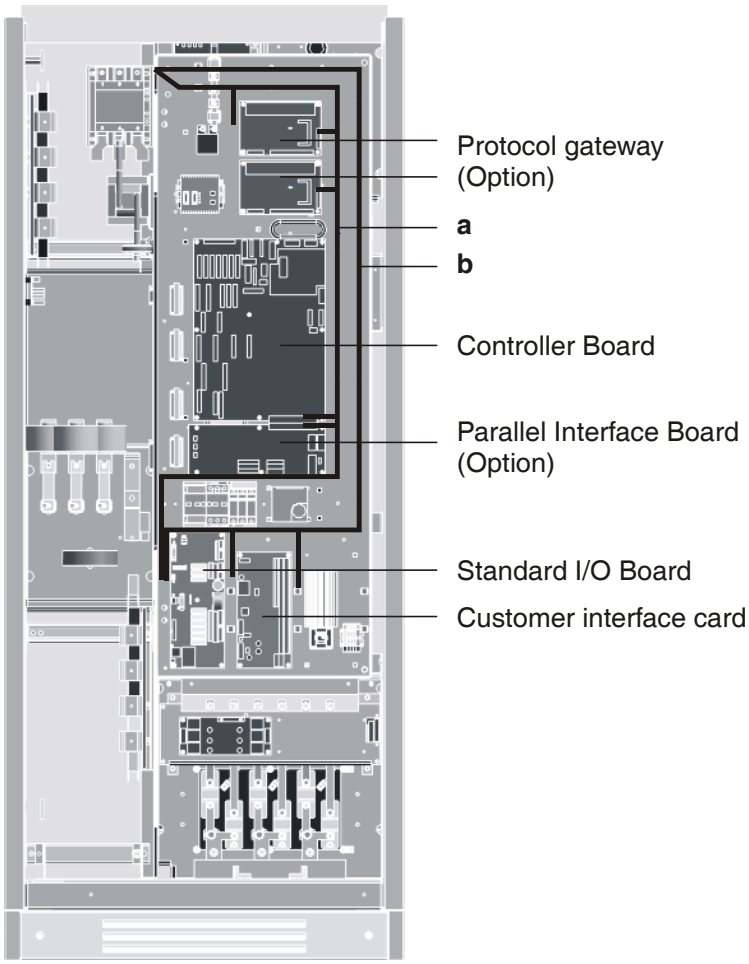


Fig. 6-10 Routing of control and communications cable into the cable compartment; AC 100 – 200 kVA, as shown on the AC 100 – 120 kVA

NOTE

1. All cables that are to be routed to the hinged bay must be flexible. Since the hinged bay is moveable and has to be occasionally opened for maintenance operations, this could otherwise lead to cable breaks which cause system malfunctions.
2. The cables should be attached to the hinged bay. In so doing ensure that the cables are free to move so that the hinged bay can be fully opened without exerting tension on the cables. At the same time, the cable installation in this area should be kept tight so that when the hinged bay is opened wide the cables do not rest on the metal edge of the bay and are sheared off when it is closed.
3. When connecting the screens of the cables that are routed to the I/O Board (A911) or the protocol gateways (A921, A922), the cable insulation must not be stripped right up to the connection point. Only the outer sheath of the cable should be removed for the width of the bus, so that the terminal supplied with the shield bus forms an electrically conducting bond between the bus and the screen.
4. In order to avoid interference signal injection, communications cables and potential-free control cables, for example, should be laid in separate cable ducts as described.

Further information on the control and communications cables, as well as their interfaces, can be obtained from the respective chapters dealing with the electronic modules.

6.5.2 Installation and cable entry on the AC 300 – 500 kVA

NOTE The figures included in this chapter show the cable routing for the AC 300 kVA. The principle of the cable routing for the AC 400/500 kVA is identical.

6.5.3 Installation with cable entry from below

Cables should be led into the unit through the floor panel via the left-hand part of the cabinet (cable compartment). Five supporting rails for attaching the cables and numerous screws for making the electrical connections are provided in the supplied mounting kit. Where there is a cutout in the panel for the cable entry, the supporting rails can be mounted on the floor panel. The arrangement of the supporting rails can be varied to suit individual requirements. Two additional permanently-mounted supporting rails are provided for attaching the cables inside the cable compartment.

The installation sequence depends on the arrangement of the connecting terminals. We recommend that the installation procedure described in the following steps be followed. In this case the cable routing in the floor panel is effected from the rear to the front and the termination panel connected up from top to bottom. During installation pay particular attention to the illustrations in Fig. 6-11 and the notes underneath this figure.

1. The load connecting cable (X6) is installed in the first step. For this, a cable supporting rail should be mounted right at the back above the cable entry on the floor panel. The load cables are laid and secured alongside each other on this rail. As Fig. 6-11 shows, the load terminals are located in the upper area of the termination panel. When connecting the load cables to the connecting terminals, the two supporting rails in the rear of the cable compartment can be used to attach the cables. The connections at terminals X6.1 (L1), X6.2 (L2), X6.3 (L3) and X6.N (N) are made to the connecting bars from above using cable lugs. The protective conductor should be connected to the PE busbar at the left-hand side panel.

2. The battery infeed (X4) connecting cables are installed in the next step. In order to support the battery cables, a further supporting rail should be fitted to the floor panel directly in front of the bypass mains infeed cables. The battery cables are laid and supported alongside each other on this rail. An additional rail should be fitted if this supporting rail is still not adequate for mounting the cables. Cable lugs are used to connect terminals X4.1 (L+) and X4.2 (L-) from above to the connecting bars. It is imperative to observe the correct polarity of all cables. A protective conductor should be connected to the PE busbar at the left-hand side panel.

3. The connecting cables for the converter infeed (Mains 1, X1) are connected in the final step. To support the infeed cables, an additional supporting rail must be mounted immediately in front of the battery cables on the floor panel. The infeed cables are laid and supported alongside each other on this rail. Connection to terminals X1.1 (L1), X1.2 (L2), X1.3 (L3) and X1.N (N) are made to the connecting bars from above, using cable lugs. The protective conductor should be connected to the PE busbar on the left-hand side panel.

4. Further earthing and equipotential bonding cables should likewise be connected to the PE busbar at the left-hand side panel.

5. On completion of work, the cable installation should be sealed to protect against soiling and/or rodent attack, using suitable means (e.g. cut out rubber matting).

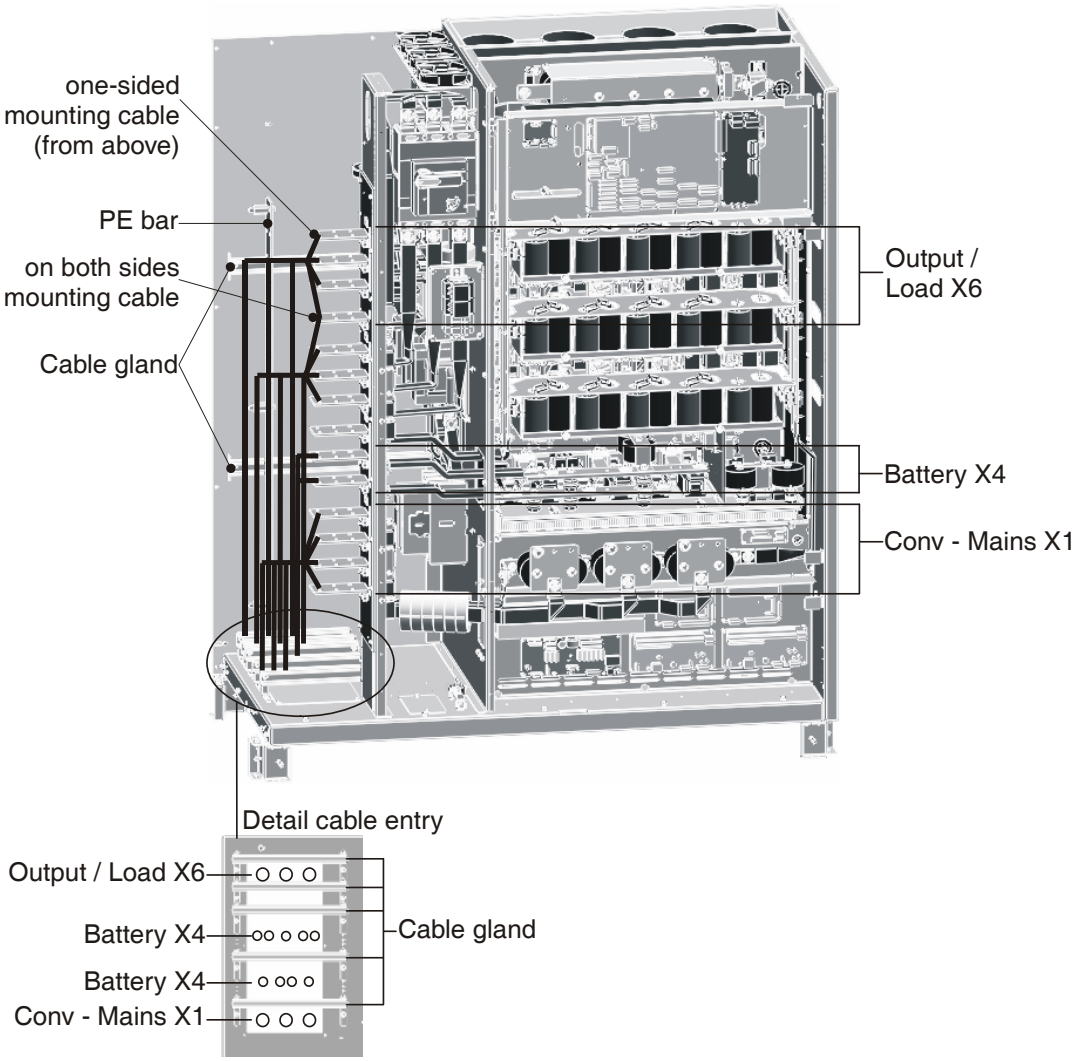


Fig. 6-11 Cable installation in the cable compartment with cable entry from below, AC 300 – 400 kVA, illustrated on the AC 300 kVA

NOTE All power cables should be attached by means of standard tubular or crimp-type cable lugs having a drilled hole for M12 screws.

6.5.3.1 Installation with cable entry from above

Cables should be routed into the unit through the panel in the roof of the left-hand part of the cabinet (cable compartment). Five supporting rails for attaching the cables and numerous screws for making the electrical connections are provided in the supplied mounting kit. Where there is a panel cutout for the cable entry the supporting rails can be mounted under the roof. The arrangement of supporting rails should be varied to suit individual requirements. A further two permanently-mounted supporting rails are provided for attaching the cables inside the cable compartment. These are also used to seal the roof and to provide strain relief. This dispenses with the need for mounting cable supporting rails under the roof.
The installation sequence depends on the arrangement of the connecting terminals. We recommend that the installation procedure described in the following steps be followed. In this case the cable routing in the roof is effected from the rear to the front and the termination panel connected up from top to bottom at the same time. During installation pay particular attention to the illustrations in Fig. 6-12 and the notes underneath this figure.

1. The connecting cables of the converter mains infeed (X1) should be installed first. For this, a cable supporting rail should be mounted right at the back under the roof for the cable entry. The mains infeed cables are laid and supported alongside each other on this rail. As Fig. 6-12 shows, the mains infeed terminals are in the lower area of the termination panel. When laying the cables, the two supporting rails at the back of the cable compartment can be used for attaching the cables. The connections to terminals X1.1 (L1), X1.2 (L2), X1.3 (L3) and X1.N (N) are made to the connecting bars from above using cable lugs. The protective conductor should be connected to the PE busbar at the left-hand side panel.

2. The connecting cable of the battery infeed (X4) should be installed in the second step. To support the battery cable, a supporting rail should be mounted under the roof immediately in front of the converter system infeed cables. Should this supporting rail still not be adequate to support the cable, an additional one should be fitted. Connections to terminals X4.1 (L+) and X4.2 (L-) are made to the connecting bars from above, using cable lugs. It is imperative that the correct polarity of all cables is observed. A protective conductor should be connected to the PE busbar at the left-hand side panel.

3. The load connecting cable (X6) should be installed in the final step. In order to support the infeed cables, a further supporting rail should be fitted under the roof immediately in front of the bypass mains infeed cables. The load cables are laid and supported alongside each other on this rail. Connections to terminals X6.1 (L1), X6.2 (L2) and X6.3 (L3) are made to the connecting rail from above, using cable lugs. The connection to terminal X6.N (N) is made to the connecting terminal from below, using a cable lug. In this case the cables for the bypass mains neutral conductor remain connected from below. The protective conductor should be connected to the PE busbar at the left-hand side panel.

4. Further earthing or equipotential bonding cables should likewise be connected to the PE busbar at the left-hand side panel.

5. On completion of work, the cable entry in the roof should be sealed by suitable means.

WARNING

Point 5 applies to protection against soiling and especially to the protection of persons against contact with electrically conducting parts and must be carried out.

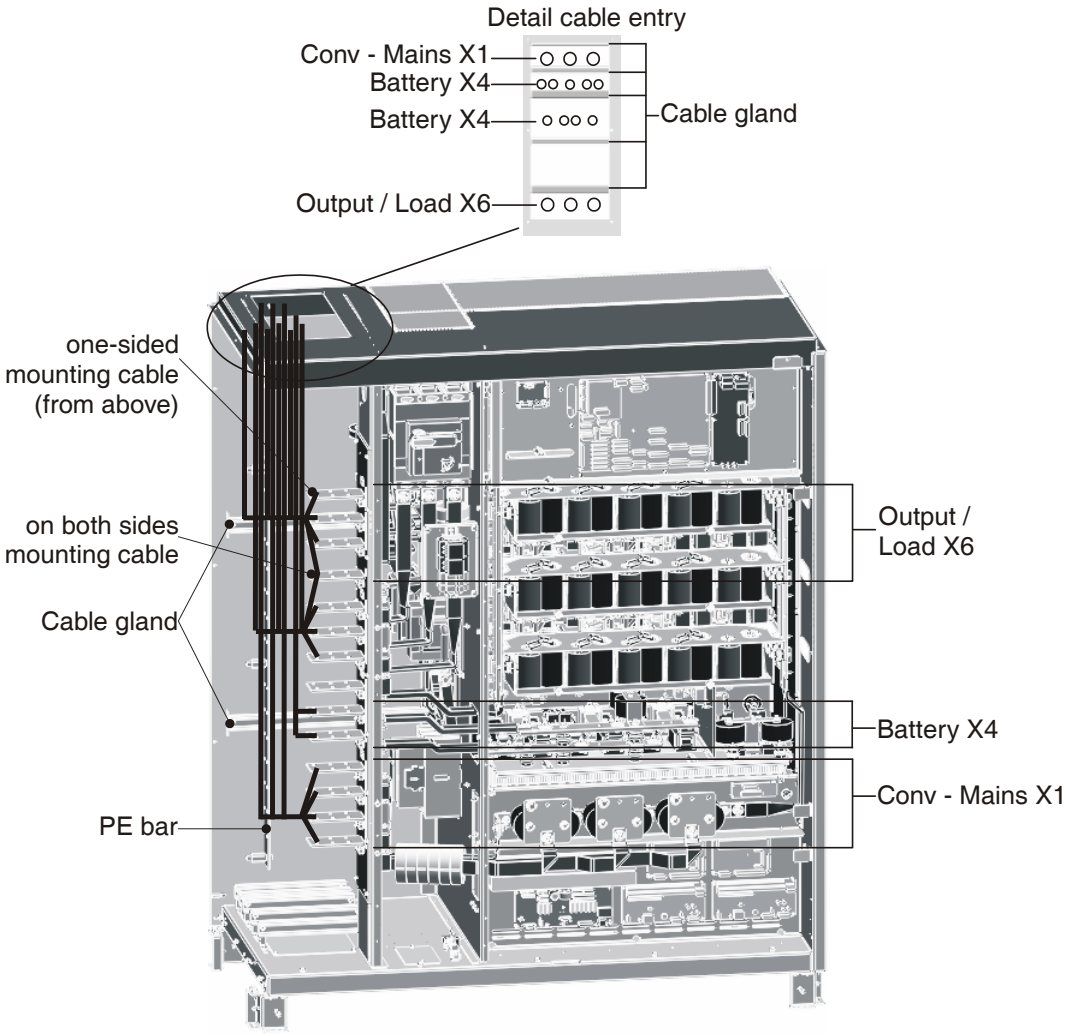


Fig. 6-12 Cable installation in the cable compartment with cable entry from above, AC 300 – 500 kVA, illustrated on the AC 300 kVA

NOTE

1. All power cables should be attached by means of tubular or crimp-type cable lugs having a drilled hole for M12 screws.
2. All parallel cables for one connecting point (e.g. X6.1) should be connected to the connecting bar from above, alongside each other.

6.5.3.2 Cable installation for control and communications cables

A number of interfaces is available to the APOCONV for data exchange with external devices. As Fig. 6-13 shows, these are located on circuit boards (some optional) at two different locations in the system:

- On the hinged bay behind the right-hand door in the upper part of the unit (A)
- On a permanently-mounted circuit board panel behind the right-hand door in the lower part of the unit (B)

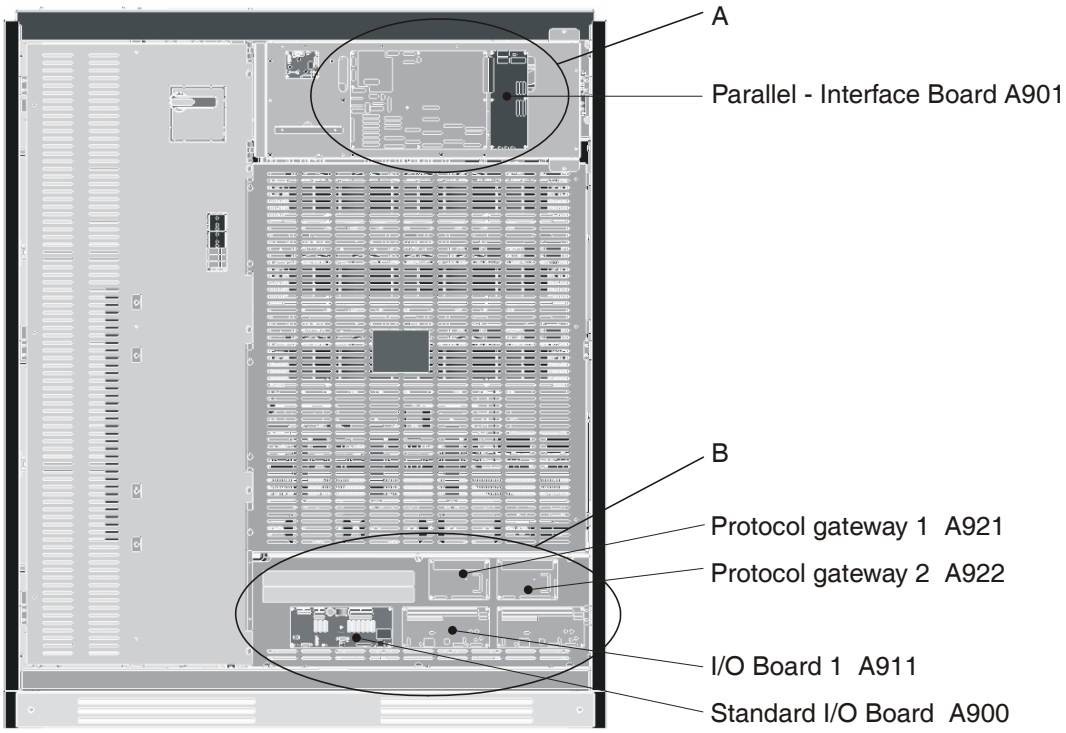


Fig. 6-13 Arrangement of circuit boards (some optional), AC 300 – 500 kVA, illustrated on the AC 300 kVA

The following circuit board is optionally mounted on the hinged bay behind the right-hand door in the upper part of the unit (A):

- Parallel - Interface Board (A901), optional

The following circuit boards (some optional) are mounted on the permanently-mounted circuit board panel behind the right-hand door in the lower part of the unit (B):

- Standard I/O Board (A900)
- I/O Board 1 (A911), optional
- Protocol Gateway 1 (A921), optional
- Protocol Gateway 2 (A922), optional

The cable routing to these circuit boards is the same as that for the power cables, i.e. via the floor panel (cable entry from below) or via the cable entry panel in the roof (cable entry from above) in the left-hand part of the cabinet (cable compartment). The possible cable routes are shown in Fig. 6-14 and described in the sections following it.

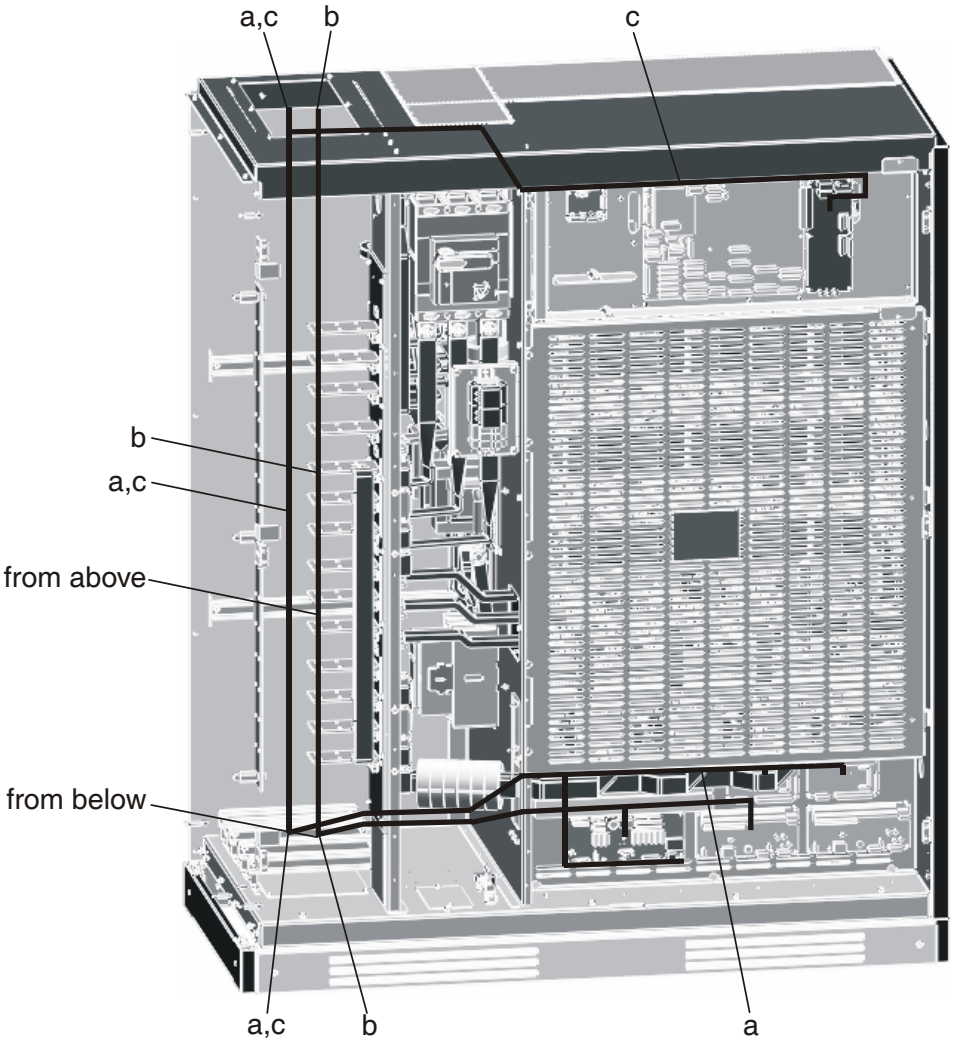


Fig. 6-14 Cable routes for the control and communications cables, AC 300 – 500 kVA, illustrated on the AC 300 kVA

Cable installation with cable entry from below for cables on hinged bay (A)

The cable route for cable entry from below for the cables on the hinged bay (A) is denoted by (c) in Fig. 6-14. The cables should be led upwards into the cable compartment under the roof. The two permanently-mounted supporting rails are used for attachment. The cables should then be led forwards under the roof. The perforated grating should be used for attachment. The cables should then be pulled through the cutout in the rear of the hinged bay and into the upper cable channel. At the end of the channel the cables should be led forwards through the opening in the hinged bay and connected to the Parallel - Interface Board (A901).

Cable installation with cable entry from above for cables on hinged bay (A)

The cable route for cable entry from above for the cables on the hinged bay (A) is also denoted by (c) in Fig. 6-14. After introduction through the roof, the cable is supported and then attached to the roof via the perforated grating and led forward. The remaining route is identical to that of the cable entry described above.

Cable installation with cable entry from below for cables on the permanently-mounted circuit board panel (B)

The cable route for cable entry from below for cables on the permanently-mounted circuit board panel (B) is denoted by (a) and (b) in Fig. 6-14. The route denoted by (a) should be used for the more interference-prone communications cables. These include, for example, data exchange cables such as CAN or current bus. The less sensitive cables should be laid along the route denoted by (b). These cables include, for example, the digital inputs/outputs of the I/O boards. The main reason for having these two routes is to reduce mutual interference between the cables. Cables in these different categories should not be bundled together and not laid in parallel without spatial separation. After being introduced from below, the cables should be attached to a supporting rail for strain relief. In the remaining installation they should be pulled behind the terminating panel for the power cabling, through the opening in the central panel and up to the permanently-mounted circuit board panel (B). The communications cables (a) should be laid in the upper cable channel and the control cables (b) laid in the lower cable channel up to the associated circuit boards. So-called shield buses are located immediately behind the cable entry on the circuit board panel. All screens of the external communications cables should be connected to these screen buses.

Cable installation with cable entry from above for cables on the permanently-mounted circuit board panel (B)

For cable entry from above, the cables should be laid up to the floor panel. In the remaining installation the route is the same as that described in the chapter: cable entry from below.

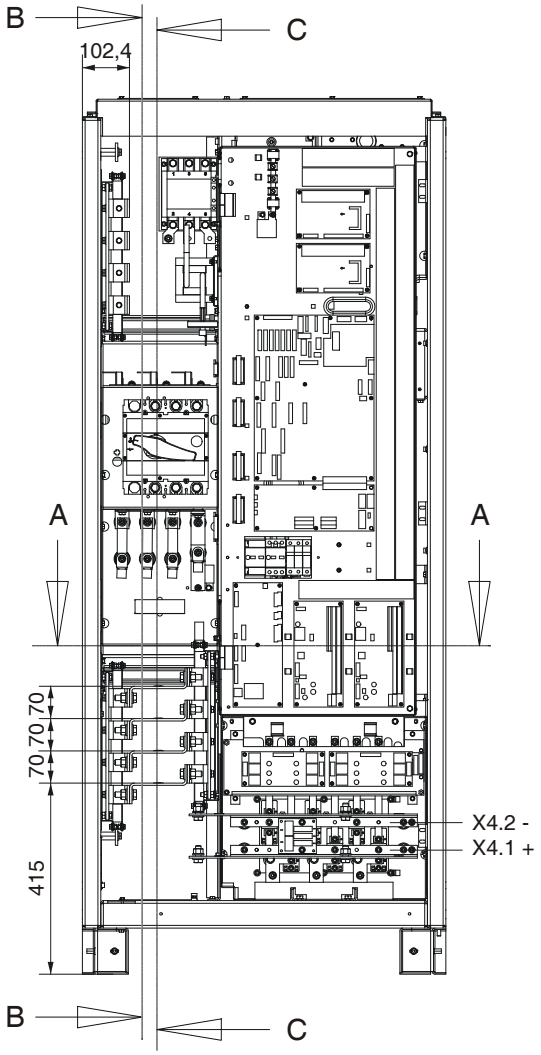
NOTE

1. When connecting the screens to the shield bus, the cable must not be stripped up to the connecting point. Only the outer insulation of the cable should be stripped for the width of the bus, so that the terminal supplied with the shield bus makes an electrically conducting bond between the bus and the screen.
2. To avoid interference signal injection, communications cables categorised as more prone to interference, e.g. CAN (a) and control cables categorised as less prone to interference, e.g. digital inputs and outputs (b) should be laid with spatial separation.
3. To avoid interference signal injection, where possible all control and communications cables should be laid separately from power cables. This applies particularly to parallel cable runs.

Further information on the control and communications cables, as well as their interfaces, can be found in the respective chapters of this manual which cover the electronic modules.

6.5.4 Terminal arrangement

6.5.4.1 AC 100 – 120 kVA



Section A-A

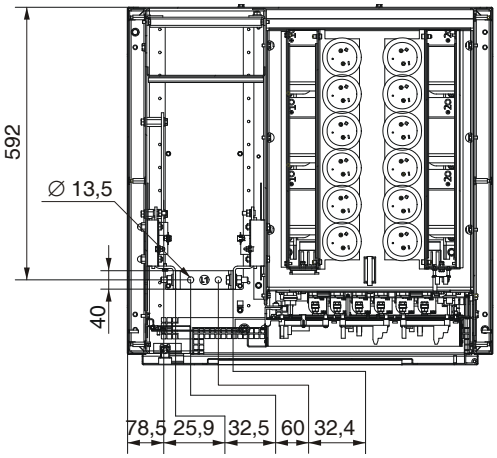


Fig. 6-15 Battery terminals AC 100 – 120 kVA

Terminal X4	1	Battery input	+
	2	Battery input	–

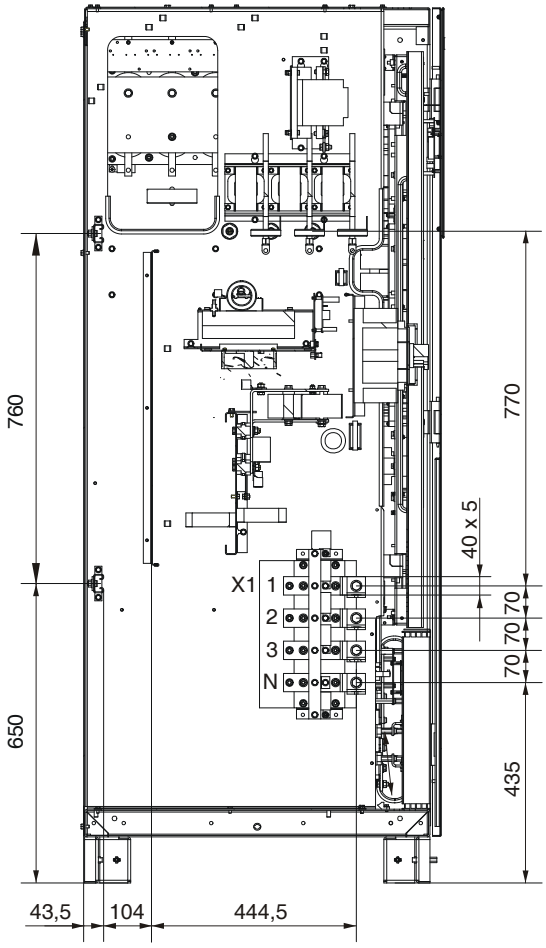


Fig. 6-16 Mains terminals AC 100 – 120 kVA, section B-B

Terminal X1	1	Converter input	L1
	2	Converter input	L2
	3	Converter input	L3
	N	Converter input	N

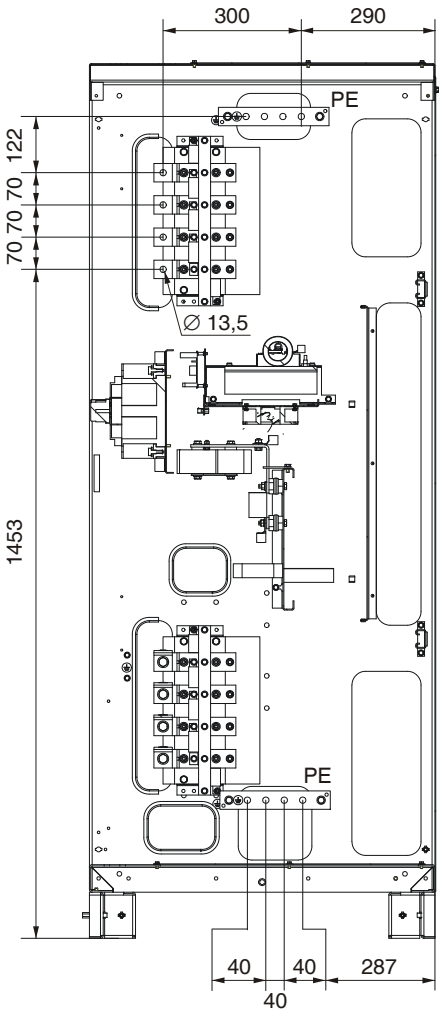
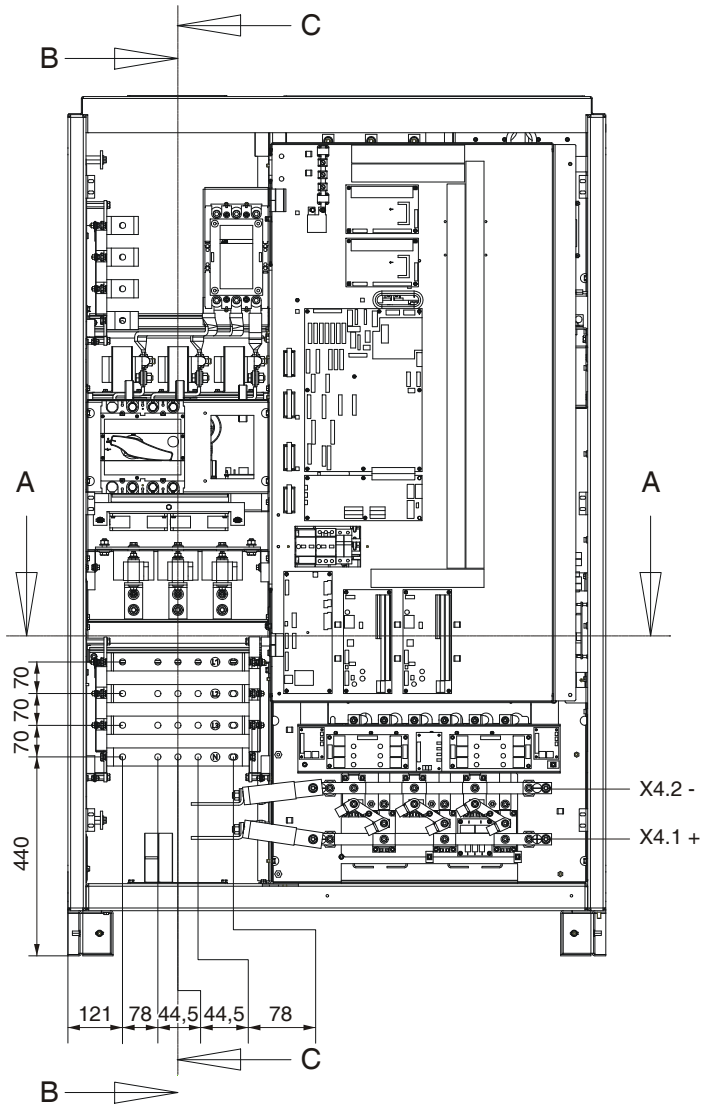


Fig. 6-17 Load and bypass terminals AC 100 – 120 kVA, section C-C

Terminal X6	1	Converter output	L1
	2	Converter output	L2
	3	Converter output	L3
	N	Converter output	N

6.5.4.2 AC 160 – 200 kVA



Section A-A

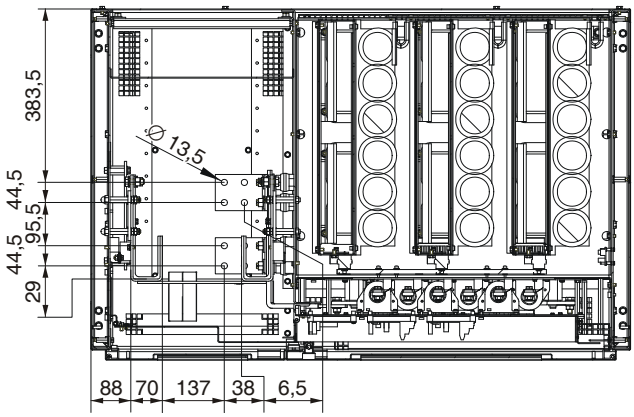


Fig. 6-18 Battery terminals AC 160 – 200 kVA

Terminal X4 1	Battery input	+
2	Battery input	–

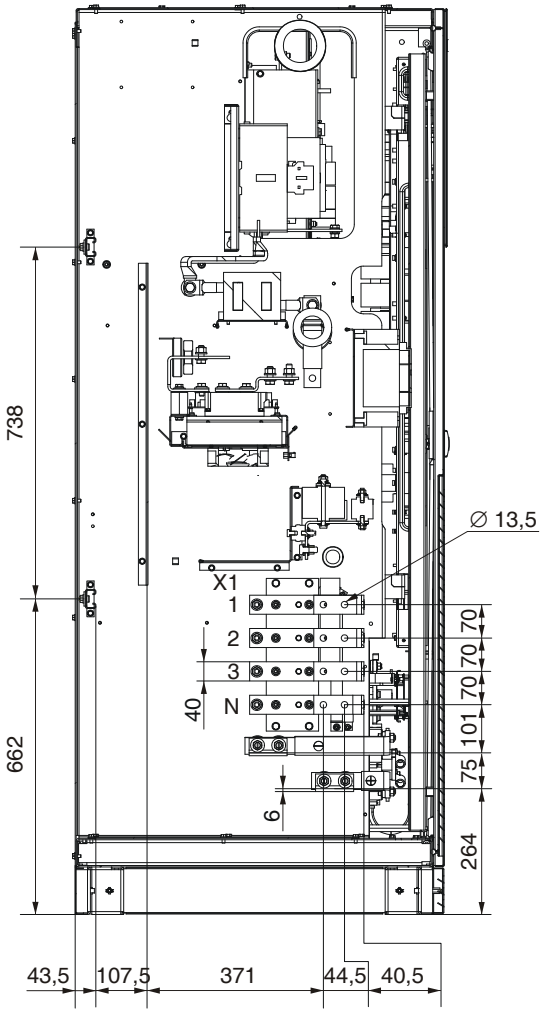


Fig. 6-19 Mains terminals AC 160 – 200 kVA, section B-B

Terminal X1	1	Converter input	L1
	2	Converter input	L2
	3	Converter input	L3
	N	Converter input	N

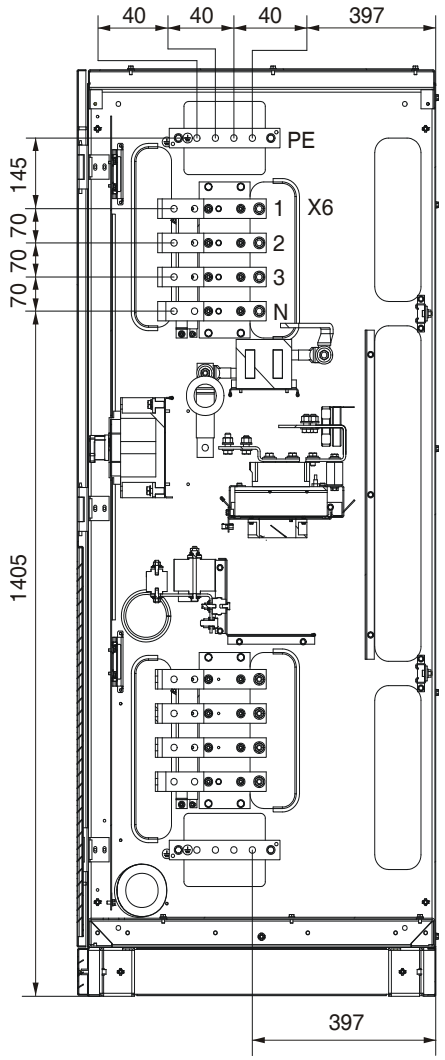


Fig. 6-20 Load and bypass terminals AC 160 – 200 kVA, section C-C

Terminal X6	1	Converter output	L1
	2	Converter output	L2
	3	Converter output	L3
	N	Converter output	N

6.5.4.3 AC 300 kVA

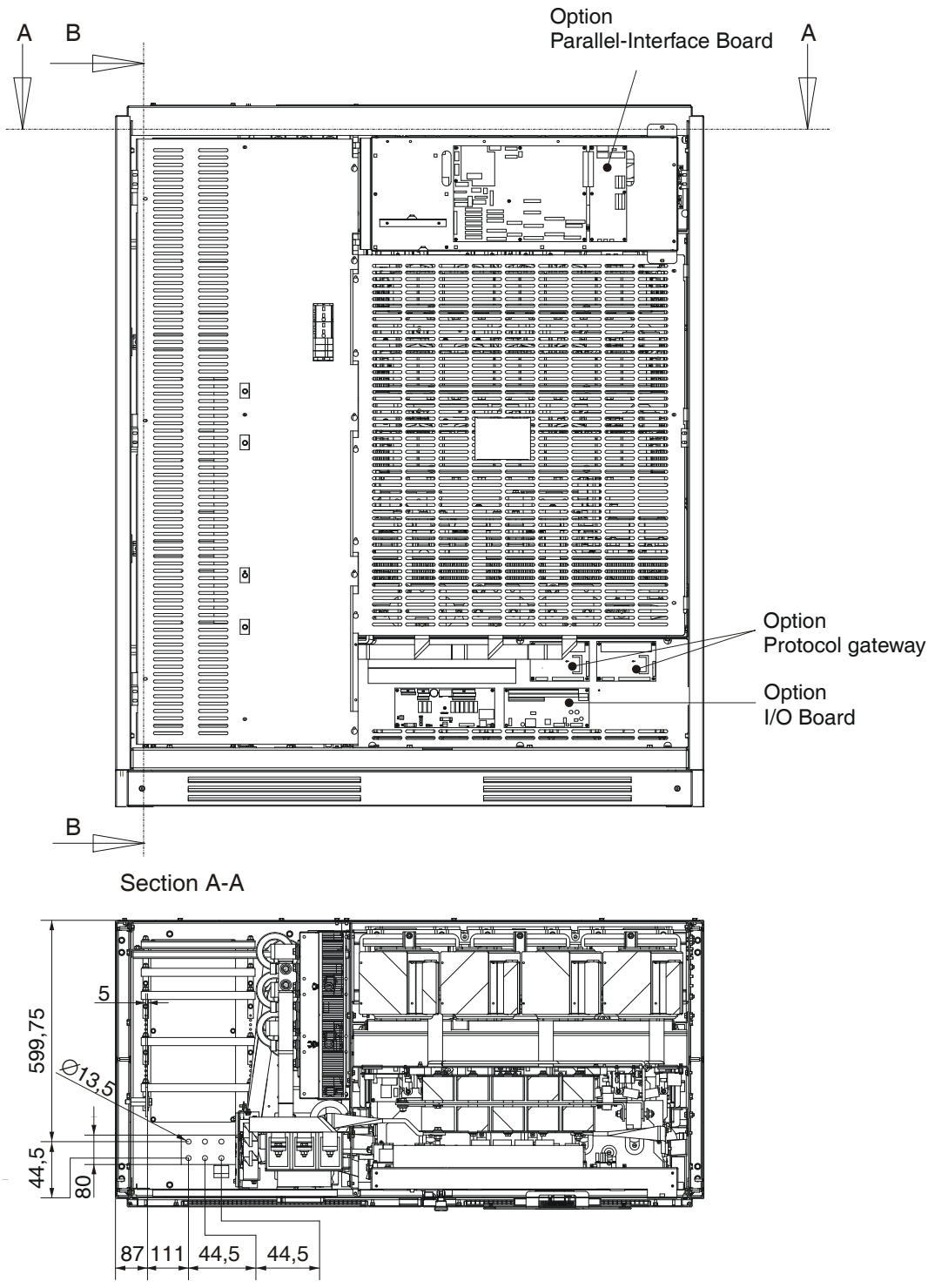


Fig. 6-21 AC 300 kVA, section A-A

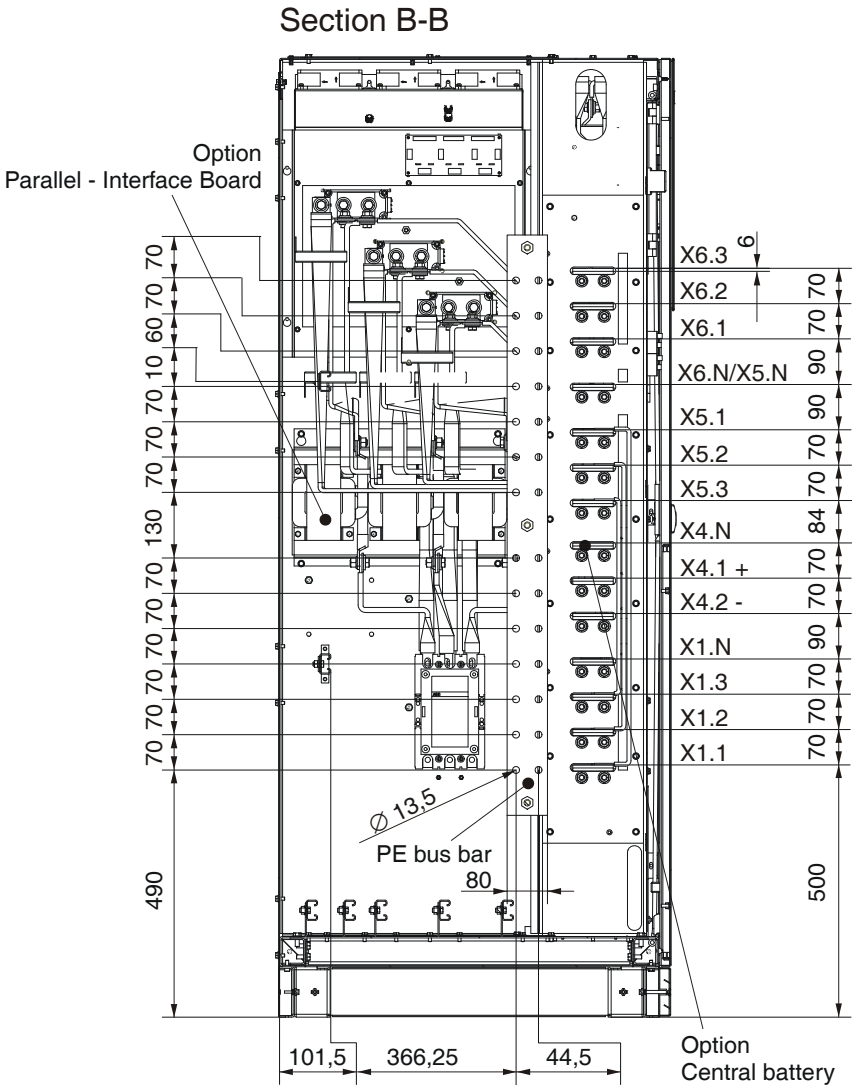
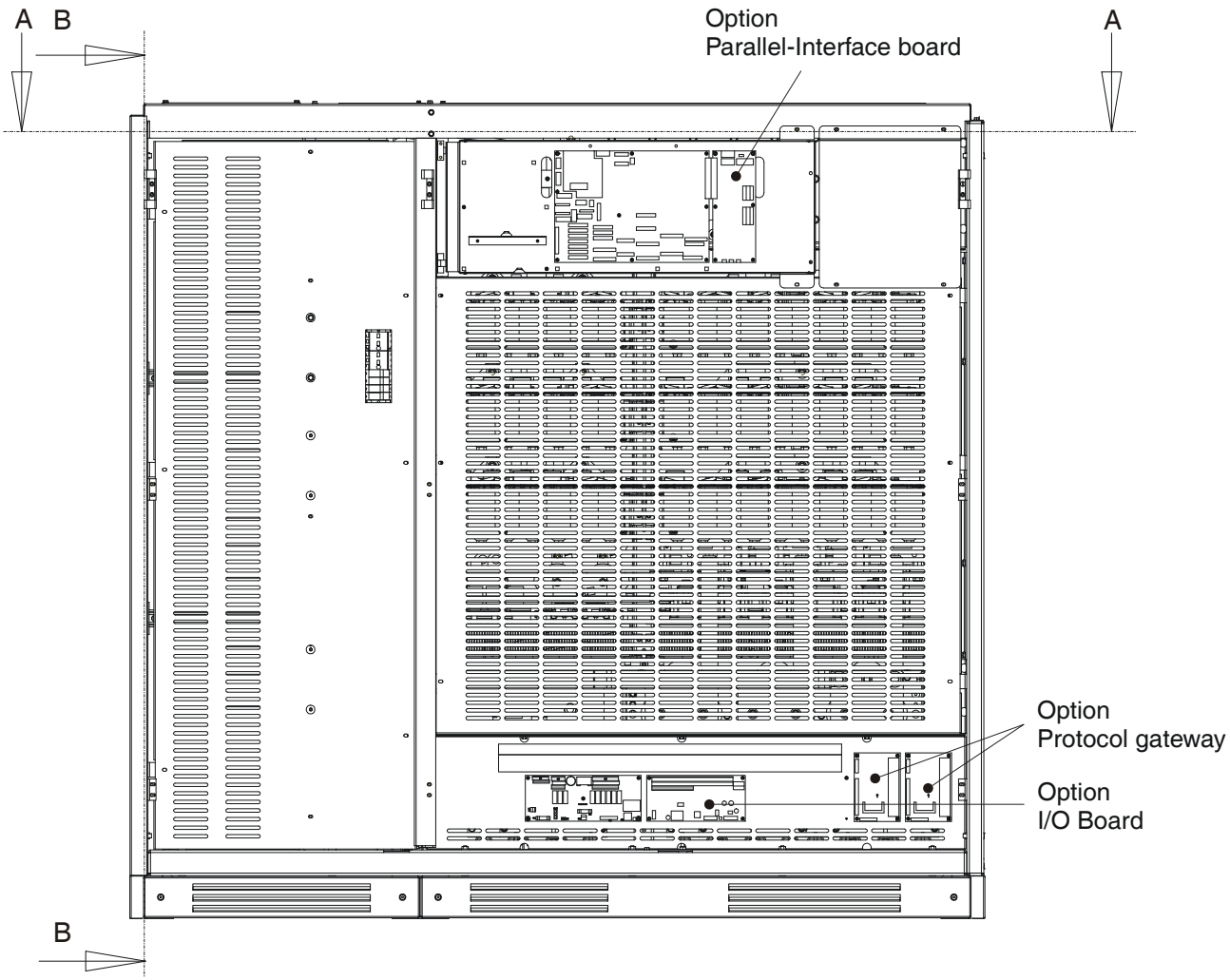


Fig. 6-22 Mains, battery and load terminals AC 300 kVA, section B-B

Terminal X1	1	Converter input	L1
	2	Converter input	L2
	3	Converter input	L3
	N	Converter input	N
Terminal X4	1	Battery input	+
	2	Battery input	–
Terminal X6	1	Converter output	L1
	2	Converter output	L2
	3	Converter output	L3
	N	Converter output	N

6.5.4.4 AC 400 – 500 kVA



Section A-A

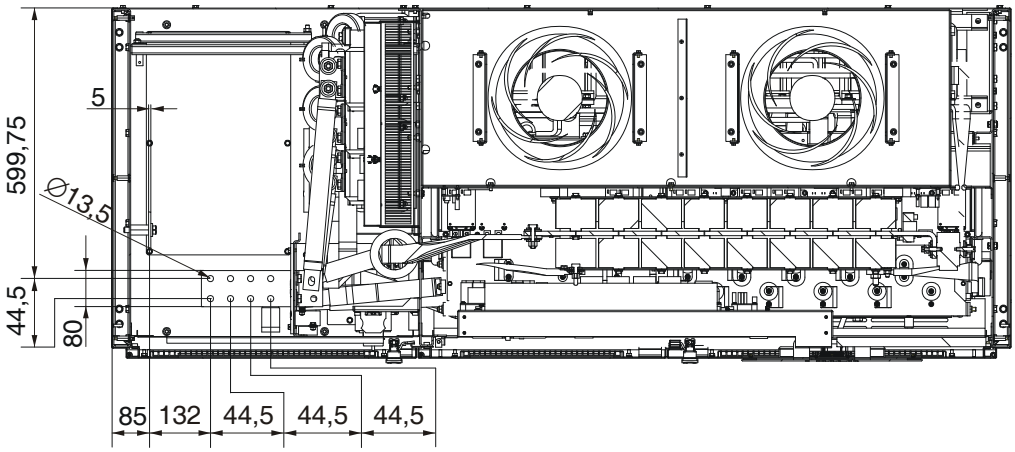


Fig. 6-23 AC 400 – 500 kVA, section A-A

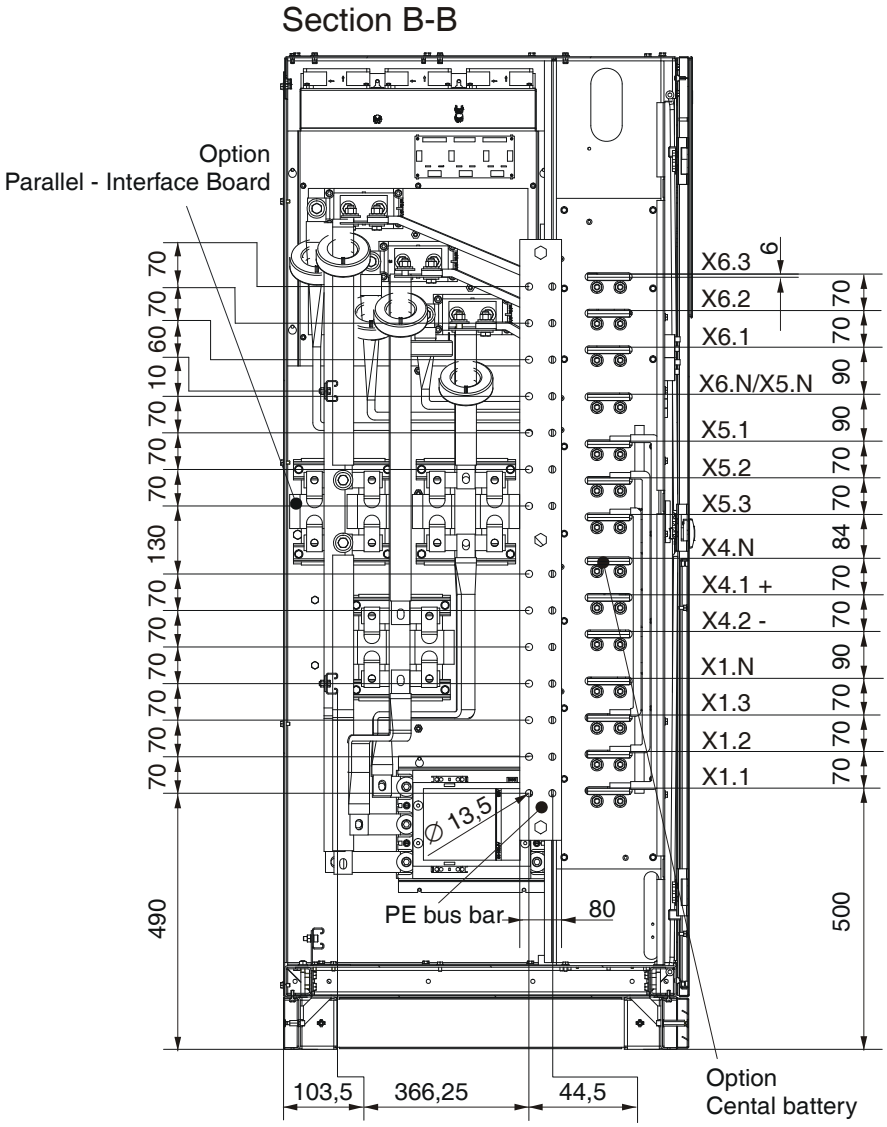


Fig. 6-24 Mains, battery and load terminals AC 400 – 500 kVA, section B-B

Terminal X1	1	Converter input	L1
	2	Converter input	L2
	3	Converter input	L3
	N	Converter input	N
Terminal X4	1	Battery input	+
	2	Battery input	–
Terminal X6	1	Converter output	L1
	2	Converter output	L2
	3	Converter output	L3
	N	Converter output	N

6.6 Battery – general notes, option

As special equipment for the APOCONV converter system Piller supplies battery sets for bridging mains failure periods.

6.6.1 Battery selection

In addition to price, maintenance and service, the main criteria for battery selection are the data listed below. The necessary data in relation to the APOCONV converter system can be found in the technical data of chapter 4.

- Battery type (open, closed, sealed)
- Runtime
- Use as a central battery (e.g. output, even number of battery cell blocks)
- Battery power (or: output power and output power factor and efficiency of the converter system)
- Number of battery cells

6.6.2 Battery installation, option

Open, sealed or closed batteries can be mounted on a rack. When open batteries are used, a specially-equipped battery room, which must comply with various safety regulations, should be set up. Further details can be obtained from the appropriate local authorities. Furthermore, the installation of a battery system should follow DIN EN 50272-2 VDE 0510-2:2001-12 procedures.

If the system power and runtime factors – which determine the overall size - permit it, sealed batteries can be mounted in a cabinet. If desired, this cabinet can be incorporated in the APOCONV design. The battery cabinet can be installed immediately alongside the converter unit on the right-hand side.

The battery cabinet or rack can also be installed remotely from the converter. In this case the battery cabinet manufacturer's distance limitations and battery connecting cables as per chapter 6.4.2 should be noted.

The optimum ambient temperature for the batteries is 20° C. Considerably higher temperatures shorten the service life of the batteries.

The supplied batteries are fully charged. The storage life is limited for this reason. Please contact us or the battery manufacturer if you intend to store the battery sets for more than a few days.

6.6.3 Battery connection, option

WARNING

The battery sets for the APOCONV system are charged up when delivered. Improper handling can cause injuries or damage. When connecting the battery sets ensure that the connecting terminals are “dead”, e.g. by opening the fuse-disconnector. Check that the circuit is dead before making connections.
Generally we recommended to follow the notes of chapter 6.3.2 Battery protection

When connecting several battery cabinets a distinction is made as to whether one battery set is installed in several cabinets (series connection) or whether several sets are installed in several cabinets to increase the capacity (parallel connection).

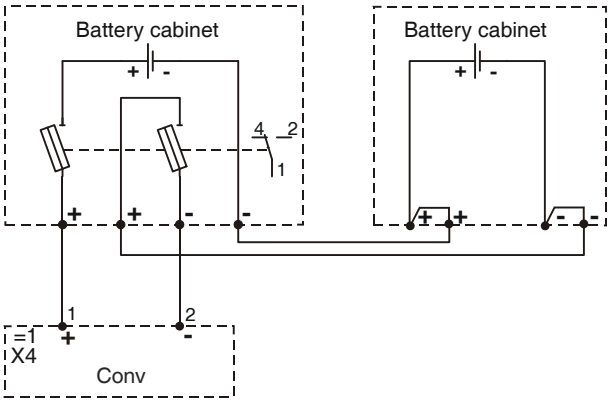


Fig. 6-25 Battery cabinets connected in series

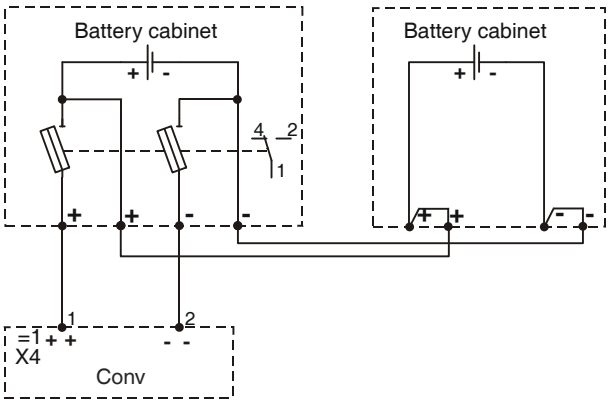


Fig. 6-26 Battery cabinets connected in parallel

7 COMMISSIONING

7.1 General

Check the following prior to commissioning:

IMPORTANT 1. Is the equipment damaged?
If so, do not put the system into service before consulting us.

2. Have the cables been correctly installed (AC input, output, battery, etc.)? Correct if necessary.

7.1.1 Tools required

You need the following to put the APOCONV into service:

- Multimeter
- Rotating field measuring instrument
- Tools

7.1.2 Commissioning the APOCONV

See section 11 for the locations of the components referred to in the following text.

WARNING

1. Commissioning should only be carried out by trained personnel, since operations involve components that can be "live"!

IMPORTANT

2. Commissioning operations should be carried out if
   - the system is being put into service for the first time,
   - modifications or repairs have been carried out.
3. Ensure that the individual steps are carried out in the correct order.

1. Switch off circuit-breakers Q301, Q305 (optional) and open the fuse holder F300.
2. Switch on the power supply for the unit and check that a clockwise rotating field appears at terminals X1.1/2/3 and X5.1/2/3.
3. Switch on circuit-breakers Q301, Q305 (optional) and close the fuse holder F300.
4. Carry out a lamp test by pressing the “Lamp Test” button 

. Pay attention to possible fault indications
5. The system is now ready for operation.

8 OPERATION

8.1 General

This section describes how the APOCONV is to be operated. The steps for commissioning and switching the system on and off are explained after an introduction to the operator controls and indicators. A smooth sequence of operations is only achieved if the individual steps are carried out in the specified order.

8.1.1 Operation

The APOCONV is operated via a membrane keyboard with twelve keys and LEDs. The control panel has a mimic display. The operating status and any malfunctions are indicted by the multicoloured LEDs. Data readout and clear menu prompts are provided by a LC display on the control panel. The control panel is controlled by the display controller that communicates with the controller board via the CAN bus.

8.1.2 Layout of the control panel

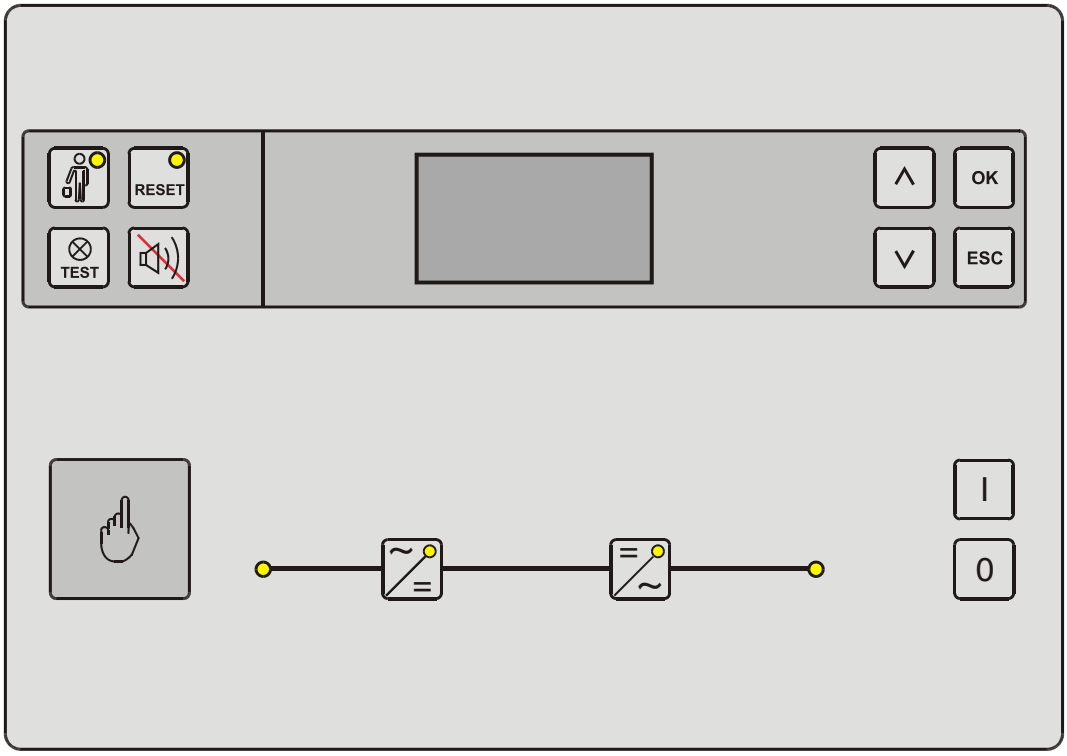


Fig. 8-1 Control panel

8.2 Operator controls

In the APOCONV, the five operator control buttons in the lower part of the membrane keyboard are used to switch the system on and off and to initiate switching operations. For further information see chapter 8.4.

„O“ button for switching off

„I“ button for switching on

„Hand“ enabling button for confirming switching processes

NOTE The APOCONV is fitted with two-handed operation. The buttons for switching the converter and the bypass on and off must always be done with the "HAND" button pressed. Otherwise an appropriate message appears in the display.

Operation of the display is effected with the four operator control buttons in the top right-hand area next to the display. For further information see chapter 8.3.

“UP“ arrow is used for incrementing in the menu.

“DOWN” arrow is used for decrementing in the menu.

Enter button

Escape button, for quit without store

The keys and display elements (on top of the left-hand side) have the following functions:

Maintenance– LED:
The LED indicates that the converter requires maintenance. This does not affect the operation of the converter. In this case please contact Piller Service.

„RESET“ Button and LED:
The LED shows red to indicate that there are fault messages to be acknowledged. If so, you can go directly to the event recorder by pressing the button (see section 5.13).
Red flashing signals the operation of the external emergency switching device (see section 5.10).

„Lamp test“ button:
Pressing the button enables you to check the operation of the LEDs on the membrane keyboard. This does not affect the operation of the converter.

„Alarm off“ button:
You can turn off the internal signal horn by pressing the button. The signal is re-activated by pressing the button again or automatically re-activated no later than one hour after de-activation. This does not affect the operation of the converter.

8.2.1 Mimic panel indicators

Fig. 8-2 Mimic display with LED indicators

Besides Mains 1 and converter output the following components of the converter set are represented by light-emitting diodes:

1 Rectifier
2 Inverter

The colour of the LEDs and whether they are steady or flashing provides information about the current operating status:

green flashing	Starting phase
green steady	running or switched on
off	available or "ready”
red flashing	fault
red steady	abnormal condition, e.g. mains fault

8.3 Operating the LC-Display

The following describes how you can navigate around the menu of the APOCONV from the standard display using only the operator control buttons: ∧, ∨, OK and the "ESC" key ESC.

NOTE Generally, a selection in the menu or toggling between various display pages (e.g. measured values) is achieved by using the "arrow" keys.
Confirm your choice or go to a lower level in the corresponding submenu by pressing the "OK" key.
Return to the respective higher menu level by means of the "ESC" key.

The standard display gives you an initial overview of the status of the system:

- Operating condition
- Battery remaining time
- Utilization of the system
- Output voltages
- Temperature[7], date, time

From there you first reach the selection menu in which you preselect the data to be displayed:

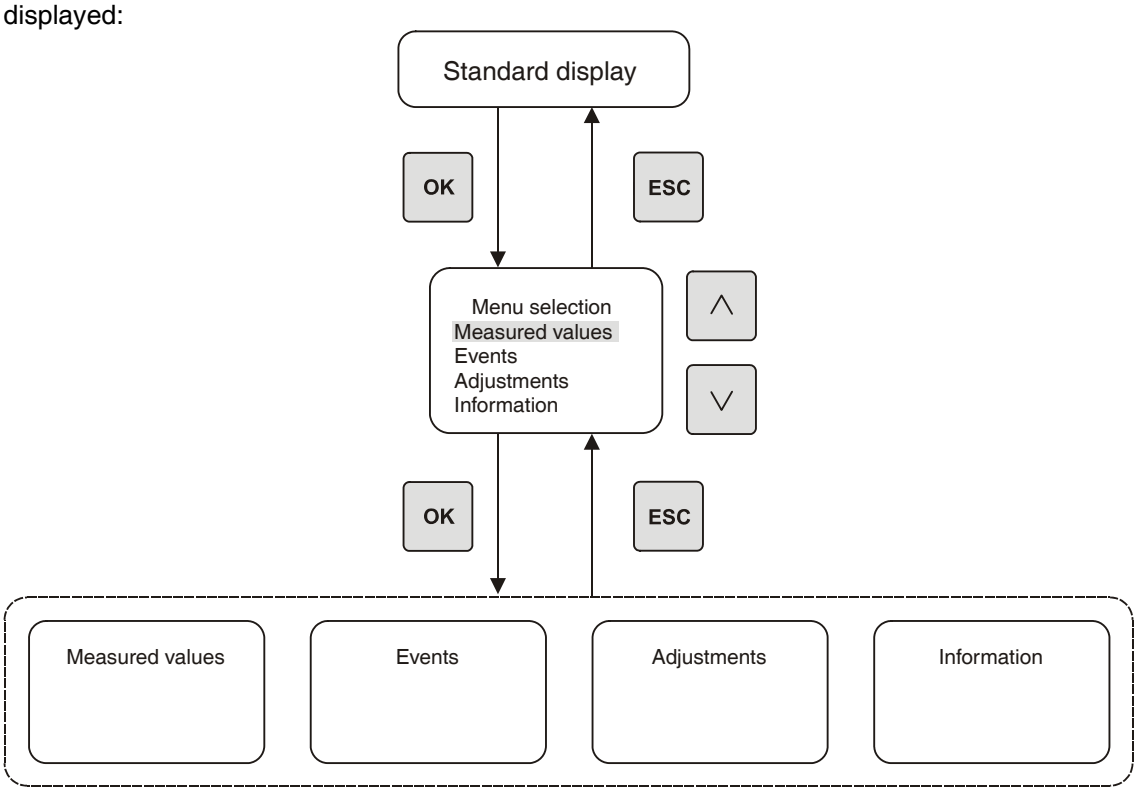


Fig. 8-3 Standard display

The following chapters give additional information about the display options and possible settings.

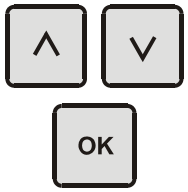
[7] Battery temperature, if available. Otherwise APOCONV supply air temperature

8.3.1 Menu „Measurement values“

You can display the system's various internal measured values via the "measured values" menu. Measured values are available for the following areas:

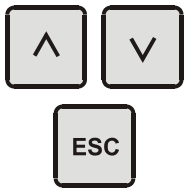
- Output
- Input
- Bypass input (option)
- Inverter
- Phase angle
- Battery (Option)
- Battery parameter (Option)
- Battery monitor (Option)
- Energy meter
- Actual intermediate meter
- Last intermediate meter

Choose the desired menu page with the „Arrow“-keys and confirm with the „OK“-key.



If you are on a display page you can toggle directly between the measured value pages by means of the "arrow" keys.

Turn back to the menu „measured values“ by pressing the „ESC“-key.



8.3.2 Menu „Events“

see chapter 5.13 Event recorder (event memory)

8.3.3 Menu „Settings“

8.3.3.1 Editing settings in the "settings" menu

First select the desired menu point with the "arrow" keys.

Confirm your choice with the "OK" key to get to the relevant submenu.

The respective chosen editing line of the submenu is displayed in reverse video.
Go to the next or preceding editing line in this menu point using the "arrow" keys.

Press "OK" to select the editing line. The editing line flashes.

Change the value to be set using the "arrow" keys.

Following the amendment, the following options are available to you:
Press the "OK" button: the set value is accepted in the menu.

Press the "ESC" button: the set value is rejected.

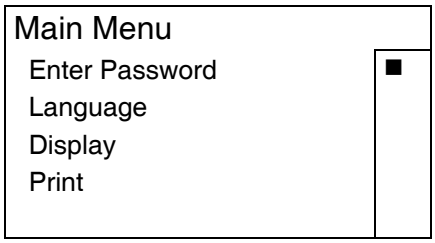
Press the "ESC" key to complete the setting.

At some menu points you are asked whether the amended values are to be stored:
Press the "ESC" key to return to the menu page.
Select "YES" to store or "NO" to reject the setting and confirm with the "OK" key.

NOTE In the case of menu points where no request appears, the settings are automatically accepted.

IMPORTANT The settings of many menu points have a big influence on the functionality of the converter. If you are uncertain about the effects of a change please contact our Service Department, who will be happy to help.

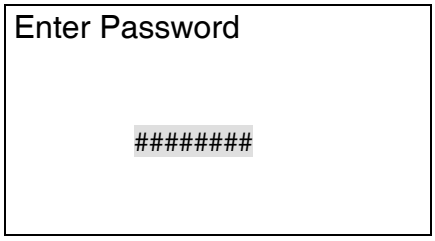
8.3.3.2 Settings



The individual submenus and possible settings are described in order below:

NOTE Password level = 0 No password required
Password level = 1 Customer password required
(Customer password = AP)
Password level = 2 Service password required

1. Enter password
Password level = 0
The customer password has to be entered to input settings in some menus.

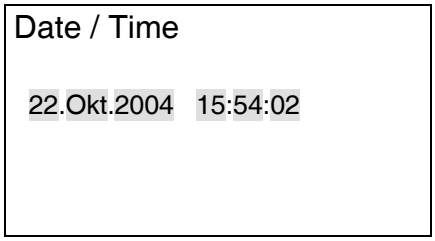


Select the "enter password" menu point with the "arrow" keys and call up with the "OK" key.
A reverse video text appears and the first character flashes: ########
The character can now be amended with the "arrow" keys.
You can then jump to the next character A####### using the "OK" key.
Proceed with the other password characters in a similar way.

When you have entered the password, quit the menu with the "ESC" key.

NOTE Only upper case letters (no umlauts), numbers and spaces are accepted.

2. Date / Time
Password level = 1
Set the current date and time.

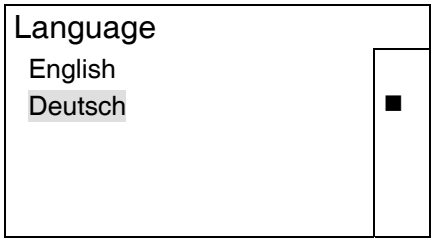


3. Language

Password level = 0

Set the language in which the display appears.

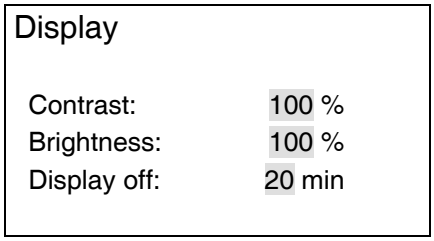
Select the desired language by pressing the arrow keys and confirm with the OK-button.



4. Display

Password level = 0

The display contrast and brightness, as well as the turn-off time of the background illumination, can be set in the display menu.



5. Battery, option

Password level = 1

- Number of cells:
  setting as per rating plate
- Float:
  Value of float charging rate resp. trickle charge in V/cell, de-pending on battery type.
- Test:
  This value is required for the manual battery test and is set at the factory (see item 8 “SW_Battery test”).

Battery		
Number of cells:	192	■
Float:	435.8V	
2.27 V / Cell		
Battery Test:	403.2V	
1.85 V / Cell		

- Low:
  This value of 1.8 V/cell is set at the factory and should not be changed (prewarning for end of stored energy time).
- High:
  Maximum battery voltage per cell.

Battery		
Number of cells:	192	
Battery low:	345.6V	■
1.80 V / Cell		
Battery high:	480.0V	
2.50 V / Cell		

- Empty:
  The value for the final discharge voltage in V/cell is depending on battery type.
- Min:
  this value is also required for the manual battery test and is set at the factory (see item 8 “SW_Battery test”).

Battery		
Number of cells:	192	
Battery empty:	316.8V	
1.65 V / Cell		
Battery minimum:	345.6V	■
1.80 V / Cell		

- Equalize:
  battery-dependant value for the equalizing charge (2,30 to 2,40 V/cell).
- Equalize Limit:
  factory-set value for the automatic equalizing chart.

Battery		
Number of cells:	192	
Equalize:	451.2V	
2.35 V / Cell		
Equalize limit:	364.8V	
1.90 V / Cell		■

6. Battery monitor, option

Password level = 1

All relevant data for the associated battery must be entered in this menu. Correct operation of the converter can be guaranteed only if you take special care with these inputs.

- Efficiency:
  in the case of older batteries the efficiency can be set to a value less than 100 % to allow the remaining stored energy time to be calculated more accurately.
- Parallel battery:
  number of battery circuits in parallel.
- Total capacity:
  total capacity of the battery in Ah (shown on the battery rating plate).
- Max. capacity:
  enter "yes" after the battery has been fully charged for the first time (adjust later if necessary).

Battery monitor	
Battery monitor:	Off
Efficiency:	100%
Parallel battery:	1
Total capacity:	0070.0Ah
Max. capacity:	No

7. Battery charging, option

Password level = 1

- SW_boost charge:
  specify "ON" if you want the battery to be charged at a high rate.
- SW_Battery test:
  if you specify "ON" after quitting the sub-menu the system switches over to battery operation. A bypass transfer can be implemented in the event of a fault! The test cannot be interrupted during the first minute. The test is finished at 1.8 V/cell automatically.
- Charging mode:
  Here you specify whether battery charging should be switched off as a general rule.

Battery charging	
SW_boost charge:	Off
SW_Battery test:	Off
Charging mode:	Off

8. Equalizing charge, option

Password level = 1

- Status:
  - OFF: the equalize timer is inoperative or off
  - REQUESTED: the equalizing charge has been requested manually or by the auto-equalize function, but it can be started only if the float voltage is reached.
  - STOPPED: the existing equalizing charge was interrupted (e.g. battery fault or mains failure). The equalizing charge continues at the current timer setting when all conditions are again met.
  - RUNNING: the equalizing charge is operative and the equalize timer is running.
- Current timer reading:
  The current timer reading in minutes is displayed here.
- Preset Time:
  Enter the time period of the required equalizing charge.
- Action (the selected action is only implemented on quitting the menu!)
  - NONE: quit the menu without any action.
  - MAN. START: equalizing charge is requested.
  - SET PRESET: the equalize timer is again reset to its specified value.
  - ABORT: an active equalizing charge is interrupted or the request is cancelled.
- Auto Equalize:
  you specify with "ON" that an equalizing charge is carried out automatically when the battery voltage reaches a certain value.
  Enter "YES" to reset the timer again to its preset value during the equalizing charge.

Equalize	
Status:	off
Timer actual:	2 min
Preset Time:	3 min
Action:	Nothing
Auto equalize:	off

9. Battery threshold, option

Password level = 1

Two values for the residual battery run time and two values for the residual battery capacity can be entered as limiting values in this menu. If the values fall below those specified, signals are generated in the software of the system, whose states can be transmitted externally via the programming of the standard I/O Board or the optional I/O Board.

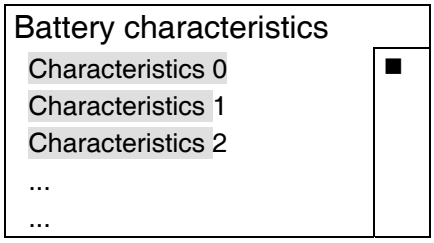
Battery threshold	
Time limit 1:	10 min
Time limit 2:	10min
Capacity limit 1:	10%
Capacity limit 2:	10%

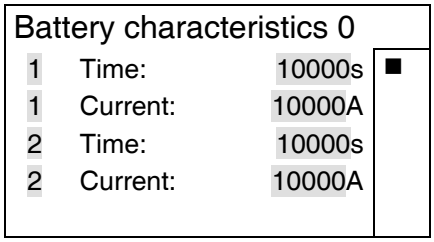
10. Battery characteristics, option

Password level = 1

The appropriate characteristic for the battery type must be entered here. A current/time characteristic is required for the final discharge voltage of 1.65 V/cell.

To do this, please contact us.





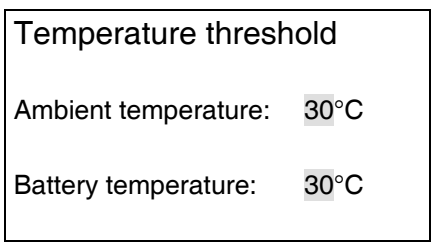
A maximum of 24 characteristic points can be input.
If a few points are input by the manufacturer for the existing battery, then only the existing data are entered. The setting for the remaining points in the system remains set at 0 s or 0 A. The sequence of the characteristic points must be followed during the input. Start with the characteristic point for the lowest current or the longest time. The data for the other points are entered accordingly. The last characteristic point is then the one for the highest current or the shortest time.

Example of input with 10 characteristic points:
1 Time: 36000 s
1 Current: 3 A
2 Time: 18000 s
2 Current: 6 A
….
10 Time: 300 s
10 Current: 141 A
11 Time: 0 s
11 Current: 0 A
….

11. Temperature threshold

Password level = 1

Here you can set the threshold values for the ambient and battery temperatures. If the measured temperature exceeds the set value, the system generates a corresponding event. A battery temperature sensor is available as an optional extra.



12. DSO – Status
Password level = 2
A storage oscilloscope (DSO) function is incorporated in the controller board. The status of the DSOs can be checked with this menu. (For service personnel only).

DSO-Status	
Controller:	#

13. Synchronisation
Password level = 1

- External synchronisation:
  "ON" enables the system to be synchronised to an external signal.
- Sync.-source:
  The "Auto" setting causes the system to be synchronised to the ext. signal when its bypass network is not available. With the "I/O" setting, synchronisation is started by an external input on the Standard I/O Board.

Synchronisation	
Ext. synchronisation:	Off
Sync. - source:	Off

14. Start (option battery)
Password level = 1

- Autostart:
  If you enter „ON“, the converter is started automatically on restoration of the mains supply.

IMPORTANT If “Autostart” is engaged, there is danger to personnel working on the system during the mains failure. Standard setting is “Off”.

- Starting delay:
  This setting allows you to specify a starting delay for the converter. On restoration of the mains, on expiry of the preset time, the converter starts the reverse transfer from battery operation to normal operation.

- Reverse transfer time:
  The time for the reverse transfer from battery operation to normal operation can be varied here. The higher the set value, the slower the load transfer by the input mains supply.

Start	
Autostart:	Off
Starting delay:	0s
Reverse transfer time:	2s

15. Output voltage
Password level = 1
The desired system output voltage can be set to a range ±5 % of nominal voltage.

Output voltage	
Voltage:	400V

16. Key protection
Password level = 1

Key protection	
Keys protect with password:	No

Here you can set the key lock to prevent unauthorised switching on/off or changeover of the APOCONV at the display. With the key lock activated you then have to enter your password in order to effect switching operations at the display.

Key protection
Enter the password to disable the key lock.
########

17. Change password
Password level = 1
Here you change your individual password.

Change password
New customer password
########

To do this, first enter the password in order to reach the extended menu points.
Select the "change password" menu point with the "arrow" keys and call it up with the "OK" key.

A reverse video text appears and the first character flashes: ########
The character can now be changed with the "arrow" keys.
You can then jump to the next character A####### using the "OK" key.
Proceed with the other password characters in a similar way.

When you have entered the password, quit the menu with the "ESC" key. The new password is now active.

NOTE Only upper case letters (no umlauts), numbers and spaces are accepted. Keep your password in a safe place.

18. Parallel operation

Password level = 1

The settings for parallel operation are displayed in the "Parallel operation" menu. The "Number of red. sets" (see Menu 20 "Load management") can be changed only in password level 1.

Parallel operation	
Parallel mode:	Redundant
Converter number:	4
Group number:	0
Number of units at least:	2
Number of red. units:	1

19. Load management

Password level = 1

The settings for load-dependent connection and disconnection of sets in the parallel mode are displayed in the "Load management" menu. The load thresholds and delay times can be set in addition to the actual activation of the functions (see chapter 5.8.5.3 Load-dependent paralleling concept).

Load management			
Red: 1	RDC: 3	Grp:	0
Management:			On
Load threshold			Delay
On	55%		30s
Off	35%		60s

20. Statistics (option battery)

Password level = 1

The mains failure counter can be reset by selecting "Yes" in the "Statistics" menu.

The current date is entered into the "Statistics" information page during the reset.

Statistics	
Mains failure meter reset:	No

21. Resetting the energy meter

Password level = 1

The totalizing counter can be reset to 0 kWh and the time interval to 0 in the "energy meter reset" menu. The current time is entered as the start time.

Energy Meter		
		888 kWh
Start:	01.02.2012	19:13:02
Durat.:	4 Days	04:03:01
Reset meter?		Yes

22. Resetting actual intermediate meter

Password level = 1

The energy intermediate meter can be reset to 0 kWh and the time interval to 0 in the "reset actual interm. meter" menu. The current time is entered as the new start time. The previous values are then displayed on the "last intermediate meter" at the measured-value side.

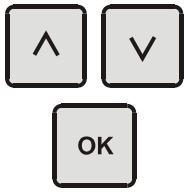
Actual interm. meter		
		888 kWh
Start:	01.02.2012	19:13:02
Durat.:	4 days	04:03:01
Reset meter?		Yes

8.3.4 Menu „Information“

Information about the APOCONV can be displayed in the "Info" menu. The following information is available:

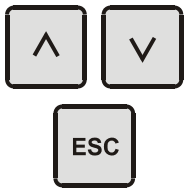
- Converter type
- Statistics (Operating hours, Mains failure meter (option battery); additional with customer password: converter system operating hours)
- Maintenance (Service telephone number, next maintenance)
- Release (SW-Idnumber and -release)

Choose the desired menu page with the „Arrow“-keys and confirm with the „OK“-key.



If you are in a display page you can toggle directly between information pages.

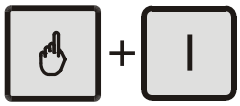
Turn back to the menu „information“ by pressing the „ESC“-key.



8.4 Operating the APOCONV

8.4.1 Switching on

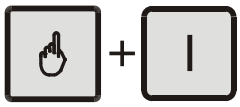
1. Press the “Hand” button and the “I” button at the same time. The following messages appear during the rectifier starting phase one after another in the display:
„Rectifier voltage ramp“
„DC/DC converter voltage ramp“



After the starting phase the following LED should be light up green on the mimic panel:
„Rectifier“

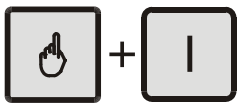
Close the battery isolator. The battery LED shows green (option battery).

2. Press the “Hand” button and the “I” button again. The inverter is switched on and the following message appears:
„Inverter voltage ramp“



After the inverter starting phase the following LED should be light up green additional on the mimic panel:
„Inverter“

3. Press the “Hand” and the “I” button again.
The converter output is switched on. The system is again in the normal operating condition – the load is supplied by the inverter.



The following LED should be light up green additional on the mimic panel:
„Converter output“

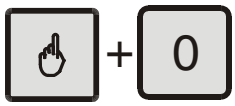
The normal operating condition is now obtained, i.e. the load is supplied from the inverter and the battery is being charged (option battery).

8.4.2 Switching off

WARNING

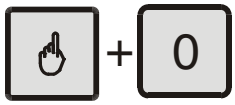
Even when switched off, a few components inside the set are still “live”. Only trained personnel should be allowed to work on the set.

1. Simultaneously press the "manual" and "0" buttons. The following safety prompt is now displayed for 10 seconds:

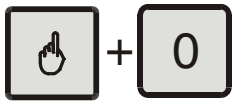


   ATTENTION!
   Switch off converter unit and load now?
   If YES -> press the button again!
   To switch off and cancel this prompt within 10 seconds, press the "Hand" and "0" buttons again. The outgoing contactor is now disengaged.
   If a different button or no other button is pressed during the 10-second period the prompt is cleared from the display and the disconnect process is aborted.

2. When the “Hand” button and the “ 0” button is pressed again the inverter is switched off.



3. If you also wish to switch off the rectifier and the charger (option battery), press the “Hand” button and the “0” button again. This switches off the set completely. The battery isolator should also be opened In the event of a prolonged shutdown (battery option)



9 TROUBLESHOOTING

9.1 General

Each type of fault in the entire system is shown in the display.

When a fault occurs, proceed as follows:

1. Press the “Reset" button to cancel the fault message. If this clears the fault you can restart the system.

2. If the fault is still not cleared, use the display to ascertain which fault or faults has occurred. Use the “UP arrow" to call up previous events since several faults can occur simultaneously or in succession.

3. **Piller’s central service department** is available 24 hours a day via telephone number

   +49 (0) 55 22 / 311 311

If possible make a note of the displayed fault message(s). These details can be useful to our service engineers for troubleshooting.

10 MAINTENANCE AND CUSTOMER SERVICE

10.1 Maintenance

IMPORTANT To ensure troublefree operation we recommend that the air inlet and outlet be examined and if necessary cleaned at regular intervals (e.g. monthly), e.g. by sucking out the gratings. In no circumstances use compressed air since this can blow dust particles into the interior and cause malfunctions.

If for safety reasons you want the system to be regularly checked, e.g. annual inspection, please contact us. We will be happy to send you a quotation for a suitable contract.

10.2 Exchange RAM buffer battery (controller board A100)

A BATTRAM device is used to store and hold operating relevant parameters. The minimum operating life time of the Lithium-Li(CF)-buffer battery in this snaphat module is about 5 years. After this time, the module is to exchange, to prevent data loss during a mains failure.
The Snaphat battery module is used M4T28-BR12SH1, Piller IdNo. 00.4.020.0098.
In order to avoid a loss of data, the replacement of the battery must be done while the board is powered up. If the operating voltage is not present, important parameters are lost and the system is no longer functional.

IMPORTANT If the storage battery is not correctly replaced this can result in loss of system function. For this reason we recommend that the replacement be carried out by our Service Department. We also recommend that during the replacement the system is inoperative, that is to say not operated with a critical load.

WARNING

Do not use metallic tools (a short circuit can initiate an explosion). During the procedure described below exposed parts of the system are "live" (protection against accidental contact is provided). Careful and prudent operations are absolutely essential.

How to carry out a replacement:

1. Supply line voltage to the system (connect infeed to the system but do not start up).
2. Refer to Chapter 11 for the location of the controller board A100.
3. Unlock and open the corresponding system door.

WARNING

Furthermore, the live components in the system are protected against accidental contact by covers. Nevertheless, with the door open there is increased risk to personnel carrying out the work.

4. Establish EMC equipotential bonding (conductive arm band, etc.).
5. Identify the Snaphat module.
6. Grip Snaphat module with thumb and index finger and release with a short tug (snap in mounting).
7. Mount the new Snaphat module with the correct orientation and snap into place with a short jerk.

IMPORTANT Note the identification mark for Pin 1 on Snaphat module and Battram module.

8. Remove EMC equipotential bonding.
9. Close and lock the door of the system.
10. Re-enter date and time on the touch screen of the unit and confirm the programming to re-activate the hardware clock.

NOTE Do not dispose exchanged batteries into normal garbage. Old Lithium batteries are hazardous waste.

10.3 Customer service

Our central service department is available 24 hours a day for **customer service** requests via telephone number:

+49 (0) 55 22 / 311 311

Details of the APOCONV or other products in our range can be obtained from one of our representatives or

Piller Group GmbH
P.o. box 1851
37508 Osterode am Harz
Germany
Telephone: +49 (0) 55 22 / 311 0
Fax: +49 (0) 55 22 / 311 414
email: info@piller.com

11 ADDITIONAL INFORMATION

11.1 Overview APOCONV 100 – 120 kVA

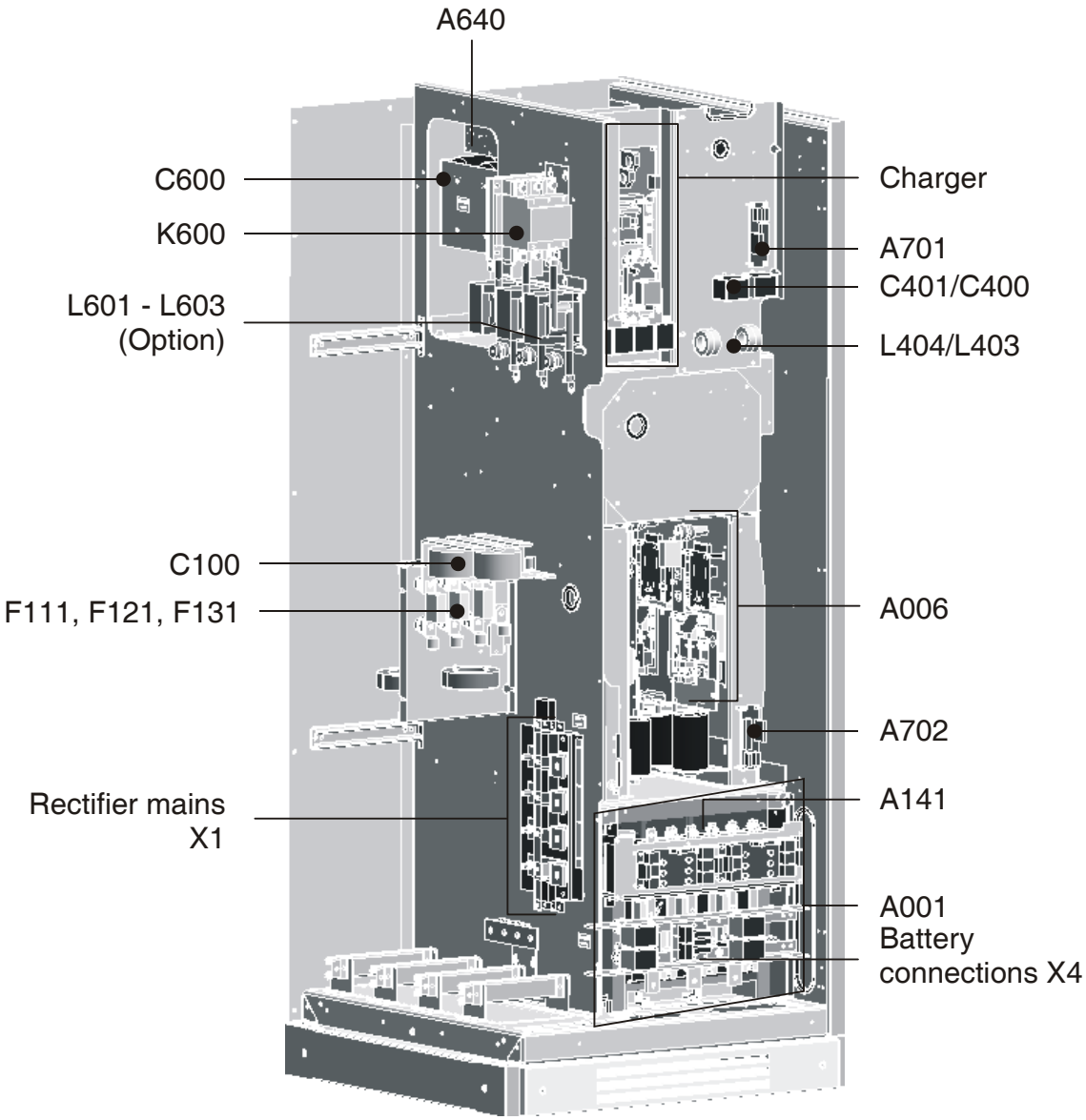


Fig. 11-1 Overview APOCONV 100 – 120 kVA

A001	Rectifier	C400	Capacitor (Option)
A006	Inverter	C401	Capacitor (Option)
A141	Measured-data acquisition rectifier	C600	Filter capacitor output
A640	Measured-data acquisition inverter	F111 – F131	Rectifier fuses
A701	Temperature measurement	K600	Output contactor
A702	Temperature measurement	L403 – L404	Annular core battery charger (Option)
C100	Filter capacitor input	L601 – L603	Paralleling chokes (Option)

NOTE Mounting plate see Fig. 11-3.

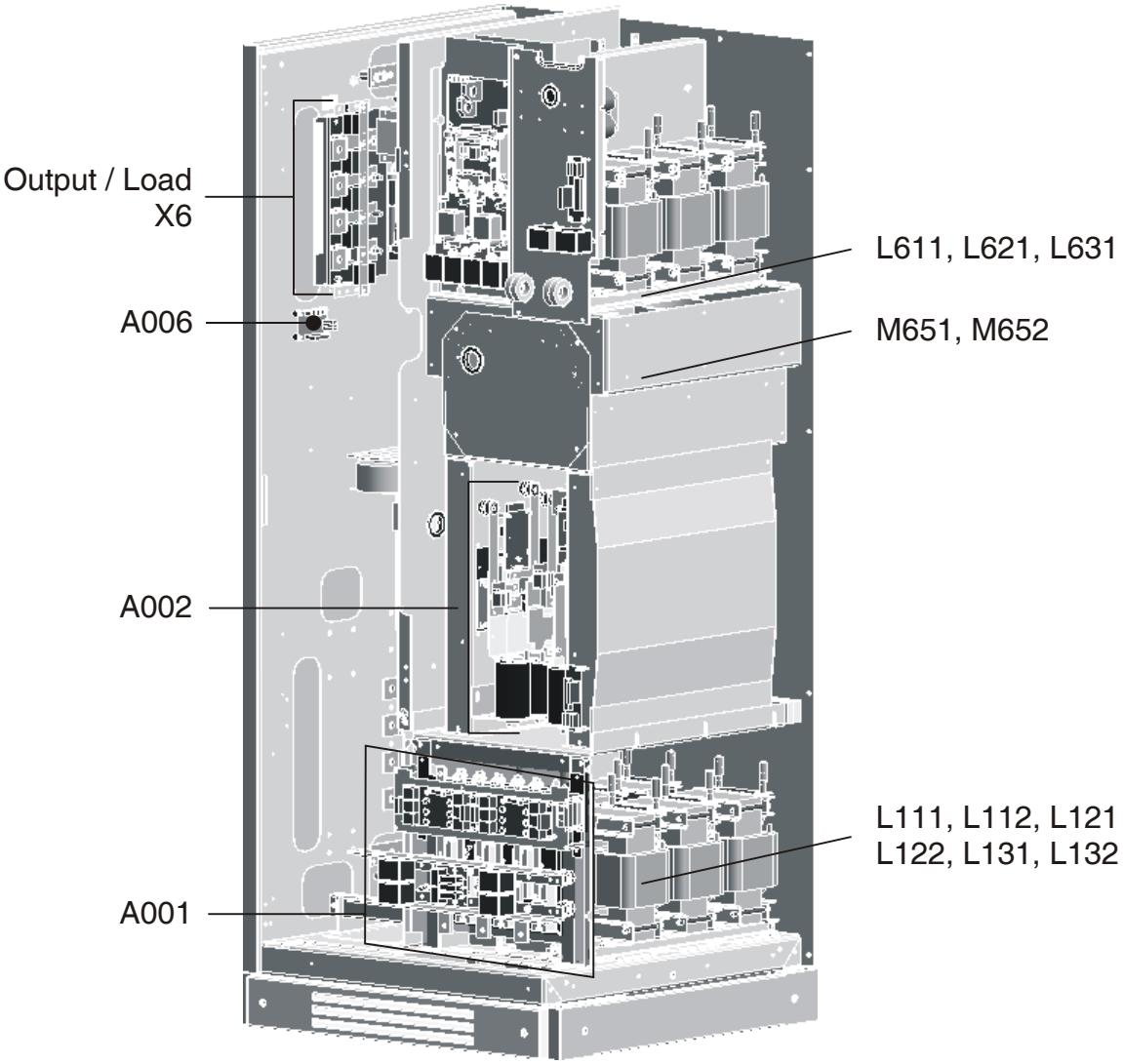


Fig. 11-2 Overview APOCONV 100 – 120 kVA

A001	Rectifier	L131	Rectifier choke
A002	DCDC Steller	L132	Rectifier choke
A006	Inverter	L611	Output choke
L111	Rectifier choke	L621	Output choke
L112	Rectifier choke	L631	Output choke
L121	Rectifier choke	M651, M652	Fan
L122	Rectifier choke		

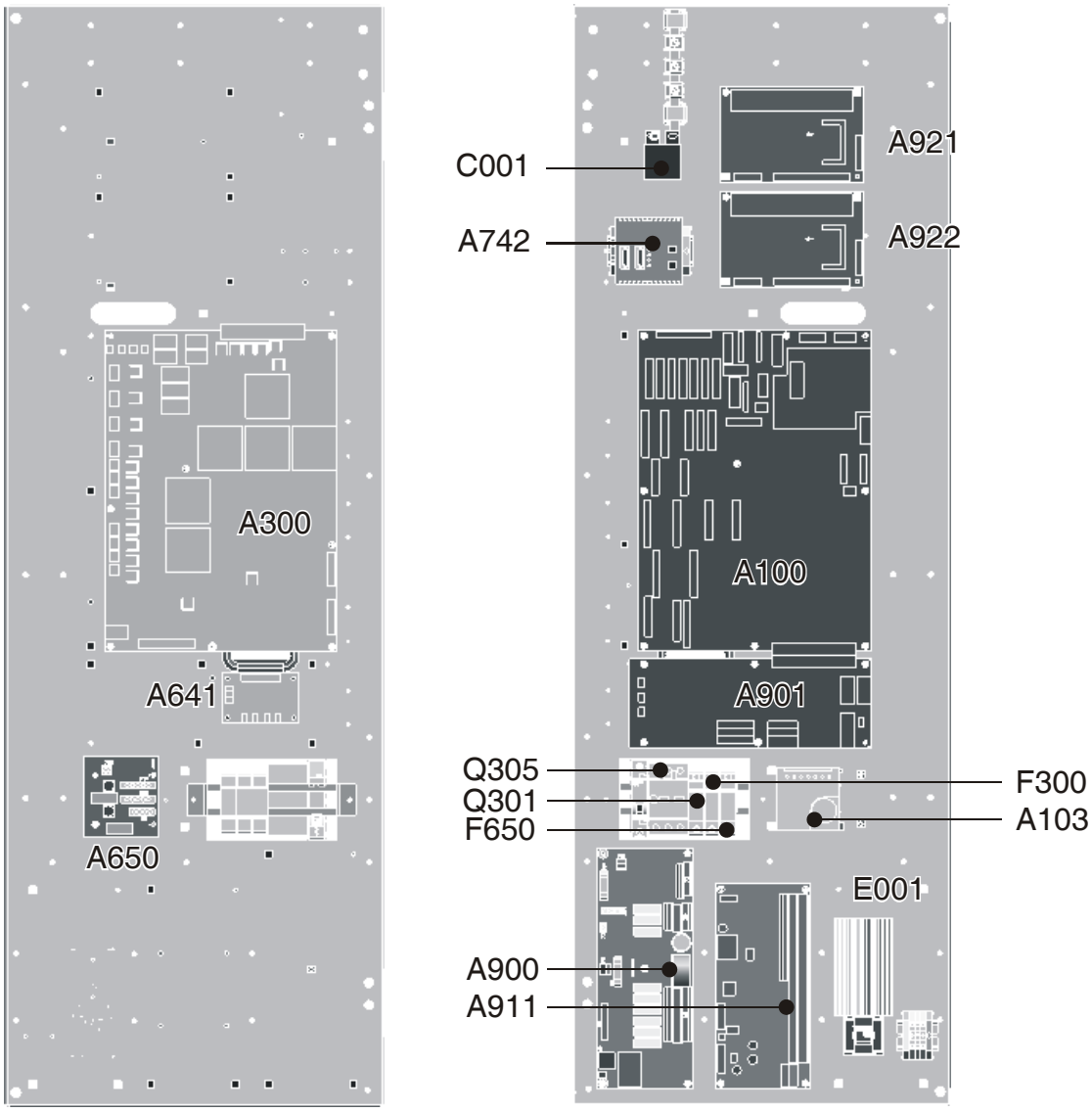


Fig. 11-3 Boards APOCONV 100 – 120 kVA

A100	Controller Board	A921	Protocol gateway (Option)
A300	Main power supply	A922	Protocol gateway (Option)
A641	Measured-data acquisition inverter	C001	Capacitor
A650	Fan relay board	E001+A103	Cabinet heating (Option)
A742	Profibus (Option)	F300	Fuse holder
A900	Standard I/O Board	F650	Fuse holder
A901	Parallel - Interface Board (Option)	Q301	Motor protection switch
A911	I/O Board (Option)	Q305	Motor protection switch Bypass (Option)

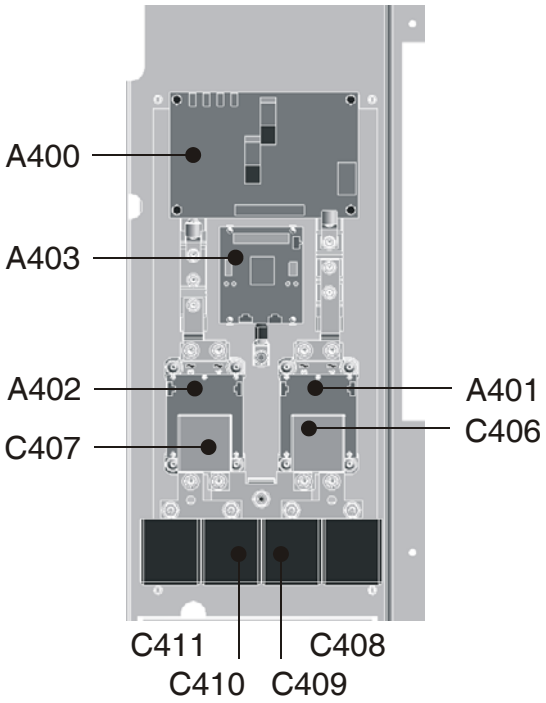


Fig. 11-4 Battery charger unit APOCONV 100 – 120 kVA, Option

A400	DC Voltage/current measurement	C407	Capacitor
A401	Adapter board for IGBT driver board	C408	Capacitor
A402	Adapter board for IGBT driver board	C409	Capacitor
A403	IGBT driver board	C410	Capacitor
C406	Capacitor	C411	Capacitor

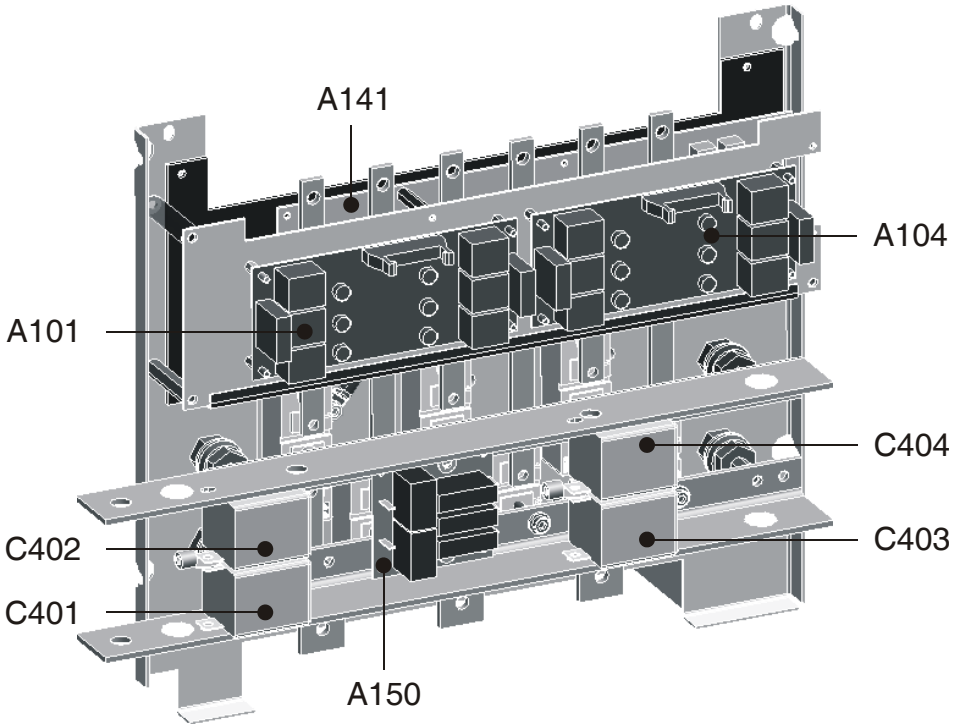


Fig. 11-5 Rectifier A001 APOCONV 100 – 120 kVA

A101	Thyristor triggering mains thyristor	C401	Capacitor (Option)
A104	Thyristor triggering battery thyristor (Option)	C402	Capacitor (Option)
A141	Measurement board	C403	Capacitor (Option)
A150	Rectifier board (Option)	C404	Capacitor (Option)

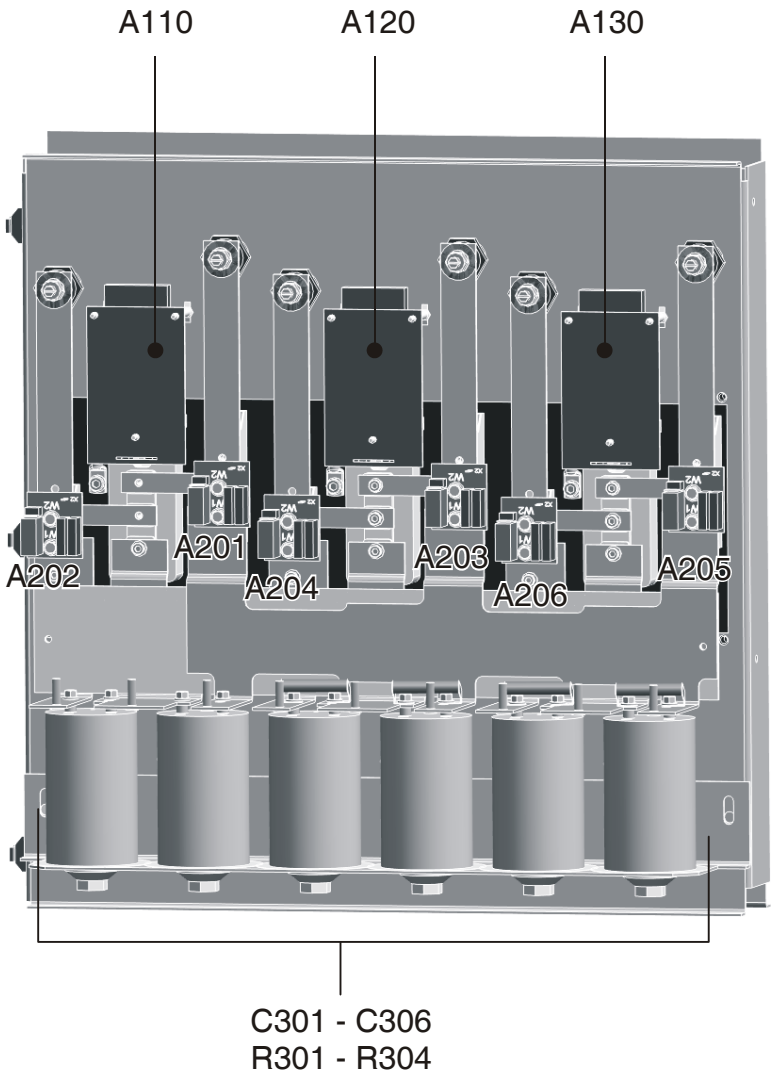


Fig. 11-6 DC/DC converter A002 (left unit) APOCONV 100 – 120 kVA

A110	IGBT driver board	A203	Diode circuit
A120	IGBT driver board	A204	Diode circuit
A130	IGBT driver board	A205	Diode circuit
A201	Diode circuit	A206	Diode circuit
A202	Diode circuit	C301 – C306	DC-link capacitors with discharge resistors R301 – R304

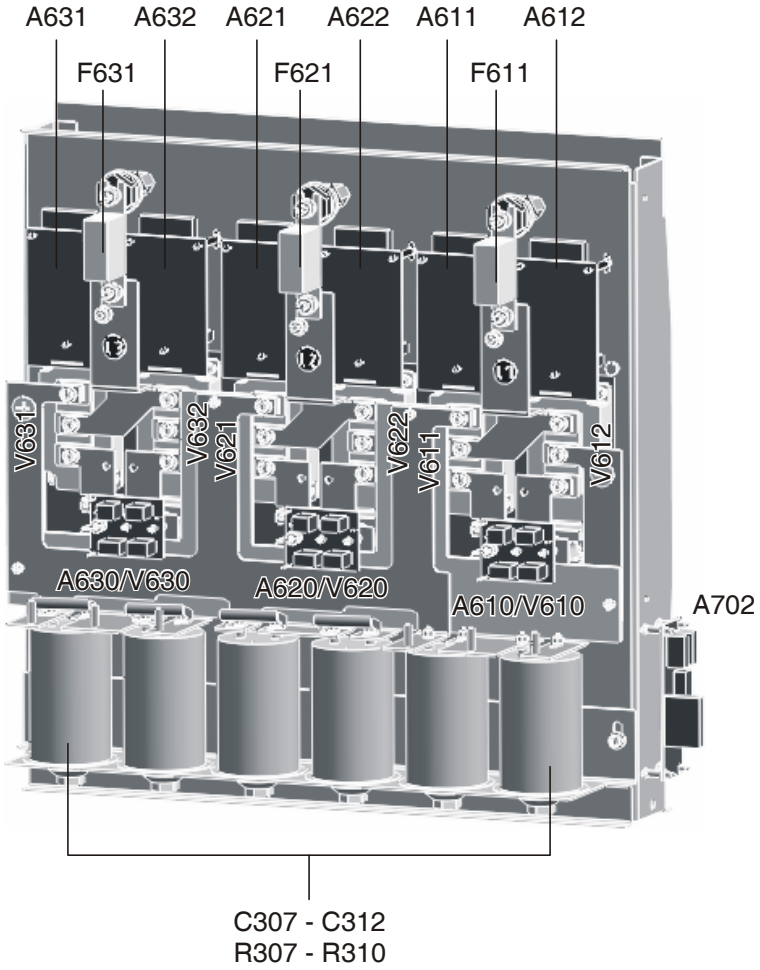


Fig. 11-7 Inverter A006 (right unit) APOCONV 100 – 120 kVA

A610	Diode circuit	A631	IGBT driver card
A611	IGBT driver board	A632	IGBT driver card
A612	IGBT driver board	A702	Temperature measurement
A620	Diode circuit	C307 – C312	DC-link capacitors with discharge resistors R307 – R310
A621	IGBT driver board	F611 – F631	Semiconductor fuse
A622	IGBT driver board	V610, V620, V630	Diode modules
A630	Diode circuit	V611, V612; V621, V622, V631, V632	IGBT modules

11.2 Overview APOCONV 160 – 200 kVA

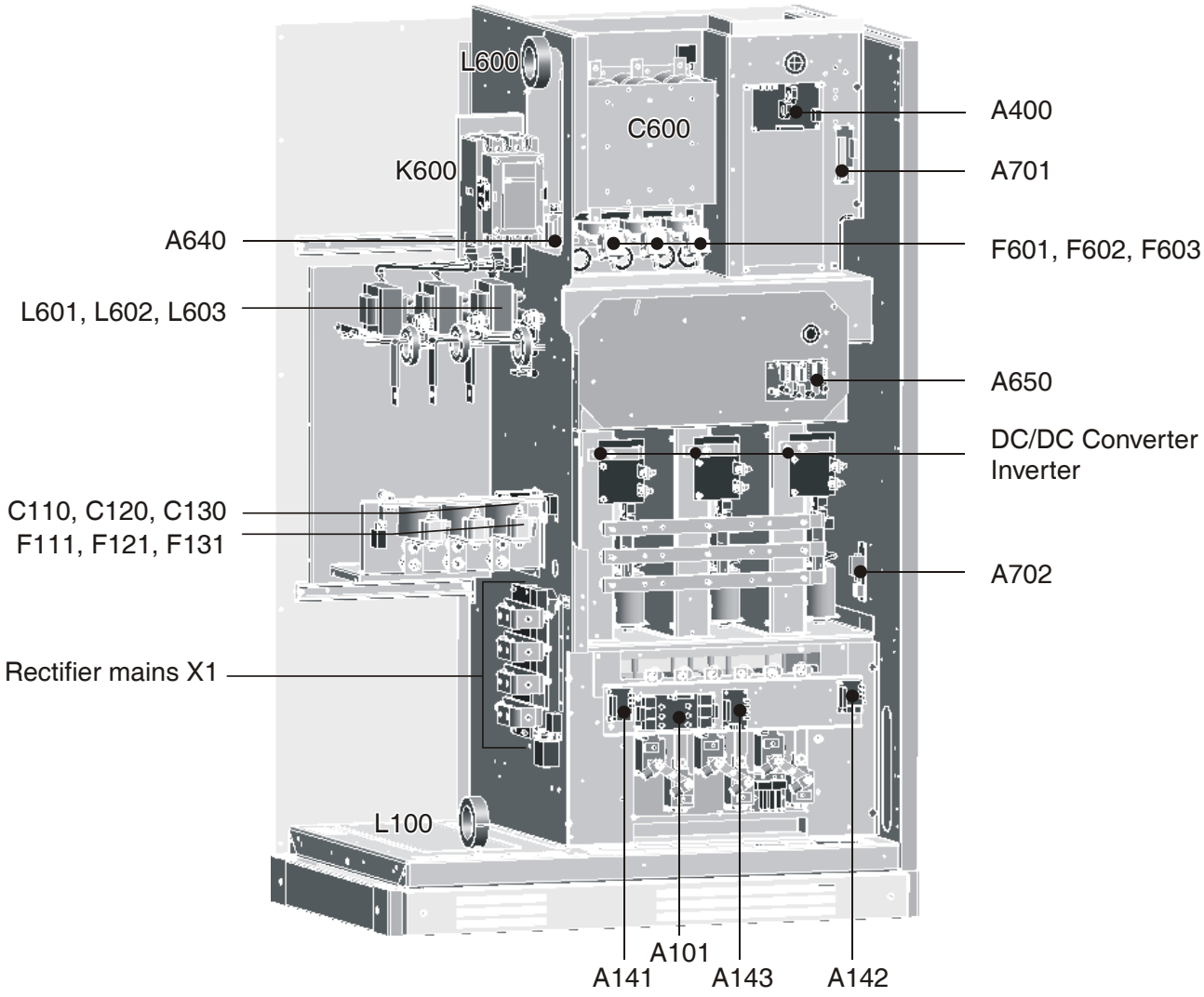


Fig. 11-8 Overview APOCONV 160 – 200 kVA

A101	Thyristor triggering mains thyristor	C110 – C130	Capacitor
A141	Measured-data acquisition rectifier	C600	Filter capacitor output
A142	Measured-data acquisition rectifier	F111 – F131	Rectifier fuses
A143	Measured-data acquisition	F601 – F603	Inverter fuses
A400	DC Measured-data acquisition	K600	Output contactor
A640	Measured-data acquisition inverter	L100	Annular core input
A650	Fan relay board	L600	Annular core output
A701	Temperature measurement	L601 – L603	Paralleling chokes (Option)
A702	Temperature measurement		

NOTE Mounting plate see Fig. 11-10.

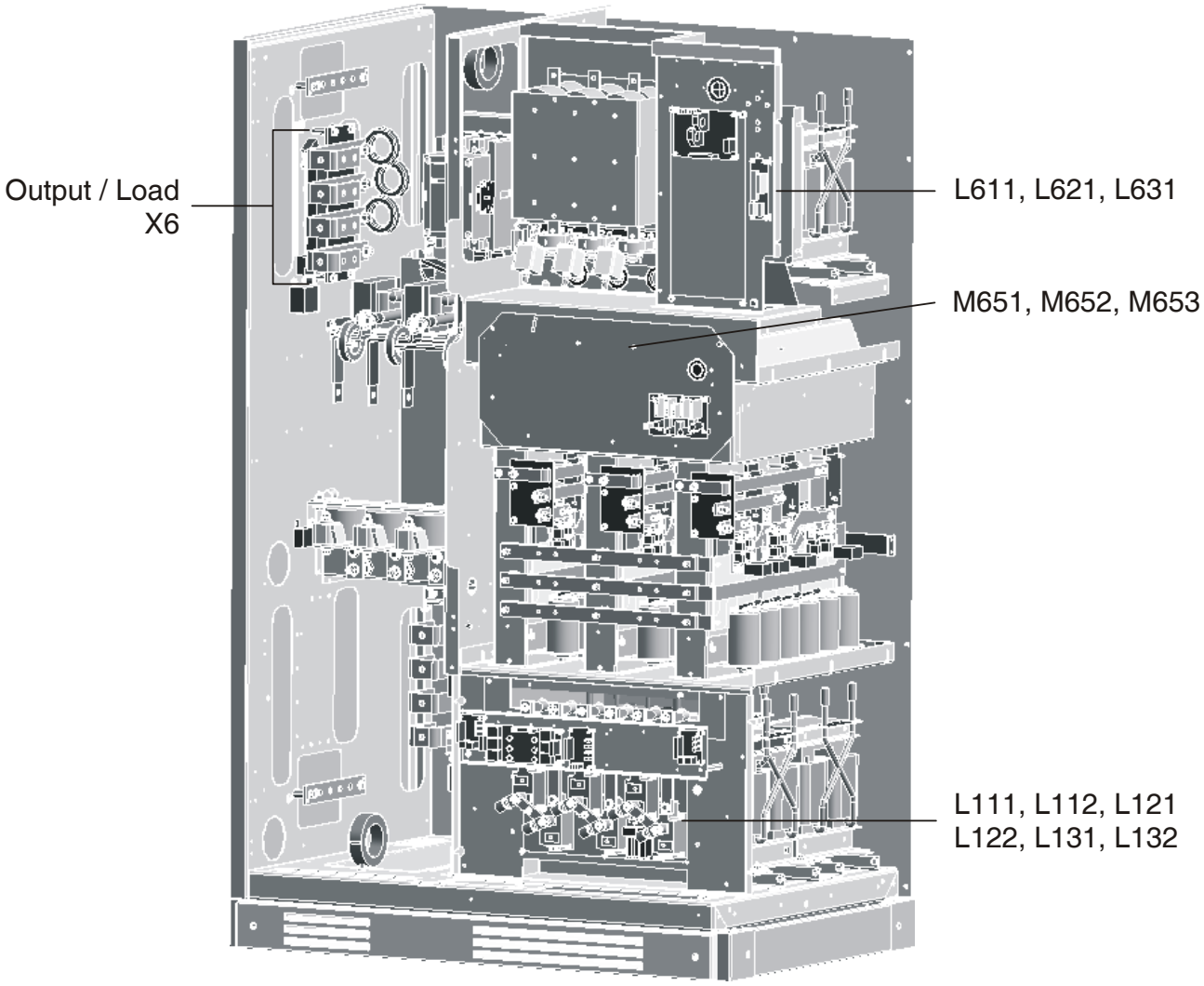


Fig. 11-9 Overview APOCONV 160 – 200 kVA

M651 – M653	Fans	L611	Output choke
L111 – L121	Rectifier choke	L621	Output choke
L122 – L132	Rectifier choke	L631	Output choke

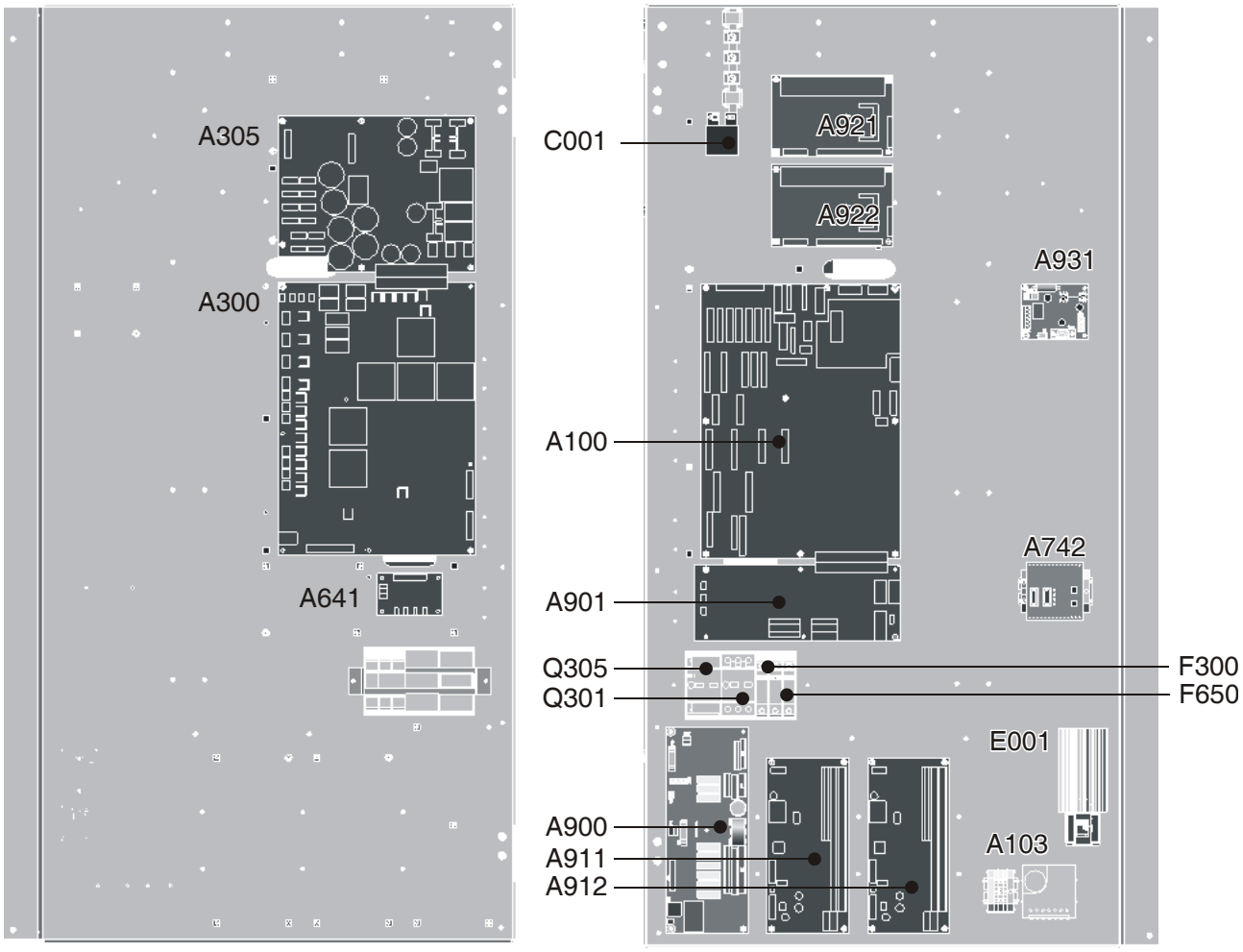


Fig. 11-10 Boards APOCONV 160 – 200 kVA

A100	Controller Board	A921	Protocol gateway (Option)
A300	Main power supply	A922	Protocol gateway (Option)
A305	Power supply Bypass (Option)	A931	Remain time display (Option)
A641	Measured-data acquisition inverter	C001	Capacitor
A742	Profibus (Option)	E001-A103	Cabinet heating (Option)
A900	Standard I/O Board	F300	Fuse holder
A901	Parallel – Interface Board (Option)	F650	Fuse holder
A911	I/O Board (Option)	Q301	Motor protection switch
A912	I/O Board (Option)	Q305	Motor protection switch Bypass (Option)

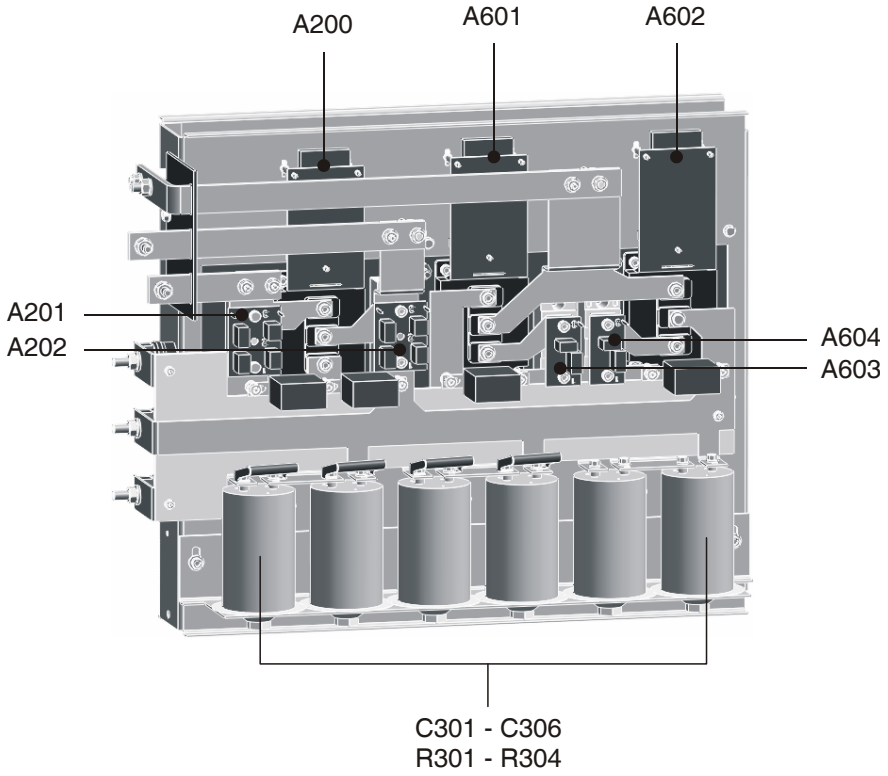


Fig. 11-11 DC/DC converter / Inverter APOCONV 160 – 200 kVA

A200	IGBT driver board	A602	IGBT driver board
A201	Diode circuit	A603	Diode circuit
A202	Diode circuit	A604	Diode circuit
A601	IGBT driver board	C301 – C306	DC-link capacitors with discharge resistors R301 – R304

11.3 Overview APOCONV 300 kVA

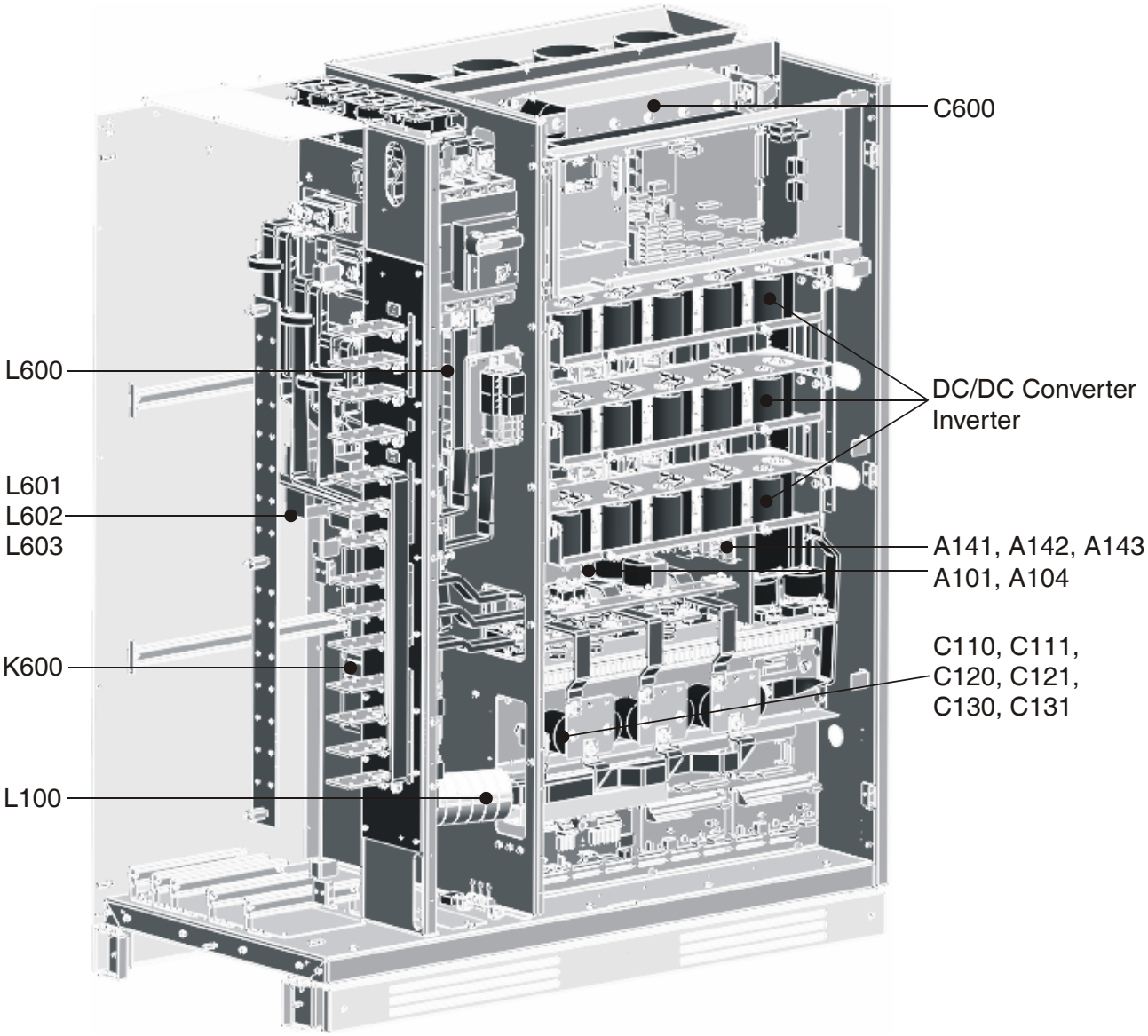


Fig. 11-12 Overview APOCONV 300 kVA

A101	Thyristor triggering mains thyristor	C600	Filter capacitor output
A104	Thyristor triggering battery thyristor (Option)	K600	Output contactor
A141	Measured-data acquisition rectifier	L100	Annular core input
A142	Measured-data acquisition rectifier	L600	Annular core output
A143	Measured-data acquisition	L601 – L603	Paralleling chokes (Option)
C110 – C131	Capacitor		

NOTE Mounting plates see Fig. 11-14 and Fig. 11-15.

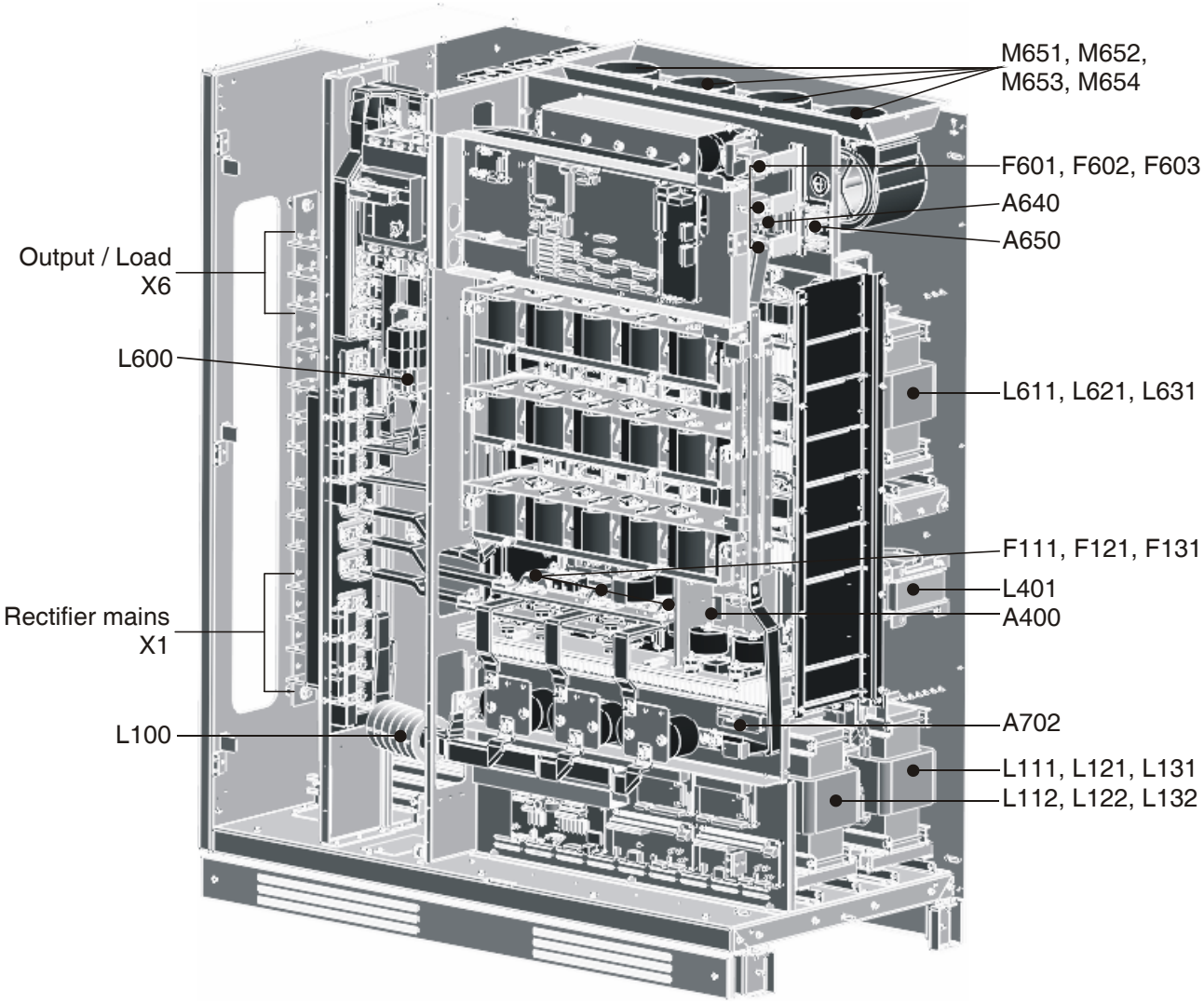


Fig. 11-13 Overview APOCONV 300 kVA

A040	Battery charger unit (Option)	L111 – L131	Rectifier choke
A640	Measured-data acquisition inverter	L112 – L132	Rectifier choke
A650	Fan relay board	L401	Battery charger choke (Option)
A702	Temperature measurement	L600	Annular core output
M651 – M654	Fans	L611	Output choke
F111 – F131	Rectifier fuses	L621	Output choke
F601 – F603	Inverter fuses	L631	Output choke
L100	Annular core input		

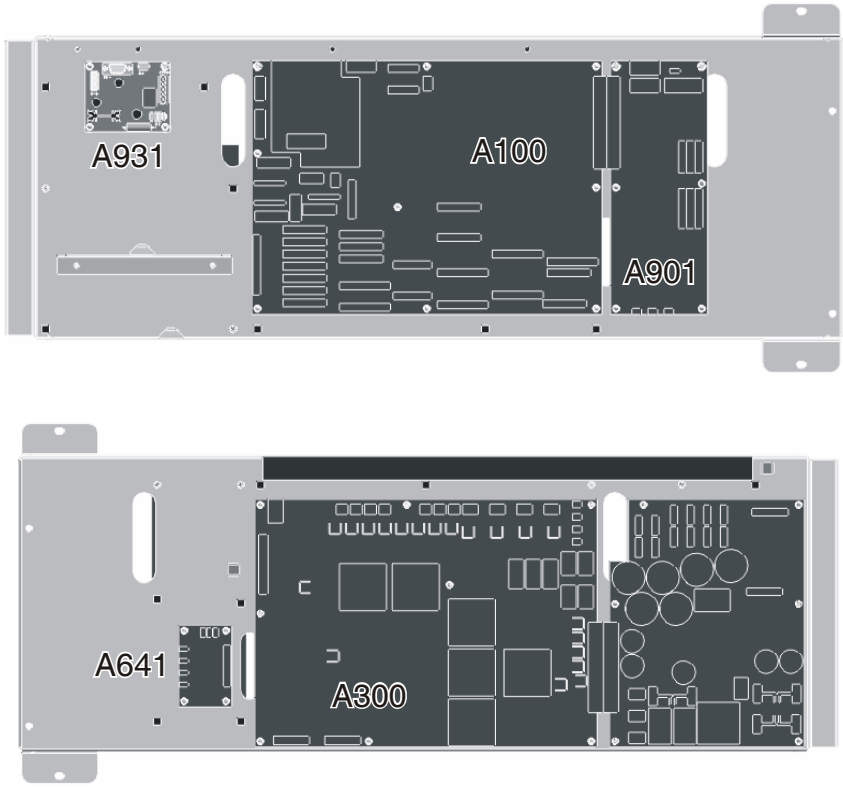


Fig. 11-14 Board APOCONV 300 kVA

A100	Controller Board	A641	Measured-data acquisition inverter
A300	Main power supply	A901	Parallel - Interface Board (Option)
		A931	DC/DC converter for remaining battery life indicator (Option)

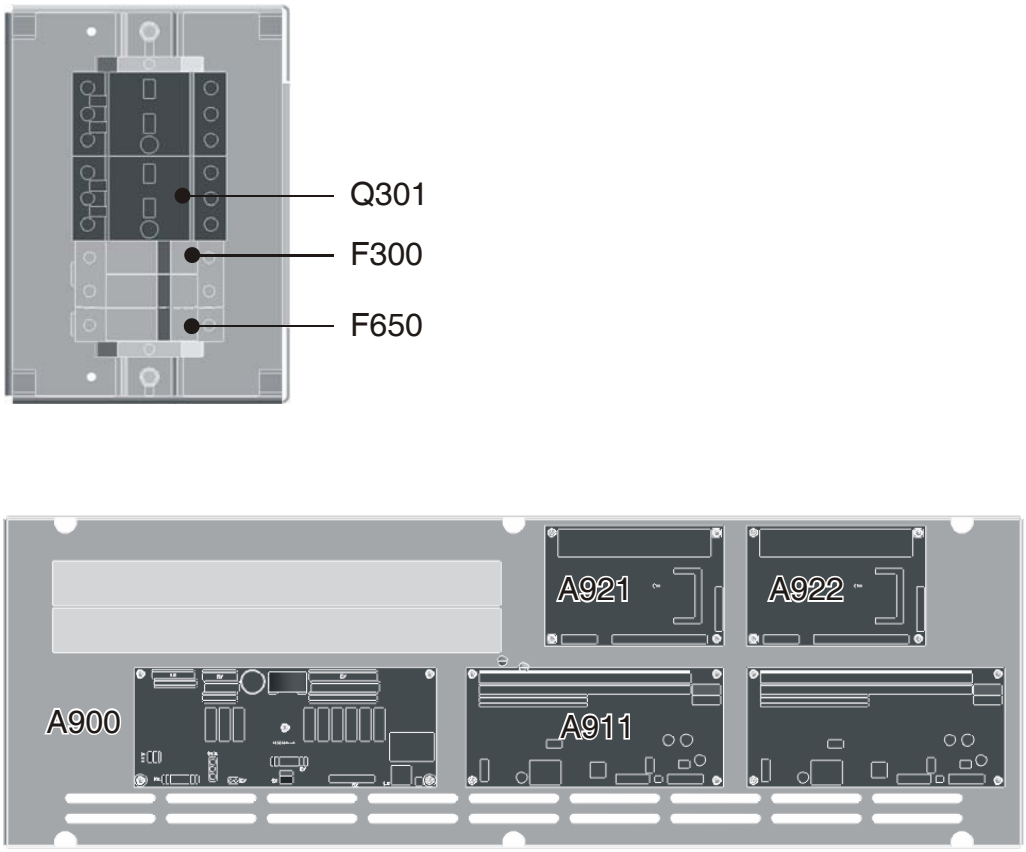


Fig. 11-15 Boards APOCONV 300 kVA

A900	Standard I/O Board	F300	Fuse holder
A911	I/O Board (Option)	F650	Fuse holder
A921	Protocol gateway (Option)	Q301	Motor protection switch
A922	Protocol gateway (Option)		

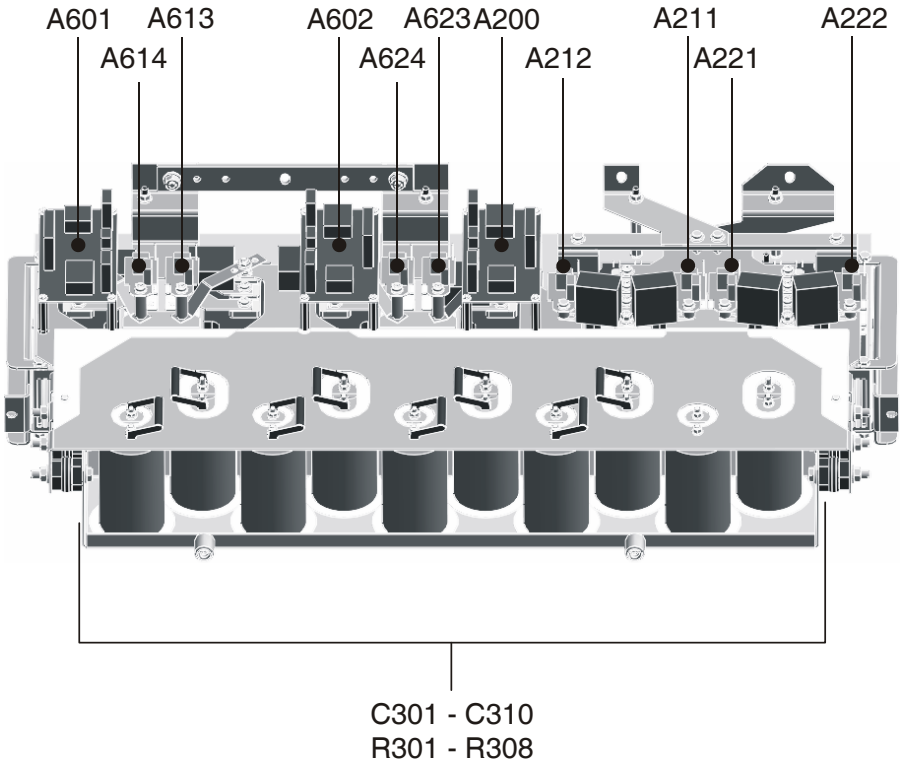


Fig. 11-16 DC/DC converter / Inverter APOCONV 300 kVA

A200	IGBT driver board	A602	IGBT driver board
A211	Diode circuit	A613	Diode circuit
A212	Diode circuit	A614	Diode circuit
A221	Diode circuit	A623	Diode circuit
A222	Diode circuit	A624	Diode circuit
A601	IGBT driver board	C301 – C310	DC-link capacitors with discharge resistors R301 – R308

11.4 Overview APOCONV 400 kVA

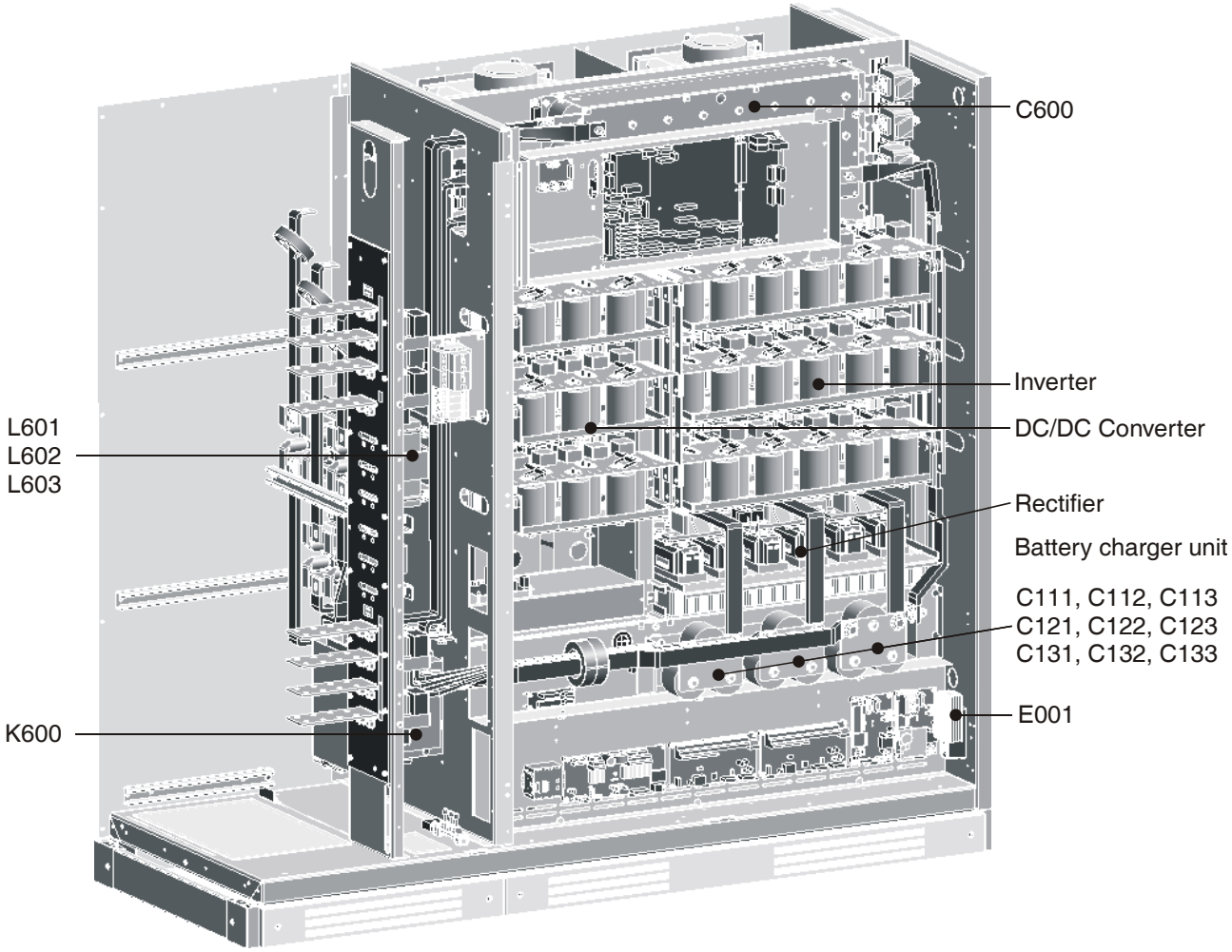


Fig. 11-17 Overview APOCONV 400 kVA

C111 – C133	Input filter capacitors	K600	Output contactor
C600	Output filter capacitor	L601 – L603	Paralleling chokes (Option)
E001	Cabinet heating (Option)		

NOTE Mounting plates see Fig. 11-19 and Fig. 11-20.

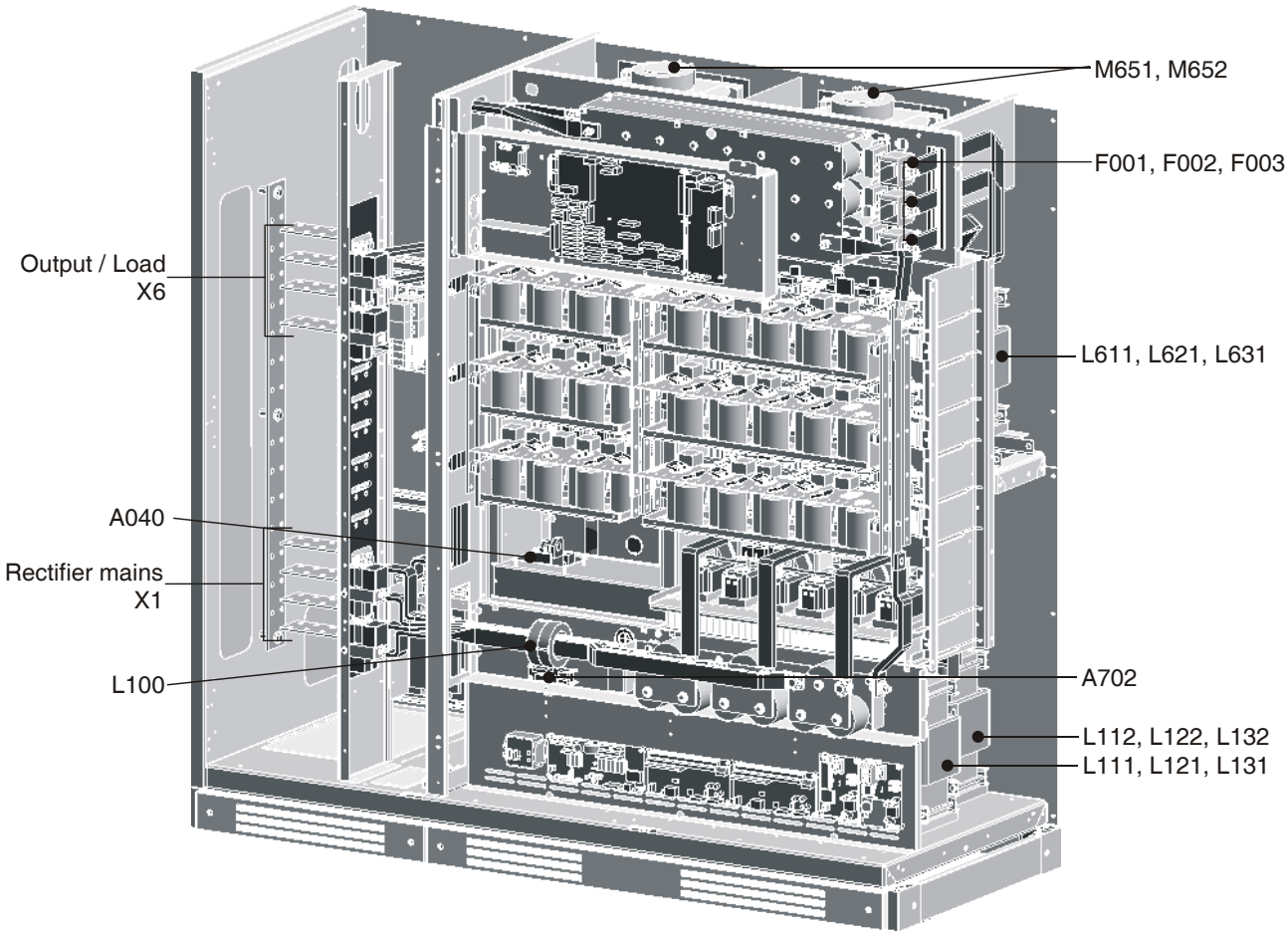


Fig. 11-18 Overview APOCONV 400 kVA

A640	Measured-data acquisition inverter	L111 – L131	Rectifier choke
A702	Temperature measurement	L112 – L132	Rectifier choke
M651, M652	Fans	L611	Output choke
F001 – F003	Inverter fuses	L621	Output choke
L100	Annular core input	L631	Output choke

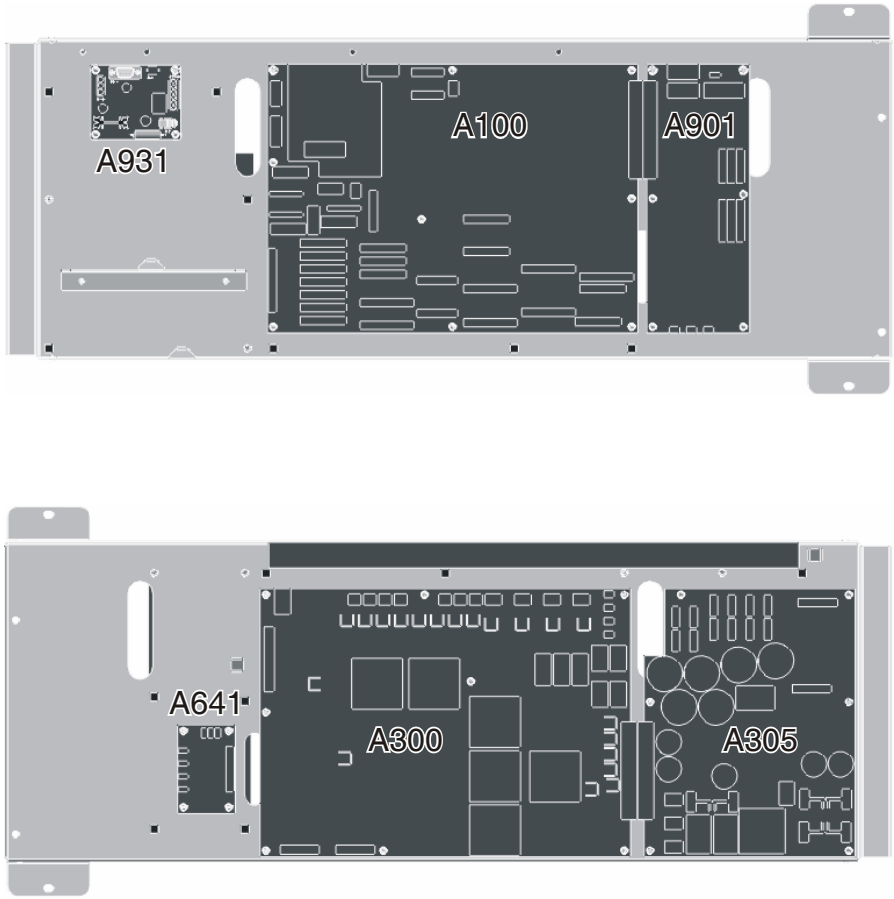
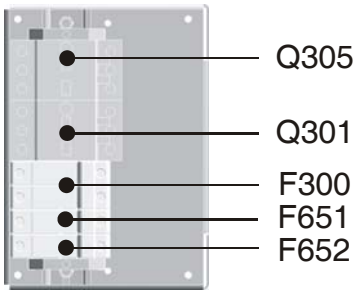


Fig. 11-19 Board APOCONV 400 kVA

A100	Controller Board	A641	Measured-data acquisition inverter
A300	Main power supply	A901	Parallel - Interface Board (Option)
A305	Power supply Bypass (Option)	A931	DC/DC converter for remaining battery life indicator (Option)



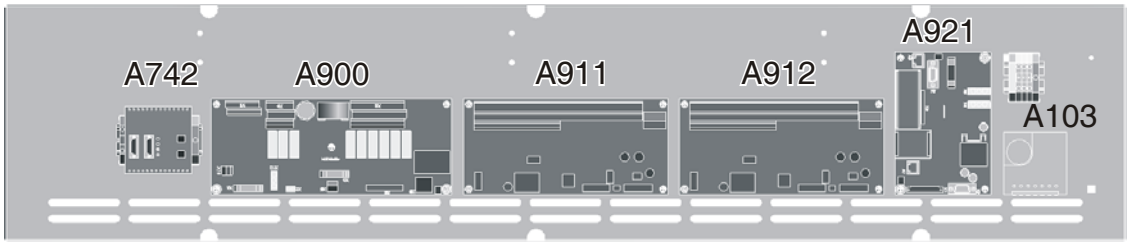


Fig. 11-20 Boards APOCONV 400 kVA

A103	Cabinet heating (Option)	F300	Fuse holder
A742	Profibus (Option)	F651	Fuse holder
A900	Standard I/O Board	F652	Fuse holder
A911	I/O Board (Option)	Q301	Motor protection switch
A912	I/O Board (Option)	Q305	Motor protection switch Bypass (Option)
A921	Protocol gateway (Option)		

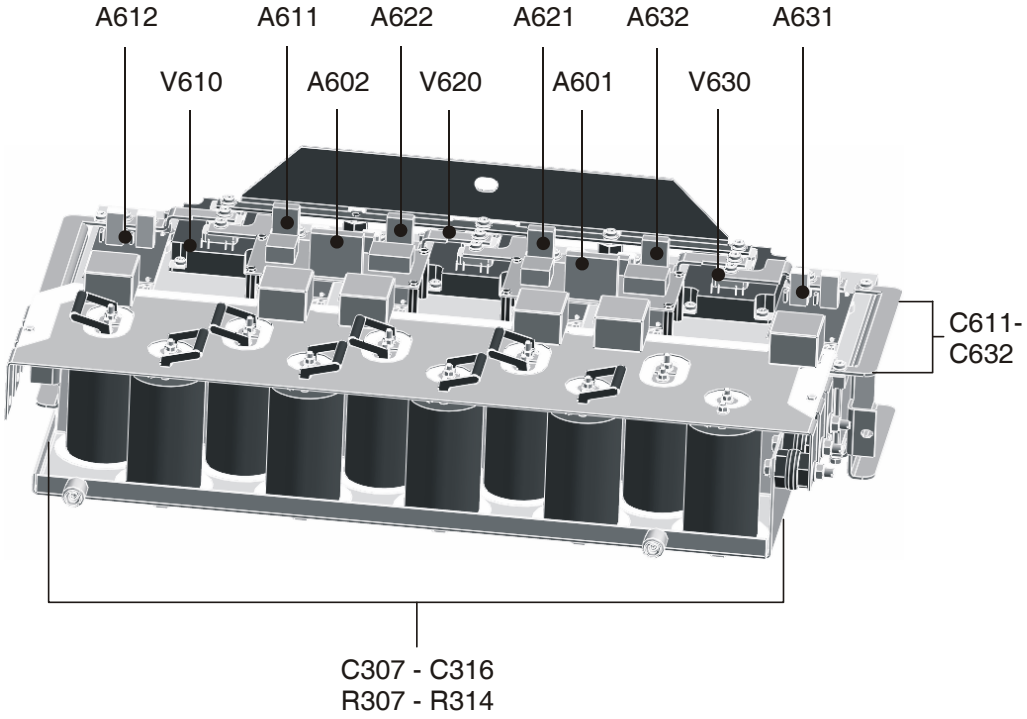


Fig. 11-21 Inverter APOCONV 400 kVA

A601	IGBT driver board	C307 – C316	DC-link capacitors with discharge resistors R307 – R314
A602	IGBT driver board	C611 – C632	Snubber capacitors
A611, A612	Diode circuit	V610	IGBT module
A621, A622	Diode circuit	V620	IGBT module
A631, A632	Diode circuit	V630	IGBT module

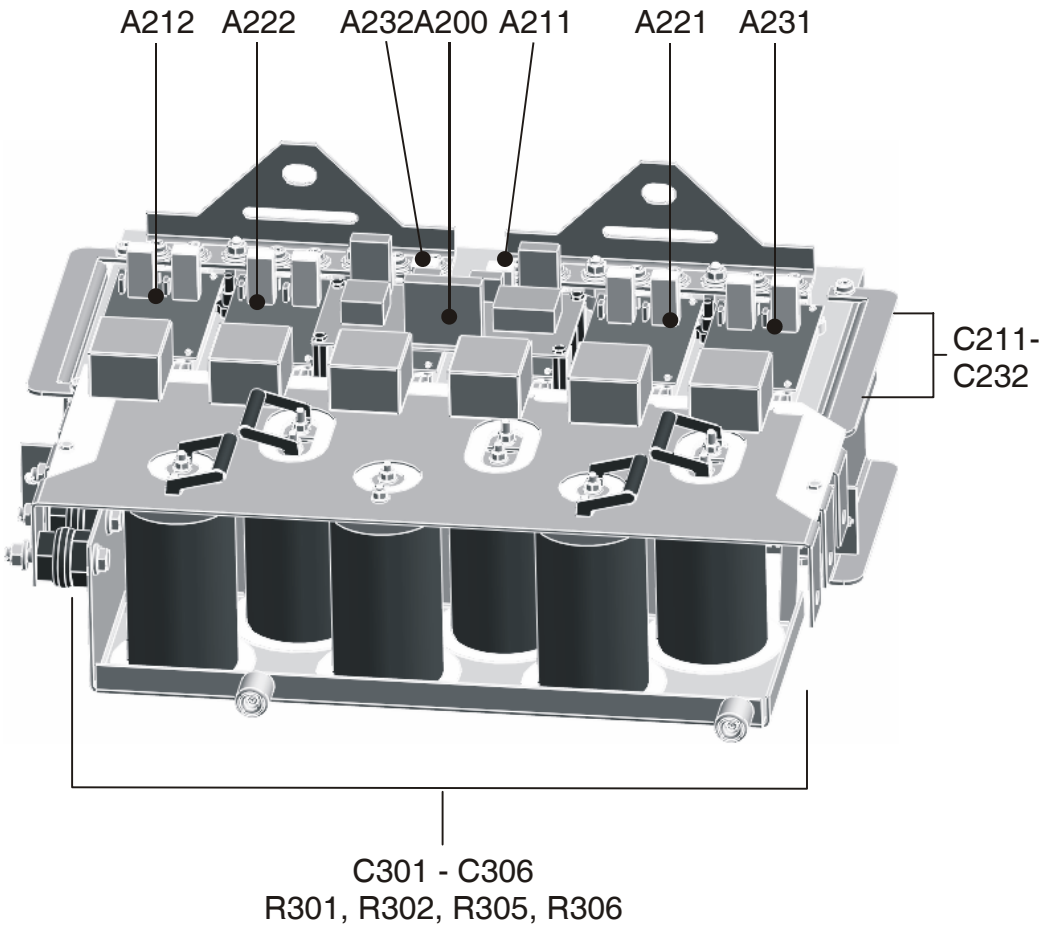


Fig. 11-22 DC/DC converter APOCONV 400 kVA

A200	IGBT driver board	A231	Diode circuit
A211	Diode circuit	A232	Diode circuit
A212	Diode circuit	C211 – C232	Snubber capacitors
A221	Diode circuit	C301 – C306	DC-link capacitors with discharge resistors R301, R302, R305, R306
A222	Diode circuit		

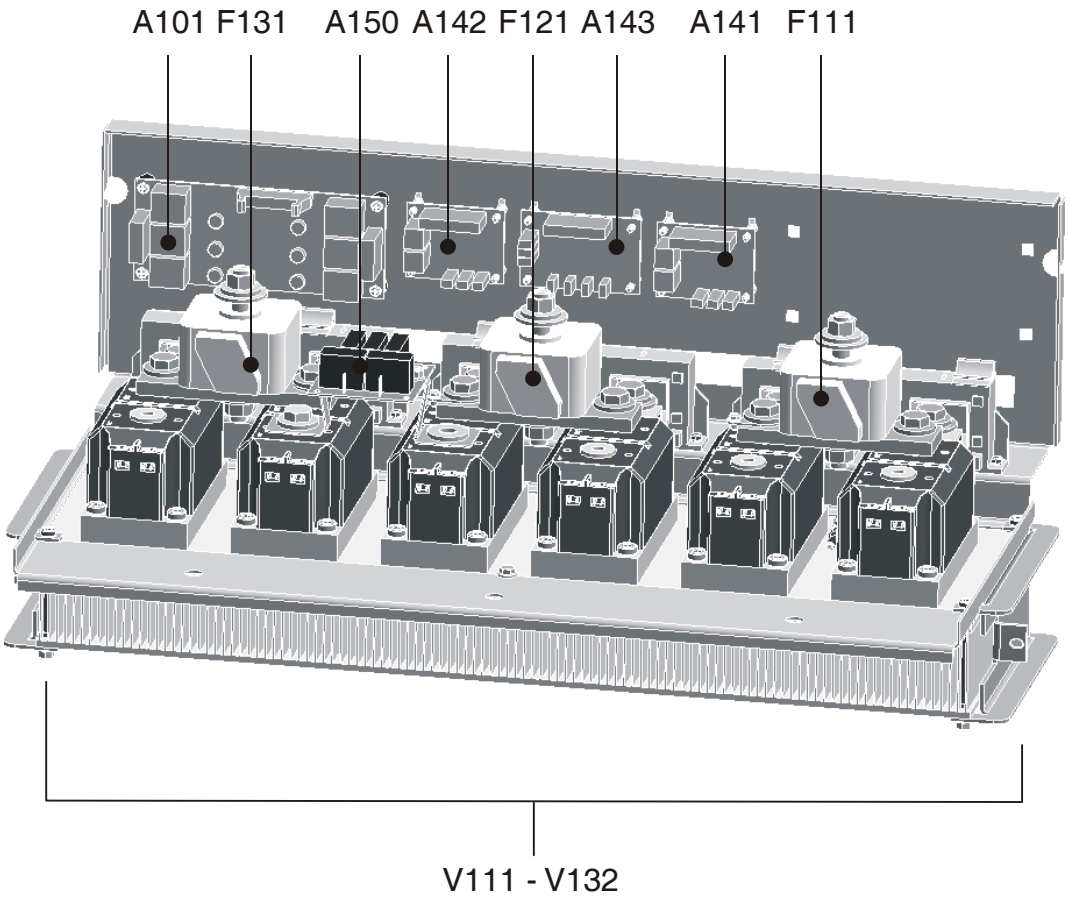


Fig. 11-23 Rectifier APOCONV 400 kVA

A101	Thyristor triggering mains thyristor	F111	Rectifier fuse
A141	Measured-data acquisition rectifier	F121	Rectifier fuse
A142	Measured-data acquisition rectifier	F131	Rectifier fuse
A143	Measured-data acquisition rectifier	V111 – V132	Thyristors
A150	Snubber capacitor board		

12 DISASSEMBLY AND DISPOSAL

At the end of the period of use, the system must be dismantled and sent for environmentally-friendly disposal.

IMPORTANT The manufacturing company does not accept any responsibility for possible personal injury or damage to property which arises from the reuse of machine parts if these parts are used for a material purpose other than the original one.

12.1 Disassembly

Before commencing disassembly:

- switch off the load supply
- switch off the system (stop the machine)
- isolate the entire power supply to the system and secure against reconnection
- discharge any existing capacitors

IMPORTANT Disassembly must be carried out only by authorized and specialized skilled personnel or specialist firms!

Disassembly must be carried out in reverse order to the assembly sequence!
The cabinets, assemblies and components should then be taken apart while observing the relevant accident prevention regulations and local environmental protection regulations.

12.2 Disposal

NOTE Disposal also may be carried out only by authorized and specialized skilled personnel or a specialist waste disposal company!

Provided that no returns or disposal agreement has been made, following proper disassembly, stripped down parts should be sent for recycling:

- residual metal materials to be scrapped
- oil and grease to be disposed of in accordance with local regulations
- plastics to be recycled in accordance with local regulations
- electronic boards and semiconductor components to be removed and recycled
- low-voltage switchgear, transformers, chokes and cable to be sent to authorized recycling firms.

NOTE Finally, the waste regulations in force in the operator's country are binding!

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