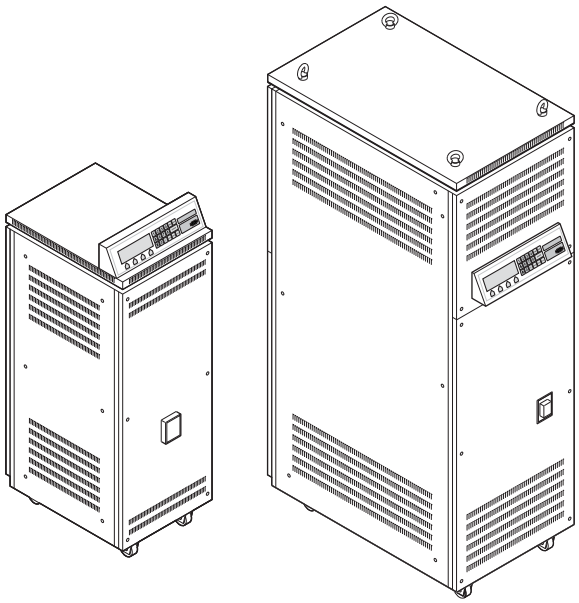
Installation Manual

Constant Current Regulator
Type VIS



A.07.375e Edition 2.0

ADB SAFEGATE

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Table of contents

1 About this manual

The manual shows the information necessary to:
- install

the VIS 2.5 to 30 kVA.
- 2.5 to 15 kVA: small cabinet.
- 20 to 30 kVA: big cabinet.

If in the manual the term equipment is used, this refers to both the small and the big cabinet.

1.1 How to work with the manual

1. Familiarize yourself with the structure and content.
2. Carry out the actions completely and in the given sequence.

1.2 Record of changes

Edition	Editor	Check	Date	Description
1.0	MR	AHU, MAW, VDV	09/2011	New
2.0	TWE		06/2017	Added mechanical improvements. Layout changes

1.3 Icons used in the manual

For all WARNING symbols, see chapter § 2.

CAUTION
Can cause damage to the equipment.

NOTE
Gives further information.

1.4 Abbreviations and terms

Table: 1.1 Terms and abbreviations

Term or abbreviation	Description
AC	Alternating Current
AGL	Airfield Ground Lighting
CENELEC	Comitée Eruopéen de Normalisation ELECtrotechniqe (European Committee for Electrotechnical Standardization)
CS	Circuit Selector
CSM	Circuit Selector Module
DC	Direct Current
DSP	Digital Signal Processor
EFD	Earth Fault Detection
EMC	Electro Magnetic Compatibility
Equipment	The stackable, the small cabinet and big cabinet, if the information is the same
FAA	Federal Aviation Administration
FDT	Flash Development Toolkit
HMI	Human-Machine Interface
HV	High Voltage
ICAO	International Civil Aviation Organisation
IGBT	Insulated Gate Bipolar Transistor
LFD	Lamp Fault Detection
MW	Multiwire
PC	Personal Computer
PCB	Printed Circuit Board
PIC	A controller from Microchip.
PVC	PolyVinylChloride
PWM	Pulse Width Modulation
PE	Protective Earth
Remote control system	The remote control system in the airport to control the equipment on the field.
RMS	Root Mean Square
SCB	Series Connector Box
SCO	Series Cut Out
SHVS	Servo High Voltage Switch

2 Safety

Read all warnings carefully. Failure to do so may result in personal injury, death, or property damage.

2.1 Use

To use the equipment safely:

- Refer to the International Standard IEC 61820, *Electrical installation for lighting and beaconing of aerodromes - Constant current series circuits for aeronautical ground lighting - System design and installation requirements*, and to the International Standard IEC 61821, *Electrical installations for lighting and beaconing of aerodromes - Maintenance of aeronautical ground lighting circuits* for instructions on safety precautions.
- See FAA Advisory Circular AC 150/5340-26, *Maintenance of Airport Visual Aids Facilities*, for additional instructions on safety precautions.
- Observe all safety regulations. To avoid injuries, always remove power prior to making any wire connections and touching any live part. Refer to the International Standards IEC 61820 and IEC 61821.
- In addition for a parallel power supply also take into account the International Standard IEC 60598 (for class I equipment).
- Read and become familiar with the general safety instructions provided in this chapter before you install, operate, maintain or repair the equipment.
- Read and carefully follow the instructions given throughout this manual before installing, operating, maintaining, or repairing the equipment.
- Store this manual within easy reach of personnel installing, operating, maintaining or repairing the equipment.
- Follow all applicable safety procedures required by your company, industry standards, and government or other regulatory agencies.
- Obtain and read Material Safety Data Sheets (MSDS) for all materials used.

2.2 Safety symbols

Become familiar with the safety symbols presented in this chapter. These symbols will alert you to safety hazards and conditions that may result in personal injury, death, or property and equipment damage.

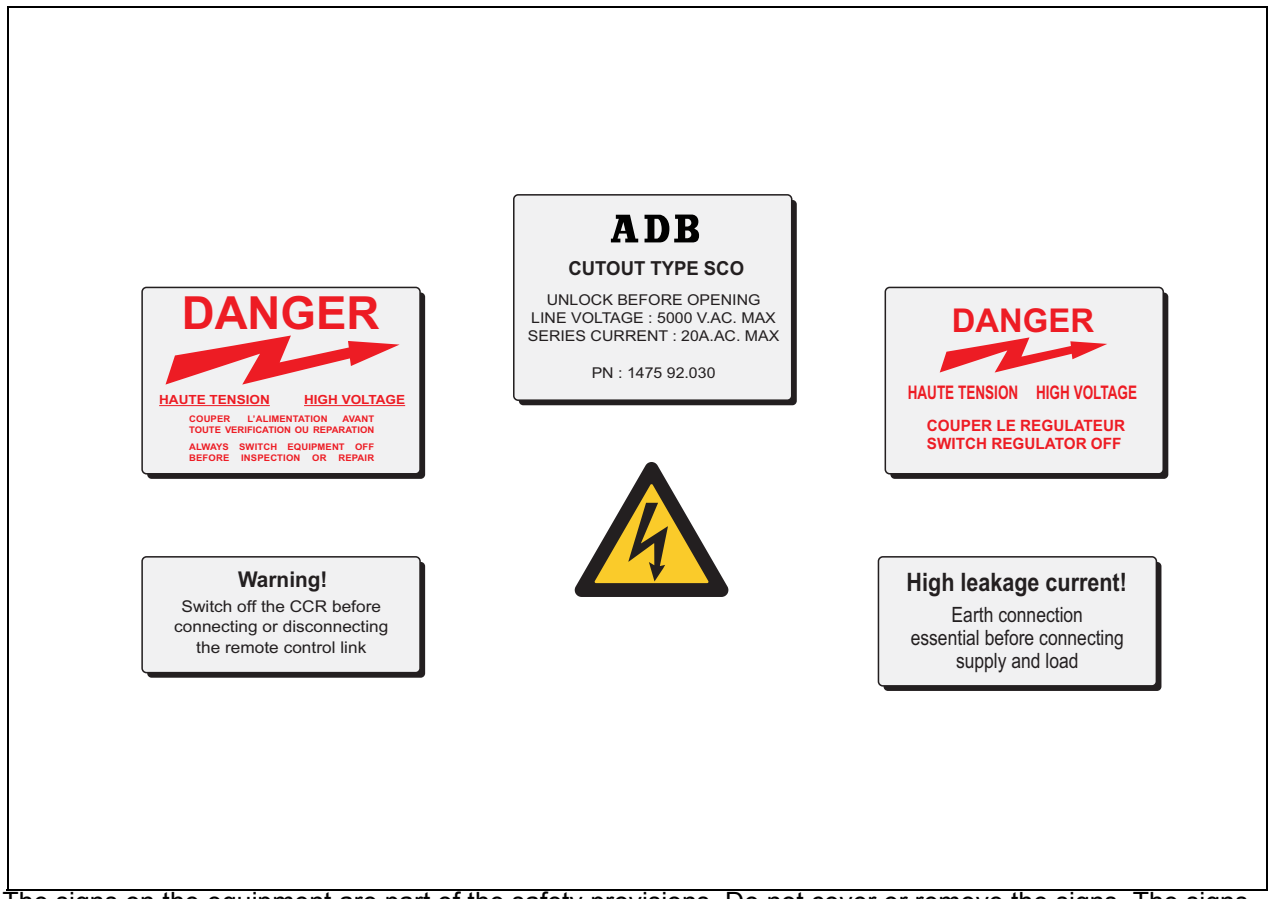
WARNING 1: Failure to observe this warning may result in personal injury, death, or equipment damage.

WARNING 2: Risk of electrical shock. Disconnect equipment from line voltage. Failure to observe this warning may result in personal injury, death, or equipment damages.

WARNING 3: Wear personal protective equipment. Failure to observe may result in serious injury.

WARNING 4: Do not touch. Failure to observe this warning may result in personal injury, death, or equipment damage.

2.3 Signs on the equipment



The signs on the equipment are part of the safety provisions. Do not cover or remove the signs. The signs must be present and legible during the entire life of the equipment.

2.4 Skilled personnel

The term skilled personnel is defined here as individual who thoroughly understand the equipment and its safe operation, maintenance, and repair. Skilled personnel are physically capable of performing the required tasks, familiar with all relevant safety rules and regulations and have been trained to safely install, operate, maintain, and repair the equipment. It is the responsibility of the company operating the equipment to see that its personnel meet these requirements.

2.5 Liability

WARNING
Use of the equipment in ways other than described in the catalogue leaflet and the manual may result in personal injury, death, or property and equipment damage. Use this equipment only as described in the manual.

ADB Safegate cannot be held responsible for injuries or damages resulting from non-standard, unintended uses of its equipment. The equipment is designed and intended only for the purpose described in the manual. Uses not described in the manual are considered unintended uses and may result in serious personal injury, death or property damage.

Unintended uses includes the following actions:
- Making changes to equipment that have not been recommended or described in this manual or using parts that are not genuine ADB Safegate replacement parts or accessories.
- Failing to make sure that auxiliary equipment complies with approval agency requirements, local codes, and all applicable safety standards if not in contradiction with the general rules.
- Using materials or auxiliary equipment that are inappropriate or incompatible with your ADB Safegate equipment.
- Allowing unskilled personnel to perform any task on or with the equipment.

2.6 Installation

Read the installation section of all system component manuals before installing your equipment. A thorough understanding of system components and their requirements will help you install the equipment safely and efficiently.

WARNING
Failure to follow these safety procedures can result in personal injury or death.

- Allow only skilled personnel to install ADB Safegate and auxiliary equipment. Use only approved equipment. Using unapproved equipment in an approved system may void agency approvals and will void the warranty.
- Make sure all equipment is rated and approved for the environment in which you are using it.
- Follow all instructions for installing components and accessories.
- Install all electrical connections to local code provided they are not in contradiction with the general rules.
- Use only electrical wire of sufficient gauge and insulation to handle the rated current and voltage demand. All wiring must meet local codes.
- Route electrical wiring along a protected path. Make sure they will not be damaged by moving equipment and animals (e.g. rodents).
- Protect components from damage, wear, and harsh environment conditions.
- Allow ample room for maintenance, panel accessibility (power products), and cover removal (power products).
- Protect equipment with safety devices as specified by applicable safety regulations.
- If safety devices must be removed for installation, install them immediately after the work is completed and check them for proper functioning.

2.7 Operation

Only skilled personnel, physically capable of operating the equipment and with no impairments in their judgment or reaction times, should operate this equipment.

Read all system component manuals before operating the equipment. A thorough understanding of system components and their operation will help you operate the equipment safely and efficiently.
- Before starting this equipment, check all safety interlocks and protective devices such as panels and covers. Make sure all devices are fully functional. Do not operate the equipment if these devices are not working properly. Do not deactivate or bypass automatic safety interlocks or locked-out electrical disconnects or pneumatic valves.
- Never operate equipment with a known malfunction.
- Do not attempt to operate or service electrical equipment if standing water is present.
- Use the equipment only in the environments for which it is rated. Do not operate the equipment in humid, flammable, or explosive environments unless it has been rated for safe operation in these environments.
- Never touch exposed electrical connections on equipment while the power is ON. Make sure the exposed electrical connections are proven to be dead.

2.8 Action in the event of an equipment malfunction

Do not operate a system that contains malfunctioning components. If a component malfunctions, turn the system OFF immediately.

1. Disconnect and lock out electrical power.
2. Allow only skilled personnel to make repairs. Repair or replace the malfunctioning component according to instructions provided in its manual.

2.9 Maintenance and repair

Allow only skilled personnel to perform maintenance, troubleshooting, and repair tasks. Only persons who are properly trained and familiar with ADB Safegate equipment are permitted to service the equipment.

- Always use safety devices when working on the equipment.
- Follow the recommended maintenance procedures in your equipment manuals.
- Do not service or adjust any equipment unless another person trained in first aid and Cardio Pulmonary Resuscitation (CPR) is present.
- Connect all disconnected equipment ground cables and wires after servicing equipment. Ground all conductive equipment.
- Use only approved ADB Safegate replacement parts. Using unapproved parts or making unapproved modifications to equipment may void agency approvals, impair specified performance and create safety hazards.
- Check interlock systems periodically to ensure their effectiveness.
- Do not attempt to service electrical equipment if standing water is present. Use caution when servicing electrical equipment in a high-humidity environment.
- Use tools with insulated handles when working with electrical equipment.

2.10 CE certification

The equipment is CE certified. It means that the product complies with the essential requirements concerning health and safety. The directives that have been taken into consideration in the design are available on written request to ADB Safegate.

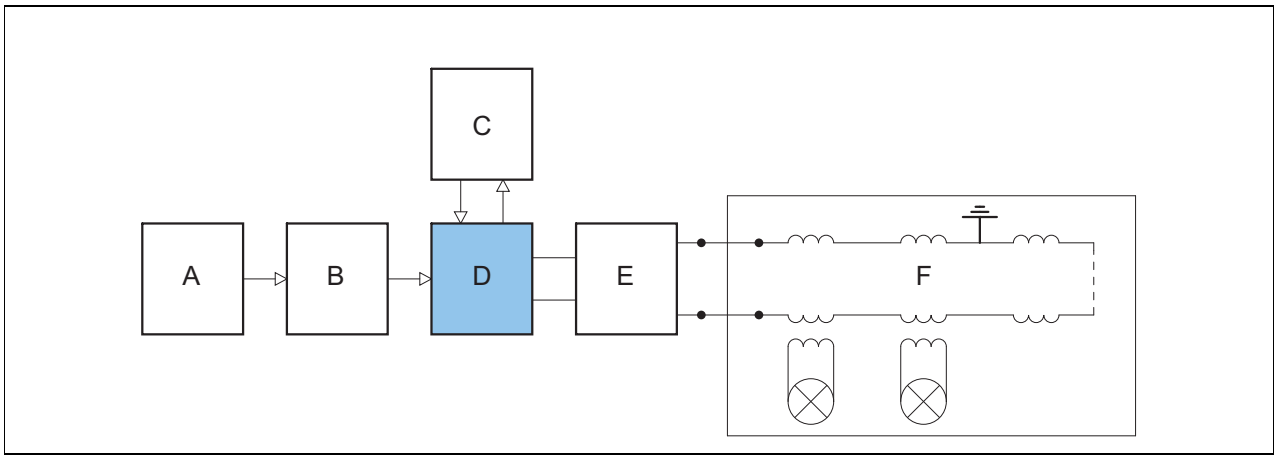
2.11 Guarantee

ADB Safegate guarantees that the performance of the equipment described in this manual, when sold by ADB or its licensed representatives, meets the corresponding requirements of FAA, ICAO and IEC.

Refer to the document ‘General Conditions for Deliveries and Services by ADB Safegate.

3 Description

3.1 Series circuit system overview



A Input power supply
B Manual switch
C Remote control system
D Equipment
E Output disconnection device
F Series circuit

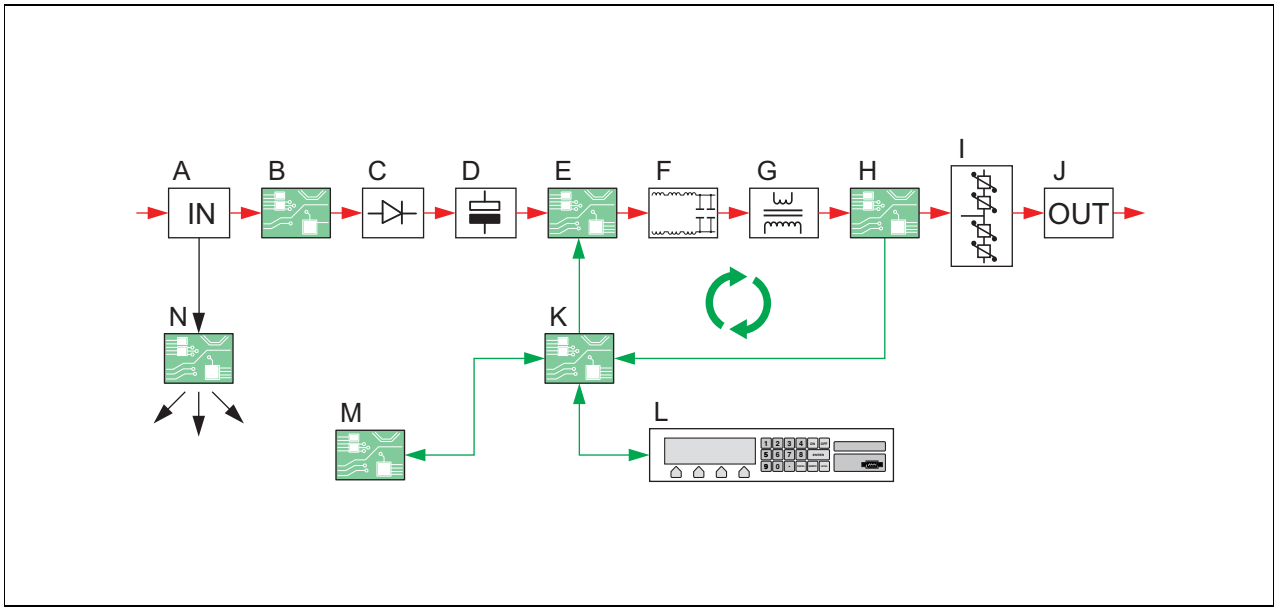
The equipment is a microprocessor-controlled constant current regulator.

3.2 Intended use

The equipment is designed to convert an AC sine wave input voltage into an adjusted output current selected in brightness steps to supply a series AGL circuit.
Any other or additional use will be considered not to be in conformity with the purpose.

Do not operate the equipment outside the limits of the specifications or outside the specified ambient conditions.

3.3 Working principle



A Line input. See § 3.5.1
B Precharge PCB. See § 3.5.1.
C Diode bridge and sensing PCB. See § 3.5.2.
D Capacitor bank. See § 3.5.3
E IGBT module and IGBT PCB. See § 3.5.2.
F Output filter. See § 3.5.5.
G Main transformer. See § 3.5.6
H Output measure PCB. See § 3.5.7
I Lightning arrestors. See § 3.5.8
J Series output connection. See § 3.5.8
K CPU PCB. See § 3.5.9
L HMI. See § 3.7
M Remote control PCB. See § 3.5.10
N Power supply PCB. See § 3.5.11

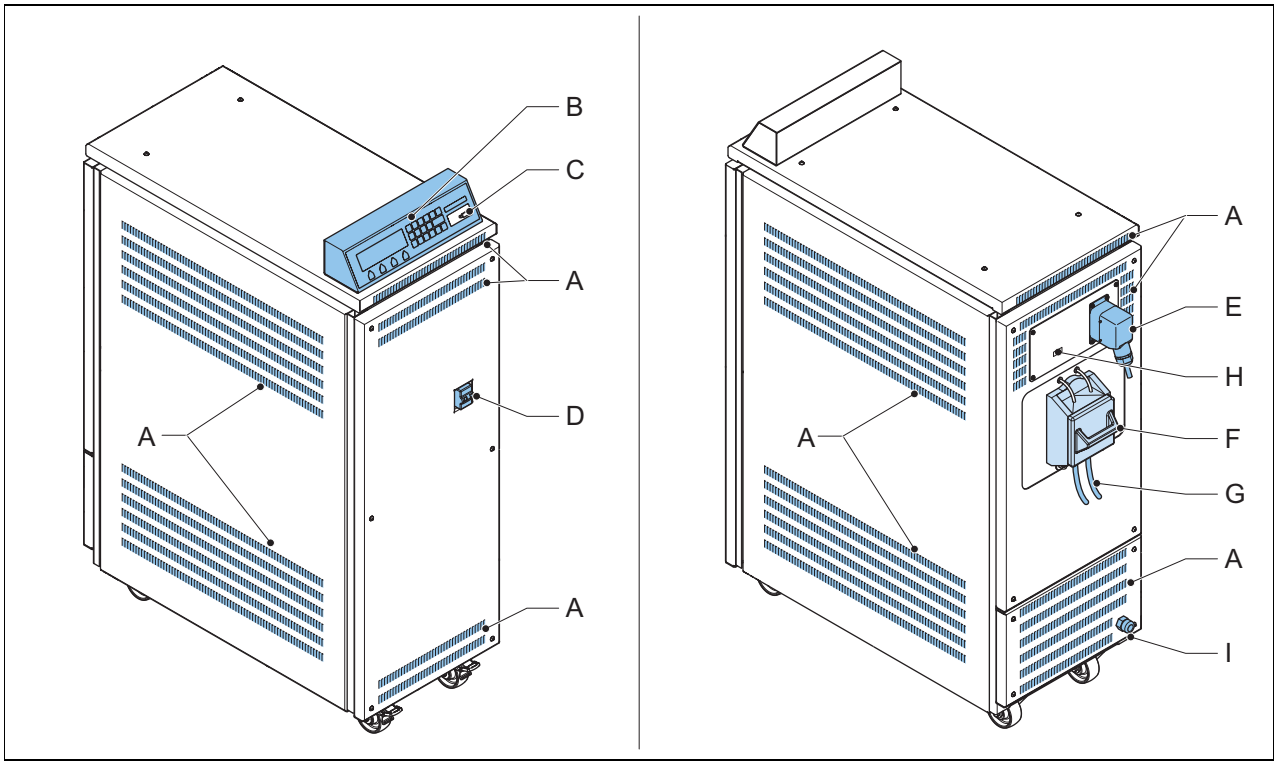
Legend
- Red lines: current
- Green lines: signal wires connections
- Black lines: low voltage connections

Current regulation
The equipment converts the three phase input voltage line into a DC current and voltage. Then, the equipment converts this DC current and voltage into a pure sine wave with a defined power rating.

Main feedback loop
The output measure PCB sends the measured output to the micro control PCB. Depending on the output, the micro control PCB automatically generates signals to adjust the regulation.

3.4 Lay-out of the equipment cabinets

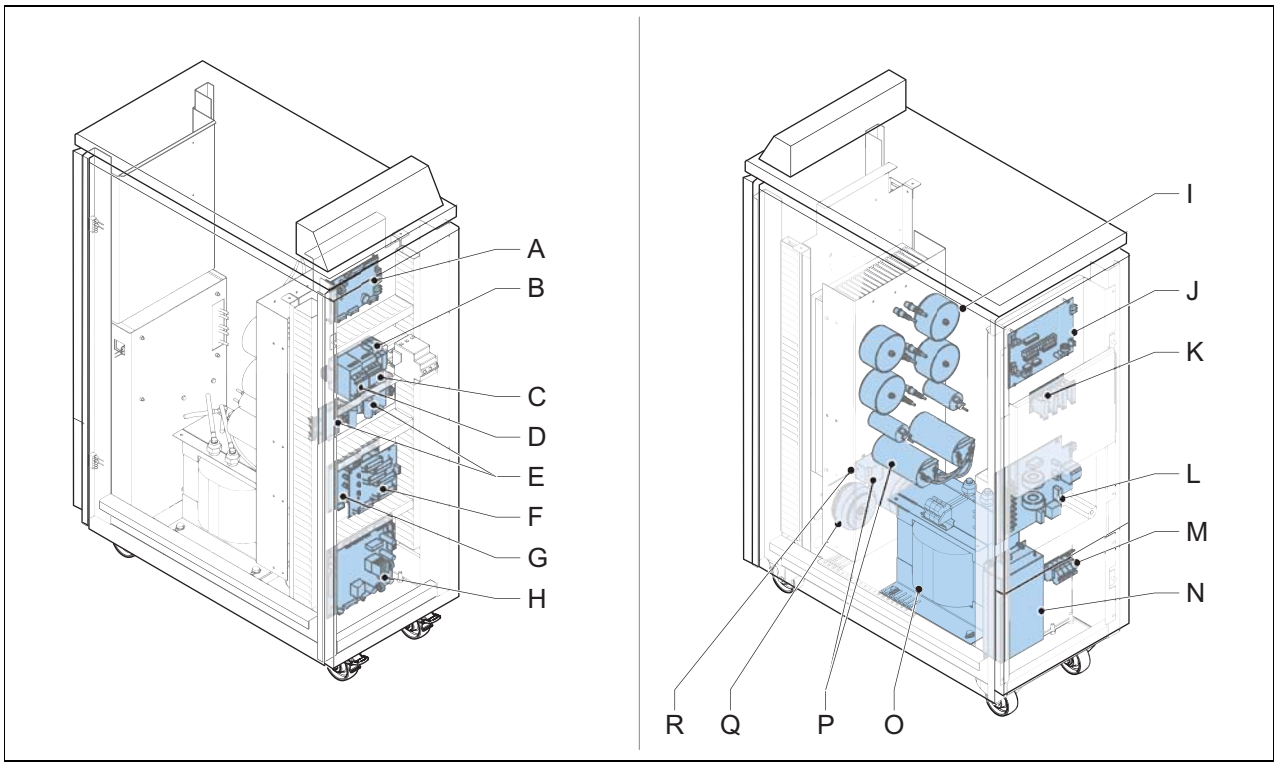
3.4.1 Outside - small cabinet: 2.5 to 15 kVA



A Ventilation grids
B HMI
C Serial communication port
D Manual switch
E Remote control connector
F Series output connection. The illustration shows the SCO.
G Output to Series Circuit
H Ethernet connector
I Power supply cable entry

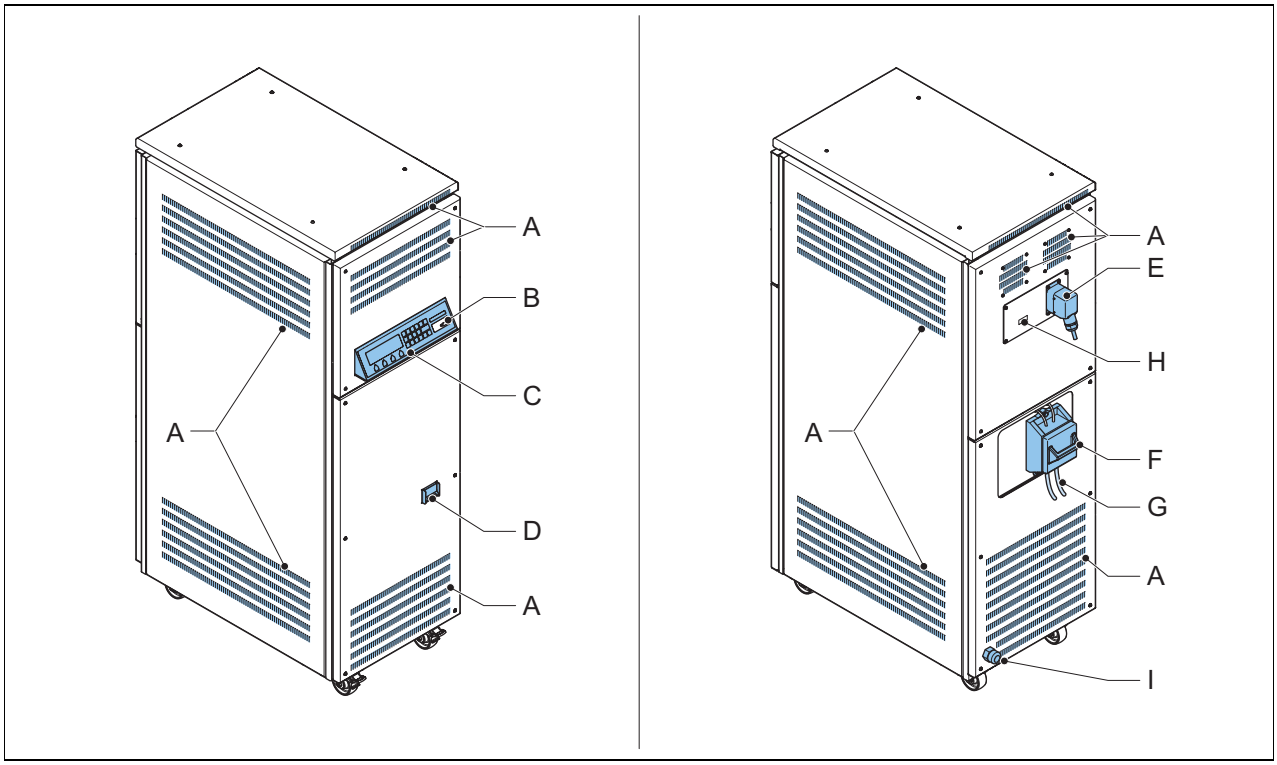
3.4.2 Inside - small cabinet: 2.5 to 15 kVA

Note
The illustrations shows the 5 kVA cabinet.



A CPU PCB (EPS479)
B Main fuses
C Main contactor
D Precharge contactor
E IGBT module and IGBT PCB (EPS477)
F Precharge PCB
G Diode bridge and sensing PCB (EPS 540 / EPS541)
H Power supply PCB (EPS480)
I Output filter
J Remote control PCB (EPS495)
K Lightning arrestors
L Output measure PCB (EPS422)
M Input terminals
N Line filter
O Main transformer
P Capacitor Bank
Q Power supply transformer
R Sensing transformer

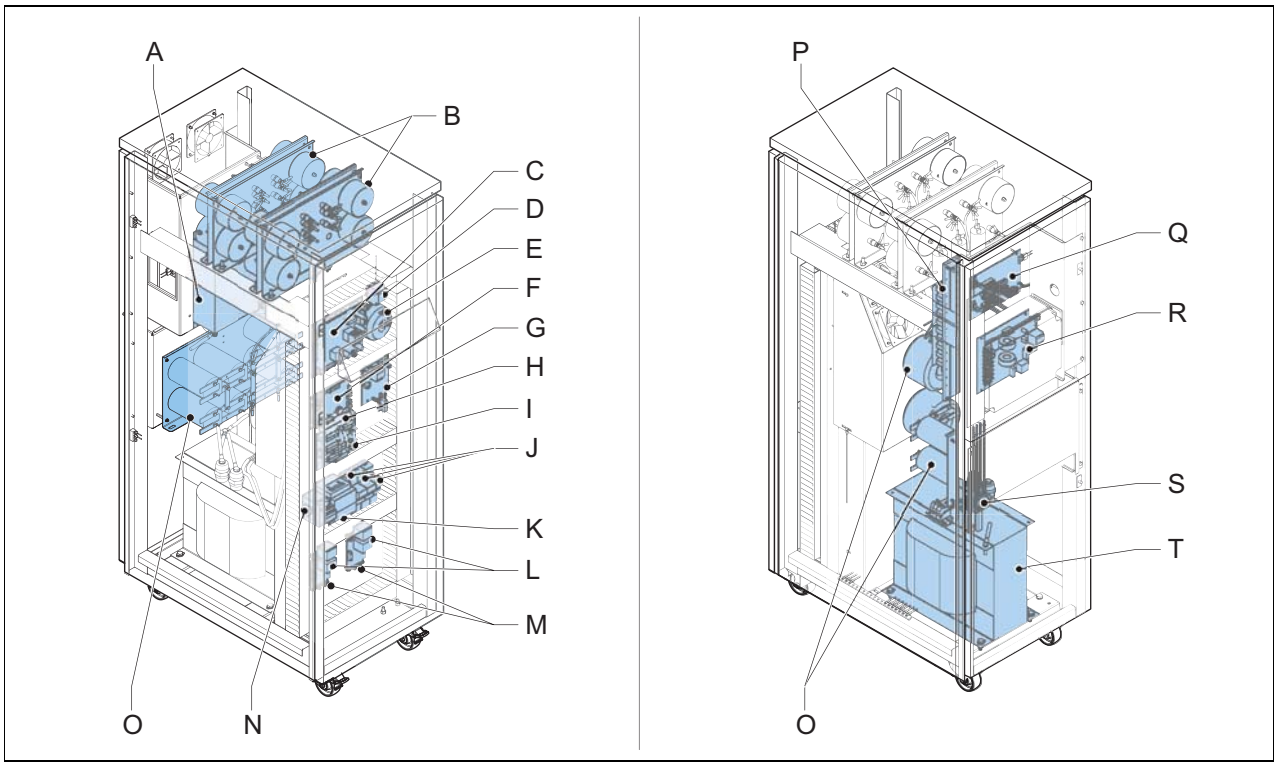
3.4.3 Outside - big cabinet 20 to 30 kVA



A Ventilation grids
B HMI
C Serial communication port
D Manual switch
E Remote control connector
F Series output connection. The illustration shows the SCO.
G Output to Series Circuit
H Ethernet connector
I Power supply cable entry

3.4.4 Inside - big cabinet 20 to 30 kVa

Note
The illustrations shows the 20 kVA cabinet.



A Line filter
B Output filter
C Power supply PCB (EPS480)
D Sensing transformer
E Power supply transformer
F CPU PCB (EPS479)
G Sensing PCB (EPS497)
H Diode bridge
I Precharge PCB (PCB456)
J Main fuses
K Main contactor
L IGBT module
M IGBT PCB (EPS496 / EPS478)
N Precharge contactor
O Capacitor bank
P Lightning arrestors
Q Remote control PCB (EPS495)
R Output measure PCB (EPS422)
S Input terminals
T Main transformer

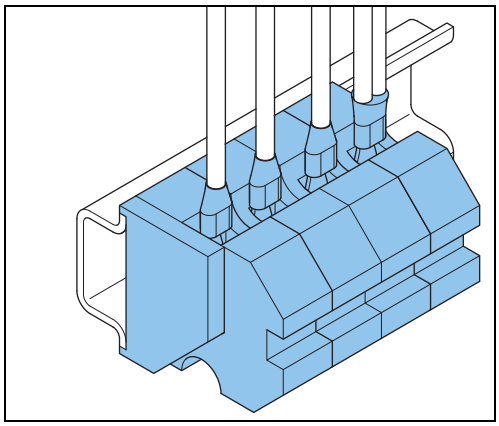
3.5 Components

For the exact location and connectors see § 3.4 and the electrical scheme. You can find the electrical scheme in the document holder inside the equipment.

3.5.1 Line input

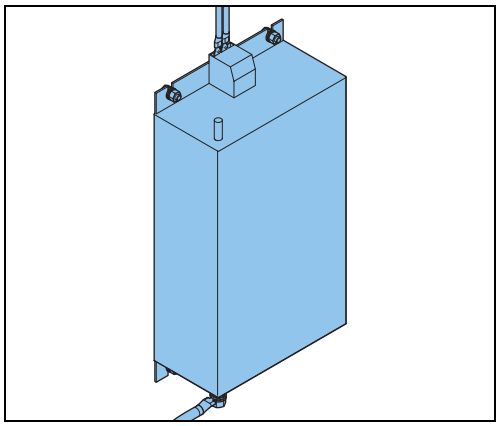
Input terminal, all cabinets

The input terminal connects the power input cables to the equipment.



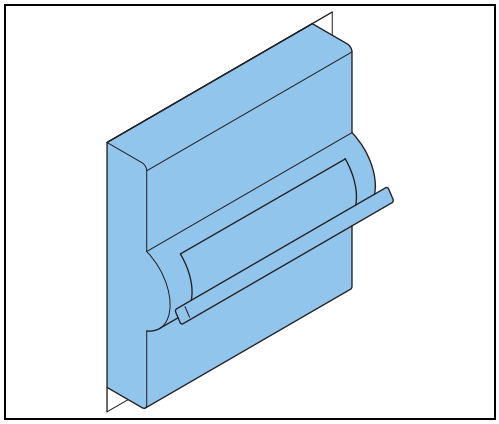
Line filter, all cabinets

The line filter blocks the noise the equipment generates to the line input and filters out voltage pulses from the input voltage.



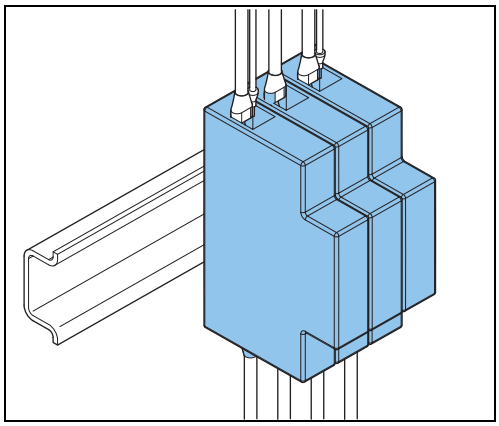
Manual switch, all cabinets

The manual switch is a magneto-thermal switch that connects the mains power supply to the equipment. You can manually set the switch to the ON or OFF position.



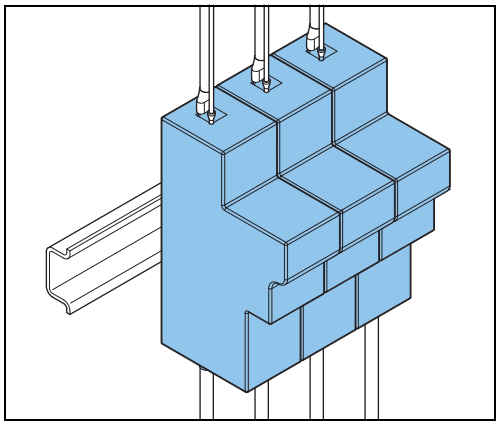
Main fuses, small cabinet

The main fuses disconnect the equipment from the mains power supply if the input current is above a given value.



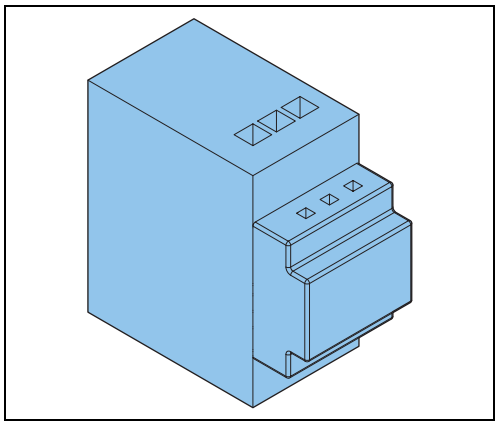
Main fuses, big cabinet

The main fuses disconnect the equipment from the mains power supply if the input current is above a given value.



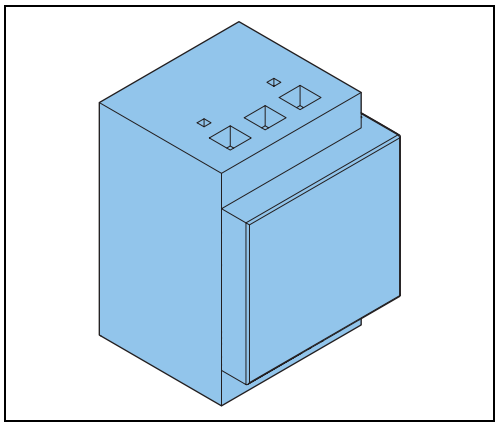
Main contactor, small cabinet

The main contactor allows the power supply PCB to automatically interrupt the power.



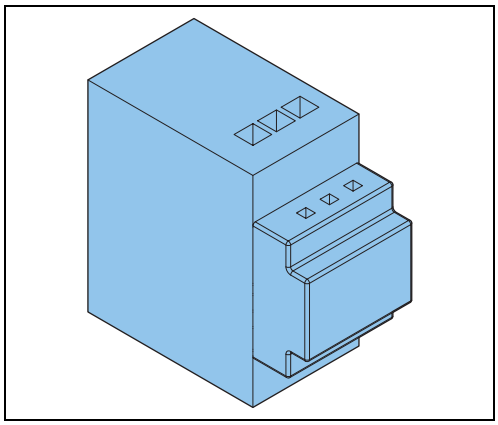
Main contactor, big cabinet

The main contactor allows the power supply PCB to automatically interrupt the power.



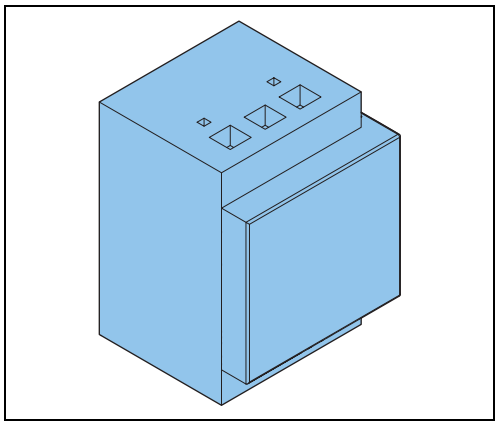
Precharge contactor, small cabinet

The precharge contactor allows a smooth charge of the capacitors on the capacitor bank.



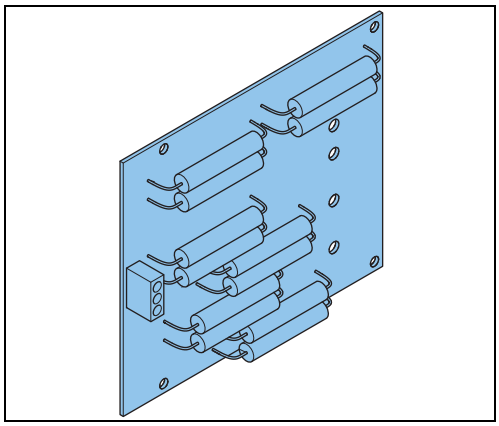
Precharge contactor, big cabinet

The precharge contactor allows a smooth charge of the capacitors on the capacitor bank.



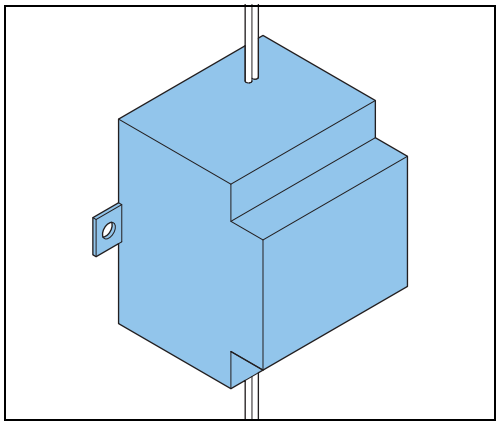
Precharge PCB (EPS456), all cabinets

The resistors on the precharge PCB limit the current for the precharge of the capacitor bank.



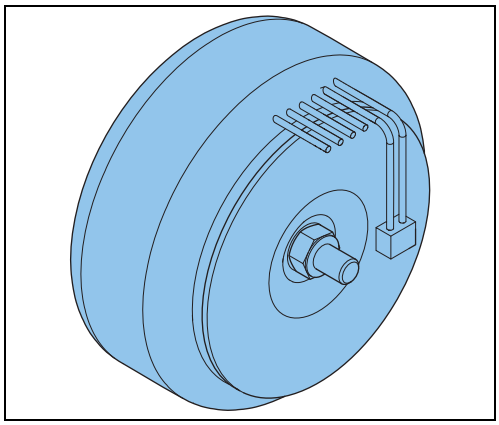
Sensing transformer, all cabinets

The sensing transformer measures the difference in the input voltage level between phases L1 and L2.



Power supply transformer, all cabinets

The power supply transformer
- Measures the input voltage level between phases L2 and L3.
- Provides the correct current and voltage to power all the electronic components such as PCBs and to power the fans (for 15 to 30kVA equipment)

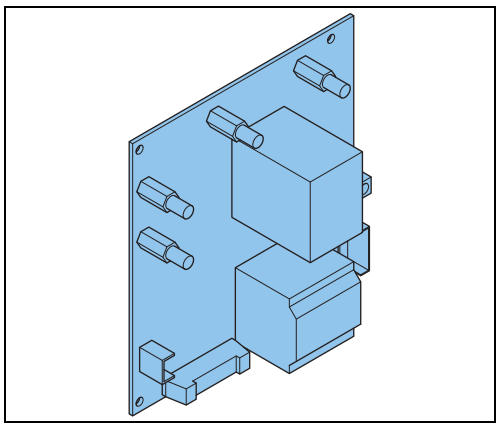


3.5.2 IGBT power bridge

Diode bridge + sensing PCB (EPS540 / EPS541), small cabinet

The diode bridge converts the AC line input to a rectified current and voltage.
The sensing PCB measures the AC input line.

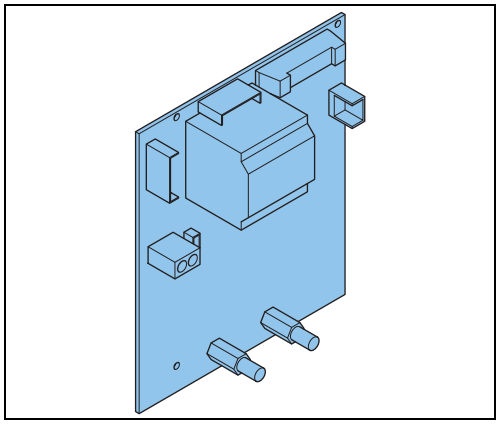
Note
In the small cabinet, the sensing PCB and the diode bridge are combined into one part.



Sensing PCB (EPS497), big cabinet

The sensing PCB measures the AC input line and controls the diode bridge.

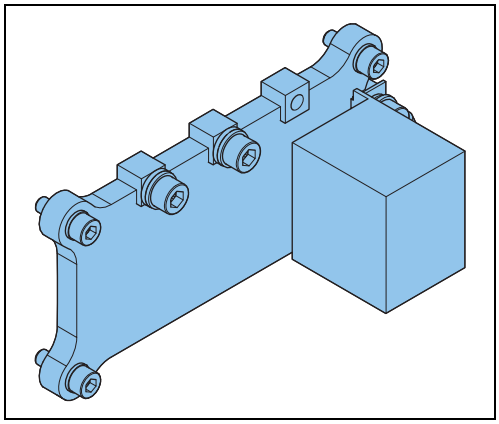
Note
In the big cabinet, the sensing PCB and the diode bridge are separate parts.



Diode bridge, big cabinet

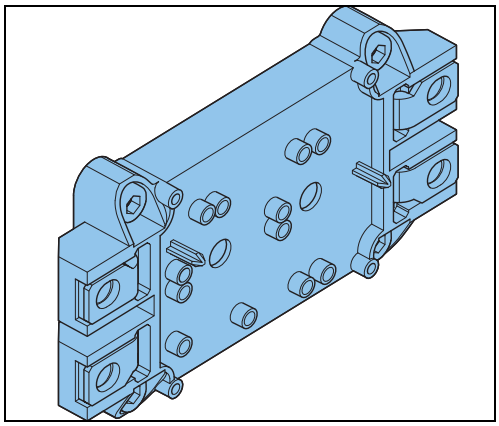
The diode bridge converts the AC line input to a rectified current and voltage.

Note
In the big cabinet, the sensing PCB and the diode bridge are separate parts.



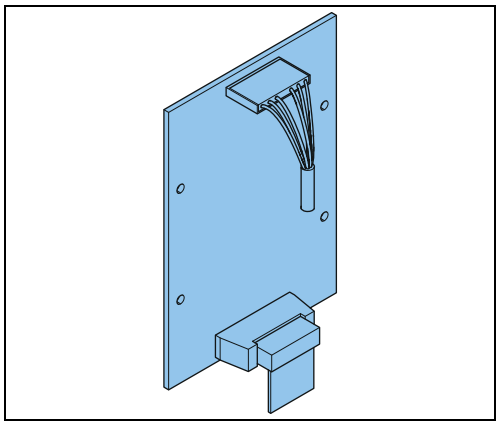
IGBT, all cabinets

An IGBT controls a high power via a low power electronic signal.
The IGBT can switch at high frequency.
Two IGBTs are installed together in one housing.
The system uses four IGBTs connected as an H-bridge to make an AC-signal.



IGBT PCB (EPS477 / EPS496 / EPS 478), all cabinets

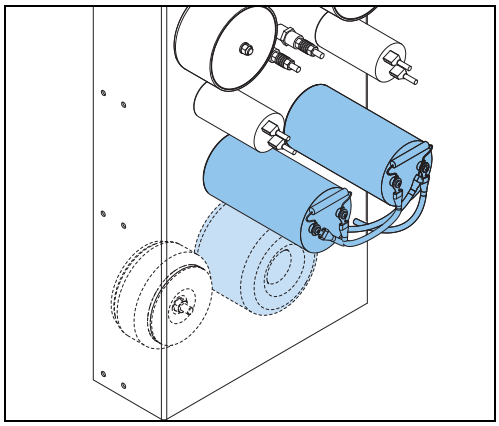
The IGBT PCB measures the output signal from the IGBT H-bridge.



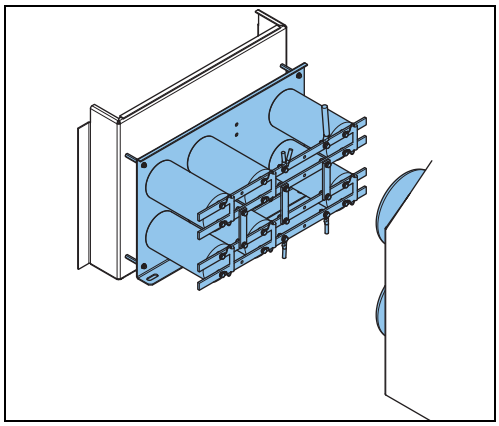
3.5.3 Capacitor bank

The capacitor bank smoothens the DC current and voltage to make a constant DC current and voltage.

Capacitor bank, small cabinet

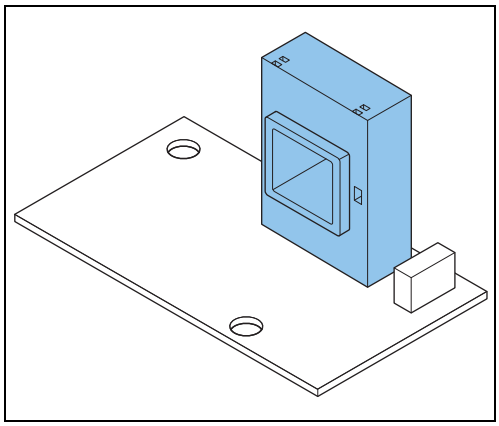


Capacitor bank, big cabinet



3.5.4 Hall sensor, big cabinet

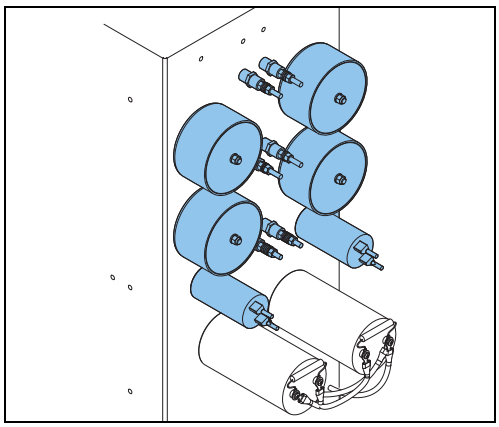
The Hall sensor measures the current between the IGBT and the output filter.



3.5.5 Output filter

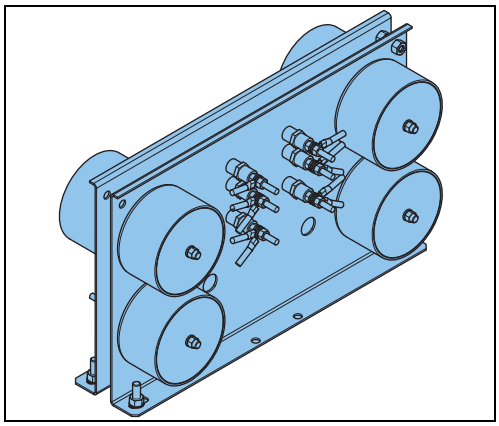
Output filter, small cabinet

The output filter is a Pulse Width Modulation (PWM) filter that builds the pure sine wave signal that comes from the H-bridge.



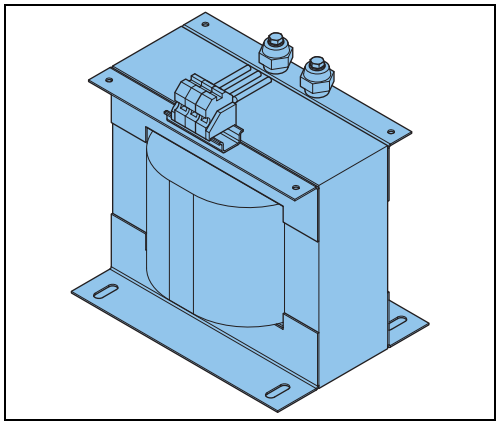
Output filter, big cabinet

The output filter is a Pulse Width Modulation (PWM) filter that builds the pure sine wave signal that comes from the H-bridge.



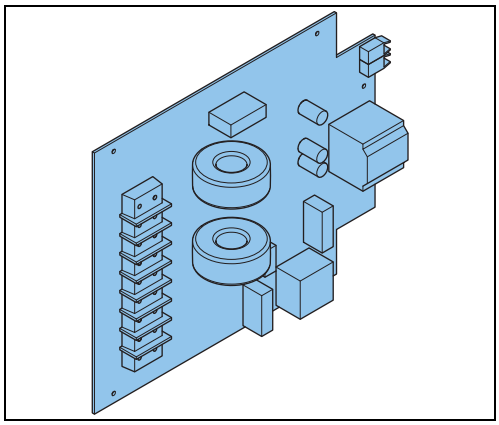
3.5.6 Main transformer, all cabinets

The main transformer converts the pure sine wave to the correct output voltage and current.



3.5.7 Output measure PCB (EPS422), all cabinets

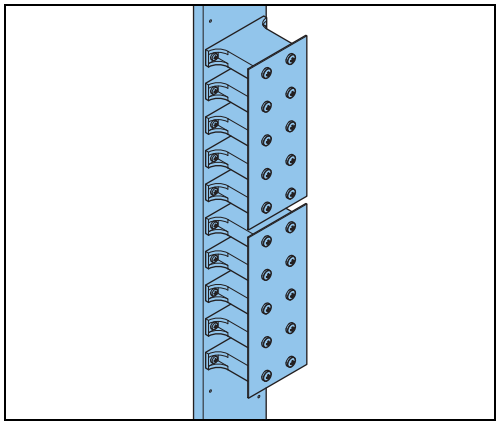
The output measure PCB measures the output voltage and current and sends these measurements to the CPU PCB.
The EFD (See § 3.5.13) and LFD (See § 3.5.12) logic is also located on the output measure PCB.



3.5.8 Power output

Lightning arrestors, all cabinets

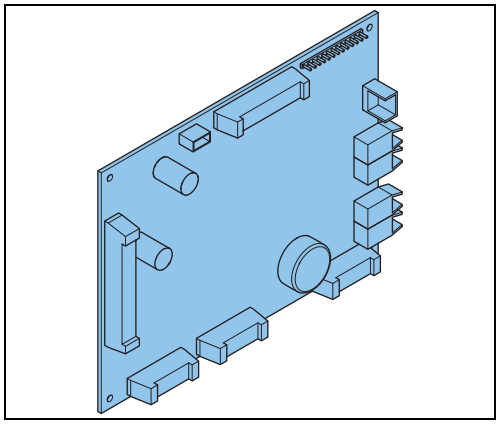
The lightning arrestors are installed on the power output. The lightning arrestors are varistors.
A varistor is a surge protection device that is connected directly across the AC output.



Connection to the series circuit
There are mutual exclusive options possible. See §3.6.

3.5.9 CPU PCB (EPS479), all cabinets

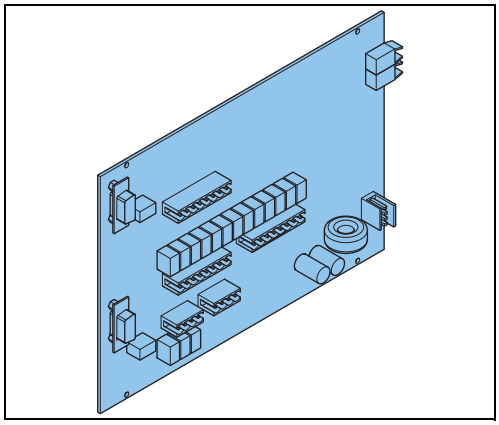
The CPU PCB
- Receives the measurement data of the output current and voltage from the output measure PCB via an optical fibre and compares these values with the required values. A software algorithm processes this data to adjust the signals from the output filters.
- Receives and processes input signals from the HMI and the remote control PCB.



3.5.10 Remote control PCB (EPS495), all cabinets

The equipment can be monitored or controlled remotely with J-Bus (2-wire RS485), multiwire or ethernet (option). This remote control allows the remote control system to:
- Receive information about the equipment.
- Configure the brightness steps.
- Test the equipment.

The remote control PCB connects the equipment to the remote control system. The internal connection between the remote control PCB and the CPU PCB goes through an optical fibre.

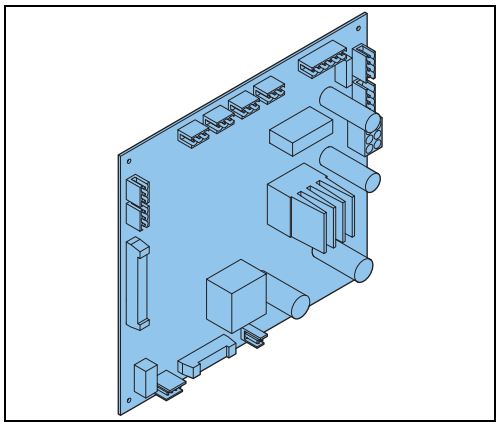


Note
For remote control through an ethernet connection, an additional ethernet PCB is required. See § 3.6.2.

3.5.11 Power supply PCB (EPS480), all cabinets

The power supply PCB provides the power supply for:
- All electronic components such as PCBs of the equipment.
- The fans (for 15 to 30 kVA equipments).
- The control for the main contactor.

The power supply PCB also manages the safety switches on the panels.



3.5.12 Lamp Fault Detection (LFD)

The equipment analyses the output current and the voltage pattern to calculate, on a linear load, the number of open circuited lamps, in compliance with IEC 61822.

The accuracy is ± 1 lamp with a range from 1 to 15 broken lamps.

The HMI shows the actual LFD value.

3.5.13 Earth Fault Detection (EFD)

The EFD measures the insulation resistance between the series circuit and the earth in compliance with IEC 61822.

The EFD module works when the equipment is connected to the mains supply, even if no output current is present.

You can set two alarm levels, Level 1 and Level 2, for the measured values. Both alarm levels can be set to any value between 5 kOhm and 500 MOhm. However, Level 1 must always be higher than Level 2.

Working principle: A high-voltage resistor applies a stable, current-limited voltage of 450 VDC between the series circuit and the earth or cable screen.

The HMI shows the actual EFD value.

3.5.14 Ventilation

The equipment has air ventilation grids for air inlet and air outlet. The air circulation cools the equipment. For 15 to 30 kVA equipments, additional fans cool the equipment.

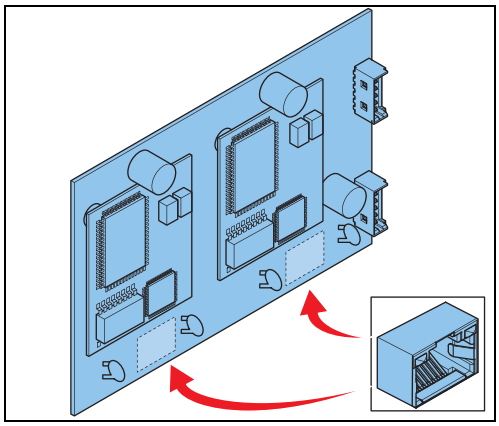
3.6 Options

3.6.1 Remote control

These remote control connections are possible:
- Ethernet (Ethernet PCB required)
  - Single
  - Double
- J-Bus
  - Single
  - Double
- Multiwire with 8 input signals and 17 output signals, always possible to monitor via single J-Bus

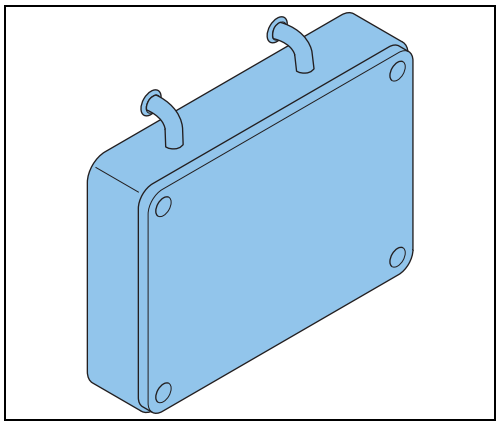
3.6.2 Ethernet PCB (EPS542), all cabinets

The ethernet PCB converts the ethernet to an RS-485 signal. This PCB is required if you need to remotely operate the equipment through an ethernet connection.
The illustration shows a double ethernet connection.



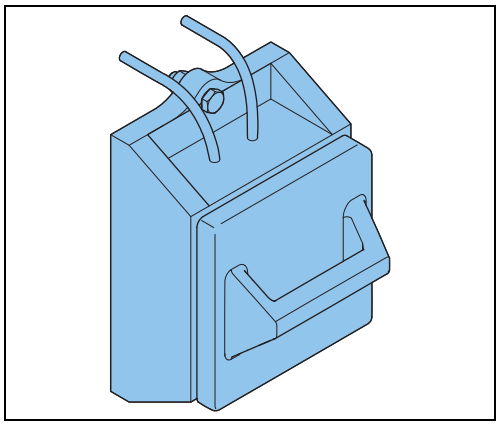
3.6.3 Series Connector Box (SCB), all cabinets

The SCB connects the equipment to the series circuit with two medium voltage cables of the primary circuit. The SCB does not allow the short circuit connection.



3.6.4 Series CutOut (SCO), all cabinets

The SCO acts as an output disconnection device between the equipment and the series circuit. The SCO also isolates the series circuit from the equipment during maintenance or testing operations. The cover is locked with a key to prevent unauthorized access.

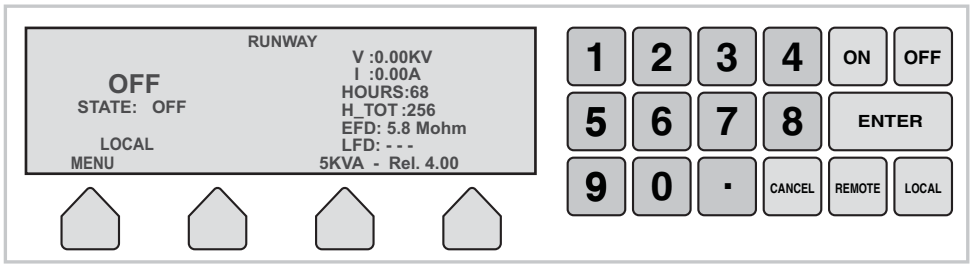


3.6.5 Rolling castors

The equipment can be supplied with two fixed and two pivoting rolling castors to facilitate the movement of the equipment.

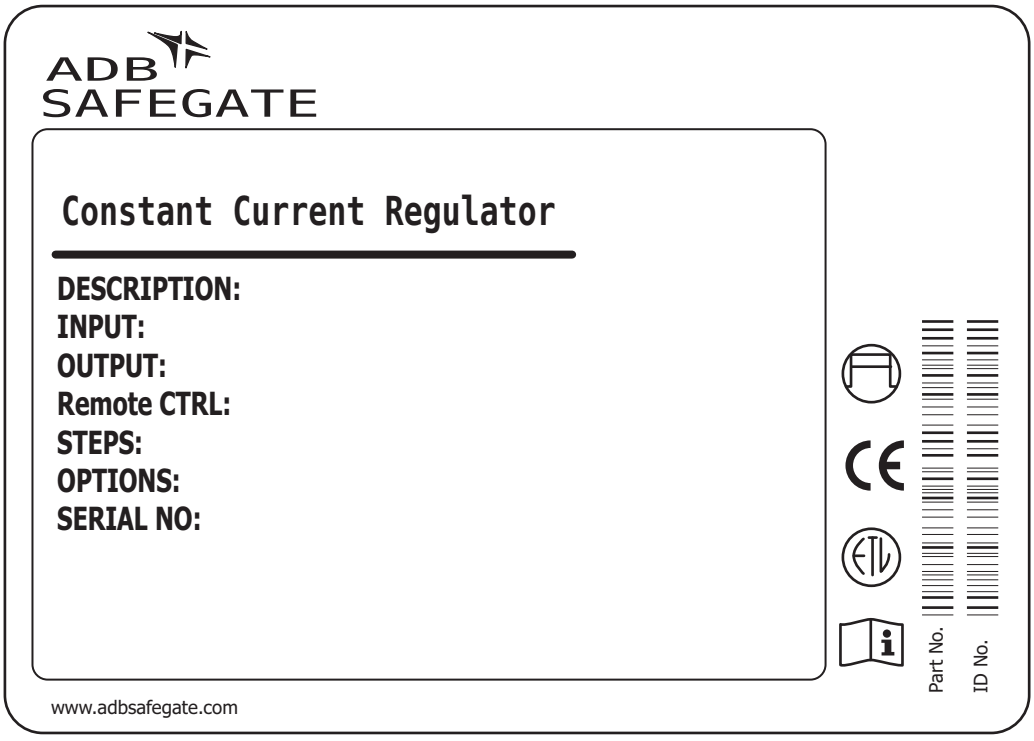
3.7 HMI

You can operate the equipment with the HMI.



3.8 Nameplate

Each equipment has a standard nameplate:



4 Inspection and transport

4.1 Inspect equipment on delivery

Each equipment comes in a crate.
1. Check if the crate is not damaged.
2. If the crate is damaged, tell the carrier immediately.
3. Unpack the crates. See § 4.3.
4. Check if the equipment corresponds to your order.
5. Check the equipment for damage.
6. If the equipment is damaged or does not correspond to your order, tell the carrier immediately.

4.2 How to transport the crate

CAUTION

- **The maximum weight of the equipment is approximately 500 kg.**
- **Keep the crate in a vertical position at all times.**
- **Do not let the crate tilt or fall.**
- **The centre of gravity of the crate is not the same as the physical centre of the crate.**

4.3 Unpack at installation area

1. Make sure that the crate is at the installation area.
2. Remove the cover and side panels of the crate.

4.4 Transport the unpacked equipment

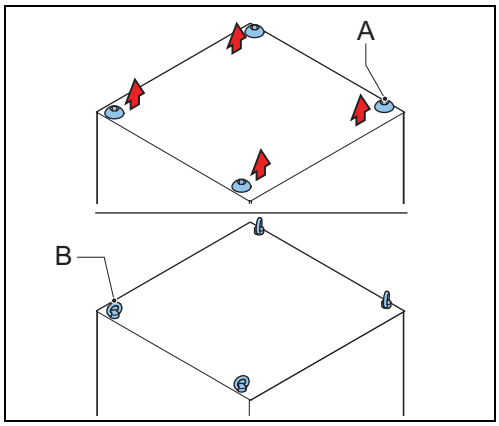
4.4.1 Transport the equipment with lifting lugs

You can lift all equipment configurations when you take into account these rules:
- Always use lifting lugs (option) and adequate hoisting cables to lift the load. If required, remove the side panels from the equipment before you lift it.
- Do not let the load swing without control.
- The top panel (roof) of the equipment must be installed.
- Use the correct type of eye bolt. Suppliers of eye bolts provide data on configurations and maximum allowed load for different types of eye bolts. Use a rotation eye bolt to cover all applications with the same eye bolt type.

Note
Contact ADB Safegate for the correct eye bolt type.

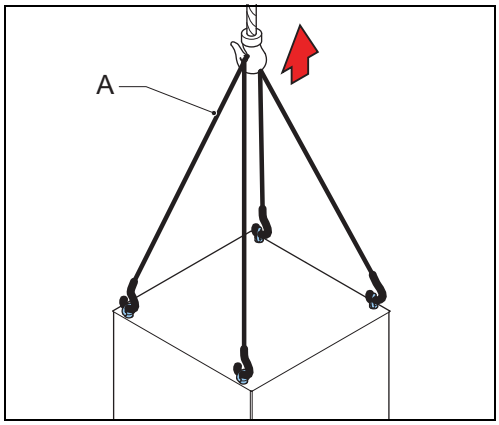
Prepare

1. Remove the bolts (A).
2. Install the lifting lugs (B).



Transport

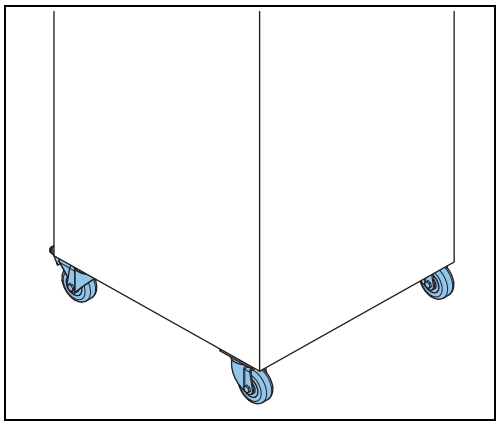
1. Secure a chain or a rope (A) to the lifting lugs.
2. Slightly lift the equiumipment. *The cables tighten.*
3. Carefully move the equipment to the applicable location.



4.4.2 Transport - small and big cabinet with wheels

1. Push the equipment to the applicable location.

WARNING
Make sure that the ground surface is flat and horizontal.



5 Pre-installation

5.1 How to pre-install - general procedure

1. Prepare the substation for the equipments. See § 5.2.
2. Prepare the lightning protection. See § 5.3.
3. Plan a power supply for each equipment. See § 5.4.
4. Plan the cables and the lay-out of the cables. See § 5.5.

5.2 Prepare substation

5.2.1 Procedure

WARNING
Make sure that the supply voltage of the equipment is in accordance with the local supply voltage.

1. Make sure that the substation complies with the general substation specifications. See § 5.2.2.
2. Make sure that sufficient heat dissipation is present. See § 5.2.3.
3. Make sure that sufficient ventilation is present. See § 5.2.4.
4. Make sure that the substation layout meets the minimum clearance specifications. See § 7.6.
5. Install an external fuse. See § 5.2.5.
6. Make sure that the circuit breakers are of the correct type. See § 5.2.6.
7. Install the separate disconnection devices. See § 5.2.7.

5.2.2 Substation specifications

- For details on the substation specifications below, see ICAO Aerodome Design Manual, Part 5 Electrical Systems, DOC 9157-AN/901.

Table: 5.1 Substation specifications

Item	Description
Vault lighting	Well illuminated for used day and night. Obey the local regulations.
Shelter	- Clean and dry; - Lockable; - Fireproof; - Separate construction with reinforced concrete floors and walls; - Adequate drainage above ground level; - Sufficient room and lighting for personnel to do maintenance work.
Location	- Reasonable distance from the control tower; - Leaves limitation surfaces free; - Vehicular access in all weather conditions; - Minimum interference with aircraft traffic.
Ventilation	Install forced ventilation.
Electrical connections	- Sufficient number of conduits and cable entrance accesses; - Sufficient power to supply all equipments; - Access to the required power supply, remote control and series circuit cabling; - Ground network; - External fuse and an electrical distribution cabinet; - Disconnection devices for the input and output current.

5.2.3 Provide heat dissipation

Table: 5.2 Indicative values for heat dissipation

Equipment [kVA]	Heat dissipation [W]
2.5	250
4	400
5	500
7.5	750
10	900
15	1200
20	1400
25	1750
30	1800

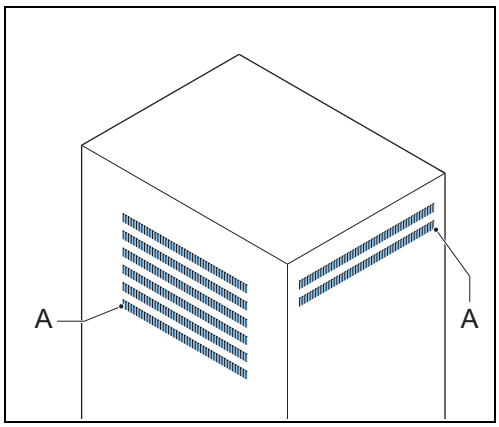
1. Make sure that the heat dissipation efficiency is better than 90% for an equipment less than 30kVA and at least 92% for a 30kVA equipment.

Note
The necessary heat dissipation also depends on the input voltage range and on the ambient conditions.

5.2.4 Ventilation

1. Make sure that you do not block the ventilation grids (A) of the equipment.

CAUTION
If there is not enough air-flow, the components of the equipment become too hot.



5.2.5 External fuse

1. Install the external fuse in the distribution panel with at least one rating higher than the manual switch (see § 7.7) for fuses type gG or aM.

5.2.6 Circuit breakers

1. If you use circuit breakers, make sure they are of the type D, or an equivalent type. *This means that the magnetic trip current must be from 10 up to 14 times higher than the nominal current.*
2. If you install more than one circuit breaker close to each other, make sure that you take into account the thermal derating to maintain the selectivity.

5.2.7 Disconnection devices

1. Install a separate disconnection device for the input and output power, according to these standards:
   - FAA: AC 150/5345-10F and L829;
   - IEC: IEC 61822.

5.3 Prepare lightning protection

1. Examine the need for additional lightning protection.
2. If you need additional lightning protection, contact ADB Safegate to supply lightning diverters in accordance with IEC 61822.

5.4 Install power supply

1. Install a power supply for each equipment.
2. Make sure the protection devices are correct. See also § 5.2.5, 5.2.6 and 5.2.7.

5.5 Plan cables and lay-out of cables

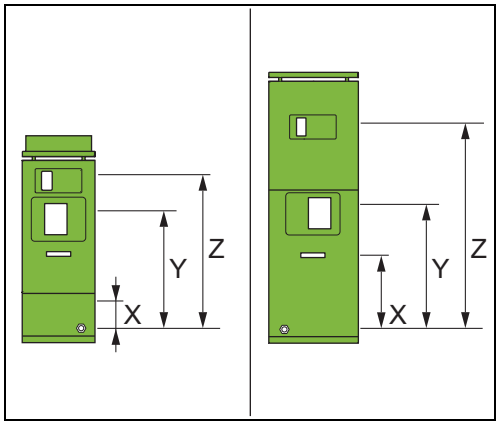
5.5.1 Procedure

1. Plan the routing of the cables so that the power cables and remote control cables are separated from each other.
2. Plan the cable slack. See § 5.5.2.
3. Plan the power supply cables and earthing cables. See § 5.5.3.
4. Plan the cables to the remote control interface (option). See § 5.5.4.
5. Plan the cables for the series circuit. See § 5.5.5.

5.5.2 Plan the cable slack, big and small cabinet

1. Plan the cable slack:

   Required cable slack from the bottom to the top of the cabinet:
   - X: maximum 1000 mm for the input power supply.
   - Y: maximum 1000 mm for the output power supply.
   - Z: maximum 1500 mm for the remote control cables.



5.5.3 Power supply cables and earthing cables

1. Make sure that you plan power supply and earthing cables that comply with table 3-B in IEC 6095-1 latest edition.

5.5.4 Cables to remote control interface

WARNING
Only earth the remote control cable at one end, preferably at the equipment side.

Multiwire cables (option)
1. Plan screened cables with the screen connected to the ground at only one end.
2. Plan the signal wires. See also the remote control scheme in § 7.8.3.
   - Plan one paired wire for the signal and the other wire of that pair as a return. Bundle all returns to the same terminal to minimize the voltage drop.
   - Do not combine the remote control and back-indication signals in one cable, except when these signals do not require more than low-level isolation. The latter is the case if the remote control and back-indication signals use one common energy source.

3. Calculate the wire sections. Take into account these items:
   - The tolerances of the power supply.
   - The maximum permitted voltage drop on the line. This is the minimum available power supply voltage minus the minimum required voltage for the load. The coils of the relays have a resistance of 1700 Ohm.
   - The typical resistance.
   - The required load current in each line.
   - The number of signals that may exist at the same time.

Table: 5.3 Recommended multiwire cables

Type	Number of conductors	Diameter [mm]
JE-LiYCY with armouring type R, B, Q or Z	number of signals + return(s)	0.5
TWAVB	number of signals + return(s)	0.8

Table: 5.4 Wire sections and cable lengths for multiwire cables

Diameter [mm]	Typical resistance at 55 °C [Ohm/m]	Power supply tolerance [%]	Maximum cable length 48 V DC [km]	Maximum cable length 24 V DC [km]
0.5	0.1	-5	3	0.65
		-10	1.7	-
0.8	0.04	-5	7.5	1.5
		-10	4	-

J-Bus cables (option)
1. For a Tx+/Tx- and Rx+/Rx- connection, plan a twisted-pairs cable.
2. Provide screened (armoured) data cable according to the selected protocol:
   - RS485 (2 wire communication).
   - One cable for a single J-bus, two cables for a dual J-Bus.

Table: 5.5 Wire sections for J-Bus cables

Cable type	Number of wires	Diameter [mm]
JE-LiYCY (with armouring type R, B, Q or Z)	2 or 3 pairs twisted	0.5
TWAVB	4 or 6 x 0.8mm (0 V wire)	0.8

Ideally, the maximum length of a J-Bus cable is 1200 m.

CAUTION
Do not mix J-bus A and J-bus B signals in one pair.

Ethernet cables (option)
1. Use an FTP CAT 5e patchcable to limit the electromagnetic interference. *You can use also a higher cable standard.*

5.5.5 Cables for series circuit

1. Make sure that the cables meet the specifications. See the table below.

Table: 5.6 Series circuit cable specifications

Type	Description
Conductor	Stranded, copper single-conductor with a 6 or 8.3 mm^2 cross-section.
Insulation	Cross-linked polyethylene, ethylene-propylene-rubber, or buna-rubber.
Jacket	Chlorosulfonated polyethylene, polyvinyl chloride, polyethylene, or heavy duty neoprene jacketed.
Shield type	Metal-tape shielding between the insulation and the jacket or between the jacket and a non-metallic covering.

6 Installation

WARNING
Always wear protective gloves and shoes when you do work on the equipment or the series circuit.

WARNING
Make sure that the power is OFF when you install the equipment.

6.1 Main installation procedure

1. Examine the pre-installation. See § 6.2.
2. Examine the required tools. See § 6.3.
3. Transport the cabinet to the correct location. See § 4.2.
4. Unpack the equipment. See § 4.3.
5. Examine the equipment. See § 4.1.
6. Remove the lower rear panel. See § 6.5.
7. Install the electrical connections:
   - Switch off the power supply. See § 6.6.
   - Install additional earthing. See § 6.7.
   - Connect the power input supply. See § 6.8.
   - Connect the output to the series circuit. See § 6.9.

8. Install the remote control connections. See § 6.10.
9. Install the panels. See § 6.11.

6.2 Check pre-installation

Table: 6.1 Pre-installation checklist

Checked	Item
	The substation meets the general requirements.
	The cables have been installed according to an applicable layout.
	All the cables have enough slack to connect to the equipment.
	All the cables meet the specifications.
	For each equipment there is a power supply cable available.
	For each equipment there is a remote control cable available.
	For each equipment there is a series circuit cable available.

6.3 Required tools

6.3.1 Required safety items

- Protective gloves;
- Protective shoes.

6.3.2 Required meters

- True RMS Multimeter;
- Isolating measurement transformer;

CAUTION
The output voltage of the 30 kVA / 6.6 A equipment can reach approximately 4600 V at full load.

- Insulation tester "Megger" 5000 V and 10000 V;
- AC True RMS measurement device (obey ICAO part 5 § 3.9.4.7).

CAUTION
The current regulation is +/- 1%. To make an acceptable readjustment of the output current, the precision of the meter should be better than 0.5% for the adjusted value.

6.3.3 Required tools

- A standard electrical and mechanical tool kit.

6.3.4 Required cables

- Remote control cable N x 0.8 mm diameter (between the equipment and the control panel)
- Earthing wire
- Input supply cable
- Series circuit cable

6.4 Inspection

1. Carry out a general inspection. See § 4.1.
2. Examine if the inner side of the equipment is not damaged.
3. Examine the transformers for displacement or bending.
4. If you see damage, displacement or bending, tell the carrier immediately.

6.5 Remove lower rear panel, big and small cabinet

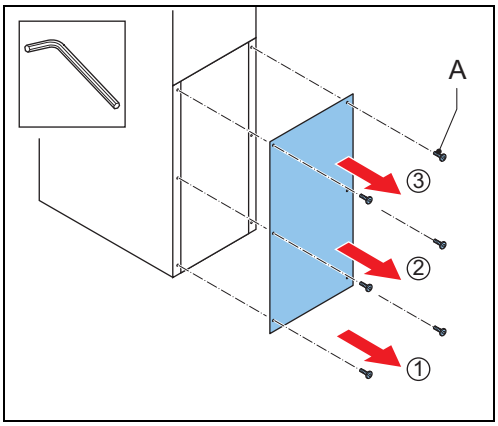
The panels of the equipment can be removed for installation or maintenance procedures.

WARNING

- **Do not operate the equipment with any of the panels removed.**
- **Do not mix panels from different equipments.**
- **Always connect the earthing wire before you install the panels.**

Remove panel

1. Set the manual switch to the ‘OFF’ position.
2. Remove the screws (A) from the bottom to the top.



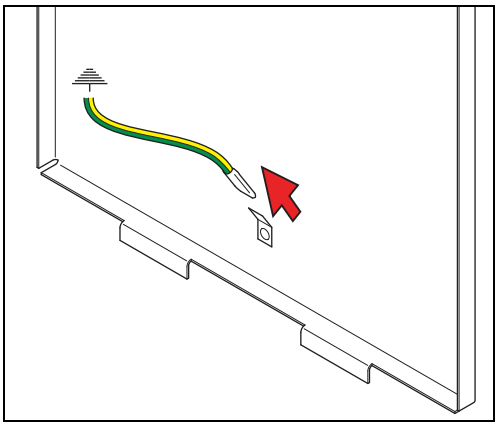
WARNING
The panels are heavy. Also, the momentum of the panel can cause damage to the panel and the screws if you remove the top screws first.

3. Carefully remove the panel (B).

CAUTION
Do not damage cables and/or connectors.

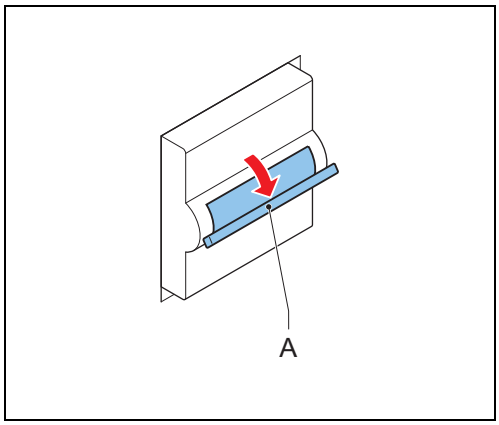
Disconnect wires

1. Disconnect the green/yellow earthing wires. *The wires have a fast-on connector.*



6.6 Switch OFF the power supply

1. Set the manual switch (A) to the OFF position.
2. Open the main switch on the main distribution board.
3. Disconnect the equipment from the series circuit.

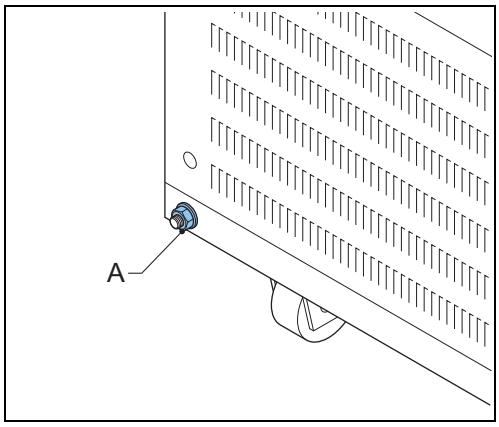


6.7 Install additional earthing

1. Connect an earthing wire to the M8 earthing screw (A). *Use an earthing wire with a cross-section of at least 10 mm². The wire must be as short as possible.*

WARNING
Earth the cabinet correctly. The equipment can create ground return currents up to 3.5 mA. Also when the equipment is not connected to the load, the equipment can create lethal ground currents.

2. Connect the earthing wire to the earthing network of the substation.



6.8 Connect power input supply

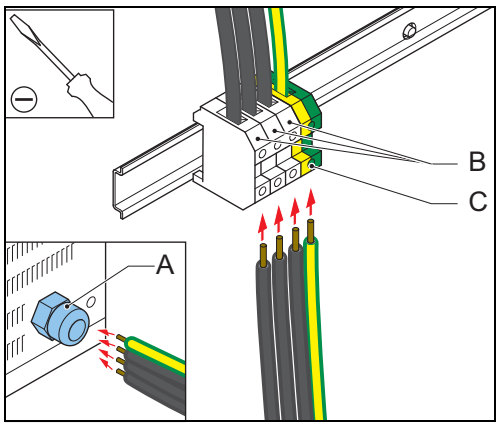
The connection is based on screw terminals.

Strip the cables

1. Strip the input power supply cables.
   - up to 15 kVA: 16 mm
   - up to 15 to 30 kVA: 18 mm

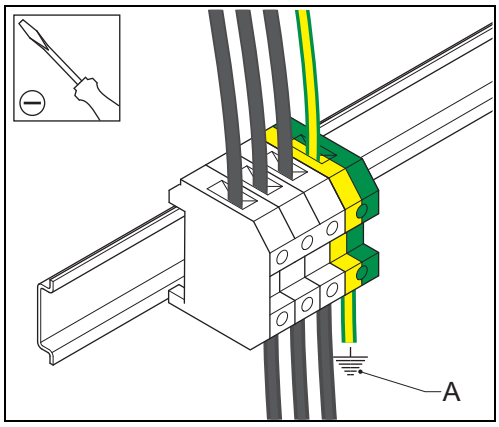
Connect - 1

1. Put the cables through the opening in the rear panel (A)
2. Connect the input supply cables to the terminals (B).
3. Connect the earthing wire to the terminal (C).



Connect - 2

1. Connect the earthing wire to the earthing network (A) of the substation.



6.9 Connect output to series circuit

CAUTION
If the series circuit cable is screened, connect the screen to an earthing network either inside or outside the equipment.

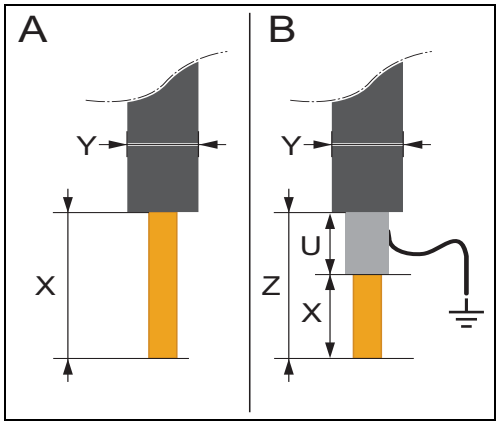
The procedures show how to connect the integrated output connections:
- With SCB (option). See § 6.9.2.
- With built-in SCO (option). See § 6.9.2.

If the output connection is not integrated in the equipment, see the dedicated installation manuals:
- AGLAS Master;
- External SCO.

6.9.1 Connect output to series circuit with SCB

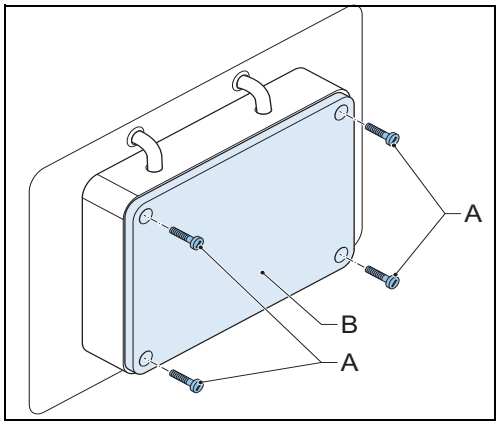
Strip cables

1. Strip the series circuit cables at the end.
   - A: unscreened cables
     - X: 16 mm
     - ∅ Y: less than or equal to 18 mm
   - B: screened cables
     - X: 16 mm
     - ∅ Y: less than or equal to 18 mm
     - U: 11 mm
     - Z: 77 mm



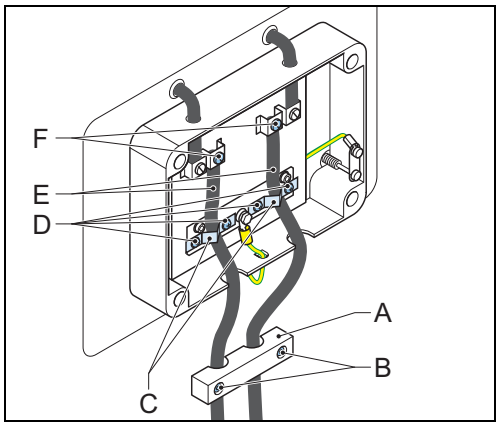
Remove the box panel

1. Loosen the screws (A).
2. Remove the box panel (B).



Connect

1. Loosen the screws (B) of the cable guide (A).
2. Loosen the screws (D) of the stress-relief clamps (C)
3. Lead the series circuit cables (E) through the cable guide and through the stress-relief clamps.
4. Loosen the screws (F).
5. Install the series circuit cables.
6. Tighten the screws (B), (D) and (E).



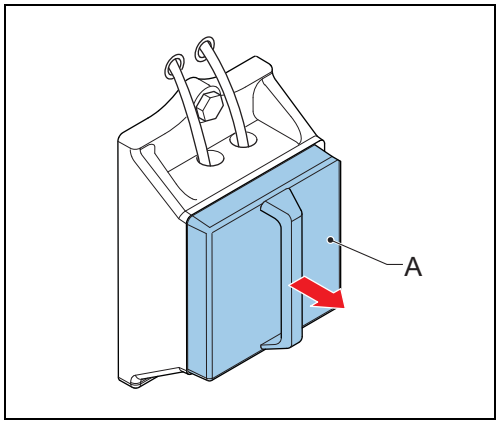
Finish

1. Install the box panel.

6.9.2 Connect output to series circuit with SCO

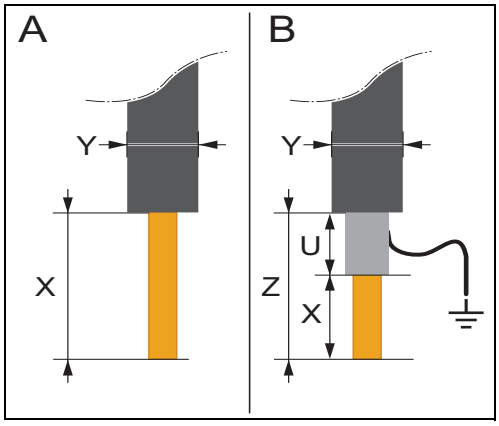
Remove cover

1. Remove the cover (A) of the SCO.



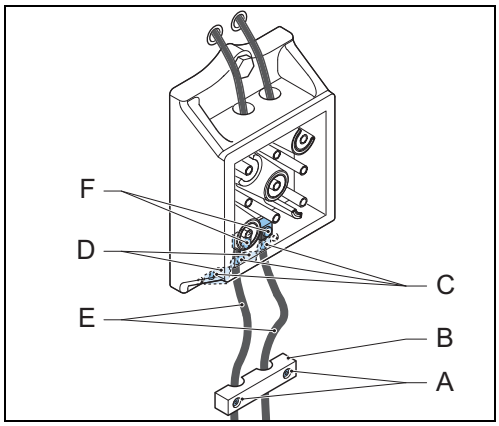
Strip cables

1. Strip the series circuit cables at the end.
   - A: unscreened cables
     - X: 14 mm
     - ∅ Y: less than or equal to 12 mm
   - B: screened cables
     - X: 16 mm
     - U: 10 mm
     - Z: 43 mm



Connect

1. Loosen the screws (A) of the cable guide (B).
2. Loosen the screws (C) of the stress-relief clamps (D)
3. Lead the series circuit cables (E) through the cable guide and through the stress-relief clamps.
4. Loosen the screws (F).
5. Install the series circuit cables.
6. Tighten the screws (A), (C) and (E).



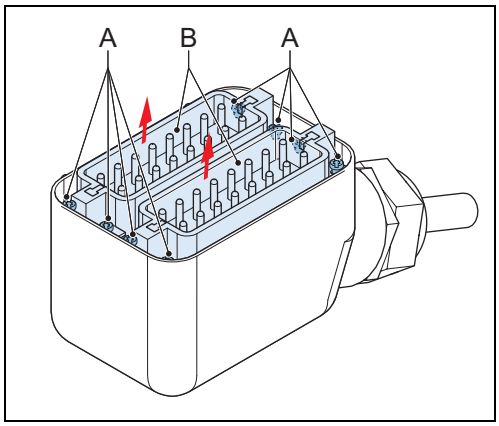
6.10 Connect remote control cables

6.10.1 Connect multiwire or J-Bus (option)

Disassemble the connector

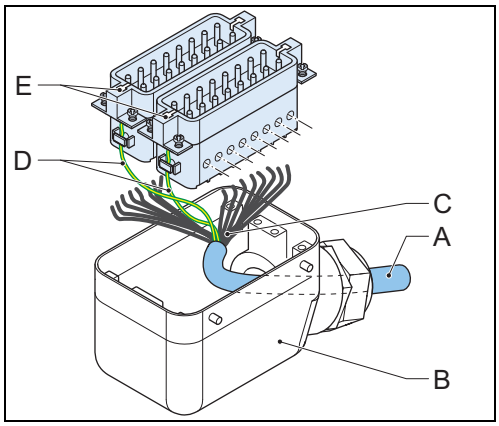
Note
If the terminal blocks are not located on the correct sides, the remote control does not work.

1. Remove the screws (A).
2. Note the correct side for each terminal block (B).
3. Remove the terminal blocks (B).



Connect - 1

1. Put the remote control wire (A) through the connector (B).
2. Strip the signal wires (C) approximately 100 mm.
3. Connect the signal wires to the terminal blocks. For the connection scheme, see § 7.8.3.
4. Connect the earthing wire (D) to the earthing connector (E).



Connect - 2

1. Install the terminal blocks to the connector.
2. Make sure that the orientation of the terminal blocks corresponds with the illustration above.
3. Examine if the numbers on the connector correspond with the numbers on the female side on the receiver of the remote connector.
4. Install the connector to the equipment.
5. Close the clamps of the connector.

6.10.2 Connect ethernet cable(s) (option)

1. Install the connector(s) to the ethernet connection(s).

6.11 Install lower rear panel

1. Connect the earthing wire and install the lower rear panel. See § 6.5.

7 Technical data

7.1 Specifications

Table: 7.1 Technical specifications

Item	Description
Rated input voltage [V]	400 V AC (± 10%) three phases
Rated frequencies [Hz]	50 or 60
Current regulation limits	Current regulation is guaranteed under the following conditions (± 0.1 A): - Under IEC 61822 environmental conditions - For nominal input voltage under IEC or FAA standard conditions - From full load to short circuit
Current regulation modes	Two preset regulation modes: - normal mode (for linear loads) - inductive mode (for non-linear loads (e.g. LED loads))
Average efficiency at full load	92 to 94% depending on the size of the equipment, under nominal resistive load, nominal output current and nominal input voltage
Power factor at output	The power factor exceeds the IEC and FAA requirements. The power factor at rated load is close to 1 and is kept at high level for any possible operational conditions.
Brightness steps	5 standard, 8 maximum, fully adjustable in 65k levels (1mA resolution)
Output current [A]	6.6
Remote control and monitoring	- Multiwire: 48 to 60 V DC - Single or dual J-Bus protocol over RS485/RS422 - Single or dual J-Bus protocol over Ethernet IEEE 802.3
Regulation response time	- Less than 0.3 seconds - Exceeds the requirements of IEC 61822
Open circuit ouput voltage	Less than 1.2 times the nominal output voltage (RMS)
Ingress protection	IP 21

Table: 7.2 Output specifications

Type	Rated output power [kW]	RMS output voltage at 6.6 A RMS output current [kV]	Insulated test on output[a] [kV]	Output overvoltage protection 25kApk
VIS 2.5	2.5	0.38	3	0.75 kV_{RMS}, 1.4 kJ
VIS 4.0	4.0	0.60	5	1.5 kV_{RMS}, 2.8 kJ
VIS 5.0	5.0	0.75	5	1.5 kV_{RMS}, 2.8 kJ
VIS 7.5	7.5	1.13	6	2.2 kV_{RMS}, 4.2 kJ

Type	Rated output power [kW]	RMS output voltage at 6.6 A RMS output current [kV]	Insulated test on output[a] [kV]	Output overvoltage protection 25kApk
VIS 10	10.0	1.50	10	2.2 kV_{RMS}, 4.2 kJ
VIS 15	15	2.30	12	3.0 kV_{RMS}, 5.6 kJ
VIS 20	20	3.00	15	4.5 kV_{RMS}, 8.4 kJ
VIS 25	25	3.80	19	5.2 kV_{RMS}, 9.8 kJ
VIS 30	30	4.54	23	6.0 kV_{RMS}, 11.2 kJ

a) Test condition: 50 Hz sinosoidal wave for 1 minute. The test is done without output overvoltage protections.

7.2 Applicable standards

The equipment is in accordance with these standards:

Table: 7.3 Applicable standards

Standard	Description
ICAO	Aerodrome Design Manual, Part 5 paragraphs 3.2. (current edition)
FAA [a]	AC 150/5345-10 (current edition), L-828 and L829 except for input voltage
IEC	IEC 61822
CENELEC	EN61822
CE certfied	

a) The equipment is not an FAA equipment but it complies with most of the FAA requirements.

7.3 ElectroMagnetic Compatibility (EMC)

The equipment is designed to operate in an industrial electro-magnetic environment. The regulator complies with IEC 61822, in accordance with IEC 61000-6-4 and IEC 6-6-2 (generic standard for industrial environment). The equipment is, with adapted test levels, in accordance with IEC/TS61000-6-5, G (substation environment, location G).

7.4 Ambient conditions

The equipment is air-cooled with fans. Thus, the equipment must have a good airflow, especially if they operate near the maximum temperature.

Table: 7.4 Ambient conditions

Item	Description
Temperature	From -20 up to +55 °C[a]
Altitude	From 0 (sea level) up to 1000 meter
Relative humidity	From 10% up to 95% RH without condensation

a) For IEC conformity to -40 °C an optional modification is required.

7.5 Dimensions and mass

The small cabinet (A) and the big cabinet (B):

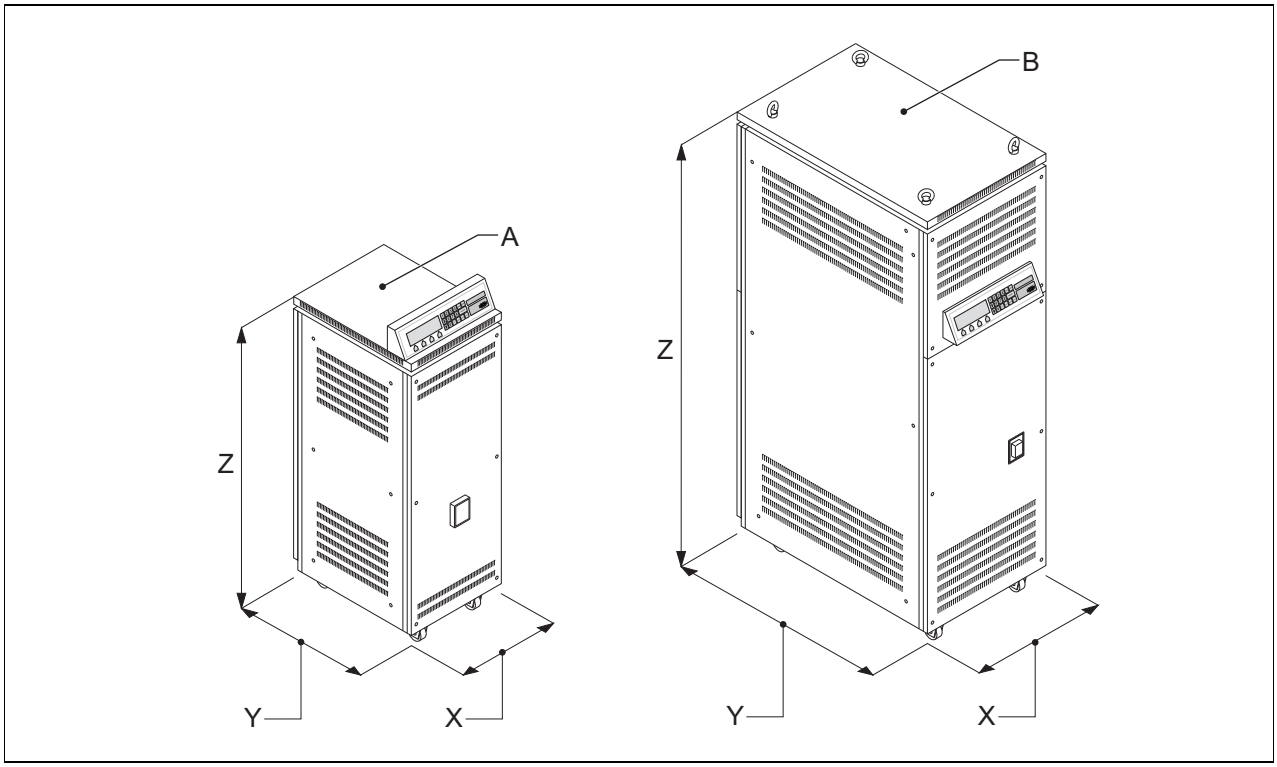


Table: 7.5 Dimensions

Item	A - 2.5 kVA	A - 4 to 15 kVA	B - 20 to 30 kVA
X [mm]	420	420	520
Y [mm][a]	550	840	840
Z [mm]	1300	1300	1600

a) Depending on the output power connection (options)

Table: 7.6 Mass

Type	Net mass	Crate mass	Crate dimensions width x depth x height [mm]
2.5	140	23	1200 x 800 x 1500
4	180	23	1200 x 800 x 1500
5	190	23	1200 x 800 x 1500
7.5	215	23	1200 x 800 x 1500

Type	Net mass	Crate mass	Crate dimensions width x depth x height [mm]
10	255	23	1200 x 800 x 1500
15	285	23	1200 x 800 x 1500
20	360	40	1200 x 800 x 1850
25	410	40	1200 x 800 x 1850
30	450	40	1200 x 800 x 1850

7.6 Substation layout, big and small cabinets

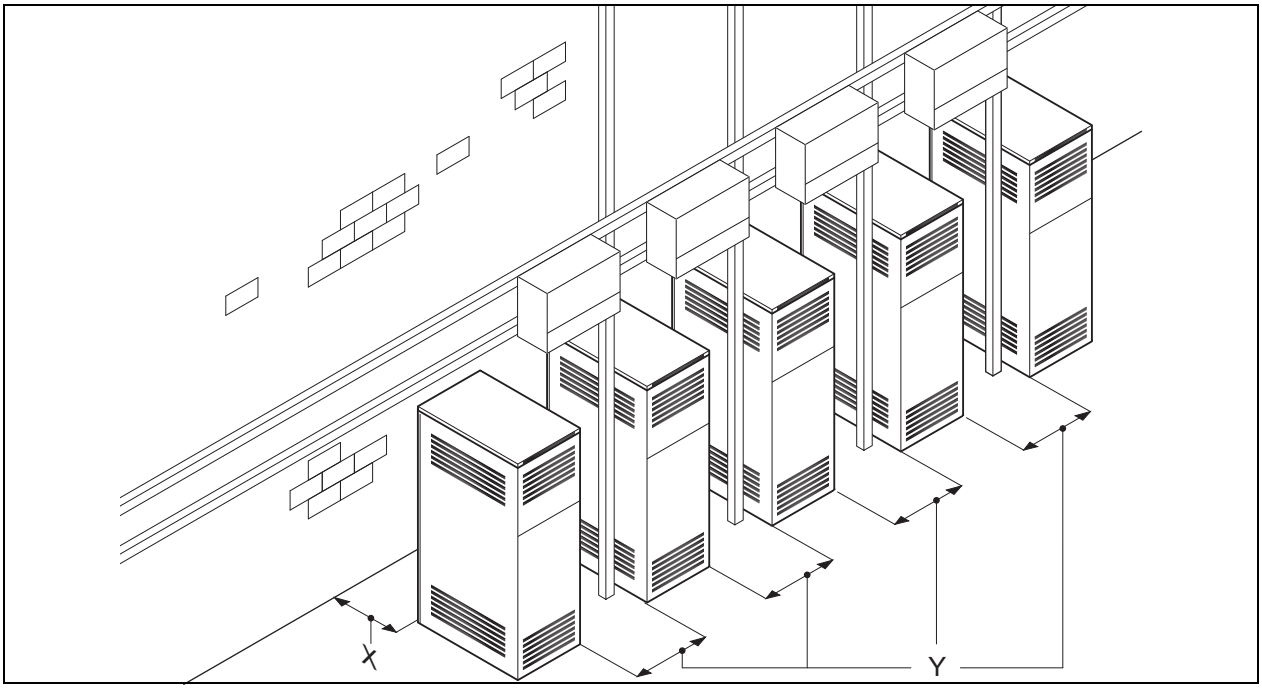


Table: 7.7 Clearance specifications

Clearance specification	Distance [mm]
Front clearance	Approximately 500
Between the rear of the machine and the wall, X	Approximately 500
Between two machines (side by side) or between another machine, Y	Minimum 150

If necessary, the distances can be increased for maintenance purposes.

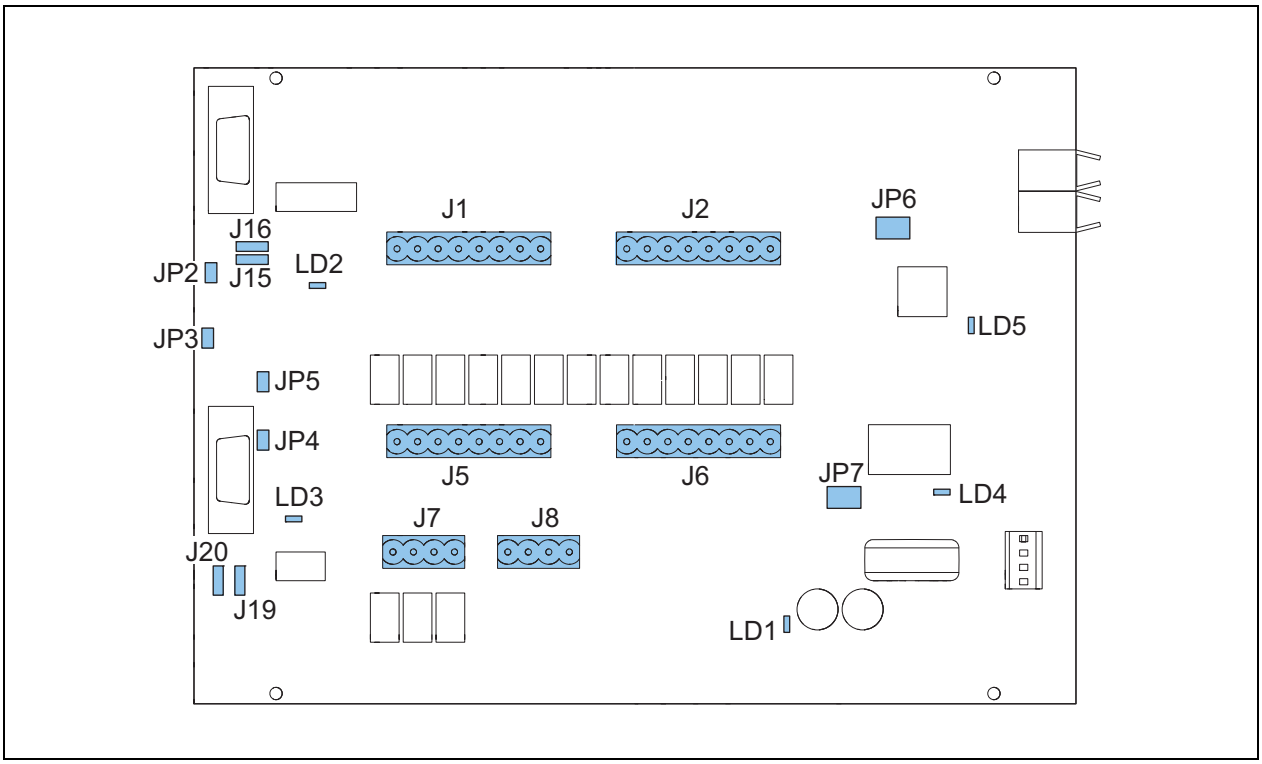
7.7 Protection devices

Table: 7.8 Protection devices specifications

Equipment type [kVA]	Equipment voltage [V]	Main fuse rating [A]	Manual switch type C rating [A]	Maximum line input current [A]
2.5	380 to 400	16	10	5.9
4		16	16	9.4
5		16	16	11.7
7.5		20	20	17.6
10		50	40	23.4
15		50	40	35.2
20		80	80	46.9
25		80	80	58.6
30		100	100	70.3

7.8 Remote control PCB (EPS495)

7.8.1 Printed Circuit Board (PCB)



7.8.2 Jumper settings

Table: 7.9 Remote control PCB jumper settings

Jumper	Position	Function
JP2	insert	enable TX serial channel 1 termination resistance
JP3	insert	enable RX serial channel 1 termination resistance
JP4	insert	enable TX serial channel 2 termination resistance
JP5	insert	enable RX serial channel 2 termination resistance
JP6	position 1-3 and position 2-4 1 3 5 2 4 6	ethernet channel 1: enable
	position 3-5 and position 4-6 1 3 5 2 4 6	serial channel 1: enable
JP7	position 1-3 and position 2-4 1 3 5 2 4 6	ethernet channel 2: enable
	position 3-5 and position 4-6 1 3 5 2 4 6	serial channel 2: enable
J15	position 2-3 3 2 1	serial channel 1: RS485 configuration
	position 1-2 3 2 1	serial channel 1: RS422 configuration (not used)

Jumper	Position	Function
J16	position 2-3 1 2 3	serial channel 1: RS485 configuration
	position 1-2 1 2 3	serial channel 1: RS422 configuration (not used)
J19	position 2-3 1 2 3	serial channel 2: RS485 configuration
	position 1-2 1 2 3	serial channel 2: RS422 configuration (not used)
J20	position 2-3 1 2 3	serial channel 2: RS485 configuration
	position 1-2 1 2 3	serial channel 2: RS422 configuration (not used)

7.8.3 Multiwire / J-Bus connection scheme

Note
The table below shows the standard remote control configuration for the signals. If you want another configuration, contact ADB Safegate.

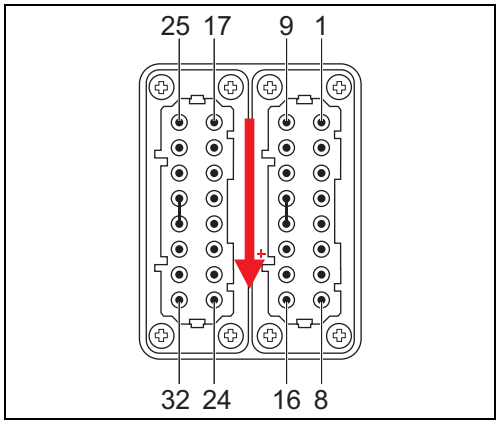


Table: 7.10 Factory set terminal assignments for remote control connections with multiwire and single J-Bus

Function	Terminal number on 32-pole connector	Relay number on Remote Control PCB (unless indicated otherwise)
Control signals (fixed)		
Step 1	1	J1.1
Step 2	2	J1.2
Step 3	3	J1.3
Step 4	4	J1.4
Step 5	5	J1.5
ON	6	J1.6
CCR OFF from HVCS	8	J1.7
Feedback signals (fixed)		
Step 1	9	J5.1
Step 2	10	J5.2
Step 3	11	J5.3
Step 4	12	J5.4
Step 5	13	J5.5
ON (step1,2...5) / OFF (OFF or Standby Step0)	19	J5.6
Feedback signals (configurable): the values below are default values, for configuration options (for the options, see the table that follows)		
Disable local/remote	14	J5.7 (NC)[a]
	28	J5.8
Open circuit	16	J6.1[a]
Overcurrent	20	J6.2[a]
Bad regulation	22	J6.3[a]
	15	J6.4 (CM)
Lamp fault	23	J6.5[a]
EFD warning	24	J6.7[a]
EFD error	25	J6.8[a]
High temperature alarm	27	J7.1[a]
Short circuit	29	J7.2[a]
Lamp fault warning	21	J7.3[a]
External signals (fixed)		
	24	CRE doorswitch (power input door)
	26	CRE doorswitch (power input door)
	7	

Function	Terminal number on 32-pole connector	Relay number on Remote Control PCB (unless indicated otherwise)
	17	
	18	
J-Bus interface (fixed)		
RS485 BusA GND	30	DB9.3
RS485 Data -	32	DB9.2
RS485 Data +	31	DB9.1

a) Configurable with HMI

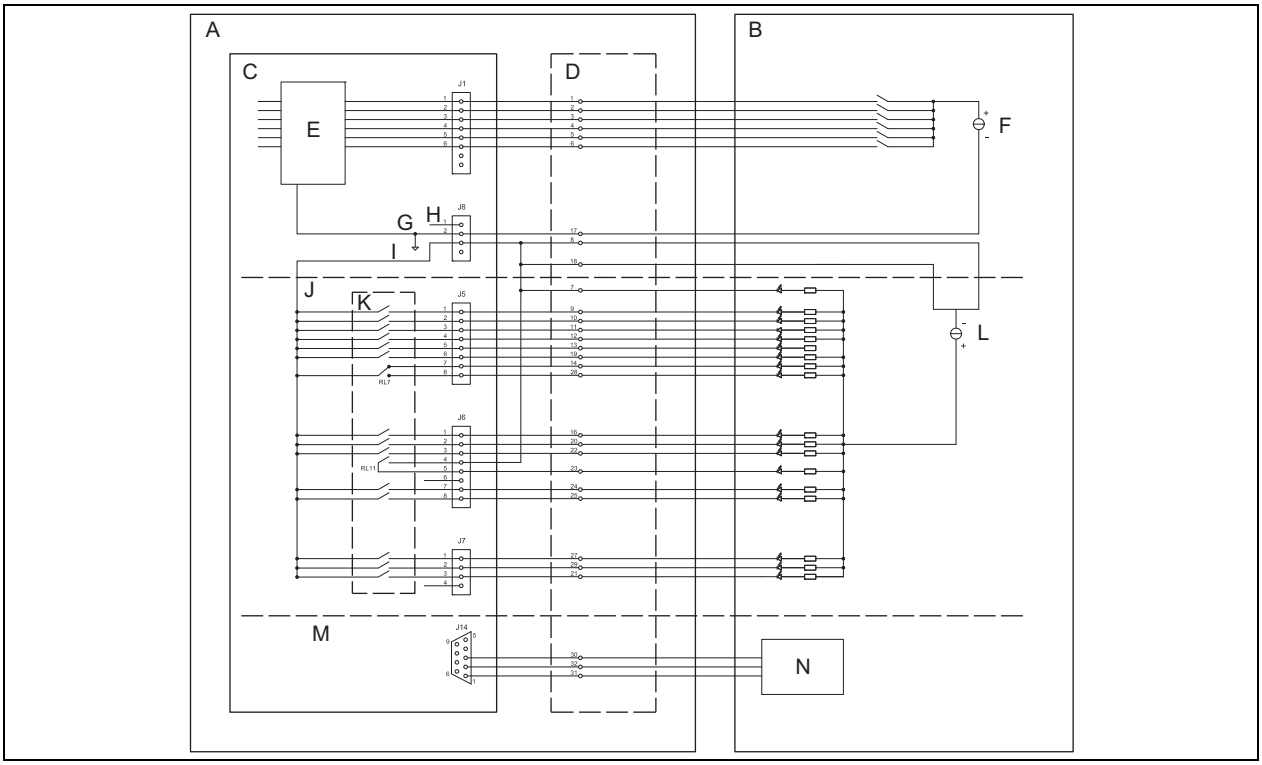
Table: 7.11 Factory set terminal assignments for remote control connections with multiwire dual J-Bus

Function	Terminal number on 32-pole connector	Relay number on Remote Control PCB (unless indicated otherwise
Control signals (fixed)		
Step 1	1	J1.1
Step 2	2	J1.2
Step 3	3	J1.3
Step 4	4	J1.4
Step 5	5	J1.5
ON	6	J1.6
CCR OFF from HVCS	8	J1.7
Feedback signals (fixed)		
Step 1	9	J5.1
Step 2	10	J5.2
Step 3	11	J5.3
Step 4	12	J5.4
Step 5	13	J5.5
ON (step1,2...5) / OFF (OFF or Standby Step0)	19	J5.6
Feedback signals (configurable):		
Disable local/remote	14	J5.7 (NC)[a]
Open circuit	16	J6.1[a]
Overcurrent	20	J6.2[a]
Bad regulation	15	J6.4 (CM)
EFD error	25	J6.8[a]
Lamp fault warning	21	J7.3[a]

Function	Terminal number on 32-pole connector	Relay number on Remote Control PCB (unless indicated otherwise
External signals (fixed)		
	7	
	17	
	18	
J-Bus interface (fixed)		
RS485 BusA GND	30	DB9.3
RS485 Data -	32	DB9.2
RS485 Data +	31	DB9.1
RS485 BusB GND	27	DB92.3
RS485 Data +	28	DB92.1
RS485 Data -	29	DB92.2

a) Configurable with HMI

Multiwire and J-Bus connection



A Equipment
B Remote control equipment
C Remote control PCB - input signals
D Remote control connector on the equipment
E Opto coupler
F 48 V DC power supply
G Isoground
H +48 V DC
I Rel com
J Remote control PCB - feedback signals
K Relais
L 24 V DC power supply
M J-Bus RS485 connection
N J-Bus RS485 interface

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