Liebert® PDX

Perimeter DX System
PAM UHD A Models

User Manual

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Documents supplied with the machine

- User Manual (this document);
- iCOM™ User Manual;
- Electric Diagrams;
- Instruction Leaflet for Transport and Handling (on the packaging);
- Labels with Gravity Center (on the packaging);
- Warranty Certificate.

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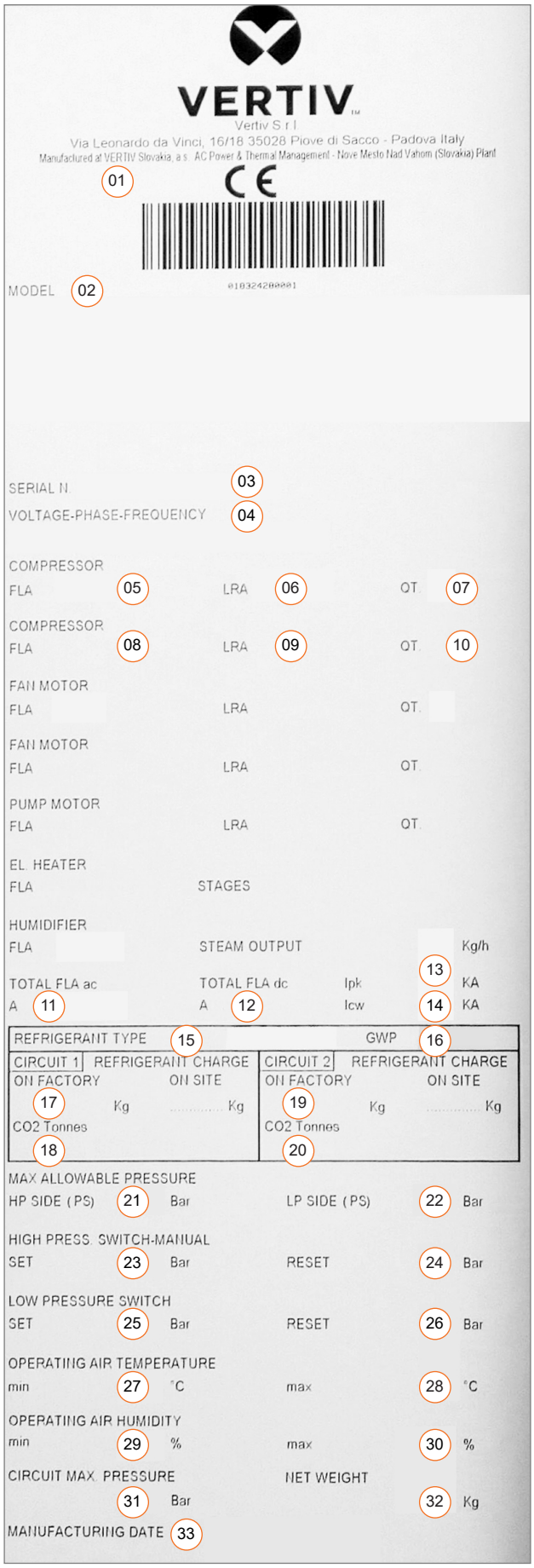


Onboard Label

Please refer to the label placed on the unit for the relevant operating data.

If you need assistance or spare parts, please find the model identification and the serial number on the label.

NOTICE

The data in the manual are referred to standard conditions and can be modified without any advance notice.

The data relevant to the supplied unit are filled in the inboard label (see beside an empty facsimile).

Pos.	Description
01	Manufacturing plant
02	Model
03	Serial number
04	Power input
05	Circuit 1 - Compressor Full Load Ampere
06	Circuit 1 - Compressor Locked Rotor Ampere
07	Circuit 1 - Compressor quantity
08	Circuit 2 - Compressor Full Load Ampere
09	Circuit 2 - Compressor Locked Rotor Ampere
10	Circuit 2 - Compressor quantity
11	Unit Total Full Load Ampere AC [A]
12	Unit Total Full Ampere DC [A]
13	Rated Peak withstand current [kA]
14	Rated short-time current [kA]
15	Refrigerant type
16	Refrigerant GWP
17	Circuit 1 - Refrigerant charge on factory
18	Circuit 1 - Refrigerant charge CO_2 tonnes
19	Circuit 2 - Refrigerant charge on factory
20	Circuit 2 - Refrigerant charge CO_2 tonnes
21	Maximum allowable pressure - High pressure side
22	Maximum allowable pressure - Low pressure side
23	High pressure switch - Stop
24	High pressure switch - Restart (software managed)
25	Low pressure switch - Stop
26	Low pressure switch - Restart (software managed)
27	Minimum room operation temperature
28	Maximum room operation temperature
29	Minimum room operation air humidity
30	Minimum room operation air humidity
31	Circuit maximum pressure
32	Net weight
33	Manufacturing date

NOTE

For single circuit units, "Circuit 1" is the only circuit, with variable speed compressor.

For dual circuit units, "Circuit 1" is the circuit with fixed speed compressor(s), "Circuit 2" is the circuit with variable speed compressor.

Abbreviations - Acronyms

Item	Definition
AHF	Active Harmonic Filter
APS	Auxiliary Power Supply
ATS	Automatic Transfer Switch
CT	Current Transformer
EC	Electronically Commutated [fans]
EEV	Electronic Expansion Valve
FIFO	First In - First Out
FLA	Full Load Amps [current]
GWP	Global Warning Potential [refrigerant]
LRA	Locked Rotor Amps [current]
MCB	Magnetic Circuit Breaker
NTC	Negative Temperature Coefficent [sensor]
PE	Protective Earth [cable]
PLP	Panel Level Package [packaging]
POE	Polyolester [oil]
PWL	Sound Power Level
RCD	Resident Current Device
SPL	Sound Pressure Level
STO	Safe Torque Off
Ultracap	Ultra capacitor
UPS	Uninterruptible Power Supply
VSD	Variable Speed Drive

1. Safety

Content of this chapter

1.1 Conventions.....1
1.2 General Instructions.....1
1.3 Personal Protective Equipment.....2
1.4 Residual Risks.....2

This chapter gives general safety instructions.
Additional safety warnings, for specific operations, are given in the rest of the manual.

1.1 Conventions

DANGER
Indicates a hazardous situation which, if not avoided, **will** result in death or serious injury.

WARNING
Indicates a hazardous situation which, if not avoided, **could** result in death or serious injury.

CAUTION
Indicates a hazardous situation which, if not avoided, **may** result in minor or moderate injury.

NOTICE
Indicates a property damage message.

ENVIRONMENT
Indicates a environment damage message.

1.2 General Instructions

Intended readers	• This User Manual is intended for transport, installation and maintenance personnel. • The end user can only switch the unit **ON** and **OFF** and modify the setpoint.
Personnel	• The operations described in this manual must be made by technical staff, expressly authorized in compliance with the regulations in force at the installation site. • The authorized personnel must be properly trained and qualified, wear appropriate personal protective equipment and use adequate equipment and tools.
Read this manual	• Carefully read the manual before performing any operation on the unit.
Keep this manual	• Keep the manual during the complete life-span of the unit. • Keep the diagrams provided with the unit (wiring, refrigerating circuit,...). They are part of the instructions for use. • If you move or sell the unit, transfer the manual and the diagrams together with the unit. • The manuals may be subject to modification. For complete and up-to-date information always consult the specific manual supplied with the unit.
Intended use	• Use the unit only for the purpose it has been designed (see *3. Intended Use*). • The manufacturer takes no liability for any improper use of the unit.
Do not modify the unit	• Do not modify the unit without Vertiv™ permission in any way, including the safety devices, the control system and the software. • The manufacturer takes no liability for any unauthorized modification of the unit.
Warning labels	• Pay attention to the warning labels on the unit. • Do not remove or cover the labels placed on the unit by the manufacturer.

Lockout-Tagout (LOTO)	Before any intervention on the electrical system or accessing the inner components: • Lock the disconnection device by a padlock or similar tool; • Apply on the general disconnecting switch a warning plate. For units with **ATS** (Automatic Transfer Switch) power supply, see *Annex G - ATS (Automatic Transfer Switch)* for details about the locking procedure.
Safeguards Raised floor	When you finish the operations on the unit, always remind the following: • Mount again and fix with screws all the safeguards (panels, grids); • Close and lock all the doors, if present; • Place again all the floor panels around and under the unit; • Never operate the unit without the above mentioned safeguards.

1.3 Personal Protective Equipment

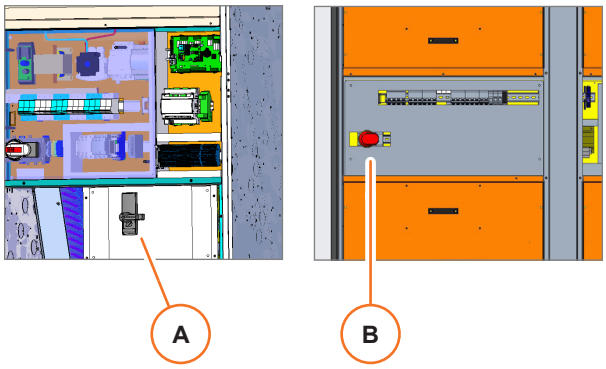
As general rule, always wear the following **PPE** (Personal Protective Equipment):

1.4 Residual Risks

Some operations may involve some residual risk.

Pay attention to the following safety measures when operating inside or near the unit.

Disconnecting switch



To disconnect the power supply proceed as following:

- Turn **OFF** the main disconnector switch [**B**];
- Unscrew the door and open it;
- For units with **ATS** power supply open the disconnecting switch [**A**], see *Annex G - ATS (Automatic Transfer Switch)* for details.

After you open the door, pay attention to the cable and components that are still energized **ATS** terminal input and output, terminal input of disconnecting device and power supply cables between **ATS** and main switch.

Electric and control system

The unit **contains potentially lethal voltage** in some circuits.

The electric and control panel can retain a stored high-voltage electrical charge for up to **15** minutes.

Risk of arc flash and electric shock.
Can cause injury or death.

General safety measures:

- Only properly trained and qualified personnel may perform repair, maintenance and cleaning.
- The key of the electric panel must be kept by the person responsible for maintenance.
- Always wear the protective equipment prescribed by the local and Vertiv™ regulations.
- It is forbidden to operate on the electrical components without using insulating platforms, or in the presence of water and humidity.

Before working inside the electric and control panels proceed as follows:

1. Open all the local and remote disconnecting switches of the unit;
2. Wait at least **5** minutes;
3. Verify with a voltmeter that the power is **OFF**.

Components at high temperature

The following components are at high temperature:

- discharge line
- compressor
- electrical heaters
- humidifiers

General safety measures:

- Always wear temperature resistant gloves when operating on the unit.

Components at low temperature

The following components are at low temperature:

- evaporator

General safety measures:

- Always wear temperature resistant gloves when operating on the unit.

Sharp elements

Evaporators and condensers are made of plates and fins, which may have sharp edges and blurs.

Also other elements inside the unit may have sharp edges, blurs, splinters and exposed fasteners.

General safety measures:

- Always wear cut resistant gloves.

Automatic startup + rotating elements

This unit operates and restarts automatically.

The fan blades can automatically start rotating without warning at any time during a cooling cycle or after the power is restored after a power failure.

Risk of contact with high-speed, rotating fan blades.
Can cause serious personal injury or death.

Before working inside the unit, removing the fan guards or servicing the fans (speed control, blades, motors) proceed as follows:

- Turn all the disconnecting switches to **OFF**.

Automatic startup + strong air flow

This unit operates and restarts automatically.

The fans may suddenly start blowing out a strong air flow, which may carry particles and small objects from inside the unit.

If the door is opened, the air flow may slam the door closed (**Upflow** versions only).

Can cause serious personal injury.

General safety measures:

- Wear eyes protection when you need to get close to the unit while it is operating.
- Pay attention to the warning labels on the unit.

Before working on the unit proceed as follows:

- Turn all the disconnecting switches to **OFF**.

Lifting and moving

- Make sure to use transport and lifting equipment rated for the unit dimensions and weight;
- Pay attention to the gravity center and warning labels placed on the unit;
- Make sure that the lifting point is aligned with the gravity center;
- Make reference to *Annex C - Dimensions and Weights* for dimensions, weight and gravity center position.

Handling area

- Never walk or stay below a suspended load;
- The area for handling and moving must be free from obstacles and persons;
- Not authorized personnel must keep at safe distance from the handling area;
- The floor of the handling area must be suitable to bear the weight of the unit and of the moving equipment.

2. Digit Nomenclature

The unit is fully defined by the following digits.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Dig.	Feature	Value	Description
1 2 3	Family name	PAM	**P** = Perimeter Unit **A** = R513A refrigerant **M** = Motorized unit
4 5 6	Model	000	
7	Air discharge	U	**Upflow**
		H	**Downflow Frontal** (displacement)
		D	**Downflow Up**
8	System type	A	Air-cooled
9	Air flow	E	High Efficency
		P	High Power
10	Power supply	3	400 V / 3 ph / 50 Hz + N CE
11	Cooling system	A	Single Circuit Variable Speed Scroll - with EEV
		B	Dual Circuit 1 Fix. + 1 Variable speed scroll - with EEV
		C	Dual Circuit Tandem + 1 Variable speed scroll - with EEV
		D	Dual Circuit Tandem + Tandem scroll – with EEV
12	Humidification	0	None
		S	Electrode humidifier
13	Microprocessor control	0	None
		7	7" touch screen
14	Heating and re-heating	0	None
		1	Electric heating Standard Capacity
15	Air filter	1	ePM10 50%
		2	ePM10 50% + Diff. Press. Trasducer
		3	ePM10 50% + Clogged Filter

Dig.	Feature	Value	Description
16	Condensing control	A	Air-Cooled
17	Color	1	Black RAL 7021
18	High voltage option	D	Standard Power Supply
		G	Dual Power Supply Alternate (ATS)
		T	Standard Power Supply with active harmonic filter
19	Predisposition	0	None
		S	Predisposition for Smart Aisle™ (predisposition for Damper sensor, 3 position switch)
		H	Predisposition for motorized damper
		L	Predisposition for plenum installation
20	Monitoring	0	None
		1	Monitoring (Modbus IP, BACnet IP, SNMP and HTTP)
21	Devices	0	None
		1	MCB 10A 1 ph
		3	Condensate pump (1)
		4	Condensate pump + MCB 10A 1 ph (1)
22	Packaging	P	PLP and Pallet
		C	PLP and wooden crate
		S	Seaworthy
23	EMC Emissions	I	Industrial Rate
		R	Residential Rate
24	Revision	E	Free option
25	Special Requirements	A	Standard Vertiv™
		X	Special Vertiv™

(1) Only available with **Upflow** and **Down Frontal** units

3. Intended Use

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3.1 Purpose of the unit

The **Liebert® PDX PAM UHD A** units have been designed and manufactured for the following purpose:

- Precision air conditioning for indoor use (for data centers, network closets, technological rooms).

3.2 Assembly

WARNING

Do not assemble or connect the unit with systems or machines that are different from what is specified in this manual for your unit.

SAFETY REQUIREMENT THAT MUST BE RESPECTED

The safety valve is provided with **Liebert® OAC** external condenser. **Liebert® PDX PAM UHD A** can be connected only to **Liebert® OAC** condenser.

Contact Vertiv™ Technical Support for any question.

The **Liebert® PDX PAM UHD A** units are factory assembled, including all the internal wiring.

The only operation to be made at the installation site are the following:

- Electrical connections for power supply;
- Refrigerant piping connections to the remote external condenser;
- Refrigerant charge.

See Chapter *5. Description* for details about the unit structure, versions and optional components.

See *6.2.4 Remote condensers models* for the condenser model that is compatible with each unit model.

3.3 Refrigerant

The **Liebert® PDX PAM UHD A** units are designed for use with **R513A**.

3.4 Functional Limits

See *6. Technical Data*.

WARNING

Risk of components failure or breakage.

Do not use refrigerants, fluids and voltage that are different from what is specified in this manual for your unit.

Contact Vertiv™ Technical Support for any question.

3.5 Space Limits

Overall unit dimensions	See *Annex C - Dimensions and Weights*.
Clearance	Keep a free space around the unit as explained in *9.3.2 Space requirements*.

3.6 Environment

WARNING
Do not use in explosive, acid or anyway aggressive atmosphere.

3.6.1 Storage conditions

Table 01 - Ambient conditions for storage

Storage environment	Indoor environment, protected against weather agents Clean (no dust), well-ventilated, non-condensing
Ambient temperature	-20°C – +50°C
Ambient humidity	<90% and preventing condensation
Storage time	The total storage time should not exceed **six** months. If the storage time is longer than **six** months, then you must check the functionality of sensors and other electronic devices before putting in operation the unit.
Position	Keep the unit vertically upright.

3.6.2 Operating conditions

Table 02 - Ambient conditions for operation

Operating environment	The unit is designed for indoor installation, protected from weather agents, with the following ambient conditions.	
Air returning to the unit inlet (indoors conditions)	Temperature	+20°C — +40°C
	Absolute humidity	5,5 — 12 g steam / kg air
	Relative humidity	15 — 60 %
	The allowed thermal load must be higher than 20% of the unit nominal cooling capacity. A lower thermal load will cause inaccurate temperature and humidity control and frequent compressor(s) switch **ON/OFF**.	
Altitude (above sea level)	Below 1 000 m	OK
	From 1 000 to 2 000 m	Allowed with inverter derating. See *6.2.3 Inverter derating factors*
	Higher than 2 000 m	Not allowed, contact Vertiv™ Technical Support
Outdoor temperature	Temperature	-20°C — +48°C
	Recommended application conditions:	
	Safety valve pipe kit option “**S**”	0°C < T < +48°C
	Safety valve pipe kit option “**R**”	-5°C < T < +48°C
	Safety valve pipe kit option “**L**”	-20°C < T < +48°C
	For installation with ambient temperature below -20°C it is necessary to contact Vertiv™ technical support.	
Remote condensers position	See *9.3.3 Refrigerant piping requirements*	

4. Reference Norms

The **Liebert® PDX PAM UHD A** units are designed, manufactured and tested according to the following directives and standards:

EU Directives	- Machinery Directive 2006/42/CE; - PED Directive 2014/68/EU; - Low Voltage Directive 2014/35/UE; - EMC Directive 2014/30/UE; - RoHS II Directive 2011/65/EU; - RoHS III Directive EU/2015/863.
CE Marking and Conformity Declaration	The units are marked “**CE**”. Each unit is supplied complete with individual test certificate and a certificate of conformity to the European Union Directives. See also the last page.
UKCA Marking and Conformity Declaration	The units are marked “**UKCA**”. Each unit is supplied complete with individual test certificate and a certificate of conformity to the UK Safety Regulations.
Performance test norms	- Cooling Capacity according to EN 14511; - Sound Power Level according to ISO 3744.

5. Description

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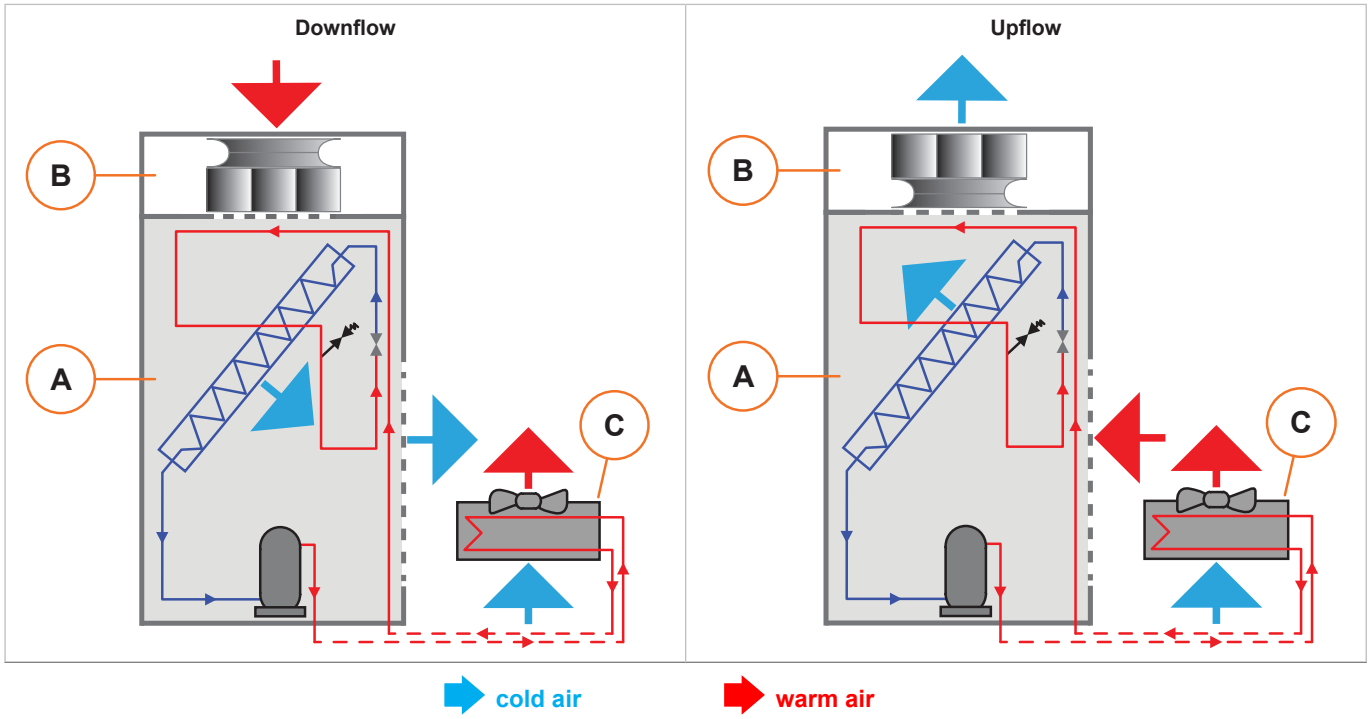
NOTE *The images in this manual refer to sample units. Some components may be different for other units but the function remains the same.*

5.1 Versions Overview

5.1.1 Unit frame



The unit frame is made by the coil section [**A**] and the fan section [**B**].

The coil section contains the refrigerating system of the unit (compressor, evaporator, expansion valve, accessories), the electric panel and the control system.

The fan takes the **warm air** from the room into the unit. The air flows through the evaporator, **cools down** and blows out again in the room.

The fan section is placed on the top.

The refrigerating system of the unit is connected on site to the external remote **Liebert® OAC** condenser [**C**] (which must be purchased separately).

The unit frames can be combined in different ways to obtain different versions.

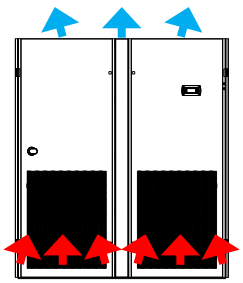
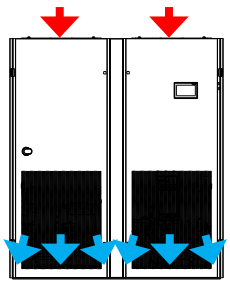
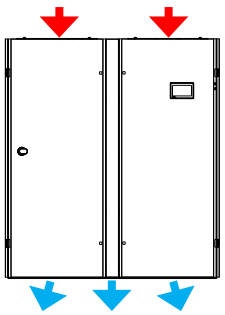
Different versions are available also for the refrigerating system.

5.1.2 Air distribution

The unit is placed on a raised floor.

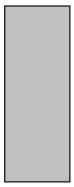
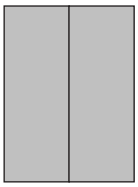
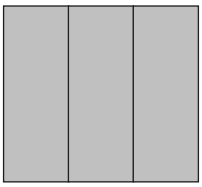
The air flow direction can be either **Upflow** or **Downflow**.

The following combinations are available:

U - Upflow	H - Downflow Frontal	D - Downflow Up
		
Placed on the floor **Warm air** though the doors **Cold air** though the top	Placed on the floor **Warm air** though the top **Cold air** though the front grid	Placed on the floor **Warm air** though the top **Cold air** though the bottom grid

5.1.3 Cabinet size

The units can have the following cabinet size:

Width	Frame type	0 - 1	3	5
	Number of bays	1	2	3
				
		NOTE *In the units of frame type 0, 1, 2, 3 the coil section and the fan section are integrated.*		
Height	**Standard** H = 1970 mm	The coil and the fan sections are factory assembled in the same cabinet.		

5.1.4 Accessories

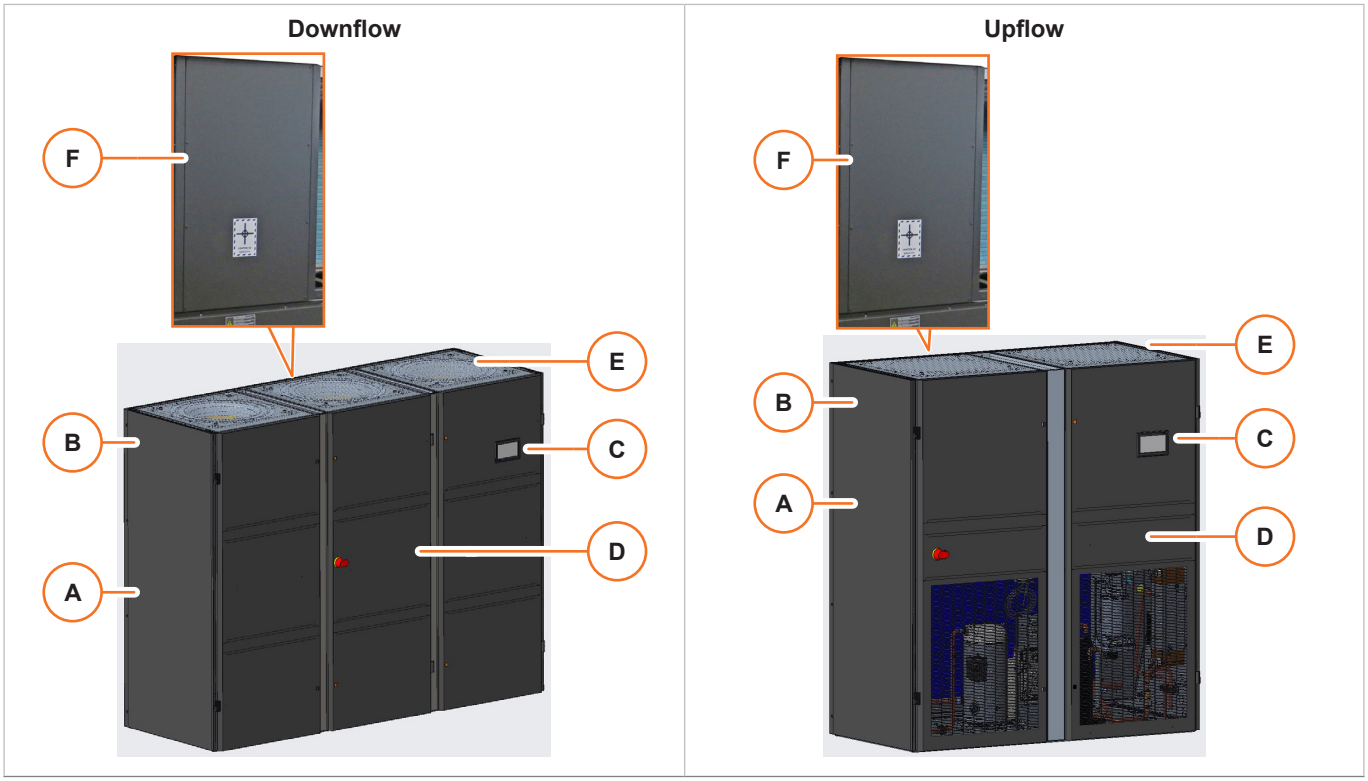
Several accessories are available for the following purposes:

- Base frame;
- Base module;
- Vertical flow extension hood;
- Horizontal hood with grid;
- Connection flange.

See *Annex E - Accessories* for details.

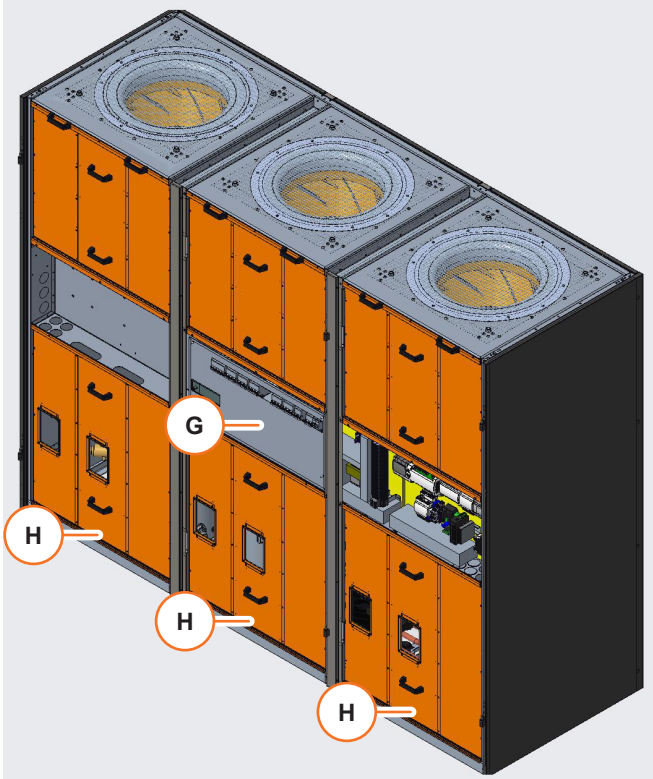
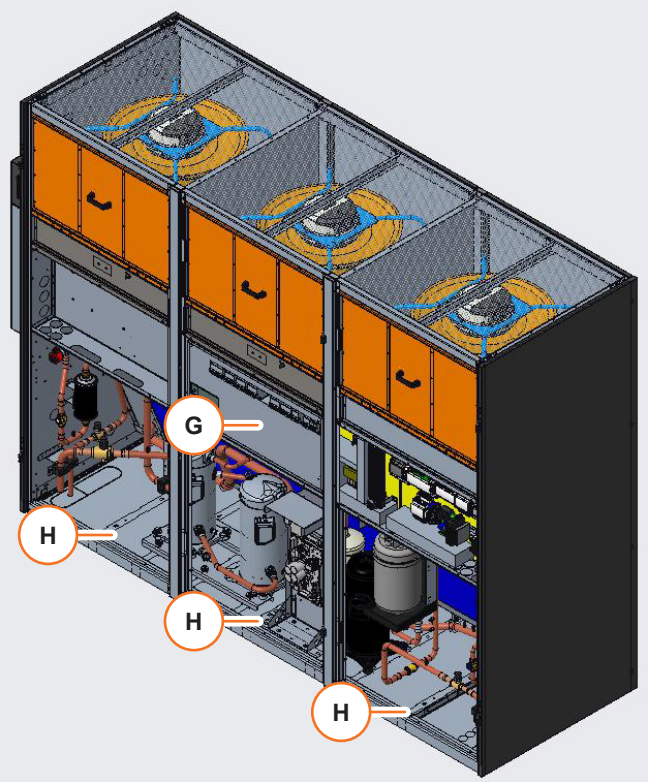
5.2 Structure

5.2.1 Standard version



Ref.	Description	Remarks
A	**Coil section**	The coil section is completely closed by panels and by the door for protection against any contact with electric parts and hot or cold surfaces.
B	**Fan section**	The fan section is completely closed by panels and grids for protection against any contact with moving parts.
C	**Control panel**	The unit is usually controlled remotely by a network connection. The control panel is optional and may be placed on the front door or inside the front door.
D	**Doors**	The doors can be opened only by the proper tool.
E	**Fan safeguards**	The fixed panels (safeguards) can be removed only by loosing the fixing screws.
F	**Rear safeguards**	

After opening the doors:

Downflow	Upflow
	

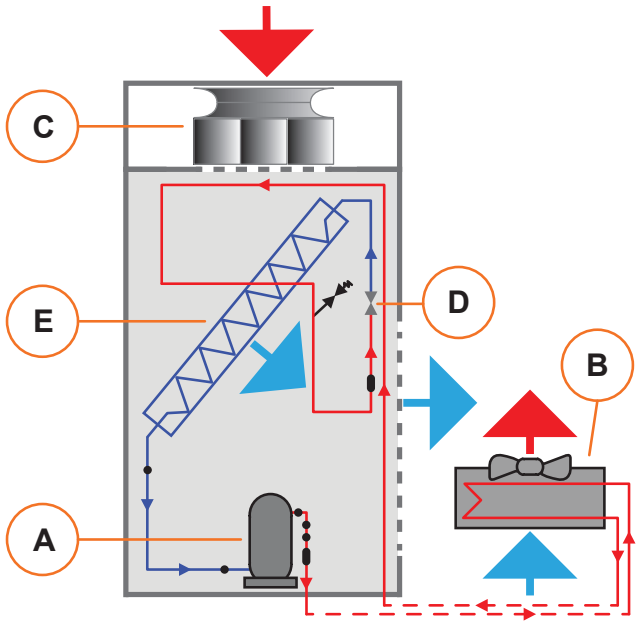
Ref.	Description	Remarks
G	**Electric and control panel safeguards**	The fixed safeguards can be removed only by loosing the fixing screws.
H	**Compressor compartment**	**For the Downflow versions:** - the fixed safeguards can be removed only by loosing the fixing screws; - the holes for inspection and access to the connectors are protected by transparent plates, fixed by screws. **For the Upflow versions:** - in order to allow free airflow through the door, there are no safeguards to close the compressor compartment.

5.3 Refrigerating System

5.3.1 Cooling versions

The **Liebert® PDX PAM UHD A** product family includes several cooling system versions.
This manual is related to units with air cooled version.
For units of the other versions, please make reference to respective manuals.

5.3.2 Main components

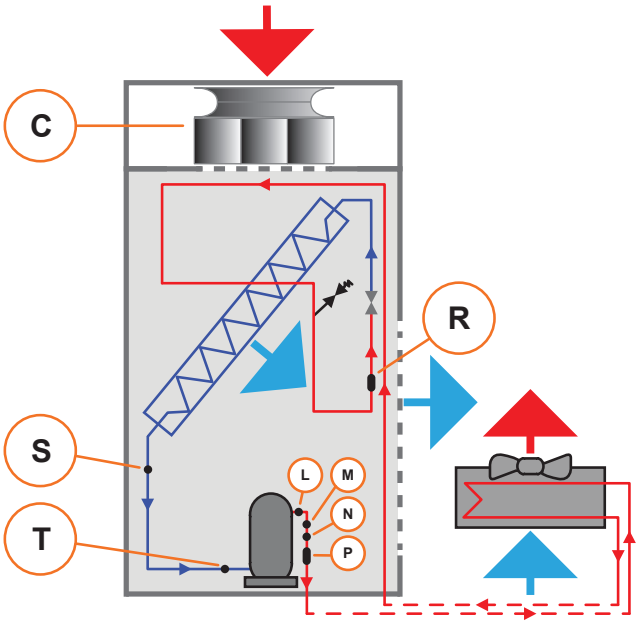


The figure shows a simplified scheme for a **Downflow** unit with a single circuit with one compressor.

The main components of the circuit the following:

A	Compressor
B	Condenser (supplied separately)
C	Fan
D	Expansion valve
E	Evaporator

Make reference to *Annex A - Refrigerating Circuit Diagrams* for details.

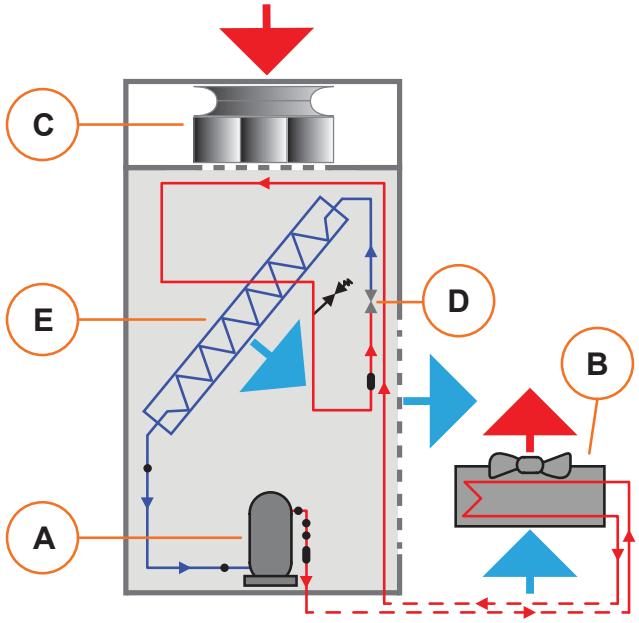


The circuit also include the following components:

L	High temperature sensor
M	High pressure switch
N	High pressure transducer
P	Oil separator (for variable speed compressors only)
R	Filter dryer
S	Temperature sensor for the expansion valve control
T	Low pressure transducer (for the expansion valve control)

Make reference to *Annex A - Refrigerating Circuit Diagrams* for details, including other relevant components of the circuit (shut-off valves, check valves, access valves).

5.3.3 Operating principle



The figure shows a simplified scheme for a **Downflow** unit with a single circuit with one compressor.

The operating principle is the same for all of the models of the A cooling version (also including **Upflow** air distribution and double or tandem circuits).

This is a direct expansion system, meaning that the refrigerant cools directly the air, without any intermediate heat exchange with other fluids.

The compressor [**A**] pumps the hot gaseous refrigerant into the outdoor air-cooled condenser [**B**].

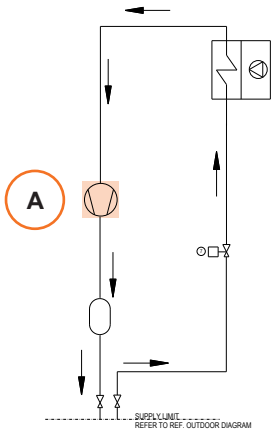
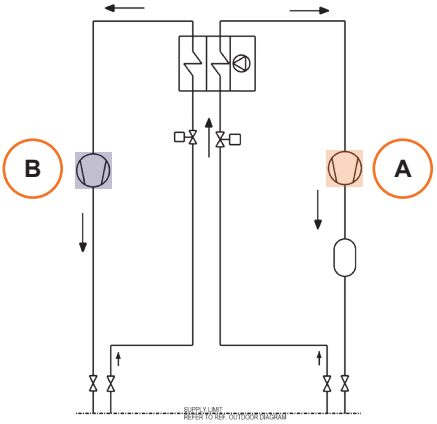
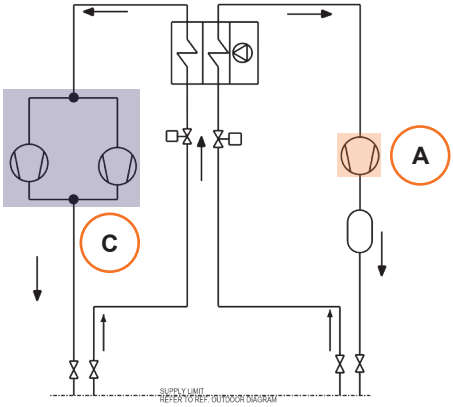
The refrigerant enters in the evaporator [**E**].

The fan [**F**] makes the warm air coming from the room to flow through the evaporator.

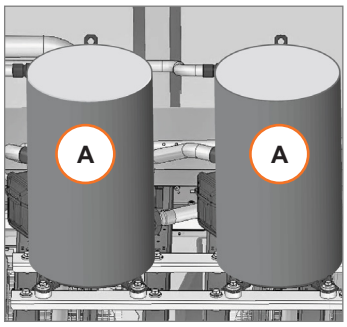
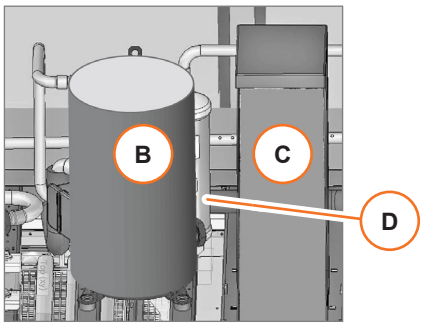
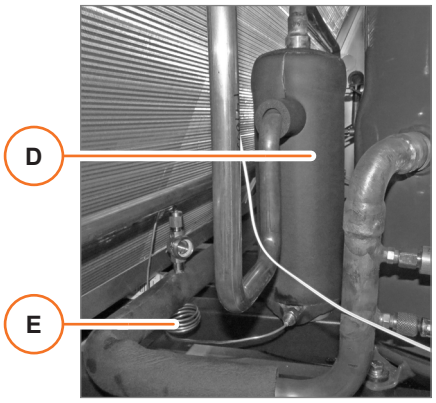
The refrigerant evaporates and cools down the air, which flows again into the room.

The refrigerant flows back to the compressor.

5.3.4 Circuit versions

Single	Double	Tandem
		
[**A**] variable speed compressor	[**A**] variable speed compressor [**B**] fixed speed compressor	[**A**] variable speed compressor [**C**] two fixed speed compressors
	The evaporators and the condensers of the two circuits are independent. The evaporators are placed one after the other in the same coil section.	

5.3.5 Compressors

	Fixed speed compressor(s)	Variable speed compressor
	The fixed speed compressor(s) are always mounted on the left side of the compressor compartment. They are present only for dual and tandem circuits.	The variable speed compressor is always present. In dual and tandem circuits the variable speed compressor is always mounted on the right side of the compartment.
		
Type	[**A**] Hermetic scroll compressor	[**B**] Hermetic scroll compressor.
Speed	Fixed	Variable, controlled by the inverter [**C**]. Speed modulation between 17% and 100% of the maximum speed.
Oil separator	Not available	 The oil separator [**D**] collects the oil at the compressor delivery. The oil returns to the piping at the compressor suction through the capillary [**E**]. The high pressure drop of the capillary keeps under control the amount of oil and the temperature of the oil that returns to the compressor, even at maximum speed.
Crankcase heater	An external crankcase heater is mounted externally, on the lower part of the compressor(s). *Function:* pre-heating of the oil / refrigerant mixture, to avoid presence of liquid at the compressor suction during the start-up. The crankcase heater may be of belt type or surface type.	
Check valve	An external check valve is mounted on the compressor discharge line. *Function:* to avoid return of liquid refrigerant from the condenser.	

5.3.6 Condensers

Each refrigerating system of the unit is connected on site to an external remote condenser which must be purchased separately.

The remote condenser must be controlled by the unit control system, therefore a **Liebert®** condenser must be used.

Liebert® PDX PAM UHD A unit can be connected only to **Liebert® OAC** condenser.

See *Table 06 - Par. 6.2.4* to check the suggested condenser size for standard rated conditions. The size of the condenser also depends on the installation configuration as explained in *Table 23 - Par. 9.3.3*.

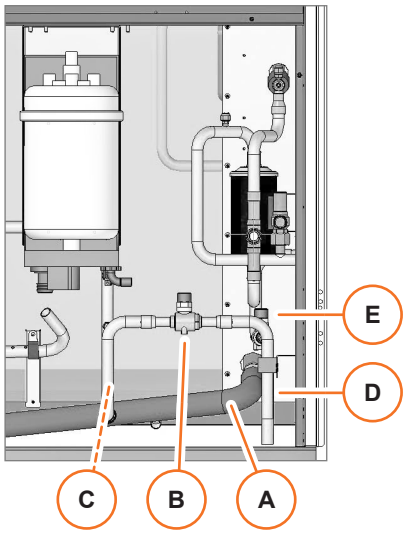
WARNING

Do not assemble or connect the unit with systems or machines that are different from what is specified in this manual for your unit.

SAFETY REQUIREMENT THAT MUST BE RESPECTED

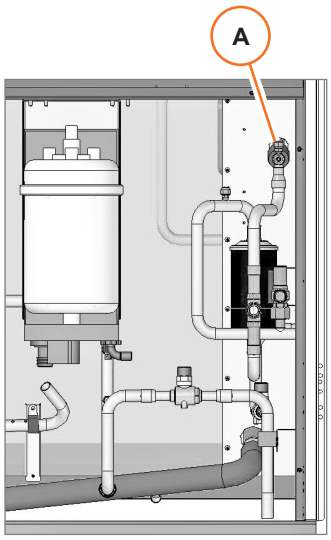
The safety valve is provided with **Liebert® OAC** external condenser. **Liebert® PDX PAM UHD A** can be connected only to **Liebert® OAC** condenser.

Contact Vertiv™ Technical Support for any question.



A	Piping - outlet to the external condenser
B	Shut-off valve at delivery to the external condenser
C	Check valve at unit outlet to the condenser *Function:* The check valves prevent unwanted refrigerant migration between the unit and the condenser in anomalous conditions.
D	Piping - inlet from the external condenser
E	Shut-off valve at inlet from the external condenser

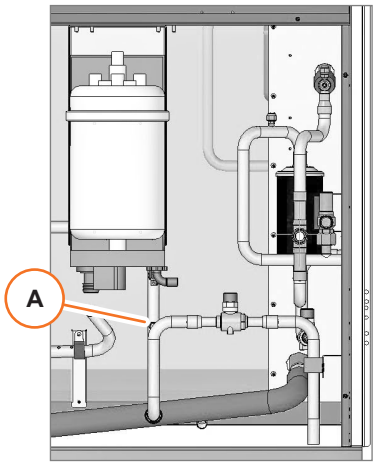
5.3.7 Expansion valve



A **Electronic expansion valve (EEV)**

The control system keeps the superheat fixed at its setpoint.

5.3.8 Safety devices



A	**High pressure switch** *Function:* Protection against too high pressure in the refrigerant circuit.
---	**High temperature sensor at compressor delivery** *Function:* Protection of the compressor against too high discharge temperature.

See *6.4 Safety Devices Settings* for details.

See also *11.6 Calibrations* for maintenance and calibration operations.

WARNING

Do not assemble or connect the unit with systems or machines that are different from what is specified in this manual for your unit.

SAFETY REQUIREMENT THAT MUST BE RESPECTED

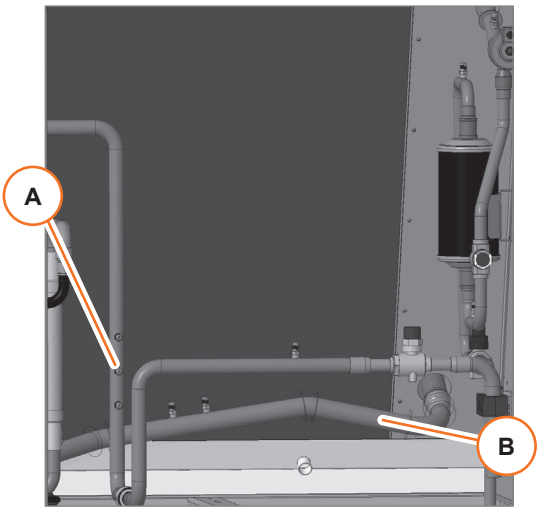
The safety valve is provided with **Liebert® OAC** external condenser. **Liebert® PDX PAM UHD A** can be connected only to **Liebert® OAC** condenser.

Contact Vertiv™ Technical Support for any question.

WARNING

Open all the shut-off valves of the system (Indoor unit **Liebert® PAM** and remote condenser **Liebert® OAC**) and seal the cups of the shut-off valve with a security seal [**H**].

5.3.9 Sensors and instruments



A **High pressure transducer**

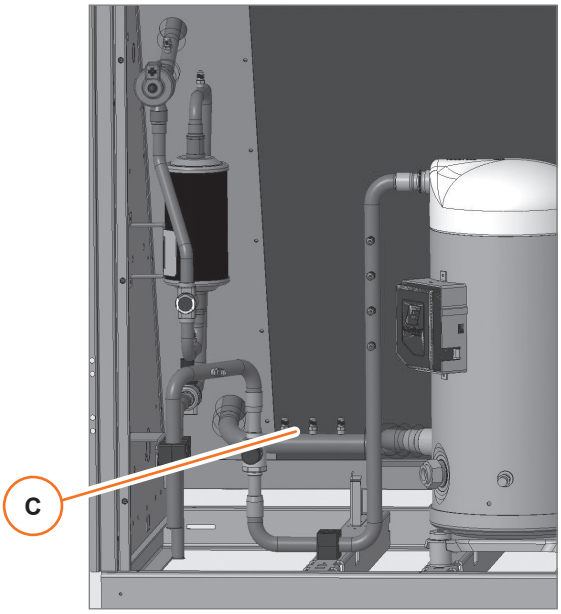
Function:

Refrigerant pressure measurement at compressor delivery.

B **Temperature sensor**

Function:

Refrigerant temperature measurement at evaporator outlet for the expansion valve control.



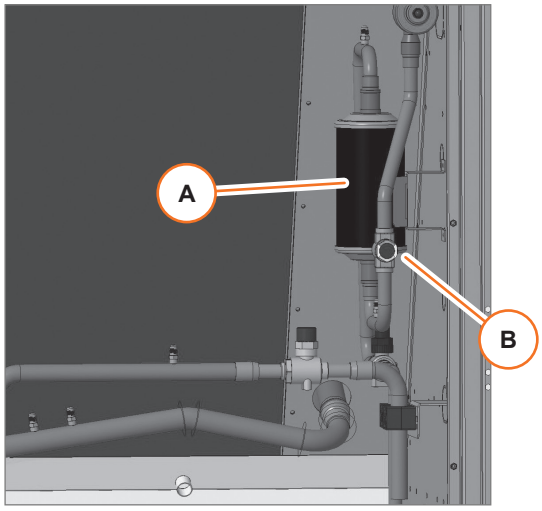
C **Low pressure transducer for the expansion valve control**

Functions:

- Measurement of the refrigerant pressure at compressor suction;
- Protection of the system against too low evaporation temperature.

NOTE *Other optional sensors may be connected to the unit by the end user. See 5.6 Modbus Connections for details.*

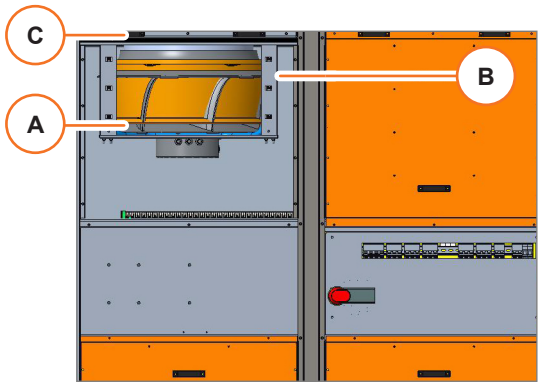
5.3.10 Filter dryer and sight glass



A	**Filter dryer** *Functions:* - **Filter:** removal of any particle such as dirt, metal or chips, to prevent that they enter into the expansion valve. - **Dryer:** removal of the moisture from the refrigerant, to prevent freezing inside the piping and formation of acids and sludge when in contact with oil in the system.
B	**Sight glass** *Function:* Check the refrigerant level and conditions (presence of bubbles, ...).

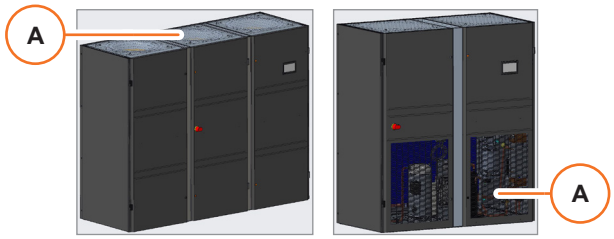
5.4 Air System

5.4.1 Fans



A	**Fan**
B	**Fan supporting frame**
C	**Protective grid** The grids protect against contact from the top.
---	The fan motors are protected by thermal magnetic circuit breakers. See *5.5 Electric and Control System* for details.

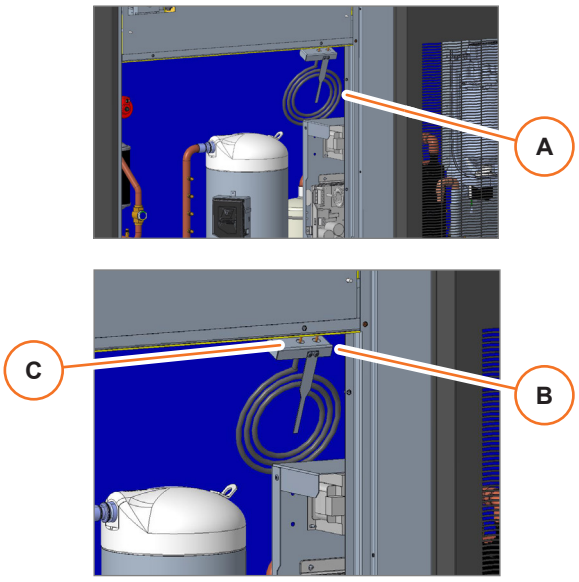
5.4.2 Filters



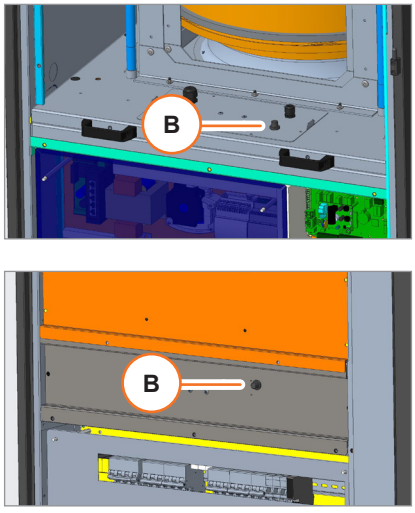
A	**Filter** The figure shows where the filters are located.
---	**Filter clog sensor** A sensor sends an alarm to the control system if the pressure difference through the filter is higher than a threshold value, meaning that the filter is clogged.

5.4.3 Heating (optional)

Downflow up and Downflow frontal



Upflow



A	**Heater**
B	**Heater temperature switch** *Function:* The temperature switch is installed on the heater. It switches **OFF** the heater if its temperature is higher than the alarm value.
C	**Reset button** *Function:* In case of activation of the temperature switch, a manual reset is required. • Press the button [**C**] to do the manual reset of the heater; • Reset the temperature alarm on iCOM™ the control panel.
---	**Safety air high temperature sensor** This sensor measures the air temperature at the unit outlet and switches **OFF** the heater if the air temperature is higher than the alarm threshold.

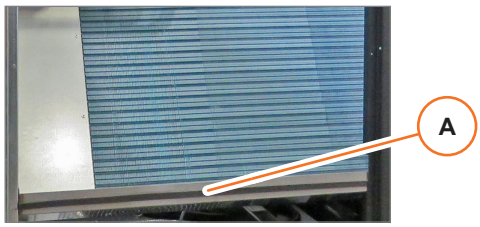
5.4.4 Humidifier (optional)

Electrode

Installed inside the machine.

See *Annex F - Electrode Humidifier*

5.4.5 Condensate tray



The tray [**A**] collects the condensate from the evaporator.

NOTE *For **Upflow** units, an optional condensate pump is available to deliver the condensate to an higher level.*

5.4.6 Sensors and instruments

- Humidity and temperature sensor for the air returning from the room into the unit;
- Temperature sensor (**NTC** type) for the air at the unit outlet.
  This sensor is normally fixed on the fan grid, but it can be moved in a remote position since its cable is more than 1 m long.

NOTE *Other optional remote temperature sensors may be connected to the unit by the end user. Only Modbus type are allowed.*

See *5.6 Modbus Connections* for details.

5.5 Electric and Control System

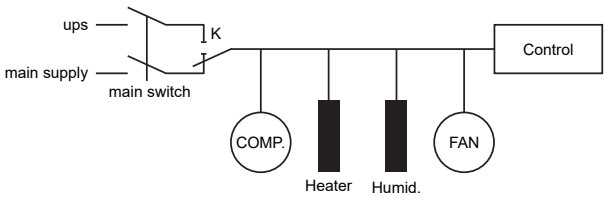
5.5.1 Standard or dual power supply

The unit may be delivered with standard power supply or optional dual power supply in order to have the units up and running if the main power supply fails.

The following table explains the main options.

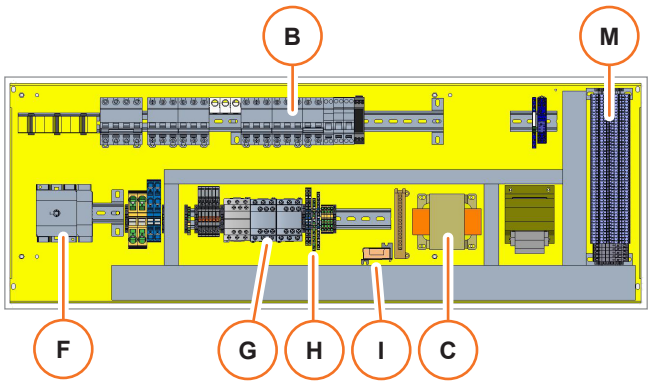
Make reference to the *Electric Diagrams* for details about your unit power supply system.

See *6. Technical Data* for the power supply relevant data and limits (voltage, frequency, ...).

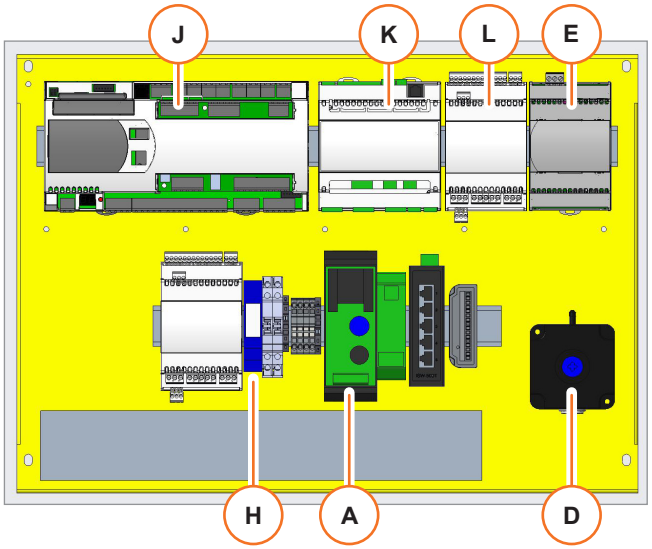
Option	Description	What happens in case of power failure	What happens when power is restored
Standard power supply	Single supply line	An **Ultracap** device supplies power to the control for about **60** seconds. The control immediately closes the **EEV**, so to avoid leakage between high and low pressure pipelines.	The unit restarts automatically. The control system reboots if the down time is more than **60** seconds.
Dual power supply alternate	Double power supply to the **ATS** electric panel, which is connected to the main electric panel. Each power supply can supply completely the unit. 	In case of failure of the main supply, the **ATS** (Automatic Transfer Switch) automatically switches to the second power supply. If the **Ultracap** avoids power interruption to the control for the time needed for the switching, then the unit restarts with a “fast startup”, which means it restarts from the status before the power failure. Otherwise the unit restarts automatically from scratch and the control system reboots. **NOTE** *The Ultracap supplies power to the control for about **60** seconds.* **NOTE** *Depending on the electric system configuration, the unit may be set to remain switched **OFF** for a certain time.*	The **ATS** remains on the second power supply until the main power supply is restored.

5.5.2 Main components

Power side (high voltage)

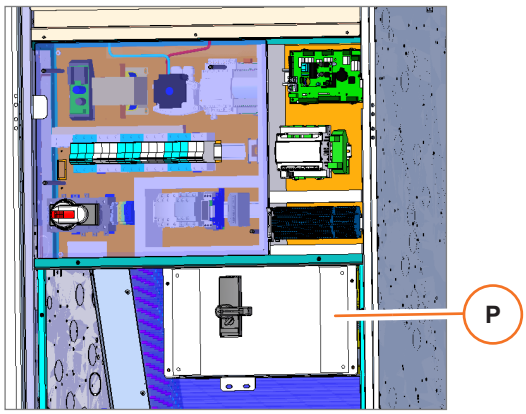


Control side (low voltage)



A	Power supply for touch screen
B	Thermal magnetic circuit breakers
C	Transformer
D	Clogged filter sensor
E	Ultracap
F	Disconnecting switch
G	Contactors
H	Relays
I	Amperometric transformer for humidifier
J	Control board
K	Humidifier control board
L	Expansion module
M	Terminal board

NOTE *The electric panel is designed and manufactured according to EN 60204-1.*



P **ATS** (Automatic Transfer Switch) electric panel (optional)

5.5.3 Disconnecting switches

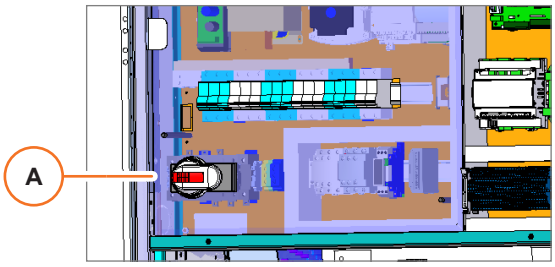
WARNING

Due to the presence of **Ultracaps** for the control, inverter and other devices, the electric and control panels can retain a stored **high-voltage electrical charge** for a certain time.

Before removing the panels and working inside the electric and control panels proceed as follows:

- Open all the local and remote disconnecting switches of the unit;
- Wait at least **5** minutes;
- Verify with a voltmeter that the power is **OFF**.

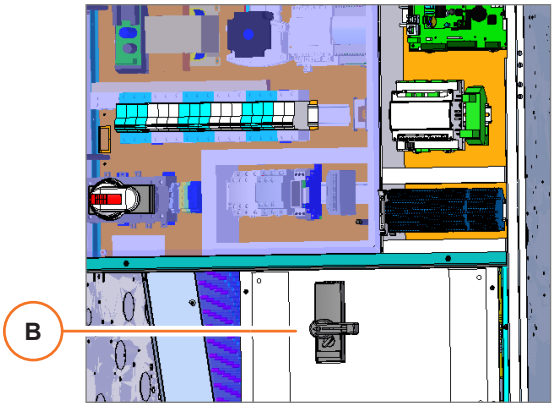
Single power supply



A **Disconnecting switch**

This is a disconnecting switch and it cuts **OFF** the electric power supply to the whole unit.

Dual alternate power supply



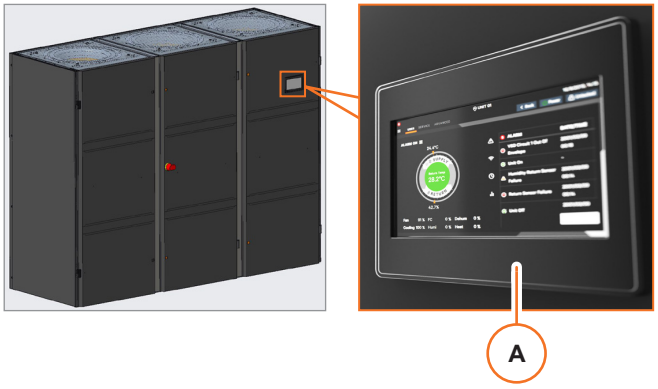
B **ATS disconnecting switch**

WARNING

The power supply is connected to the **ATS** disconnecting switch [**B**].

After you turn **OFF** the main disconnector switch and you open the door, pay attention to the cable and components that are still energized.

5.5.4 iCOM™ control panel



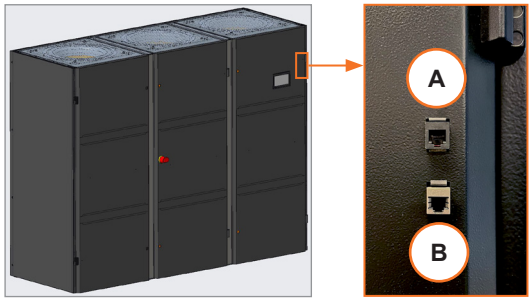
A **iCOM™ control panel**

The unit is usually controlled remotely by a network connection.

The unit may also have a iCOM™ control panel (optional) on the front door.

See the *iCOM™ User Manual* for details.

5.5.5 Ethernet connection



A	**RJ11 - CANbus** port for connection of an external display.
B	**RJ45 - Ethernet** port for connection of an external laptop (not available when the unit is equipped with iCOM™ control panel. If required, it must be selected the ethernet switch in price list option).

5.5.6 Protective functions

The control system manages all the safety and operating devices needed for reliable automatic operation.

The main alarms are briefly explained below.

Out of Envelope alarm	An alarm may occur if the control system can not keep the compressor operating point within the compressor operating map. The controlled parameters are the following: - condensation setpoint; - maximum evaporating temperature (controlled by the **EEV**).
Fixed speed compressors	The fixed speed compressors are equipped with a protection against overload.
Pressure control	High pressure and low pressure alarm.
High pressure switch	The high pressure alarm may be handled in two different ways depending on the unit model. - **Relay:** the high pressure switch sends a signal to a relay that cuts-off the power supply to the compressor. - **STO (Safe Torque Off):** the high pressure switch sends a signal to the inverter that cuts-off the power supply to the compressor (after the inverter) through a **STO** port. See *6.4 Safety Devices Settings* for the solution used for each unit model.

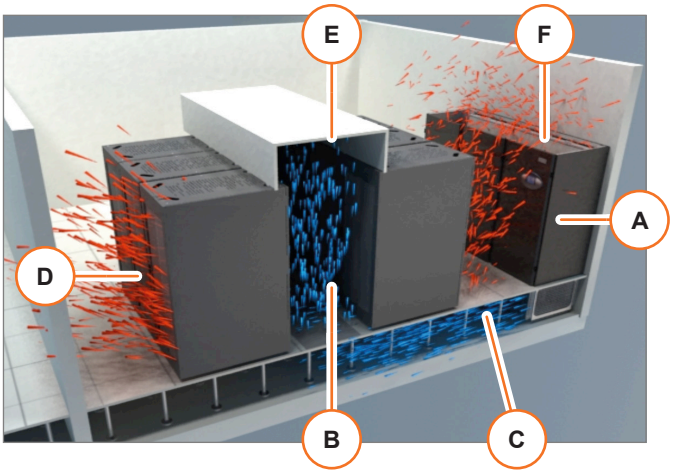
5.5.7 Fans control

Both condenser and evaporator fans are EC fans.

The unit control system adjusts the fans rotation speed depending on the operating conditions.

Protective functions	Electronics overheating protection. Motor overheating protection. Locked rotor protection. Short circuit at the motor output.
Condenser fans (remote)	Connection to the unit through Modbus protocol. If the Modbus connection is interrupted, then the fans continue to run at a preset speed. Speed adjustment between 0 and 100% of the maximum speed. The input parameters for the speed adjustment are the following: - compressor delivery pressure (measured by the pressure transducer); - outdoor temperature (measured by an optional remote sensor in the condenser). **NOTE** *It is possible to set a limit to the maximum speed in order to reduce the noise emission.*
Evaporator fans (inside the unit)	Speed adjustment between 30% and 100% of the maximum speed

5.5.8 Smart Aisle™



The **Liebert® PDX PAM UHD A** units can be used in a **Smart Aisle™** system.

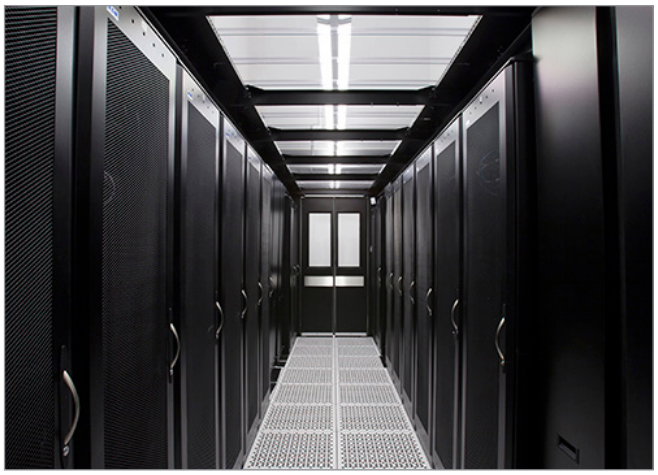
The **Smart Aisle™** is a **Liebert®** patented system for the control of the units in a room with cold aisle arrangement.

The **Liebert® PDX PAM UHD A** unit [**A**] blows the **cold air** into the **Smart Aisle™** [**B**] through the raised floor [**C**].

The **hot air** coming from the active equipment [**D**] returns to the **Liebert® PDX PAM UHD A** unit [**A**].

The unit airflow is managed by the fan speed modulation according to the readings from remote temperature sensors [**E**] installed on the border of cold/hot aisle area.

The unit can be equipped with optional motorized dampers [**F**] on the air suction.



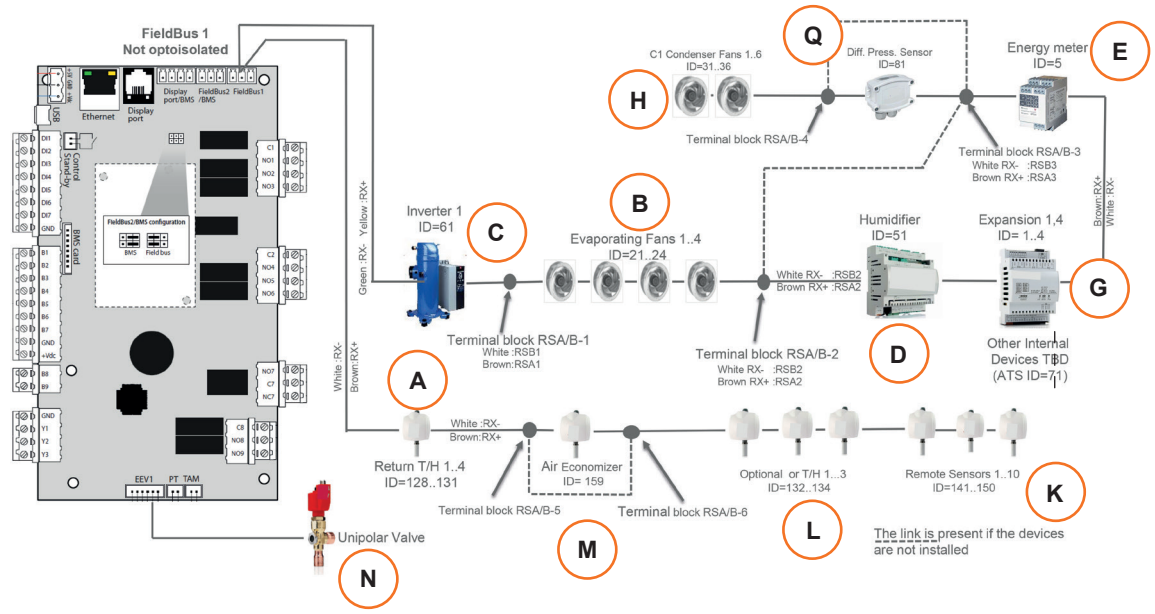
5.6 Modbus Connections

5.6.1 General description

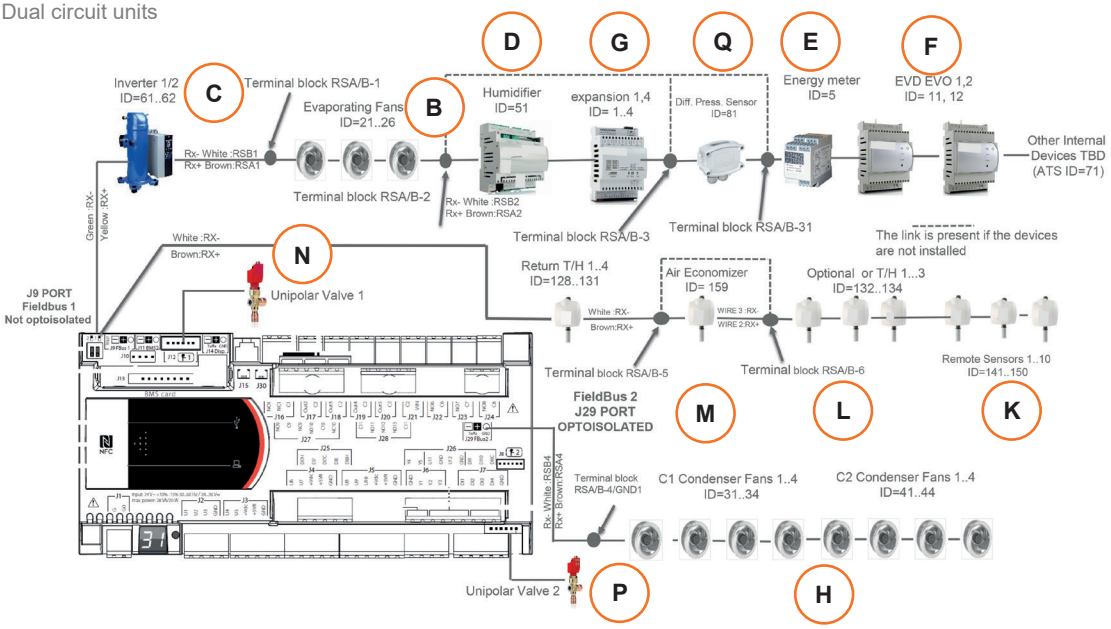
The control system can manage different devices via Modbus.

The following figures show the architecture and detail of the structure.

Single circuit units



Dual circuit units



A	Return sensor T+H (up to 4)
B	Evaporating fans (up to 6)
C	Inverter compressor (up to 2)
D	Humidifier
E	Energy meter (not available as standard)
F	EEV driver (up to 2)
G	Expansion board
H	Condensing fans (up to 4 per circuit)

J	Other internal devices
K	Remote sensors T or T+H (up to 10)
L	Optional sensors T or T+H (up to 3)
M	Air Economizer sensor T+H
N	Unipolar valve 1
P	Unipolar valve 2
Q	Diff. Press. Sensor

Settings

The internal connections and the related settings are factory made, but you may need to connect more remote devices at the installation or modify the settings of some Modbus devices.

In that case, you need to redo the settings for the Modbus connection. See *9.6 Modbus Connections and Settings*.

5.6.2 Fan management

Speed control

The fan speed can be managed in one of the following ways:

Return sensor	The fan speed is modulated from minimum value to maximum value following the return temperature deviation.
Supply sensor	The fan speed is modulated from minimum value to maximum value following the supply temperature deviation.
Remote sensor	The fan speed is modulated from minimum value to maximum value following the remote temperature deviation.
Delta (Temperature difference)	The control tries to achieve a fixed temperature difference between return temperature and supply temperature. When the temperature difference is inside the dead band the fan speed will not change. When the temperature difference is outside the dead band the control will change (increasing or decreasing) the speed of the fan trying to put the temperature difference inside the dead band. - If the temperature difference Return - Supply is lower than the difference setpoint, then the fan will decrease the speed. - If the temperature difference Return - Supply is higher than the difference setpoint, then the fan will increase the speed.
Static pressure	The speed of the evaporating fans are modulated in order to keep fixed the static pressure in the raised floor. When the pressure is inside the dead band the fan speed does not change; when the pressure is outside the dead band the control increases or decreases the speed of the fan trying to put the pressure inside the dead band.
Fixed speed	During normal operation the fan will operate at the fixed speed set.

Fan speed override

The fan speed can be limited or overwritten in the following cases:

Compressor(s) ON	The minimum fan speed cannot be lower than 30%.
High temperature alarm	The fan will run at defined speed. This feature can be enabled or disabled.
No power	The fan will run at defined speed.
Modbus high speed operation	If enabled in case of single fan failure or single fan communication failure (or up to N-1), the remaining fans will be forced to maximum speed.
Fan and cooling forcing by user (cool/fan 100%)	The fan will run at 100%.
Heating ON Humidification ON Dehumidification ON	The fan will run at defined speed. If a higher call for fans speed occurs, the fan will operate at the higher call.

5.6.3 Compressors management

A dedicated unit code defines the circuits and compressor number setting and related I/O to be managed.

“The minimum inverter compressor speed is set at 25% of maximum compressor velocity. The minimum speed could be decrease to the minimum compressor’s velocity through a software parameter”.

Circuit Priority for Cooling

A dedicated parameter defines the circuit activation priority for cooling:

1 First	This selection forces a defined sequence that is not respected only in case of alarms or **OFF** timings. **Circuit 1** is used as lead circuit.
2 First	This selection forces a defined sequence that is not respected only in case of alarms or **OFF** timings. **Circuit 2** is used as lead circuit.
Auto	Activation is based on working hours (or starts), so the first chosen is the circuit with the compressor with less hours (or starts).

Priority selection rules for two circuits:

1 Modulating compressor + 1 Fix compressor	= Forced to “2 first” because compressor on **circuit 2** is modulating
1 Modulating compressor + 1 Tandem fix	= Forced to “2 first” because compressor on **circuit 2** is modulating The compressor start sequence in the same circuit is based on the working hours or starts (like “Automatic”).

If a modulating compressor is present (and available with no alarms or **OFF** timings) it is always engaged with higher priority. For the **Liebert® PDX PAM UHD A** units the modulating compressor is placed in the **circuit 2**.

In case of double circuit, balanced mode is always applied: once a circuit is selected and first compressor is defined, the next compressor will be one on the other circuit.

OFF sequence is always defined by **FIFO** (First In – First Out) logic.

Circuit Priority for Dehumidification

A dedicated parameter defines the circuit activation priority for dehumidification:

Circ1	**Circuit 1** only is used for dehumidification. In case of alarm the other circuit will not be activated.
Circ2	**Circuit 2** only is used for dehumidification. In case of alarm the other circuit will not be activated.
Both	**Both circuits** (with different activation/de-activation points) are used for dehumidification.

Usually the circuit number 2 is the designated one for dehumidification.

If a compressor is running for cooling request, and a dehumidification request arrives:

Designated for dehumidification	The compressor remains active, till the cooling or dehumidification request is valid.
Not designated for dehumidification	The compressor remains active, till the cooling request is valid. The other compressor designated for dehumidification will start in addition to the first one.

Compressor Timings

Compressor minimum ON time	**180** seconds as default value
Compressor minimum OFF time	**180** seconds as default value **NOTE** *Minimum compressor **OFF** time for VSD compressor cannot be set lower than **10** seconds.*
Start to next start activation delay	**360** seconds (according to supplier indication)
Activation delay between different circuits	**30** seconds
Activation delay between compressors in the same circuit	**120** seconds
Manual mode	In case of compressor driven in manual mode the above timings are not respected.
Fast start	Compressor minimum **OFF** Time: it is internally reduced to **10** seconds for VSD compressor or **0** seconds for fixed compressor. Start to Next Start Activation delay: Not considered. **NOTE** *The compressor starts cannot exceed the limit of **10** per hour.* Activation delay between different circuits: Reduced to **8** seconds. Activation delay between tandem compressors in the same circuit: Reduced to **8** seconds.

DX Restart Timings in case of fast start

- After a power cycle, if the main control board is kept alive by the **Ultracapacitor** (power loss lower than **1** minute), the first DX circuit will restart (if required) within **20** seconds. The second DX circuit is allowed to start **8** seconds later the first one.
- After a power cycle, if the main control board is **OFF** (power loss higher than **1** minute or **Ultracapacitor** is down), the first DX circuit will restart (if required) within **80** seconds. The second DX circuit is allowed to start **8** seconds later the first one. Those delays are due to the main control board rebooting time.

NOTE 1 *With Fast Start enabled, the watchdog feature is also activated on both evaporating and condensed fans. This means that these depart as soon as the unit is powered by missing the Modbus signal from control as it is starting.*

NOTE 2 *Before turning the main power switch **OFF**, **shut down** the unit by the control (throught he switch inside the electrical panel).*

NOTE 3 *ATS minimum switching time must be set at **3** seconds*

Variable Speed Compressor Startup Routine

Compressor	The compressor will start at defined speed for defined time.
Dual circuit unit	The compressor is kept **OFF** during the **EEV** valve preopening routine.
Single circuit unit	When the compressor starts, the **EEV** valve is kept closed until the condensing evaporating pressure difference exceeds the minimum pressure difference.

6. Technical Data

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6.1 Structure

Table 03 - Frames and air distribution

Unit model	Frame type	Number of bays	U Upflow	H Downflow Frontal	D Downflow Up
PAM010	0	1	YES	YES	YES
PAM020	1	1	YES	YES	YES
PAM030	1	1	YES	YES	YES
PAM060	3	2	YES	YES	YES
PAM080	5	3	YES	YES	YES

6.2 Refrigerating System

6.2.1 Refrigerant Type

WARNING

All the data given in this manual refer to systems using **R-513A** as refrigerant.

6.2.2 Circuit versions

For double circuit models:

- **Refrigerant circuit 1:** compressor/s on the **left** side (**fixed speed compressor/s**);
- **Refrigerant circuit 2:** compressor on the **right** side (**variable speed compressor**).

For single circuit models:

- There is only r**efrigerant circuit 1** (variable speed compressor).

Table 04 - Circuit version

Unit model	Number of circuits	Refrigerant Circuit 1	Refrigerant Circuit 2
PAM010	1	1 x Variable speed compressor	---
PAM020	1	1 x Variable speed compressor	---
PAM030	1	1 x Variable speed compressor	---
PAM060	2	1 x Fixed speed compressor	1 x Variable speed compressor
PAM080	2	2 x Fixed speed compressor	1 x Variable speed compressor

6.2.3 Inverter derating factors

Table 05 - Refrigerating system - Inverter derating factors

Unit model	
PAM010 **PAM020** **PAM030** **PAM060** **PAM080**	For altitudes below 1000 m no derating is required. For altitudes between 1000 m and 2000 m, apply the following derating factors: - decrease the output current by 1% per 100 m of altitude above 1000 m; - or otherwise reduce the maximum ambient temperature by 1°C per 200 m of altitude above 1000 m. For altitudes above 2000 m please contact Vertiv™ Technical Support.

6.2.4 Remote condensers models

WARNING

Do not assemble or connect the unit with systems or machines that are different from what is specified in this manual for your unit.

SAFETY REQUIREMENT THAT MUST BE RESPECTED

The safety valve is provided with **Liebert® OAC** external condenser. **Liebert® PDX PAM UHD A** can be connected only to **Liebert® OAC** condenser.

Contact Vertiv™ Technical Support for any question.

Table 06 - Refrigerating system - Remote condensers models Liebert® OAC finned tube condensers

Unit model	Refrigerant circuit 1				Refrigerant circuit 2			
	t < 35°C	35°C < t < 40°C	40°C < t < 46°C	t > 46°C	t < 35°C	35°C < t < 40°C	L40°C < t < 46°C	t > 46°C
PAM010	OAC17	OAC17	OAC33	OAC33	---	---	---	---
PAM020	OAC33	OAC33	OAC33	OAC42	---	---	---	---
PAM030	OAC42	OAC42	OAC58	OAC58	---	---	---	---
PAM060	OAC42	OAC42	OAC58	OAC58	OAC42	OAC42	OAC58	OAC58
PAM080	OAC58	OAC58	OAC87	OAC87	OAC58	OAC58	OAC87	OAC87

6.2.5 Refrigerant piping diameters and thickness

Table 07 - Refrigerant piping diameters and thickness - single circuit models

Unit model	Refrigerant circuit	Gas		Liquid	
		External diameter	Thickness	External diameter	Thickness
		[mm]	[mm]	[mm]	[mm]
PAM010	**C1**	18	1,0	16	1,0
PAM020	**C1**	22	1,5	16	1,0
PAM030	**C1**	22	1,5	18	1,0
PAM060	**C1**	22	1,5	18	1,0
	C2	22	1,5	18	1,0
PAM080	**C1**	28	1,5	22	1,5
	C2	22	1,5	18	1,0

NOTE *Data valid for equivalent length up to 100 m and R513A refrigerant.*

6.2.6 Refrigerant charge

The following table gives an estimation of the refrigerant amount needed to charge a system made of the following components:

- the unit;
- remote condenser(s) selected for an ambient temperature of 35°C, **Liebert® OAC (finned and tube type)**;
- piping with an equivalent length of 30 m.

The precise amount of refrigerant charge must be determined by the installer as explained in *9.7 Refrigerant Charge*.

Table 08 - Charge [kg] of refrigerant for the reference system

Unit model	System with Liebert® OAC condenser(s)	
	Refrigerant circuit 1 [kg]	Refrigerant circuit 2 [kg]
PAM010	16.8	---
PAM020	18.7	---
PAM030	24.9	---
PAM060	25.1	25.1
PAM080	37.3	31.6

6.2.7 Compressor oil

The units are delivered with the compressor already containing the initial amount of oil given in the following table.

Table 09 - Oil type and initial amount for units with 50Hz power supply

Unit model	Refrigerant circuit 1		Refrigerant circuit 2	
	Oil type	Initial oil charge [dm³]	Oil type	Initial oil charge [dm³]
PAM010	FVC56EA	1,20	---	---
PAM020	FVC56EA	1,20	---	---
PAM030	FVC56EA	0,90	---	---
PAM060	POE RL32-3MAF	3,38	FVC56EA	0,9
PAM080	POE RL32-3MAF	2 x 1,89	FVC56EA	0,9

6.3 Air System

Table 10 - Air system - Fans number and weight

Unit model	High Power EC Fan Module		EC Fan Module	
	Fan Number	Weight [kg]	Fan Number	Weight [kg]
PAM010	1	47,5	1	37,5
PAM020	1	47,5	1	37,5
PAM030	1	47,5	1	37,5
PAM060	2	52,9	2	47,2
PAM080	3	52,9	3	47,2

NOTE *Values given for each single fan.*

6.4 Safety Devices Settings

Table 11 - Safety devices settings

Unit model	High pressure alarm management		Safety devices settings	
	Refrigerant circuit 1	Refrigerant circuit 2	Refrigerant circuit 1	Refrigerant circuit 2
PAM010	STO	---	Open 20,8 +0/-1,4 bar(g) Manual reset 14,8 ±2 bar(g) Normally closed Durability 10000 times	---
PAM020	STO	---	Open 20,8 +0/-1,4 bar(g) Manual reset 14,8 ±2 bar(g) Normally closed Durability 10000 times	---
PAM030	STO	---	Open 20,8 +0/-1,4 bar(g) Manual reset 14,8 ±2 bar(g) Normally closed Durability 10000 times	---
PAM060	Relay	STO	Open 20,8 +0/-1,4 bar(g) Manual reset 14,8 ±2 bar(g) Normally closed Durability 10000 times	Open 20,8 +0/-1,4 bar(g) Manual reset 14,8 ±2 bar(g) Normally closed Durability 10000 times
PAM080	Relay	STO	Open 20,8 +0/-1,4 bar(g) Manual reset 14,8 ±2 bar(g) Normally closed Durability 10000 times	Open 20,8 +0/-1,4 bar(g) Manual reset 14,8 ±2 bar(g) Normally closed Durability 10000 times

Relay	The high pressure switch sends a signal to a relay that cuts-off the power supply to the compressor.
STO (Safe Torque Off)	The high pressure switch sends a signal to the inverter that cuts-off the power supply to the compressor (after the inverter) through a **STO** port.

6.5 Electrical System

6.5.1 Unit electrical data

General remarks

- The cables have to be sized in compliance with local standards and according to the type and characteristics (for example Amperes) of installation.
- The recommended wires size have been determined considering the maximum electrical heaters capacity selectable and the maximum humidifier capacity selectable.
- The data in the tables do not consider the absorbed current from the condensate pump and for other options not explicitly described.
- The specific energy allowed to flow from the circuit breakers, installed by the user, must be lower than 300.000 A^2s.
- Prescriptions on the differential relay required to the user:
  - For special places (healthcare facilities, etc...) comply with the local regulations;
  - For ordinary places, a low sensitivity is suggested (300 mA) coordinated with the value of the earth resistance (IEC 364): Ra 50/Ia (Art. 413.1.4.1, CEI 64-8 or IEC 60364-4-45);
  - In case of frequent over-voltages with mains impulse, it is advisable Io install a selective differential and to evaluate the need for adopting other devices;
  - The FLA is for units without the options of condensate pump and condensing unit;
  - The FLA is for units with AUTOMATIC FUNCTIONS only: in manual mode operation the FLA must be lower than the maximum current of the main switch;
- The Modbus wiring is field-supplied and must be:
  - Shielded;
  - 24-18 AWG (0.20-0.82 mm^2) stranded tinned copper until 107 m, 18AWG (0.75 mm^2) stranded tinned copper until 130 m;
  - Twisted pair (minimum 8 twists per foot);
  - Low capacitance (17pF/ft or less);
  - Plenum rated (NEC type CMP) if required by local codes;
  - UV and moisture resistant or run within conduit once in an outdoor environment, and must be temperature and voltage rated for conditions present.

Examples: Belden part number 89207 (plenum rated) or Alpha Wire part number 6454 (UV resistant outdoor rated) category 5, 5e or higher.

CAUTIONS

Do not run the Modbus cable in the same conduit, raceway or chase used for high-voltage wiring.

Mandatory shield connection to ground close Master (indoor unit control board).

For Modbus network lengths greater than 130 m, contact Vertiv™ for assistance.

Units with power supply 400 V / 3ph + N / 50 Hz + Earth

Table 12 - Electrical data for cooling only - 400 V / 3ph + N / 50 Hz + Earth

Unit model	High Power EC Fan Module				EC Fan Module				Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]
	FLA TOT [A]	LRA [A]	Reccomended circuit breaker (1)	Power factor cosφ	FLA TOT [A]	LRA [A]	Reccomended circuit breaker (1)	Power factor cosφ		
PAM010	28	28	32	0,90	29	29	40	0,90	5G 10mm² or 3x10 + 1x10 + 1x10 mm²	1.5...35mm²
PAM020	28	28	32	0,90	29	29	40	0,90	5G 10mm² or 3x10 + 1x10 + 1x10 mm²	1.5...35mm²
PAM030	36	36	50	0,90	37	37	50	0,90	5G 10mm² or 3x10 + 1x10 + 1x10 mm²	1.5...35mm²
PAM060	68	163	80	0,86	67	162	80	0,86	5G 25mm² or 3x25 + 1x16 + 1x16mm²	10...70mm²
PAM080	84	170	100	0,87	82	168	100	0,87	5G 35mm² or 3x35 + 1x16 + 1x16mm²	10...70mm²

(1) Recommended circuit breaker size breaker C curve, RCD Idn=0,3A type B or B++
(2) PVC insulated Cu cables 40°C see tab.6 EN60204-1 B1

Table 13 - Electrical data for cooling + heating - 400 V / 3ph + N / 50 Hz + Earth

Unit model	High Power EC Fan Module				EC Fan Module				Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]
	FLA TOT [A]	LRA [A]	Reccomended circuit breaker (1)	Power factor cosφ	FLA TOT [A]	LRA [A]	Reccomended circuit breaker (1)	Power factor cosφ		
PAM010	34	34	40	0,94	35	35	40	0,94	5G 10mm² or 3x10 + 1x10 + 1x10 mm²	1.5...35mm²
PAM020	34	34	40	0,94	35	35	40	0,94	5G 10mm² or 3x10 + 1x10 + 1x10 mm²	1.5...35mm²
PAM030	42	42	50	0,93	43	43	50	0,93	5G 10mm² or 3x10 + 1x10 + 1x10 mm²	1.5...35mm²
PAM060	75	170	100	0,89	74	169	100	0,89	5G 25mm² or 3x25 + 1x16 + 1x16mm²	10...70mm²
PAM080	90	176	125	0,90	89	175	125	0,90	5G 35mm² or 3x35 + 1x16 + 1x16mm²	10...70mm²

(1) Recommended circuit breaker size breaker C curve, RCD Idn=0,3A type B or B++
(2) PVC insulated Cu cables 40°C see tab.6 EN60204-1 B1

Table 14 - Electrical data for cooling + humidification - 400 V / 3ph + N / 50 Hz + Earth

Unit model	High Power EC Fan Module				EC Fan Module				Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]
	FLA TOT [A]	LRA [A]	Reccomended circuit breaker (1)	Power factor cosφ	FLA TOT [A]	LRA [A]	Reccomended circuit breaker (1)	Power factor cosφ		
PAM010	31	31	40	0,92	32	32	40	0,92	5G 10mm² or 3x10 + 1x10 + 1x10 mm²	1.5...35mm²
PAM020	31	31	40	0,92	32	32	40	0,92	5G 10mm² or 3x10 + 1x10 + 1x10 mm²	1.5...35mm²
PAM030	39	39	50	0,92	40	40	50	0,92	5G 10mm² or 3x10 + 1x10 + 1x10 mm²	1.5...35mm²
PAM060	72	167	100	0,87	70	165	100	0,87	5G 25mm² or 3x25 + 1x16 + 1x16mm²	10...70mm²
PAM080	93	179	125	0,90	91	177	125	0,90	5G 35mm² or 3x35 + 1x16 + 1x16mm²	10...70mm²

(1) Recommended circuit breaker size breaker C curve, RCD Idn=0,3A type B or B++
(2) PVC insulated Cu cables 40°C see tab.6 EN60204-1 B1

6.5.2 Fans

Table 15 - Fans electrical data

Unit model	High Efficency EC Fan Module		High Power EC Fan Module	
	Motor Size [kW]	FLA @ 400V 50Hz	Motor Size [kW]	FLA @ 400V 50Hz
PAM010	1,90	3,1	2,60	4,2
PAM020	1,90	3,1	2,60	4,2
PAM030	1,90	3,1	2,60	4,2
PAM060	3,35	6,2	3,50	5,6
PAM080	3,35	6,2	3,50	5,6

NOTE *Values given for each single fan. The model is for 50 Hz.*

6.5.3 Compressors

Table 16 - Compressors electrical data for 400 V / 3ph / 50 Hz

Unit model	Operating Ampere [A]		FLA [A]		LRA [A]		Nominal Power [kW]		Widing Resistance [Ω]	
	Fixed Speed	Variable Speed	Fixed Speed	Variable Speed	Fixed Speed	Variable Speed	Fixed Speed	Variable Speed	Fixed Speed	Variable Speed
PAM010	--	--	---	18,0	---	18	---	10,50	---	1,23
PAM020	--	--	---	18,0	---	18	---	10,50	---	1,23
PAM030	--	--	---	24,0	---	24	---	14,00	---	0,37
PAM060	--	--	23,0	24,0	118	24	--	14,00	1,23	0,37
PAM080	--	--	15.9+15.9	24,0	102+102	24	--	14,00	1.72+1.72	0,37

6.5.4 Electrical heaters

Table 17 - Electrical heaters data

Unit model	400 V / 3ph / 50 Hz	
	FLA [A]	Nominal Power [kW]
PAM010	6,5	1,50
PAM020	6,5	1,50
PAM030	6,5	1,50
PAM060	6,5	1,50
PAM080	13,0	3,00

6.5.5 Electrode humidifier

Table 18 - Electrode humidifier electrical data

Unit model	400 V / 3ph / 50 Hz	
	FLA [A]	Nominal Power [kW]
PAM010	3,2	2,25
PAM020	3,2	2,25
PAM030	3,2	2,25
PAM060	3,2	2,25
PAM080	8,7	6,00

6.5.6 Condensate pump

Table 19 - Condensate pump electrical data

Unit model	FLA [A]	Nominal Power [kW]
All models	1,6	0,15

NOTE *Available only for **Upflow** units and for 400 V / 3ph / 50 Hz power supply*

Condensate pump outlet connection: internal diameter 20 mm

As an option it is possible to have **Upflow** unit with a condensate pump that allows draining of the water up to 3 m above the floor.

The pump discharges both condensate water from exchange coil and drain water from humidifier (if installed).

Maximum discharge total head allowed 3 m (head + hydraulic connection loss); the final drain must be able to receive 10 l/min water at high temperature (max water temperature 80°C).

6.6 Noise Level

Measurement conditions: Inverter scroll cooling system@100% cooling capacity, High Power EC fan module, max airflow.

Table 20 - Sound Power Level [dB] - Upflow configuration

Unit model	Mode	Level	Octave band frequency (Hz)									Sound level [dB(A)]
			31,5	63	125	250	500	1000	2000	4000	8000	
PAM010	(1)	SPL	62,2	62,2	65,3	71,7	64,8	56,2	53,4	52,9	49,2	66,6
	(2)	SPL	62,2	62,2	65,3	71,7	64,8	56,4	55,3	53,7	50	66,8
	(3)	PWL	64,4	64,4	70,9	80,2	75,5	73,4	69,5	66,4	64,7	78,6
PAM020	(1)	SPL	63,2	63,2	66,3	72,7	65,8	57,2	54,4	53,9	50,2	67,6
	(2)	SPL	63,2	63,2	66,8	72,7	65,9	57,9	57,4	56,1	51,8	68,1
	(3)	PWL	65,4	72,1	79	87,8	83,2	81,5	78,3	75,5	73,1	86,8
PAM030	(1)	SPL	62,9	62,9	66	72,4	65,5	56,9	54,1	53,6	49,9	67,3
	(2)	SPL	62,9	62,9	66,1	72,4	65,6	57,4	56,4	54,5	53,4	67,7
	(3)	PWL	65,1	71,8	78,3	87,5	82,9	81	77,3	73,9	74,7	86,3
PAM060	(1)	SPL	51,8	54,9	65,9	62,9	64,9	63,9	62,9	60,9	52,9	69,3
	(2)	SPL	54	56,6	67,6	64,6	65	65,3	63,5	63,6	54,3	70,6
	(3)	PWL	91,8	89,6	81,2	79,7	80,3	82,1	77,9	76,2	71,4	85,8
PAM080	(1)	SPL	56,8	59,8	70,8	67,8	69,8	68,8	67,8	65,8	57,8	74,2
	(2)	SPL	56,8	59,8	70,8	67,8	69,9	70,2	68,5	68,5	59,2	75,5
	(3)	PWL	92,8	92,8	84,4	82,9	85,2	87	82,9	81,1	76,3	90,6

Table 21 - Sound Power Level [dB] - Downflow Up configuration

Unit model	Mode	Level	Octave band frequency (Hz)									Sound level [dB(A)]
			31,5	63	125	250	500	1000	2000	4000	8000	
PAM010	(1)	SPL	63,2	63,2	66,3	72,7	65,8	57,2	54,4	53,9	50,2	67,6
	(2)	SPL	63,2	63,2	66,3	72,7	65,8	57,4	56,3	54,7	51	67,8
	(3)	PWL	65,4	65,4	71,9	81,2	76,5	74,4	70,5	67,4	65,7	79,6
PAM020	(1)	SPL	64,2	64,2	67,3	73,7	66,8	58,2	55,4	54,9	51,2	68,6
	(2)	SPL	64,2	64,2	67,8	73,7	66,9	58,9	58,4	57,1	52,8	69,1
	(3)	PWL	66,4	73,1	80	88,8	84,2	82,5	79,3	76,5	74,1	87,8
PAM030	(1)	SPL	64	64	67,1	73,5	66,6	58	55,2	54,7	51	68,4
	(2)	SPL	64	64	67,2	73,5	66,7	58,5	57,5	55,6	54,5	68,8
	(3)	PWL	66,2	72,9	79,4	88,6	84	82,1	78,4	75	75,8	87,4
PAM060	(1)	SPL	50,9	54	65	62	64	63	62	60	52	68,4
	(2)	SPL	53,1	55,7	66,7	63,7	64,1	64,4	62,6	62,7	53,4	69,7
	(3)	PWL	90,9	88,7	80,3	78,8	79,4	81,2	77	75,3	70,5	84,9
PAM080	(1)	SPL	54,7	57,7	68,7	65,7	67,7	66,7	65,7	63,7	55,7	72,1
	(2)	SPL	54,7	57,7	68,7	65,7	67,8	68,1	66,4	66,4	57,1	73,4
	(3)	PWL	90,7	90,7	82,3	80,8	83,1	84,9	80,8	79	74,2	88,5

LEGEND

The sound levels global and for each octave band are expressed in dB with a tolerance of (0/+2) dB.
(1) Unit SPL Fan (2m, f.f.,dB).
(2) Unit SPL Fan+comp (2m, f.f.,dB).
(3) Unit PWL Fan+comp discharge (dB).

Table 22 - Sound Power Level [dB] - Downflow frontal configuration

Unit model	Mode	Level	Octave band frequency (Hz)									Sound level [dB(A)]
			31,5	63	125	250	500	1000	2000	4000	8000	
PAM010	(1)	SPL	70,4	70,4	73,5	79,9	73	64,4	61,6	61,1	57,4	74,8
	(2)	SPL	70,4	70,4	73,5	79,9	73	64,6	63,5	61,9	58,2	75
	(3)	PWL	72,6	72,6	79,1	88,4	83,7	81,6	77,7	74,6	72,9	86,8
PAM020	(1)	SPL	71,3	71,3	74,4	80,8	73,9	65,3	62,5	62	58,3	75,7
	(2)	SPL	71,3	71,3	74,9	80,8	74	66	65,5	64,2	59,9	76,2
	(3)	PWL	73,5	80,2	87,1	95,9	91,3	89,6	86,4	83,6	81,2	94,9
PAM030	(1)	SPL	71,2	71,2	74,3	80,7	73,8	65,2	62,4	61,9	58,2	75,6
	(2)	SPL	71,2	71,2	74,4	80,7	73,9	65,7	64,7	62,8	61,7	76
	(3)	PWL	73,4	80,1	86,6	95,8	91,2	89,3	85,6	82,2	83	94,6
PAM060	(1)	SPL	55,8	58,9	69,9	66,9	68,9	67,9	66,9	64,9	56,9	73,3
	(2)	SPL	58	60,6	71,6	68,6	69	69,3	67,5	67,6	58,3	74,6
	(3)	PWL	95,8	93,6	85,2	83,7	84,3	86,1	81,9	80,2	75,4	89,8
PAM080	(1)	SPL	59,6	62,6	73,6	70,6	72,6	71,6	70,6	68,6	60,6	77
	(2)	SPL	59,6	62,6	73,6	70,6	72,7	73	71,3	71,3	62	78,3
	(3)	PWL	95,6	95,6	87,2	85,7	88	89,8	85,7	83,9	79,1	93,4

LEGEND

The sound levels global and for each octave band are expressed in dB with a tolerance of (0/+2) dB.
(1) Unit SPL Fan (2m, f.f.,dB).
(2) Unit SPL Fan+comp (2m, f.f.,dB).
(3) Unit PWL Fan+comp discharge (dB).

7. Handling

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7.4 Unpacking....45
7.5 Transport without Package....45
7.5.1 Using piano jacks....45
7.5.2 Using a crane....46

This chapter explains how to handle the unit or its modules in the following situations:

- Shipping;
- Moving to a storehouse;
- Moving to the installation site.

7.1 Safety Instructions

WARNING

Improper operations can cause injury or death.

Verify that all the lifting and moving equipment is rated for the weight of the unit before attempting to move, lift, remove packaging from or prepare the unit for installation.

Make reference to the local safety regulations about lifting and handling heavy loads.

NOTICE

Improper operations can cause product damage.

NOTICE

Improper storage can cause product damage.

Keep the unit in a storehouse with the ambient conditions given in *3.6.1 Storage conditions*.

Read carefully the chapter *1. Safety*.

Pay attention to the *safety labels* on the unit and to the safety warnings in this chapter.

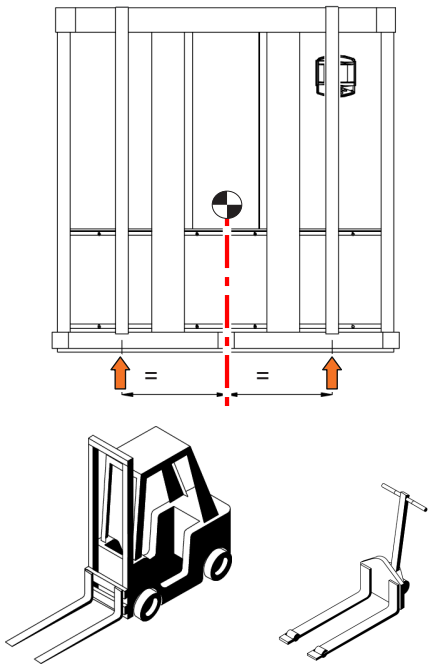
7.2 Inspection

- After receiving the product, check the accessories against the packing list.
- If any parts are found missing or damaged, please report to the carrier immediately.
- If you find any damage, please report to the carrier and to the local distributor too.

7.3 Transport with Package

NOTE *The following instructions are valid both for standard units and for the modules of the extended units (coil module and fan module).*

7.3.1 Using a fork lift or a pallet jack

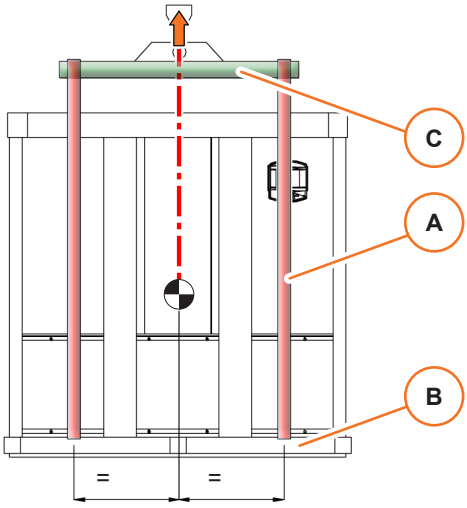


- Make sure that the fork length and distance is suitable for the unit length and to ensure the unit stability;
- Spread the forks to the widest allowable distance to still fit under the skid;
- Lift the unit from the side that is indicated in the instructions on the package;
- Make reference to the local safety regulations about lifting and handling heavy loads.

WARNING

Pay attention to overhead obstacles, for example doorways.

7.3.2 Using a crane



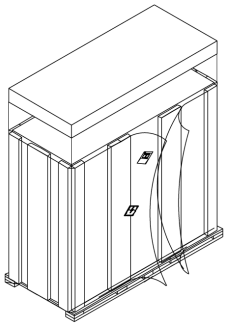
- Place the slings [**A**] between the unit bottom rails and the skid [**B**], at the widest allowable distance;
- Be sure that the distance between slings guaranties the unit stability;
- Fix the slings [**A**] to the spreader bar [**C**].

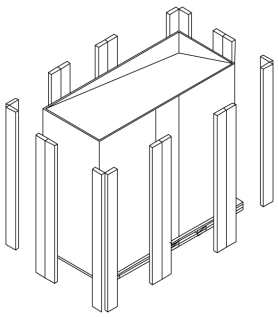
NOTICE

Lift the unit with a speed suitable for the load to be moved, so as not to damage the structure.

7.4 Unpacking

NOTE *The following instructions are valid both for standard units and for the modules of the extended units (coil module and fan module).*





- Remove the exterior packaging material from around the unit;
- Remove the top cover, the corner and the side planks.

ENVIRONMENT

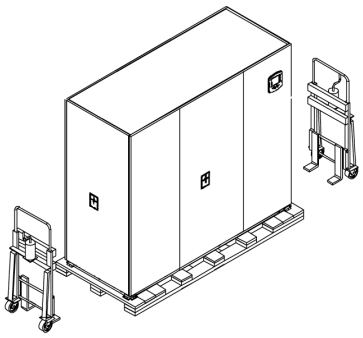
All material used to package this unit is recyclable.

Please save for future use, or dispose the package materials according to the local regulation about waste disposal.

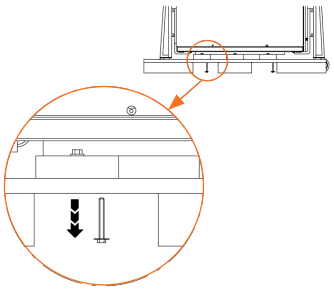
7.5 Transport without Package

NOTE *The following instructions are valid both for standard units and for the modules of the extended units (coil module and fan module).*

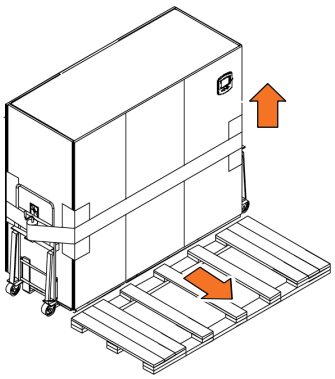
7.5.1 Using piano jacks



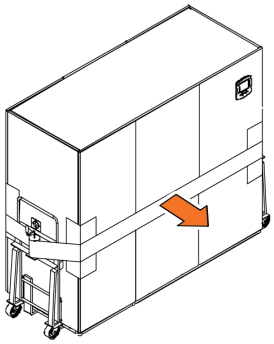
- Make sure that the floor can support the unit when you move it by piano jacks. If necessary, cover the floor by metal plates or other support that can distribute the weight on the floor;
- Place the piano jacks at the two sides of the unit.



- Remove the four bolt (two at each side) that fix the unit to the skid.

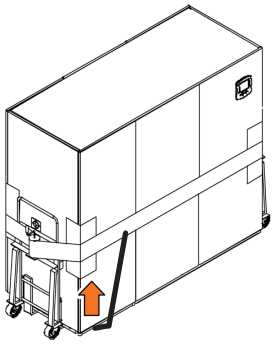


- Slide the forks of the piano jacks between the unit and the pallet;
- Place a protective material between the unit and the piano jacks;
- Fix the piano jacks to the unit by straps, placing a protective material between the unit and the straps;
- Lift slightly the forks of the piano jacks and remove the pallet.



- Move the unit to its installation site.

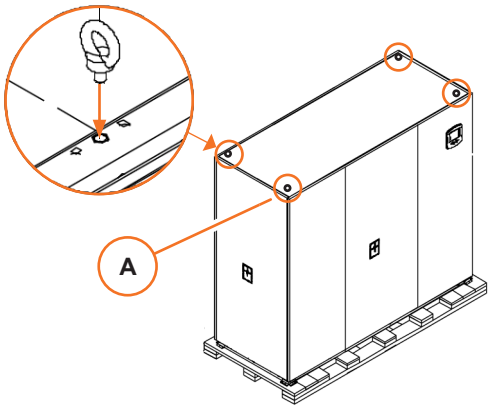
CAUTION
At least two persons are needed.



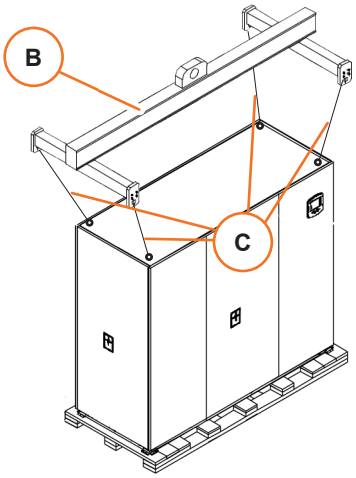
Remove the piano jacks:

- Place the unit as low as the piano jacks allow;
- Remove all the straps;
- Using a pry bar or a similar tool, lift the unit at one side high enough to remove the piano jack;
- Do the same on the other side;
- Remove the protecting materials.

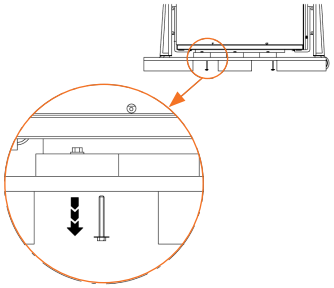
7.5.2 Using a crane



- Get four eyebolts M8 that suitable to hold the full weight of the unit (they are not supplied with the unit);
- Insert the eyebolts in each of the holes [**A**].



- Insert a sling or a chain [**C**] in each of the eyebolts [**A**].
- Fix the slings or chains [**C**] to a 4-points lifting bar [**B**].



- Remove the four bolts (two at each side) that fix the unit to the skid;
- By a crane or bridge crane, lift slightly the unit and remove the skid;
- Move the unit to its installation site.

NOTICE

Lift the unit with a speed suitable for the load to be moved, so as not to damage the structure.

8. Assembly and Positioning

Content of this chapter

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8.2.1 Assembly.....49
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8.1 Safety Instructions

WARNING

Improper operations can cause injury or death.

NOTICE

Improper operations can cause product damage.

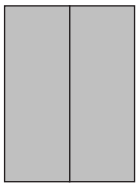
Read carefully the chapter *1. Safety*.
Pay attention to the *safety labels* on the unit and to the safety warnings in this chapter.

8.2 Overview

8.2.1 Assembly

- Move the unit or the modules close too the final position as explained in *7. Handling*.

Standard height

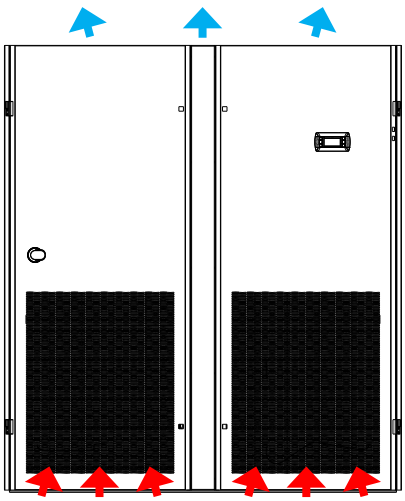
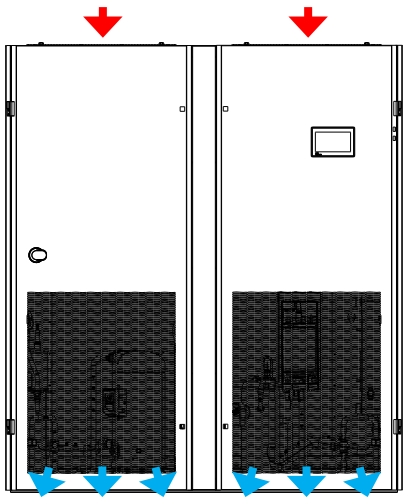
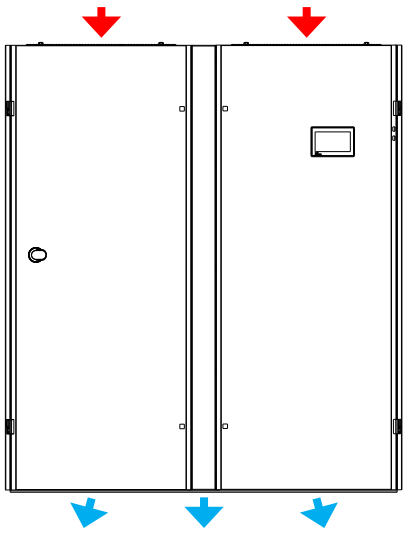


The unit is already assembled.

NOTE *For all the above versions, if you need to assemble any accessory* see *Annex E - Accessories*.

8.2.2 Positioning

- Move the unit to its final position as explained in *7. Handling*;
- Place the unit as explained below.

U - Upflow	H - Downflow Frontal	D - Downflow Up
		
Placed on the floor **Warm air** though front grid **Cold air** though the top	Placed on the floor **Warm air** though the top **Cold air** though the front grid	Placed on the raised floor **Warm air** though the top **Cold air** though the bottom grid

NOTICE

See *9. Installation* for specifications about the installation site.

Ensure isolation between the unit and the floor to avoid transmission of vibration.

NOTICE

The unit may contain special brackets or supports that secure some elements for the transport. They are highlighted by special labels.

When you finish assembly and positioning of the unit, make sure that all the transport brackets and supports have been removed.

9. Installation

Content of this chapter

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9.8 Final Checks....73

9.1 Safety Instructions

WARNING

Improper operations can cause injury or death.

WARNING

Do not assemble or connect the unit with systems or machines that are different from what is specified in this manual for your unit.

SAFETY REQUIREMENT THAT MUST BE RESPECTED

The safety valve is provided with **Liebert® OAC** external condenser. **Liebert® PDX PAM UHD A** can be connected only to **Liebert® OAC** condenser.

Contact Vertiv™ Technical Support for any question.

NOTICE

Improper operations can cause product damage.

NOTICE

The installation of the unit must comply with EN378-3.

Read carefully the chapter *1. Safety*.

Pay attention to the *safety labels* on the unit and to the safety warnings in this chapter.

9.2 Overview

9.2.1 Preparation of the installation site (by the customer)

NOTICE

Vertiv™ takes no responsibility for systems not compliant with the specifications given in this manual.

Lack of compliance to the specifications given by Vertiv™ voids the warranty.

The customer is responsible for the following operations.

Operation	See ...
Prepare the area	*9.3.1 Location* and *9.3.2 Space requirements*
Prepare the piping for the refrigerating system	*9.3.3 Refrigerant piping requirements*
Prepare the electric system	*9.3.4 Electric system requirements*

9.2.2 Operations on the unit

The following operations must be done on the unit at the installation site:

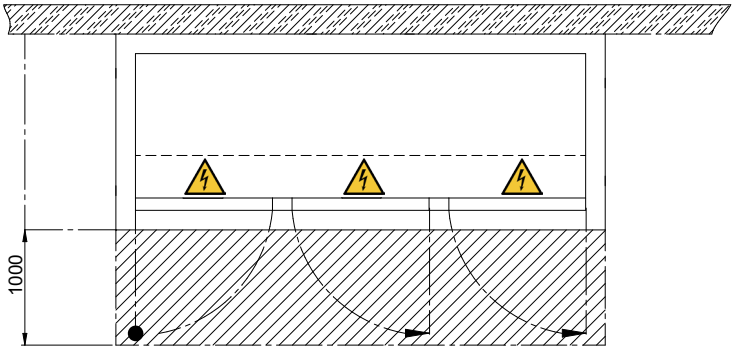
Operation	See ...
1. For extended height versions, assemble the fan module and the coil module	*8. Assembly and Positioning*
2. Assemble any optional accessory	*Annex E - Accessories*
3. Position the unit at the final location and fix it on the floor or the supporting structure	*8. Assembly and Positioning*
4. Prepare the piping for the connection between the remote condenser and the unit	*9.4 Piping Connections* - *9.4.2 Piping between the remote condenser and the unit*
5. Connect the piping to the remote condenser and to the unit	*9.4 Piping Connections* - *9.4.3 Welding the piping to the remote condenser* - *9.4.4 Welding the piping to the unit* - *9.4.5 Connecting the safety valves to outdoors*
6. Connect the water supply and the water drain piping of the humidifier	- *Annex F - Electrode Humidifier*
7. Connect the electric power supply	*9.5 Electrical connections* - *9.5.1 Power supply cable*
8. Connect the electric equipment to the electric panel	*9.5 Electrical connections* - *9.5.2 Contacts for the unit status signals* - *9.5.3 Remote condenser cables connections*
9. Check or adjust the Modbus settings	*9.6 Modbus Connections and Settings*
10. Charge the refrigerating circuit	*9.7 Refrigerant Charge* - *9.7.2 Estimate the weight of refrigerant to charge* - *9.7.3 Estimate the weight of oil to charge* - *9.7.4 Create the vacuum* - *9.7.5 Fill up the compressor oil* - *9.7.6 Pre-charge the refrigerant from the cylinder* - *9.7.7 Charge the refrigerant by the compressor* - *9.7.8 Check the oil level*
11. Check the whole system	*9.8 Final Checks*
12. Start the unit	*10. Operation*

9.3 Specifications for Site Preparation

9.3.1 Location

- The units must be installed indoors, in rooms protected from weather agents.
- Before installing the unit, determine whether any building alterations are required to run piping, wiring and ductwork.
- Prepare a level surface suitable to support the weight of the unit.
- Install the unit in an area with clean air, away from loose dirt and foreign matter.

9.3.2 Space requirements



- See *Annex C - Dimensions and Weights* for the unit dimensions
- Keep a free space between the unit and any obstacle as shown in the figure.

WARNING

Leave a free space of at least 1000 mm on the front to allow safe installation and maintenance operations.

9.3.3 Refrigerant piping requirements

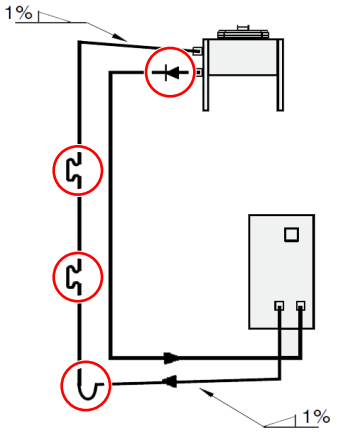
Prepare the piping for connecting the remote condenser to the main unit according to the following specifications.

Material	Soft or hard copper
Diameter and thickness	See *6.2.5 Refrigerant piping diameters and thickness* ***NOTICE*** The guarantee becomes invalid if you do not respect the diameters given in this manual. If you need to use piping with a larger diameter (for example for long winding runs), please contact Vertiv™ Technical Support. ***NOTICE*** Refrigerant R513A requires piping and fitting with a minimum thickness of 1,5 mm when the external diameter is bigger than 18 mm
Thermal insulation	Wrap the piping by thermal insulating material as specified in the following *Table 23 - Installation conditions* ***NOTICE*** Make sure that no electrical cables are in contact with piping that is not thermally insulated. The high temperature of the piping would damage the cables.

Check valve

NOTICE

It is mandatory to install a check valve at the condenser outlet



Piping gradient

- Lay the horizontal gas piping with a 1% downward gradient along the refrigerant flow.

Oil traps

- Create oil traps as following:
  - every 6 m of piping;
  - before each lift in the horizontal discharge line.

Piping layout

- Keep the piping as short as possible. This helps to minimize the total charge of refrigerant and the pressure drops.
- Avoid bends as much as possible. Make bends with large radius (bending radius at least equal to the pipe diameter).
- For hard copper piping use preformed curves. You may bend soft copper piping by hand or by a bending tool.
- Keep a separation of at least 20 mm between the gas and the liquid piping. If this is not possible then insulate both the piping.
- Support both the horizontal and the vertical piping by vibration dampening clamps that include rubber gaskets. Place the clamps every 1,5-2 m.

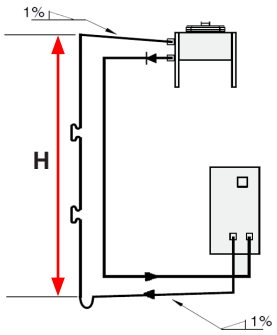
Condenser matching

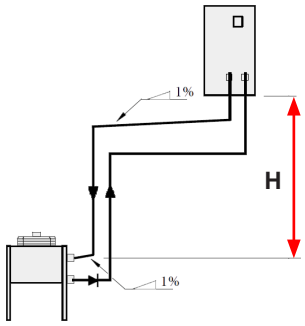
- The safety valve is provided with **Liebert® OAC** external condenser. **Liebert® PDX PAM UHD A** can be connected only to **Liebert® OAC** condenser. Contact Vertiv™ Technical Support for any question.
- Select the right condenser depending on the installation configuration as explained in the following *Table 23 - Installation conditions*.

NOTICE

It is recommended to install the condenser at higher level with respect to the unit.

Table 23 - Installation conditions





H = level difference between the unit delivery and the condenser inlet.

L = total linear length of the piping + equivalent length of curves and valves (see *9.7.1 Calculate the equivalent length of the piping*)

Installation condition		Condenser	Check valve on return line	Liquid line thermal insulation
L < 60 m	-3 m < **H** < 20 m	Standard	Mandatory	Mandatory
L < 100 m	-8 m < **H** < 30 m	20% oversized	Mandatory	Mandatory
L < 60 m	-15 m < **H** < -8 m	30% oversized	Mandatory	Mandatory

NOTICE

- Insulation of the gas line is just for safety oraestetic reasons
- Insulation waterproof and UV resistant

9.3.4 Electric system requirements

Power supply requirements for the unit

- Check the electrical data on the label applied on the unit.
- Check that the available power supply is consistent with the unit power requirements given in *6. Technical Data.*
- Refer to the electrical schematic supplied with the unit when making line voltage supply, low voltage main unit interlock and any low voltage alarm connections.

Local codes

- Electrical service must conform to national and local electrical codes.
- All wiring must be done in accordance with all applicable local, state, and national electrical codes.

External disconnecting switch

- The final customer must install on site an external disconnecting switch, easy to reach, to facilitate a quick and easy shutdown and power cut-off of the unit
- According to EN60204-1 standard, paragraph 5.3, an ON/OFF handle must be easily accessible and positioned between 0.6m and 1.9m above the service level. When this is not available on the front door of the unit, it is mandatory to install an external disconnecting device (for all power sources to the unit) positioned as close as possible to the unit, easy accessible, visible and located between 0.6m and 1.9m above the service level.

Protection

- Select and install the line side electrical supply wire and over current protection device(s) according to the specifications on the unit nameplate(s), per the instructions in this manual and according to the applicable national, state, and local code requirements.
- The customer is responsible for the system protection.
- Protect the system by a differential switch.
- If the system includes devices with inverter, then use a type B or B++ **RCD** (Residual Current Device) switch.

Power supply variability

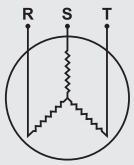
- Check that the maximum unbalance between the phases does not exceed the value given in *6. Technical Data.*
- Make sure to comply with the following data:
  - Electrical voltage between 0.9 and 1.1 nominal voltage
  - Frequency between 0.99 and 1.01 the nominal frequency
  - Variability of supply voltage less than 2%
  - Harmonic Distortion: the supply voltage quality shall present a THD not exceeding 8% and in general shall be in compliance with CEI/EN-50160

See the figure below for variability evaluation.

Example of calculating phase to phase variability

1) The 400 V supply has the following variability:

RS = 388 V
ST = 401 V
RT = 402 V



2) The average voltage is:

$$\frac{388 + 401 + 402}{3} = 397$$

3) The maximum deviation from the average is:

397 - 388 = 9

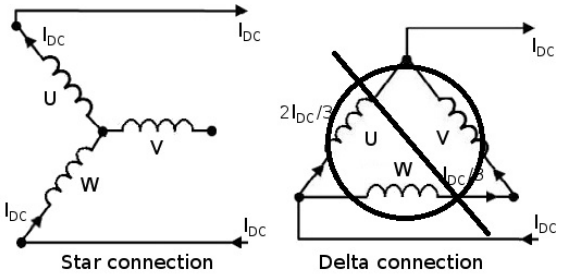
4) The phase to phase variability is:

$$\frac{9}{397 \times 100} = 2{,}3 \text{ (non acceptable)}$$

Power supply connection

The units are equipped with electrical devices (power supplies module, control devices,...) that are designed to operate properly with star-connected power (Wye) with earthed neutral (TN or TT system).

If you need three-phase distribution Delta-connected (Δ) or Star-connected power (Wye) without ground or floating ground (IT) please contact Vertiv™ Technical Support.



Power supply type

Acceptable:

- TT, TN-S, TN-C, TN-C-S systems
- 380 V Wye with solidly grounded neutral (220 V line to ground) for **Liebert® PDX PAM010-020-030** only

Unacceptable:

- 380 to 460 V Wye without ground connection or with high-resistance (or impedance) ground (IT);
- 380 to 460 V Δ without ground or with high-resistance (or impedance) ground (IT);
- 380 to 460 V Δ with corner ground or with grounded center-tapped.

Cables type

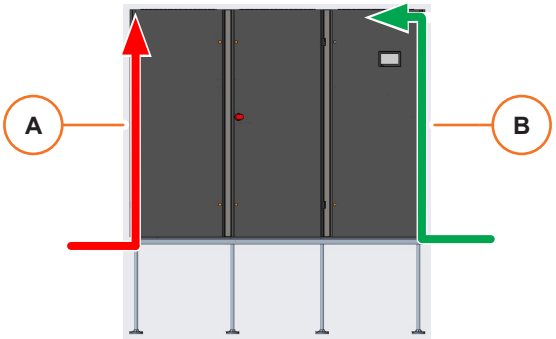
- Use copper wiring only.

The units are equipped with electrical panel with one disconnecting switch for the power section.

Choose a supply cable (four-pole type with ground) for the power section, according to:

- the local norms;
- the system absorption (FLA unit);
- the system voltage;
- installation type;
- cable length;
- upstream protection.

Cables connection



- Do not fit the supply cable in the raceways inside the electric panel. The electrical cables must pass through the unit shoulder; the **power cable** [**A**] on left and **sensor/alarms cable** [**B**] on the right.
- The connection for remote ON-OFF must be done be the installer.
- The general alarm terminals allow remote alarm signaling.
- In case of short circuit, check the sticking of the involved switch and replace it.
- The remote ON/OFF and the Fire Alarms Signal are connect directly to the unit.

Check integrity

- Make sure that all electrical connections are tight.
- Make sure that all electrical components are undamaged.

Hot surfaces

- The cables must not touch hot surfaces. If necessary, wrap the electrical cables by a thermal insulating sheath.

9.4 Piping Connections

WARNING

Only authorized personnel is allowed to perform operations on the piping.

WARNING

The unit is delivered with the circuit pressurized by nitrogen at 2 bar.

9.4.1 General instructions

Connections	The inlet and outlet directions are clearly marked with labels and arrows on the respective pipings; Pay attention to follow the directions.
Take care of the sensors	• Protect all refrigerant line components within 460 mm of the brazing site by wrapping them with a wet cloth or with a suitable heat-sink compound.
Keep clean	• Keep the piping clean and dry; • Make sure that the surfaces to be brazed are clean and that the ends of the tubes have been carefully reamed to remove any burrs; • Ensure that all loose material has been cleaned from inside the tubing before brazing.
Joints	• All the joints must be braze-welded; • Avoid butt joints, use sleeves or enlarge one of the pipes by a pipe opener.
Brazing	**NOTE** *When copper is heated in the presence of air, copper oxide forms. POE oil will dissolve these oxides from inside the copper pipes and deposit them throughout the system, clogging filter driers and affecting other system components.* • Use copper piping with a brazing alloy with a minimum temperature of 732°C, such as Sil-Fos; • Avoid soft solders such as 50/50 or 95/5; • For copper-to-copper joints, the phosphorus in the Sil-Fos product serves as the fluxing agent and no separate flux by nitrogen is necessary to protect the brazing site. For brass application however, nitrogen flux is recommended; • In any case, during brazing always use pure dry nitrogen through the piping with a flow of 0,5-1,5 l/s. This avoids the presence of oxygen on the heated surfaces; • Do not overheat the piping (to minimize oxidation).

9.4.2 Piping between the remote condenser and the unit

Prepare the piping according to *9.3.3 Refrigerant piping requirements* and *9.4.1 General instructions*.

9.4.3 Welding the piping to the remote condenser

Joints	• Remove the butts welded on the pipes of the remote condenser; • Enlarge the pipes of the remote condenser and weld them to the piping already prepared for the connection to the unit. See the condenser manual for details.
Cleaning	Clean the connecting piping and the condenser by repeating the following procedure several times: • Insert a plug into the two free ends of the piping; • Connect to the 1/4" access valve of the condenser a nitrogen cylinder with pressure reducer (maximum 10 bar); • Pressurize the piping; • Unplug the piping instantaneously. ***NOTICE*** This procedure is very important to avoid clogging of the filter dryer due to the brazing operation.

9.4.4 Welding the piping to the unit

WARNING

The circuit is pressurized by nitrogen at 2 bar.

Before welding the piping, discharge completely the circuit to release the pressure.

NOTICE

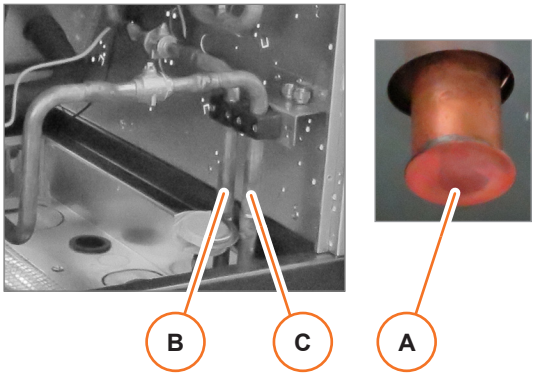
The following operations must be done one immediately after the other.

Do not leave the piping open for a long time.

Release the pressure

- Insert a drain shut-off valve on each access valve, to be able to open/close it manually;
- Open all the access valves to discharge all the circuit sections (receiver, low pressure side, compressor delivery);
- Open all the shut-off valves of the unit.

Remove the end caps

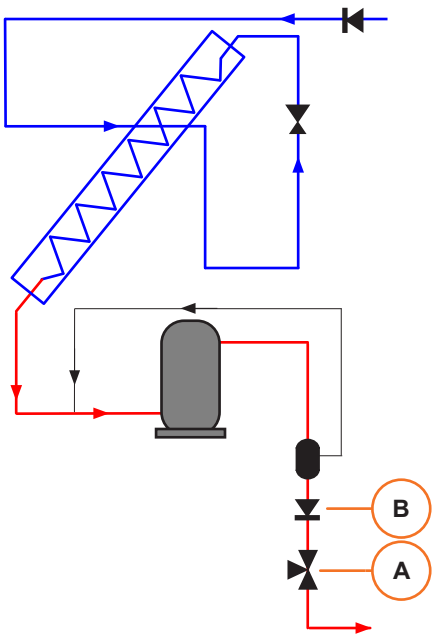


- Remove the end caps [**A**] from the inlet piping [**B**] and the outlet piping [**C**].

Joints

- Braze the piping to the main unit inlet and outlet piping.

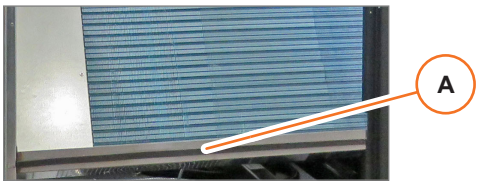
Additional access valve



- Install an additional access valve [**A**] after the compressor check valve [**B**]. Place the additional access valve on the piping outside the unit.

NOTE *If you have installed other additional check valves on the pipings, then also install access valves before and after the check valves, so to make sure that you can make the vacuum and discharge the refrigerant in every section of the refrigerant circuit.*

9.4.5 Connecting the condensate drain tray to an external piping



- Connect the flexible pipe that collects the condensate from the tray [**A**] to an external drainage piping.

9.5 Electrical connections

9.5.1 Power supply cable

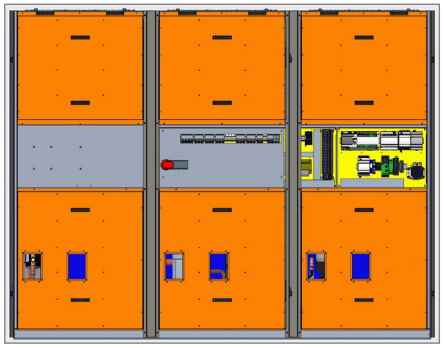
General instructions

- After opening the passage in the structural works (precut), for the supply line inlet, restore the original protection degree with suitable accessories for the wiring and junction boxes;
- Install the cable avoiding carefully to touch the hot parts;
- After having connected the cable, restore the protections against direct contacts;
- The system/line cable protection is to be arranged by the customer;
- Use a protection with differential switch;
- For details about the cable entrance holes see *Annex D - Connections*.

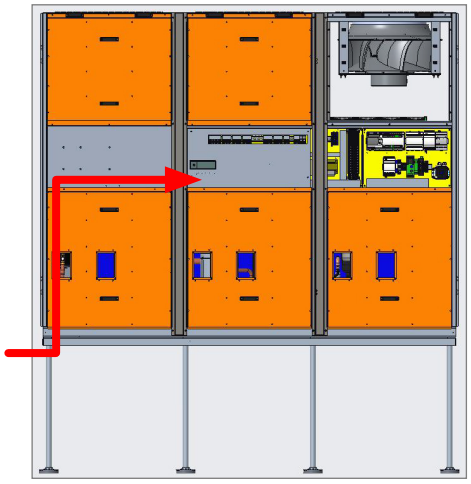
NOTICE

For fixed speed compressors, if the compressor makes a loud and unusual noise it is necessary to invert the electrical connections of the phases.

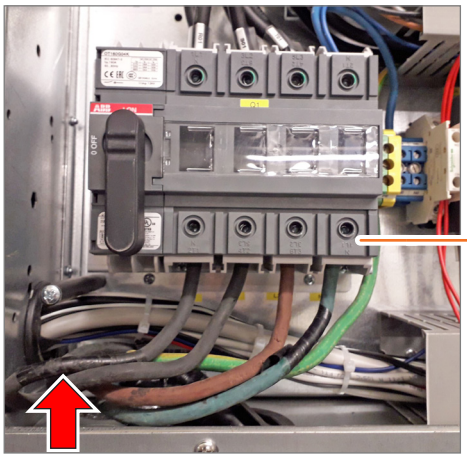
Standard power supply



- Open the front door to get access to the electrical panel and to the internal safety panels;
- Remove the electrical panel cover by unscrewing the screws that hold it;
- Remove the internal safety panels by unscrewing the screws that hold each panel;
- Remove the frontal panels or frontal grids from the fan module;



- Run the **power cable** from the bottom through the precut in the fan module;
- Use appropriate cable ties to fix the cable to the frame on the left shoulder;

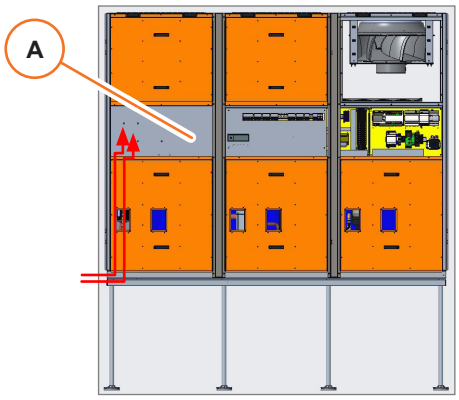


- Connect the power cable to the inlet terminals [**C**];

- Reposition all the panels removed for the cable connection:
  - the electrical panel cover;
  - the internal safety panels with the appropriate screws;
  - the fan electrical connection cover inside the fan module;
  - the panels or grids removed from the fan module;

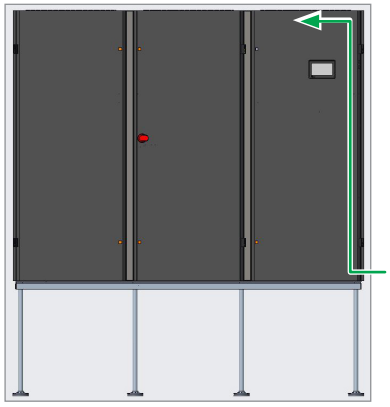
Make sure not to damage the electrical cable between the panels and the unit.

Dual power supply with ATS



If the unit is provided with **ATS**, then the procedure is the same as for standard power supply or dual power supply parallel, but there are **two power cables** (4 + 4 cords) to be connected to the inlet terminals of the **ATS** panel [**A**].

9.5.2 Contacts for the unit status signals



- Run the **signal cable** through the precut on the right shoulder of the frame.
- For details about the cable entrance holes see *Annex D - Connections*.
- Use appropriate cable ties to fix the cable to the frame on the left shoulder.
- Restore the original protection degree with suitable accessories for the wiring and junction boxes.

	1 compressor	2 compressor	3 compressor
Remote ON-OFF (CLOSE = ON)	394 395	394 395	394 395
Clogged Filter (CF) (CLOSE = OK)	GND ID6 [1]	394 364	394 364
General Alarm [2]	C8 NO9 [3]	400 401	400 401
Warning [2]	C8 NO8 [3]	300 301	300 301
Smokestat firestat (AAP) (CLOSE = OK)	86 83	86 83	86 83
Circuit 1 compressor 1 (CLOSE = ON)		76 77	76 77
Circuit 1 compressor 2 (CLOSE = ON)			78 79
Inverter compressor status (CLOSE = ON)	500 501	500 501	500 501
User alarm 1 (CLOSE = OK)	GND 30	86 030	86 030
User alarm 2 (CLOSE = OK)	GND 31	86 ID2 [4]	86 ID2 [4]
Freecooling ON	O FO	3610 369	3610 369
Remote Sensor Power Supply 24V ac	G1 G01	G1 G01	G1 G01
Terminals available for MODBUS: REMOTE CONDENSER AIR ECONOMIZER REMOTE SENSOR	RSA4 / RSB4 RSA5 [5] / RSB5 [5] RSA6 [5] / RSB6 [5]	RSA4 / RSB4 RSA5 [5] / RSB5 [5] RSA6 [5] / RSB6 [5]	RSA4 / RSB4 RSA5 [5] / RSB5 [5] RSA6 [5] / RSB6 [5]

The dry contacts can be used only with PELV type sources, as described by the norm EN 60204-1 “Safety of machinery - Electrical equipment of machines”.

The table on the left shows the available terminals and their meaning (refer to the Electric diagrams for details).

The cable must be protected by a sheath.

NOTES

[1] ID6 Terminal available on the iCOM™ control board;

[2] The fans alarms are managed through Modbus, the compressor inverter alarms are managed through Modbus;

[3] NO8 and NO9 are available on the iCOM™ control board;

[4] ID2 available on the iCOM™ control board;

[5] Remove the link between RSA5-RSA6 and between RSB5-RSB6 if the AIR ECONOMIZER SENSOR is installed.

9.5.3 Remote condenser cables connections

Electrical connections

- If the condenser has an independent power supply, then make reference to the condenser manual for the condensers power connections.
- If the condenser power is supplied by the unit electric panel, then proceed as following:
  - Connect the condenser power cable to the **MCB** (Magnetic Circuit Breaker) in the unit electric panel;
  - Make sure that the **MCB** supply is consistent with the condenser supply (one-phase or three-phase);
  - For dual circuit units, make sure that the condenser of **circuit 1** is connected to **MCB number 1**, and condenser of **circuit 2** is connected to **MCB number 2**.

Modbus connection

- Connect the unit Modbus cable to the remote condenser(s) electrical panel.
- For dual circuit units, connect the two condensers to each other by the Modbus chain connection and identify the condensers fans by their address.
- See *9.6 Modbus Connections and Settings*.

NOTICE

Do not run the Modbus cable in the same conduit, raceway or chase used for high-voltage wiring.

For Modbus network lengths greater than 130 m, please contact Vertiv™ Technical Support.

Modbus cable specifications:

The Modbus wiring is field-supplied and must be:

- Shielded;
- 24-18 AWG (0.5 mm²) stranded tinned copper until 107 m, 18-16 AWG (0.75 mm²) stranded tinned copper until 130 m;
- Twisted pair (minimum 8 twists per foot);
- Low capacitance (17pF/ft or less);
- Plenum rated (NEC type CMP) if required by local codes;
- UV and moisture resistant or run within conduit once in an outdoor environment, and must be temperature and voltage rated for conditions present.

Examples: Belden part number 89207(plenum rated) or Alpha Wire part number 6454 (UV resistant outdoor rated) category 5, 5e or higher.

CAUTIONS: Do not run the Modbus cable in the same conduit, raceway or chase used for high-voltage wiring. Mandatory shield connection to ground close Master (indoor unit control board).

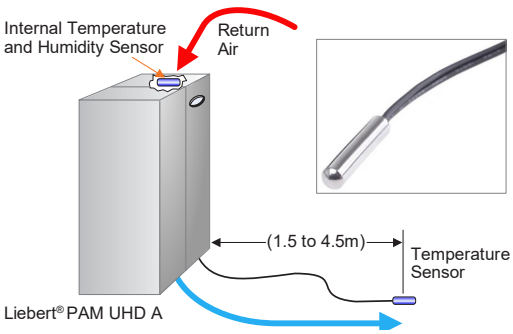
For Modbus network lengths greater than 130 m, contact Vertiv™ for assistance.

9.5.4 Supply air Temperature sensor

The supply temperature sensors should be installed in an area that is influenced only by the unit it is connected to. The supply sensor should be 1.5 - 4.5m from the cooling unit to provide an accurate reading for the control.

The sensor has been already installed in the unit and it's fixed in the fan module with at least 3m of cable lenght available. Remove the stripe and place it according the drawing.

NOTE: *To grant a proper unit regulation, install the sensor according the drawing. Vertiv™ is not responsable in case of improper installation.*



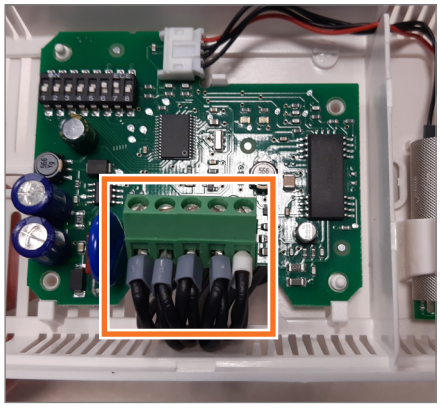
9.5.5 Sensors connections

Any remote or additional sensor must be connected to the unit via Modbus.

See *9.6 Modbus Connections and Settings*.

9.6 Modbus Connections and Settings

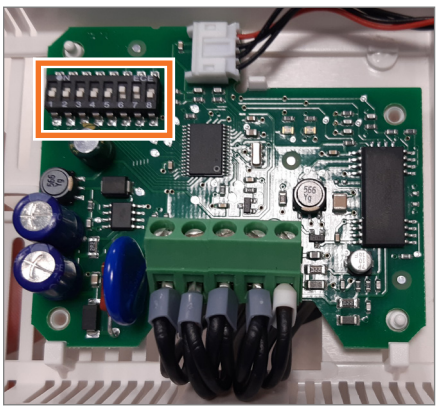
9.6.1 Connection of a device to the Modbus cable



- Use a Modbus (RS485) cable, which is made of four shielded cables inside the sheath;
- Connect two wires to terminal G and G0 24Vac;
- Connect two wires to Modbus RX+ and RX-;
- Refer also to the Vertiv™ document code “10027754_ Modbus_Simple_Rules” to realize the Modbus chain connections between the devices (internal and external) of the unit.

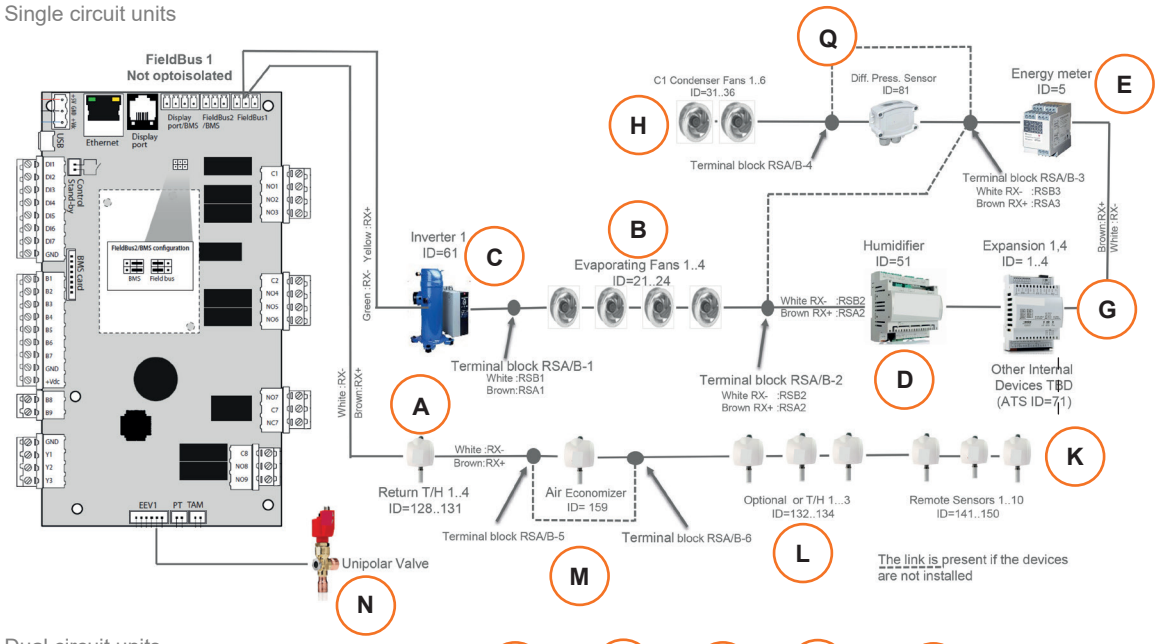
9.6.2 Setting of Modbus devices

The setting of a Modbus device requires the setting of the following parameters:

Dip switched address	Address of the device (unique)	• **For any sensor:** set the pins on its board.  • **For the evaporator fans** (inside the unit): the setting is factory made. However you might need to do again the setting in case of fan replacement. Do the setting by the programming tool. • **For the condenser fans:** you need to do the setting at the installation by the programming tool. ***NOTICE*** In case of dual circuit, pay attention to match the condenser fan name with the related circuit.
Baud rate = 19200 **Parity = Even** **StopBits = 1**	Same parameter for all the devices in the Modbus chain.	

The following figures and *Table 24 - Modbus options and addresses* provide the details and the addresses for the settings.

Single circuit units



Dual circuit units

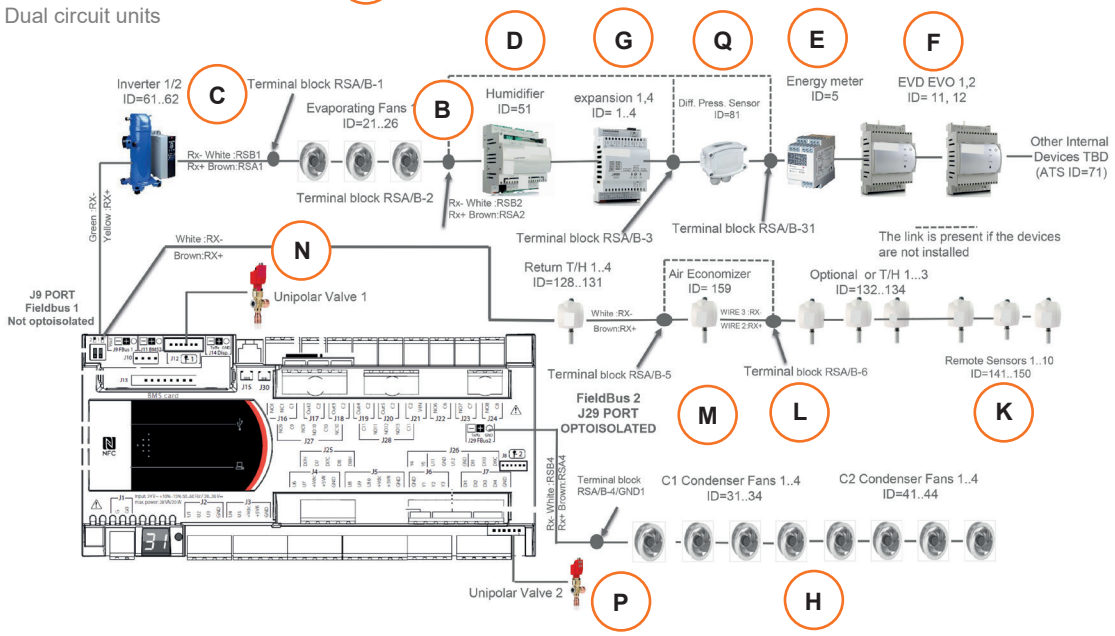


Table 24 - Modbus options and addresses

Ref.	Device	Number	Modbus address
A	Return sensor T+H	Up to 4	Return: 128...131
B	Evaporating fans	Up to 6	21...26
C	Inverter Compressors	Up to 2	61...62
D	Electrode humidifier	1	51
E	Energy meter (not available as standard)	Up to 4	5...8
F	Driver for bipolar electronic expansion valve	Up to 2	11...12
G	Expansion board	Up to 4	1...4
H	Condensing fans	Up to 4	31...34 for circuit 1 41...44 for circuit 2
K	Temperature and humidity remote probes	Up to 10	141...150
L	Optional sensors T or T+H	Up to 3	132...134
M	Air Economizer Probe	1	159
N	Unipolar valve 1		
P	Unipolar valve 2		
Q	Diff. Press. Sensor	1	81

9.7 Refrigerant Charge

WARNING

Use only the refrigerant type specified on the *Onboard Label*.

NOTICE

It is important to carry out charging correctly.

An excess of refrigerant causes an increase in sub-cooling and consequent operating difficulties in the hot season.

A shortage of charge generates an increase in super-heating and possible compressor stop.

Whenever work is carried out on the unit, then check the sub-cooling and super-heating to make sure that the working conditions are correct.

ENVIRONMENT

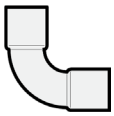
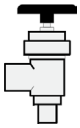
While operating on the refrigerating circuit recover all the refrigerant in a container: do not allow it to escape.

9.7.1 Calculate the equivalent length of the piping

Add up the following items:

- total linear length of the piping from unit to condenser
- equivalent length [in meters] of curves and valves (see the following table)

Table 25 - Equivalent lengths

Nominal diameter [mm]	 90°	 45°	 180°	 90°	
12	0,5	0,25	0,75	2,1	1,9
14	0,53	0,26	0,8	2,2	2
16	0,55	0,27	0,85	2,4	2,1
18	0,6	0,3	0,95	2,7	2,4
22	0,7	0,35	1,1	3,2	2,8
28	0,8	0,45	1,3	4,0	3,3
35	1,0	0,5	1,7	4,6	4,3

9.7.2 Estimate the weight of refrigerant to charge

- See *Table 08 - Charge [kg] of refrigerant for the reference system* for the amount of refrigerant needed for a reference system made of the unit, the condenser(s) and connecting piping with equivalent length up to 30 m.
- If the piping equivalent length is more than 30 m, then use the following table to estimate the additional charge.

Table 26 - Weight of refrigerant for meter of pipe

Pipe external diameter [mm]	Gas (1)	Liquid (2) at different condensing temperatures R513A [kg/m]		
	[kg/m]	35,0°C	46,0°C	57,0°C
12x1	0,0045	0,0888	0,0851	0,0808
14x1	0,0065	0,1279	0,1225	0,1164
16x1	0,0088	0,1741	0,1668	0,1584
18x1	0,0115	0,2274	0,2178	0,2069
22x1,5	0,0162	0,3207	0,3072	0,2917
28x1,5	0,028	0,5553	0,5318	0,505
35x1,5	0,0459	0,9098	0,8713	0,8274
42x1,5	0,0682	1,3513	1,2942	1,229

(1) Gas density evaluated at 26,2 bar - discharge temperature 65°C.
(2) Liquid pressure and density varies according to condensing temperature (see *refrigerant tables*).

The values given in the tables are only indicative. The actual amount of refrigerant depends on the operating conditions of the system as explained later in this chapter.

NOTICE

At the end of the charging procedure, the installer must weight the actual amount of refrigerant charged in the system and write the amount on the *Onboard Label*, both in kilograms and as CO_2 equivalent tonnes (see *14. Regulation (EU) No. 517/2014 (F-gas)*).

9.7.3 Estimate the weight of oil to charge

The units are delivered with the compressor containing the initial amount of oil given in *6.2.7 Compressor oil*.

You may need to add more oil depending on the length and complexity of the piping.

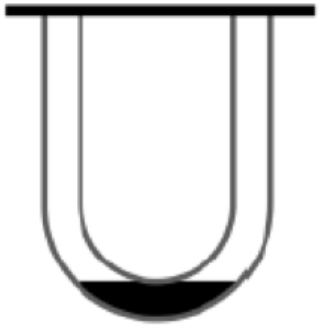
► If the piping length is less than 10 m, with good oil return, then no additional oil is required: skip this step and go to *9.7.5*

► If the piping length is more than 10 m, then you need to top up the oil.

Estimate the amount of oil for top up as following:

- As an indication, consider around 2% of the total system refrigerant charge (in kg);
- Add 0,3 liters for the oil separator integrated receiver;
- Also consider the number of oil traps along the line and add for each trap the amount of oil given in the following table:

Table 27 - Volume of oil in a standard trap



Pipe diameter [mm]	Oil volume [ml]
12	5.9
16	11.8
18	17.7
22	26.6
28	53.2
35	97.6
42	162.7

NOTICE

The maximum amount of top-up is 3% of the total system refrigerant charge.

NOTICE

In any case, after completing the refrigerant charge, check the oil level and top-up if necessary.

9.7.4 Create the vacuum

NOTICE

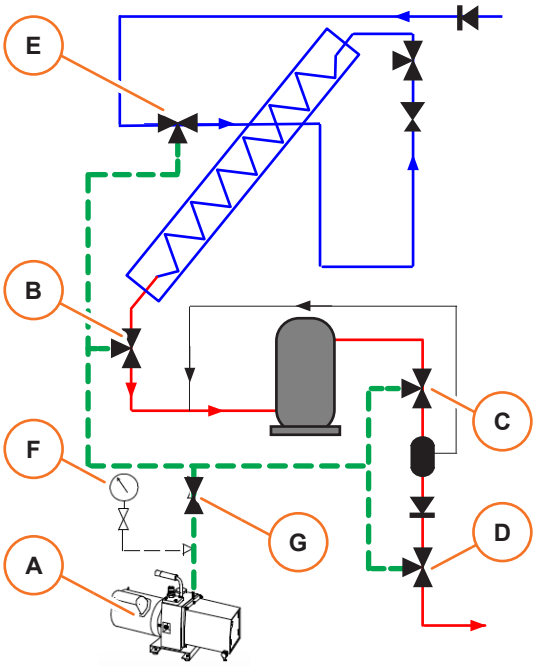
Never use the compressor for the system vacuum (this invalidates the warranty).

Unit status

Unit switched **OFF.**

No refrigerant in the unit.

Prepare



- Connect a proper, high efficiency vacuum pump [**A**], suitable for polyester oils, to the following access valves:
  - [**B**] compressor suction;
  - [**C**] compressor delivery;
  - [**D**] delivery to the condenser;
  - [**E**] liquid receiver outlet;

IMPORTANT:
Open all the shut-off valves of the system (Indoor unit **Liebert® PAM** and remote condenser **Liebert® OAC**) and seal the cups of the shut-off valve with a security seal [**H**].

NOTE *With this operation all the components of the refrigerating circuit must have a free connection to the vacuum pump and to the refrigerant cylinder.*

Make the vacuum

- Set the vacuum pump at 0,3 mbar absolute;
- Make the vacuum;
- Wait **3** hours and check that the pressure on the manometer [**F**] is lower than 1,3 mbar absolute.

NOTE *This condition ensures a humidity lower than 50 ppm inside the system and that there is no leakage in the system.*

Vacuum not reached

► If the system has not reached the required vacuum, it means that there are some leaks. In this case do the following:

- Inspect all the connections using a leak detector;
- Find the leak and seal it;
- Repeat the procedure explained above until the system has reached the required vacuum.

Vacuum OK

► If the system has reached the required vacuum of 1,3 absolute mbar, it means that the system is ready for the next step:

- Close the shut-off valve [**G**] and remove the pump.

Next step

9.7.5 Fill up the compressor oil

9.7.5 Fill up the compressor oil

► If the estimated length is less than 10 m, with good oil return, then no additional oil is required: skip this step and go to *9.7.6 Pre-charge the refrigerant from the cylinder*.

► Otherwise, if you need to top up the oil, then proceed as following:

Oil type

- Use the oil type given in *6.2.7 Compressor oil*;
- Check the nameplate on each compressor to make sure to use the right oil for your unit;
- Remember that dual circuits have different type of compressors on each circuit.

NOTE *The type of oil to be used depends on the compressor manufacturer, family and model.*

NOTICE

Do not mix different polyolester (**POE**) and mineral based oil.

Do not mix oils of different viscosities.

NOTICE

Improper compressor lubrication can cause compressor and refrigerant system damage.

Failure to use oils types, viscosities and quantities recommended by the compressor manufacturer may reduce compressor life and void the compressor warranty.

Contact **Vertiv**™ Technical Support for any question.

Avoid oil contamination

NOTE *If the oil absorbs humidity present in the air, then the ester molecules in the oil can break down, forming acidity.*

- Open the oil can immediately before the filling up and expose the oil to atmosphere for as short time as possible (no more than a **few** minutes).

Fill up

- Start the unit and check that the compressor is running;
- Fill a hand pump with the required amount of oil;
- Connect the pump to an access valve on the low pressure side and inject the oil.

Cleaning

- If you spill any oil, then wipe it off immediately since the oil on hot surfaces may catch fire.

9.7.6 Pre-charge the refrigerant from the cylinder

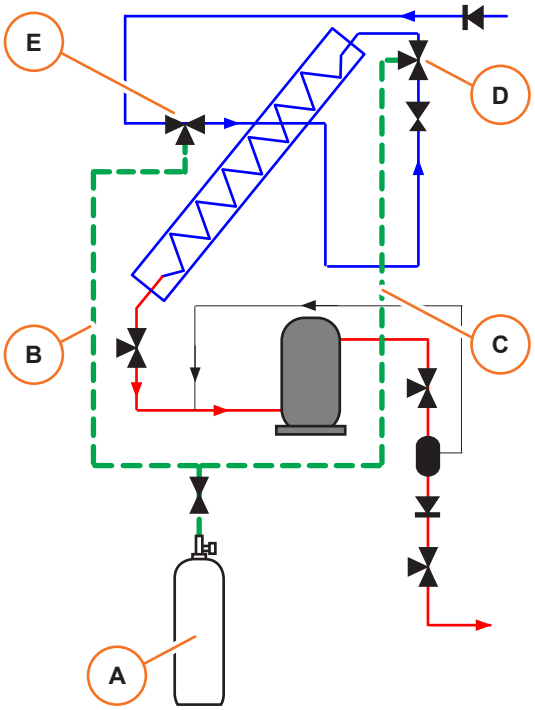
Unit status

Unit switched **OFF.**

No refrigerant in the unit, vacuum already made.

Compressor oil already filled in.

Prepare



- Place the refrigerant cylinder [**A**] on a scale;

NOTICE

You must weigh the refrigerant cylinder before and after the charge.

At the end of the charging procedure, you must write the actual amount of refrigerant charged in the system on the *Onboard Label*, both in kilograms and as CO_2 equivalent tonnes (see 14. Regulation (EU) No. 517/2014 (F-gas)).

- Drain the pipes [**B**] and [**C**];
- Connect the pipe to the shut-off valve of the cylinder and to the following access valves:
  - [**D**] after the expansion valve;
  - [**E**] at the liquid receiver outlet.
- Check that the connections are tight.

Charge

- Open the shut-off valve [**C**] of the cylinder;
- Charge the refrigerant until the pressure in unit is equal to the pressure in the cylinder.

NOTICE

The refrigerant must be charged taking only liquid from the cylinder.

Check for leaks

- Make sure that there are no leaks: inspect all the connections using a leak detector.

► If you find a leak do the following:

- Discharge the refrigerant from the system;
- Seal the leak;
- Repeat the procedures explained in *9.7.4 Create the vacuum* and *9.7.6 Pre-charge the refrigerant from the cylinder.*

No leaks

► If there is no leak do the following:

- Close the shut-off valve of the refrigerant cylinder;
- Close the access valves of the unit.

Next step

9.7.7 Charge the refrigerant by the compressor

9.7.7 Charge the refrigerant by the compressor

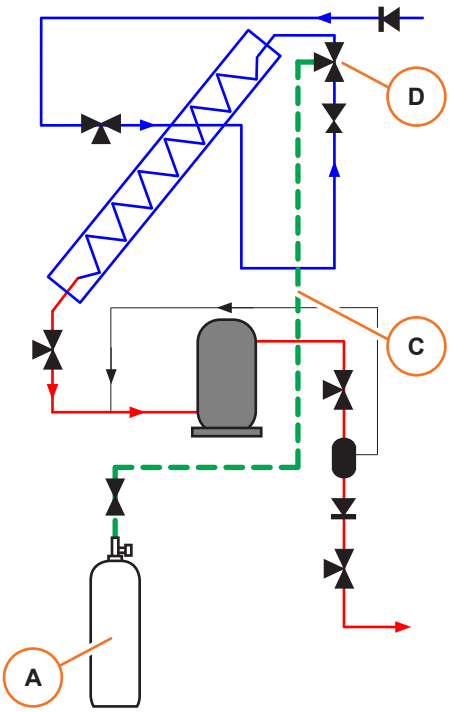
Unit status

Unit switched **ON.**

Unit already pre-charged with refrigerant, or unit in need of topping up some refrigerant.

You need to monitor the operating conditions during the charge procedure. If the unit has no iCOM™ control panel, then connect the unit to a computer via the Ethernet port.

Prepare



- Place the refrigerant cylinder [**A**] on a scale;

NOTICE

You must weigh the refrigerant cylinder before and after the charge.

At the end of the charging procedure, you must write the actual amount of refrigerant charged in the system on the *Onboard Label*, both in kilograms and as CO_2 equivalent tonnes (see 14. Regulation (EU) no. 517/2014 (F-gas)).

- Drain the pipe [**C**];
- Connect the pipe to the shut-off valve of the cylinder and to the following access valves:
  - [**D**] after the expansion valve;
- Check that the connections are tight.

Charge

- Open the shut-off valve of the cylinder;
- Start the unit as described in *10. Operation*;
- Manually start the compressor (if the unit is equipped with tandem compressors start both of them);
- Set the variable speed compressor to the maximum speed;
- Make sure that the unit is not in the dehumidification phase;
- Guarantee a fixed condensing temperature (preferably 42-45°C). If necessary, partially obstruct the condenser coil surface or limit its ventilating power to obtain these conditions;
- Charge the unit continuously and slowly;

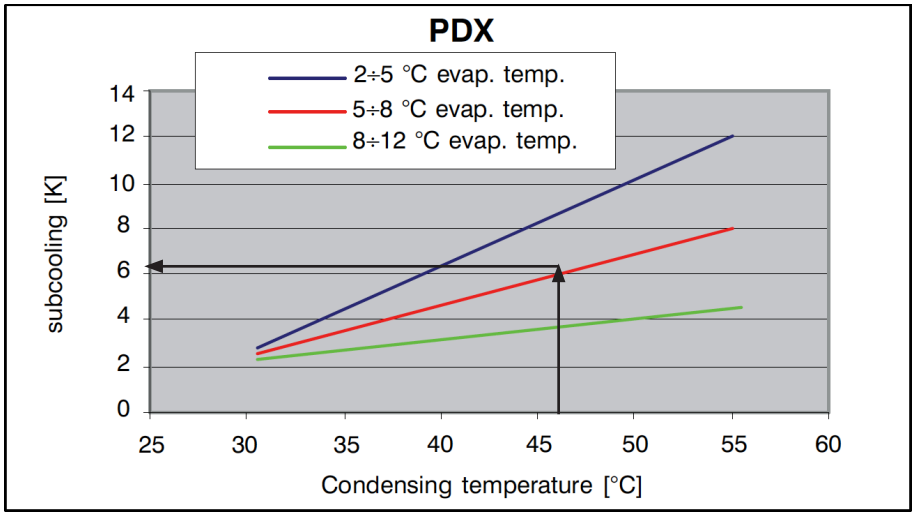
NOTICE

The refrigerant must be charged taking only liquid from the cylinder.

- During the charging, check the operating conditions as explained below.

Check the operating conditions

- Continue to charge until the following conditions are reached:
  - no bubbles visible in the sight glass;
  - the evaporating temperature is above 0°C;
  - the super-heating is steady around the setpoint (5 – 7 K);
  - the sub-cooling is steady and its value is within the values given in the following graphic:

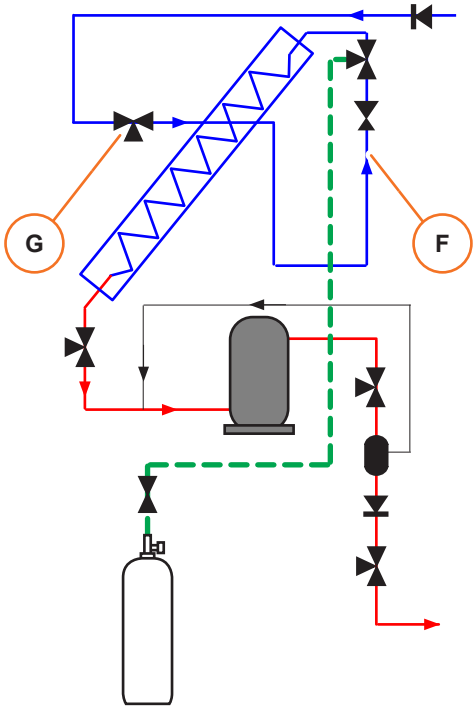


NOTE *The evaporating temperature and the super-heating are measured by the control system and you can read the values on the iCOM™ display.*

► If the super-heating is higher and the sub-cooling is lower, than you need to charge more refrigerant.

► If the super-heating is lower and the sub-cooling is higher, than you have charged too much refrigerant and you need to release some refrigerant.

How to measure the sub-cooling



- Place a contact thermometer on the tube [**F**] on the liquid line;
- Measure the temperature T1 of the liquid;
- Connect a manometer (with a tube of maximum 300 mm) to the access valve [**G**] on the liquid line;
- Measure the condensing pressure and obtain the corresponding saturated condensing temperature T2 for the refrigerant;
- The sub-cooling is the difference T2-T1.

Operating conditions OK

Now the charge is complete.

- Remove the refrigerant cylinder and the instruments;
- Write the weight of refrigerant charged in the system on the *Onboard Label*, both in kilograms and as CO_2 equivalent tonnes (see *14. Regulation (EU) No. 517/2014 (F-gas)*).

Next step

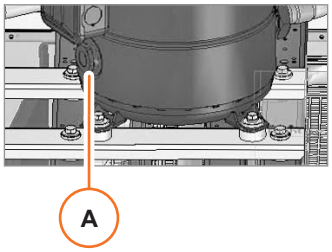
9.8 Final Checks

9.7.8 Check the oil level

NOTE *The following procedure is valid only for compressors that have an oil sight glass.*

NOTICE

In tandem compressors, check the oil level with both compressors running at maximum capacity, otherwise you find the oil of the running compressor at the maximum level, and the oil of the not running compressor at the minimum level.



- Let all the compressors of the unit to run at maximum capacity for at least **30** minutes;
- Check the oil level through the oil sight glass [**A**];
  - ► The oil level must be between ½ and ¾ of the sight glass.

For fixed speed compressors:

- Check again when the compressors are running under steady conditions for at least **1** hour and make sure that the oil level remains visible in the sight glass.

For variable speed compressors:

- Repeat the oil check over the speed range to guarantee:
  - a good oil return at low speed with minimum gas velocity;
  - a good oil management at high speed with maximum oil carryover.

NOTES

The presence of foam in the sight glass indicates large concentration of refrigerant in the oil and/or presence of liquid returning to the compressor.
*The oil level can also be checked a **few** minutes after the compressor stops, the level must be between ¼ and ¾ of sight glass.*
*When the compressor is **OFF**, the level in the sight glass can be influenced by the presence of refrigerant in the oil.*

- If you need to top up the oil level see *9.7.5 Fill up the compressor oil*.

9.8 Final Checks

NOTE *Follow these instructions at first Start-Up and also in case of Restart after a long stop.*
NOTE *Record the functional data on the Start-Up certificate.*

Electrical system

WARNING
Disconnect the power supply before doing the following checks on the electric system as explained in *1. Safety*.

- Check all the cable connections particularly the main power connections on the power fuses and contactors;
- Check that all thermal protections are calibrated according the electrical data tables reported on wiring diagram;
- Check the electrical absorption of all components;
- Check the tightening of all terminal block and screws.

Tightness

After finishing all of the connections and installation operations, including mounting accessories (plenum, ducting) and floor elements (base frame), check all the unit edges and gaps and make sure that they comply with the protection degree IP2x specification (protection against finger access).

Refrigerating system

- Make sure that the electric and signal connections of each remote condenser is consistent with the respective refrigerating circuit connections (**condenser 1** with **circuit 1**, **condenser 2** with **circuit 2**);
- Make sure that the condensate drain line is connected and not obstructed;
- Make sure that all the factory clamps that fix the piping to the structure have been reinstalled (if removed during the installation);
- Check that the compressor operates when required;
- Check that there is no anomalous vibration of the piping while the compressor is operating.

Air system

- Check that the unit fans are operating properly;
- Check all the unit options that involve the air flow management (such as air economizer, return dampers and *Smart Aisle™*) operate properly;
- Check that all the temperature and humidity probes read a correct value;
- Make sure that the humidifier supply and drain water connections are connected properly;
- Check that the humidifier works properly;
- Check that electrical heaters operate when required.

Safeguards

- Make sure that all the safeguards (panels, grids) have been mounted again;
- Close and lock all the doors;
- Place again all the floor panels around and under the unit.

Everything OK?

Start the normal operation: see *10. Operation*

10. Operation

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10.1 Safety Instructions

WARNING

Improper operations can cause injury or death.

NOTICE

Improper operations can cause product damage.

Read carefully the chapter *1. Safety*.
Pay attention to the *safety labels* on the unit and to the safety warnings in this chapter.

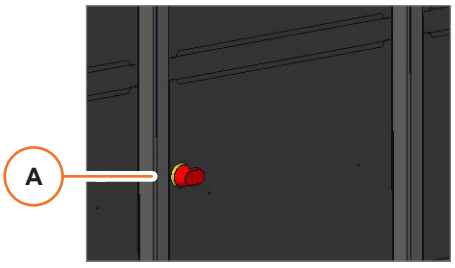
NOTICE

The power supply should never be disconnected during normal operation, except when performing maintenance.

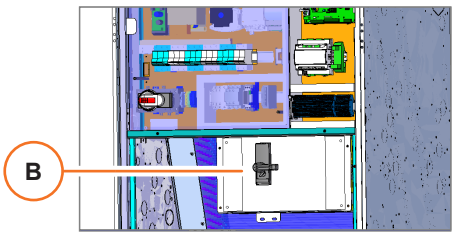
10.2 Power-up

Main unit

Single power supply



Dual power supply



1. Close the disconnection device upstream the unit (to be installed by the customer);
2. Close the disconnecting switch [**A**].

For units with ATS:

1. Put **ATS** in automatic mode by removing the manual handle [**B**];
2. Close the door and screw it;
3. Close the disconnecting switch [**A**].

- If the iCOM™ display is present, then check that it switches **ON**.
- In case of first startup or after maintenance on the electric system, check again by a voltmeter or tester if the voltage and phase difference fall within the indicated limits.

Remote condenser

---

4. Close the disconnecting switch of the condenser(s), if they are not connected to the unit electric panel.

10.3 Preparation

NOTE *Follow this instructions at first startup and also in case of restart after a long stop.*

When you set the disconnecting switch to the position "**I**", the compressor crankcase heaters are automatically powered **ON**.

NOTICE

The pre-heating of the compressor crankcase takes about **8** hours.

Remember to power up the unit well in advance before starting the normal operation.

Compressor pre-heating and check

- Make sure the auxiliary circuit has been powered and check the operation (a fault due to an incorrect procedure will invalidate the compressor guarantee).

At the end of the pre-heating:

- check that all the manually operated valves of the refrigerating circuit are open;
- check that the suction pressure is higher than 7.0 bar.

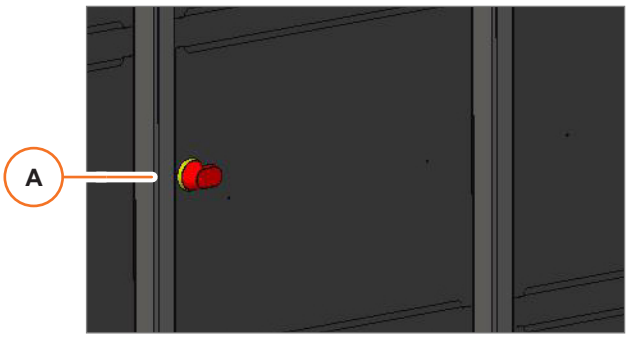
If this is not the case, extend the pre-heating of the compressor and check that the refrigerant **EEV** valve is properly closed.

Remote condensers power ON

When the compressor is ready, make sure that the remote condenser is powered **ON**.

Make reference to the condenser *User Manual* for details.

10.4 Start



NOTICE

Before starting the unit, make sure that the compressor has been heated properly.

- Close the main disconnecting switch [**A**];
- Adjust the setpoint as indicated in the iCOM™ User Manual.

See the iCOM™ User Manual for details.

NOTE

*The fan starts immediately (the fan always works when the unit is **ON**).*

*The compressors start **30** seconds after the fans (if there is cooling request).*

The dehumidification can start after the compressors.

*The heaters can start **10** seconds later.*

*The variable speed compressors run at fixed speed for **60** seconds before starting the speed regulation.*

10.5 Check the Operation

NOTICE

The following checks must be done:

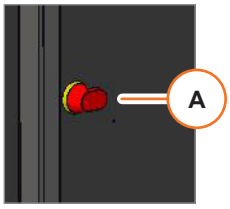
- at first startup;
- in case of restart after a long stop;
- at time intervals during the normal operation.

Alarms	• Make sure that all the alarms due to protective devices interventions have been reset (see *iCOM™ User Manual*)
Control and safety devices	• Check the correct operation of the control and safety devices.
Compressor	• With the compressor at full load, check there are no bubbles visible in the flow indicator. If there are any, check the charge as explained in *9.7.7 Charge the refrigerant by the compressor*.

10.6 Stop

In case of a short stop:

- Turn **OFF** the unit by the user display.



In case of a long stop (seasonal shutdown):

- Turn **OFF** the main disconnector switch [**A**];
- Maintain the disconnecting switch [**A**] to the position "**O**". This will disconnect the compressor crackcase heaters;
- If the machine is provided with the **ATS** device set the **ATS** disconnecting switch to position "**O**".

10.7 Restart

After a short stop	The unit is still powered. • Turn **ON** the machine by the user display.
After a long stop	• Do the complete procedure as described in: *10.2 Power-up, 10.3 Preparation, 10.4 Start*.
In case of power blackout	See *5.5.1 Standard or dual power supply*

10.8 Teamwork

The factory setting for the iCOM™ control system is the stand-alone mode.

If the unit is connected to other units in a network (by Ethernet), a master unit controls the switching ON/OFF of all of the units.

The base configuration for the Teamwork can be one of the following:

- Lead-Lag (standby + rotation + changeover on alarm);
- Cascade.

See the iCOM™ User Manual for more information and instructions about the Teamwork configuration.

10.8.1 Dehumidification

The setpoint for the dehumidification is the required value of relative humidity or the required dew point of the air returning from the room into the unit.

The actual dew-point of the returning air is calculated from the humidity and temperature measured by the sensor of the unit.

If the returning air dew point is higher than the required value, then the dehumidification function is activated: the compressors run at full capacity and the evaporator fans could reduce the speed.

11. Maintenance

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11.1 Safety Instructions

WARNING

Improper operations can cause injury or death.

NOTICE

Improper operations can cause product damage.

Check the unit regularly and solve the problems as they occur.

Lack of maintenance could reduce the performance or damage the unit.

NOTICE

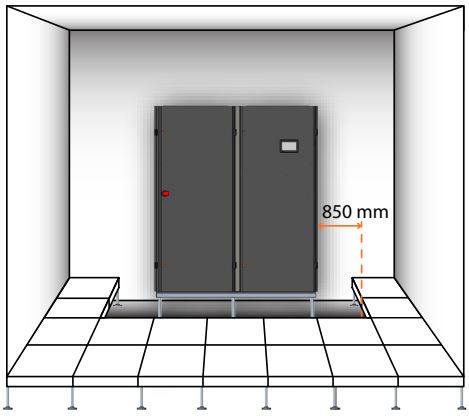
All the tasks that are explained in this chapter must be carried out only by authorized and trained technicians.

We recommend the Vertiv™ Customer Service.

For any operation that is not specifically mentioned in this manual you must contact Vertiv™ Technical Support.

Read carefully the chapter *1. Safety*.

Pay attention to the *safety labels* on the unit and to the safety warnings in this chapter.



For **Downflow** units installed on a raised floor.

WARNING

Rotating elements, hot surface elements!

If you need to remove the floor tiles within a distance of 850 mm from the unit, first disconnect the unit from the power supply.

11.2 General Instructions

Safety components

- Check and calibrate the safety valves according to the local regulations.

Warning labels

- Check regularly that the warning label are still on the unit and that they are clearly visible;
- Replace any missing or damaged label.

See *Annex B - Safety Labels* for the mapping of the safety labels placed on the unit.

Spare parts

The use of original spare parts is recommended.

Using third-party material can invalidate the warranty.

When placing an order refer to the *Component List* enclosed with the unit and quote the unit model and serial number.

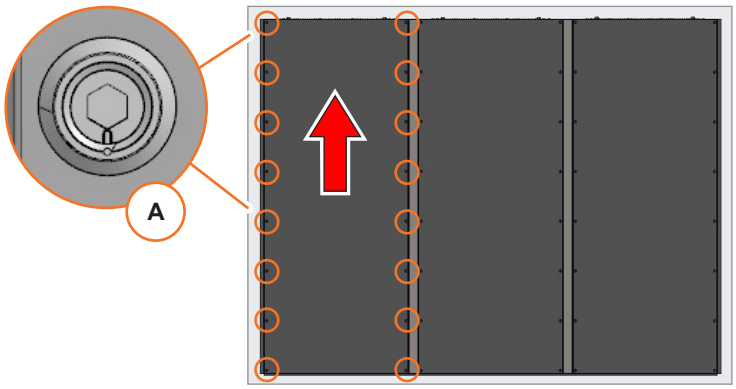
NOTICE

If you need to replace a component, then follow carefully the instructions of the manufacturer that come with the component.

NOTICE

If you need to weld a component, then be careful not to damage other components (like gaskets, seals, O-rings, ...)

Removing the upper panels



- Loose the fixing screws [**A**] using a Hex/Allen key, open all the latches on the panel.
- Lift the panel and release it from the hook on top.

CAUTION

The panels are heavy (up to 25 kg).

This operation must be done by two maintenance operators.

11.3 Maintenance Program

NOTE *If you encounter any problem, then see also 12. Troubleshooting.*

11.3.1 Electrical and control system

WARNING

The unit contains potentially lethal voltage in some circuits.

The electric and control panels can retain a stored high-voltage electrical charge for up to **15** minutes.

Before working inside the electric and control panels proceed as follows:

- Open all the local and remote disconnecting switches of the unit;
- Wait at least **5** minutes;
- Verify with a voltmeter that the power is **OFF**.

NOTICE

Make reference to the *Electric Diagrams* provided with the unit.

Perform the periodic checks and maintenance operations as specified in the following table.

Component or function	Operation	Frequency [months]		
		3	6	12
Power consumption	Measure the power consumption of the connected devices. Do the measurements after the thermal magnetic circuit breakers. If a measured value is different from its nominal value, then check the power supply line and the cables. If you do not find any fault in the cables, then replace the device.		X	
Connections	Check if the connections are tight. Tighten any loose connection.		X	
Display (if present)	Check if there are faulty pixels or any malfunctioning.		X	
Ultracap	Check that the ultracap feeds the control board at least for **30** seconds.		X	
Controll battery	Check that the ultracap feeds the control board at least for **30** seconds.		X	
Safety devices	See *11.6 Calibrations*		X	
Protective covers	Make sure that all the protective covers are in place and that they are not loose or damaged. Repair or replace if necessary.			X
Fuses	Check visually. Replace if necessary.			X

11.3.2 Refrigerant system

WARNING

The unit contains potentially lethal voltage in some circuits.

The electric and control panels can retain a stored high-voltage electrical charge for up to **15** minutes.

Before working inside the electric and control panels proceed as follows:

- Open all the local and remote disconnecting switches of the unit;
- Wait at least **5** minutes;
- Verify with a voltmeter that the power is **OFF**.

Perform the periodic checks and maintenance operations as specified in the following table.

Component or function	Operation	Frequency [months]		
		3	6	12
Operating conditions	See the following points in *9.7.7 Charge the refrigerant by the compressor*: - Check the evaporating temperature; - Measure the superheat; - Measure the sub-cooling.	X		
Compressor	The compressor operates as required? The compressor is noisy? Any frost on the surface? Check the following parameters: - power consumption; - surface temperature of the compressor upper part.	X		
Compressor oil	Check the level (see *9.7.8 Check the oil level*). Top up if necessary (see *9.7.5 Fill up the compressor oil*). Check the moisture indicator on the sight glass. If the indicator shows high moisture then change the filter dryer and make sure that there are no leaks in the circuit.	X		
Compressor crankcase heater	Measure the temperature on the crankcase heater surface to check if the crankcase heater is operating properly. Make reference to the manufacturer documentation for details.		X	
Piping	Any abnormal vibration? Tighten or replace the clamps fixing the piping and the anti-vibration connections.		X	
Safety devices	See *11.6 Calibrations*		X	
Evaporator	Any frost on the surface? The resistance operates as required?		X	
External condensers	The fan operation controller on the external condenser is calibrated correctly? The condenser fan operation is correct? See the condenser manual for other periodic checks and operations.		X	

11.3.3 Air system

WARNING

This unit operates and restarts automatically.

The fan blades can automatically start rotating without warning at any time during a cooling cycle or after the power is restored after a power failure.

The fans may suddenly start blowing out a strong air flow, which may carry particles and small objects from inside the unit.

Before working inside the unit cabinet, removing the fan guards or servicing the fans (speed control, blades, motors) proceed as follows:

• Turn all the disconnecting switches to **OFF**.

Perform the periodic checks and maintenance operations as specified in the following tables.

Component or function	Operation	Frequency [months]		
		3	6	12
Fans	The fans operate as required?	X		
Fans	Visual inspection for dirtiness, damage, corrosion: Clean if necessary.	X (*)		
Fans	Any abnormal vibration? Then tighten the fixing to the supporting structure.	X		
Fans	Any abnormal sound? Then check the bearings.	X		
Fans	Measure the power consumption.		X	
Filters	Visual inspection for dirtiness, damage, corrosion: Clean or replace if necessary (see *11.5.2 Replacing an air filter*)	X (*)		
Filter clog sensor	The sensor operates as required?		X	
Humidity and temperature sensor	See *11.6 Calibrations*.		X	
Heaters (optional)	The accessory operates as required?		X	
Temperature safety switch	See *11.6 Calibrations*.		X	
Condensate tank (optional)	Visual inspection for dirtiness, damage, corrosion: Clean if necessary.	X		
Humidifier	See *Annex F - Electrode Humidifier*.			

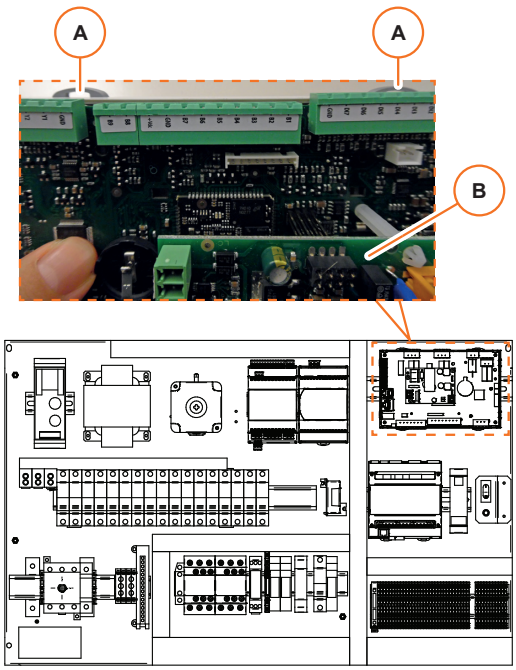
(*) Check more frequently in dusty environment.

11.4 Operations with the Refrigerant

Shut-off valves	You can separate some sections of the refrigerating system by closing the shut-off valves shown in *Annex A - Refrigerating Circuit Diagrams*.
Piping	In case of operations on the piping, for example for replacing components or sealing a leak, see *9.4 Piping Connections*. **NOTICE** Make sure to clean properly the piping before restoring the refrigerant charge.
Refrigerant charge	See *9.7 Refrigerant Charge* if you need to deal with the refrigerant charge in the following situations: - in case of operations that require to empty the refrigerating circuit; - if the operating conditions show that the refrigerant charge is too high or too low. **WARNING** Use only the refrigerant type specified on the *Onboard Label*.
Refrigerant recover	• In case of operations that require to empty the refrigerating circuit, or a section of the circuit, recover all the refrigerant in a container. • Do not allow the refrigerant to escape.

11.5 Replacement of Components

11.5.1 Replacing the control board



WARNING
Disconnect the unit from the power supply.

How to remove:

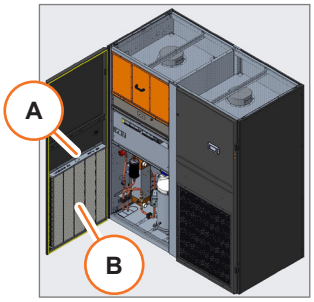
- Remove the cover plate of electrical and control panel;
- Remove all the cables connected with the control board;
- Insert a screw driver in one of the eyes [**A**] and lever out the control board [**B**];
- Repeat for the other eye(s) until the control board is released.

How to reassemble:

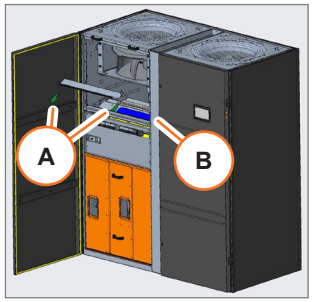
- Press the control board in the DIN rail until it locks;
- Connect again the cables;
- Reassemble the cover plate of electrical and control panel;
- Connect the unit from the power supply;
- Upload the software from the computer (or USB drive) to the control board;
- Restart the unit.

11.5.2 Replacing an air filter

Upflow



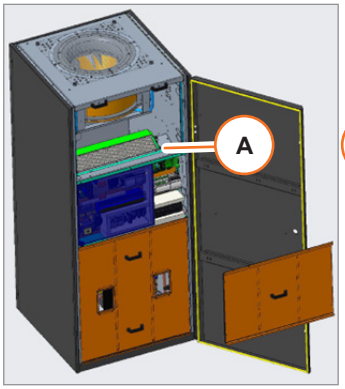
Downflow

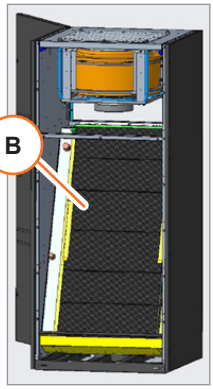


- Switch **OFF** the unit and open the front panel with the key;
- Unscrew and remove the filter brackets [**A**];
- Remove the air filter [**B**].

11.5.3 Replacing the air filters

11.5.3.1 Downflow Frontal and Downflow Up





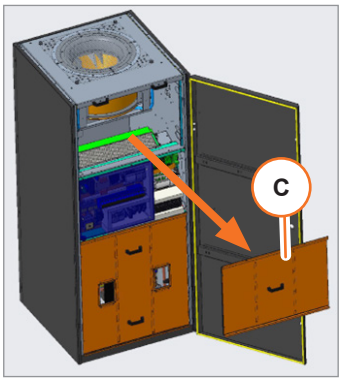
Liebert® PDX PAM units with **Frontal Air Delivery** configuration has filter array which consists of:

- Block/s of filters [**A**] on the top surface of the coil.
- Block/s of filters [**B**] located on the rear side of the coil.

Unit model	Filter blocks on the top of the coil	Filter blocks on rear side of the coil
PAM010	1	1
PAM020	1	1
PAM030	1	1
PAM060	2	3
PAM080	3	4

NOTICE

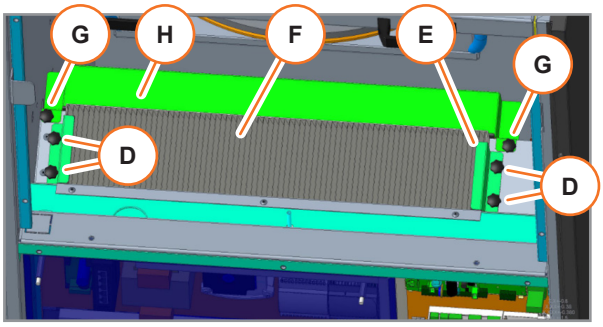
All the filters are accessible from the front of the unit, through the fan section.



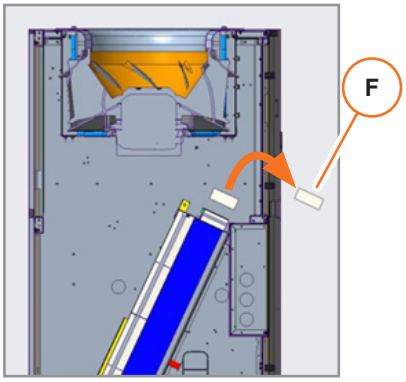
WARNING

Disconnect the unit from power supply.

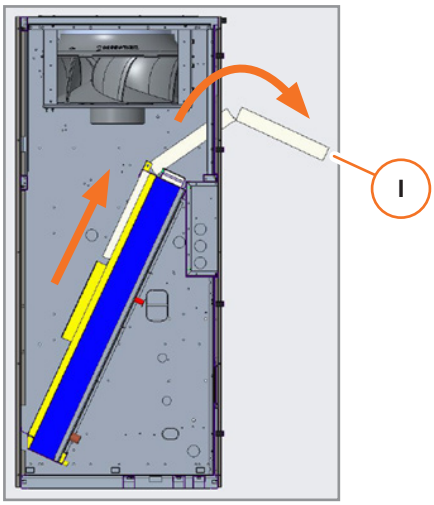
- Switch **OFF** the unit;
- Open frontal door;
- Remove upper front safety panel [**C**].



- Unscrew the knob [**D**] and remove the bracket [**E**] holding the filters in place, Both the left and right sides;



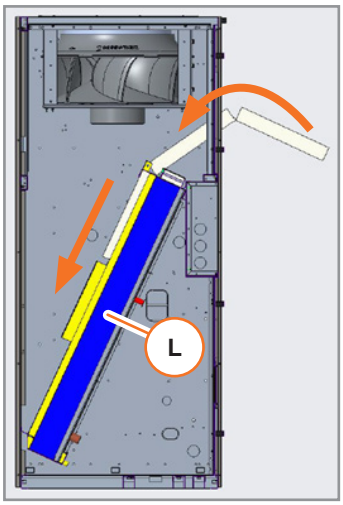
- Remove all the filter [**F**] from the top surface of the coil;
- Unscrew the knobs [**G**] on the left and right sides and remove the bracket [**H**] holding the filter in place;



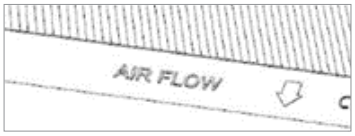
- Carefully pull the filter upwards;
- The filter consists of **3** connected sections;
- Pull the filter [**I**] upwards, between the edge of the coil and fan frame;
- Remove all filter blocks [**I**] from the coil.

NOTICE

Pay attention to not damage the coil surface.

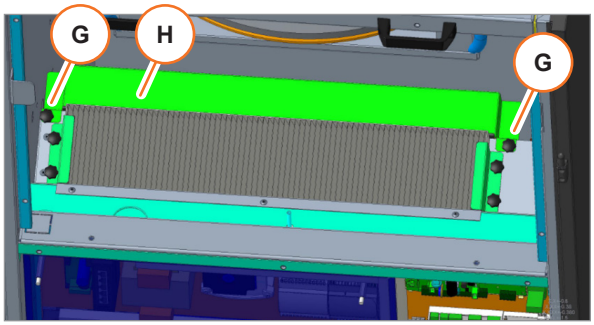


- To replace the filter [**I**], proceed in reverse order;
- Slide the filter [**I**] into the cabinet between the coil edge and fan frame;
- The filter need to slide under the brackets [**L**];
- Pay attention to correct orientation of the filter module relative to the **airflow**;

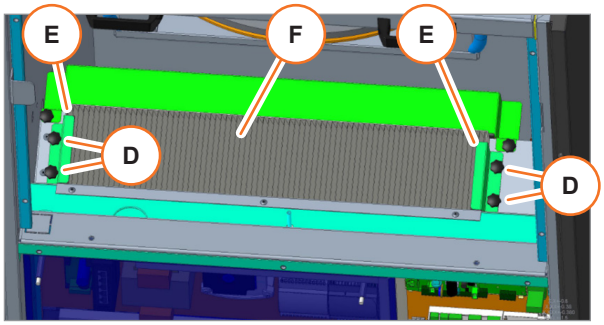


NOTICE

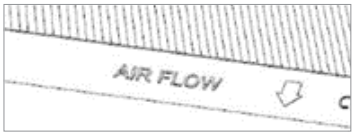
Check the correct position of the filter block with a mirror.



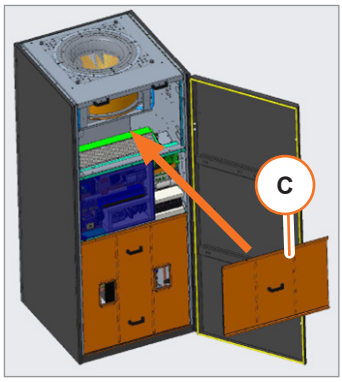
- Re-attach the securing bracket [**H**] and knobs [**G**] on the left and right sides;



- Arrange the filter [**F**] on top of the coil;
- Pay attention to correct orientation of the filter module relative to the **airflow**;



- Re-attach the securing brackets [**E**] and knobs [**D**] on the left and right sides;



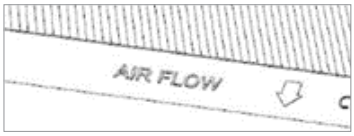
- Re-attach the upper front safety panel [**C**];
- Close the frontal door.

11.5.3.2 Upflow

WARNING

Disconnect the unit from power supply.

- Switch **OFF** the unit;
- Open frontal door;
- Unscrew and remove the filter bracket [**A**];
- Remove the air filter [**B**];
- Replace the filter;
- Pay attention to correct orientation of the filter module relative to the **airflow**;



- Re-attach the securing bracket [**A**];
- Close the frontal door.

11.5.4 Replacing a fan - General instructions

Safety

WARNING

Disconnect the unit from the power supply.

CAUTION

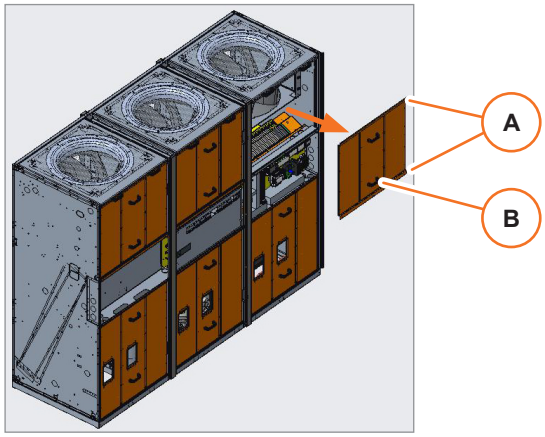
The fans and the support frame are heavy.

This operation must be done by **two** maintenance operators.

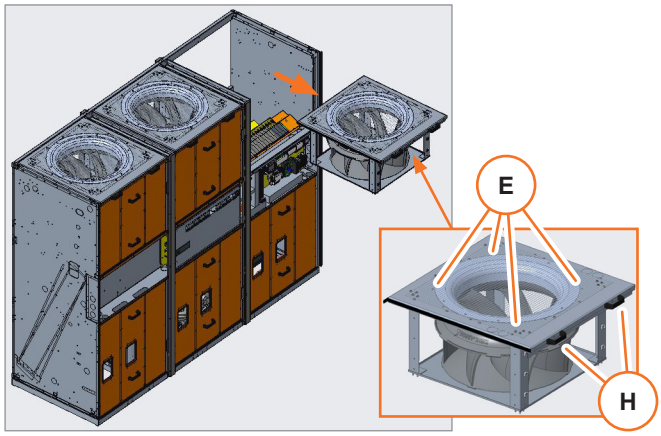
Use adequate lifting equipment and follow the fan manufacturer instructions for handling.

Additional information	Make reference to the fan manufacturer instructions for transport, handling and mounting the fans.
Modbus address	After reassembling, connect the fan to a laptop and use the configuration software provided by the manufacturer to set the fan Modbus address (see *9.6.2 Setting of Modbus devices* and the *iCOM™ User Manual* for details.

11.5.5 Replacing a fan - Downflow up and Downfolw frontal units



- Remove the screws from the panel [**A**];
- Remove the panel [**B**];
- Disconnect the fan electrical cable from the connector;

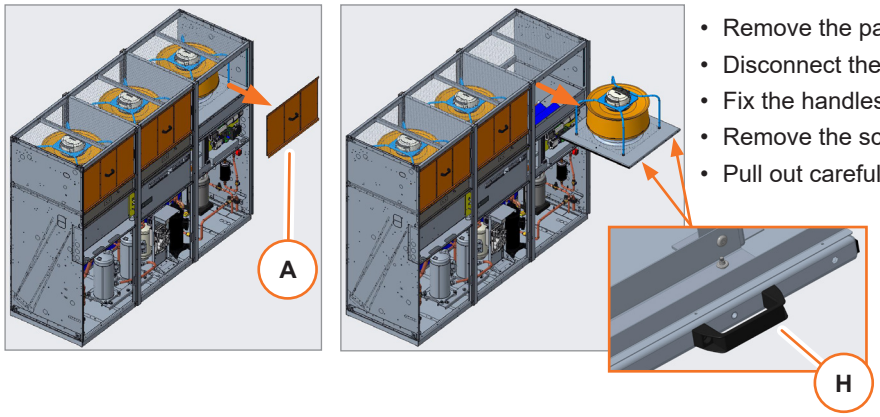


- Fix the handles [**H**] on the top of the fan support frame;
- Remove the screws from the fan support frame;
- Pull out carefully the fan support frame using the handles.

NOTE *It might be helpful (if possible) to support the fan frame from the top by adding eyebolts in the 4 specific holes **[E]** on the top.*

- Proceed in reverse order to reassemble the fan.

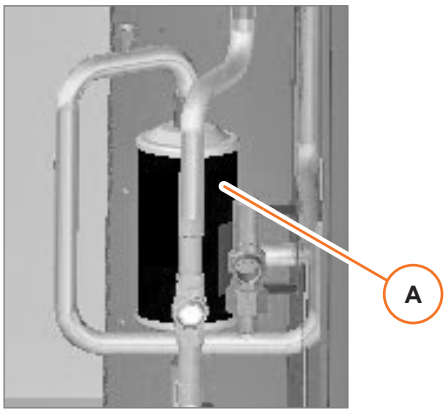
11.5.6 Replacing a fan - Upflow units



- Remove the panel [**A**];
- Disconnect the fan electrical cable from the connector;
- Fix the handles [**H**] on the top of the fan support frame;
- Remove the screws from the fan support frame;
- Pull out carefully the fan support frame using the handles.

- Proceed in reverse order to reassemble the fan.

11.5.7 Replacing the filter dryer



- Shut-down the unit. The **EEV** closes completely;
- Close the shut-off valves on the piping to/from the condenser;
- Discharge and recover the refrigerant;
- Unsolder the pipings connecting the filter dryer [**A**];
- Weld the new filter dryer;
- See *9.7 Refrigerant Charge.*

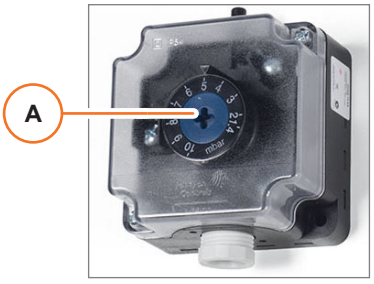
11.6 Calibrations

ENVIRONMENT

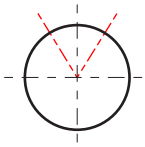
A misuse or an incorrect calibration of the unit leads to increased energy consumption, resulting in an economic and environmental damage.

For calibrations of sensors installed on the external condensers refer to the respective manual.

For control system calibrations refer to *iCOM™ User Manual.*

Safety valves **High pressure switches**	See *6.4 Safety Devices Settings* **WARNING** The safety devices are mounted and calibrated by the manufacturer. • Do not tamper with the safety devices. In case of intervention on a pressure switch, press the button on the pressure switch to reset it manually.
Electronic expansion valve (EEV)	The control system monitors continuously the super-heating. The **EEV** is factory set for a super-heating of 6K. The super-heating must not exceed 30K. The super-heating may be different from the setpoint for variable speed compressors, while they are modulating.
Pressure transducers	Low pressure transducer range: 0 – 9,3 bar High pressure: 0 – 34,5 bar
Clogged filter differential pressure switch	Adjustment range: 0,5 – 4 mbar Setting: 3 mbar (300 Pa)  In case of replacement of the clogged filter differential pressure switch, then turn the screw [**A**] to adjust the setting.
Temperature safety switch (if heating is present	Setting: 120°C ± 6°C Manual reset

12. Troubleshooting

Symptom	Possible Cause	Check or Remedy
The unit does not start	No power supply to the unit	Check voltage at input terminal block
	The circuit breaker or fuse for low-voltage transformer in unit is tripped	Locate the problem in the unit electrical panel and repair
	Remote ON/OFF	Check the remote switch
Low evaporating pressure	Low refrigerant charge	Check the refrigerant charge
	EEV problem	Check the **EEV** configuration
	High pressure drop on the liquid line	Check shut-off valve, filter drier...
High condensing pressure	High refrigerant charge	Check the refrigerant charge
	High pressure drop on the discharge line	Check shut-off valve, pipes
	Dirty condenser fins	Clean the remote condensers
	Condenser fans not operating	Check the fan motors and fuses
The compressor does not run or does not run properly	The connection is loose or disconnect	Check the connection to verify that is connected securely
	The phases of the fixed compressor are wrong	Check the phase sequences
	The compressor does not modulate the capacity properly	Check the Modbus connection and the inverter setting
High vibration on the unit	The compressor is not properly fixed	Check the compressor dampers
	The discharge and suction piping are not properly fixed	Check the piping
The pressure transducer does not read correctly	The sensor is not enough tight	Fix the sensor
	The sensor is fixed in a wrong position	Change the position
	The sensor has a wrong reading range	Change the sensor with a right one
The EEV temperature sensor does not read a correct value	The probe is too close to the evaporator outlet	Move the probe at least 30 cm from the evaporator outlet
	The probe is located in a wrong position	Place the probe at hour 2:00 or 10:00 
	The sensor is located after the oil injection (from the oil separator)	Move the sensor before the oil injection
A Modbus component is not read	Wrong Modbus cabling	Check the cabling
	The address name is not correct	Check the address
The fans do not run	The power cables are not connected	Connect the cables
	There is not signal	Check the Modbus chain
The unit is noisy	The compressor is noisy	Check the compressor fixing
	The fan is noisy	Check the fan fixing

13. Dismantling the Unit

The unit has been designed and built to ensure continuous operation.
The working life of some of the main components, such as the compressors, depends on the maintenance that they receive.
The unit must be dismantled if it is moved to another site, or at the end of its technical and operational life.

13.1 Safety Instructions

WARNING

Improper operations can cause injury or death.

Read carefully the chapter *1. Safety*.
Pay attention to the *safety labels* on the unit and to the safety warnings in this chapter.

ENVIRONMENT

While operating on the refrigerating circuit recover all the refrigerant in a container: do not allow it to escape.

ENVIRONMENT

The unit contains substances and components hazardous for the environment (electronic components, refrigerating gases and oils).

At the end of the useful life, when the unit is dismantled, the operation must be carried out by specialized refrigerating technicians.

The unit must be delivered to suitable centers specialized for the collection and disposal of equipment containing hazardous substances.

The electronic components, the refrigerating fluid and the lubricating oil inside the circuit must be recovered according to the laws in force at the installation site.

13.2 Operations

Operation	Notes
1. Disconnect the disconnecting switch from the electric power supply	Reverse the procedure from chapter *9. Installation*: *9.5.1 Power supply cable*
2. Remove the refrigerant	 ***NOTICE*** Handle the refrigerant according to regulations about F-Gases and safety data sheet. See *14. Regulation (EU) no. 517/2014 (F-gas)*
3. Cut the piping at inlet and outlet of the unit	 **WARNING** Before cutting the pipeline, make sure that the circuit is completely discharged.
4. Remove the unit	Reverse the procedure from chapter *8. Assembly and Positioning*
5. Move away the unit	See *7. Handling*
6. If you need to keep the unit in a storehouse for reuse	See *3.6.1 Storage conditions*
7. If you need to scrap the unit	Handle to authorized disposal company according to the local regulations about waste disposal.

14. Regulation (EU) no. 517/2014 (F-gas)

Content of this chapter

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14.1 Introduction

Stationary air conditioners placed into the European Community market and operating with fluorinated greenhouse gases (F-gas, such as R-513A), have to comply with the F-gas Regulation (EU) No. 517/2014.

This Regulation is in force since Jan 1, 2015 an it replaces the Regulation (EU) No. 342/2006.

This document summarizes the obligations for the operators that are responsible for the equipment during all its operative life until its disposal.

14.2 Normative References

F-gas	517/2014	Regulation (EU) No. 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No. 842/2006.
Certified personnel and Companies	2015/2067	Commission Implementing Regulation (EU) No. 2015/2067 of 17 November 2015 establishing, pursuant to Regulation (EU) No. 517/2014 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of natural persons as regards stationary refrigeration, air conditioning and heat pump equipment, and refrigeration units of refrigerated trucks and trailers, containing fluorinated greenhouse gases and for the certification of companies as regards stationary refrigeration, air conditioning and heat pump equipment, containing fluorinated greenhouse gases.
Leak check air conditioning	1516/2007	Commission Regulation No. 1516/2007 of 19 December 2007 establishing, pursuant to Regulation (EC) No. 842/2006 of the European Parliament and of the Council, standard leakage checking requirements for stationary refrigeration, air conditioning and heat pump equipment containing certain fluorinated greenhouse gases.
Leak check fire protection systems	1497/2007	Commission Regulation No. 1497/2007 of 18 December 2007 establishing, pursuant to Regulation (EC) No. 842/2006 of the European Parliament and of the Council, standard leakage checking requirements for stationary fire protection systems containing certain fluorinated greenhouse gases. From 01/01/2017 to be replaced by: Commission Implementing Regulation (EU) No. 2015/2068 of 17 November 2015 establishing, pursuant to Regulation (EU) No. 517/2014 of the European Parliament and of the Council, the format of labels for products and equipment containing fluorinated greenhouse gases.

14.3 Fluorinated Greenhouse Gases

Following notes have to be considered when operating with the above mentioned equipments:

- Fluorinated greenhouse gases are covered by the Kyoto Protocol;
- The fluorinated greenhouse gases in this equipment should not be vented to the atmosphere;
- Referring to the value noted in Annex I and Annex IV of Regulation (EU) No. 517/2014 here below the global warming potential (GWP) of some major F-gases or mixtures:
  - R-513A GWP 631

NOTE: *the refrigerants as R22 are not F-gas and their relevant regulation is Regulation (EU) No. 1005/2009.*

14.4 Operators

14.4.1 Definitions

- Operator, according to Regulation (EU) No. 517/2014 Article 2, point 8, means the natural or legal person exercising actual power over the technical functioning of products and equipment covered by this Regulation.
- The State may, in defined, specific situations, designate the owner as being responsible for the operator's obligations.
- Where large installations are involved, service companies are contracted to carry out maintenance or servicing. In these cases the determination of the operator depends on the contractual and practical arrangements between the parties.

14.4.2 Obligations

Operators of stationary air conditioners, which contain fluorinated greenhouse gases, shall, using all measures which are technically feasible and do not entail disproportionate cost:

a Prevent leakage of these gases and as soon as possible repair any detected leakage.

b Ensure that they are checked for leakage by certified personnel.

c Ensure for putting in place arrangements for the proper recovery by certified personnel.

d According to Regulation (EU) No. 517/2014 the operators shall ensure that the equipment is checked for leaks as following:

Case 1 - Non-sealed equipment contains less than 5 tonnes of CO_2 equivalent of fluorinated greenhouse gases.

► Leakage test not required;

Case 2 - Hermetically sealed equipment contains less than 10 tonnes of CO_2 equivalent of fluorinated greenhouse gases.

► Leakage test not required;

Case 3

► **Leakage test required:** check the equipment for leaks with the minimum frequency given in the following table:

X = Tonnes of CO_2 Equivalent	Y = equivalent amount of refrigerant [kg]	Minimum frequency for leak check	
	R513A	without leakage detection	with leakage detection
5 ≤ X < 50	7,9 ≤ Y < 79,2	12 Months	24 Months
50 ≤ X < 500	79,2 ≤ Y < 792,4	6 Months	12 Months
X ≥ 500	Y > 792,4	3 Months	6 Months

e Recovery for the purpose of recycling, reclamation or destruction of the fluorinated greenhouse gases, pursuant to Art. 8 of the Regulation (EU) No. 517/2014 shall take place before the final disposal of that equipment and, when appropriate, during its servicing and maintenance.

14.5 Leakage Detection

The manufacturer approves the following leakage check methods according to Reg. (EU) No. 1516/2007 and No. 1497/2007:

Method		Specifications
a	Check of circuits and components representing a risk of leakage with gas detection devices adapted to the refrigerant in the system.	Gas detection devices shall be checked every **12** months to ensure their proper functioning. The sensitivity of portable gas detection devices shall be at least **five** grams per year.
b	Application of ultraviolet (UV) detection fluid or suitable dye in the circuit.	The method shall only be undertaken by personnel certified to undertake activities which entail breaking into the refrigeration circuit containing fluorinated greenhouse gases.
c	Proprietary bubble solutions/soapsuds.	---

14.6 Labelling

The label applied on the unit (see *Onboard Label*) is designed to fill-in the relevant amounts of refrigerant according to Regulation (EU) No. 1494/2007 (2015/2068):

a Where fluorinated greenhouse gas is foreseen to be added to the equipment outside of the manufacturing site at the point of installation, a dedicated label accommodates notation of both the quantity [kg] pre-charged in the manufacturing plant and of the quantity charged at the installation site as well as the resulting total quantity of F-gas as a combination of the above mentioned quantities, in a manner which conforms to the legibility and indelibility.

Our split units are usually not pre-charged on factory, in this case the total quantity of refrigerant charged in the unit has to be written in the relevant label, during the commissioning operation at the installation site.

All of the quantities of must be given both as mass of refrigerant [kg] and as Tonnes of CO_2 Equivalent.

Use the following rule for computation:

$$\textbf{Tonnes of } CO_2 = \frac{\textbf{kg of refrigerant x GWP of refrigerant}}{\textbf{1000}}$$

where:

Refrigerant	GWP
R-513A	631

b Our packaged units (not split) operating with F-gas are usually full charged on factory and the total amount of refrigerant charge is already reported on the label. In this case, the label has no need of further written information.

c In general, the above mentioned information has been located in the main nameplate of relevant unit.

d For equipment with double refrigeration circuits, in regards to differentiates requirements on the basis of the quantity of F-gas contained, the required information about refrigerant charge quantities has to be listed separately for each individual circuit.

e For equipment with separate indoor and outdoor sections connected by refrigerant piping, the label information will be on that part of the equipment which is initially charged with the refrigerant. In case of a split system (separate indoor and outdoor sections) without a factory pre-charge of refrigerant, the mandatory label information will be on that part of the product or equipment which contains the most suitable service points for charging or recovering the fluorinated greenhouse gas(es).

NOTE *Safety data sheets of F-gases used in the products are available on demand.*

14.7 Record Keeping

Operators of equipment which is required to be checked for leaks (see *14.5 Leakage Detection*), shall establish and maintain records for each piece of such equipment specifying the following information:

a the quantity and type of fluorinated greenhouse gases installed.

b the quantities of fluorinated greenhouse gases added during installation, maintenance or servicing or due to leakage.

c whether the quantities of installed fluorinated greenhouse gases have been recycled or reclaimed, including the name and address of the recycling or reclamation facility and, where applicable, the certificate number.

d the quantity of fluorinated greenhouse gases recovered.

e the identity of the undertaking which installed, serviced, maintained and where applicable repaired or decommissioned the equipment, including, where applicable, the number of its certificate.

f the dates and results of the leak checks carried out (see *14.5 Leakage Detection*).

g if the equipment was decommissioned, the measures taken to recover and dispose of the fluorinated greenhouse gases.

Unless the records are stored in a database set up by the competent authorities of the Member States the following rules apply:

a the operators shall keep the records for at least **five** years.

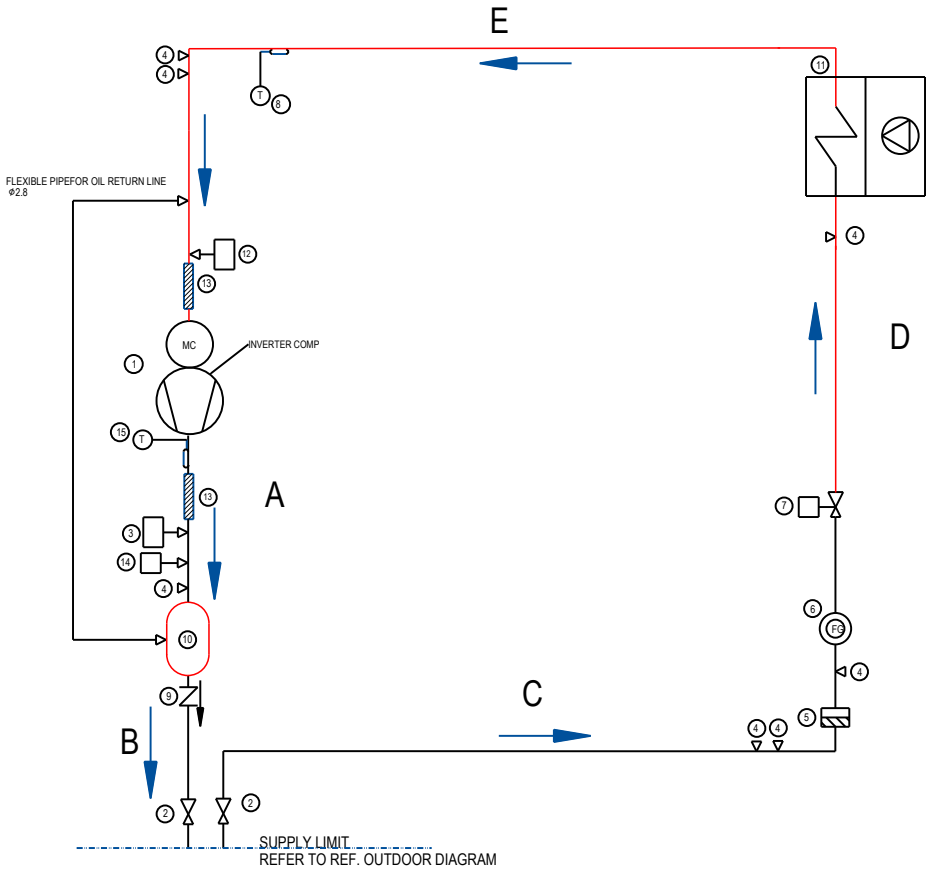
b undertakings carrying out activities for operators shall keep copies of the records for at least **five** years.

Annex A - Refrigerating Circuit Diagrams

Content

1 - PAM010 - PAM020 - PAM030.....100
2 - PAM060.....101
3 - PAM080.....102

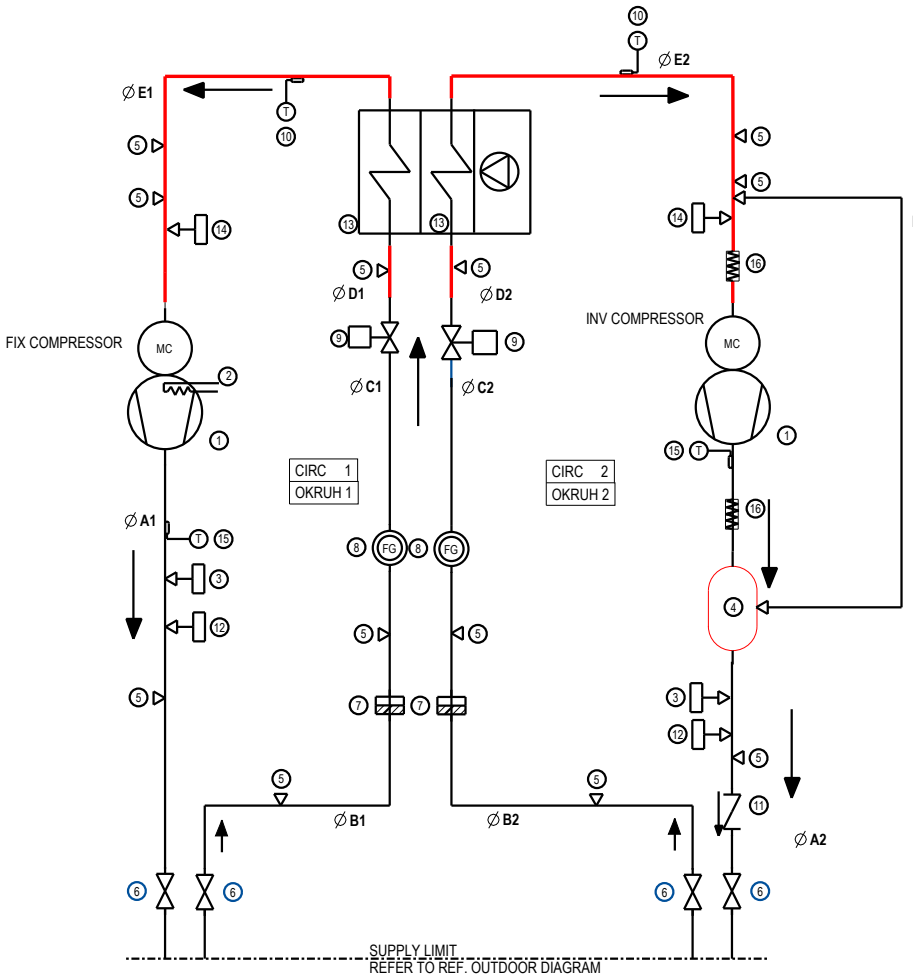
1 - PAM010 - PAM020 - PAM030



Ref.	Description
1	Compressor
2	Shut-off
3	High pressure switch
4	Access valve 1/4"
5	Filter dryer
6	Sight glass
7	Electronic expansion valve (EEV)
8	Temperature sensor for EEV
9	Check valve
10	Oil separator
11	Evaporator
12	Low pressure transducer
13	Vibration absorber
14	High pressure transducer
15	Temperature discharge sensor

Pipe insulation

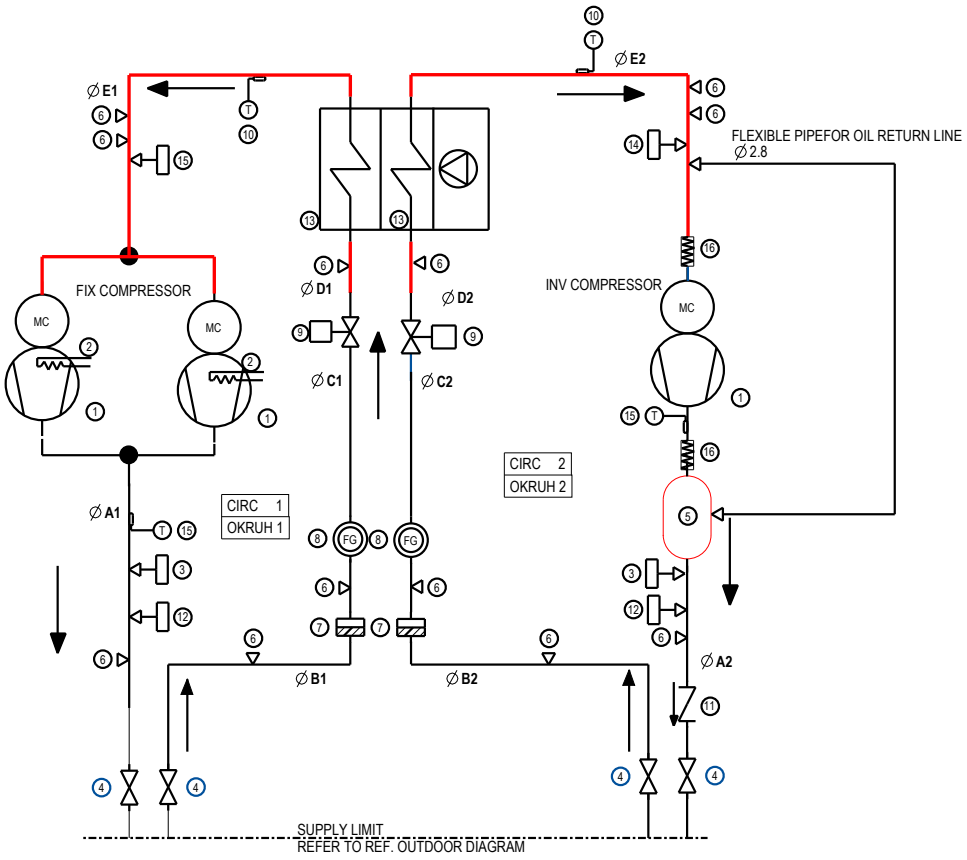
2 - PAM060



Ref.	Description
1	Compressor
2	Cranckcase heater
3	High pressure switch
4	Oil separator
5	Access valve 1/4"
6	Shut-off valve
7	Filter dryer
8	Sight glass
9	Electronic expansion valve
10	Temperature sensor for EEV
11	Check valve
12	High pressure transducer
13	Evaporator
14	Low pressure transducer
15	Temperature discharge sensor
16	Vibration adsorber

Pipe insulation

3 - PAM080



Ref.	Description
1	Compressor
2	Crankcase heater
3	High pressure switch
4	Shut-off
5	Oil separator
6	Access valve 1/4"
7	Filter dryer
8	Sight glass
9	Electronic expansion valve (EEV)
10	Temperature sensor for EEV
11	Check valve
12	High pressure transducer
13	Evaporator
14	Low pressure transducer EEV
15	Temperature discharge sensor
16	Vibration adsorber

Pipe insulation

Annex B - Safety Labels

Content

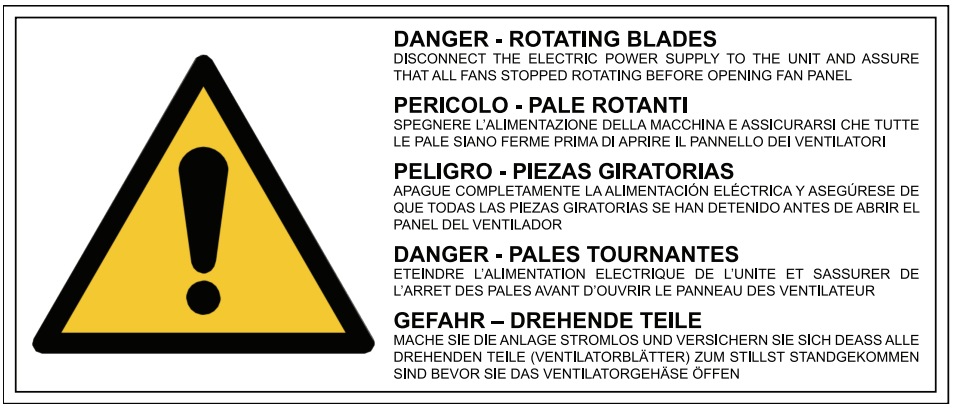
1 - Labels list.....103
2 - Labels position.....105

WARNING

Do not remove or cover the labels placed on the unit by the manufacturer.
Check regularly that the warning label are still on the unit and that they are clearly visible.
Replace any missing or damaged label.

1 - Labels list

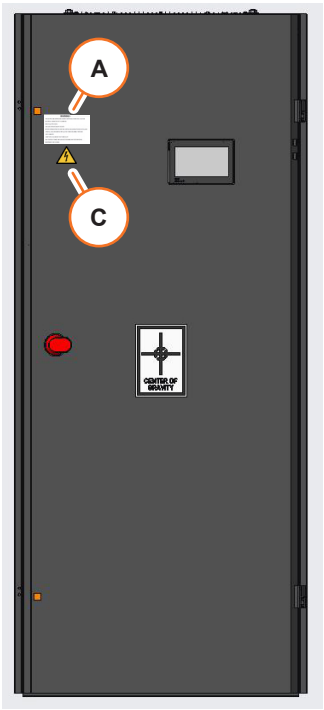
Identification	Description
A	**WARNING!** THE ELECTRIC AND CONTROL ENCLOSURES CAN RETAIN A STORED HIGH- VOLATAGE ELECTRICAL CHARGE FOR UP TO 10 MINUTES. RISK OF ELECTRIC SHOCK. CAN CAUSE SERIOUS ENJURY OR DEATH. BEFORE WORKING WITHIN THE UNIT AND CONTROL ENCLOSURES PROCEED AS FOLLOWS: -OPEN ALL LOCAL AND REMOTE UNIT ELECTRIC POWER DISCONNECT SWITCHES -WAIT 10 MINUTES -VERIFY WITH A VOLTMETER THAT POWER IS OFF ONLY PROPERLY TRAINED AND QUALIFIED PERSONNEL MAY PERFORM REPAIR. MAINTENANCE AND CLEANING
B	**WARNING:** HOT AND MOVING PARTS ENCLOSED, DISCONNECT THE MAINS SUPPLY BEFORE REMOVING THIS COVER. **ATTENZIONE:** PARTI IN MOVIMENTO, CORPI CALDI, APRIRE IL SEZIONATORE ELETTRICO GENERALE PRIMA DI RIMUOVERE QUESTO PANNELLO. **ACHTUNG:** DREHENDE UND ERHITZTE TEILE, VOR OFFNEN DIESES PANEELS DAS GERAT SPANNUNGSFREI MACHEN. **ATTENTION:** PIECES EN MOUVEMENT: ELEMENTS CHAUFFANTS. ACTIONER LE SECTIONNEUR GENERAL AVANT DE DEMONTER CE PANNEAU. **ATENCION:** PARTES EN MOVIMENTO, CUERPOS CALIENTES, ABRIR EL INTERRUPTOR ELETRICO GENERAL ANTES DE GUITAR EL PANEL PROTECTOR. **ΠΡΟΣΟΧΗ:** ΠΕΡΙΚΛΥΕΙ ΘΕΡΜΑ ΚΑΙ ΚΙΝΟΥΜΕΝΑ ΜΕΡΗ. ΑΠΟΣΥΝΔΕΣΑΤΕ ΤΟΝ ΓΕΝΙΚΟ ΔΙΑΚΟΠΤΗ ΠΡΙΝ ΑΝΟΙΞΕΤΕ ΑΥΤΟ ΤΟ ΚΑΛΥΜΑ.

Identification	Description
C	
D	
E	
F	
G	

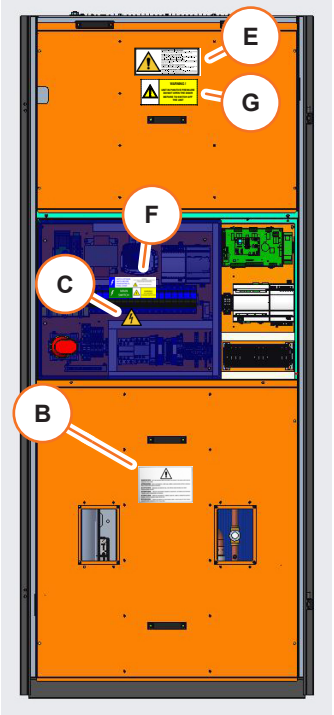
2 - Labels position

Frame type 0 - 1 (1 bay)

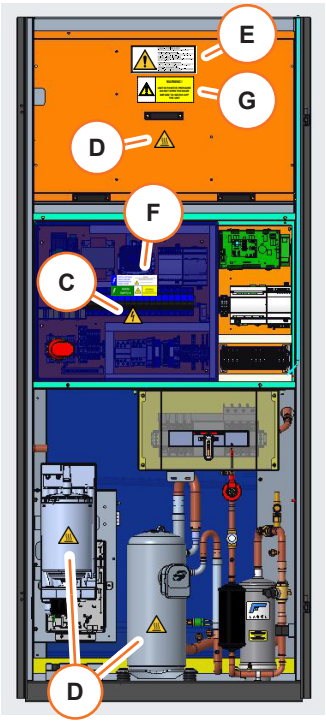
Downflow/Upflow - Outside



Downflow - Inside

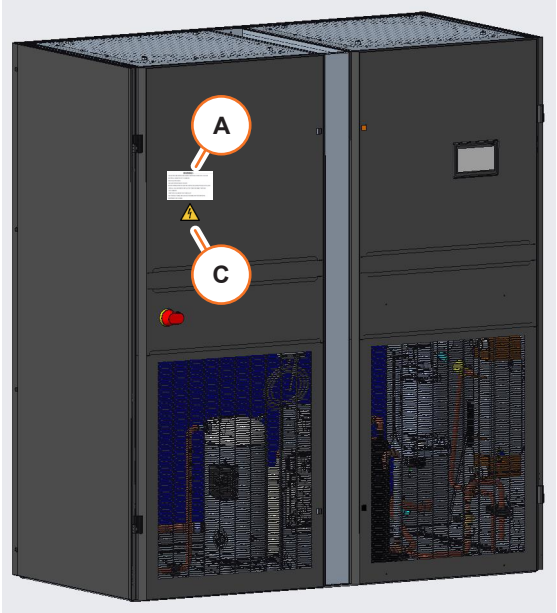


Upflow - Inside

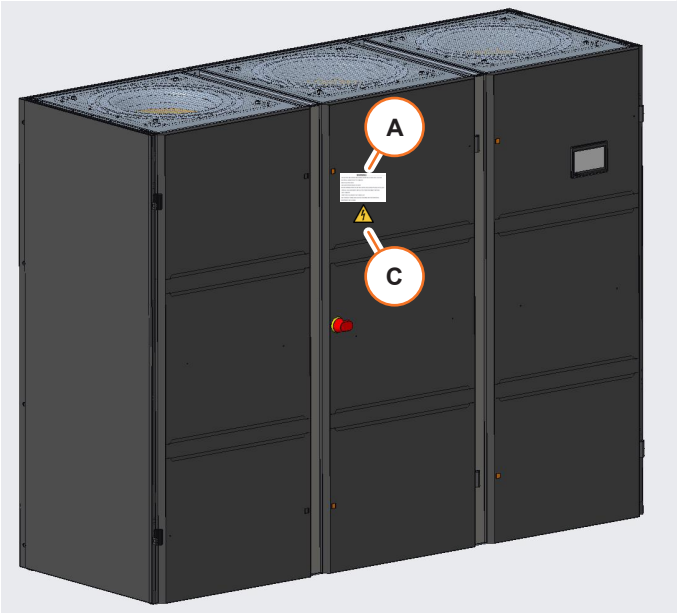


Frame types 3 - 5 (2 - 3 bays)

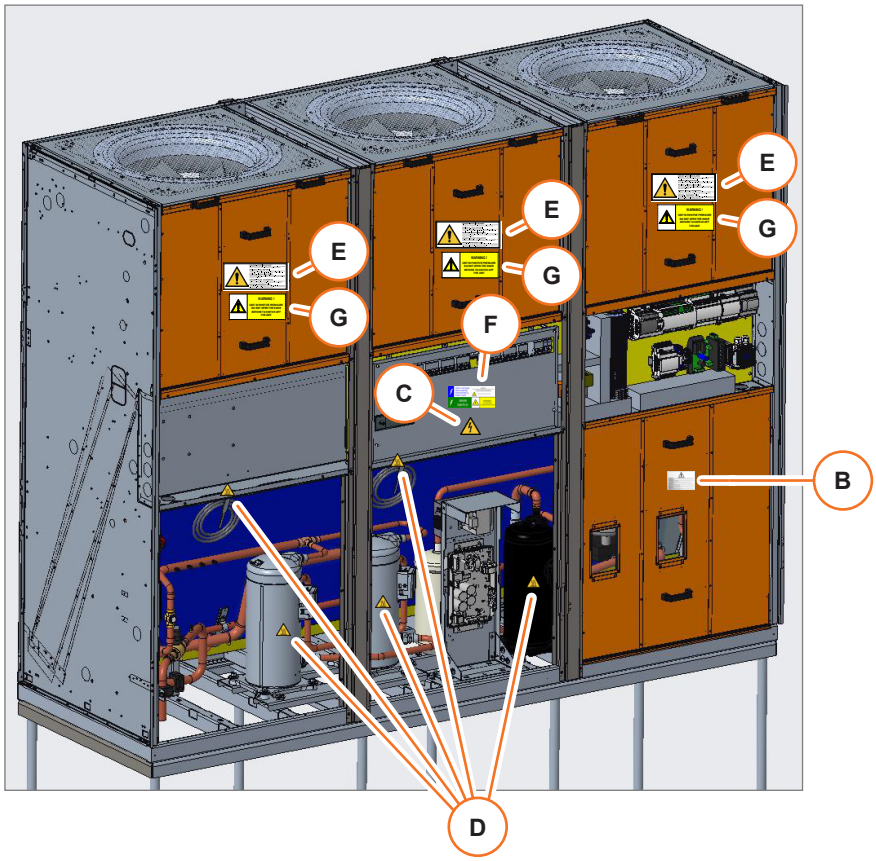
Frame types 3 - Outside



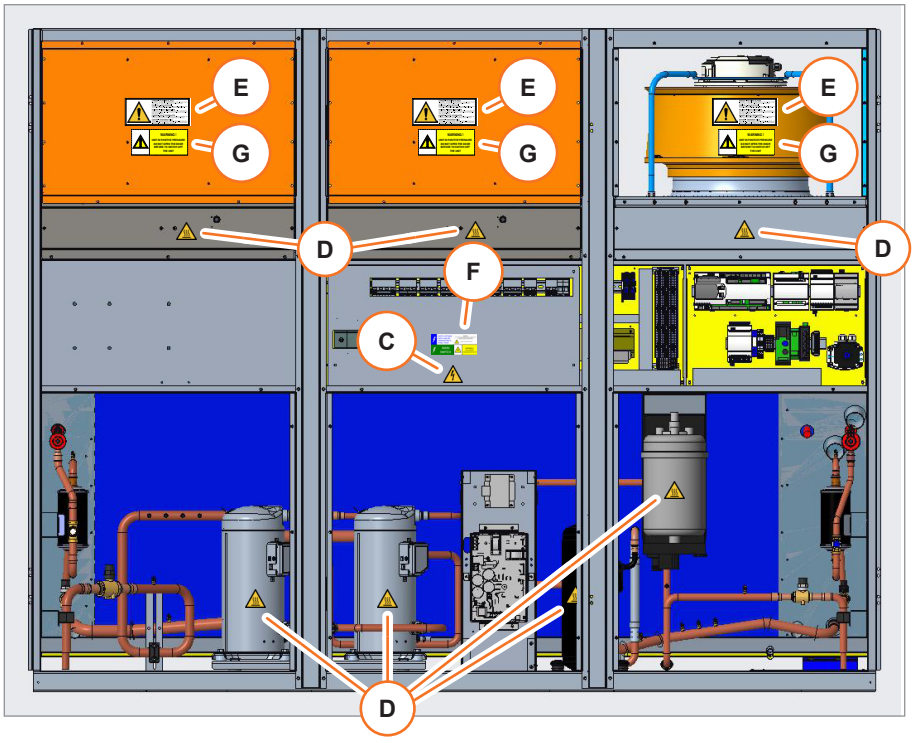
Frame types 5 - Outside



Downflow - Inside



Upflow - Inside



Annex C - Dimensions and Weights

Content

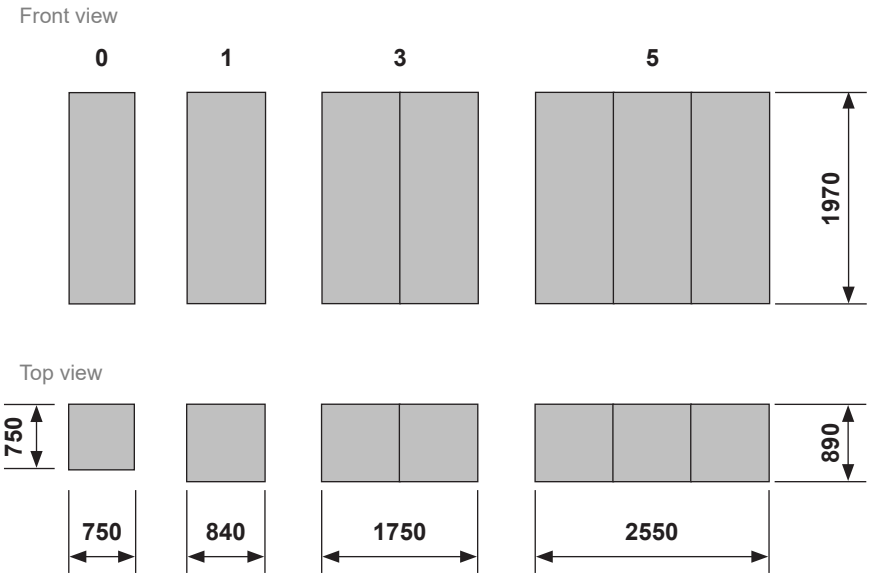
1 - Overview.....107
2 - Overall dimensions.....108
3 - Height from the floor.....108
4 - Height of the accessories at bottom.....109
5 - Height of the accessories on top.....109
6 - Free space from the floor.....110
7 - Free space from the ceiling.....110
8 - Hole in the floor for Downflow Up units.....111
9 - Weights.....112
10 - Gravity centers.....113

1 - Overview

Identify the model and air distribution of your unit.	See *2. Digit Nomenclature*
Identify the type of frame of your unit.	See *6.1 Structure*
Find the overall dimensions for the unit frame, without accessories.	See in this annex: *2 - Overall dimensions* *3 - Height from the floor*
Check which accessories are mounted on the unit.	See *Annex E - Accessories*
Find the dimensions of the accessories. Calculate the total height of the unit.	See in this annex: *4 - Height of the accessories at bottom* *5 - Height of the accessories on top*
Check if there is enough free space at top and bottom of the unit.	See in this annex: *6 - Free space from the floor* *7 - Free space from the ceiling*
If you are going to install a **Downflow** unit: find the dimensions of the hole in the raised floor.	See in this annex: *8 - Hole in the floor for Downflow Up units*
Check if there is enough free space for service in front of the unit.	See *9.3.2 Space requirements*

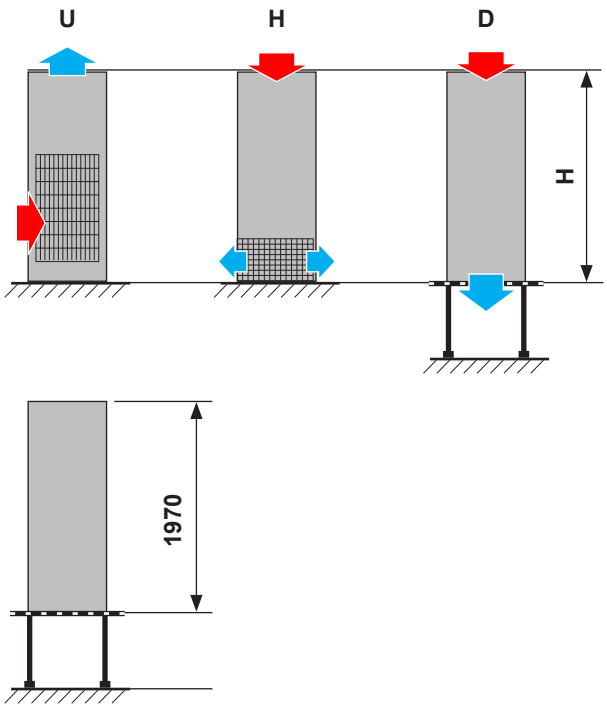
2 - Overall dimensions

Standard units



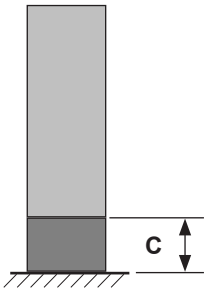
The figure above shows the dimensions of the standard units, by frame type, without any accessory.

3 - Height from the floor



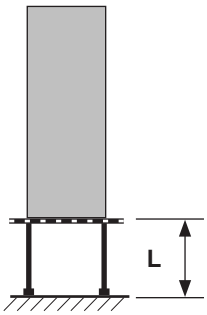
Standard [H] = 1970 mm

4 - Height of the accessories at bottom



U - Upflow
H - Downflow Frontal

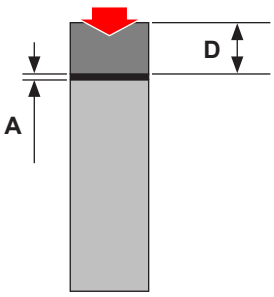
Base module	Height [**C**]: - 200 mm



D - Downflow Up

Legs kit	The height [**L**] is adjustable within the following ranges: - 30–370 mm - 370–570 mm - 570–800 mm
Base frame	The height [**L**] is adjustable within the following range: - 120–800 mm

5 - Height of the accessories on top



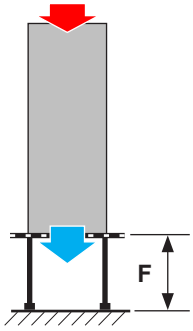
H - Downflow Frontal
D - Downflow Up

Connecting flange (accessory needed to mount other accessories on top of the unit)	Height [**A**] 50 mm
Accessory on top of the unit	Height [**D**]: see the table below.

Accessory	Height D [mm]	+ Height A of connecting flange [mm]*
Vertical flow extension hood	500 - 600 - 700 - 800 - 900	50
Motorized damper	150	50
Plenum with Damper	600	50
Horizontal hood with grid	600	50

* For **Downflow Up** and **Frontal** air delivery.

6 - Free space from the floor

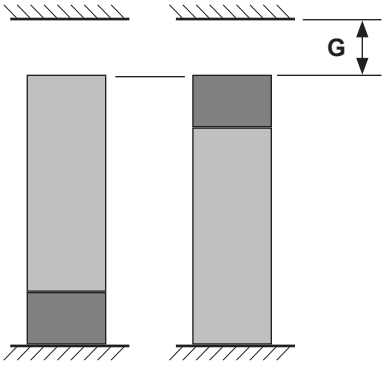


D - Downflow Up

Free space [**F**] between the bottom of the unit and the floor

- Maximum: 800 mm, which is the maximum available height for the base frame or legs kit (see above).
- Minimum to obtain the declared performances: 600 mm
- Minimum allowable to obtain the minimum working conditions: 300 mm

7 - Free space from the ceiling

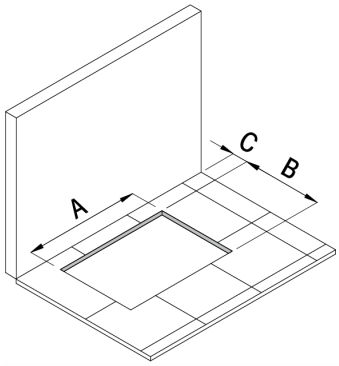


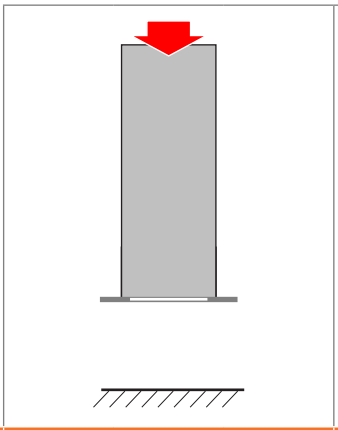
H - Downflow Frontal
D - Downflow Up

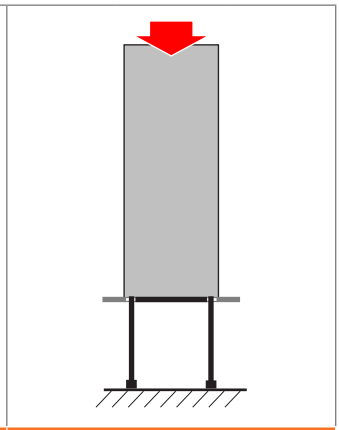
Free space [**G**] between the ceiling and the unit top, including any accessory mounted on top or bottom

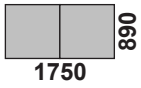
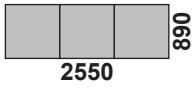
- Minimum to obtain the declared performances: 600 mm
- Minimum allowable to obtain the minimum working conditions: 300 mm

8 - Hole in the floor for Downflow Up units







Frame type	No accessories for support			With base frame		
	A [mm]	B [mm]	C [mm]	A [mm]	B [mm]	C [mm]
0 	650	620	70	714	690	30
1 	740	760	70	804	830	30
3 	1650	760	70	1726	840	30
5 	2450	760	70	2526	840	30

NOTE *[C] is the minimum free space between the unit at its final position and any back wall or obstacle. You might need more space for assembly or installation operations. In that case, do the assembly or installation operation nearby and then place the unit at the final position.*

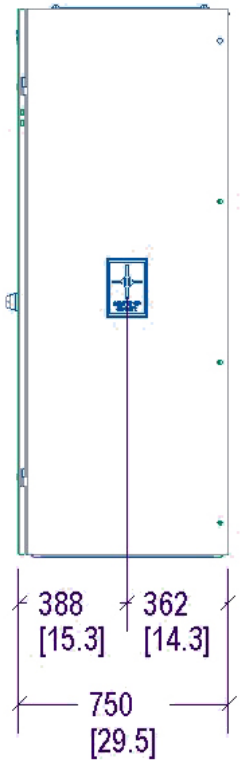
9 - Weights

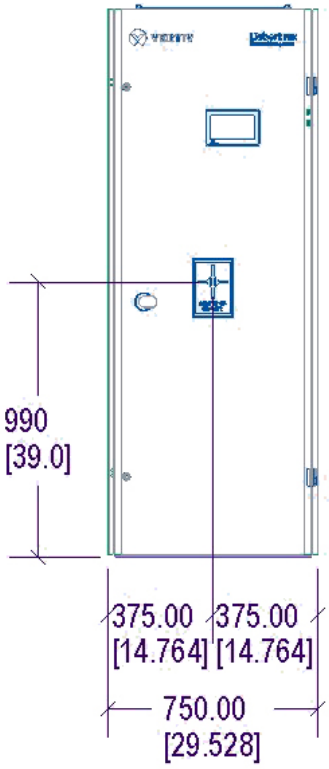
Table 28 - Unit weight

Unit Model	Unit Weight [kg]	Packaging Weight [kg]
PAM010	285	17
PAM020	354	19
PAM030	363	19
PAM060	730	28
PAM080	937	42

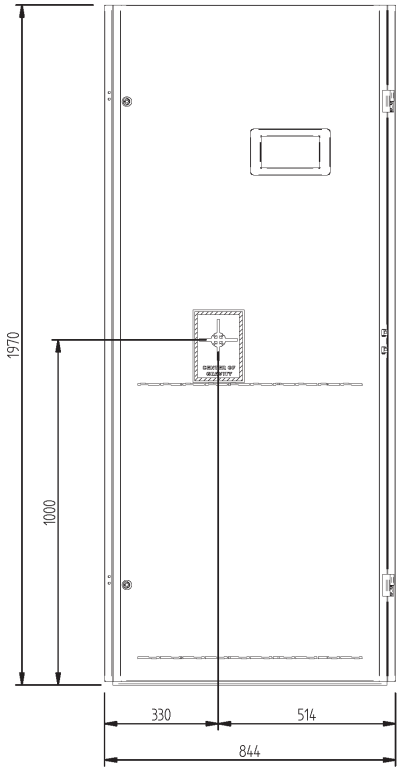
10 - Gravity centers

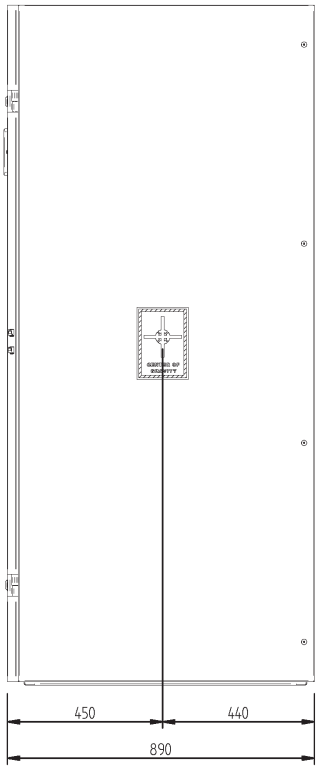
Gravity center - Frame type 0 - Downflow & Upflow



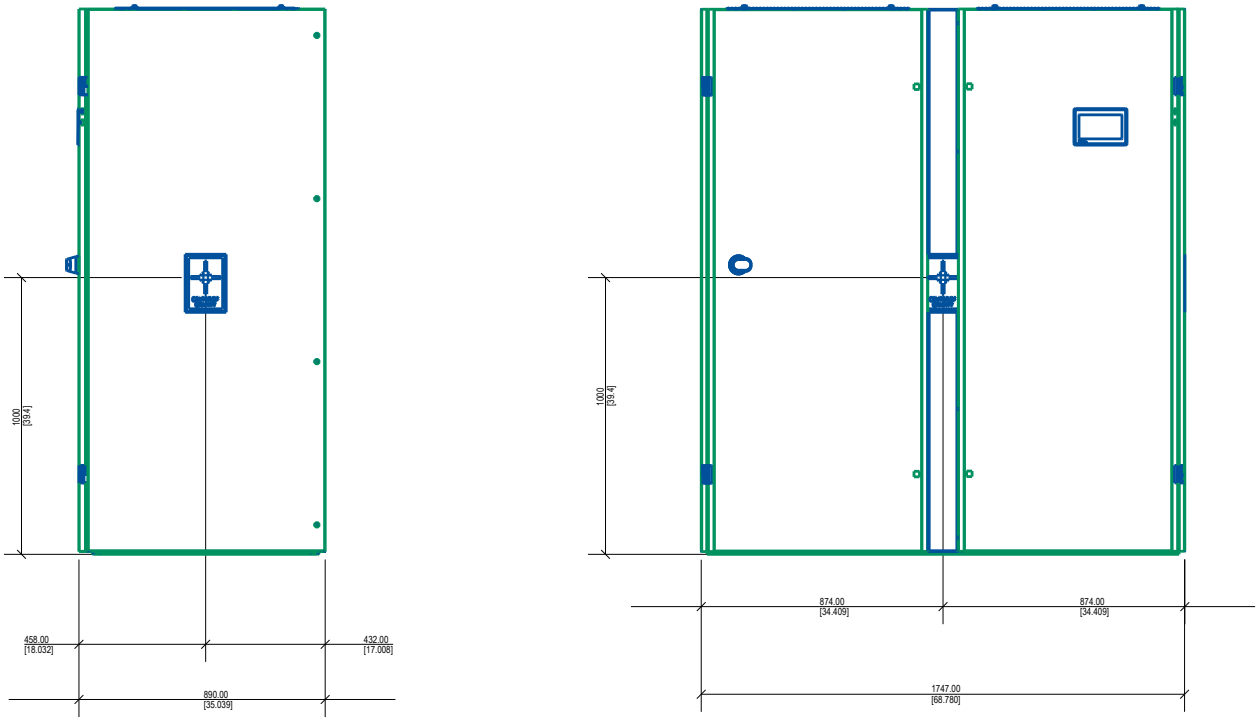


Gravity center - Frame type 1 - Downflow & Upflow

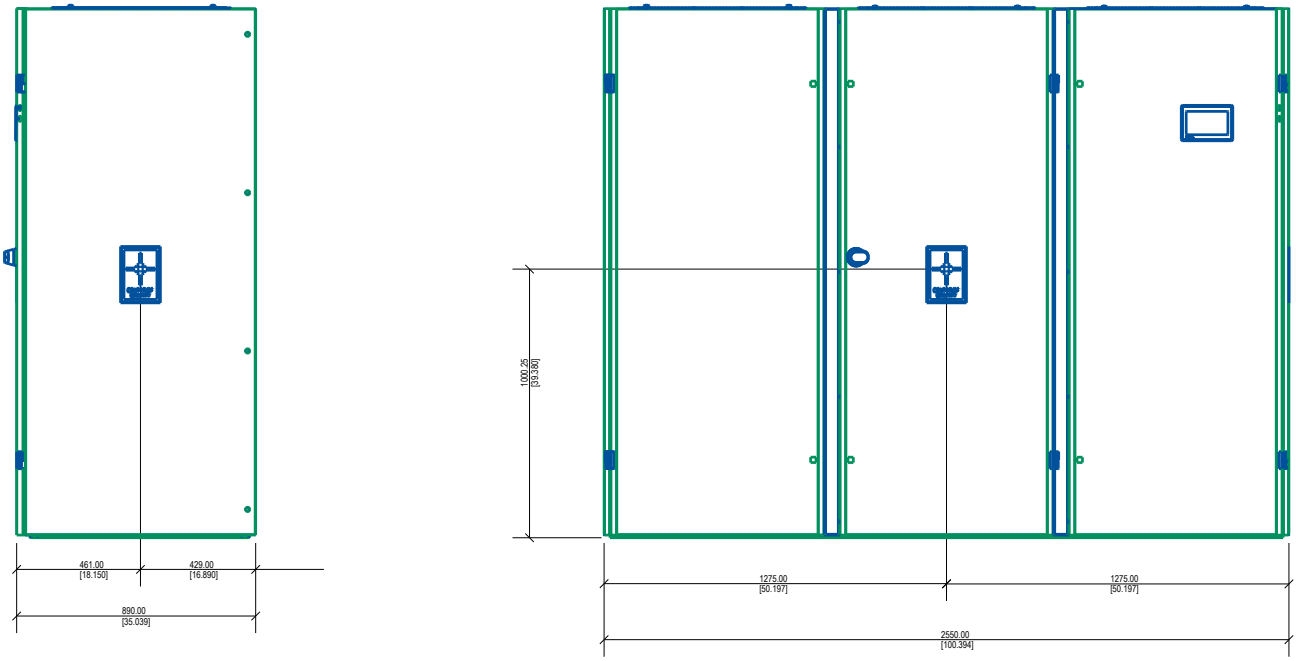




Gravity center - Frame type 3 - Downflow & Upflow



Gravity center - Frame type 5 - Downflow & Upflow



Annex D - Connections

Content

1 - PAM010.....116
2 - PAM020-030.....116
3 - PAM060.....117
4 - PAM080.....118

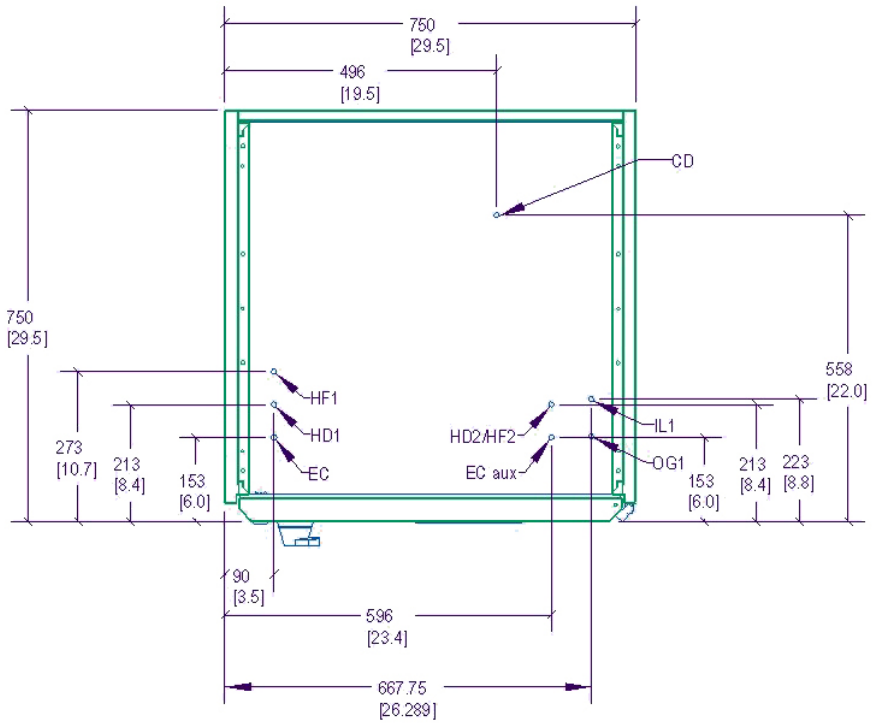
Key to symbols

Symbol	Description	See ...
IL1	Refrigerant liquid line inlet circuit 1	Table *Unit Refrigerable Connection*
IL2	Refrigerant liquid line inlet circuit 2	
OG1	Refrigerant gas line outlet 1	
OG2	Refrigerant gas line outlet 2	
HF	Humidifier feed	*Annex F - Electrode Humidifier*
HD	Humidifier drain	
EC	Electrical power supply	Chapter *6.5.1 Unit electrical data*
EC aux	Low voltage cables	
CD	Condensate Drain	Chapter *6.5.7 Condensate pump*

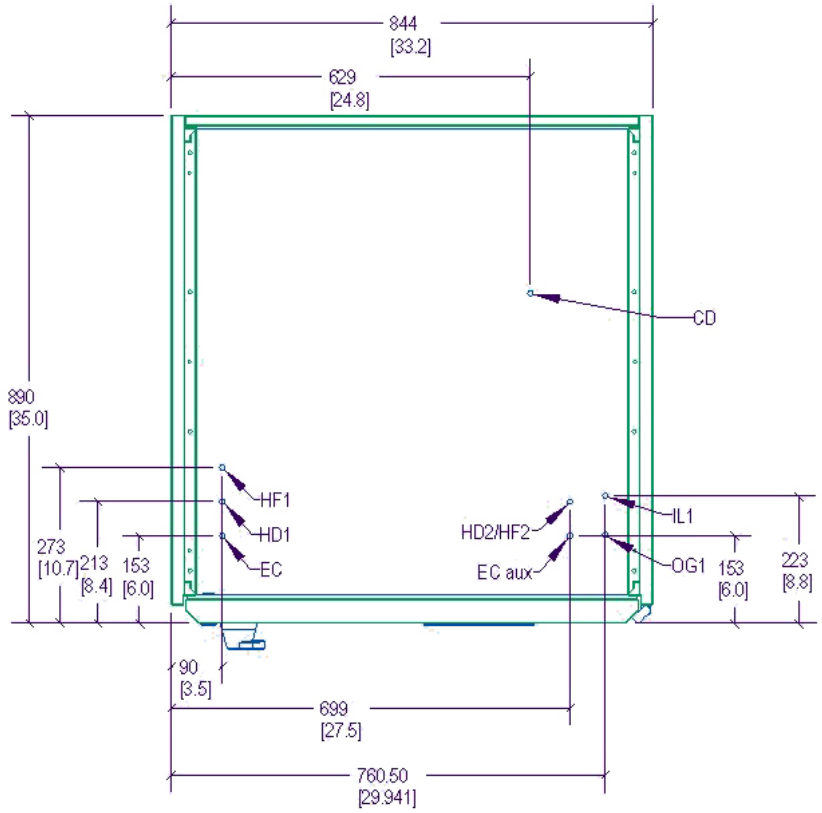
NOTE *All the dimensions are in millimeters*

Symbol	1 BAY			2 BAY	3 BAY
	PAM010	PAM020	PAM030	PAM060	PAM080
IL1	16	16	18	18	22
IL2	/	/	/	18	18
OG1	18	22	22	22	28
OG2	/	/	/	22	22

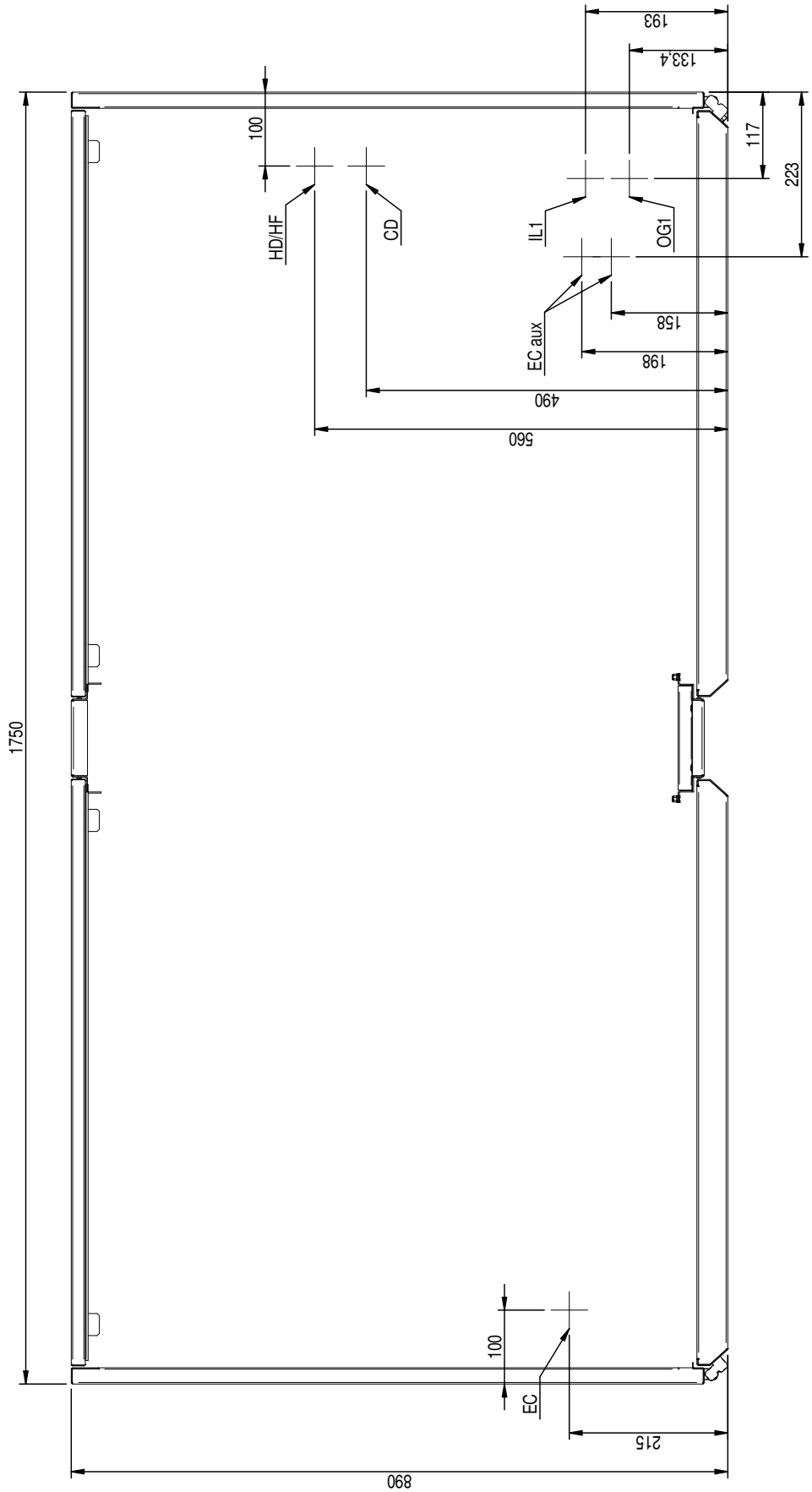
1 - PAM010



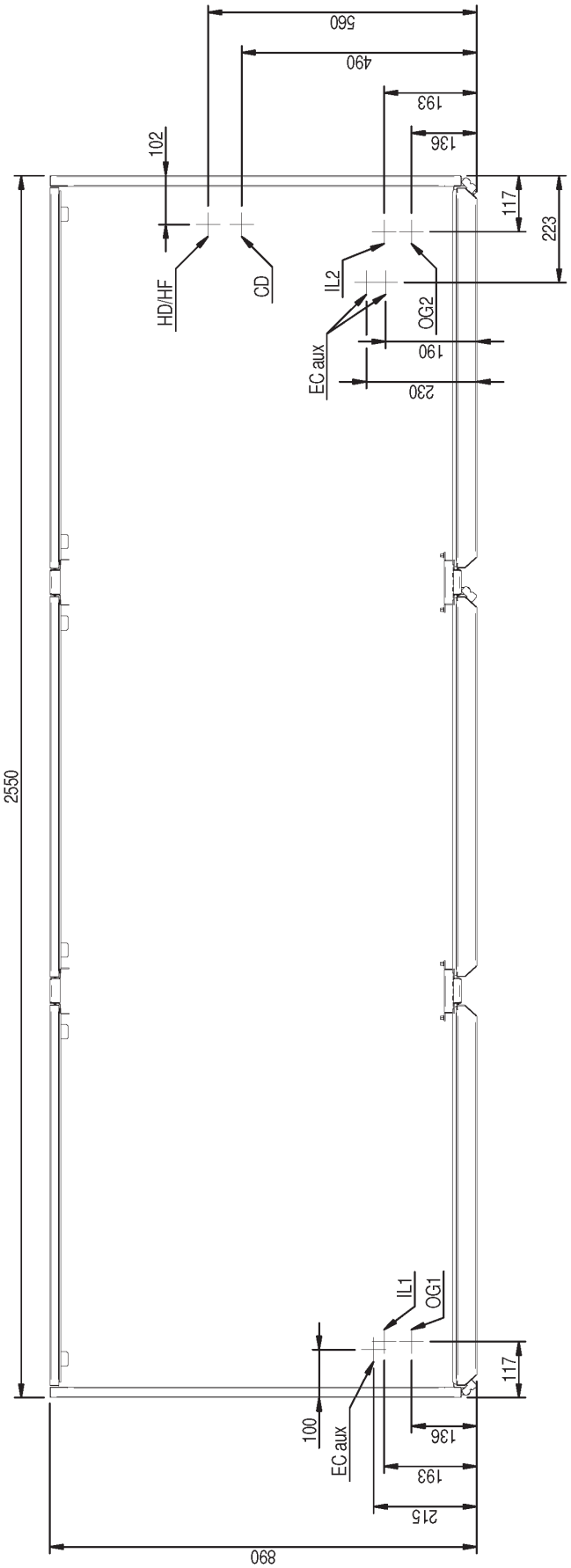
2 - PAM020-030



3 - PAM060


193
133,4
100
117
223
HD/HF
CD
IL1
OG1
EC aux
158
198
490
560
1750
100
EC
215
890

4 - PAM080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EC aux
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Annex E - Accessories and cabinet mechanical options

Content

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3 - Base module.....120
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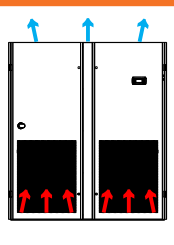
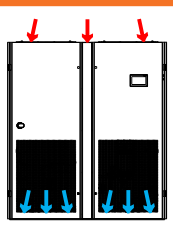
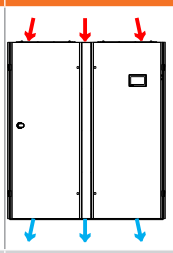
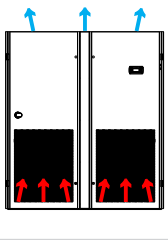
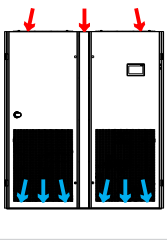
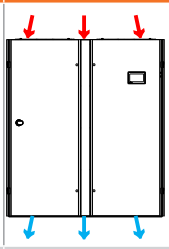
5 - Vertical flow extension hood with damper.....121
6 - Horizontal hood with grid.....122
7 - Connecting flange.....122
8 - Overpressure damper.....123
9 - Motorized damper with spring return.....123

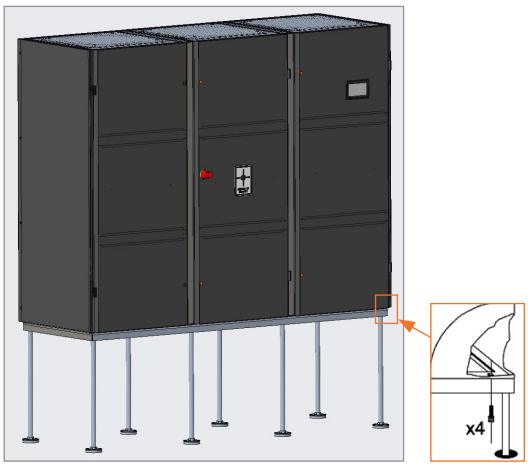
1 - Overview

Accessory	Purpose	Position	U Upflow	H Downflow Frontal	D Downflow Up
					
Base frame with antivibrations dampers	Support	Bottom	Yes	Yes	Yes
Base module	Support + connections lay down	Bottom	Yes	Yes	No
Vertical flow extension hood (*)	Air flow	Top	Yes	Yes	Yes
Vertical flow extension hood with damper (*)	Air flow	Top	Yes	Yes	Yes
Horizontal flow extension hood with grille	Air flow	Top	Yes	No	No
Connecting flange	(*)	Top	No	Yes	Yes

Mechanical Options (**)	Purpose	Position	U Upflow	H Downflow Frontal	D Downflow Up
					
Overpressure Damper (**)	Air flow	Top	Yes	No	No
Motorized Damper (*) (**)	Air flow	Top	Yes	Yes	Yes
Motorized Damper with spring return (*) (**)	Air flow	Top	Yes	Yes	Yes

(*) The connecting flange accessory is required to mount all accessories and mechanical options on top of the downflow frontal and downflow up units.
(**) Standard design doesn't allow to install any mechanical option if a top accessory is already present: no dampers can be installed if a flow extension hood is configured.

2 - Base frame with antivibrations dampers



Purpose	To support the unit when installed with a raised floor.
Description	The legs are adjustable and allow to support the unit at different height. A protective grid prevents any contact with the fans from below.
For airflow version	**U - Upflow** **H - Downflow Frontal** **D - Downflow Up**
Available height	120–800 mm
Assembly	Fix the accessory using the threaded inserts that you find in the fan module frame. You need M8 screws (they are not supplied with the unit).

3 - Base module

Purpose	To support the unit. Allow the piping to enter the base of the unit when a raised floor is not installed.
For airflow version	**U - Upflow** **H - Downflow frontal**
Available height	200 mm
Assembly	Fix to the unit base by 4 screws (the screws are not supplied with the unit)

4 - Vertical flow extension hood

Purpose	Additional duct on the unit top, to simplify the connection to the ceiling or to other equipment.
Description	The hood has the same design as the unit and consists of sandwich panels lined with non-flammable insulation material of class 0 (ISO 1182.2), density 30 kg/m^3.
For airflow version	**U - Upflow** **H - Downflow Frontal** **D - Downflow Up**
Available heights	500 mm 600 mm 700 mm 800 mm 900 mm
Assembly	For **all units**: fix the accessory to the unit top by screws (the screws are not supplied with the unit).

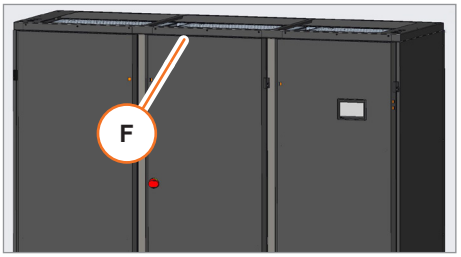
5 - Vertical flow extension hood with damper

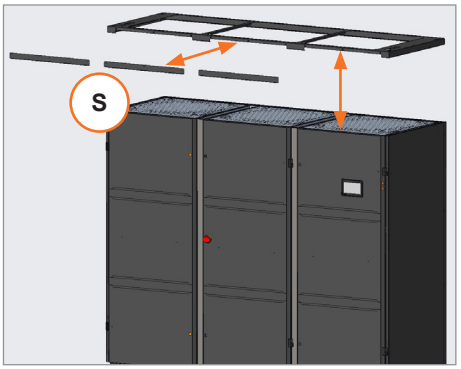
Purpose	Additional duct on the unit top, to simplify the connection to the ceiling or to other equipment. Equipped with damper.
Description	The hood has the same design as the unit and consists of sandwich panels lined with non-flammable insulation material of class 0 (ISO 1182.2), density 30 kg/m3. Motorized damper is included.
For airflow version	**U - Upflow** **H - Downflow Frontal** **D - Downflow Up**
Available heights	600 mm
Assembly	For **all units**: fix the accessory to the unit top by screws (the screws are not supplied with the unit).

6 - Horizontal hood with grid

Purpose	Airflow optimization Noise reduction
Description	A supply plenum with horizontal air flow can be installed on top of the unit. The plenum consists of sandwich panels lined with non-flammable insulation material of class 0 (ISO 1182.2), density 30 kg/m^3. It is equipped with a double deflection grill.
For airflow version	**U - Upflow**
Available height	600 mm
Assembly	For the **Downflow** units: mount first the connecting high flange on top of the unit (see *6 - Connecting flange*). For **all units**: fix the accessory to the unit top by screws (the screws are not supplied with the unit).

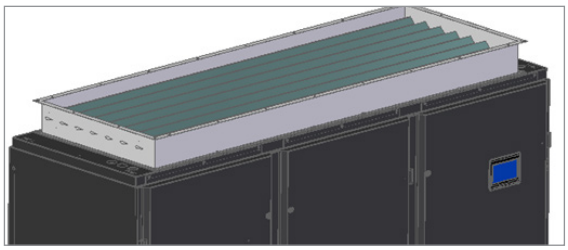
7 - Connecting flange





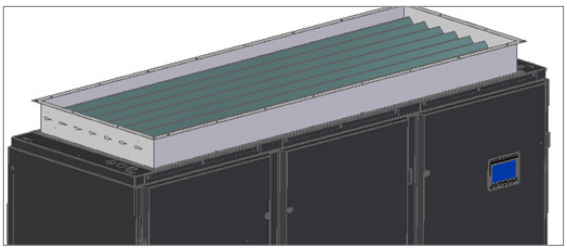
Purpose	To allow mounting on top of the unit the following accessories.
For airflow version	**H - Downflow Frontal** **D - Downflow Up**
Available height	50 mm
Assembly	If you ordered a unit with the arrangement for the above mentioned accessories, the flange [**F**] is already mounted on the unit top. Therefore the unit is 50 mm higher. To remove the flange you need to remove the side panel [**S**] to access the fixing screws.

8 - Overpressure damper



Purpose	Avoid air flow inside the unit when fans are not running.
Description	Gravity backdraught damper, fitted on the top of the unit.
For airflow version	**U - Upflow**
Available height	150 mm
Assembly	This option is already installed on the unit when selected.

9 - Motorized damper - Motorized Damper with spring return



Purpose	Avoid air flow inside the unit when fans are not running.
Description	Gravity backdraught damper, fitted on the top of the unit. The option with or without spring return is available.
For airflow version	**U - Upflow** **H - Downflow Frontal** **D - Downflow Up**
Available height	150 mm
Assembly	This option is already installed on the unit when selected.

Annex F - Electrode Humidifier

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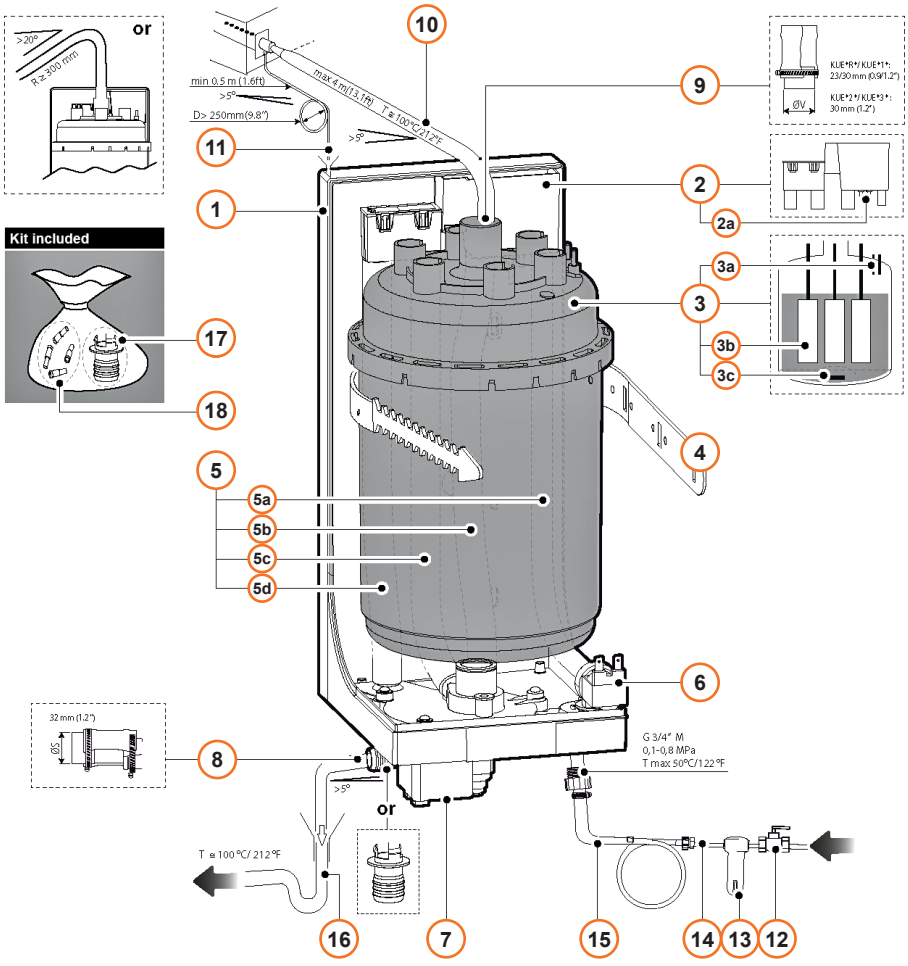
2 - Specifications.....126
3 - Installation.....127
4 - Startup and operation.....128
5 - Maintenance.....128
6 - Troubleshooting.....130

1 - Description

Main Components



1	Chassis
2	Fill tank
2a	Conductivity electrodes
3	Cylinder
3a	High level electrodes
3b	Immersed electrodes
3c	Filter inside the cylinder
4	Cylinder fastening strap
5	Hose kit
5a	Supply hose
5b	Fill hose
5c	Drain pump and overflow outlet hose
5d	Drain hose
6	Fill solenoid valve
7	Drain pump
8	Drain connection (Ø 32 mm)

Steam distribution

9	Steam outlet
10	Steam distribution hose
11	Steam condensate hose

Water fill

12	Manual valve (not supplied)
13	Mechanical filter
14	Supply hose (not supplied)
15	Connection hose

Water drain

16	Drain hose with siphon (not supplied)

Kit included

17	Straight and 90° connection hose (Ø 32 mm)
18	Connectors for electrodes **2a** e **3a**

Operating principle

The metal electrodes are immersed in the tank filled with common drinking water. When a voltage is applied on the electrodes, an electric current is created in the water, which is slightly conductive since it contains a certain quantity of dissolved mineral salts. The electric current heats the water until producing steam (Joule effect). The quantity of steam produced is proportional to the electric current, which is in turn proportional to the level of water.

2 - Specifications

Technical data

Electrode humidifier technical data

Model	Main power supply	Setting (1)	Absorbed current	Power	MAX water cylinder volume	MAX water supply	MAX drained water
	[V ± 10%]	[kg/h]	[A]	[kW]	[l]	[l/min]	[l/min]
KUECLH	400 V / 3 ph / 50 Hz	1,3 - 3	3,2	2,25	3,3	0,6	7,0
KUECLL	400 V / 3 ph / 50 Hz	3,9 - 8	8,7	6	5,5	0,6	7,0

(1) The humidifier can be set between the 30 - 100% of the capacity, in steps of 10%. The humidifier mounted in the unit is factory-set to produce about 50% of the maximum value (see the iCOM™ manual).

Supply water

Only use drinking water with the following specifications:

- pressure between 0,1 and 0,8 MPa (1 and 8 bar);
- temperature between 1 and 40°C;
- instant flow rate no higher than the “MAX water supply” given in the table *Electrode humidifier technical data* above.
- hardness no greater than 400 ppm of $CaCO_3$ (40°fH);
- conductivity range: 75-1250 µS/cm.

Supply water chemical specifications

Inorganic compounds	Unit of measure	Normal water		Water with low salt content	
		MIN	MAX	MIN	MAX
Hydrogen ions	(pH)	7	8,5	7	8,5
Specific conductivity at 20°C (σR, 20°C)	(σR, 20°C) S/cm	350	1250	75	350
Total dissolved solids (TDS)	mg/l	(1)	(1)	(1)	(1)
Dry residue at 180°C (TH)	mg/l	(1)	(1)	(1)	(1)
Total hardness	mg/l $CaCO_3$	100 (2)	400	50 (2)	160
Temporary hardness	mg/l $CaCO_3$	60 (3)	300	30 (3)	100
Iron + Manganese	mg/l Fe+Mn	=	0.2	=	0.2
Chlorides	ppm Cl-	=	30	=	20
Silica	mg/l SiO_2	=	20	=	20
Residual chlorine	mg/l Cl_2	=	0.2	=	0.2
Calcium sulphate	mg/l $CaSO_4$	=	100	=	60
Metallic Impurities	mg/l	0	0	0	0
Solvents, thinners, detergents, lubricants	mg/l	0	0	0	0

(1) = values depend on the specific conductivity; in general: TDS≈0,93*σR, 20°C; R180≈0,65*σR, 20°C;
(2) = not less than 200% of the chloride content in mg/l CL-;
(3) = not less than 300% of the chloride content in mg/l CL-.

NOTE *There is not reliable relationship between hardness and conductivity of the water.*

CAUTION

Do not add disinfectants or anticorrosive compounds to the water, as these are potential irritants.

The use of well water, industrial water or water from cooling circuits and, in general, any potentially chemically or bacteriologically contaminated water is not recommended.

NOTICE

Do not treat the water with softeners, this may cause the entrainment of foam, affecting the operation of the unit.

Drain water

The drain water contains the same substances dissolved in the supply water, however in larger quantities.

It may reach a temperature of 100°C.

It is not toxic and can be drained into the sewerage system, category 3, EN 1717.

Connect the drain hose to an ordinary drainage network with the following specifications:

- install a siphon that must be able to withstand temperatures up to 100°C;
- the network must be able to drain a water flow up to 10 l/min.

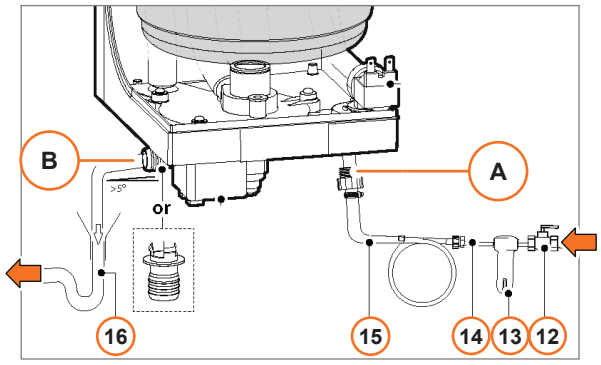
NOTICE

Pay attention in the manual drainage of the steam cylinder if the drainage network is not able to drain 10 l/min, there is a risk of water overflow on the humidifier.

3 - Installation

The humidifier is supplied already mounted within the **Liebert® PDX PAM UHD A** unit.

The only necessary operations are the connections to the supply water and drain water.



Supply water connection

- Connect to the pipe connection [**A**] (G 3/4") the following components:
  - [**15**] connection hose with double non-return valve;
  - [**14**] supply hose (not supplied);
  - [**13**] mechanical filter;
  - [**12**] manual valve (not supplied).

Drain water connection

- Connect to the drain connection [**B**] (Ø 32 mm) the drain hose with siphon [**16**] (not supplied).

Use a drain hose Ø 32 mm, maximum length 10 m with minimum 5% gradient, don't make siphon on this hose to avoid back pressures in the drain piping.

For configuration with bigger length or high head consider the **Liebert® PDX PAM UHD A** option with condensate pump.

4 - Startup and operation

Initial checks

Before using the humidifier, check the following conditions:

- The water supply and drain piping are properly connected;
- The shut-off valve is open;
- All the wirings are properly connected;
- The steam hose is properly connected to the steam cylinder and distributor.

Startup

The humidifier is available as soon as the **Liebert® PDX PAM UHD A** unit is switched **ON**. The humidification request starts the humidifier.

When starting with an empty cylinder, the water conductivity is normally insufficient for the humidifier steam output to be reached immediately. Therefore, the humidifier produces as much steam as possible to fill the cylinder completely.

If the cylinder is empty at the startup, then the water conductivity could be insufficient to reach immediately the required humidifier steam output. In this case the following actions take place:

- The water that has evaporated is immediately refilled;
- The drain valve is kept shut and therefore, as the steam does not contain any salts, the conductivity of the water within the cylinder slowly increases until the required humidifier steam output is obtained.

The length of the startup period depends on the water conductivity.

For very conductive water it may occur that the required humidifier steam output is obtained immediately.

Operation

The adjustable parameters which determine the humidifier operation have already been factory-preset (see iCOM™ manual).

The steam production rate is controlled by varying the water level in the cylinder.

The higher the water level, the deeper the electrodes are immersed into the water and the greater the steam production.

NOTE *In case of low water conductivity consult Vertiv™.*

5 - Maintenance

WARNING

Presence of potentially lethal voltage in some circuits. Presence of water that may leak or pour out.

Before doing any operation, always disconnect the power supply.

WARNING

High temperature of some components. High temperature of water.

Before doing any operation, wait until all the components and the water have cooled down. Use protective gloves.

NOTICE

Maintenance operations must be carried out only by authorized and trained technicians. We recommend the Vertiv™ Customer Service.

For any operation that is not specifically mentioned in this manual you must contact Vertiv™ Technical Support.

Periodic checks

After extended use, or when using water with a high salt content, the solid deposits that naturally form on the electrodes may reach the stage where they also stick to the inside wall of the cylinder.

If the deposits are very conductive, the heat may melt the plastic, with possible puncture of the cylinder, allowing water to leak back into the tank.

As a precaution, check, at the frequency recommended below, for deposits and the blackening of the wall of the cylinder, and replace the cylinder if necessary.

When	What to check	Disposable cylinders	Openable cylinders
After one hour of operation	• Any significant water leaks	YES	YES
Every fifteen days or no more than 300 operating hours	• Regular operation • Any significant water leaks • General condition of the casing • Arcs or sparks between the electrodes during operation	YES	YES
Every three months or no more than 1000 operating hours	• Regular operation • Any significant water leaks: - If necessary, replace the cylinder.	YES	NO
Every three months or no more than 1000 operating hours	• Marked blackened parts on the casing: - If this is the case, check the condition of the electrodes. - If necessary, replace the electrodes together with the O-rings and the cover gasket.	NO	YES
Annually or no more than 2500 operating hours	• Regular operation • Any significant water leaks • General conditions of the container • Marked blackened parts on the casing: - If this is the case, check the condition of the electrodes; - If necessary, replace the electrodes together with the O-rings and the cover gasket.	NO	YES

Cylinder replacement

Due to the aging of the plastic and the consumption of the electrodes, even an operable steam cylinder has a limited life and it is, therefore, recommended to replace it according to the following table.

When to replace the cylinder	Disposable cylinders	Openable cylinders
Annually or no more than **2500** operating hours	YES	NO
After five years or no more than **10000** operating hours	YES	YES

Procedure

- Completely drain the water contained in the cylinder;
- Switch **OFF** the **Liebert® PDX PAM UHD A** unit and open the disconnecting switch of the power supply (safety procedure);
- Remove the steam hose from the cylinder;
- Disconnect the electrical connections from the top of the cylinder;
- Release the cylinder from the fastening device and lift it up to remove it;
- Fit the new cylinder in the humidifier by performing the previous operations in reverse order.

NOTICE

Check that the model and the power supply voltage of the new cylinder is the same as the one being replaced.

Replacement and maintenance of other components

Fill solenoid valve	After having disconnected the cables and the piping, remove the solenoid valve and check the condition of the inlet filter. Clean, if necessary, using water and a soft brush.
Supply and drain manifold	Check that there are no solid residues in the cylinder attachment, remove any impurities. Check that the gasket (O-ring) is not damaged or cracked. If necessary, replace it.
Drain pump	Disconnect the power supply. Unscrew the three fastening screws and remove the motor body. Remove any impurity and rinse.
Supply tank and conductivity meter	Check that there are no obstructions or solid particles. Check that the electrodes for measuring the conductivity are clean. Remove any impurity and rinse.
Hose kit	Check that the hoses are free and do not contain impurities. Remove any impurity and rinse.

6 - Troubleshooting

Problem	Cause	Solution
The humidifier does not turn ON	No electrical power supply	Check the protection device upstream of the humidifier and that the power supply is present
	Controller connectors plugged in incorrectly	Make sure the connectors are properly connected
	Fuses blown Transformer fault	Check the fuses
The humidifier does not start operation	Remote ON/OFF contact open or control signal not compatible with the type set	Make sure the controller is working correctly
	Manual supply valve closed, fill solenoid valve fault or inlet filter dirty	Open the manual valve, check or clean the inlet filter to the fill solenoid valve, replace the fill solenoid valve
	The steam hose is blocked or not installed correctly, that is, blocked by condensate or choked (pocket that fills with condensate)	Check the positioning of the steam hose with reference to the assembly instructions
The humidifier fills with water without producing steam	Excessive back-pressure in steam outlet	Check that the steam outlet hose is not bent or choked
	Cylinder inlet filter blocked	Clean the filter
	Lime scale in the supply tank	Clean the fill/supply tank
	Drain solenoid valve/pump fault	Check for presence of voltage 24 V_{AC}/230 V_{AC} at the drain solenoid valve/pump and/or replace the drain solenoid valve/pump
The line circuit breaker is activated	The circuit breaker is under-rated	Check that the circuit breaker is rated for a current equal at least 1,5 times the rated current of the humidifier
	Excess current at the electrodes	Check the operation of the drain solenoid valve/pump, the seal of the fill solenoid valve when not energized, drain some of the water and restart

Problem	Cause	Solution
The humidifier wets the duct	The steam distributor is not installed correctly (too near the top of the duct or the condensate return is blocked)	Make sure the steam distributor has been installed correctly
	The system is oversized	Decrease the steam production, CP/CPY board
	Humidifier on when the fan in the duct is **OFF**	Check the connection of the device (flow switch or differential pressure switch) slaving the operation of the humidifier to the fan in the duct Check the remote ON/OFF input
The humidifier wets the floor below	The supply or overflow circuit has leaks	Check the entire water circuit
	The steam outlet hose is not properly secured to the cylinder	Check that the clamp on the steam outlet is tight

Annex G - ATS (Automatic Transfer Switch)

Content

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1 - Safety instructions

WARNING

Improper operations can cause injury or death.

NOTICE

Improper operations can cause product damage.

Read carefully the chapter *1. Safety*.

Pay attention to the *safety labels* on the unit and to the safety warnings in this chapter.

Covers	- The only cover that can be opened is the one for the auto/manual switching. - Do not open any other cover (with or without voltage) as there may still be dangerous voltage inside the unit from external circuits.
Cables	- Do not handle any control or power cables connected to the **ATS** when voltage may be present on the unit (directly through the mains or indirectly through external circuits). - Always use an appropriate voltage detection device to confirm the absence of voltage.
Personnel	- Maintenance and servicing operations must be performed only by trained and authorized personnel.
Arc hazard	- Ensure that no metal objects can fall in the cabinet (risk of electrical arcing).

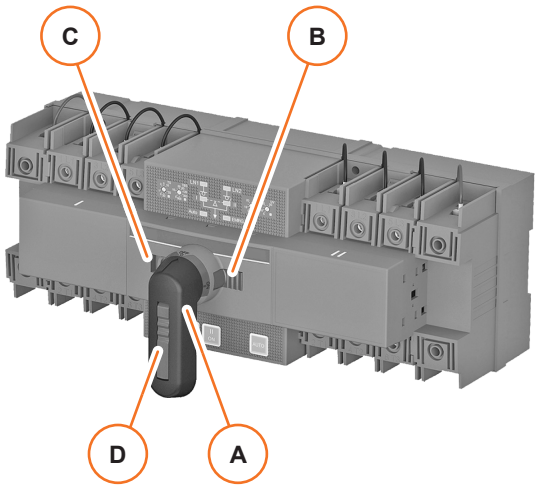
2 - Description

Two types of ATS are available:

- **Type 01**: configurable through four potentiometer and DIP switches;
- **Type 03**: configurable through a controller.

2.1 ATS type 01

Components for manual operation and locking



A	Handle for manual operation
B	Locking clip for padlock
C	Locking latch for releasing the handle and locking electrical control
D	Locking clip for locking manual operation

Operating principle

ATS is an “Automatic Transfer Switching” equipment and it is designed for use in power system for the safe transfer of a load supply between a normal (priority) power supply and a secondary (alternate) power supply. The changeover is done in open transition and with minimum supply interruption.

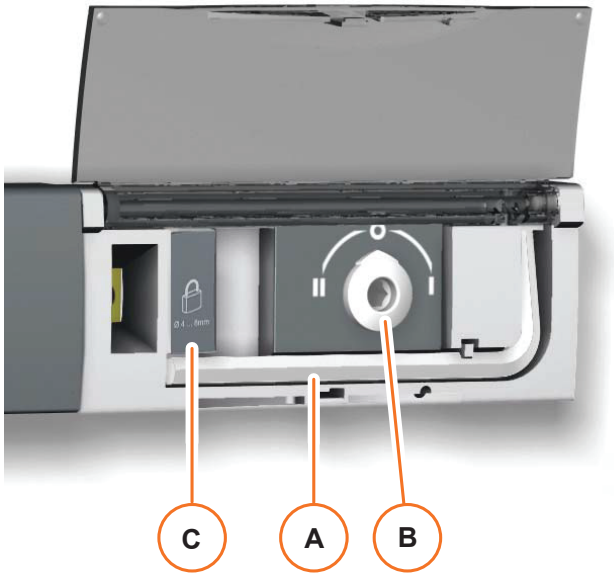
The **ATS** models used in the **Liebert® PDX PAM UHD A** units are with 4 poles.

The transfer switch ensures:

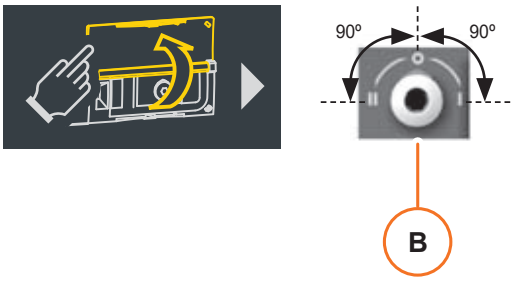
- Power control and safety between a normal and an alternate source;
- Intuitive HMI for emergency and local operation;
- Integrated and robust switch connection;
- Clearly visible position indication **I** – **O** – **II**;
- An inherent failsafe mechanical interlock;
- Stable positions (**I** – **O** – **II**) non-affected by typical vibrations and shocks;
- Fixed pressure on the contacts non-affected by network voltage;
- Energy efficiency with virtually no consumption whilst on the normal, alternate or **OFF** positions.

2.2 ATS type 03

Components for manual operation and locking



A	The hex/Allen key for manual operation
B	Changeover switch for manual operation
C	Safety locking clip for locking disconnected position "**O**"



NOTE *Open the front cover as shown to put into manual mode.*

Operating principle

ATS is an “Automatic Transfer Switching” equipment and it is designed for use in power system for the safe transfer of a load supply between a normal (priority) power supply and a secondary (alternate) power supply. The changeover is done in open transition and with minimum supply interruption.

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- Integrated and robust switch connection;
- Clearly visible position indication **I** – **O** – **II**;
- An inherent failsafe mechanical interlock;
- Stable positions (**I** – **O** – **II**) non-affected by typical vibrations and shocks;
- Fixed pressure on the contacts non-affected by network voltage;
- Energy efficiency with virtually no consumption whilst on the normal, alternate or **OFF** positions.

Three types of ATS are available:

- Type 03: configurable through Controller.

ATS feedback (optional):

Monitoring Relay to provide customer information for use of Main or Backup line.

3 - Specifications

3.1 ATS type 01

Operation

The module integrates a simplified **ATS** (Automatic Transfer Switch) functionality: in case of line **I** failure, it can be used for operating the motorized change-over switch to the line **II**, provided that line **II** is operational.

Electrical connection

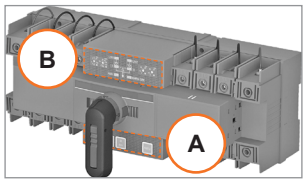
A bridge bars provides a common point on the outgoing side of the switch (load side) and it is direct linked to the unit disconnecting switch.

This cabling arrives from the factory.

The terminal below the handle (for motor operator and control) are linked to the dual power source that provides power supply to the motor by using two 230 V_{ac} lines.

Thereby the motor operator is automatically energized whenever power is available in one of the lines.

Product overview



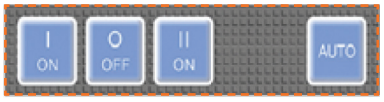
The automatic transfer switch can be used as a source transfer switch in a threephase or single-phase networks.

Monitored conditions are, no-voltage, phase-loss, overvoltage and under-voltage detection, transfer delays, generator start and stop, and remote test function.

Source transfer can be performed using a manually operated handle, locally using push buttons or fully automatically. The automatic mode includes several operating methods: Line 1 priority, no line priority and manual back switching mode.

Buttons

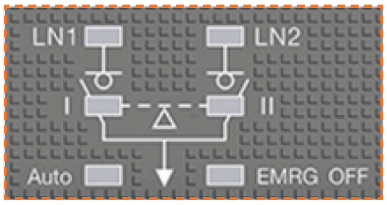
A



Buttons	Function	Remarks
I - ON	Transfer to **LN1**	Only available in automatic and remote test mode
O - OFF	Transfer to **O** position	
II - ON	Transfer to **LN2**	
AUTO	Select automatic mode, fault clearence and reset	

LEDs Display

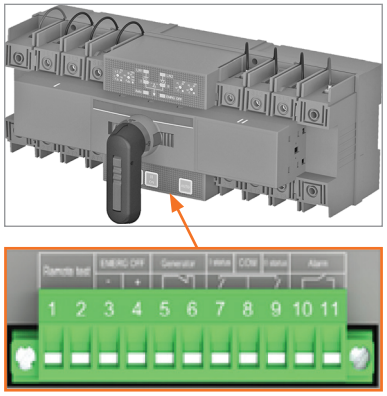
B



LEDs Display	Display	Status description
LN1 / LN2	ON	Source available
	Blinking	Overvoltage, undervoltage or phase loss
	OFF	Source not available
I / II	ON	Switch I or II closed
	Blinking	Switch I or II open
	OFF	Switch failure
Auto	ON	Transfer switch in automatic mode
	Blinking	Transfer switch in test mode or invalid setting
	OFF	Transfer switch in manual mode
EMRG OFF	ON	Receiving emergency signals
	OFF	No emergency signals input

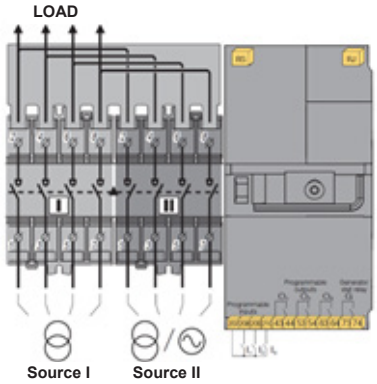
Terminals outputs and inputs

The automatic transfer has 11 bits of signal terminals for users to input and output signals.

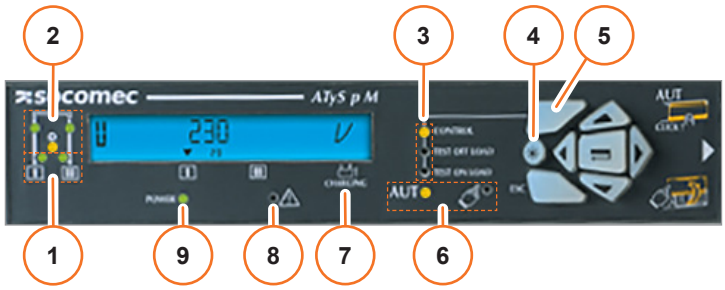


No.	Description
1 - 2	**Remote test:** Connection for at least 100ms for the switch to enter the remote test mode.
3 - 4	**EMRG OFF:** Input the 24Vdc **EMRG OFF** signals for at least 1s until the switch transfers to the **EMRG OFF** position and the **EMRG OFF LED** is **ON**. At this time, the switch cannot enter the automatic or test mode and only handle operation is allowed. After the signal is canceled, press **AUTO** to quit **EMRG OFF**.
5 - 6	**Generator start:** Dry contact, Generator start signal output. When the secondary power is a generator, they are used to start (close signal) and stop (disconnect signal) the generator. After the switch transfers to the primary power, the generator stop signal is sent after the preset delay for generator stop.
7 - 8 - 9	Switch status, Dry contact, Switch feedback output signal to show the actual position of the transfer switch.
10 - 11	**Alarm:** Dry contact, The switch outputs consecutive alarm signals in **EMRG OFF** mode or refuses to perform operations. The alarm signals are cleared after quitting the **EMRG OFF** mode or fault recovered.
Output contacts	Output contact relays are dry contacts and therefore external voltage supply is required. 24 Vdc or up to 250 Vac max. 3A AC1.

3.2 ATS type 03

Power section	A fully integrated and interlocked transfer switch, with high electrical performance offering microprocessor control and monitoring.
Operation	A flexible operating mechanism enabling quick motorized transfer in automatic mode or locally in manual mode for emergency operations. Features a locking device to ensure (in position **zero**) a secured isolation of the load (padlocked).
Measurement	Accuracy: frequency ±0,1% and voltage ±1%.
Electrical connection	 A bridge bars provides a common point on the outgoing side of the switch (load side) and it is direct linked to the unit disconnecting switch. This cabling arrived from the factory.

LEDs indications



The LEDs signalling is only active when the product supply is **ON** (supply LED lit). The LEDs indicates the source availability, the fault and the state of the product as specified in the following table:

1	**Availability of sources:** 2 **green** LEDs to indicate whether source **I** and/or source **II** are available (voltage and frequencies check): • LED lit = source available; • LED OFF = source unavailable.
2	**Position of the switch:** 2 **green** LEDs • LED I lit = switch in position **I** • LED II lit = switch in position **II** 1 **yellow** LED • LED lit = switch in position **0**
3	**Test / Control modes:** 2 **yellow** LEDs • For the test **ON** load and test **OFF** load which are linked to the test mode selection button so as to facilitate selection 1 **yellow** LED: • For the control function. The user may force the position of the switch
4	**LED test button:** • Illuminates all LEDs to test their operation
5	**Mode button:** • Test mode selection button
6	**Operating mode (Auto / Manu):** 1 **yellow** LED: • For MANU mode active 1 **yellow** LED: • For AUTO MODE active
7	**Capacitor charge indicator:** • Return to zero capacitor charge. When the indicator flashes, the RETURN to **0** function is unavailable
8	**Fault LED:** 1 **red** LED: • To indicate the status of the product control fault. Open and close the AUT/MAN after cleaning the fault
9	**Power supply LED:** 1 **green** LED: • Always OFF: power supply **OFF** or software error if the other indicators are operational (LAD and Screen) • Always lit: product power supply **ON**

NOTE *To reset a fault, it is required to open the cover.*

Technical data

Ratings		63 A	125 A	160 A
Type		**Type 01**	**Type 01**	**Type 03**
Frequencies		**50 Hz**	**50 Hz**	**50 Hz**
Thermal current I_{th} at 40°C [A]		63	125	160
Short-circuit capacity	Rated short-time withstand current: I_{CW} 1s [KA_{eff}]	2,5 @ 1sec	2,5 @ 1sec	4
	Rated short-time withstand current: I_{CW} 30ms [KA_{eff}]	Not available	Not available	10
Switching time at I_n excluding loss of supply sensing time and excluding any delay timers applicable	**I** – **II** or **II** – [ms]	2500	2500	180
	Duration of “Electrical Blackout” at U_n [ms]	Not available	Not available	90
	I – **O**, **O** – **I**, **II** – **O**, **O** – **II** [ms]	1800–1900	1800–1900	45
Connection cross-section	Minimum size [Cu mm^2] flexible and rigid	10	10	10
	Maximum size [Cu mm^2] flexible and rigid	70	70	70

NOTE *Maximum altitude without de-rating: 2000 meters. Maximum air temperature without de-rating: 40°C.*

Unit models	ATS Type	Rating
PAM010 - PAM020 - PAM030	Type 01 - 63 A	63 A
PAM060	Type 01 - 125 A	125 A
PAM080	Type 03 - 160 A	160 A

4 - Installation

4.1 ATS type 01

The **Liebert® PDX PAM UHD A** unit is delivered with the **ATS** already installed.

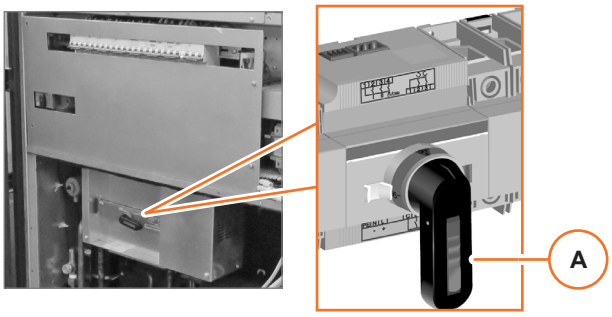
The only operation to be done on site is to connect the priority supply line and the secondary supply line to the **ATS**.

The **ATS** is placed inside a separate electrical panel and fixed on a DIN rail.

Two cable glands are present on the bottom part of the electric panel to allow the cable passage with the required IP rates.

The position of the **ATS** can be different than attached picture.

Cables connections

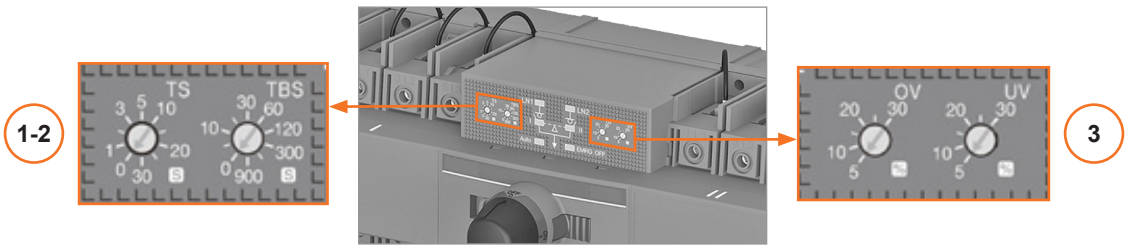


- Disconnect the power supply to the **Liebert® PDX PAM UHD A** unit through the general disconnecting switch;
- Insert the handle [**A**] in the **ATS** disconnecting switch and turn the handle to position "**O**";
- Insert a padlock in the handle as explained in *5 - Operation - Locking the switch in the disconnecting position* to prevent uncontrolled restore of the electrical power;
- Connect the priority line on the terminals **I**;
- Connect the secondary line on the terminal **II**.

Configuration for type 01

Rotary switch settings

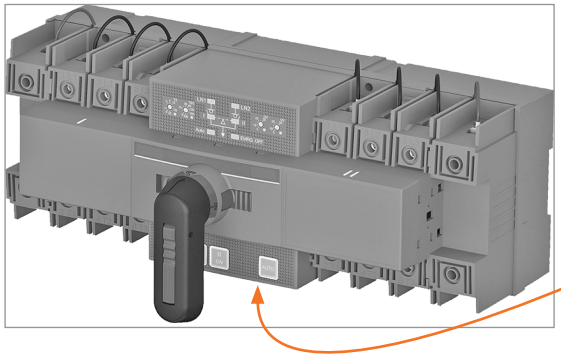
1. **Switching delay TS:** The delay of switcing from primary line to secondary line in automatic mode; Choose from 0, 1, 2, 3, 5, 10, 15, 20, 25, and 30 seconds.
2. **Back switching delay TBS:** The delay of switching from secondary line to primary line in automatic mode; Choose from 0, 5, 10, 20, 30, 60, 120, 300, 600, and 900 seconds.



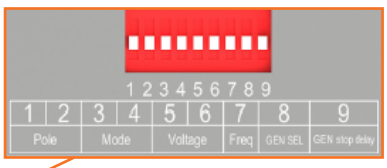
3. **Overvoltage threshold OV (%) and under voltage threshold UV (%):** The benchmarks of the **OV** and **UV** are the rated voltage of the switch. When the voltage is higher than the preset **OV** value or lower than the preset **UV** value, the switch performs automatic transfer. The value of **OV** can be 5%, 10%, 15%, 20%, 25%, and 30%. The value of **UV** can be 5%, 10%, 15%, 20%, 25%, and 30%.

Dip switch setting

The 9 dip switch used to set the working modes to transfer switch.



The **9 dip switch** is placed under the **ATS type 01**



Dip switch n°	Function	Setting			
		01	10	11	00
1 - 2	Pole setting	01 = 2 poles	10 = 3 poles	11 = 4 poles	invalid setting
3 - 4	Mode setting	01 = no line priority	10 = manual back switching	11 = line priority LN1 (default)	invalid setting
5 - 6	Voltage setting	01 = 240/415V_{ac}	10 = 230/400V_{ac}	11 = 220/380V_{ac}	invalid setting
7	Frequency setting	1 = 50 Hz (default)			
8	Generator Selection	0 = NO 1 = YES (default)			
9	Generator stop delay setting	0 = 240 sec 1 = 30 sec (default)			

Factory settings:

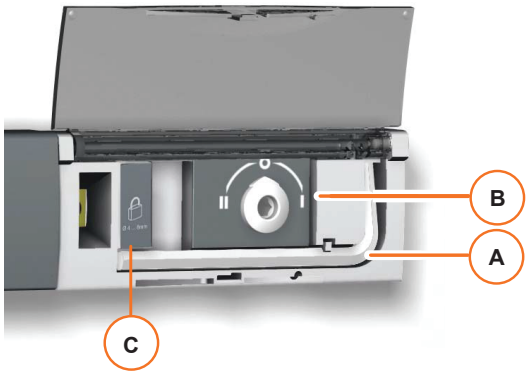
Dip switch n°	Function	Setting
1 - 2	Pole setting	11 = 4 poles
3 - 4	Mode setting	11 = line priority LN1 (default)
5 - 6	Voltage setting	10 = 230/400Vac
7	Frequency setting	1 = 50 Hz (default)
8	Generator Selection	1 = YES (default)
9	Generator stop delay setting	1 = 30 sec (default)

Rotary switch settings		
TS	Delay from primary to secondary	3 sec.
TBS	Delay from secondary to primary line	300 sec.
OV	Over voltage	10%
UV	Under voltage	10%

4.2 ATS type 03

The **Liebert® PDX PAM UHD A** unit is delivered with the **ATS** already installed.
The only operation to be done on site is to connect the priority supply line and the secondary supply line to the **ATS**.
The **ATS** is placed inside a separate electrical panel and fixed on a DIN rail.
Two cable glands are present on the bottom part of the electric panel to allow the cable passage with the required IP rates.

Cables connections



- Disconnect the power supply to the **Liebert® PDX PAM UHD A** unit through the general disconnecting switch;
- Insert the Hex/Allen key [**A**] in the **ATS** disconnecting switch and turn the handle to position "**O**";
- Insert a padlock in the handle as explained in *5 - Operation - Locking the switch in the disconnecting position* to prevent uncontrolled restore of the electrical power;
- Connect the priority line on the terminals **I**;
- Connect the secondary line on the terminal **II**.

Configuration for type 03

Product programming: programming access is possible in Automatic mode, when the product is in position **I** with source 1 available, and in Manual mode in any position and with at least one available source:

Configure parameters		
1 - SETUP		
DEFINITION	DEFAULT VALUE	FACTORY VALUE
NETWORK	4NBL	4NBL
NEUTRAL	Auto	LEFT
CHECK ROT	YES	YES
PROT PH.	---	---
NOM. VOLT	400 Vac (version 230/400V)	400 Vac (version 230/400V)
NOM. FREQ	50 Hz	50 Hz
APP	M-G	M-G
GE START	NO	NO
PRIO TON	NO	NO
PRIO EON	NO	NO
PRIO NET	1	1
RETRANS	NO	NO
RETURN 0	NO	NO
2ND TRIP	NO	NO
MODE AUT	NO	NO
CNT RST	NO	NO
BACKLGHT	INT	INT
CODE P	1000	1000
CODE E	0000	0000

Configure voltage thresholds and hysteresis		
2 - VOLT LEVELS		
DEFINITION	DEFAULT VALUE	FACTORY VALUE
SOURCE 1		
OV. U	115%	110%
OV. U HYS	110%	108%
UND. U	85%	98%
UND. U HYS	95%	92%
UND. U	00%	02%
UNB. U HYS	01%	01%
SOURCE 2		
OV. U	115%	110%
OV. U HYS	110%	108%
UND. U	85%	90%
UND. U HYS	95%	92%
UND. U	00%	02%
UNB. U HYS	01%	01%

Frequency thresholds and hysteresis configuration		
3 - FREQ. LEVELS		
DEFINITION	DEFAULT VALUE	FACTORY VALUE
SOURCE 1		
OV. F	105%	102%
OV. F HYS	103%	101%
UND. F	95%	98%
UND. F HYS	97%	99%
SOURCE 1		
OV. F	105%	102%
OV. F HYS	103%	101%
UND. F	95%	98%
UND. F HYS	97%	99%

Timer configuration		
4 - TIMERS VALUE		
DEFINITION	DEFAULT VALUE	FACTORY VALUE
1FT	3 s	3 s
1RT	180 s	300 s
10T	2 s	2 s
2FT	3 s	3 s
2RT	5 s	5 s
2AT	5 s	5 s
2CT	180 s	180 s
20T	10 s	10 s
2ST	30 s	30 s
0DT	3 s	3 s
TOT	UNL	UNL
TFT	UNL	UNL
E1T	5 s	5 s
E2T	UNL	UNL
E3T	5 s	5 s
35T	5 s	5 s
E6T	LMT	LMT
E6T	600 s	600 s
E7T	5 s	5 s
EET	168 h	168h
LST	4 s	4 s

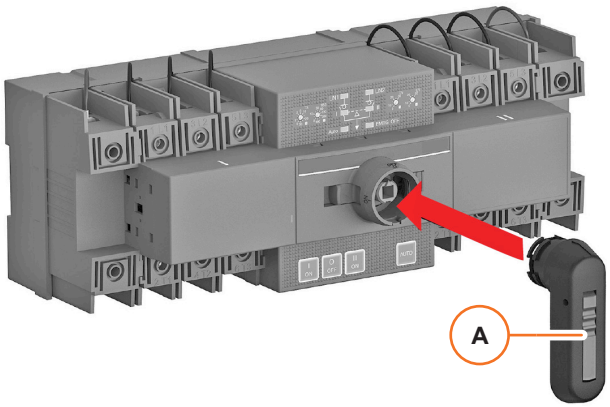
Input - output configuration			Communication configuration		
5 - I-O			6 - COMM		
DEFINITION	DEFAULT VALUE	FACTORY VALUE	DEFINITION	DEFAULT VALUE	FACTORY VALUE
IN 1	**/**	**/**	**ADDRESS**	5	5
IN 1	NO	**NO**	**SPEED**	9600	**9600**
IN 2	/	**/**	**STOP BIT**	1	1
IN 2	NO	**NO**	**PARITY**	NO	NO
IN 3	/	**/**			
IN 3	**NO**	**NO**			
OUT 1	/	**/**			
OUT 1	NO	**NO**			
OUT 2	/	**/**			
OUT 2	NO	**NO**			
OUT 3	/	**/**			
OUT 3	NO	**NO**			

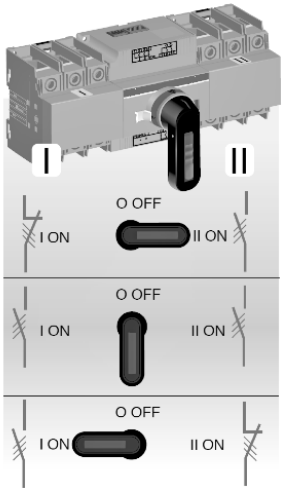
NOTE: *For different voltage and frequency, please contact the Vertiv™ Technical Support.*

5 - Operation

5.1 ATS type 01

Manual mode





- Insert the handle to set the **ATS** to the manual mode.

Now the automatic operations are disabled and the switch will not operate automatically in case of power failure.

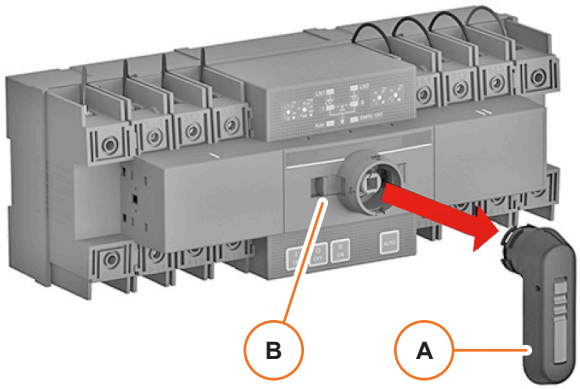
You may turn the handle [**A**] to each of the following positions:

I - priority power supply;

O - power supply disconnected;

II - secondary (alternate) power supply.

Automatic mode



- Pull the latch [**B**] and remove the handle [**A**] to enable the automatic mode;

Now the power supply is normal.

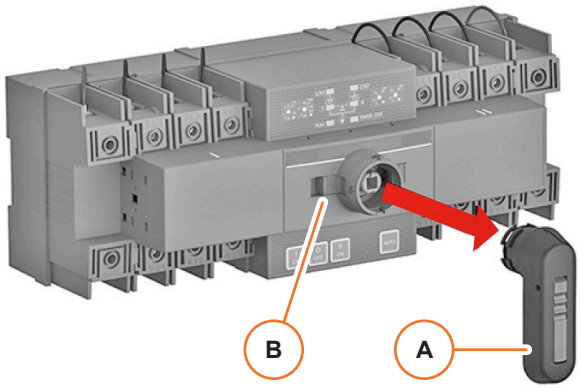
During the initial power-up the **ATS** will be in automatic mode and it will switch to the primary line.

NOTE *Keep the handle attached if you do not want the **ATS** to be in automatic mode during the initial power-up.*

NOTICE

Before powering on the **ATS**, manually operate it to ensure that it can move normally.

Locking the electrical operation



The purpose of this procedure is to lock the **ATS** in a selected electrical operation mode:

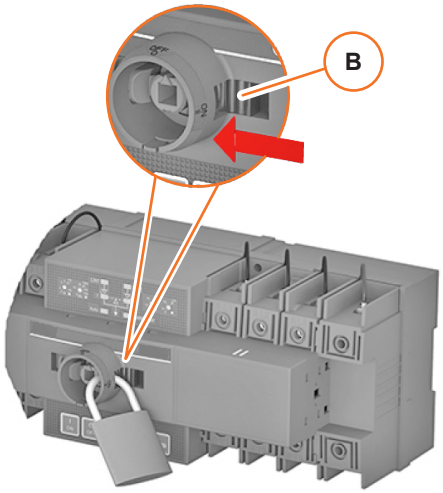
I - priority power supply;

O - power supply disconnected;

II - secondary (alternate) power supply.

To lock the electrical operation:

- Turn the handle [**A**] in the position that you want to lock;
- Pull the latch [**B**] and remove the handle;

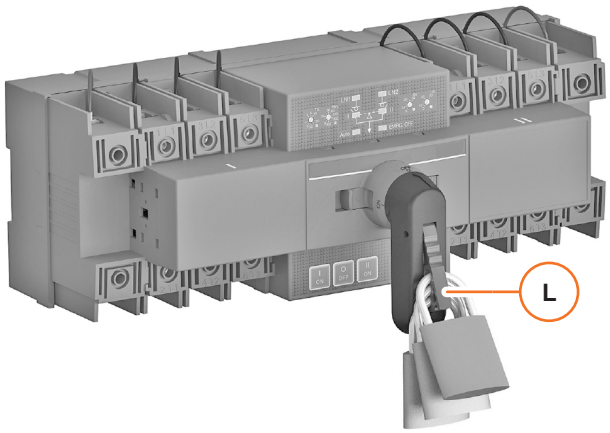


- Push the latch [**B**];
- Insert a padlock in the switch.

Now all operating modes and test operations are disabled and handle cannot be inserted.

NOTE *The switch can be padlocked in any position.*

Locking the switch in the disconnecting position



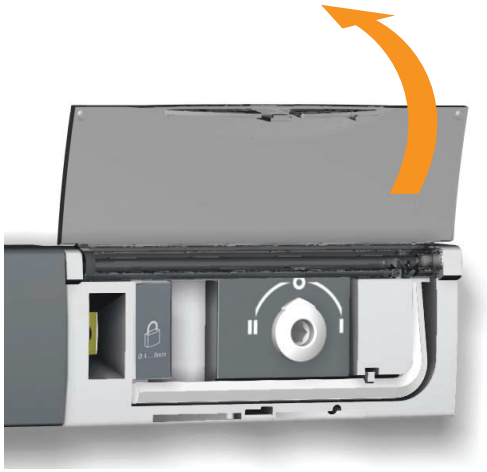
- Insert the handle and turn it to position "**O**";
- Lift the locking clip [**L**];
- Insert your padlock in the clip.

Now the switch is locked in the power disconnecting position.

NOTE *The handle can be padlocked only in the "**O**" position.*

5.2 ATS type 03

Manual mode



- Open the cover to switch to manual mode;
- Insert the Hex/Allen key to set the **ATS** to the manual mode;

Now the automatic operations are disabled and the switch will not operate automatically in case of power failure.

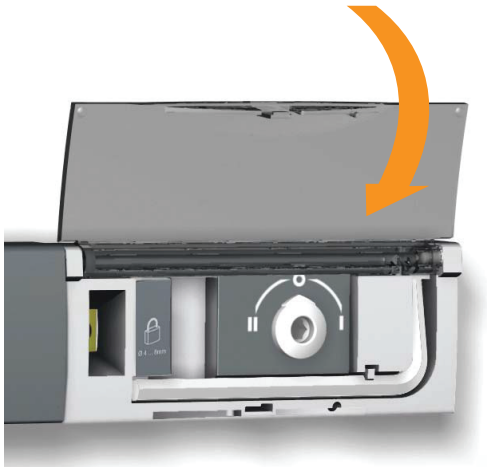
You may turn the switch to each of the following positions:

I - priority power supply;

O - power supply disconnected;

II - secondary (alternate) power supply.

Automatic mode



- Close the cover to switch to automatic mode.

Now the power supply is normal.

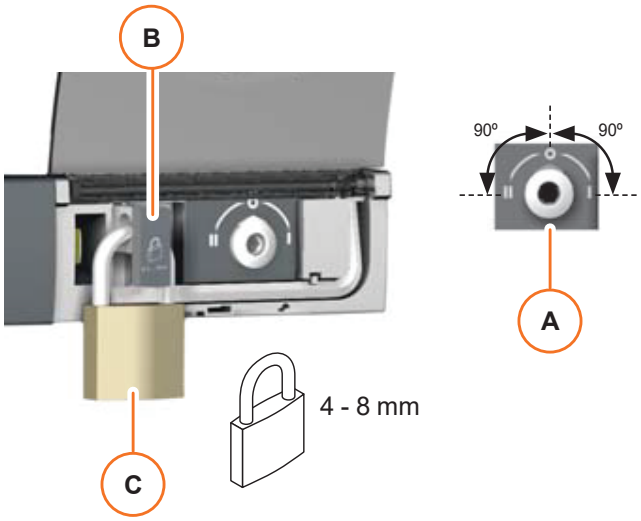
During the initial power-up the **ATS** will be in automatic mode and it will switch to the primary line.

NOTE *Keep the cover open if you do not want the **ATS** to be in automatic mode during the initial power-up.*

NOTICE

Before powering on the **ATS**, manually operate it to ensure that it can move normally.

Locking the switch in the disconnecting position



- Insert the handle to the switch [**A**] and turn it to position "**O**";
- Lift the locking clip [**B**];
- Insert your padlock [**C**] in the clip (4-8 diameter).

Now the switch is locked in the power disconnecting position.

NOTE *The handle can be padlocked only in the "**O**" position.*

6 - Maintenance

6.1 ATS type 01

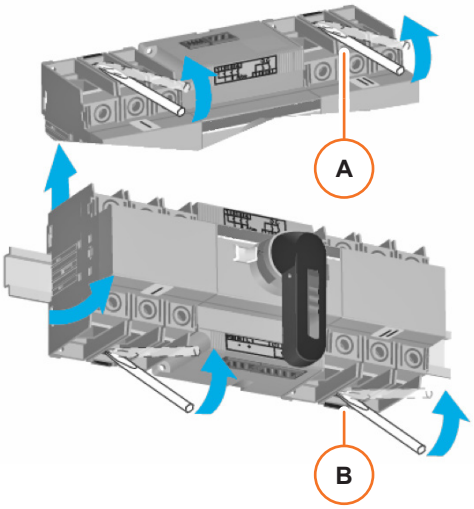
Periodic checks and operations

- Check if the electrical connections are tight;
- Tighten any loosen connection.

Replacement

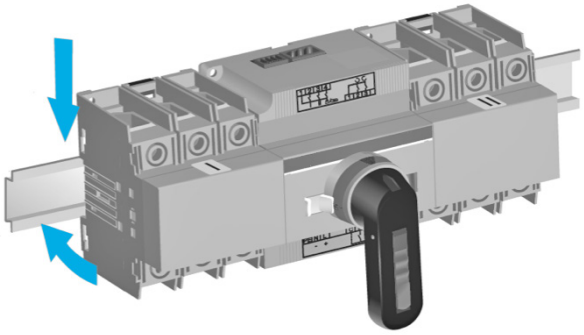
The **ATS** fault is indicated by the LEDs as following:

- **ATS type 01**: both LEDs are **OFF**.



How to remove the ATS

- Disconnect the power supply to the **Liebert® PDX PAM UHD A** unit through the general disconnecting switch;
- Switch in manual mode and set the position of the handle on "**O**";
- Disconnect all the electrical cables:
  - line **I**;
  - line **II**;
  - outgoing line (load side);
  - control cables.
- Remove all the screws that fix the **ATS** on the DIN rail and on the electrical panel (if they are present);
- Insert a screw driver in one of the eyes [**A**] placed on the upper part of the **ATS** and pull it out from the DIN rail (repeat for the other eye(s));
- Insert a screw driver in one of the eyes [**B**] placed below the **ATS** and pull it out from the DIN rail (repeat for the other eye(s));
- When all the connection points are free, lift the **ATS** and remove it.



How to reassemble the ATS

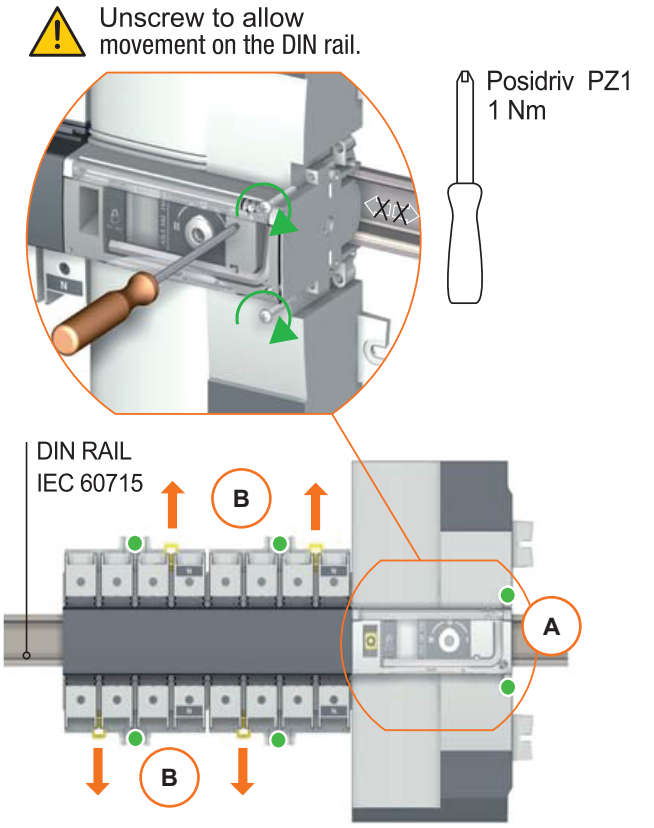
- Switch the new **ATS** in manual mode and set the position of its handle on "**O**";
- Place the **ATS** on the DIN rail and press until it locks;
- Fix all the screws that fix the **ATS** at the DIN rail and at the electrical panel (if they are present);
- Connect all the electrical cables:
  - line **I**;
  - line **II**;
  - outgoing line (load side);
  - control cables.
- Connect the **Liebert® PDX PAM UHD A** unit to the power supply;
- Restart the **Liebert® PDX PAM UHD A** unit.

6.2 ATS type 03

Periodic checks and operations

- Check if the electrical connections are tight.
- Tighten any loosen connection.

Replacement



NOTE: *Screws indicated by green dot ●*
*Eyes [**A**], [**B**] indicated by orange arrow* ↓↑

The **ATS** fault is indicated by the LEDs as following:

- **ATS type 03**: the "**Fault**" LED IS **ON**

NOTE *For **ATS type 03**, you may try to reset the error by opening and the closing the cover. If the fault persists, follow the procedure below to replace it.*

How to remove the ATS

- Disconnect the power supply to the **Liebert® PDX PAM UHD A** unit through the general disconnecting switch;
- Switch in manual mode and set the position of the handle on "**O**";
- Secure disconnected position with the padlock (follow previous chapter *5 - Operation - Locking the switch in the disconnecting position*;
- Disconnect all the electrical cables:
  - line **I**
  - line **II**
  - outgoing line (load side)
  - control cables
- Remove all the screws that fix the **ATS** on the DIN rail [**A**] (2x screws on the right from position switch - PZ1 screwdriver needed) and on the electrical panel [**B**] (4x screw - Hex nut driver 10 mm needed);
- Insert a screwdriver in one of the eyes [↑] placed on the upper part of the **ATS** and pull it out from the DIN rail (repeat for the other eye(s)) [↑];
- Insert a screwdriver in one of the eyes placed below [↓] the **ATS** and pull it out from the DIN rail (repeat for the other eye(s)) [↓]. When all the connection points are free, lift the **ATS** and remove it.

How to remove the ATS

- Switch the new **ATS** in manual mode and set the position of its handle on "**O**";
- Secure disconnected position with the padlock (follow previous chapter *5.2 ATS type 03*;
- Place the **ATS** on the DIN rail and press until it locks;
- Fix all the screws that fix the **ATS** at the DIN [**A**] rail and at the electrical panel [**B**];
- Connect all the electrical cables:
  - line **I**;
  - line **II**;
  - outgoing line (load side);
  - control cables.

For the ATS type 03: adjust the configuration settings:

- Connect the **Liebert® PDX PAM UHD A** unit to the power supply;
- Restart the **Liebert® PDX PAM UHD A** unit.

7 - Troubleshooting

7.1 ATS type 01

Symptoms	Actions to be carried out	Expected results
Power supply functioning normally, but LED not ON	Control unit power supply terminal not connected with switch wiring terminal, check, and connect the power line	LEDs sources available **ON**
Power supply LED functioning normally but "AUTO" LED OFF, or no response with "AUTO" button pressed	Handle not pulled out or electrical padlock not removed, pull out the handle or remove the padlock, and then press the "**AUTO**" button	LED Auto **ON** and Auto button works correctly for the selection mode
Switching failure in case of faulty power supply	Switch not operating in automatic mode or both power supplies malfunctioning, make sure the switch working in automatic mode; check and make sure both power supplies are not malfunctioning simultaneously	**ATS** switching source in case of faulty power supply
EMRG OFF function failure	Check if the **EMRG OFF** signal is 24V DC or too short duration of **EMRG OFF** signal, correctly switch **ON** the **EMRG OFF** signal, which should only be 24V DC with the duration ≥ 1 s	**ATS** transfer to "**0**" when the signal **EMRG OFF** is applied
"AUTO" LED blinking No response from buttons	**DIP switch** setting is invalid or generator is **ON** in no priority mode, check if the **DIP switch** setup matches the power supply. Turn **OFF** generator in **no priority mode**	LED Auto **ON** and Auto **I** – **0** – **II** buttons works correctly for the selection mode
"I" or "II" LED blinking	Execution rejected during switching operation, thus expected result not achieved, manually set the switch to Position "**O**", and press the "**AUTO**" button to reset	LEDs "**I**" or "**II**" must be **ON** (switch closed) of **OFF** (switch open)
Power supply functioning normally and LED blinks	Wrong connection of the **N** wire, re-connect the wires	LEDs sources available **ON**

7.2 ATS type 03

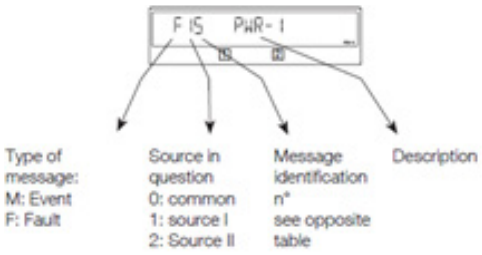
Symptoms	Actions to be carried out	Expected results
The product is not functioning	Check for a voltage of 106 to 305 Vac on the supply terminals: Model 230/400 Vac: • Terminals 1 - 7 corresponding to the Priority Source • Terminals 1 - 7 corresponding to the Emergency source	The "**POWER**" LED is lit and the display is operational
The "Priority SOURCE Availability" LED does not come ON	Press the "**LED test**" button	All the LEDs and the display illuminate
	Check whether the message "**F13 ROT-1**" is shown on the display (Priority Source Phase Rotation Fault). If this message appears, check for phase rotation consistency (or conventional direction) between the source and the **ROT** parameter on the **SETUP** menu, or between the 2 sources.	The "**Priority SOURCE Availability**" LED is lit

Symptoms	Actions to be carried out	Expected results
The "Priority SOURCE Availability" LED does not come ON	Check the following parameters in the **SETUP** menu (programming mode): • The type of the network → 230/400 Vac version: NETWORK: 4NBL, 41NBL, 42NBL, 1BL, 3NBL; → 127/230 Vac version: NETWORK: 4NBL, 3NBL, 2NBL, 2BL, 42NBL. • Nominal voltage => Un: measure at the cage terminals using a multimeter; • Frequency => Fn: 50 Hz Check the voltage and frequency thresholds and hysteresis in the **VOLT LEVELS** and **FREQ LEVELS** menus.	The "**Priority SOURCE Availability**" LED is lit
	If using an Auto transformer – proceed as follows: • **Step 1:** Enter programming mode; • **Step 2:** In the **SETUP** menu, configure the **NETWORK** parameter to **3NBL**; • **Step 3:** In the **SETUP** menu, configure the **NEUTRAL** parameter (location of Neutral) to the left or right depending on where the neutral is connected; • **Step 4:** Exit programming mode.	
The "Emergency SOURCE Availability" LED does not come ON	Press the "**LED test**" button.	The "**Emergency SOURCE Availability**" LED is lit
	Check whether the message "**F23 ROT-2**" is shown on the display (Emergency Source Phase Rotation Fault). If this message appears, check for phase rotation consistency (or conventional direction) between the source and the **ROT** parameter in the **SETUP** menu, or between the 2 sources.	
	CAUTION: a Generator operating **OFF** load can generate a Fr and a U lower than the nominal values: • Check the nominal voltage threshold and hysteresis in the **VOLT LEVELS** menu; • Check the frequency threshold and hysteresis in the **FREQ LEVELS** menu.	
	Check the following parameters in the **SETUP** menu (programming mode): • the type of network → 230/400 Vac version: NETWORK: 4NBL, 41NBL, 42NBL, 1BL, 3NBL; • Nominal voltage => Un: measure at the cage terminals using a multimeter – Frequency => Fn: 50 Hz.	
The "Emergency SOURCE Availability" LED does not come ON	If using an Auto transformer – proceed as follows: • **Step 1:** Enter programming mode; • **Step 2:** In the **SETUP** menu, configure the **NETWORK** parameter to **3NBL**; • **Step 3:** In the **SETUP** menu, configure the **NEUTRAL** parameter (location of Neutral) to left or right depending on where the neutral is connected; • **Step 4:** Exit programming mode.	The "**Emergency SOURCE Availability**" LED is lit

Symptoms	Actions to be carried out	Expected results
The product remains switched OFF after the Priority SOURCE is lost	Check for a voltage of 106 to 305 Vac on the supply terminals: • Model 230/400 Vac: Terminals 1-7 corresponding to source **II**	The "**POWER**" LED is lit and the display is operational
	For a Transformer/Generator application Check that **1FT** (1 Failure Timer) has counted down. • Use a stopwatch. • Start the stopwatch when the product has lost its Priority SOURCE. • If GE START = **NO** (Normally Open) in the **SETUP** menu: Contact 73-74 Closed = Generator starting order Contact 73-74 Open = Generator stoppage order • If GE START = **NC** (Normally Closed) in the **SETUP** menu: Contact 73-74 Closed = Generator stoppage order Contact 73-74 Open = Generator starting order	The Generator is operating The "**POWER**" LED is lit and the display is operational
The product does not switch over after the Priority SOURCE is lost	Check that the product is not in manual mode: • Automatic mode = Cover closed • Manual mode = Cover open	The "**AUT**" LED is lit
	Check that automatic operation has not been inhibited by external orders	
	Check the state of the "**Emergency Source Availability**" LED. If it is **OFF**, refer to the symptom concerned (higher in the list)	The "**AUT**" and "**Emergency SOURCE Availability**" LEDs are lit
The product does not switch over when the Priority SOURCE is restored	Check that the product is not in manual mode: • Automatic mode = Cover closed • Manual mode = Cover open	The "**AUT**" LED is lit
	Check that automatic operation has not been inhibited by external orders	
	Check the state of the "**Priority Source Availability**" LED. If it is **OFF**, refer to the symptom concerned (higher in the list)	The "**AUT**" and "**Priority SOURCE Availability**" LEDs are lit
	Check the setting of **1RT** (1 Return Timer). If necessary, use a stopwatch to check the switch to **Priority SOURCE**. The duration of this delay is between 0 and 3600s	The display shows **1RT xxxSEC** At the end of the delay, the product switches over to the mechanical position **O**, then to **Priority SOURCE**
	Check that the "manual retransfer" function is not active (if this function is not required) • Go to the **SETUP** menu • Set **RETRANS** to **NO**	Message "**RETRANS?**" not displayed The product should return automatically to the **Priority SOURCE**

Symptoms	Actions to be carried out	Expected results
Return to Priority SOURCE has been executed, but the Emergency Source (for a Generator) continues to operate	Check that **2CT** (2 Cool Timer) counts down – Duration between 0 and 600s • Use a stopwatch. Start the stopwatch when the product has switched over to the Priority SOURCE. • Contact 73-74 should change state once this delay has counted down • If GE START = **NO** (Normally Open) in the **SETUP** menu: • Contact 73-74 Closed = Generator starting order • Contact 73-74 Open = Generator stoppage order • If GE START = **NC** (Normally Closed) in the **SETUP** menu: Contact 73-74 Closed: Generator stoppage order Contact 73-74 Open: Generator starting order	The display shows **2CT xxxSEC** At the end of this delay, the Generator stops and the "**Emergency SOURCE Availability**" LED goes out
	Check that the product is not in Automatic mode: • Automatic mode = Cover closed • Manual mode = Cover open	The "**AUT**" LED is lit
	Check that automatic operation has not been inhibited by external orders	
ON LOAD and OFF LOAD tests cannot be started via the keypad	Check that the product is not in Automatic mode: • Automatic mode = Cover closed • Manual mode = Cover open	The "**AUT**" LED is lit
	Check that automatic operation has not been inhibited by external orders	
	Check the Operating mode password (factory code **0000**) to access the test functions	The "**TEST ON LOAD**" or "**TEST OFF LOAD**" LED is lit, depending on the selected test mode
	Check that the product is in **M-G** application	The **APP** parameter should be **M-G** in the **SETUP** menu
	Check the state of the "**Priority Source Availability**" LED. If it is **OFF**, refer to the symptom concerned (higher in the list)	The "**Priority SOURCE Availability**" LED must be lit to allow these Tests to be run
The product cannot be switched over using the handle	Check the direction of rotation of the handle: • Manual switchover from position **I** to position **II** is executed clockwise • The return operation is executed anticlockwise	The product can be switched over using the handle
	Check that the product is not padlocked	
	Use the handle extension on the ALLEN key to check that the appropriate adjustment torque is applied.	
	When using a single AC, check that the length of the screws used is not greaten than 20 mm	
AUTOMATIC mode is not activated even though the cover is closed	Check that the plastic pin (sensor) is in place on the bottom of the cover. This pin activates the sensor which indicates the position of the cover (open or closed)	The "**AUT**" LED is lit
	Check that automatic operation has not been inhibited by external orders	
The product cannot be locked	Check the mechanical position of the changeover switch: • Locking is only possible in position **0** as standard • Locking in position **I - 0 - II** is possible by modifying the product in accordance with the instructions	Locking is possible
The product is faulty	See listing "*Event list*" table on the next page	The **FAULT** LED is **OFF** and the error message disappears

Event list:



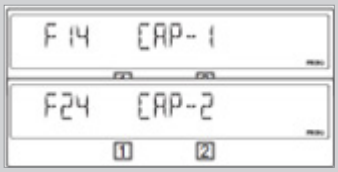
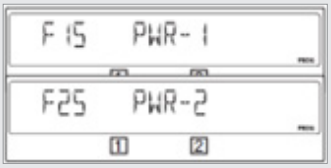
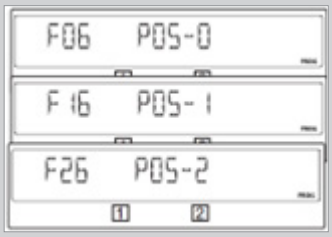
Message identification		
N°	Status message	Fault message
0	Manual switching	Duty cycle
1	Under-voltage	Fault
2	Over-voltage	Alarm
3	Under-frequency	Neutral wiring / Phase rotation mismatch
4	Over-frequency	Capacitor back to 0
5	Phase unbalance	Insufficient switchover power
6	Phase rotation	Position not reached

Message	Definition
M00 MANUAL	Manual switching
M11 UV1	Under-voltage on source I
M21 UV2	Under-voltage on source II
M12 OV1	Over-voltage on source I
M22 OV2	Over-voltage on source II
M13 UF1	Under-frequency on source I
M23 UF2	Under-frequency on source II

Message	Definition
M14 OF1	Over-frequency on source I
M24 OF2	Over-frequency on source II
M15 UN21	Phase unbalance on source I
M25 UN22	Phase unbalance on source II
M16 ROT1	Incorrect direction of rotation on source I
M26 ROT2	Incorrect direction of rotation on source II

Errors messages:

Error message	Definition	Action	Reset
F00 OP FCT	**Duty cycle** Limited number of operations in a defined period.	Wait **1** min. for the error message to disappear.	Automatic
F03 NEUTRAL	**Source I / source II neutral wiring mismatch** The neutral on source **I** is not wired on the same side as the neutral on source **II**.	Rewire one of the two sources. E.g. both neutrals on the left, of both neutrals on the right.	Open and then close the cover
F11 FLT-1 F21 FLT-2	**Source I / source II fault** This fault only appears if input **FT1**/**FT2** (see **I-O** Menu) and the parameter **2ND TRIP** (see **Setup** Menu) are activated. Activation of this fault shifts the changeover switch to position **0**.	Resolve the external problem that caused activation of input **FT1**/**FT2**	Open and then close the cover or activate the **RST** input, if configured (see **I-O** Menu) or via RS485.

	**Alarm 1 / Alarm 2** This fault only appears if input AL1/AL2 is activated (see **I-O** Menu).	Resolve the external problem that caused activation of input **AL1**/ **AL2**. Once this is done, the error message will automatically disappear.	Automatic
	**Phase rotation fault on source I / source II** The phase rotation does not correspond to the **ROT PH**. Variable in the **Setup** menu.	Either invert two phases on source **I** / source **II**, or change the status of the **ROT PH**. Variable in the **Setup** menu, if both sources are faulty.	Automatic
	**Return to zero capacitor charging fault on source I / source II** Recharging malfunction of capacitor associated with source **I** / source **II**.	Provisional action: deactivate the **RETURN 0** function in the **Setup** menu (Set to **NO**), or open the cover and operate manually. Then: contact you retailer.	Open and then close the cover
	**Insufficient switchover power on source I / source II** The power is insufficient to leave position **II/I**.	Supply the power (U,I) from source **I** or **II** for at least **20** secs or open the cover and operate manually.	Open and then close the cover
	**Fault position 0, I, II** Following an electric or automatic order, position **0** / **I** / **II** is not reached.	Provisional action: open the Aut/Man cover and operate manually. Than: contact your retailer.	Change source status. Manual operation.
	**Source starting timeout II** If the genset does not start after the **2ST** delay, the message will be sent.	Press the validation key. Check that **2ST** is greater than 15s at **2AT**.	Check the genset.

Annex H - THDI (harmonic filter)

Content

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1 - Safety instructions

WARNING

Improper operations can cause injury or death.

NOTICE

Improper operations can cause product damage.

Read carefully the chapter *1. Safety*.

Pay attention to the *safety labels* on the unit and to the safety warnings in this chapter.

Arc hazard	Ensure that no metal objects can fall in the cabinet (risk of electrical arcing).
Controls	Check the device for external damage before installation, if the device is defective, it must not be used.
Electric shock	When the device is installed, unused terminal points may be live.
Personnel	Installation of the active filter, inspection for proper operation, and certain troubleshooting measures may only be performed by qualified personnel. All other measures may be performed by people who have read these instructions.
Regulations	The relevant country-specific regulations must be observed.

DANGEROUS VOLTAGE

Risk of death due to short circuits and electric shock if the active filter is opened while connected to the ac mains or for up to 30 minutes after being disconnected from the ac mains.

- All interventions involving opening the device cover or removing or installing the connection cable may only be performed by qualified personell.
- Make absolutely sure that the filter is grounded. Good grounding is required to prevent any risk from leakage current.
- Do not setup the filter near liquids.
- Do not expose the filter to excessive humidity.
- Remove or open the covers/doors only if the power is switched **OFF**.

CAUTION

All AHF must be installed in a clean, dry location, e.g. in sufficiently ventilated or air conditionated electric cabinets or closed electric rooms.

Contaminants such as oils, liquids, corrosive vapors, abrasive debris, dust and aggresive gases msut be kept out of the filter enclosure.

WARNING

Conductive dust may cause damage to AHF. Ensure that installation site of AHF is free of conductive dust.

During the power **ON** process, AHF output terminal is electrified. User needs to make sure whether it is safe to supply power to the load if it is connected to AHF output terminal. If the load is not ready to receive power, it must be separated from AHF output terminal.

To prevent personal injury, if maintenance or cabinet opening is needed after power **OFF**, a multimeter is required to measure the voltage at input terminals so as to make sure no grid power is connected! Operation should be done more than **10** minutes after power **OFF** when the internal DC busbar capacitance is discharged!

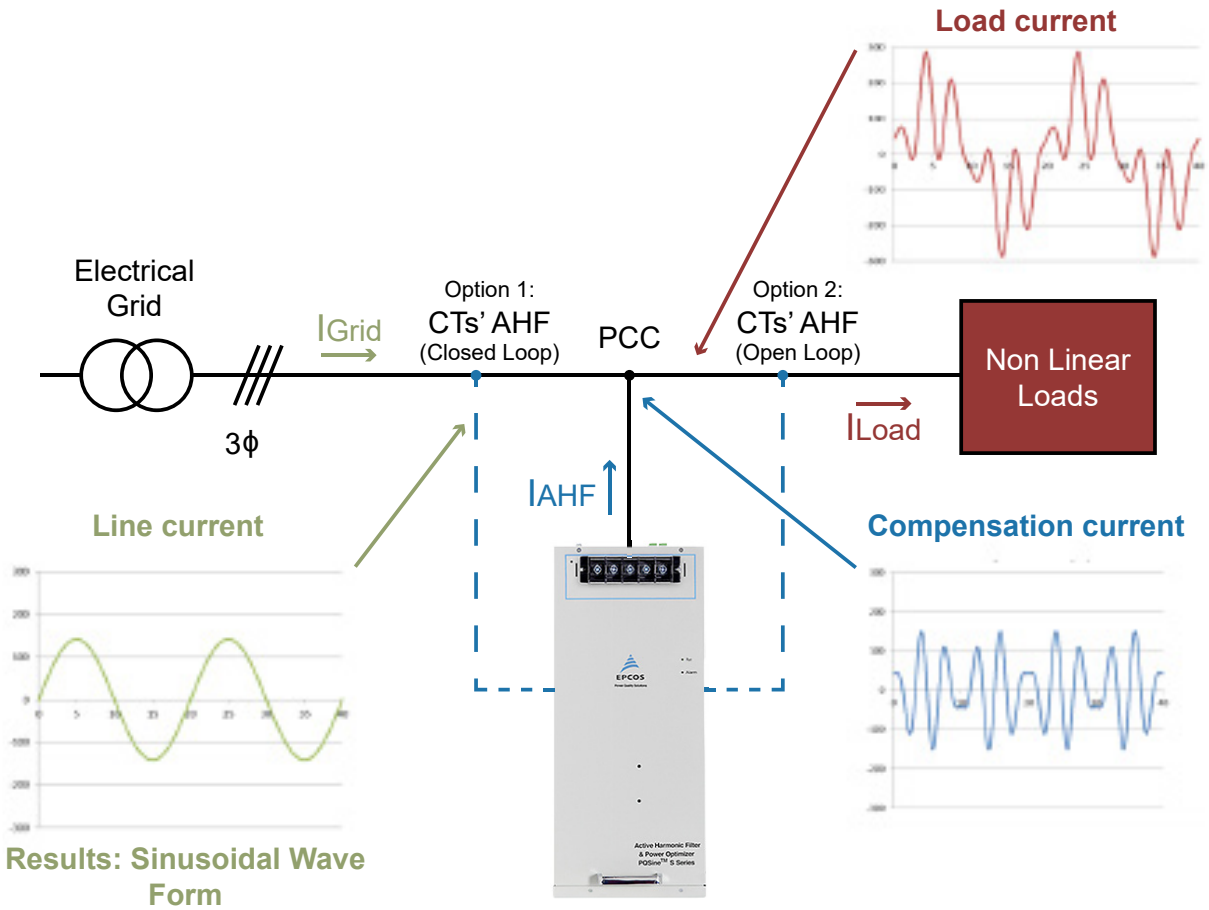
2 - Description

The active filter enables:

- Reduction of the harmonic current content;
- Compensation of reactive power;
- Load balancing;

The AC mains current, disturbed by a non-linear load, is measured by the active filter via external current transformers. The harmonic content and reactive power components are detected and processed in a digital control structure.

The active filter continually generates a compensating current that compensates the harmonic content and reactive current in the load, so the AC mains only has to provide only the active fundamental phase current:

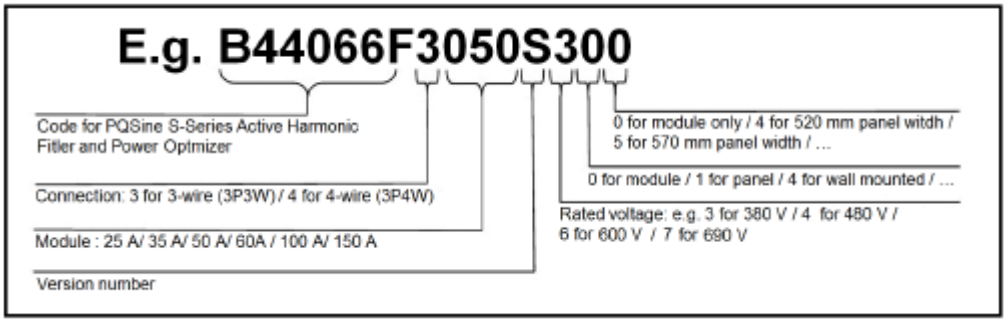


The active filter instantly adapts to all changes in the load and the system harmonic content spectrum, in order to be able to optimally respond at any time.

The active harmonic filter is primarily designed to eliminate harmonic oscillations, additionally it can also perform reactive power compensation and load balancing, AHF monitors the current permanently and compensates the unwanted elements of the measured current.

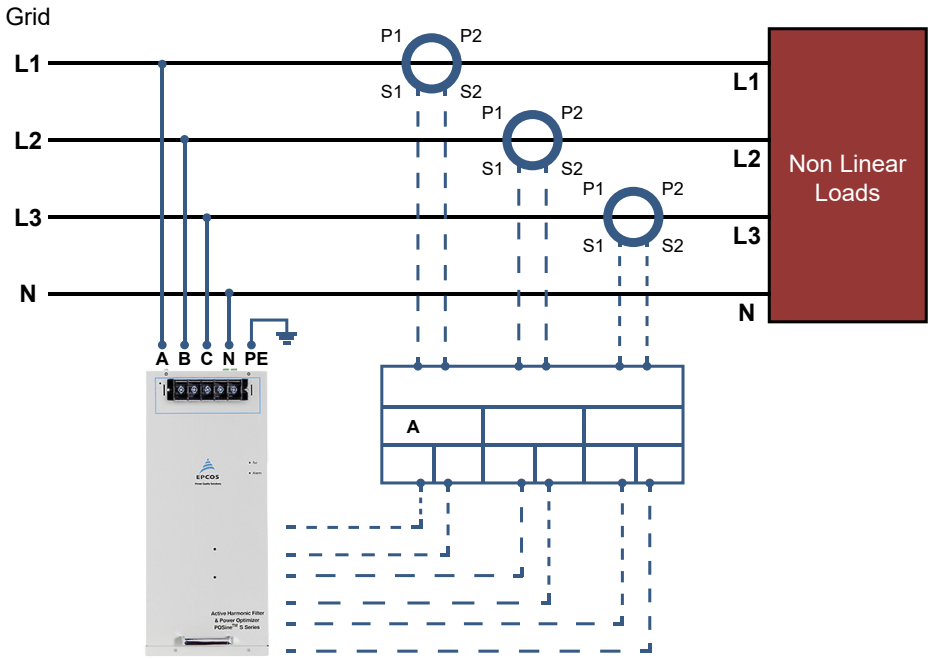
3 - Specifications

- **Multifunction:** A filter allows harmonic suppression, reactive compensation and three phase imbalance compensation at the same time;
- Wide range: 2nd to 50th harmonic simultaneous compensation, with designated compensation frequency;
- **Excellent effect of reactive compensation:** Allow fast (ms response), exact (-1.0<PF<1.0) and two way (both capacitive and inductive compensation) suppression;
- **Excellent effect of three-phase imbalance compensation:** Correct the active or reactive imbalance and filter out neutral current (only for three-phase four-wire series);
- Wide range of input voltage and frequency, suitable for site of power supplied by diesel engine or bad power site, upper voltage limit 793V, and lower limit of 228V;
- **Simple and flexible application:** Modular construction, easy installation, able to work together with other power distribution systems;
- **Easy maintenance and expansion:** Supporting easy modular change and expansion, fool-proofing design ensuring maintenance without the assistance from professional personnel;
- **Wide capacity coverage:** Modular system of 25A, 35A , 50A, 60A, 75A, 90A, 100A and 150A extendable;
- **User-friendly English interface:** auto failure warning, failure alarm and operation record;
- **Perfect function setup:** parameter personalization setup, self-inspection, start-up and **EPO** (Emergency Power OFF);
- Easy installation and external **CT** connection;
- Internal fuse protection;
- Three level topology inverter;
- Low electric power losses;
- Harmonic compensation for 3-wire and 4-wire application;



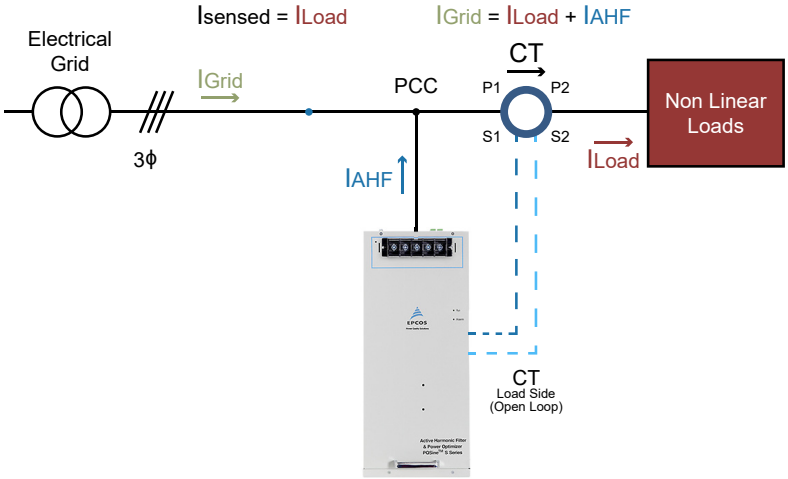
4 - Installation

For the electrical installation of the wall-mounted **AHF** device 3-phase power cable, **N** cable, **PE** cable and external **CT** (current transformer) are required to install. As indicated on this picture for a 3-phase 4-wire system the **CT** (current transformer) need to be installed on phase **A**, phase **B** and phase **C**.



- Input **A** – phase **L1** power input terminal;
- Input **B** – phase **L2** power input terminal;
- Input **C** – phase **L3** power input terminal;
- **PE** – protective earth, because the shell of the chassis is metal, it must be confirmed that the terminal is connected to the ground before the machine is turned **ON** so as to prevent any personal injury;
- **CT-A** (+) connected to **S1** of phase **A CT**
- **CT-A_GND** (-) connected to **S2** of phase **A CT**
- **CT-B** (+) connected to **S1** of phase **B CT**
- **CT-B_GND** (-) connected to **S2** of phase **B CT**
- **CT-C** (+) connected to **S1** of phase **C CT**
- **CT-C_GND** (-) connected to **S2** of phase **C CT**

The **CT** (current transformer) are installed at the load side with reference to the point of installation **AHF**. In 3-phase 4-wire system (phase 1 – phase 2 – phase 3 – neutral) a total of 3 sets of **CT**s one in each of the phases is needed. The installation direction of **CT** must be observed as in the figure and the phase order of detection signal cannot be interchanged:



- To ensure **AHF** has good reliability and to avoid overheating, do not block or cover the air inlet/outlet;
- Make sure that no corrosive gas and conductive dust exist in work environment and that the working temperature is ranged between -10°C and 40°C. **AHF** current will start to derate if operated outside these temperature range. The device will be shutting down when the IGBT temperature reaches 100°C, which can be equated roughly to an ambient temperature of 55°C;
- User needs to specify it particulary when grid voltage distortion rate is higher than 15% so that the possibility of other alternate/add on solutions can be discussed;
- The ventilation clearence requirement varies from case to case, depending on the panel design, no of units in the panel, horizontal/vertical/wall mounting, etc. So please make sure to seek expert opinion on ventilation requirement needed for the selected solution. Sufficient ventilation should be provided to the modules/wall mounted units/cabinets. For the standard enclosure having horizontal modules mounted horizontal, a minimum clearence of 600 mm should be allowed on the front and rear side of the enclosure.

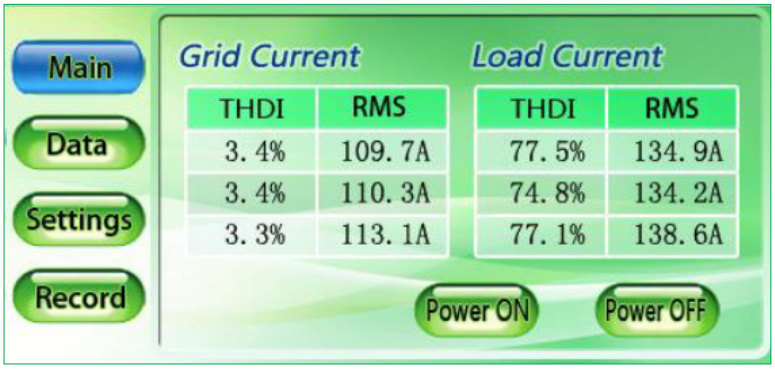
Please ensure that no power-factor compesation systems, which are not de-tuned, are connected to the same grid. Otherwise interactions between the **AHF** and the compensation systems could occur.

5 - Operation

The device does not require any external / manual operation (for example adjustment of setting) by the user after the installation on the electrical panel.

From the factory it is already electrically installed on the machine and configured.

The device is provided with a 4.3" LCD screen which allows to display all the information about voltage and current on a real-time basis:



The only required activities are:

- Maintenance (See *chapter 11*);
- Replacement exhaust or broken parts (See *chapter 11.5*);

6 - Maintenance

Precautions:

EPCOS – TDK AHF adopt modular design. As to daily maintenance, user only needs to check whether the display data on the LCD screen is correct. If possible, used can use infrared thermo detector to check whether there are some exceptional high temperature points in the machine. User should turn **OFF** the power and contact the **EPCOS – TDK** product engineer if any abnormalities are found.

EPCOS – TDK AHF is a strong – current product. To ensure the safety of the maintenance staff, no one is allowed to touch any live part of the device when it is working. The earth point should be regularly checked to see if the connections is solid.

WARNING

To prevent personal injury, if maintenance or cabinet opening is needed after power **OFF**, a multimeter is required to measure the voltage at input terminals so as to make sure no grid power is connected! Operation should be done more than **10** minutes after power **OFF** when the internal **DC** busbar capacitance is discharged!

General maintenance:

Because **EPCOS – TDK AHF** has implemented air channel isolation, air filter is not required in ordinary usage environments. But in adverse environments, such as high temperature, high humidity, or environments with heavy conductive dust, user should contact **EPCOS – TDK** product engineer in advance to determine the specific planning of project before installation and electrical connections.

The maintenance schedule depends on the operation and ambient conditions and is valid for the following typical conditions

- Device mounted in clean environment without dust in the air or in a cabinet with air inlet filter;
- Ambient temperature approx. 25°C;
- Symmetrical load in steady state operation;
- Typical device output 60%;
- **One** power OFF/ON **per month**.

In the other cases the maintenance interval has to be adapted. Please ask the service department for specific support and for the service and maintenance documents.

Year after start operation	1	2	3	4	5	6	7	8	9	10	11	12
Maintenance job												
Check operation and clean air inlet/outlet grilles	X	X	X	X	X	X	X	X	X	X	X	X
Replace cabinet fan*			X			X			X			X
Replace air filter pads**		X		X		X		X		X		X
Replace the internal fans						X						X
Replace input fuses			X			X			X			X
General inspection at factory / service point (check of all components, replace of DC link capacitors and wom components if needed)						X						X

(*) Only in the case of special cabinet having additional fans;
(**) Only in the case of cabinets / wall mounted designs having air filters.

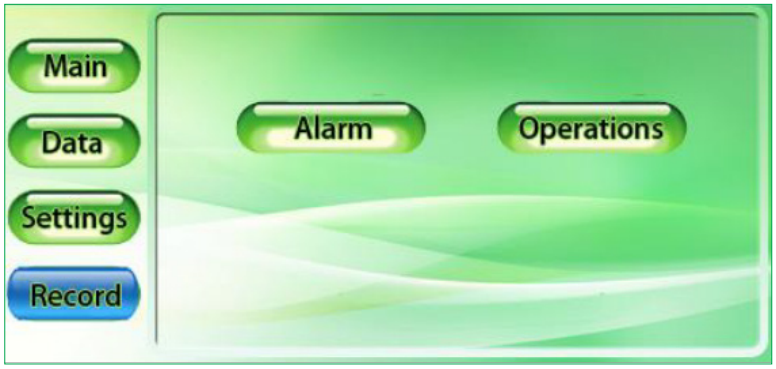
7 - Troubleshooting

WARNING

For your personal safety, whatever failure the device encounters, you should not disassemble it without permission from **EPCOS – TDK**. We are not obliged to fix products with torn or damaged tags.

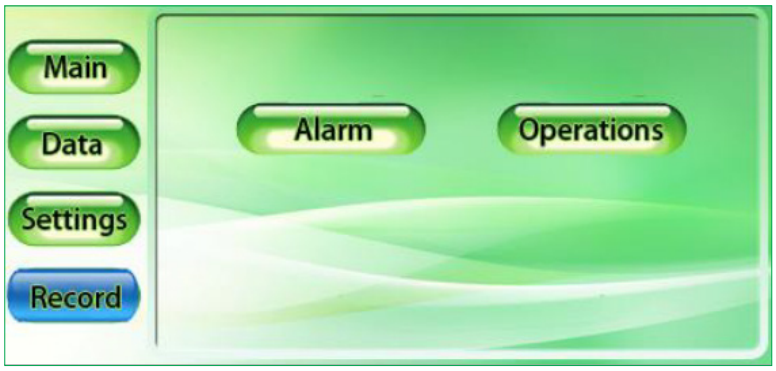
No	Fault & alarm	Possible cause	Solution
1	**Communication failure**	Communication failure between monitor and **AHF** module	Check if communication cable is reliably connected
2	**Over temperature**	1. Ambient temperature too high; 2. Air duct blocked; 3. Fan failure.	Troubleshooting the faults one by one
3	**Input voltage abnormal**	1. Wiring system of power cable not correct (3-phase 3-wire or 3-phase 4-wire); 2. Input voltage over-loaded or under-loaded; 3. Inverter not working or disabled	Check whether the model is correctly connected according to its wiring system, whether the power cable is reliably connected, and input phase voltage is within mentioned range
4	**Input frequency abnormal**	Inverter is disabled or not work as input frequency exceeds limitation	Check whether the frequency of **AC** inputs is within 45-62.5Hz
5	**DC bus overvoltage**	Inverter disabled or not work due to excessively high DC bus voltage	Contact **EPCOS – TDK** product engineer
6	**Auxiliary power supply (APS) failure**	Internal failure of **APS**	Contact **EPCOS – TDK** product engineer
7	**No compensation current**	**1.** **AHF** is not powered **ON**; 2. Something wrong with **CT** installation and wiring; 3. Compensation rate too low.	Check if **AHF** is turned **ON**, check the setup of compensation rate and CT location and wiring, and whether **CT** cable is reliably connected.
8	**Fuse failure**	At least one input fuse open circuit	Contact **EPCOS – TDK** product engineer
9	**Controller parameter setup**	The read controller parameter and the set controller parameter not matched	Contact **EPCOS – TDK** product engineer
10	**Inverter overloaded**	**AHF** compensation current exceeding rated current	Check if **AHF** capacity is matched with load
11	**Fan failure**	Fan malfunctioning	Contact **EPCOS – TDK** product engineer
12	**CT ratio setup failure**	External **CT** ratio setup failure	Check if installation direction of **CT** and phase order are correct

Click “**Record**” on the **Main** menu to enter the record interface, Click “**Alarm**” to enter the **Alarm** interface,



Click “**Active**” and “**History**” to check information of active and **History** alarm:

Click “**Operations**” to enter the **Operations** interface,



the **Name**, **Start Time**, **Original - > Setting** value of history operation are displayed:

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