Liebert® PDX Econophase

Perimeter DX System PI Models with Variable Speed Compressor

User Manual

English, 10020534MAN_ENG, rev. F - 14.03.2023

This document, written in English, is the original version

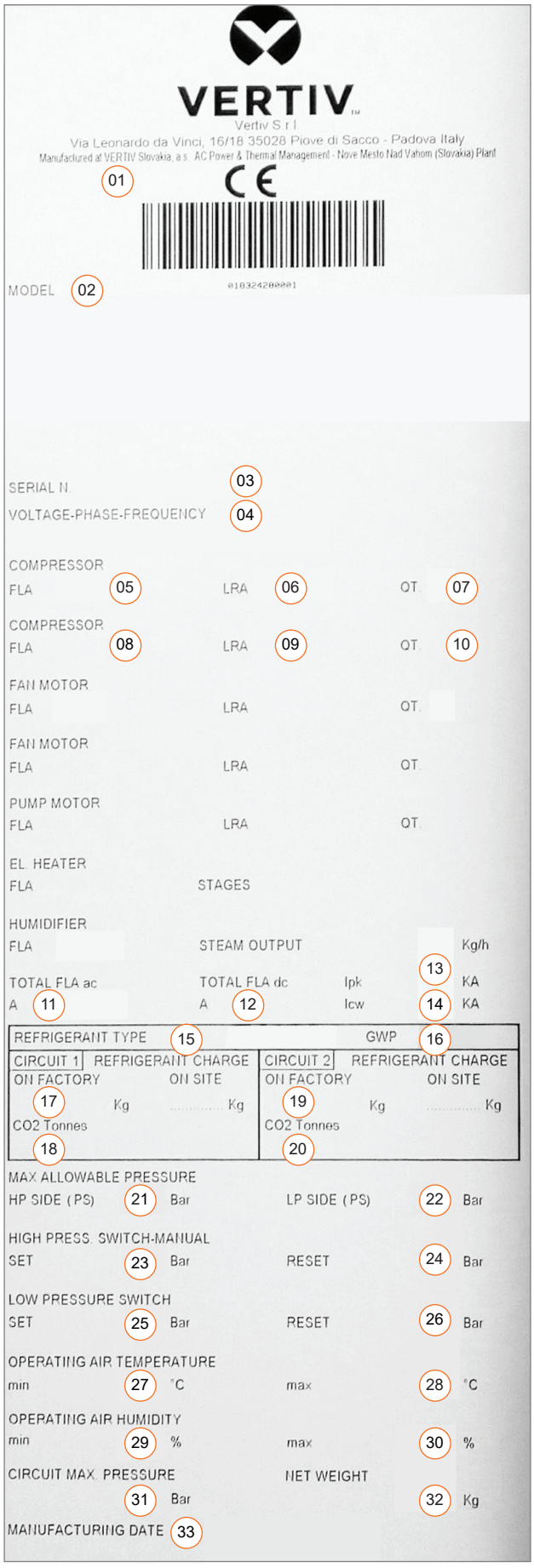
Contents

Annexes

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

List of Tables with Data by Unit Model



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 below 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	Rated Short-Time Current [kA]
13	Rated Peak withstand current
14	Rated short-time current
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
ATS	Automatic Transfer Switch
EC	Electronically Commutated [fans]
EEV	Electronic Expansion Valve
MCB	Miniature Circuit Breaker
STO	Safe Torque Off
Ultracap	Ultra capacitor
UPS	Uninterruptible Power Supply
VSD	Variable Speed Drive

1. Safety

Content of this chapter

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 J - 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

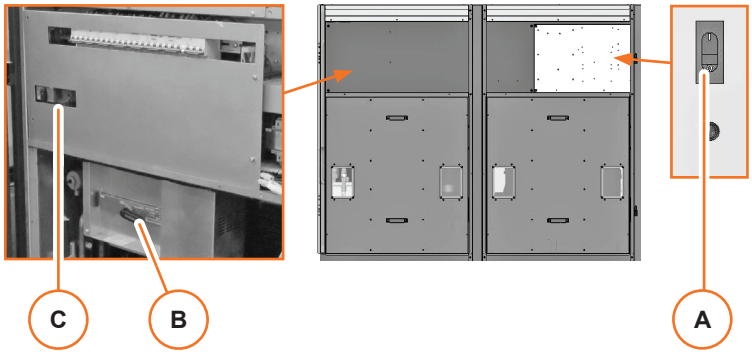
As general rule, always wear the following **PPE** (Personal Protective Equipment):

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



The ON/OFF switch [**A**] on the control panel does not disconnect the unit from the power supply

To disconnect the power supply proceed as following:

- Unscrew the door and open it.
- For units with ATS power supply open the disconnecting switch [**B**], see *Annex J - ATS (Automatic Transfer Switch)* for details.
- For units without ATS open the disconnecting switch [**C**].

After you open the door, pay attention to the cable and components that are still energized.

Open the disconnecting switch before removing any protective cover.

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 **10** 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 D - 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

Dig.	Feature	Value	Description
1 2	Family name	PI	
3 4 5	Model	000	
		D	Downflow Up
		E	Downflow Down (in the raised floor)
7	System type	P	Air-cooled + predisposition for pump refrigerant economizer
8	Air flow	L	High power EC fans
		1	EC fans
9	Power supply	3	400 V / 3 ph / 50 Hz + N CE
		T	380 V / 3 ph / 60 Hz + N CE
		6	460 V / 3 ph / 60 Hz CE
10	Cooling system	G	Single Circuit Variable Speed Scroll R410A with EEV
		I	Dual Circuit Variable Speed Scroll R410A with EEV
11	Humidification	0	None
		H	Infrared humidifier
		U	Ultrasonic humidifier
		S	Electrode humidifier
12	Microprocessor control	0	None
		7	7” touch screen
		F	10” touch screen
13	Heating and re-heating	0	None
		1	Electric heating standard capacity
		2	Electric heating high capacity
14	Air filter	1	ePM10 50%
		3	ePM10 50% + clogged filter
15	Condensing control	A	Air-Cooled
16	Color	1	Black RAL 7021

Dig.	Feature	Value	Description
17	High voltage option	D	Standard Power Supply
		F	Dual Power Supply Parallel
		G	Dual Power Supply Alternate (ATS)
18	Predisposition	0	None
		S	Predisposition for Smart Aisle™ (predisposition for damper sensor, 3 position switch)
		F	Predisposition for Economizer (sensors, predisposition for dampers)
		G	Predisposition for Smart Aisle™ + Economizer
		H	Predisposition for motorized overpressure damper
		L	Predisposition for plenum installation
19	Monitoring	0	None
		1	Monitoring (Modbus IP, BACnet IP, SNMP and HTTP)
		4	LIFE compatibility
20	Devices	0	None
		1	MCB 10A 1 ph
		2	MCB 10A 3 ph
		3	Condensate pump (1)
		4	Condensate pump + MCB 10A 1 ph (1)
		5	Condensate pump + MCB 10A 3 ph (1)
21	Packaging	P	PLP and Pallet
		C	PLP and wooden crate
		S	Seaworthy
22	EMC Emissions	I	Industrial rate
		R	Residential rate
23	Revision	E	Free option
25	Special requirements	A	Standard Vertiv™
		X	Special Vertiv™

(1) - Only available with Upflow units

Fan module

The fan module can be delivered separately:

- always for extended height units
- in case of fan module replacement for standard units (with the exception of the 1 bay units)

The fan modules are not available for 1 bay units, since the fan section of these units are integrated with the cabinet structure.
The fan module is fully defined by the following digits.
The unit is fully defined by the following digits.

1	2	3	4	5	6	7	8	9	10	11	12	13

Dig.	Feature	Value	Description
1 2 3	Fan Module	BMX	Fan Base Module
		BFX	Fan Base Frame
4 5	Size: Normal Lenght	33	3350 mm
6	Air Delivery	S	Standard
		B	Back (fans removal from the front)
		F	Front
7	Fans	L	High Power EC Fan Module
		1	EC Fan Module
8	Heaters	0	No heaters
		1	Standard Capacity
		2	High Capacity

Dig.	Feature	Value	Description
9	Packaging	P	PLP and Pallet
		C	PLP and wooden crate
		S	Seaworthy
10	Power Supply	3	400 V / 3 ph / 50 Hz + N CE
		T	380 V / 3 ph / 60 Hz + N CE
		6	460 V / 3 ph / 60 Hz CE
11 12	Free Digits		
13	Special requirements	A	Standard Vertiv™
		X	Special Vertiv™

Note: *For all configurations see* *5.2.2 Extended version*

3. Intended Use

Content of this chapter

3.1 Purpose of the unit

The **PDX** 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

The **PDX** units are factory assembled, including all the internal wiring.

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

- Mounting of the fan section (only for the extended versions)
- 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.

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.

Contact Vertiv™ Technical Support for any question.

3.3 Refrigerant

The **PDX** units are designed for use with R410A.

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 D - 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	Below -30°C	Not allowed
	From -30°C to -20°C	Exceeding the winter low temperature limits could drive to issues at the electric devices and at the fan operation. Normally with these low temperatures the compressor is stopped and the EconoPhase is active. In case of compressor running, exceeding these temperatures could stop the compressor(s) by Low Pressure transducer. Reset to normal operation can only be carried out manually through the unit control.
	From -30°C to +48°C	OK **NOTE** ***Higher limit*** *This limit is determined by coupled condenser model. Exceeding this limit (or a lack of maintenance), the compressor(s) could stop by High Pressure switch. Reset to normal operation can only be carried out manually*
	Above +48°C	Not allowed.
Remote condensers position	See *9.3.3 Refrigerant piping requirements*	

4. Reference Norms

The **PDX** units are designed, manufactured and tested according to the following directives and standards:

EU Directives	- Machine 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.
Product Standards and Approvals	The manufacturer's products installed and operated in compliance with this document and the Product Documentation, conform to the Low Voltage directive 2014/35/EU, the EMC directive 2014/30/EU and the Pressure Equipment directive 2014/68/EU. Products are designed to comply with an IP21 rating. This product is cULus / ETL / MET (TBC) listed for the appropriate voltage models and certificates will be made available on request.
Performance test norms	- Cooling Capacity according to EN 14511 - Sound Power Level according to ISO 3744

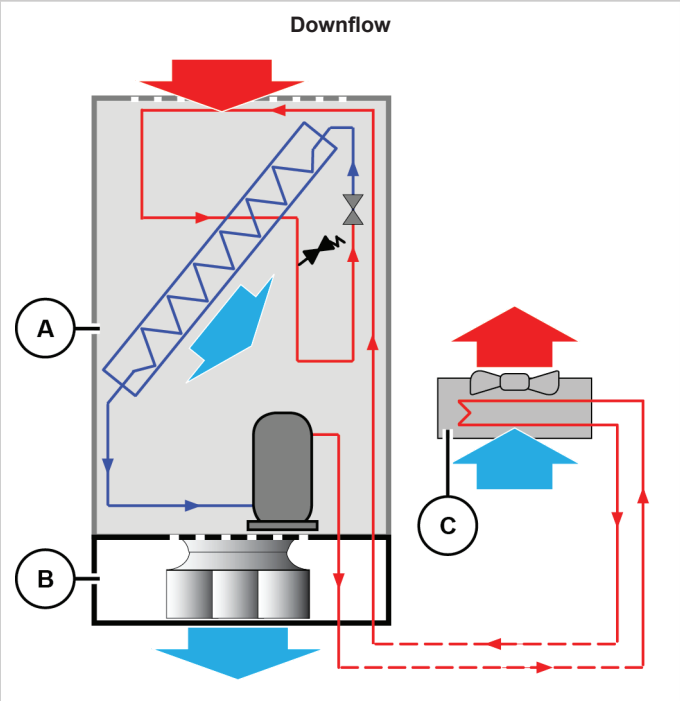
5. Description

Content of this chapter

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 may be placed at the bottom of the coil section (**Downflow versions**) or on top (**Upflow versions**).

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

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

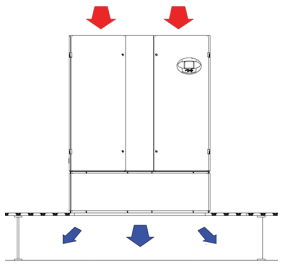
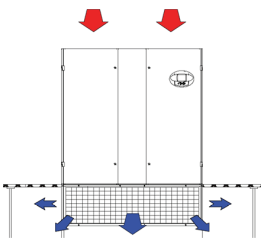
Different versions are available also for the refrigerating system.

5.1.2 Air distribution

The unit is placed on a raised floor, whereas the unit fan module can be placed under a raised floor.

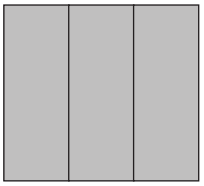
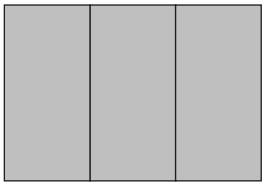
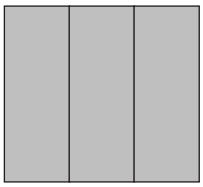
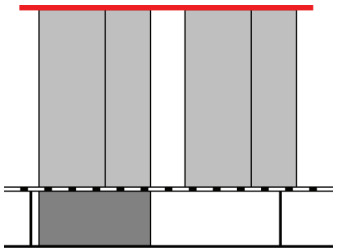
The air flow direction can be either **Upflow** (fan section on top) or **Downflow** (fan section at the bottom).

The following combinations are available:

D - Downflow Up	E - Downflow Down
	
Placed on the floor **Warm air** though the top **Cold air** though the bottom grid	Placed under a raised floor **Warm air** though the top **Cold air** though the front grid

5.1.3 Cabinet size

The units can have the following cabinet size:

	Frame type	5	7
	Number of bays	3	
Width			
Height	Standard H=1970 mm		The coil and the fan sections are factory assembled in the same cabinet.
	Extended H=2570 mm Fan module at bottom of the coil module		

5.1.4 Accessories

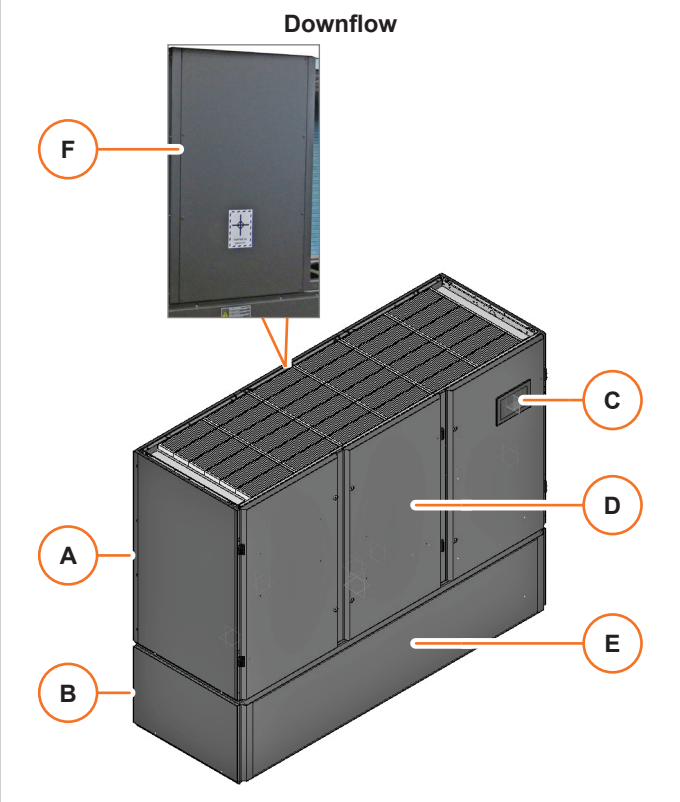
Several accessories are available for the following purposes:

- support and adjustment of the unit height
- different options for air intake (from outdoor, through hoods or plenum, ...)
- noise damping
- high efficiency filters

See *Annex F - Accessories* for details.

5.2 Structure

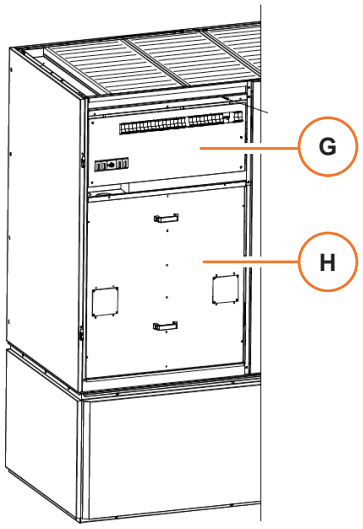
5.2.1 Standard version



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

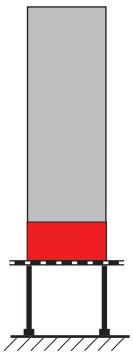


Ref.	Description	Remarks
G	Electric and control panel safeguards	The fixed safeguards can be removed only by loosing the fixing screws.
H	Compressor compartment	For the **Downflow** versions: - the fixed safeguards can be removed only by loosing the fixing screws - the holes for inspection and access to the connectors are protected by transparent plates, fixed by screws

5.2.2 Extended version

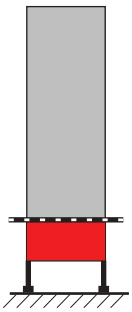
In the extended versions the fan section and the coil section are separate modules which must be assembled at the installation site.

The fan module for the extended versions is named differently as shown below.



Fan base module

when placed on the floor or raised floor



Fan base frame

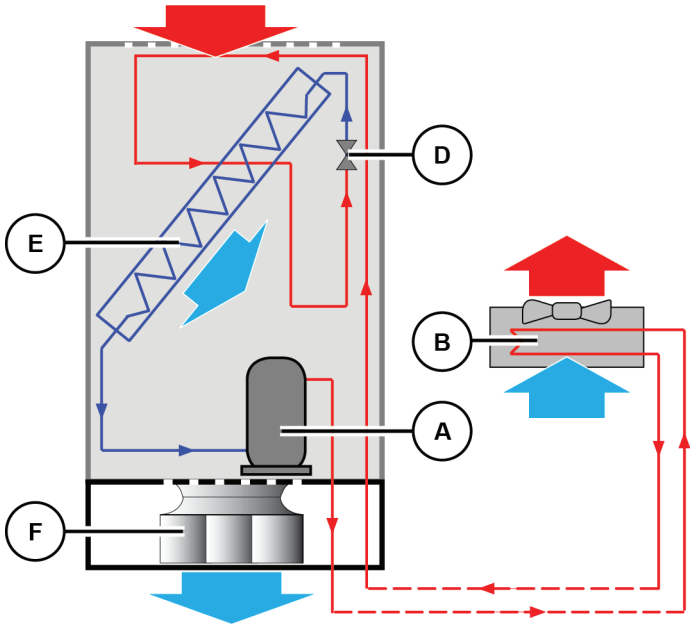
when placed under a raised floor

5.3 Refrigerating System

5.3.1 Cooling versions

The **PDX** product family includes several cooling system versions.
This manual is related to units with **Econophase version**.
For units of the other versions, please make reference to respective manuals.

5.3.2 Main components

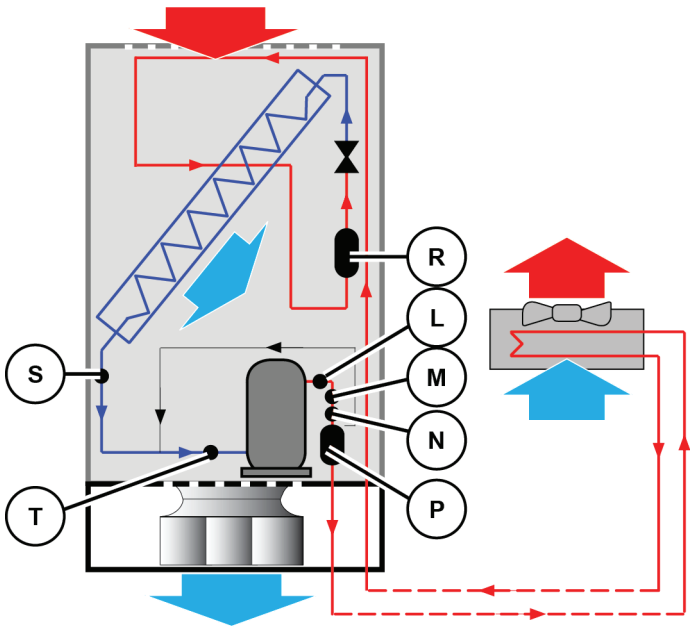


The figure shows a simplified scheme for a **Downflow** unit with a single circuit with one compressor.

The main components of the circuit the following:

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

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

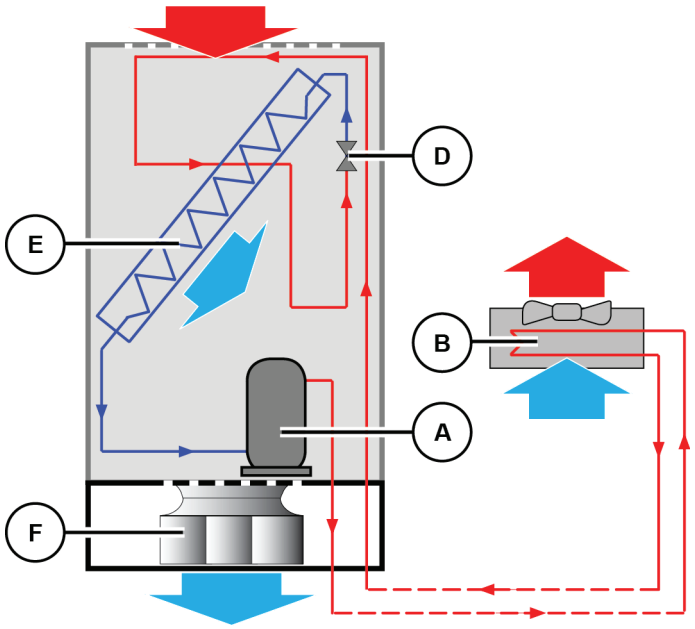


The circuit also include the following components:

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 liquid refrigerant coming from the condenser enters in the liquid receiver, which ensures a fixed and even refrigerant flow to the expansion valve [**D**].

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

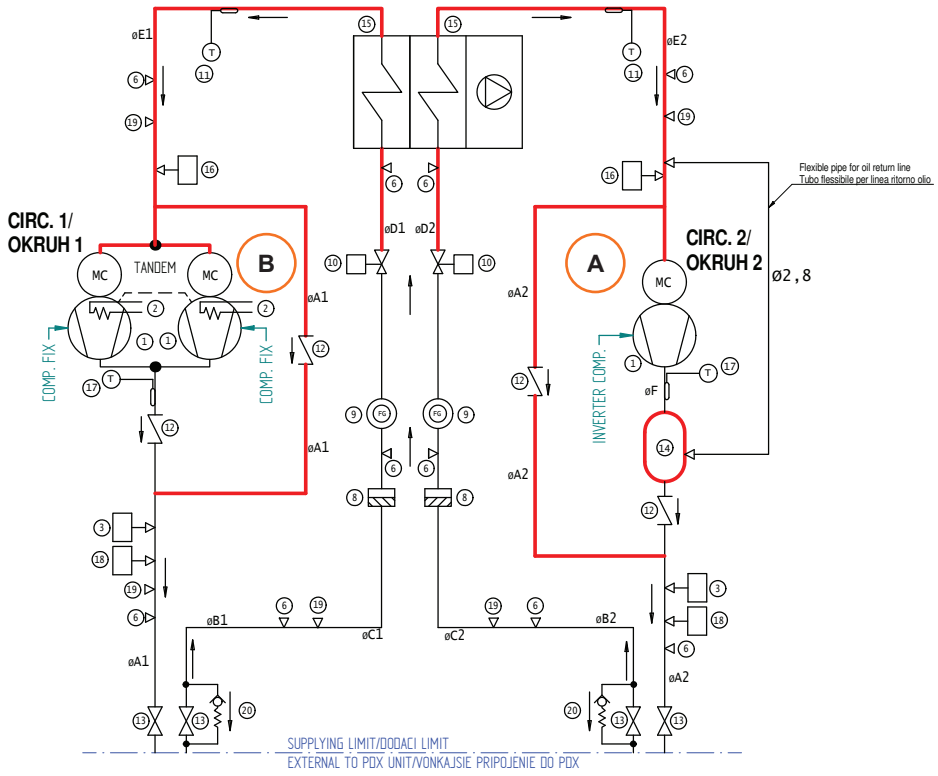
The fan [**F**] makes the warm air coming from the room to flow through the evaporator.

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

Tandem



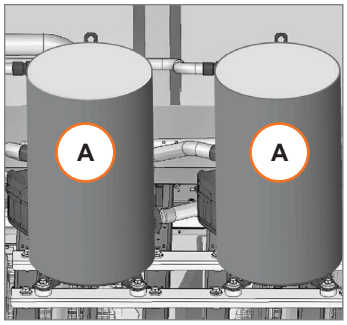
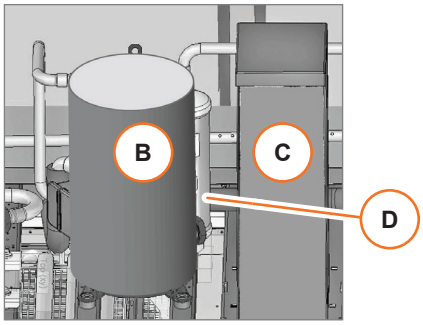
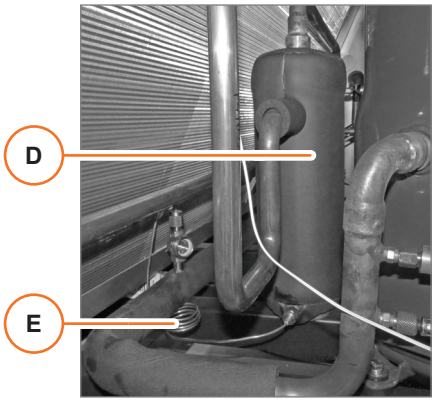
[**A**] variable speed compressor

[**B**] 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**] Semi-hermetic scroll compressor	[**B**] Semi-hermetic scroll compressor
Speed	Fixed	Variable, controlled by the inverter [**C**] Speed modulation between 20% 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 may be of belt type or surface type.	Not available
Check valve	An external check valve is mounted on the compressor discharge line. **Function:** to avoid return of liquid refrigerant from the condenser	

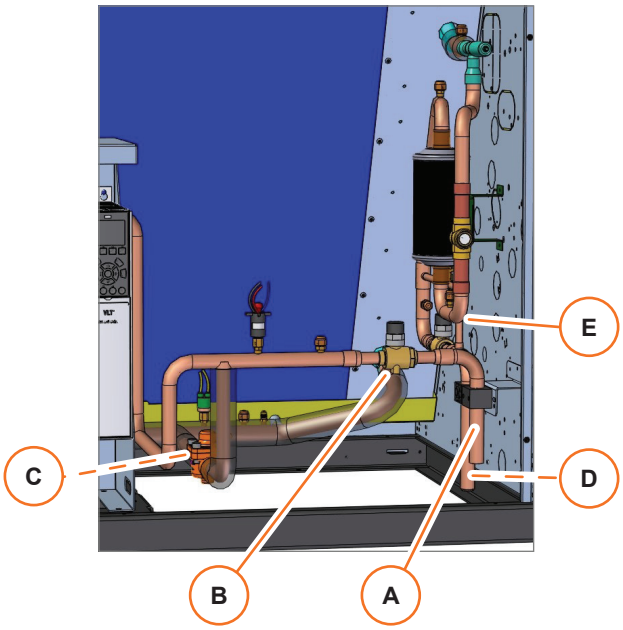
5.3.6 Condensers

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.

See *6.2.4 Remote condensers models* to check which condensers are compatible with your unit.

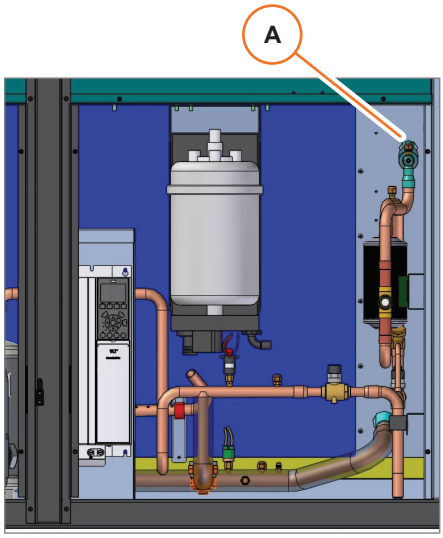
NOTICE

Connecting the unit to remote condensers not approved by **Vertiv™** invalidates the warranty.



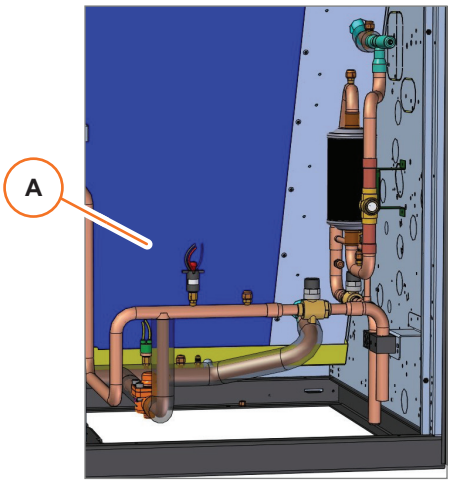
A	Piping - outlet to the external condenser
B	Shut-OFF valve at delivery to the external condenser
C	Check valve at unit outlet to the condenser **Function** The check valves prevent unwanted refrigerant migration between the unit and the condenser in anomalous conditions.
D	Piping - inlet from the external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

Make sure that the safety valves are always free to discharge.

Do not cover the safety valves.

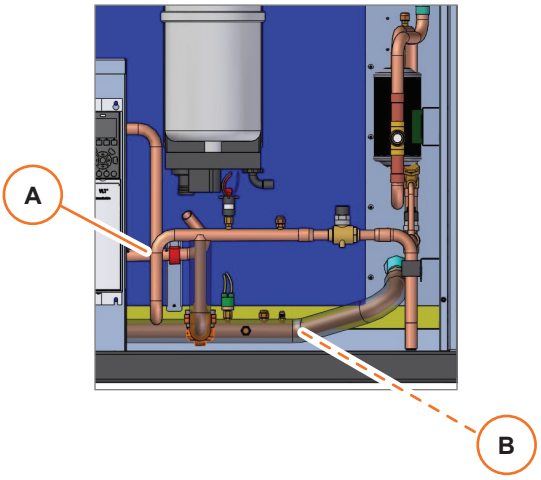
WARNING

The safety valves are installed in open position and the ball spindle is protected by means of a cap screwed to the body and sealed with lead.

Do not tamper or force the safety valves.

Only authorized technicians or officials of a Competent Body are allowed to perform interventions on the safety valves. These persons are also responsible to substitute and for restoring the safety valve operating conditions.

5.3.9 Sensors and instruments



A High pressure transducer

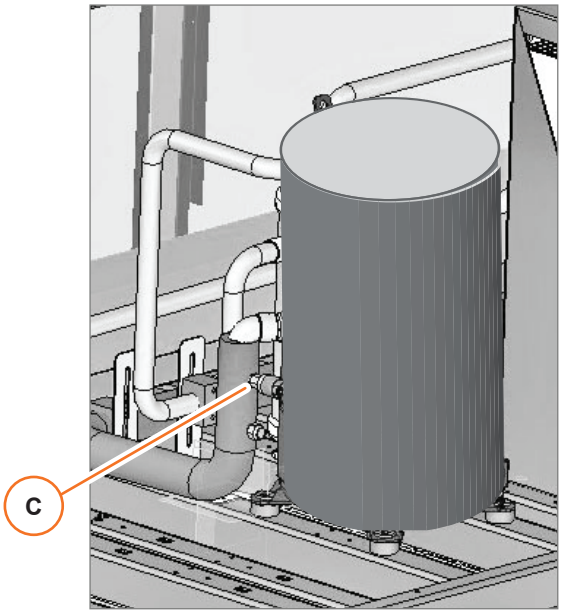
Function

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

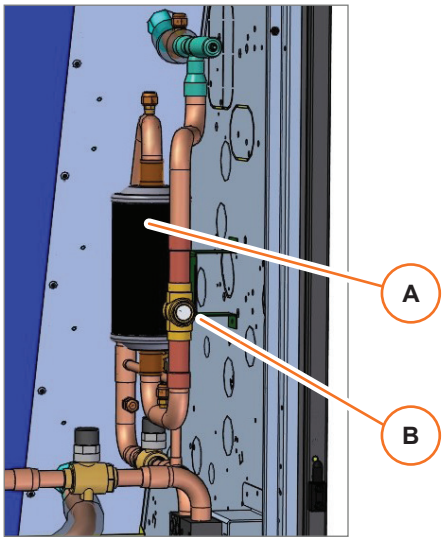
for the expansion valve control

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.*

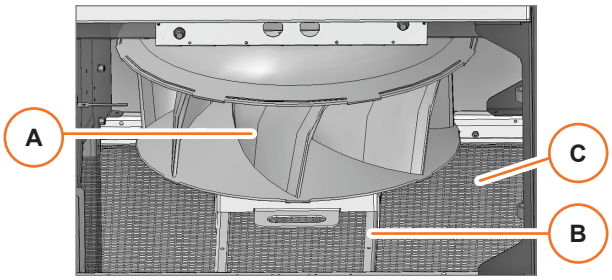
5.3.10 Filter dryer and sight glass



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, ...)

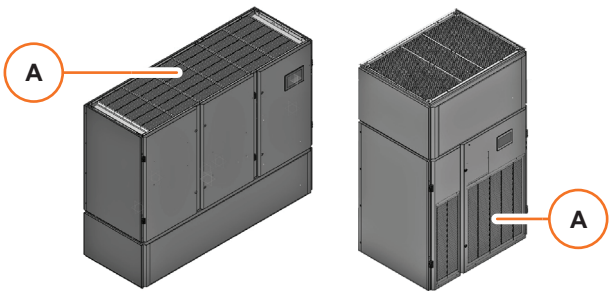
5.4 Air System

5.4.1 Fans



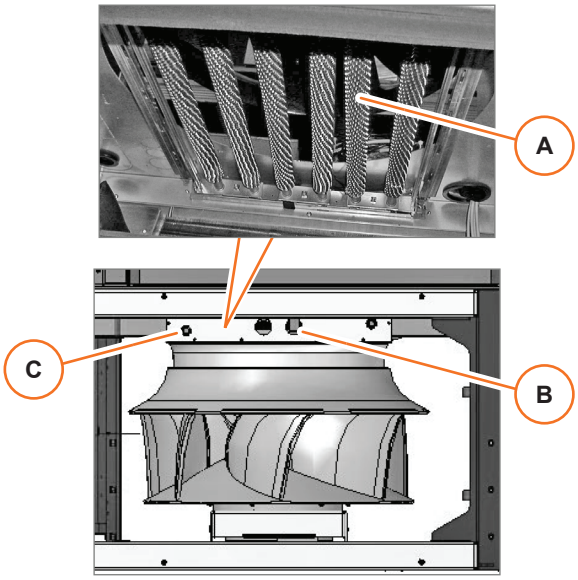
A	Fan
B	Fan supporting frame
C	Protective grid The grids protect against contact from the top (for the Upflow versions) or from below the floor, if the floor is opened for any reason near the machine (for the Downflow versions).
---	The fan motors are protected by thermal magnetic circuit breakers. See *5.5 Electric and Control System* for details.

5.4.2 Filters



A	Filter The figure shows standard filters. Other type of filters are available as options. See *Annex F - Accessories* for details
---	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.

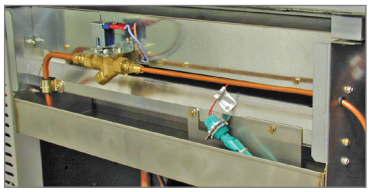
5.4.3 Heating (optional)



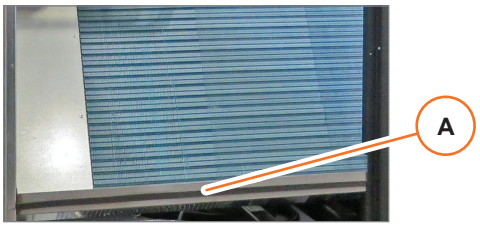
A	Heater
B	Heater temperature switch **Function** The temperature switch is installed on the heater. It switches off the heater if its temperature is higher than the alarm value.
C	Reset button **Function** In case of activation of the temperature switch, a manual reset is required. • Press the button [**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)

The humidifier can be of the following types:

Electrode	**Infrared**	**Ultrasonic**
		
Installed inside the machine	Installed inside the machine	Independent module installed under the machine Only for Downflow configurations
See *Annex G - Electrode Humidifier*	See *Annex H - Infrared Humidifier*	See *Annex I - Ultrasonic 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

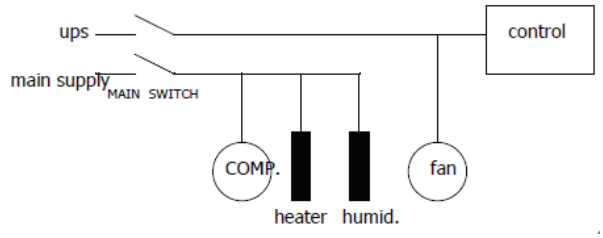
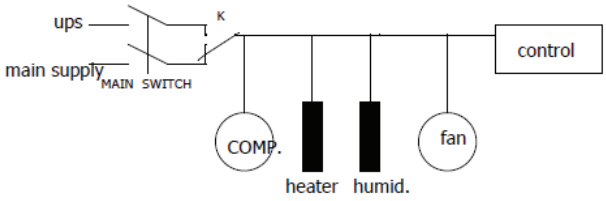
5.5.1 Standard or dual power supply

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.

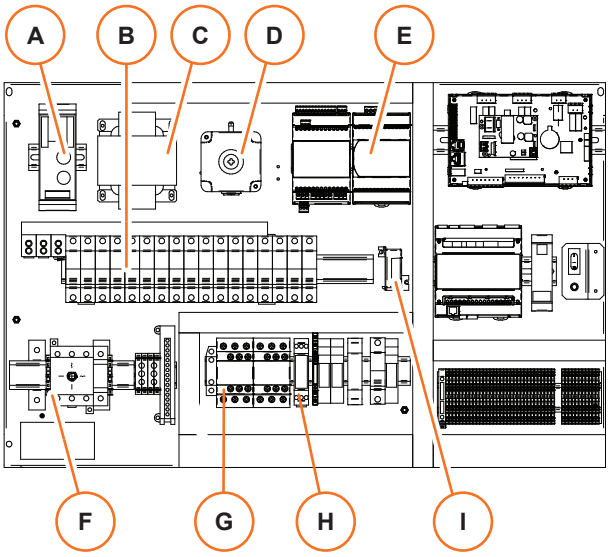
Make reference to the *Electric Diagrams* for details about your unit power supply system.

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 parallel	Double power supply to the same disconnecting switch 	A UPS is connected to the main power supply. **NOTE** *The UPS is not part of the unit.* In addition to the Ultracap(s), the UPS supplies power to the control and the fans. Heating, humidifier and compressors are disabled.	If the Ultracap and UPS have avoided power interruption to the control, 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.
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.

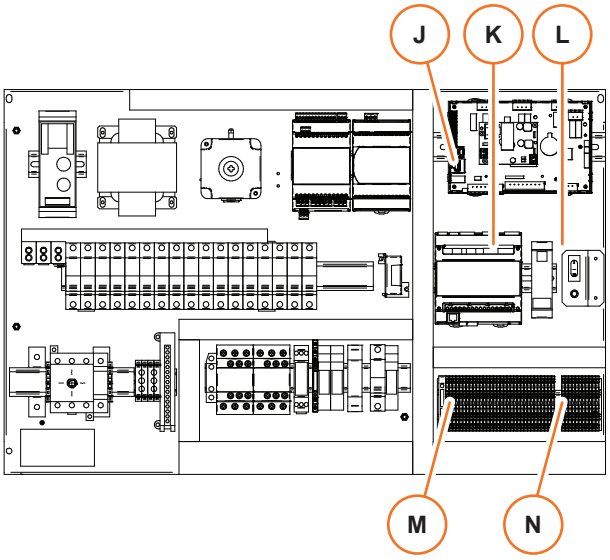
5.5.2 Main components

Power side (high voltage)



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

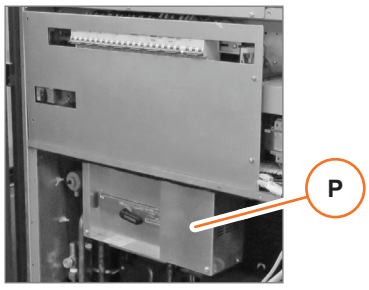
Control side (low voltage)



J	Control board
K	Humidifier control board
L	Expansion module
M	Terminal board
N	ON/OFF switch with LED indicator

WARNING
This is not a disconnecting switch.
See *5.5.3 Disconnecting switches*

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.

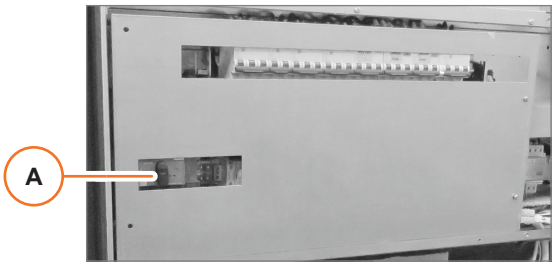
Before removing the panels and working inside the electric and control panels proceed as follows:

- 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**.

Access to the disconnecting switches

To have access to the disconnecting switches you need to unscrew the door and open it.

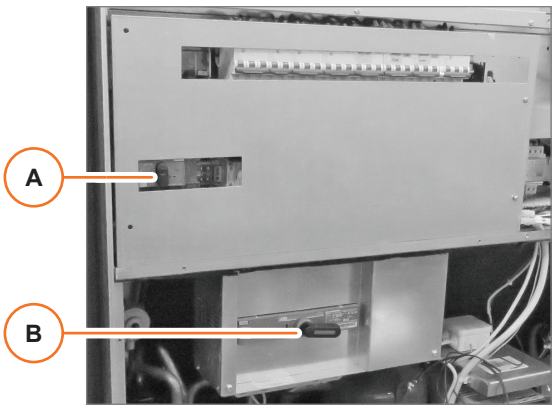
Single power supply



A Disconnecting switch

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

Dual alternate power supply



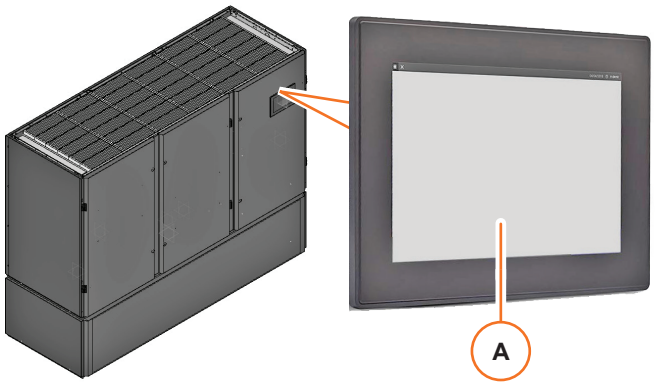
A	Standard disconnecting switch
B	ATS disconnecting switch

WARNING

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

You must open the ATS disconnecting switch to cut-off the power supply to the unit.

5.5.4 iCOM™ control panel



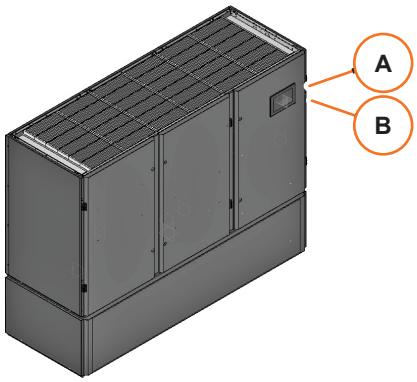
A iCOM™ control panel

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.

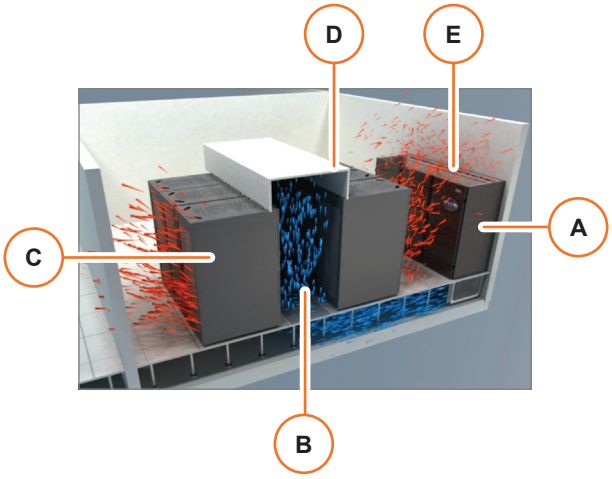
5.5.7 Fans control

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** 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 unit [**A**] blows the air into the cold aisle [**B**] through the raised floor.

The hot air coming from the active equipment [**C**] returns to the unit.

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

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

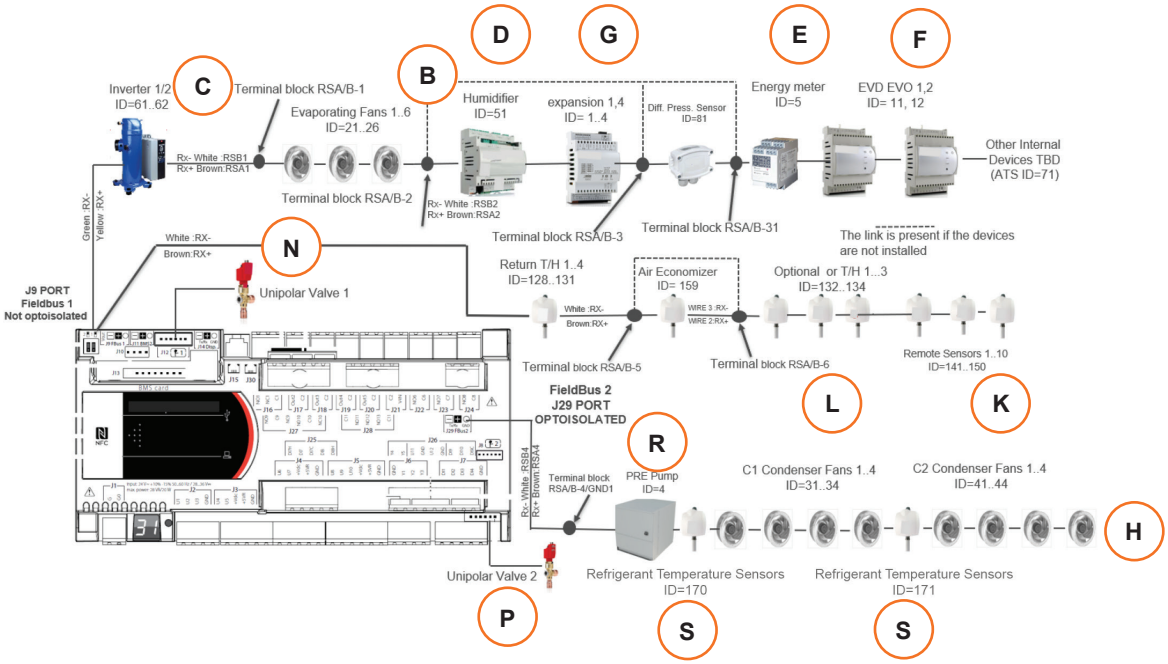
5.6 Modbus Connections

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.

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
J	Other internal devices

H	Condensing fans (up to 4 per circuit)
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
R	PRE
S	Refrigerant Temperature 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 **PDX** 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:

Circuit 1	Circuit 1 only is used for dehumidification. In case of alarm the other circuit will not be activated.
Circuit 2	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

- 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 1: *Before removing power to the control it is a good rule to put the drive in **OFF** to ensure the correct shutdown routine and avoid an unwanted start to the Power **ON**.*

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 (except PI057 and PI075)	When the compressor starts, the EEV valve is kept closed until the condensing evaporating pressure difference exceeds the minimum pressure difference.

6. Technical Data

Content of this chapter

6.1 Structure

Table 03 - Frames and air distribution

Unit model	Frame type	Number of bays	U - Upflow	H - Downflow Frontal	D - Downflow Up	E - Downflow Down	Extended
PI082	5	3	YES	---	YES	YES	---
PI094	5	3	YES	---	YES	YES	---
PI104	5	3	YES	---	YES	YES	---
PI120	5	3	YES	---	YES	YES	---
PI150	7		---	---	YES	YES	YES
PI165	7		---	---	YES	YES	YES

6.2 Refrigerating System

6.2.1 Refrigerant Type

WARNING

All the data given in this manual refer to systems using R410A as refrigerant.

6.2.2 Circuit versions

For double circuit models:

- The circuit with fixed speed compressor(s) is on the left side and it is identified as Fixed speed circuit
- The circuit with variable speed compressor is on the right side and it is identified as Variable speed circuit

For single circuit models:

- There is only one circuit with variable speed compressor. To maintain consistency, this circuit is identified as Variable speed circuit

Table 04 - Circuit version

Unit model	Number of circuits	Fixed speed circuit	Variable speed circuit
PI082	2	YES	YES
PI094	2	YES	YES
PI104	2	YES	YES
PI120	2	YES	YES
PI150	2	YES	YES
PI165	2	YES	YES

6.2.3 Inverter derating factors

Table 05 - Refrigerating system - Inverter derating factors

Unit model	
PI082 **PI094** **PI104** **PI120** **PI150** **PI165**	For altitudes above 1000 m above see level, apply the following derating factors: **Altitude [m]** / **Derating factor** 1 000 / 1 1 500 / 0,95 2 000 / 0,90 **NOTE** *The derating factor is applied to the maximum output current. The current limit must be scaled according to the derating table. As a result the compressor might not be able to run the full envelope (need to calculate)*
	For altitudes below 1000 m no derating is required. For altitudes above 2000 m please contact Vertiv™ Technical Support. 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

6.2.4 Remote condensers models

NOTICE

The remote condenser(s) must be purchased separately.

Each unit can be connected only to the matching condenser(s) given in the following tables.

The size of the condenser also depends on the installation configuration as explained in *9.3.3 Refrigerant piping requirements* - *Table 34 - Installation conditions*

Table 06 - Refrigerating system - Remote condensers models - MC Microchannel condensers

Unit model	Variable speed circuit			
	t < 35°C	35°C < t < 40°C	40°C < t < 46°C	t > 46°C
PI082	MCL055	MCM080	MCM080	MCL110
PI094	MCL055	MCM080	MCM080	MCL110
PI104	MCL055	MCM080	MCL110	MCL110
PI120	MCM080	MCM080	MCL110	MCL110
PI150	MCL110	MCL110	MCL165	MCL165
PI165	MCL110	MCL110	MCL165	MCL165

6.2.5 Refrigerant piping diameters and thickness

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

Unit model	Variable speed circuit					
	Gas		Liquid from condenser to PRE		Liquid from PRE to room unit	
	External diameter	Thickness	External diameter	Thickness	External diameter	Thickness
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
PI082	28	1,5	35	1,5	22	1,5
PI094	28	1,5	35	1,5	22	1,5
PI104	28	1,5	35	1,5	22	1,5
PI120	28	1,5	35	1,5	22	1,5
PI150	35	1,5	35	1,5	28	1,5
PI165	35	1,5	35	1,5	28	1,5

NOTE *Data valid for equivalent length up to 100 m and R410A 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, either **Vertiv™ MC (Microchannel 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 MC condenser(s)	
	Fixed speed circuit	Variable speed circuit
PI082	29,5	28,8
PI094	32,1	31,8
PI104	32,1	32,0
PI120	32,1	32,0
PI150	45,4	45,4
PI165	45,4	45,3

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	Fixed speed circuit - 50 Hz		Variable speed circuit - 50 Hz	
	Oil type	Initial oil charge [dm^3]	Oil type	Initial oil charge [dm^3]
PI082	POE - 160SZ Oil	6,0	DAPHNE Hermetic Oil FVC68D - 320H	1,6
PI094	POE - 160SZ Oil	6,0	DAPHNE Hermetic Oil FVC68D - 320H	1,6
PI104	POE - 160SZ Oil	6,0	POE - 160SZ Oil	3,3
PI120	POE - 160SZ Oil	6,6	POE - 160SZ Oil	3,6
PI150	POE - 160SZ Oil	6,6	POE - 160SZ Oil	3,6
PI165	POE - 160SZ Oil	7,2	POE - 160SZ Oil	6,7

Table 10 - Oil type and initial amount for units with 60Hz power supply

Unit model	Fixed speed circuit - 60 Hz		Variable speed circuit - 60 Hz	
	Oil type	Initial oil charge [dm^3]	Oil type	Initial oil charge [dm^3]
PI082	---	---	---	---
PI094	POE - 160SZ Oil	6,0	DAPHNE Hermetic Oil FVC68D - 320H	1,6
PI104	POE - 160SZ Oil	6,0	POE - 160SZ Oil	3,3
PI120	POE - 160SZ Oil	6,6	POE - 160SZ Oil	3,6
PI150	POE - 160SZ Oil	6,6	POE - 160SZ Oil	3,6
PI165	POE - 160SZ Oil	6,6	POE - 160SZ Oil	6,7

6.3 Air System

Table 11 - Air system - Fans number and weight

Unit model	High Power EC Fan Module		EC Fan Module	
	Fan Number	Weight [kg]	Fan Number	Weight [kg]
PI082	3	27,9		
PI094	3	27,9		
PI104	3	27,9		
PI120	3	27,9		

Unit model	High Power EC Fan Module		EC Fan Module	
	Fan Number	Weight [kg]	Fan Number	Weight [kg]
PI150	4	34,7	4	27,9
PI165	4	34,7	4	27,9

NOTE *Values given for each single fan. The model is the same both for 50 Hz and 60 Hz.*

6.4 Safety Devices Settings

Table 12 - Safety devices settings

Unit model	High pressure alarm management		Safety devices settings	
	Fixed speed circuit	Variable speed circuit	HP Switch	Safety Valve
PI082	Relay	STO	Open 42 ± 1 bar(g) Manual reset 33 ± 1,5 bar(g) Normally closed Durability 10 000 times	Setting 45 bar(g) Over pressure 10% Closing variation 15%
PI094	Relay	STO		
PI104	Relay	STO		
PI120	Relay	STO		
PI150	Relay	STO		
PI165	Relay	STO		

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.
Safety Valve	Is located on the condenser's liquid receiver

WARNING
Make sure that the safety valves are always free to discharge.
Do not cover the safety valves.

WARNING
The safety valves are installed in open position and the ball spindle is protected by means of a cap screwed to the body and sealed with lead.
Do not tamper or force the safety valves.
Only authorized technicians or officials of a Competent Body are allowed to perform interventions on the safety valves.
These persons are also responsible to substitute and for restoring the safety valve operating conditions.

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 ground heater (IEC 364): Ra 50/ Ia (Art.413.1.4.1, CEI 648 or IEC 60364445).
  - 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.

    Modbus Premium Efficiency Control condensers are designed to use Modbus communication between **Liebert® MC** and **Liebert® iCOM™** control on main unit.

    The Modbus wiring is field-supplied and must be:

    - shielded
    - 24-18 AWG (0.20-0.82 mm²) stranded tinned copper until 107m , 18-16 AWG (0.82-1.31 mm²) stranded tinned copper until 200m
    - 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 200 m, contact Vertiv™ for assistance.

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

Table 13 - 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]	Recommended circuit beaker (1)	Power factor cosφ	FLA TOT [A]	LRA [A]	Recommended circuit beaker (1)	Power factor cosφ		
PI082	81	160	100	≥ 0,9				≥ 0,9	5G25mm²	10.....70mm²
PI094	86	165	100	≥ 0,9				≥ 0,9	5G35mm²	10.....70mm²
PI104	97	171	125	≥ 0,9				≥ 0,9	5G35mm²	10.....70mm²
PI120	109	227	125	≥ 0,9				≥ 0,9	5G50mm²	10.....70mm²
PI150	136	263	160	≥ 0,9	129	256	160	≥ 0,9	5G95mm²	M8X25
PI165	146	307	160	≥ 0,9	139	300	160	≥ 0,9	5G95mm²	M8X25

(1) Recommended circuit beaker size breaker C curve, RCD Idn=0,3A type B or B++

(2) PVC CABLE 40°C see tab.6 EN60204-1 B1

Table 14 - Electrical data for cooling + heating or electrical data for cooling + heating + humidification

Unit model	High Power EC Fan Module			EC Fan Module			Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]	Power factor cosφ
	FLA TOT [A]	LRA [A]	Reccomended circuit beaker(1)	FLA TOT [A]	LRA [A]	Recommended circuit beaker (1)			
PI082	113	160	125				5G50mm²	10.....70mm²	≥ 0,9
PI094	118	165	125				5G50mm²	10.....70mm²	≥ 0,9
PI104	125	171	150				5G50mm²	10.....70mm²	≥ 0,9
PI120	141	227	160				5G70mm²	10.....70mm²	≥ 0,9
PI150	168	263	200	161	256	200	5G95mm²	M8X25	≥ 0,9
PI165	178	307	200	171	300	200	5G95mm²	M8X25	≥ 0,9

(1) Recommended circuit beaker size breaker C curve, RCD Idn=0,3A type B or B++ (A)

(2) PVC CABLE 40°C see tab.6 EN60204-1 B1

Table 15 - 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]	Power factor cosφ
	FLA TOT [A]	LRA [A]	Reccomended circuit beaker(1)	FLA TOT [A]	LRA [A]	Recommended circuit beaker(1)			
PI082	90	169	125				5G35mm²	10.....70mm²	≥ 0,9
PI094	95	174	125				5G50mm²	10.....70mm²	≥ 0,9
PI104	101	180	125				5G50mm²	10.....70mm²	≥ 0,9
PI120	118	236	150				5G70mm²	10.....70mm²	≥ 0,9
PI150	144	271	150	138	265	150	5G95mm²	M8X25	≥ 0,9
PI165	154	315	200	148	309	200	5G95mm²	M8X25	≥ 0,9

(1) Recommended circuit beaker size breaker C curve, RCD Idn=0,3A type B or B++ (A)

(2) PVC CABLE 40°C see tab.6 EN60204-1 B1

Units with power supply 460 V / 3ph / 60 Hz + Earth

Table 16 - Electrical data for cooling only - 460 V / 3ph / 60 Hz + Earth

Unit model	High Power EC Fan Module			EC Fan Module			Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]	Power factor cosφ
	FLA TOT [A]	LRA [A]	Reccomended circuit beaker(1)	FLA TOT [A]	LRA [A]	Recommended circuit beaker(1)			
PI082									
PI094	78	157	100				5G35mm²	10.....70mm²	≥ 0,9
PI104	87	163	125				5G35mm²	10.....70mm²	≥ 0,9
PI120	96	215	125				5G50mm²	10.....70mm²	≥ 0,9
PI150	118	237	125	112	231	125	5G95mm²	M8X25	≥ 0,9
PI165	124	251	150	118	245	150	5G95mm²	M8X25	≥ 0,9

(1) Recommended circuit beaker size breaker C curve, RCD Idn=0,3A type B or B++ (A)

(2) PVC CABLE 40°C see tab.6 EN60204-1 B1

Table 17 - Electrical data for cooling + heating or electrical data for cooling + heating + humidification - 460 V / 3ph / 60 Hz + Earth

Unit model	High Power EC Fan Module			EC Fan Module			Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]	Power factor cosφ
	FLA TOT [A]	LRA [A]	Reccomended circuit beaker(1)	FLA TOT [A]	LRA [A]	Recommended circuit beaker(1)			
PI082									
PI094	107	157	125				5G50mm²	10.....70mm²	≥ 0,9
PI104	112	163	125				5G50mm²	10.....70mm²	≥ 0,9
PI120	124	216	150				5G70mm²	10.....70mm²	≥ 0,9
PI150	147	237	150	141	231	150	5G95mm²	M8X25	≥ 0,9
PI165	153	251	200	147	245	200	5G95mm²	M8X25	≥ 0,9

(1) Recommended circuit beaker size breaker C curve, RCD Idn=0,3A type B or B++ (A)

(2) PVC CABLE 40°C see tab.6 EN60204-1 B1

Table 18 - Electrical data for cooling + humidification - 460 V / 3ph / 60 Hz + Earth

Unit model	High Power EC Fan Module			EC Fan Module			Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]	Power factor cosφ
	FLA TOT [A]	LRA [A]	Reccomended circuit beaker(1)	FLA TOT [A]	LRA [A]	Recommended circuit beaker(1)			
PI082									
PI094	86	165	125				5G50mm²	10.....70mm²	≥ 0,9
PI104	91	170	125				5G50mm²	10.....70mm²	≥ 0,9
PI120	103	223	125				5G70mm²	10.....70mm²	≥ 0,9
PI150	126	245	150	120	239	150	5G95mm²	M8X25	≥ 0,9
PI165	132	259	200	126	253	200	5G95mm²	M8X25	≥ 0,9

(1) Recommended circuit beaker size breaker C curve, RCD Idn=0,3A type B or B++ (A)

(2) PVC CABLE 40°C see tab.6 EN60204-1 B1

Units with power supply 380 V / 3ph + N / 60 Hz + Earth

Table 19 - Electrical data for cooling only - 380 V / 3ph + N / 60 Hz + Earth

Unit model	High Power EC Fan Module			EC Fan Module			Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]	Power factor cosφ
	FLA TOT [A]	LRA [A]	Reccomended circuit beaker(1)	FLA TOT [A]	LRA [A]	Recommended circuit beaker(1)			
PI082									
PI094	92	193	100				5G35mm²	10.....70mm²	≥ 0,9
PI104	102	200	125				5G35mm²	10.....70mm²	≥ 0,9
PI120	111	245	125				5G50mm²	10.....70mm²	≥ 0,9
PI150	136	271	150	130	265	150	5G95mm²	M8X25	≥ 0,9
PI165	144	284	200	138	278	200	5G95mm²	M8X25	≥ 0,9

(1) Recommended circuit beaker size breaker C curve, RCD Idn=0,3A type B or B++ (A)

(2) PVC CABLE 40°C see tab.6 EN60204-1 B1

Table 20 - Electrical data for cooling + heating or electrical data for cooling + heating + humidification - 380 V / 3ph + N / 60 Hz + Earth

Unit model	High Power EC Fan Module			EC Fan Module			Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]	Power factor cosφ
	FLA TOT [A]	LRA [A]	Reccomended circuit beaker(1)	FLA TOT [A]	LRA [A]	Recommended circuit beaker(1)			
PI082									
PI094	126	193	125				5G50mm²	10.....70mm²	≥ 0,9
PI104	133	200	150				5G50mm²	10.....70mm²	≥ 0,9
PI120	145	245	160				5G70mm²	10.....70mm²	≥ 0,9
PI150	170	271	200	164	265	200	5G95mm²	M8X25	≥ 0,9
PI165	178	284	200	172	278	200	5G95mm²	M8X25	≥ 0,9

(1) Recommended circuit breaker size breaker C curve, RCD Idn=0,3A type B or B++ (A)

(2) PVC CABLE 40°C see tab.6 EN60204-1 B1

Table 21 - Electrical data for cooling + humidification - 380 V / 3ph + N / 60 Hz + Earth

Unit model	High Power EC Fan Module			EC Fan Module			Recommended wires size [mm²] (2)	MIN/MAX Cu cable size [mm²]	Power factor cosφ
	FLA TOT [A]	LRA [A]	Reccomended circuit beaker(1)	FLA TOT [A]	LRA [A]	Recommended circuit beaker(1)			
PI082									
PI094	101	202	125				5G50mm²	10.....70mm²	≥ 0,9
PI104	108	209	125				5G50mm²	10.....70mm²	≥ 0,9
PI120	121	255	150				5G70mm²	10.....70mm²	≥ 0,9
PI150	145	280	150	139	274	150	5G95mm²	M8X25	≥ 0,9
PI165	153	293	200	147	287	200	5G95mm²	M8X25	≥ 0,9

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

6.5.2 Fans

Table 22 - Fans electrical data

Unit model	High Power EC Fan Module			EC Fan Module		
	"Motor Size [kW]"	"FLA@50Hz [A]"	"FLA@60Hz [A]"	"Motor Size [kW]"	"FLA@50Hz [A]"	"FLA@60Hz [A]"
PI082	3,5	5,6	4,4			
PI094	3,5	5,6	4,4			
PI104	3,5	5,6	4,4			
PI120	3,5	5,6	4,4			
PI150	4,6	7,4	6,0	3,5	5,6	4,4
PI165	4,6	7,4	6,0	3,5	5,6	4,4

NOTE *Values given for each single fan. The model is the same both for 50 Hz and 60 Hz.*

6.5.3 Compressors

Table 23 - Compressors electrical data for 400 V / 3ph / 50 Hz power supply

Unit model	Operating Ampere [A]		FLA [A]		LRA [A]		Nominal Power [kW]		Winding Resistance [Ω]	
	Fixed speed	Variable speed	Fixed speed	Variable speed	Fixed speed	Variable speed	Fixed speed	Variable speed	Fixed speed	Variable speed
PI082			19+19	26,0	98+98	[-]		11,0	1,47+1,47	0,177
PI094			19+19	31,2	98+98	[-]		15,0	1,47+1,47	0,177
PI104			19+19	37,5	98+98	[-]		15,0	1,47+1,47	0,100
PI120			24+24	40,0	142+142	[-]		18,5	1,05+1,05	0,080
PI150			37+37	44,0	158+158	[-]		18,5	0,83+0,83	0,080
PI165			41+41	44,0	197+197	[-]		18,5	0,83+0,83	0,050

Table 24 - Compressors electrical data -for 380 V / 3 ph / 60 Hz power supply

Unit model	Operating Ampere [A]		FLA [A]		LRA [A]		Nominal Power [kW]		Winding Resistance [Ω]	
	Fixed speed	Variable speed	Fixed speed	Variable speed	Fixed speed	Variable speed	Fixed speed	Variable speed	Fixed speed	Variable speed
PI082	---	---	---	---	---	---	---	---	---	---
PI094			23+23	32,8	124+124	[-]		15,0	1,05+1,05	0,177
PI104			23+23	39,4	124+124	[-]		15,0	1,05+1,05	0,100
PI120			26+26	46,2	160+160	[-]		18,5	0,72+0,72	0,080
PI150			33+33	46,2	168+168	[-]		18,5	0,62+0,62	0,080
PI165			37+37	46,2	177+177	[-]		18,5	0,57+0,57	0,050

Table 25 - Compressors electrical data -for 460 V / 3 ph / 60 Hz power supply

Unit model	Operating Ampere [A]		FLA [A]		LRA [A]		Nominal Power [kW]		Winding Resistance [Ω]	
	Fixed speed	Variable speed	Fixed speed	Variable speed	Fixed speed	Variable speed	Fixed speed	Variable speed	Fixed speed	Variable speed
PI082						0,1				
PI094			19+19	27,1	98+98	0,1		15,0	1,47+1,47	0,177
PI104			19+19	32,6	98+98	0,1		15,0	1,47+1,47	0,100
PI120			22+22	38,3	142+142	0,1		18,5	1,05+1,05	0,080
PI150			28+28	38,3	147+147	0,1		18,5	0,83+0,83	0,080
PI165			31+31	38,3	158+158	0,1		18,5	0,83+0,83	0,050

6.5.4 Electrical heaters

Table 26 - Electrical heaters data

Unit model	400 V / 3ph / 50 Hz				460 V / 3ph / 60 Hz				380 V / 3ph / 60 Hz			
	Standard Capacity [A]		High Capacity [A]		Standard Capacity [A]		High Capacity [A]		Standard Capacity [A]		High Capacity [A]	
	FLA [A]	Nominal Power [kW]	FLA [A]	Nominal Power [kW]	FLA [A]	Nominal Power [kW]	FLA [A]	Nominal Power [kW]	FLA [A]	Nominal Power [kW]	FLA [A]	Nominal Power [kW]
PI082	10,8	7,5	21.6** 32.4***	15.0** 22.5***	---	---	---	---	---	---	---	---
PI094	10,8	7,5	21.6** 32.4***	15.0** 22.5***	9,4	7,5	18.8** 28.2***	15.0** 22.5***	11,3	7,5	22.6** 33.9***	15.0** 22.5***
PI104	10,8	7,5	21.6** 32.4***	15.0** 22.5***	9,4	7,5	18.8** 28.2***	15.0** 22.5***	11,3	7,5	22.6** 33.9***	15.0** 22.5***
PI120	10,8	7,5	32,4	22,5	9,4	7,5	28,2	22,5	11,3	7,5	33,9	22,5
PI150	10,8	7,5	32,4	22,5	9,4	7,5	28,2	22,5	11,3	7,5	33,9	22,5
PI165	10,8	7,5	32,4	22,5	9,4	7,5	28,2	22,5	11,3	7,5	33,9	22,5

NOTE
* Not available with EC Fan Module;
** With EC Fan Module;
*** With High Power EC Fan Module;

6.5.5 Electrode humidifier

Table 27 - Electrode humidifier electrical data

Unit model	400 V / 3ph / 50 Hz		460 V / 3ph / 60 Hz		380 V / 3ph / 60 Hz	
	FLA [A]	Nominal Power [kW]	FLA [A]	Nominal Power [kW]	FLA [A]	Nominal Power [kW]
PI082	8,7	6,0	---	---	---	---
PI094	8,7	6,0	7,5	6,0	9,1	6,0
PI104	8,7	6,0	7,5	6,0	9,1	6,0
PI120	8,7	6,0	7,5	6,0	9,1	6,0
PI150	8,7	6,0	7,5	6,0	9,1	6,0
PI165	8,7	6,0	7,5	6,0	9,1	6,0

6.5.6 Infrared humidifier

Table 28 - Infrared humidifier electrical data

Unit model	400 V / 3ph / 50 Hz		460 V / 3ph / 60 Hz		380 V / 3ph / 60 Hz	
	FLA [A]	Nominal Power [kW]	FLA [A]	Nominal Power [kW]	FLA [A]	Nominal Power [kW]
PI082	13,9	9,6	---	---	---	---
PI094	13,9	9,6	12,0	9,6	14,3	9,6
PI104	13,9	9,6	12,0	9,6	14,3	9,6
PI120	13,9	9,6	12,0	9,6	14,3	9,6
PI150	13,9	9,6	12,0	9,6	14,3	9,6
PI165	13,9	9,6	12,0	9,6	14,3	9,6

6.5.7 Condensate pump

Table 29 - 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 3m above the floor.

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

Maximum discharge total head allowed 3m (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, max airflow”

Table 30 - Sound Power Level [dB] - Downflow up configuration, Inverter scroll cooling system @100% cooling capacity, max airflow

Unit model	Model	Level	Octave band frequency (Hz)									Sound level [dB(A)]
	Mode		31,5	63	125	250	500	1000	2000	4000	8000	
PI082	(1)	SPL	56,2	59,2	70,2	67,2	69,2	68,2	67,2	65,2	57,2	73,6
	(2)	SPL	56,2	59,2	70,2	67,2	69,3	69,6	67,9	67,9	58,6	74,9
	(3)	PWL	92,2	92,2	83,8	82,3	84,6	86,4	82,3	80,5	75,7	90
PI094	(1)	SPL	56,2	59,2	70,2	67,2	69,2	68,2	67,2	65,2	57,2	73,6
	(2)	SPL	56,2	59,2	70,2	67,2	69,5	70,3	67,9	67,3	59	75
	(3)	PWL	92,2	92,2	83,8	82,3	84,8	87,1	82,3	79,9	76,1	90,3
PI104	(1)	SPL	55	58,0	69,0	66,0	68,0	67,0	66	64	56	72,4
	(2)	SPL	55	58,0	69,0	66,0	68,2	67,8	67,3	66,2	56,7	73,5
	(3)	PWL	91	91,0	82,6	81,1	83,5	84,6	81,7	78,8	73,8	88,6
PI120	(1)	SPL	56,2	59,2	70,2	67,2	69,2	68,2	67,2	65,2	57,2	73,6
	(2)	SPL	57,4	59,2	70,2	67,2	69,3	68,9	68	66,2	57,7	74,3
	(3)	PWL	93,4	92,2	83,8	82,3	84,6	85,7	82,4	78,8	74,8	89,5
PI150	(1)	SPL	66,5	66,5	72,1	70,2	70,6	68,8	68	66	58,8	74,6
	(2)	SPL	66,5	66,5	72,1	70,2	70,8	69,2	68,4	66,6	59	75
	(3)	PWL	66,1	86,6	92,2	90,2	90,9	89,2	88,4	86,6	79	95
PI165	(1)	SPL	67,2	67,2	72,8	70,9	71,3	69,5	68,7	66,7	59,5	75,3
	(2)	SPL	67,2	67,2	72,8	70,9	71,4	69,8	69,2	67,5	59,7	75,7
	(3)	PWL	66,8	87,3	92,9	90,9	91,5	89,8	89,2	87,5	79,7	95,7

Table 31 - Sound Power Level [dB] - Downflow Down configuration, Inverter scroll cooling system @100% cooling capacity, max airflow

Unit model	Model	Level	Octave band frequency (Hz)									Sound level [dB(A)]
	Mode		31,5	63	125	250	500	1000	2000	4000	8000	
PI082	(1)	SPL	54,8	57,8	68,8	65,8	67,8	66,8	65,8	63,8	55,8	72,2
	(2)	SPL	54,8	57,8	68,8	65,8	67,9	68,2	66,5	66,5	57,2	73,5
	(3)	PWL	90,8	90,8	82,4	80,9	83,2	85,0	80,9	79,1	74,3	88,6
PI094	(1)	SPL	54,8	57,8	68,8	65,8	67,8	66,8	65,8	63,8	55,8	72,2
	(2)	SPL	54,8	57,8	68,8	65,8	68,1	68,9	66,5	65,9	57,6	73,6
	(3)	PWL	90,8	90,8	82,4	80,9	83,4	85,7	80,9	78,5	74,7	88,9
PI104	(1)	SPL	53,6	56,6	67,6	64,6	66,6	65,6	64,6	62,6	54,6	71
	(2)	SPL	53,6	56,6	67,6	64,6	66,8	66,4	65,9	64,8	55,3	72,1
	(3)	PWL	89,6	89,6	81,2	79,7	82,1	83,2	80,3	77,4	72,4	87,2
PI120	(1)	SPL	54,8	57,8	68,8	65,8	67,8	66,8	65,8	63,8	55,8	72,2
	(2)	SPL	56	57,8	68,8	65,8	67,9	67,5	66,6	64,8	56,3	72,9
	(3)	PWL	92	90,8	82,4	80,9	83,2	84,3	81	77,4	73,4	88,1
PI150	(1)	SPL	65	65	70,6	68,7	69,1	67,3	66,5	64,5	57,3	73,1
	(2)	SPL	65	65	70,6	68,7	69,2	67,6	67	65,3	57,5	73,5
	(3)	PWL	64,6	85,1	90,7	88,7	89,3	87,6	87	85,3	77,5	93,5
PI165	(1)	SPL	65,7	65,7	71,3	69,4	69,8	68	67,2	65,2	58	73,8
	(2)	SPL	65,7	65,7	71,3	69,4	69,9	68,3	67,7	66	58,2	74,2
	(3)	PWL	65,3	85,8	91,4	89,4	90	88,3	87,7	86	78,2	94,2

LEGEND

The sound levels global and for each octave band are expressed in dB with a tolerance of (0/+2) dB.
(1) Only ventilation (30 Pa available external static pressure), 2m in front of the unit and 1,5 m height, in free field conditions.
(2) Working compressor (30 Pa available external static pressure), 2m in front of the unit and 1,5 m height, in free field conditions.
(3) Working compressor, on discharge side.

7. Handling

Content of this chapter

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.

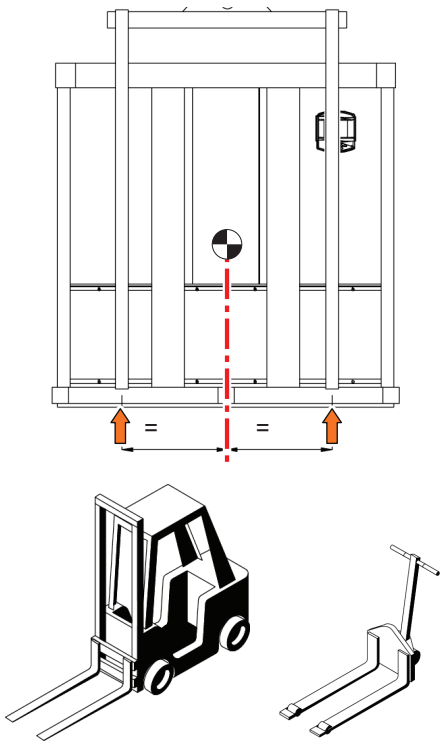
7.2 Inspection

- 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

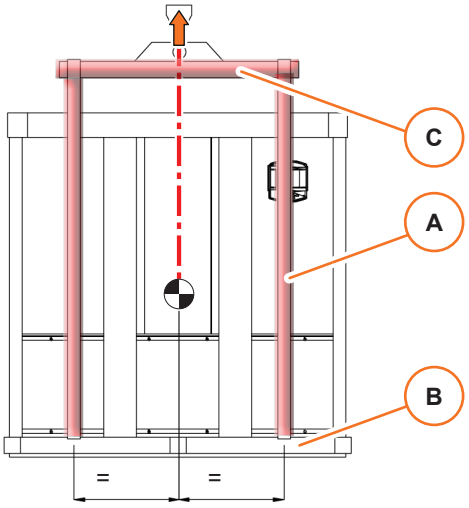


- Make sure that the fork length and distance is suitable for the unit length and to ensure the unit stability.
- Spread the forks to the widest allowable distance to still fit under the skid.
- Lift the unit from the side that is indicated in the instructions on the package.
- Make reference to the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

WARNING

Pay attention to overhead obstacles, for example doorways.

7.3.2 Using a crane



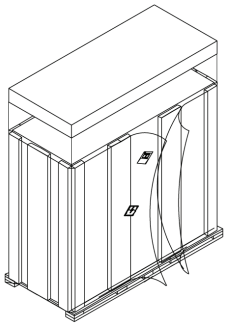
- Place the slings [**A**] between the unit bottom rails and the skid [**B**], at the widest allowable distance.
- Be sure that the distance between slings guaranties the unit stability.
- Fix the slings to the spreader bar [**C**]

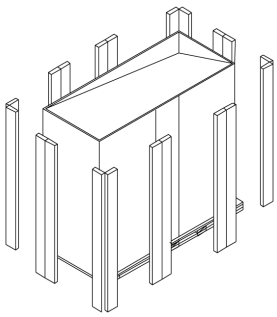
NOTICE

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

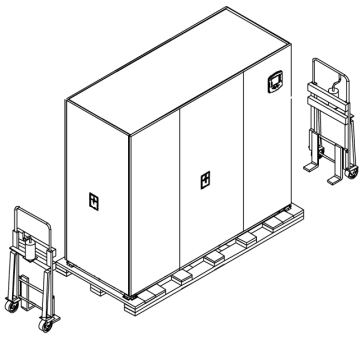
All material used to package this unit is recyclable.

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

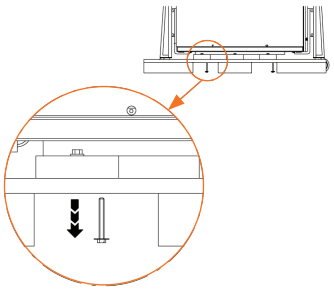
7.5 Transport without Package

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

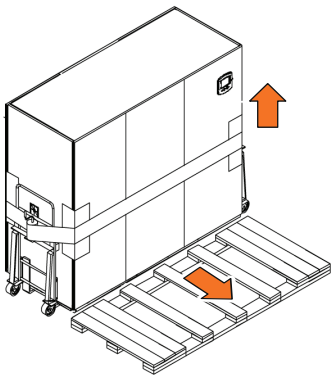
7.5.1 Using piano jacks



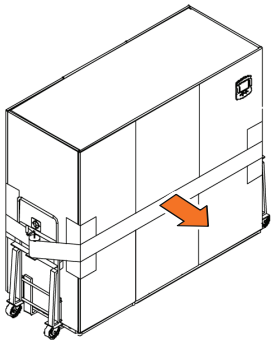
- Make sure that the floor can support the unit when you move it by piano jacks. If necessary, cover the floor by metal plates or other support that can distribute the weight on the floor.
- Place the piano jacks at the two sides of the unit.



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

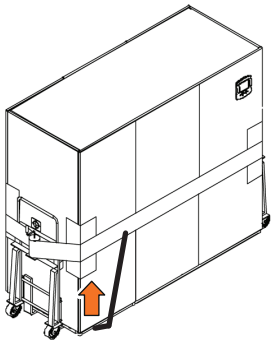


- Slide the forks of the piano jacks between the unit and the pallet.
- Place a protective material between the unit and the piano jacks.
- Fix the piano jacks to the unit by straps, placing a protective material between the unit and the straps.
- Lift slightly the forks of the piano jacks and remove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



- Move the unit to its installation site.

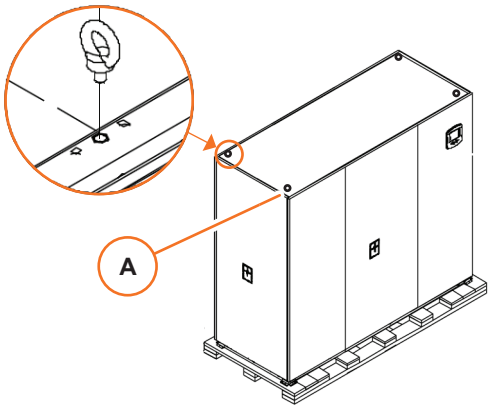
CAUTION
At least two persons are needed.



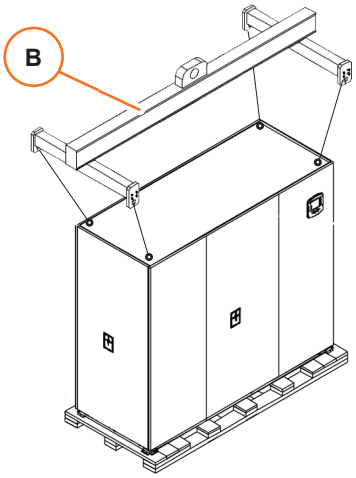
Remove the piano jacks

- 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.

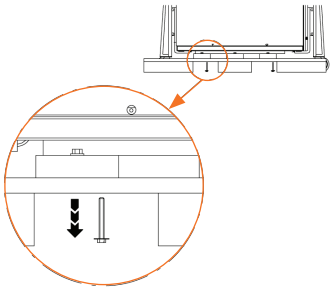
7.5.2 Using a crane



- 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 in each of the eyebolts.
- Fix the slings or chains 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

8.1 Safety Instructions

WARNING

Improper operations can cause injury or death.

NOTICE

Improper operations can cause product damage.

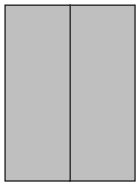
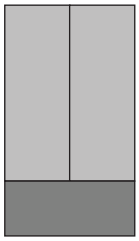
Read carefully the chapter *1. Safety*.

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

8.2 Overview

8.2.1 Assembly

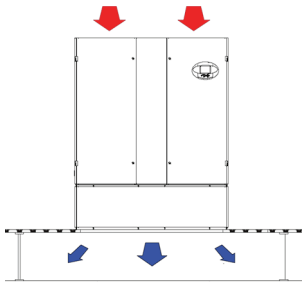
- Move the unit or the modules close too the final position as explained in *7. Handling*.
- If necessary, assemble the modules as explained below.

Standard height	Extended height Downflow
	
The unit is already assembled.	Assemble the coil module on top of the fan module See *8.4 Assembling an Extended Downflow Unit*

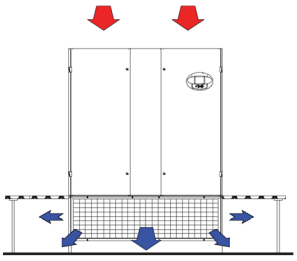
NOTE *For all the above versions, if you need to assemble any accessory* see *Annex F - Accessories*.

8.2.2 Positioning

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



Place the unit on top of a raised floor with an opening below the unit



Place the unit under a raised floor

See *Annex D - Dimensions and Weights* for the dimensions of openings.

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 Downflow Down units must be placed at the right height with respect to the floor level.

Provide the right support under the unit.

See *Annex F - Accessories* for the available support systems.

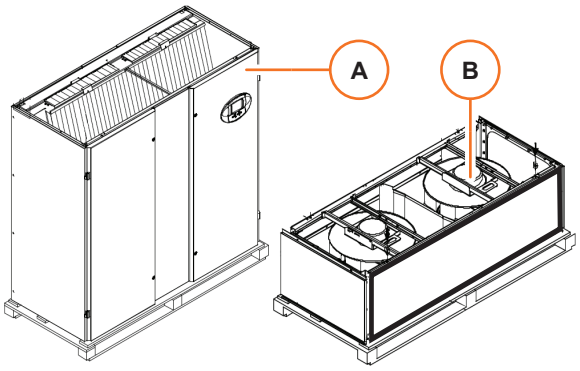
NOTICE

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

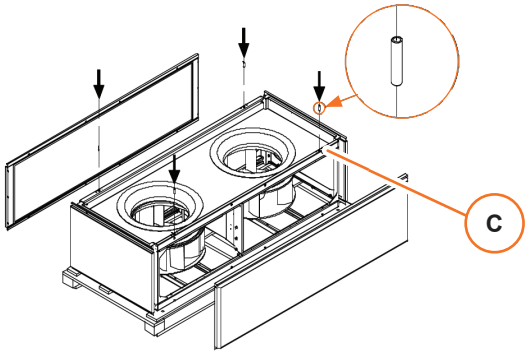
When you finish assembly and positioning of the unit, make sure that all the transport brackets and supports have been removed.

8.3 Assembling an Extended Downflow Unit

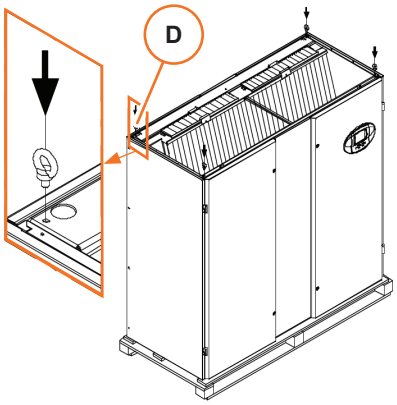
8.3.1 Prepare



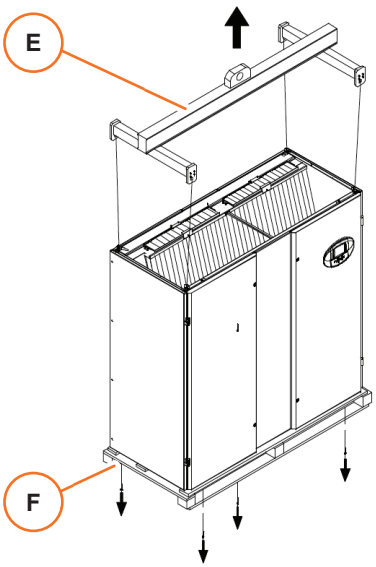
- Place the coil module [**A**] and the fan module [**B**] close to the final position.



- Remove the front and back panels from the fan module.
- Insert four M8 dowels [**C**] in the upper frame of the fan module.

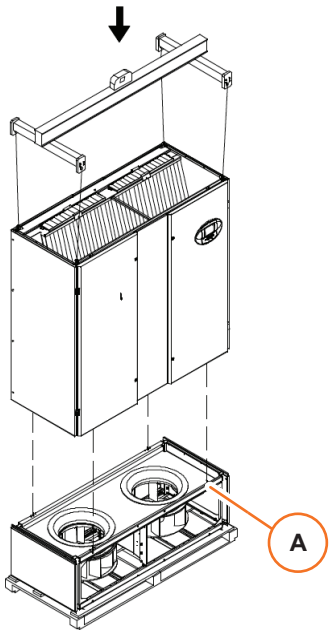


- Get four eyebolts M8 that are suitable to hold the full weight of the unit (they are not supplied with the unit).
- Insert the eyebolts in each of the holes [**D**].

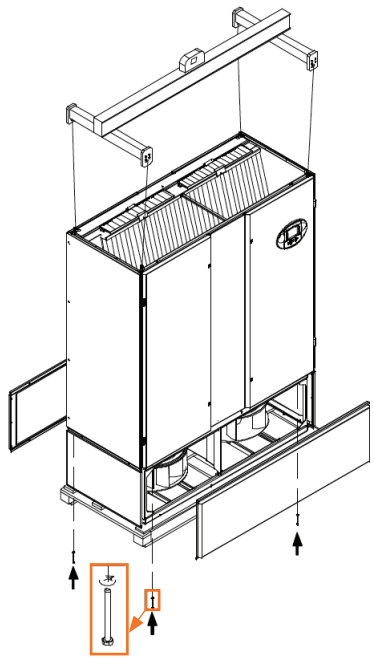


- Insert a sling or a chain in each of the eyebolts.
- Fix the slings or chains to a 4-points lifting bar [**E**].
- Remove the four bolts [**F**] (two at each side) that fix the coil module to the skid.

8.3.2 Fix the modules together

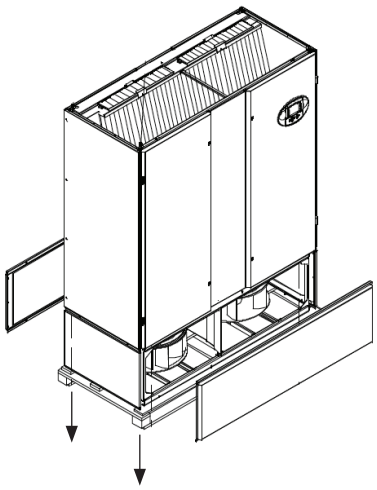


- Lift the coil module by a crane and place it on top of the fan module.
- Use the four dowels [**A**] for centering the fan module with the coil module.



- Fix the two modules by the four hex head screws supplied with the unit.

8.3.3 Arrange the cables and close the fan module



- Take from the coil module the power cable and the Modbus cable that are ready for the connection with the correspondent cables of the fan module.
- Insert the cables through the bushing into the fan module.
- Connect the power cable of the coil module with the power cable of the fan module.
- Connect the Modbus cable of the coil module with the Modbus cable of the fan module.
- If installed, connect all the electrical heaters cables to the electrical connectors inside the electrical panel lower duct:
  - Standard Capacity: connect the electrical heaters cables to the connector Xp5.
  - High Capacity (PI092): connect the electrical heaters cables to the connectors Xp5 and Xp6.
  - Electrical Heater thermostats
  - Temperature sensor
- Place the cover provided with the unit to protect the connections. Fix the cover to the frame by screws.

See *9.5 Electrical connections* for details.

- Remove the four bolts that fix the fan module to the skid.
- Mount the front and back panels on the fan module.

The unit is ready for positioning.

9. Installation

Content of this chapter

9.1 Safety Instructions

WARNING

Improper operations can cause injury or death.

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:

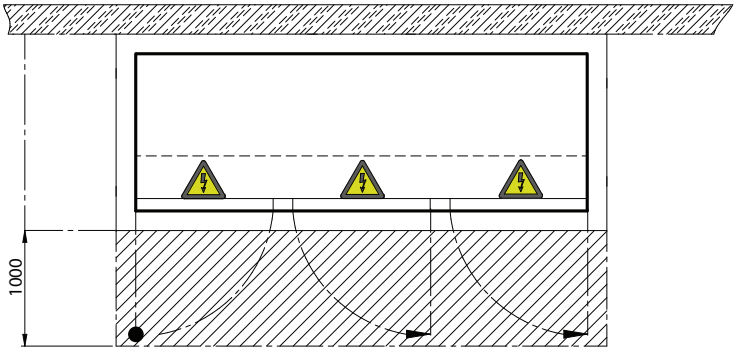
Operation	See ...
1. For extended height versions, assemble the fan module and the coil module	*8. Assembly and Positioning*
2. Assemble any optional accessory	*Annex F - Accessories*
3. Position the unit at the final location and fix it on the floor or the supporting structure	*8. Assembly and Positioning*
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 outlet of the condensate drain tank to an external piping	- *9.4.6 Connecting the condensate drain tray to an external piping*
7. Connect the water supply and the water drain piping of the humidifier	- *Annex G - Electrode Humidifier*, *Annex H - Infrared Humidifier* , *Annex I - Ultrasonic Humidifier*
8. Connect the electric power supply	*9.5 Electrical connections* - *9.5.1 Power supply cable*
9. 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*
10. Check or adjust the Modbus settings	*9.6 Modbus Connections and Settings*
11. Charge the refrigerating circuit	*9.7 Refrigerant Charge* - *9.7.2 Estimate the weight of refrigerant to charge* - *9.7.4 Create the vacuum* - *9.7.3 Estimate the weight of oil to charge* - *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*
12. Check the whole system	*9.8 Final Checks*
13. 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 D - Dimensions and Weights* for the unit dimensions
- Keep a free space between the unit and any obstacle as shown in the figure.

WARNING

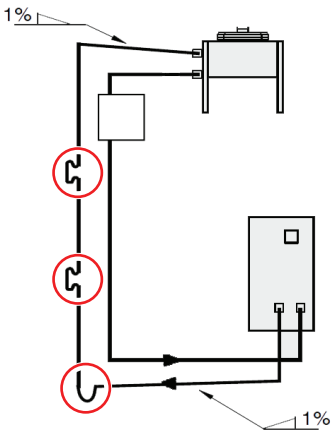
Leave a free space of at least 1000 mm on the front to allow safe installation and maintenance operations.

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 R410A 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 32 - 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.

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

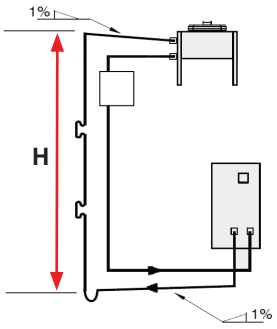


Piping layout	• Keep the piping as short as possible. This helps to minimize the total charge of refrigerant and the pressure drops. • Avoid bends as much as possible. Make bends with large radius (bending radius at least equal to the pipe diameter). • For hard copper piping use preformed curves. You 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 mm.
Condenser matching	• See *6.2.4 Remote condensers models* for the list of condensers that can be matched with the **PDX** unit. • Select the right condenser depending on the installation configuration as explained in the following *Table 32 - Installation conditions*.

NOTICE

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

Table 32 - 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	Liquid line thermal insulation	Gas line thermal insulation
L < 60 m	0 m < H < 18 m	Standard	Mandatory	Mandatory
L < 100 m	0 m < H < 18 m	20% oversized	Mandatory	Mandatory

NOTICE

- 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% See the figure below for variability evaluation.

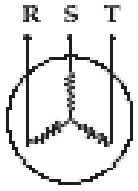
Example of calculating phase to phase variability

1) The 400 V supply has the following variability:

RS = 388 V

ST = 401 V

RT = 402 V



2) The average voltage is:

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

3) The maximum deviation from the average is:

402 - 397 = 5 V

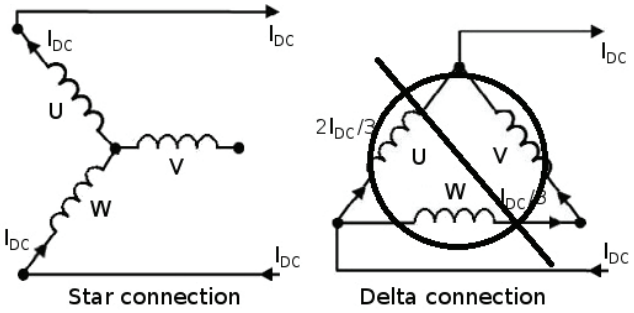
4) The phase to phase variability is:

$$\frac{5}{397 \times 100} = 1.26 \text{ (acceptable)}$$

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
- 460 V Wye with solidly grounded neutral (266 V line to ground)
- 380 V Wye with solidly grounded neutral (220 V line to ground)

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

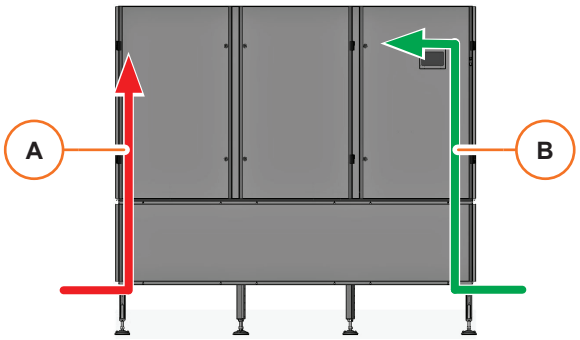
- Use copper wiring only.

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 (maximum10 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

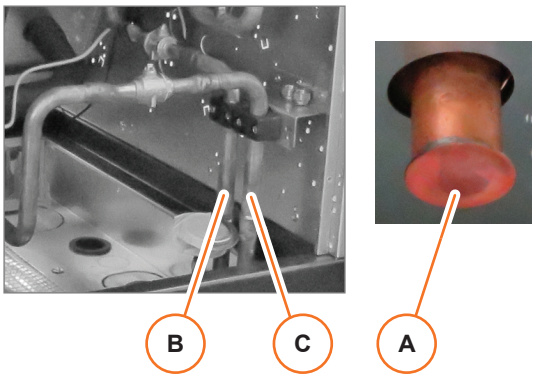
The following operations must be done one immediately after the other.

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

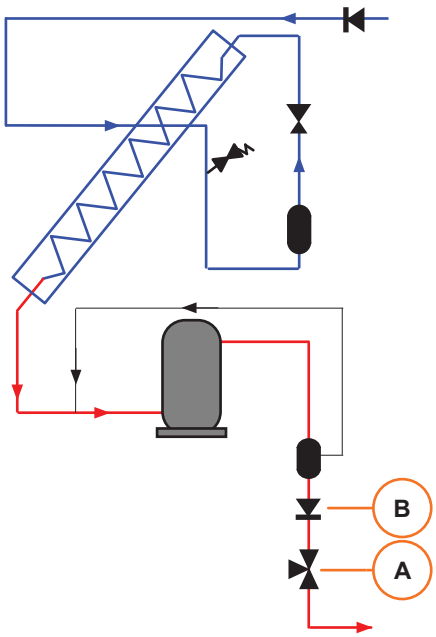


- Remove the end caps [**A**] from the inlet piping [**B**] and the outlet piping [**C**].

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 safety valves to outdoors

WARNING

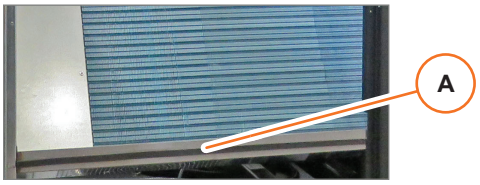
If the safety valves open, they release refrigerant.

To avoid risk of refrigerant inhalation, you must convey outside the safety valves discharge.

Convey the discharge

- Leave free the valve body.
- Convey the piping outlet to areas where the refrigerant cannot harm people.

9.4.6 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

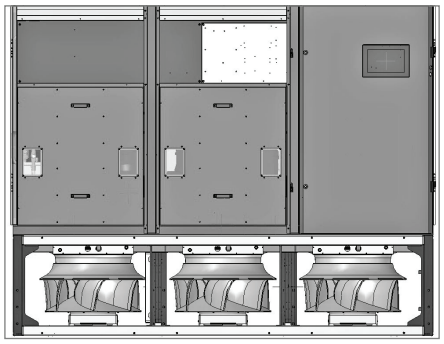
General instructions

- 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 E - Connections*.

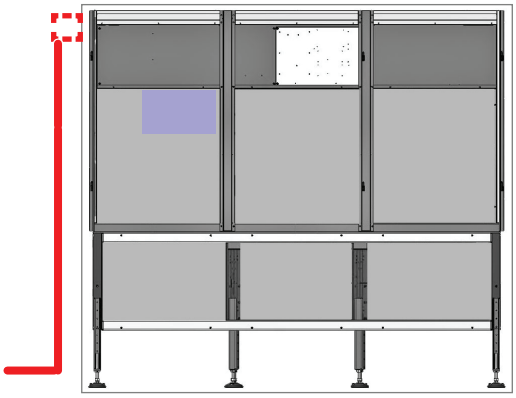
NOTICE

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

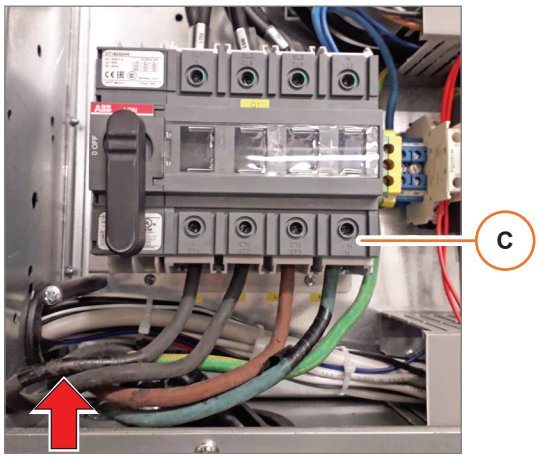
Standard power supply or dual power supply parallel



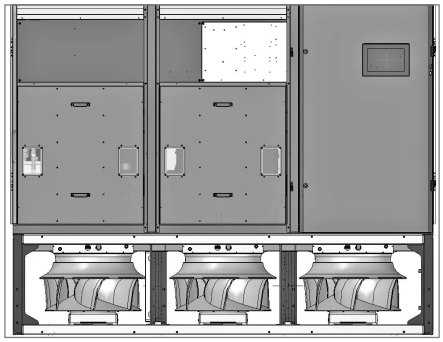
- Open the front door to get access to the electrical panel and to the internal safety panels.
- Remove the electrical panel cover by unscrewing the screws that hold it.
- Remove the internal safety panels by unscrewing the screws that hold each panel.
- Remove the frontal panels or frontal grids from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



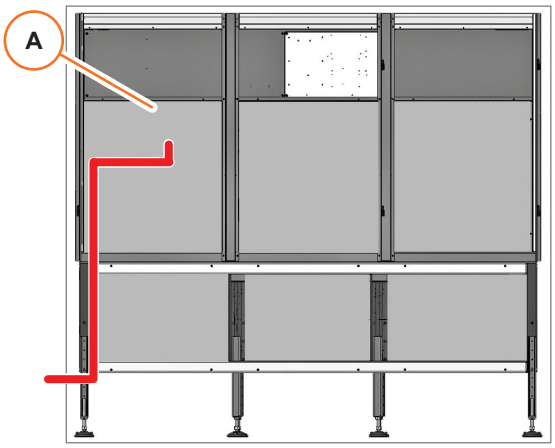
- Connect the power cable to the inlet terminals [**C**].



- 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

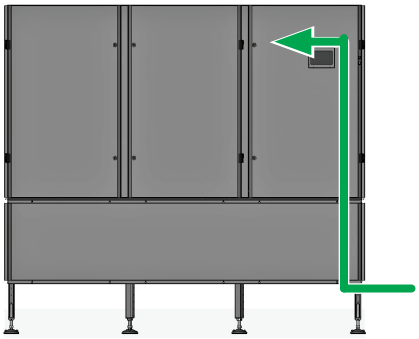
Make sure not to damage the electrical cable between the panels and the unit.

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.

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 E - 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 compressors	3 compressors
remote on - off (CLOSE = ON)	394 – 395	394 – 395	394 – 395
clogged filter (CF) (CLOSE = OK)	GND – ID6	394 – 364	394 – 364
GENERAL ALARM (*) NO or NC contact selectable		400 – 401	400 – 401
WARNING AND ALARM	C8* – NO8* – NO9*	300 – 301	300 – 301
smokestat firestat (AAP) (CLOSE = ON)	86 – 83	86 – 83	86 – 83
operating compressor 1 (CLOSE = ON)		76 – 77	76 – 77
operating compressor 2 (CLOSE = ON)		78 – 79	78 – 79
operating compressor 3 (CLOSE = ON)			500 – 501
user alarm 1 (CLOSE = OK)	GND – 30	86 – 030	86 – 030
user alarm 2 (CLOSE = OK)	GND – 31	86 – ID2	86 – ID2
freecooling relay enabling, F/D/H only or AIR ECONOMIZER ON	O – FO	3610 – 369	3610 – 369

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

**The C8-NO8 (warning) and C9-NO9 (alarm) terminals are on the control board.*

The fans alarms are managed through Modbus.

The compressor inverter alarms are managed through Modbus.

The ID contacts are on the control board

TERMINALS AVAILABLE for AIR ECONOM. SENSOR and CONDENS.

1 COMP.		2 E 3 COMP.	
RSA2	RSB2	RSA2	RSB2
RSA3	RSB3	RSA3	RSB3
RSA4	RSB4	RSA31	RSB31
RSA5	RSB5	RSA4	RSB4
RSA6	RSB6	RSA5	RSB5
		RSA6	RSB6

Remove the link if the AIR ECONOM. 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 107m, please contact Vertiv™ Technical Support.

Modbus cable specifications:

The Modbus wiring is field-supplied and must be:

- shielded
- 24-18 AWG (0.20-0.82 mm²) stranded tinned copper until 107m, 18-16 AWG (0.82-1.31 mm²) stranded tinned copper until 200m
- 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.

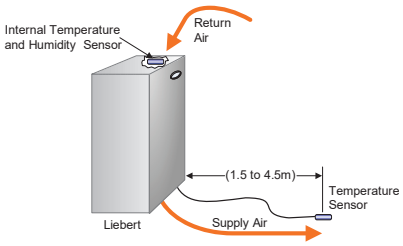
CAUTIONS: Do not run the Modbus cable in the same conduit, raceway or chase used for high-voltage wiring. Mandatory shield connection to ground close Master (indoor unit control board). For Modbus network lengths greater than 200m, contact Vertiv™ for assistance.

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.*



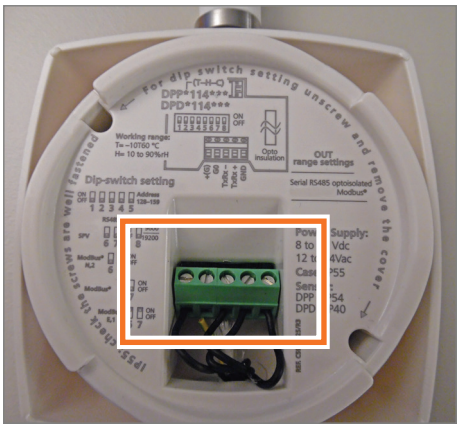
9.5.5 Sensors connections

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

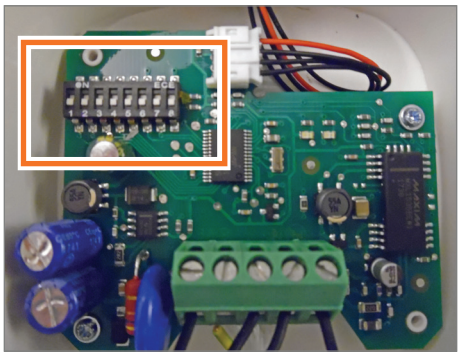
9.6.1 Connection of a device to the Modbus cable



- Use a Modbus (RS485) cable, which is made of four shielded cables inside the sheath.
- Connect a positive and a negative wire to the inlet terminal.
- Connect a positive and a negative wire to the outlet terminal.

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 *Table 35 - Modbus options and addresses* provide the details and the addresses for the settings.

Dual circuit units

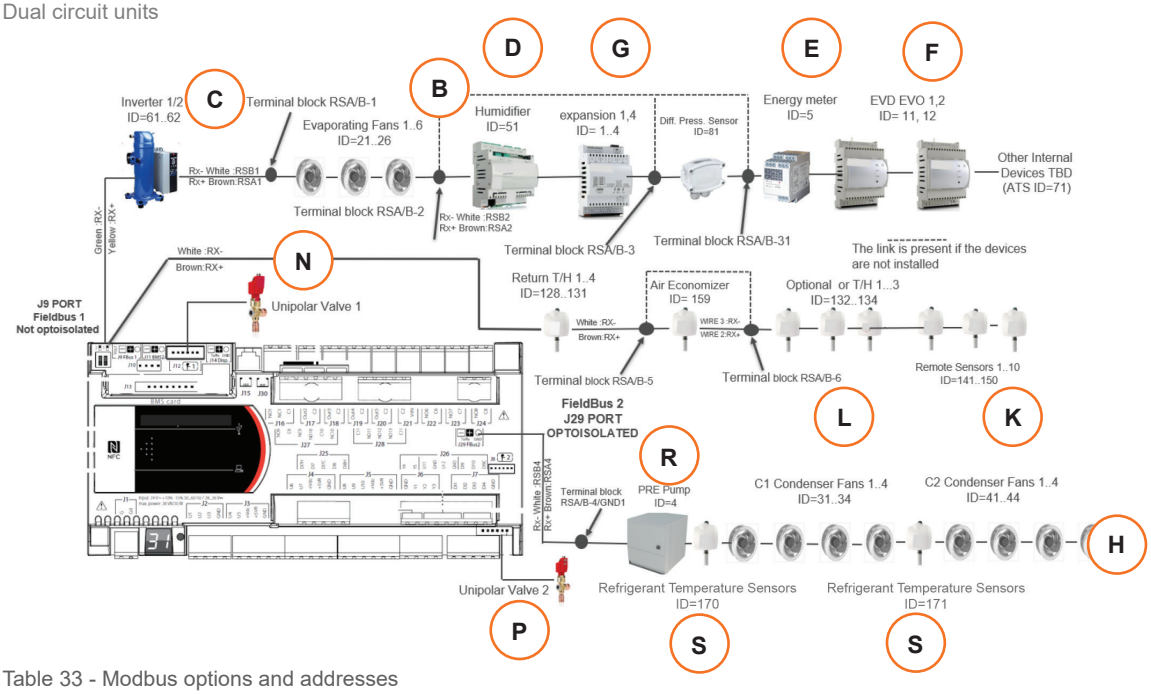


Table 33 - Modbus options and addresses

Ref.	Device	Number	Modbus address
A	Return sensor T+H	Up to 4	Return: 128..131
B	Evaporating fans	Up to 6	21...26

Ref.	Device	Number	Modbus address
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
R	PRE Pump	Up to 2	4
S	Refrigerant Temperature Sensor	Up to 2	170...171

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

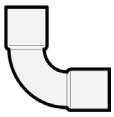
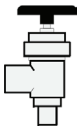
While operating on the refrigerating circuit recover all the refrigerant in a container: do not allow it to escape.

9.7.1 Calculate the equivalent length of the piping

Add up the following items:

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

Table 34 - 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	3,3

9.7.2 Estimate the weight of refrigerant to charge

- See *Table 10 - 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 35 - Weight of refrigerant for meter of pipe

Pipe external diameter (mm)	**Gas** (1)	**Liquid** (2)		
		35,0 °C	**46,0 °C**	**57,0 °C**
10 x 1.0	0,0048	0,0507	0,047	0,0426
12 x 1.0	0,0075	0,0793	0,0734	0,0665
14 x 1.0	0,0108	0,1142	0,1056	0,0958
16 x 1.0	0,0147	0,1554	0,1438	0,1304
18 x 1.0	0,0192	0,203	0,1878	0,1703
22 x 1.5	0,0271	0,2862	0,2648	0,2402
28 x 1.5	0,0469	0,4956	0,4585	0,4158
35 x 1.5	0,076	0,812	0,751	0,681

(1) Due to the small weight influence (at 25,5 bar - discharge temperature 65°C), only 0,062 kg/l for R410A is considered.

(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.

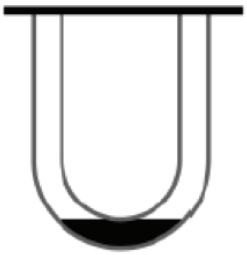
► If the piping length is less than 10 m, with good oil return, then no additional oil is required: skip this step and go to *9.7.5*

► 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 36 - 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

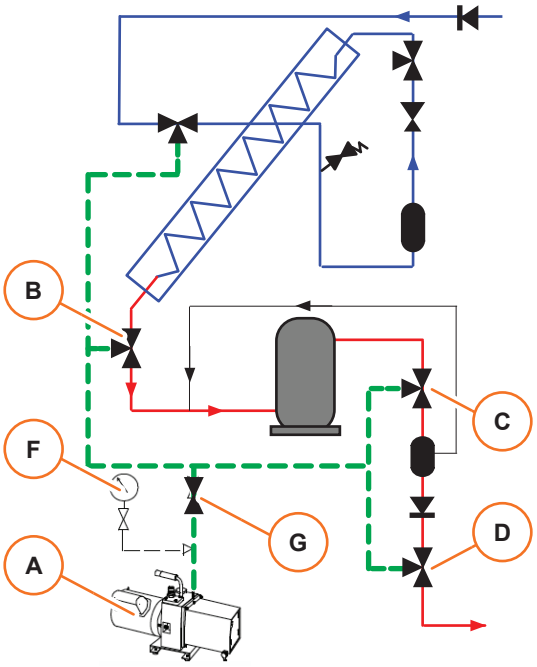
Never use the compressor for the system vacuum (this invalidates the warranty).

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
- Open all the shut-OFF valves of the system (main unit and remote condenser) including those used for pressurizing.

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

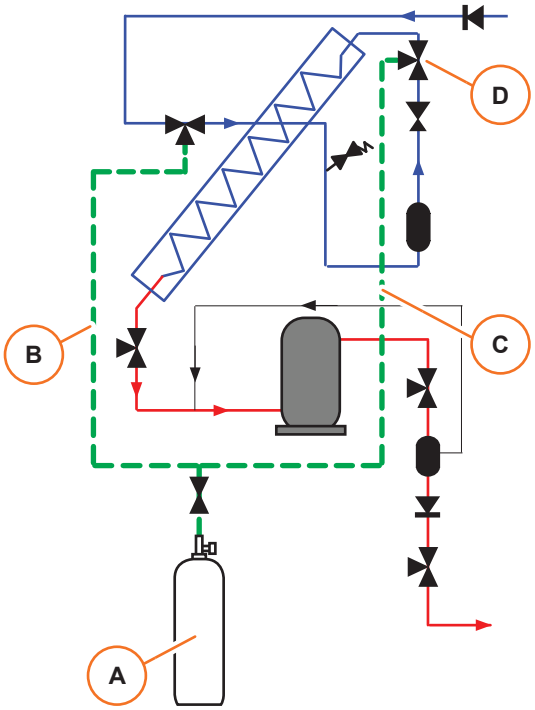
- If you spill any oil, then wipe it off immediately since the oil on hot surfaces may catch fire.

9.7.6 Pre-charge the refrigerant

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
- 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

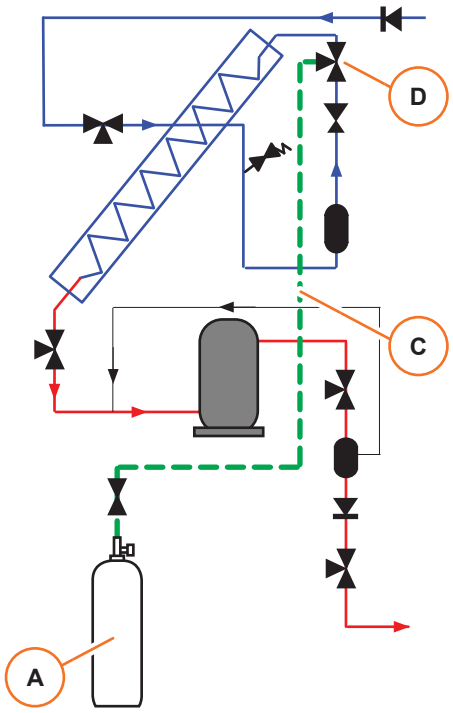
Unit status

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.

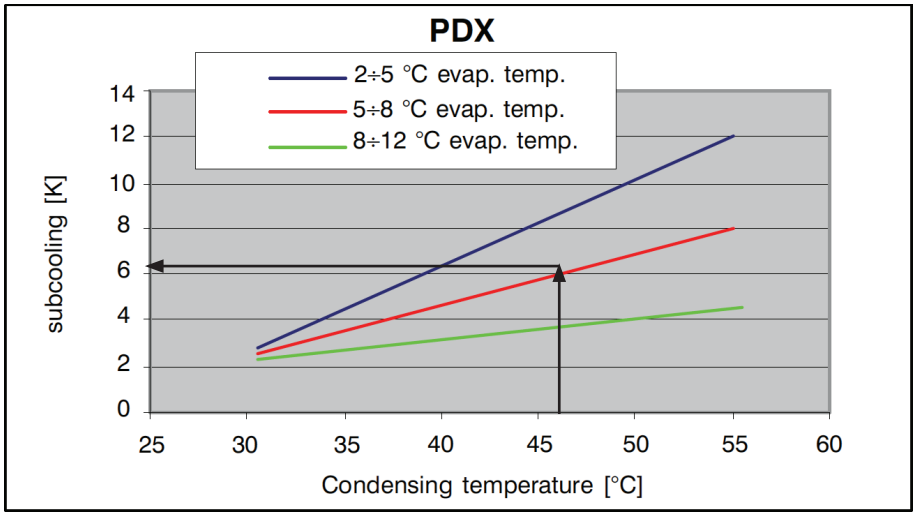
NOTICE

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:

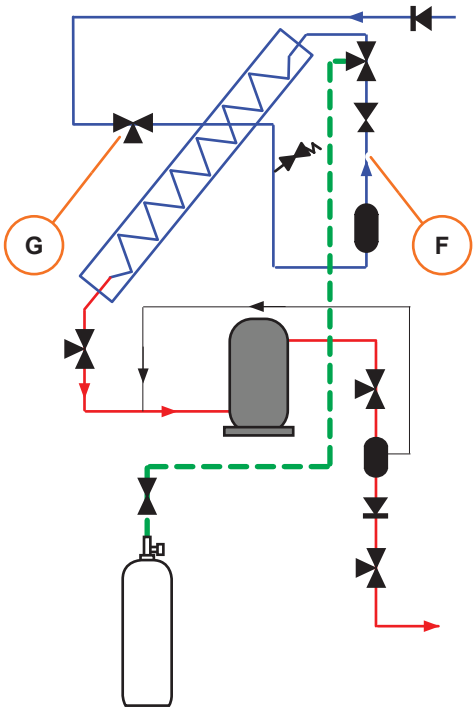


NOTE *The evaporating temperature and the super-heating are measured by the control system and you can read the values on the iCOM™ display.*

► 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

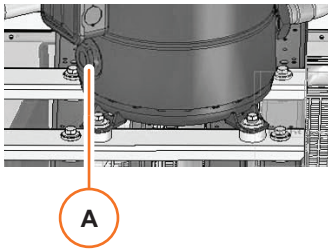
9.8 Final Checks

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 startup 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

Content of this chapter

10.1 Safety Instructions

WARNING
Improper operations can cause injury or death.

NOTICE
Improper operations can cause product damage.

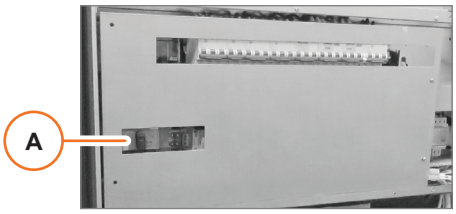
Read carefully the chapter *1. Safety*.
Pay attention to the safety labels on the unit and to the safety warnings in this chapter.

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

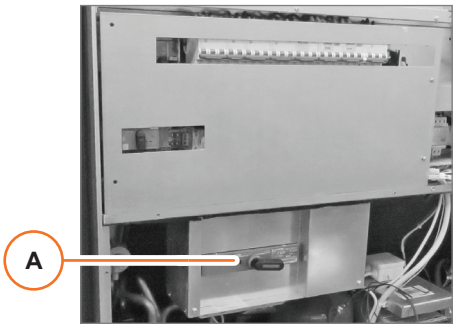
10.2 Power-up

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**]

- 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 ---

3. 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

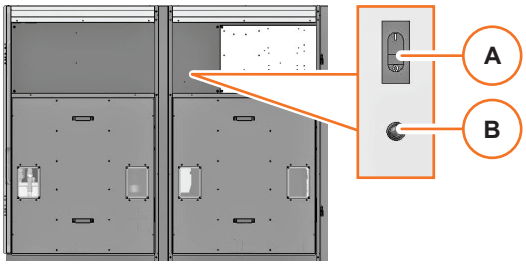
If this is not the case, extend the pre-heating of the compressor and check that the refrigerant EEV valve is properly closed.

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.

- Set the ON/OFF switch [**A**] to **ON**.
- Adjust the setpoint as indicated in the iCOM™ User Manual.

The LED [**B**] lights up, showing the presence of the electric power.

See the iCOM™ User Manual for details.

If the LED does not light up see *12. Troubleshooting*

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

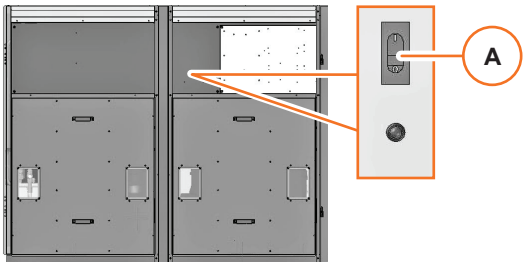
NOTICE

The following checks must be done:

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

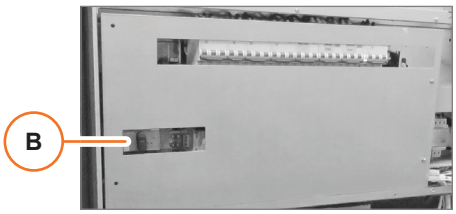
Alarms	• Make sure that all the alarms due to protective devices interventions have been reset (see *iCOM™ User Manual*)
Control and safety devices	• Check the correct operation of the control and safety devices.
Compressor	• With the compressor at full load, check there are no bubbles visible in the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

10.6 Stop

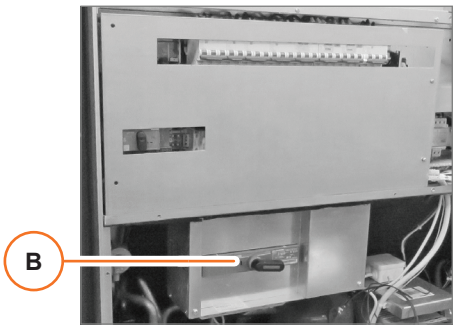


- Set the ON/OFF switch [**A**] to **OFF**.

Single power supply



Dual power supply



In case of a short stop:

- Maintain the disconnecting switch [**B**] to the position "**I**" to maintain the supply to the crankcase heater.

In case of a long stop (seasonal shutdown):

- Set the disconnecting switch [**B**] to the position "**O**".

This will disconnect the compressor crankcase heaters.

- Close the disconnection device upstream the unit.

10.7 Restart

After a short stop	The unit is still powered • Set the ON/OFF switch to **ON**.
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 (stabdby + 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

Content of this chapter

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

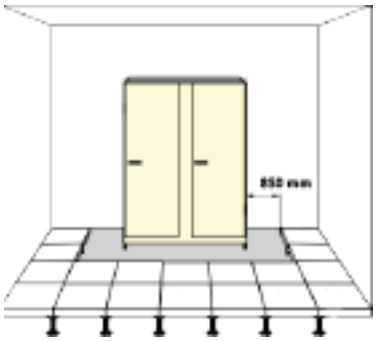
All the tasks that are explained in this chapter must be carried out only by authorized and trained technicians.

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 C - 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.

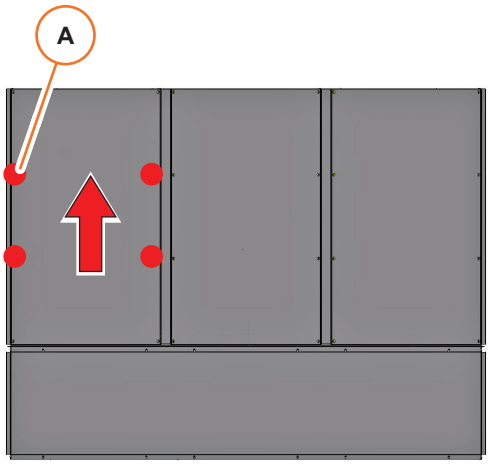
NOTICE

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**].
- 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 **10** 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 **10** 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	
Fresh air intake Economizer (if present)	The accessory 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 the related annex.			

(*) 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

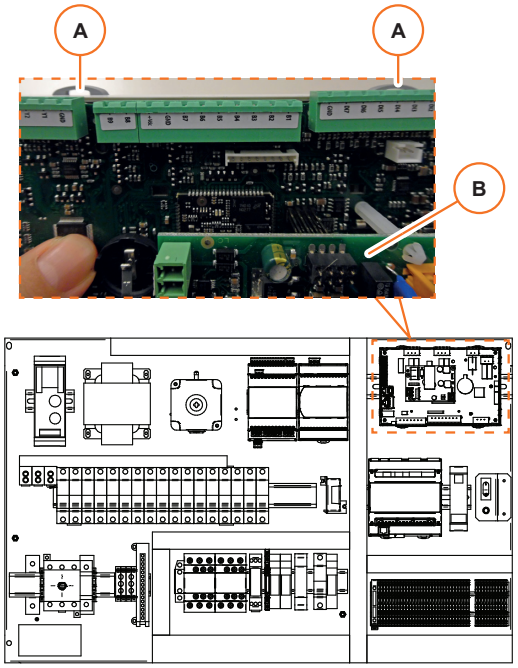
WARNING
Use only the refrigerant type specified on the *Onboard Label*.

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

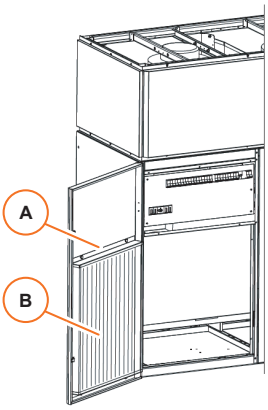
- Remove the cover plate of electrical and control panel.
- Remove all the cables connected with the control board.
- Insert a screw driver in one of the eyes [**A**] and lever out the control board [**B**].
- Repeat for the other eye(s) until the control board is released.

How to reassemble

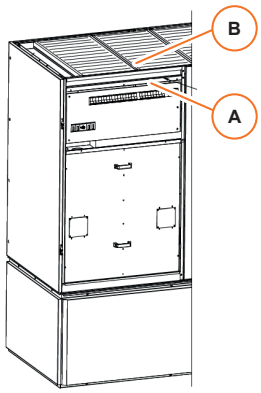
- Press the control board in the DIN rail until it locks.
- Connect again the cables.
- Reassemble the cover plate of electrical and control panel.
- Connect the unit from the power supply.
- Upload the software from the computer (or USB drive) to the control board.
- Restart the unit.

11.5.2 Replacing an air filter

Upflow units



Downflow units



- 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 a fan - general instructions

Safety

WARNING

Disconnect the unit from the power supply.

CAUTION

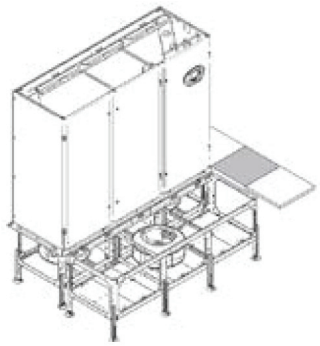
The fans and the panel are heavy.

This operation must be done by two maintenance operators.

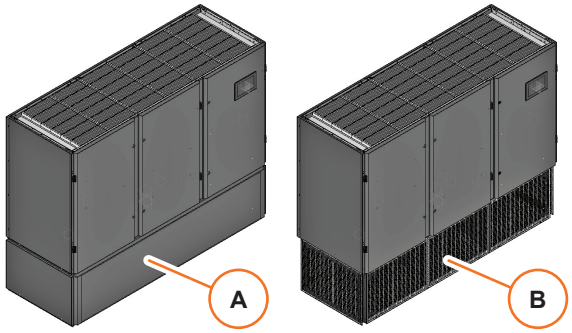
Use adequate lifting equipment and follow the fan manufacturer instructions for handling

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.

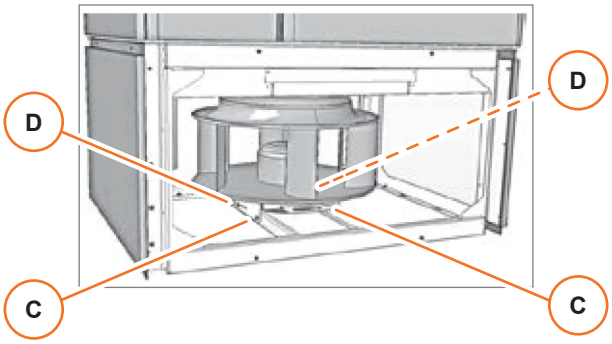
11.5.4 Replacing a fan - Downflow units



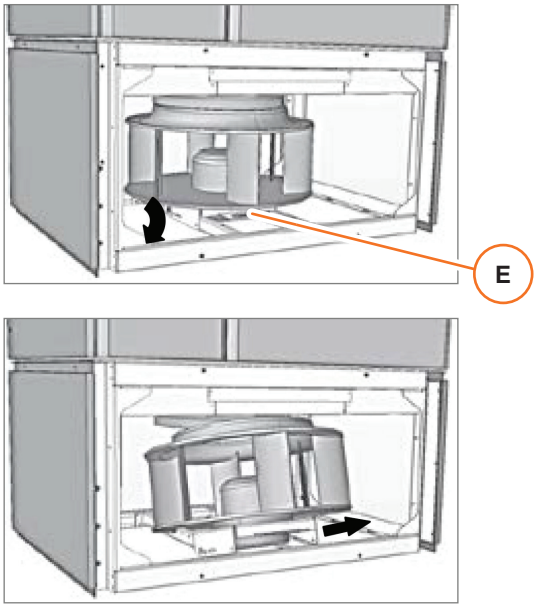
- Remove a few floor tiles in front of the fan section.
- Remove any obstacle in front of the fans to allow the fan extraction (raised floor structure, piping, ...).



- Remove the panel [**A**] or the grid [**B**].



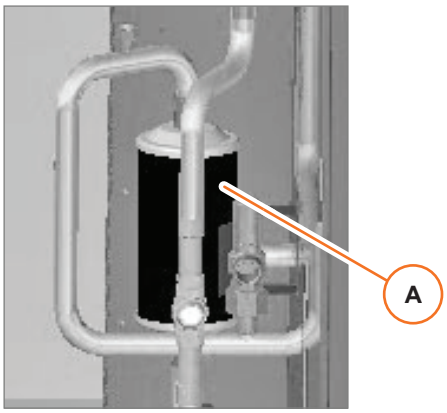
- Disconnect the fan electrical cable from the connector.
- Remove the two front screws [**C**] that fix the fan support to the sliding bars.
- Loosen the two back screws [**D**] that fix the fan support to the sliding bars.



- Slide down the fan by pulling the handle [**E**].
- Remove completely the two screws [**D**] on the back of the fan.
- Pull the handle to slide the fan out of the bay

- Proceed in reverse order to reassemble the fan.

11.5.5 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*

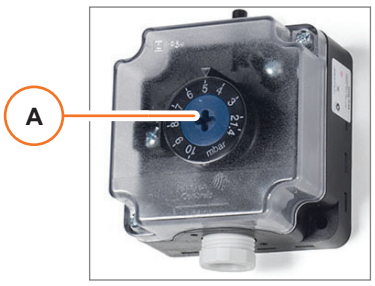
11.6 Calibrations

ENVIRONMENT

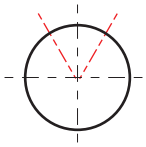
A misuse or an incorrect calibration of the unit leads to increased energy consumption, resulting in an economic and environmental damage.

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

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

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 of an 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 – 17,3 bar High pressure: 0 – 45 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
	The local control switch is opened	Check the local switch (green=ON)
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

14.1 Introduction

Stationary air conditioners placed into the European Community market and operating with fluorinated greenhouse gases (F-gas, such as R407C, R134a, R410A), 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 Re. (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) 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) 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-134a GWP 1430
  - R-407C GWP 1774
  - R-410A GWP 2088

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

14.4 Operators

14.4.1 Definitions

- Operator, according to Regulation 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 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	
	R134a	R410A	R407C	without leakage detection	with leakage detection
5 ≤ X < 50	3,5 ≤ Y < 35	2,4 ≤ Y < 24	2,8 ≤ Y < 28	12 Months	24 Months
50 ≤ X < 500	35 ≤ Y < 350	24 ≤ Y < 240	28 ≤ Y < 282	6 Months	12 Months
X ≥ 500	Y ≥ 350	Y ≥ 240	Y ≥ 282	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 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. 1516/2007 and Reg. 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 1494/2007 (2015/2068):

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.

a 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:

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

where:

Refrigerant	GWP
R-134a	1430
R-407C	1774
R-410A	2088

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:

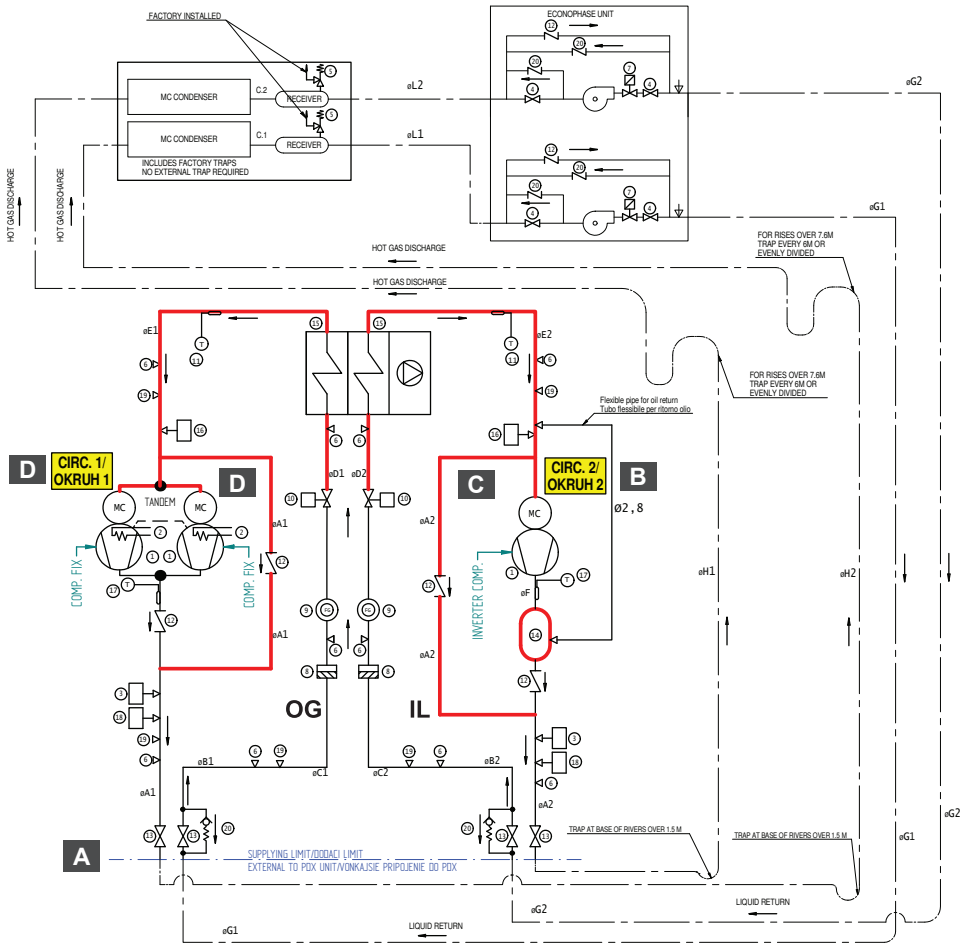
a the operators shall keep the records for at least **five** years

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 - PI082 – PI094 – PI104 – PI120 – PI150 – PI165



Ref.	Description
1	Compressor
2	Crankcase heater
3	High pressure switch
4	Ball valve
5	Safety valve
6	Access valve 5/16”
7	Solenoid valve
8	Filter dryer
9	Sight glass
10	Electronic expansion valve (EEV)
11	Fast reading temperature sensor for EEV
12	Check valve
13	Shut-OFF valve
14	Oil separator
15	Evaporator
16	Low pressure transducer EEV
17	Temperature discharge sensor
18	High pressure transducer
19	Access valve 1/4”
20	Check valve

A	Supply limit
B	Flexible pipe for oil return line
C	Variable speed compressor (with inverter)
D	Fixed speed compressor

Thermal insulation

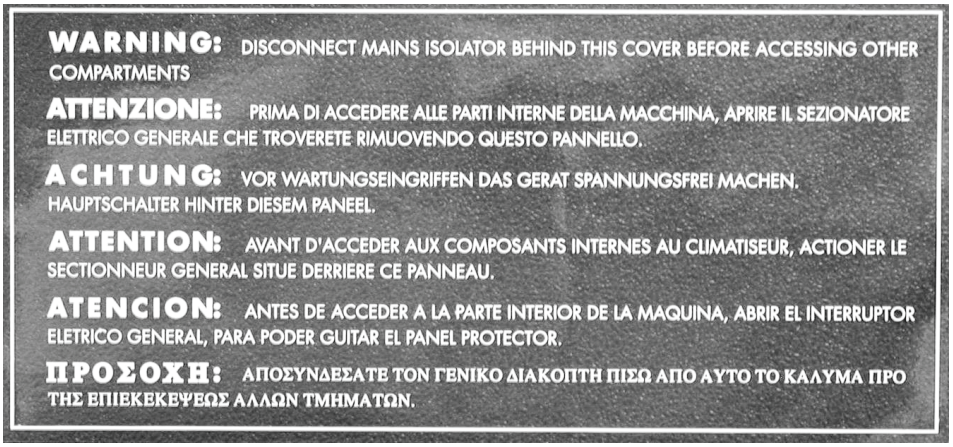
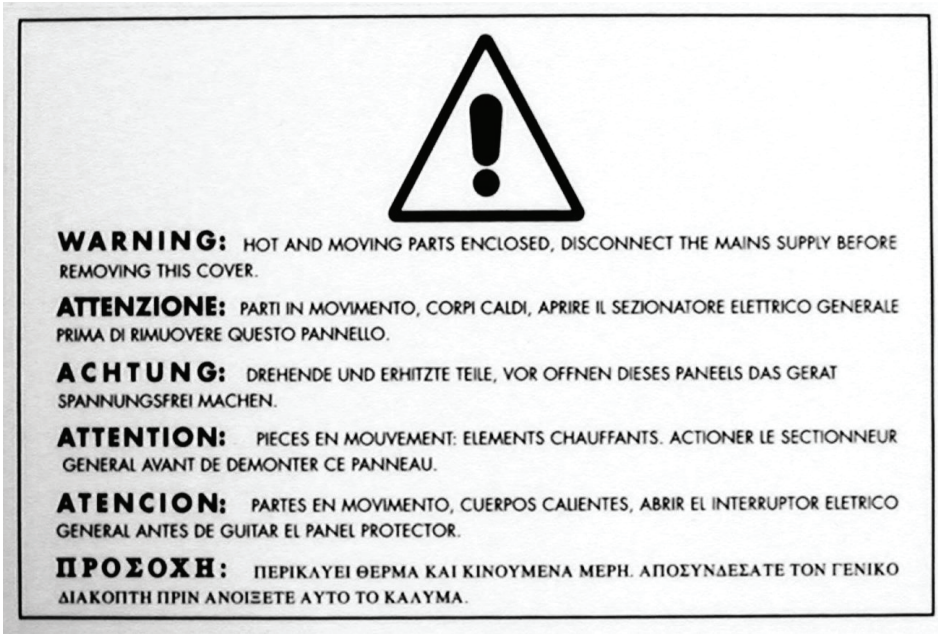
Annex B - Safety Labels

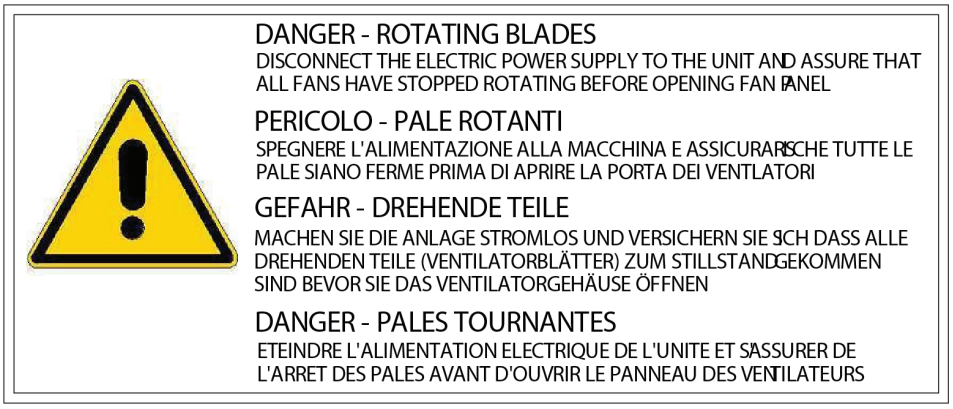
Content

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

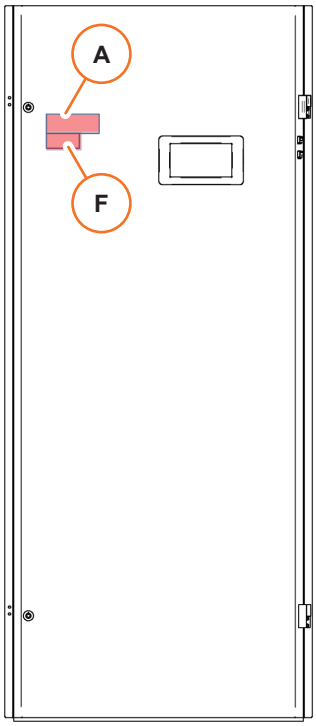
Identification	Description
A	
B	

Identification	Description
C	
D	
E	
F	

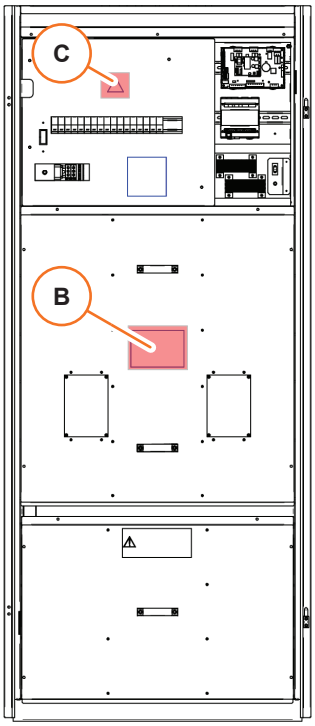
2 - Labels position

Frame type 1 (1 bay)

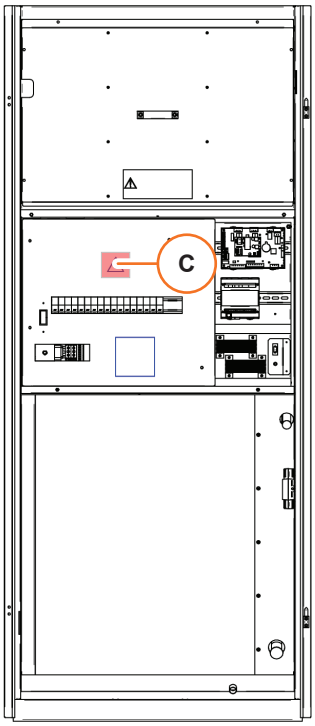
Downflow/Upflow - Outside



Downflow - Inside

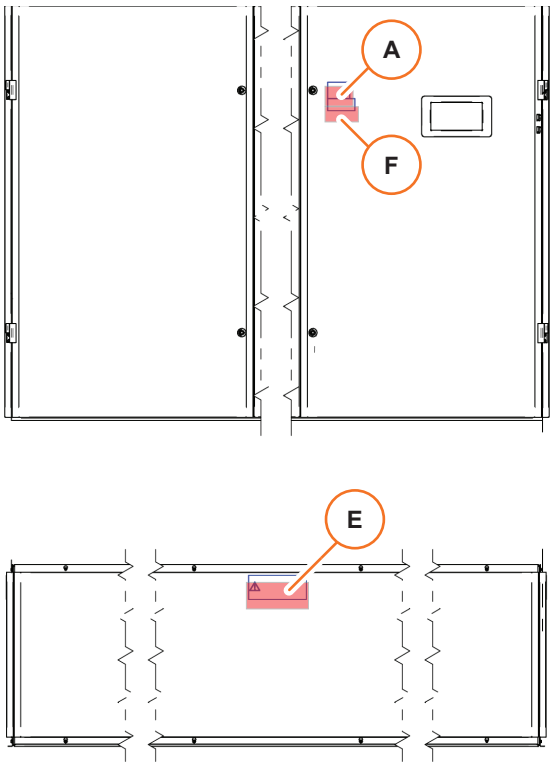


Upflow - Inside

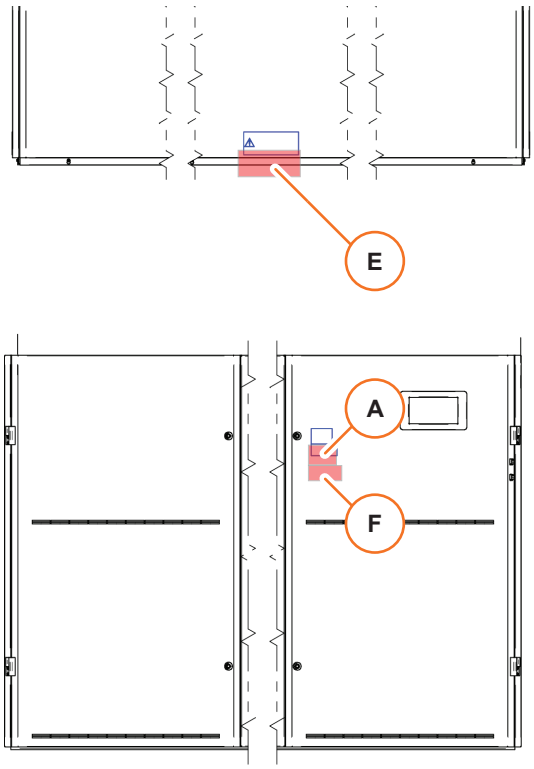


Frame types 2, 3, 5 (1,5 / 2 / 3 bays)

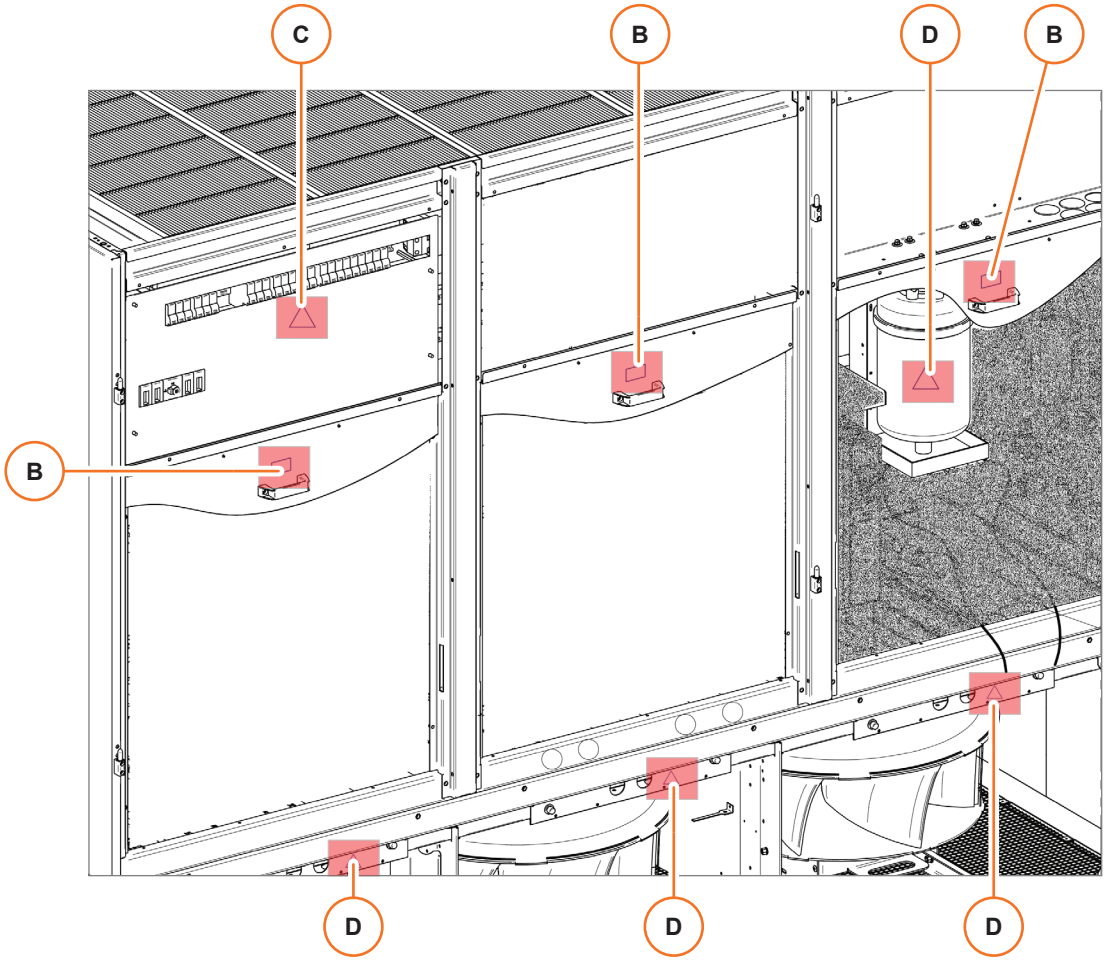
Downflow - Outside



Upflow - Outside



Downflow - Inside



Annex C - Dimensions and Weights

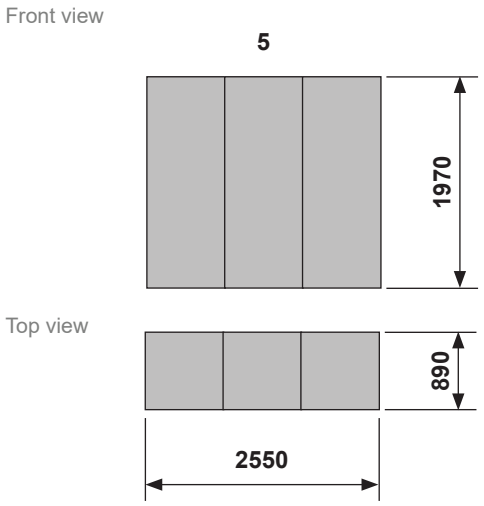
Content

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 F - 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* *9 - Hole in the floor for Downflow Down units*
Check if there is enough free space for service in front of the unit	See *9.3.2 Space requirements*

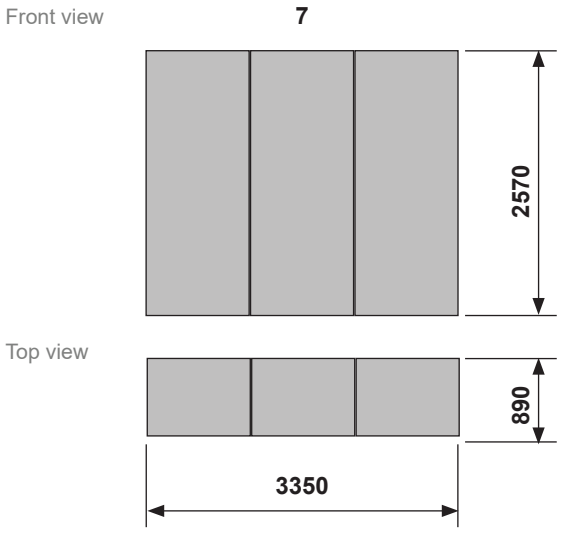
2 - Overall dimensions

Standard units



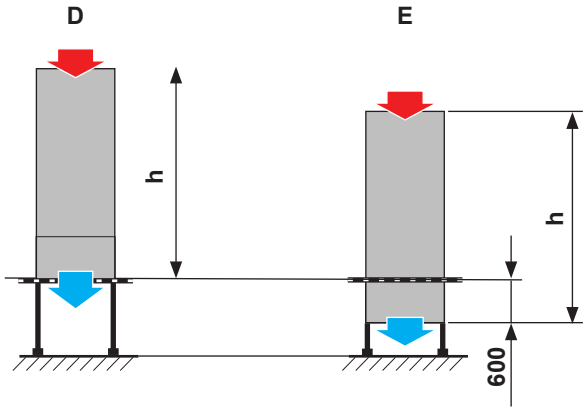
The figure above shows the dimensions of the standard units, by frame type, without any accessory.

Extended units



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

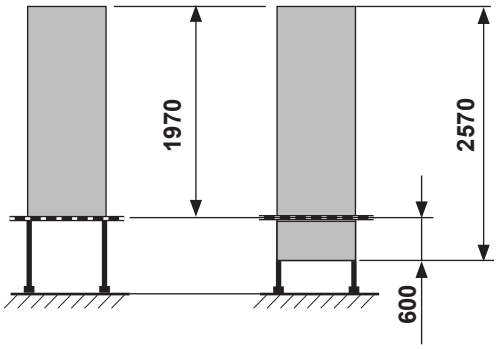
3 - Height from the floor



Standard h = 1970 mm

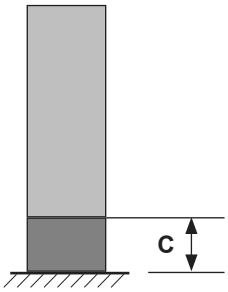
Extended h = 2570 mm

The figure above shows the height from the floor for each air distribution configuration.



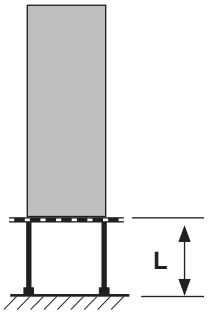
NOTE *The top of an extended unit placed under a raised floor will be at the same height as the top of a standard unit placed on the floor*

4 - Height of the accessories at bottom



U - Upflow / **H** - Downflow Frontal

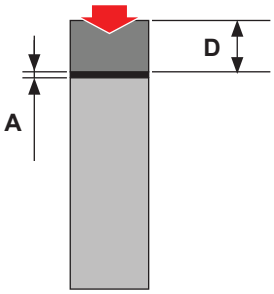
Base module	Height [**C**]: - 200 mm
Base module H 600/300 mm with rear air intake	Height [**C**]: - 600 mm for rear/bottom air intake - 300 mm for bottom air intake



D - Downflow Up / **E** - Downflow Down

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

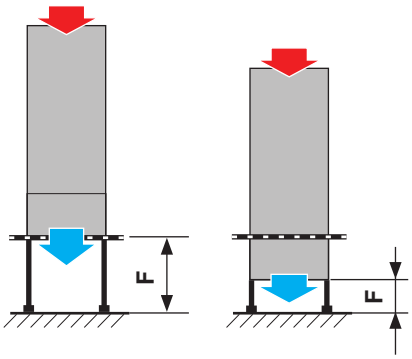
D - Downflow Up

E - Downflow Down

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
Hood with high efficiency air filter	600 - 900	50
Plenum with silencing cartridges	600 - 900	50
Horizontal hood with grid	600	50
Air economizer	850	50

6 - Free space from the floor



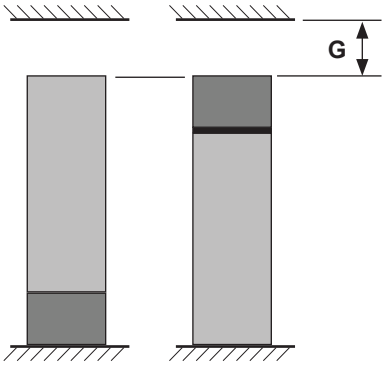
D - Downflow Up

E - Downflow Down

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



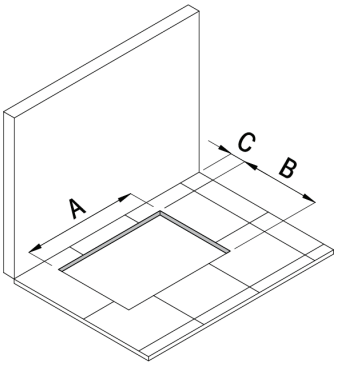
D - Downflow Up

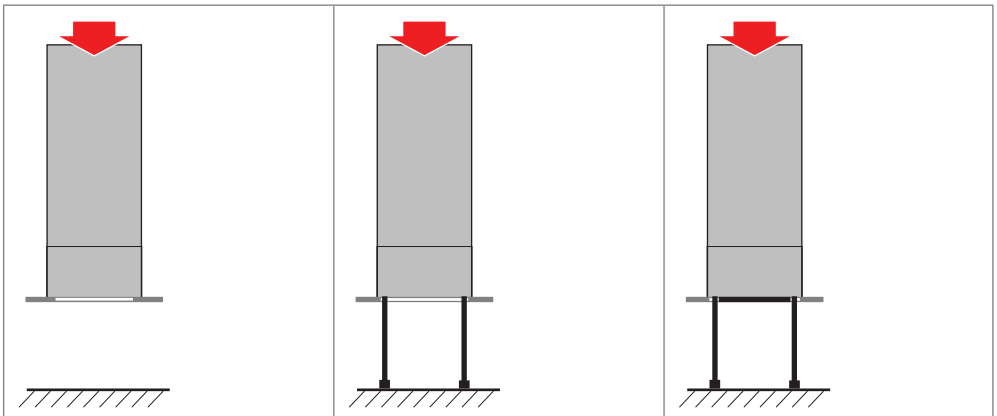
E - Downflow Down

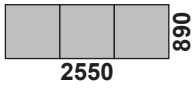
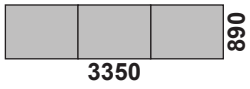
Free space [**G**] between the ceiling and the unit top, including any accessory mounted on top or bottom

- 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

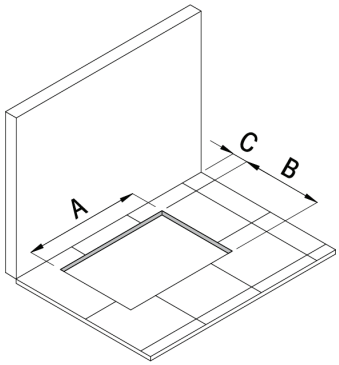


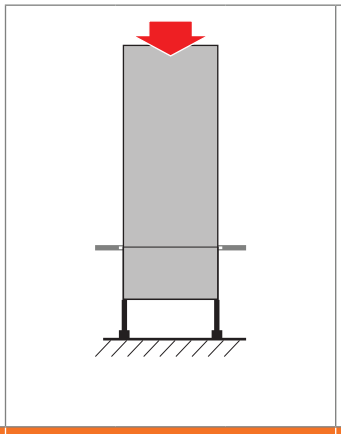


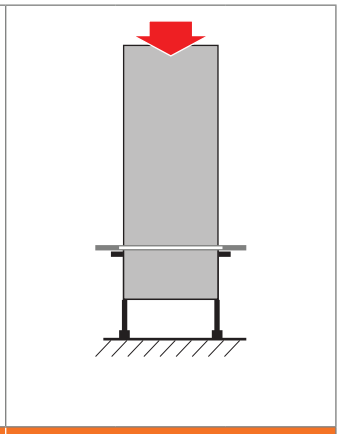
Frame type	No accessories for support			With legs kit			With base frame		
	A [mm]	B [mm]	C [mm]	A [mm]	B [mm]	C [mm]	A [mm]	B [mm]	C [mm]
5 	2 450	760	70	2 506	820	30	2 526	840	30
7 	3 250	760	70	3 306	820	30	3 326	840	30

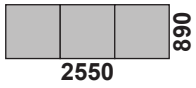
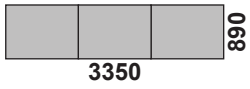
NOTE *[C] is the minimum free space between the unit at its final position and any back wall or obstacle. You might need more space for assembly or installation operations. In that case, do the assembly or installation operation nearby and then place the unit at the final position.*

9 - Hole in the floor for Downflow Down units







Frame type	No accessories for support			With floor tiles support kit		
	A [mm]	B [mm]	C [mm]	A [mm]	B [mm]	C [mm]
5 	2 532	846	20	2 570	885	50
7 	3 332	846	20	3 370	885	50

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.*

10 - Weights

Table 37 - Unit weight

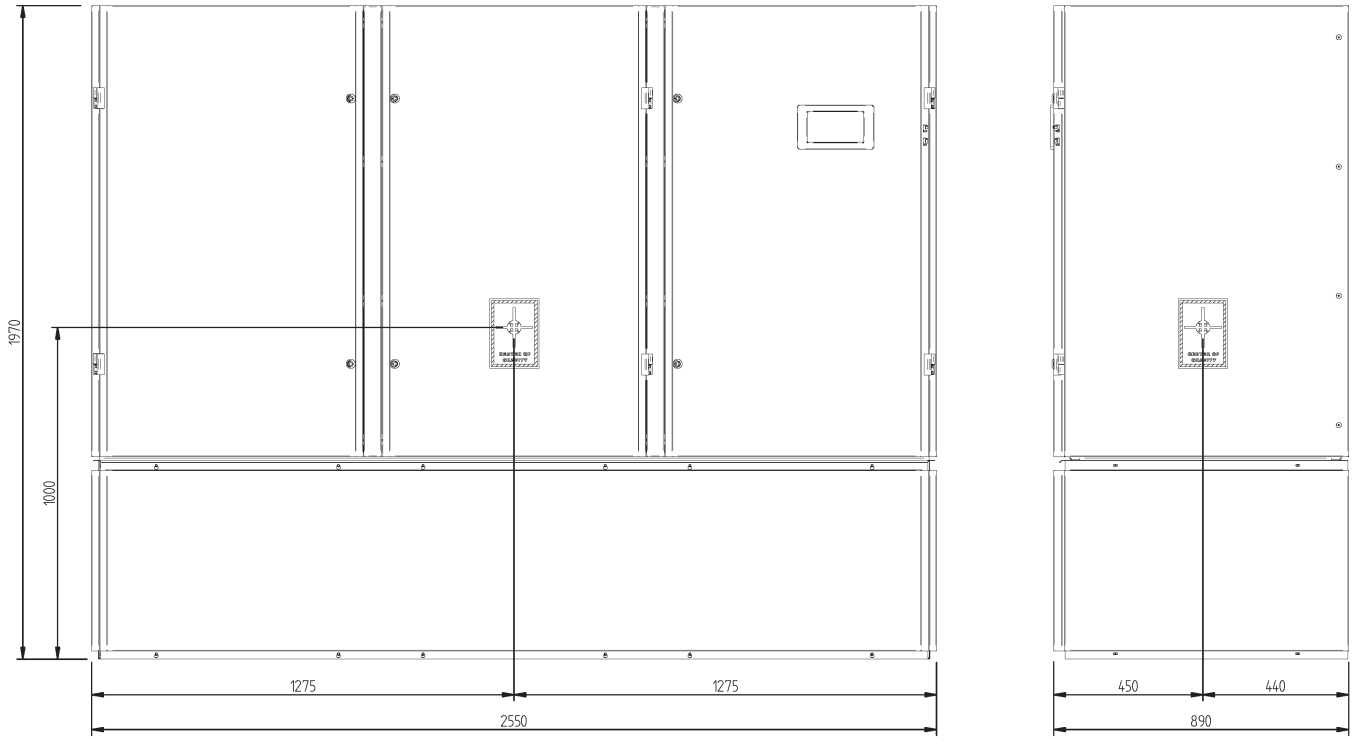
Unit Model	Unit Weight [kg]	Packaging Weight [kg]
PI082	957	42
PI094	967	42
PI104	987	42
PI120	1006	42
PI150	1091	58
PI165	1139	58

Table 38 - Fan module weight

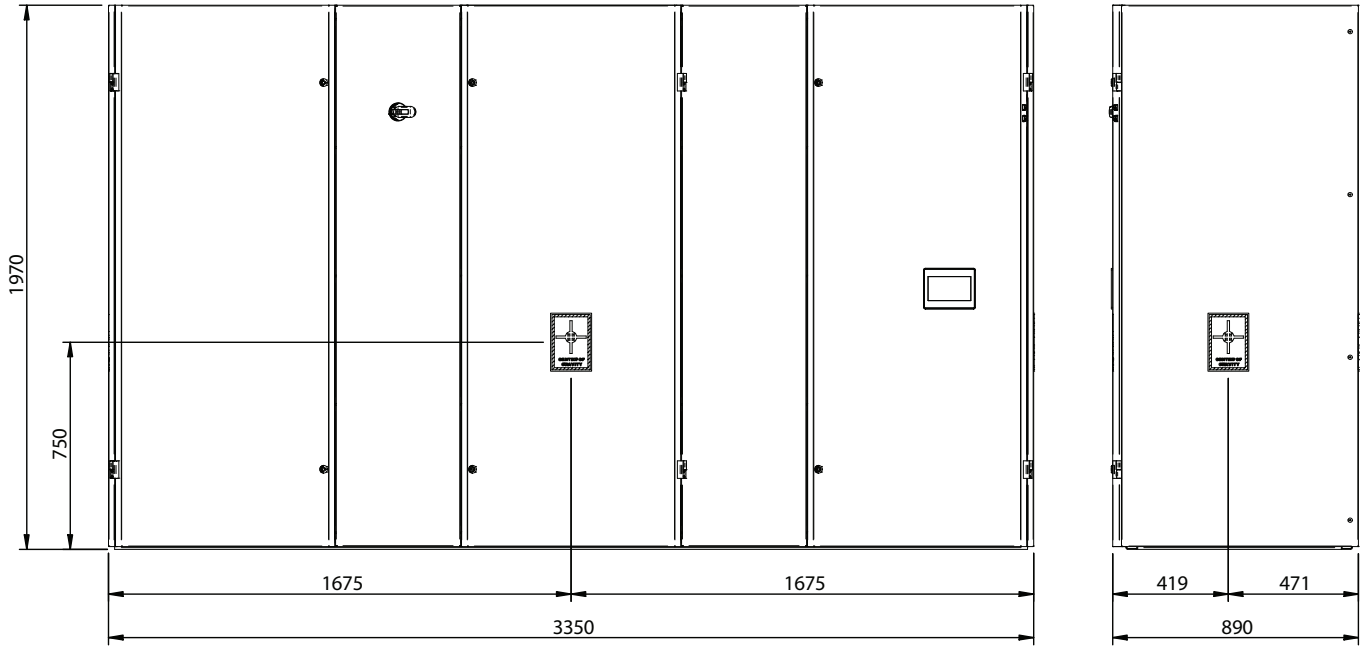
Type	Model	Unit Weight [kg]	Packaging Weight [kg]
Base Frame	**BFX33**	325	78
Base Module	**BMX33**	405	78

11 - Gravity centers

Gravity center - Frame type 5 (3 bays) - Downflow



Gravity center – Frame type 7 – Downflow Extended Height



Annex D - Connections

Content

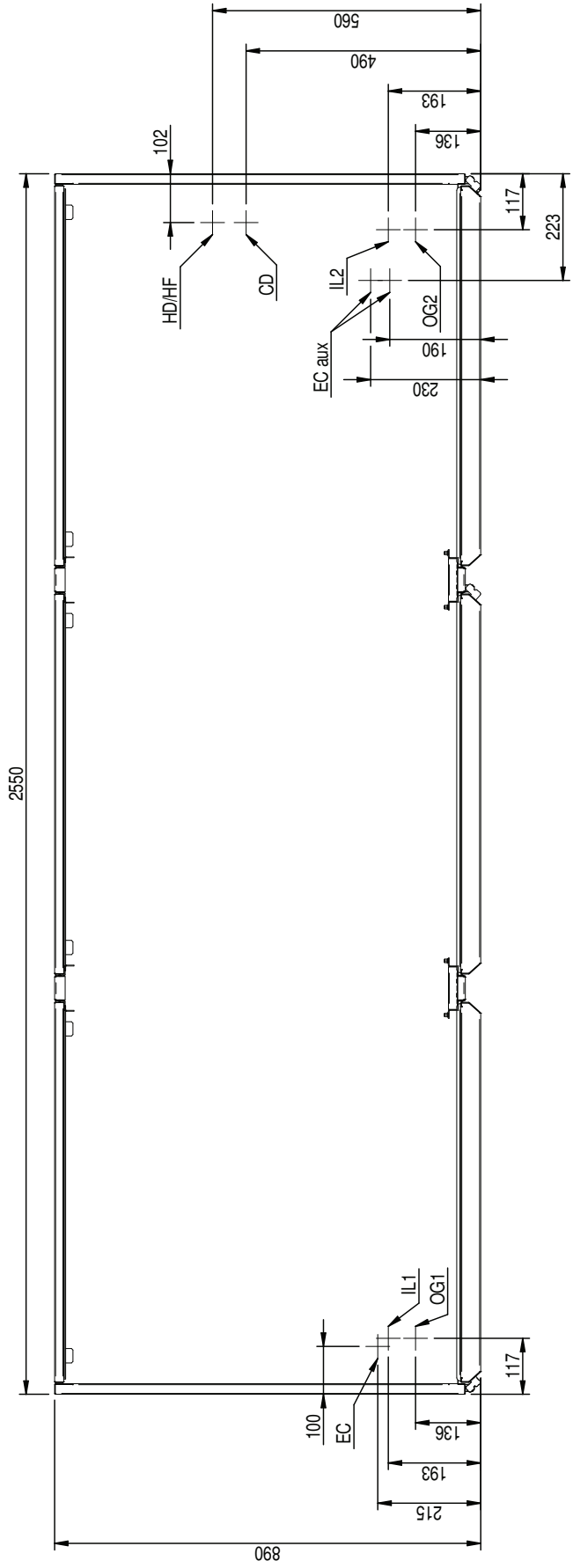
Key to symbols

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 G - Electrode Humidifier* *Annex H - Infrared 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*

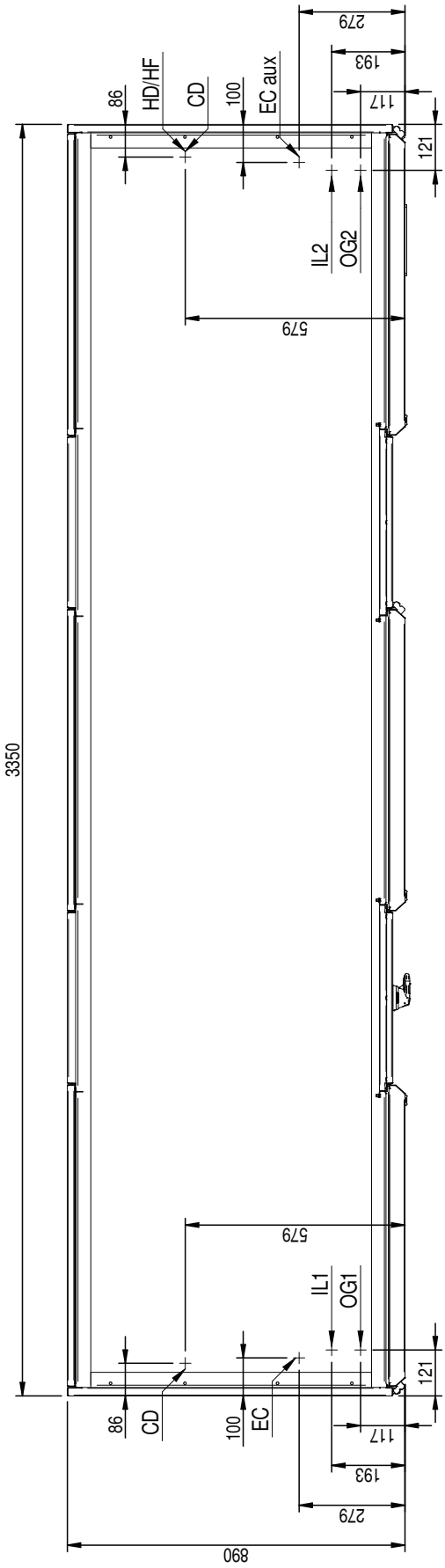
NOTE *All the dimensions are in millimeters*

	3 BAY				4 BAY	
	PI082A	PI094A	PI104A	PI120A	PI150A	PI165A
IL1	22	22	22	22	22	22
IL2	18	18	22	22	22	22
OG1	28	28	28	28	28	28
OG2	22	22	22	22	28	28

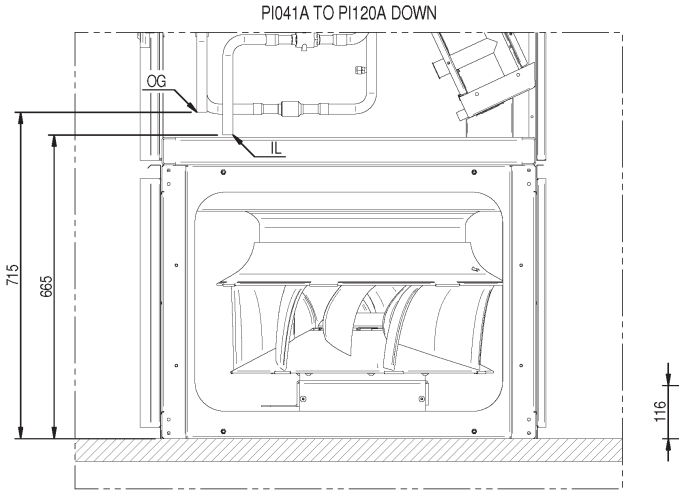
1 - PI082A - PI094A - PI104A - PI120A



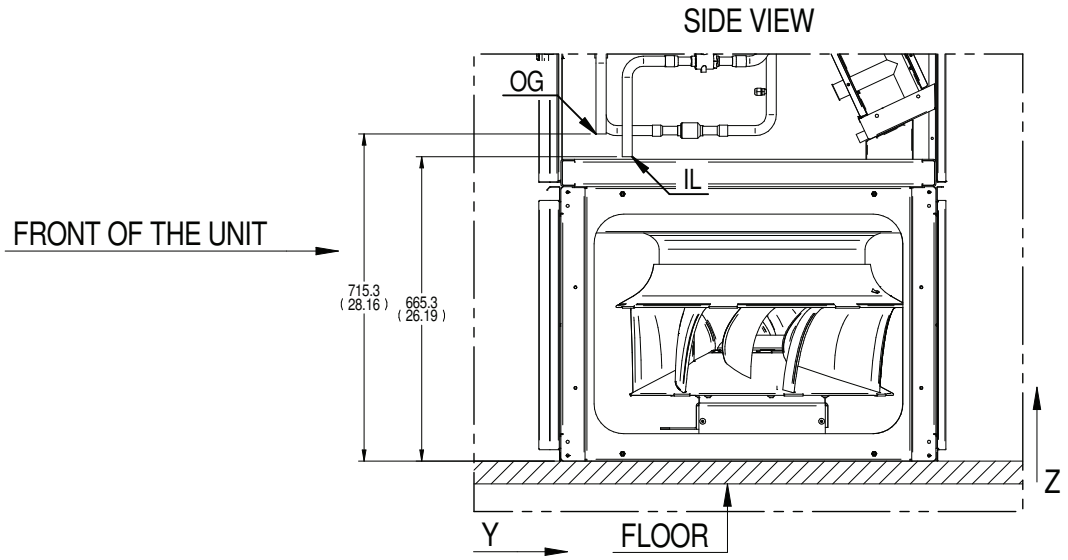
2 - PI150 - PI165

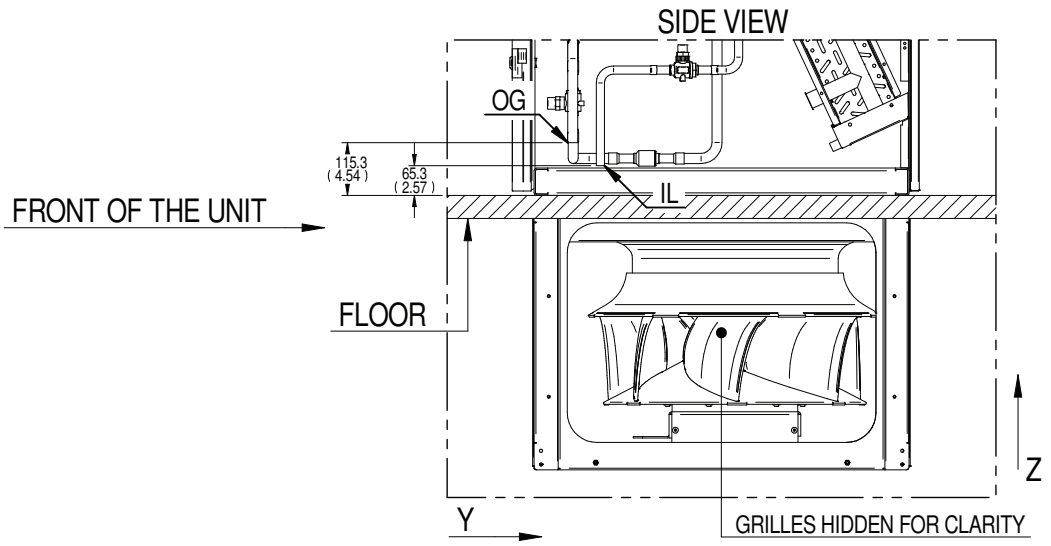


3 - PI082 TO PI120 DOWN



4 - PI150-PI165

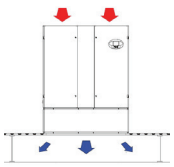
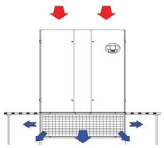




Annex E - Accessories

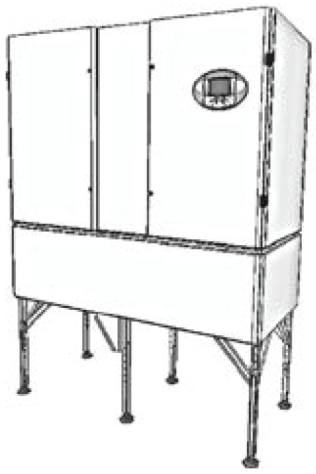
Content

1 - Overview

Accessory	Purpose	Position	D - Downflow Up	E - Downflow Down
				
Legs kit	Support	Bottom	YES	YES
Base frame	Support	Bottom	YES	YES
Base module	Support + piping lay-down	Bottom	NO	NO
Base module 600/300 mm high with rear/ bottom air intake	Air flow	Bottom	NO	NO
Fresh air module	Air flow	Fan inlet	YES	YES
Vertical flow extension hood (*)	Air flow	Top	YES	YES
Hood with high efficiency air filter (*)	Better filtering	Top	YES	YES
Plenum with silencing cartridges (*)	Noise reduction	Top	YES	YES
Horizontal hood with grid	Air flow	Top	NO	NO
Air economizer (*)	Air flow	Top	YES	YES
Floor tiles support kit	Support	Bottom	NO	YES
Fans maintenance kit	Maintenance	Bottom	NO	YES
Connecting flange	(*)	Top	YES	YES

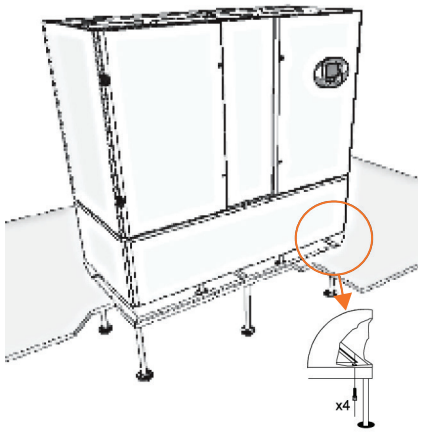
(*) The connecting flange is required to mount the accessory on top of the Downflow units.

2 - Legs kit



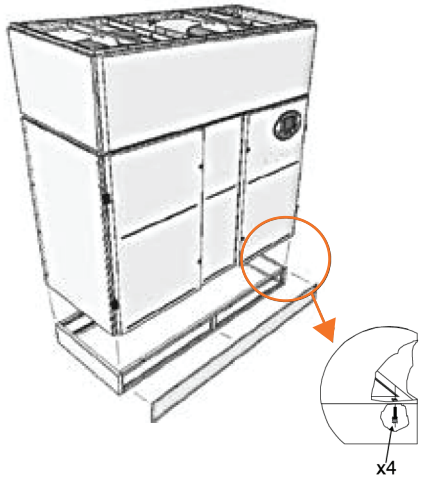
Purpose	To support the unit when installed with a raised floor.
Description	The legs are adjustable and allow to support the unit at different height.
For airflow version	**D** - Downflow Up **E** - Downflow Down
Available height	30–370 mm 370–570 mm 570–800 mm
Assembly	Fix the accessory using the threaded inserts that you find in the fan module frame. You need M8 screws (they are not supplied with the unit).

3 - Base frame



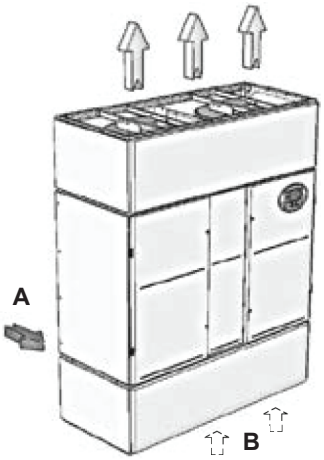
Purpose	To support the unit when installed with a raised floor.
Description	The legs are adjustable and allow to support the unit at different height. A protective grid prevents any contact with the fans from below.
For airflow version	**D** - Downflow Up **E** - Downflow Down **U** - Upflow Frontal
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).

4 - 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** - Frontal
Available height	200 mm
Assembly	Fix to the unit base by 4 screws (the screws are not supplied with the unit)

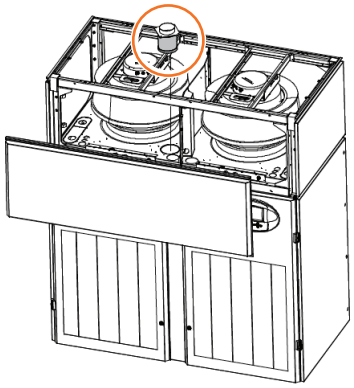
5 - Base module 600/300 mm high with rear/bottom air intake



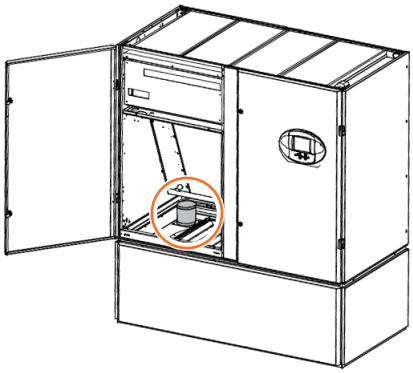
Purpose	To allow an Upflow unit to work with a rear/bottom or a bottom air intake. Supporting the unit. Allow the piping to enter the base of the unit when a raised floor is not installed.
For airflow version	**U** - Upflow
Available height	[**A**] rear/bottom air intake H=600 mm [**B**] bottom air intake H=300 mm
Assembly	Fix to the unit base by 4 screws (the screws are not supplied with the unit)
NOTE	The unit must be ordered with a blind front panel and an open basement

6 - Fresh air module

Upflow



Downflow

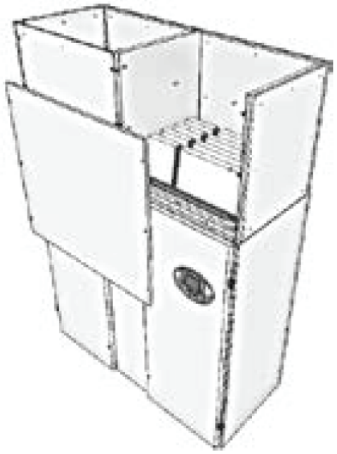


Purpose	To allow filtered fresh air intake from outdoor. The fresh air is mixed with the recirculation air returning from the room.
Description	The kit is made of a G3 class filter with a 100 mm diameter plastic duct.
Available diameter	100 mm
For airflow version	**U** - Upflow **H** - Downflow Frontal **D** - Downflow Up **E** - Downflow Down
Assembly	The kit must be installed on the low pressure side of the fan. • Remove the pre-cut in the plate that separates the fan module from the coil module. • Insert the kit in the hole, paying attention to push the filter into the low pressure side. • Connect the fresh air piping to the kit.

7 - Vertical flow extension hood

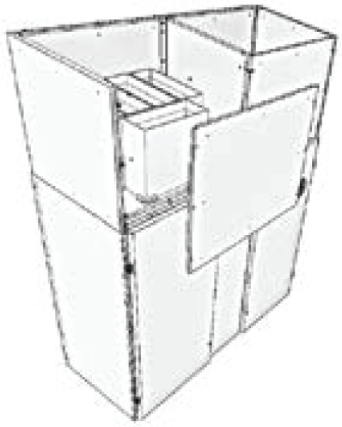
Purpose	Additional duct on the unit top, to simplify the connection to the ceiling or to other equipment.
Description	The hood has the same design as the unit and consists of sandwich panels lined with non-flammable insulation material of class 0 (ISO 1182.2), density 30 kg/m^3.
For airflow version	**U** - Upflow **H** - Downflow Frontal **D** - Downflow Up **E** - Downflow Down
Available heights	500 mm 600 mm 700 mm 800 mm 900 mm
Assembly	For the Downflow units: mount first the connecting high flange on top of the unit (see *14 - Connecting flange*). For all units: fix the accessory to the unit top by screws (the screws are not supplied with the unit).

8 - Hood with high efficiency air filter



Purpose	Optional high efficiency filters, filtration class ePM10 70% in accordance with the ISO/EN 16890 standard.
Description	The filters are made of fiberglass filter media. They are placed in ”V” sections with a solid external frame in polypropylene and can withstand remarkable pressure and flow variations. The filters are installed inside an additional duct on the unit top.
For airflow version	**U** - Upflow **H** - Downflow Frontal **D** - Downflow Up **E** - Downflow Down
Available height	600 mm 900 mm
Assembly	For the Downflow units: mount first the connecting high flange on top of the unit (see *14 - Connecting flange*). For all units: fix the accessory to the unit top by screws (the screws are not supplied with the unit).

9 - Plenum with silencing cartridges

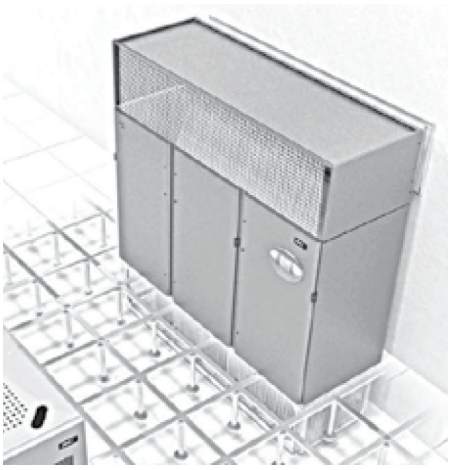


Purpose	Noise reduction
Description	These are special cartridges made of self - extinguishing material with a high noise attenuation capacity. They are guaranteed against disintegration and release of particles do to friction of the air. Despite a small additional pressure drop, these cartridges provide a remarkable sound power level reduction.
For airflow version	**U** - Upflow **H** - Downflow Frontal **D** - Downflow Up **E** - Downflow Down
Available height	600 mm 900 mm
Assembly	For the Downflow units: mount first the connecting high flange on top of the unit (see *14 - Connecting flange*). For all units: fix the accessory to the unit top by screws (the screws are not supplied with the unit).

10 - 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 *14 - Connecting flange*). For all units: fix the accessory to the unit top by screws (the screws are not supplied with the unit).

11 - Air economizer



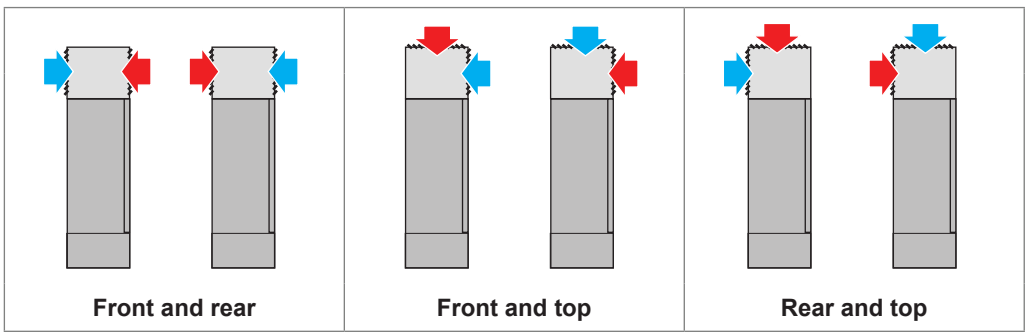
Purpose	High energy savings by reducing the refrigerant circulation. The unit takes cool air from outdoors and uses it for room conditioning.
Description	The air economizer is an extension hood with two dampers and two temperature sensors. A sensor measures the temperature of the outdoor (cold) air. The other sensor measures the temperature of the warm air returning to the unit from the room. When the outdoor temperature is low enough, the control stops the compressor(s) and opens the dampers, one for outdoor air intake, the other for room air intake. The outdoor air is mixed with the room air to adjust the temperature. The air mixture is filtered by flowing through to unit. When the outdoor temperature is too high, the control restarts the compressor(s) and closes the dampers.
For airflow version	**H** - Downflow Frontal **D** - Downflow Up **E** - Downflow Down
Available height	860 mm
Assembly	Mount first the connecting high flange on top of the unit (see *14 - Connecting flange*). Then fix the accessory to the unit top by screws (the screws are not supplied with the unit).
NOTE	*To use the air economizer the building has to be equipped with suitable air ducts for the outdoor air intake.* *The air economizer is supplied with a remote temperature sensor, to be mounted on the outdoor air intake.*

Dampers arrangement

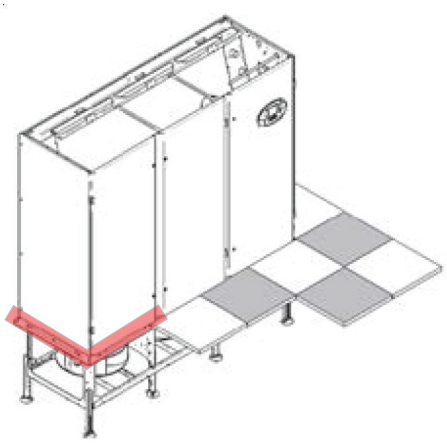
The two dampers can be placed in different positions, to fit best the room and air ducts layout. See below all the possible arrangements.

Outdoor (**cold**) air

Room (**warm**) air

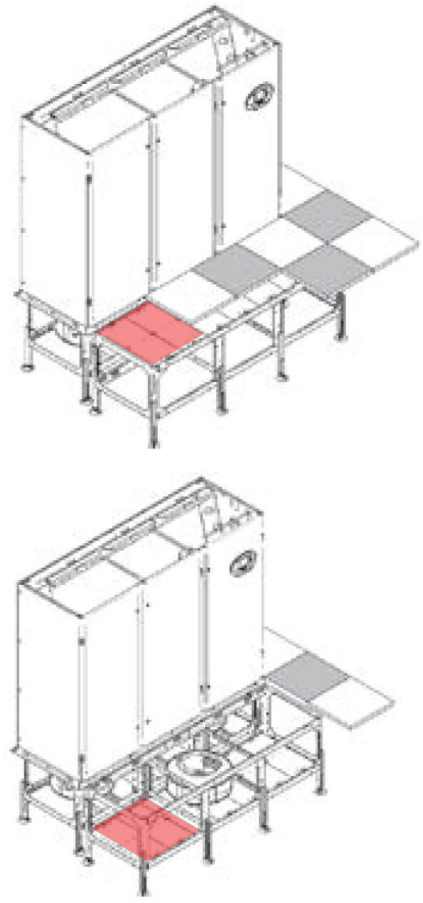


12 - Floor tiles support kit



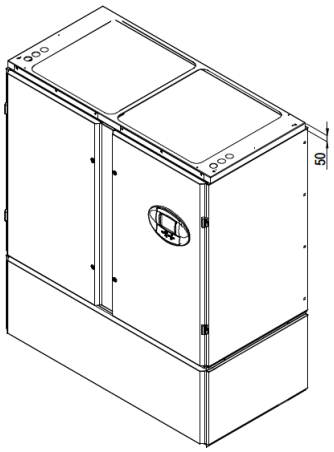
Purpose	To support the floor tiles around the Downflow Down units when installed with a raised floor.
Description	The floor tiles support is fixed on the fan module frame.
For airflow version	**E** - Downflow Down
Available dimension	For tiles thickness up to 40 mm.
Assembly	Fix the accessory using the threaded inserts that you find in the fan module frame. You need M8 screws (they are not supplied with the unit).
NOTE 1	*With a correct installation, the maximum admitted vertical distributed load on the perimeter is 180 kg/m.* *It means that on the lateral side, which is 870 mm long, the maximum admitted distributed load is 157 kg.*
NOTE 2	*The floor tiles support is earthed with the unit frame.* *Follow local rules for system grounding*

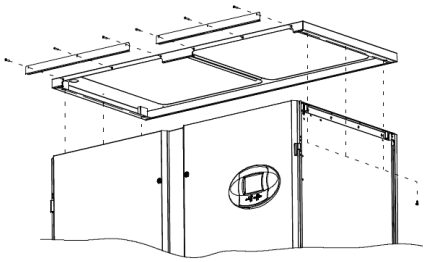
13 - Fans maintenance kit



Purpose	To allow maintenance operations, in particular fans replacement, when the fans are installed below the floor level.
Description	Removing tiles on the frontal area, it is possible to lift some footboards, moving them on the lower level, creating a service volume in the raised floor.
For airflow version	**E** - Downflow Down
Dimension of the footboards	50x50 mm
Assembly	Additional frame to be placed under the raised floor in front of the fan compartment.
NOTE 1	*The footboards are designed to support a maximum vertical distributed load of 600 kg/ m^2 and a maximum concentrated load of 150 kg.*
NOTE 2	*The fans maintenance kit must be earthed following the local rules.*

14 - Connecting flange





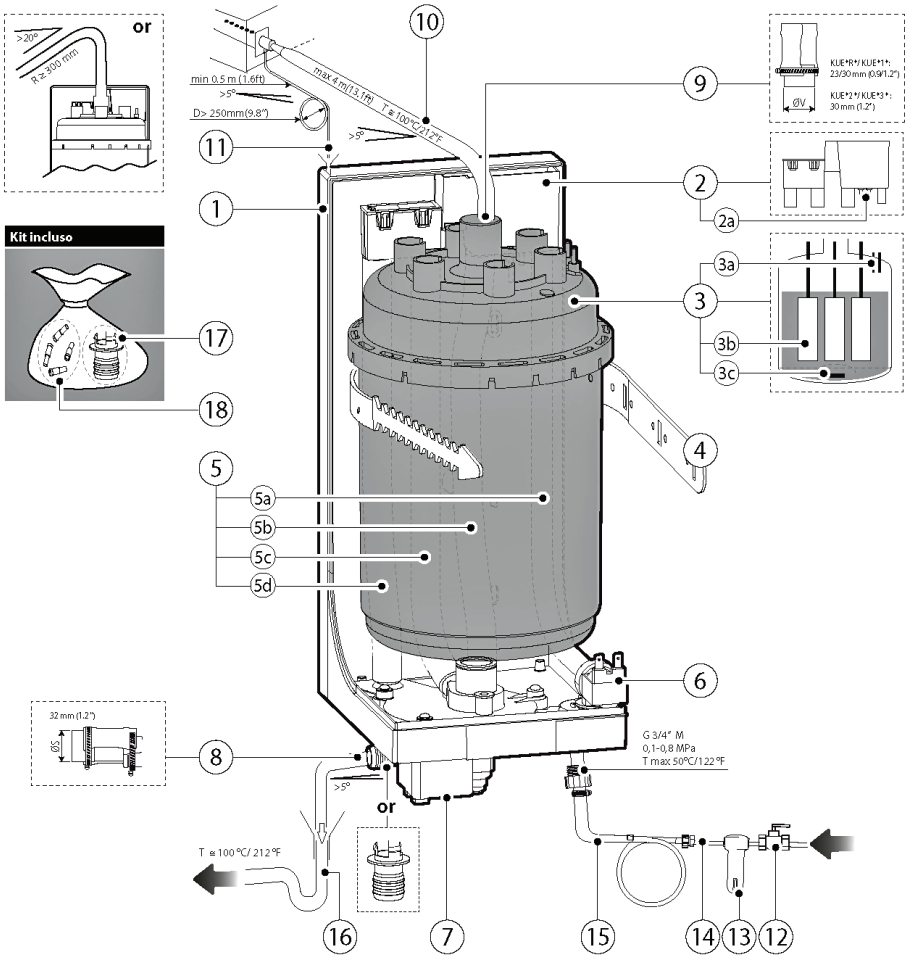
Purpose	To allow mounting on top of the unit the following accessories: - Vertical flow extension hood - Hood with high efficiency air filter - Plenum with silencing cartridges - Air economizer
For airflow version	**H** - Downflow Frontal **D** - Downflow Up **E** - Downflow Down
Available height	50 mm
Assembly	If you ordered a unit with the arrangement for the above mentioned accessories, the flange 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 to access the fixing screws.

Annex F - Electrode Humidifier

Content

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
KUECLO	380 V / 3 ph / 60 Hz	1,3 - 3	3,4	2,25	3,3	0,6	7,0
	460 V / 3 ph / 60 Hz	1,3 - 3	2,8	2,25	3,3	0,6	7,0
KUECLQ	380 V / 3 ph / 60 Hz	3,9 - 8	9,1	6	5,5	0,6	7,0
	460 V / 3 ph / 60 Hz	3,9 - 8	7,5	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 “MAXwater supply” given in the table *Electrode humidifier technical data*
- 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

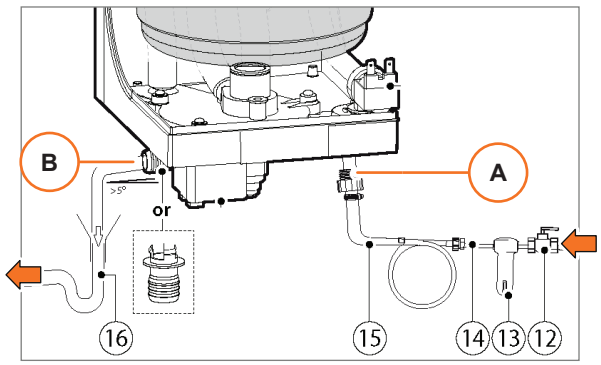
NOTICE

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 **PDX** 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 Ø32 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** 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 **PDX** 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 **PDX** 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 VAC/230 VAC 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

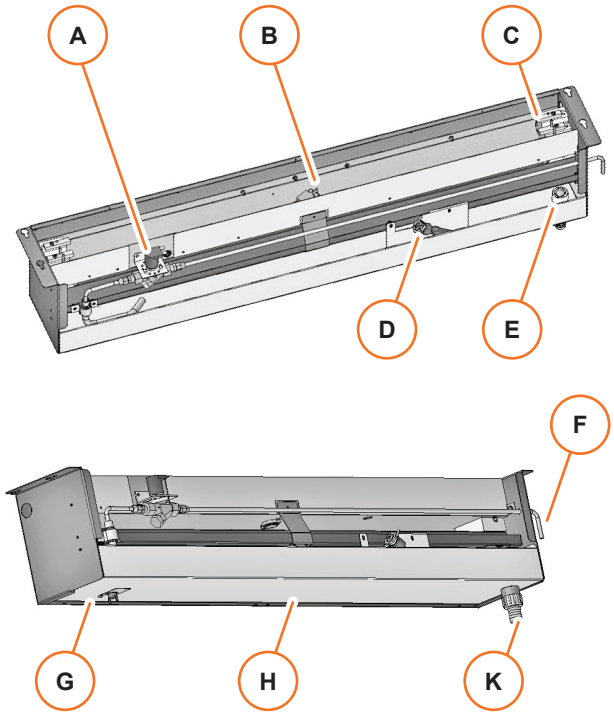
Problem	Cause	Solution
The humidifier wets the duct	The steam distributor is not installed correctly (too near the top of the duct or the condensate return is blocked)	Make sure the steam distributor has been installed correctly
	The system is oversized	Decrease the steam production, CP/CPY board
	Humidifier 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 - Infrared Humidifier

Content

1 - Description

Main components



A	Solenoid valve flow regulation
B	Infrared quartz lamps
C	Junction block
D	Float switch
E	Standpipe
F	Water supply
G	Manual reset for the thermostat
H	Pan
K	Discharge connection

Operating principle

The quartz lamps [**B**] are mounted above the stainless steel pan [**H**], which is filled with water through the supply inlet [**F**].

The float switch [**D**] detects if the water level is too high.

When humidification is required, the lamps are switched on and infrared rays generate steam within seconds (without impurities or odor).

The lamps never come in contact with the water.

2 - Specifications

Technical data

Infrared humidifier technical data

Size	Main power Supply	Pan	Capacity	Absorbed Current	Power
	[V ± 10%]	Material	[kg/h]	[A]	[kW]
Small	400 V / 3 ph / 50 Hz	Stainless steel	5,0	6,4	4,8
	380 V / 3 ph / 60 Hz	Stainless steel	5,0	6,9	4,8
	460 V / 3 ph / 60 Hz	Stainless steel	5,0	6,0	4,8
Big	400 V / 3 ph / 50 Hz	Stainless steel	10,0	13,9	9,6
	380 V / 3 ph / 60 Hz	Stainless steel	10,0	14,3	9,6
	460 V / 3 ph / 60 Hz	Stainless steel	10,0	12,0	9,6

Supply water

- Pressure between 138 kPa and 1000 kPa
- Flow rate 3,8 l/min

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.

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

3 - Installation

The humidifier is supplied already mounted within the **PDX** unit.

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

- Supply water connection: external diameter 6 mm
- Drain water connection: internal diameter 22 mm, male tread

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 starts up automatically as soon as the **PDX** unit is switched on.
Operation	The adjustable parameters which determine the humidifier operation have already been factory-preset (see iCOM™ manual).

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.

WARNING

Optical radiation from the quartz lamps.

Before opening the door, always switch off the **PDX** unit.

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

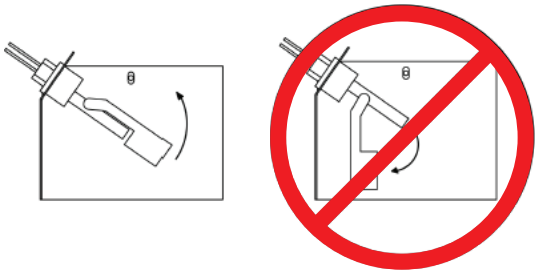
- Check drain piping and trap for clogs.
- Check the pan. Clean it from mineral deposits.
- Clean the reflector.
- Check the water supply valve for leaks.
- Check the quartz lamps (replace if burnt out).
- Check the wirings connections (inside the humidifier electric panel).

NOTE *Deposits of mineral solids will collect in the humidifier pan and on the float switch. These must be cleaned periodically to ensure proper operation. The frequency of cleaning must be locally established because it depends on humidifier usage and local water quality. A spare pan is recommended to reduce the maintenance time. The Liebert® autoflush system can greatly increase the time between cleaning, but does not eliminate the need for periodic checks and maintenance.*

Removing the pan

Before switching off **PDX** unit	• With the **PDX** unit operating, remove the call for humidification at the iCOM™ control. • Let the fans operate 5 minutes to allow the humidifier and water to cool. • Let the pan drain and the condensate pump operate (if applicable) until the pan is dry. • If applicable, let the condensate pump operate until the drain tank is dry. • Switch off the **PDX** unit.
With the **PDX** unit disconnected from the power supply	• Remove safety panels, if installed. • Pull out the humidifier standpipe from the pan. • Inspect the O-ring (replace if necessary). • Disconnect the drain coupling from the bottom of the pan. • Remove the thermostat from the bottom of the pan. • Remove the fixing screws from the sides of the pan and slide the pan out.

Cleaning the pan and the float switch

With the **PDX** unit disconnected from the power supply	• Loosen the scale on the side and bottom of the pan with a stiff nylon brush or plastic scraper. • Flush with water. • Carefully clean the scale from the float switch. Make sure to reassemble it correctly:  • Reassemble pan, thermostat, standpipe, drain coupling, cover and screws into the humidifier.
With the **PDX** unit connected again to the power supply	• Operate the humidifier and check for leaks.

Changing the lamps

NOTICE

Touching quartz lamps with bare hands will severely shorten their life. Skin oils create hot spots on lamp surface. Wear clean cotton gloves when handling lamps

With the PDX unit disconnected from the power

- Remove the humidifier pan as explained in *Removing the pan*.
- Remove the screws and cover from the high-voltage compartment of the humidifier.
- Disconnect one end of the purple jumper wires.
- Using a continuity meter, locate the burned-out lamp.
- Remove the lamp brackets under the lamps.
- Loosen the two screws securing the lamp lead wires to the junction block.
- Pull the quartz lamp straight down and discard it.
- Wrap the lead wires once around the new lamp's metal ends. This will support the lamp and allow for thermal expansion.
- Insert the lead wires into the junction block and tighten the screws
- Reassemble by performing the previous operations in reverse order.

6 - Troubleshooting

Symptom	Possible cause	Check or remedy
No humidification	Humidifier pan not filling	• Check water supply
		• Check fill valve operation
		• Check drain stand pipe adjustment
		• Check for clogged water supply piping
	Control not calling for humidity	• Check status on iCOM™
	Control calling but humidifier not starting	• Check visually • If contact is made, check line voltage after contactor, fuses and circuit breakers.
		• Check for open humidifier safety stat
	Quartz lamp burned out	• Replace the quartz lamp
	Loosen lead on old quartz lamp	• Trim excess lead length on new quartz lamp to avoid shorts

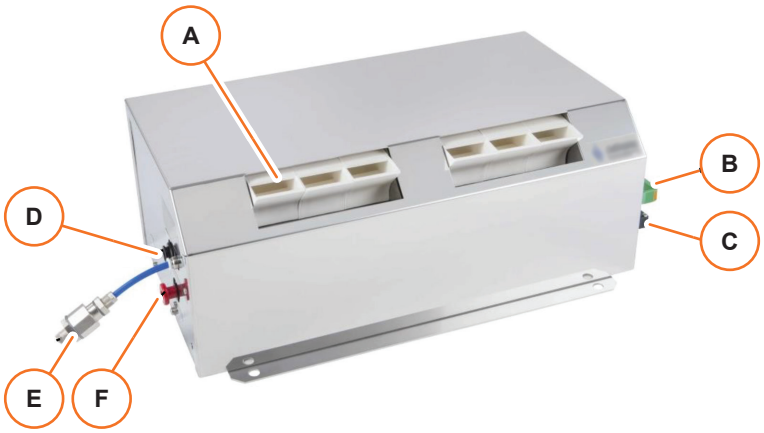
Annex H - Ultrasonic Humidifier

Content

1 - Description

NOTE *This type of humidifier is available only for units with Downflow air distribution.*

Main components



A	Mist outlet
B	Input and output for control signals
C	Input for power supply
D	Water overflow push-in connection Ø 12 mm
E	Demineralized water inlet screwed connection for Ø 6/4 mm
F	Water drainage push-in connection Ø 12 mm

Operating principle

Piezoceramic transducers are attached to the bottom of a tank filled with water.

The transducers produce ultrasonic vibrations that create capillary waves on the water surface, developing a water mist.

The air flow produced by a fan diffuses the aerosol in the ambient air.

The humidifier consists of nebulization modules, valve for the control of the supply water, float switch and a case that houses the fan.

The humidifier is provided with the following protective functions:

Dry-running	If the water level falls below minimum, humidification switch-es OFF automatically.
Overheating	Humidification switches off at water temperatures > 60°C.
Overflow	If the water tank is overfilled, the excess water is drained off to the outside.

2 - Specifications

Technical data

Ultrasonic humidifier technical data

Model	Main power Supply(1)	Capacity(2)	Transformer	Power Consumption	Absorbed Current	Number of Transducers
	[V ± 10%]	[kg/h]	[VA]	[W]	[A]	-
RB/P-16	400 V / 1 ph / 50 Hz	0 - 8,0	800,0	530,0	11,0	16

(1) The unit is equipped with an internal transformer to provide the 48 V_{AC} at the humidifier.
(2) The humidification capacity is modulated by the control based on the request.

NOTE *The ultrasonic humidifier has its own internal microprocessor, the main unit provides a 0 – 10 V_{DC} signal to regulate the capacity.*

Operating conditions

Air	Maximum air humidity	< 90 % relative humidity – no condensation
	Air temperature	5 - 45 °C
Supply water	Pure water pressure	1 - 4 bar
	Pure water quality	fully demineralized
	Pure water conductivity	5 - 20 µS/cm

NOTE *If demineralized water is not available, provide a demineralizer (not supplied). Dust or dirt must not get into the water lines.*

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

NOTICE
The demineralized water is corrosive, therefore use stainless steel or plastic only.
Non-ferrous metals (e.g. copper, brass) must not be used.

Drain water

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

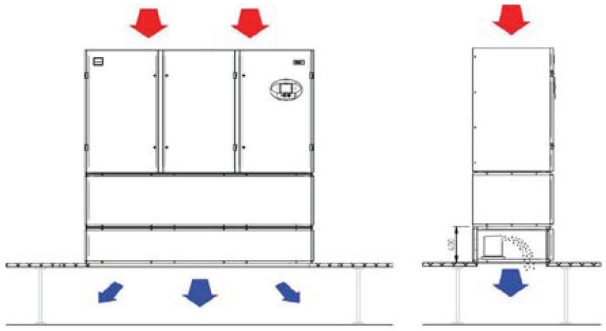
- install a siphon

3 - Installation

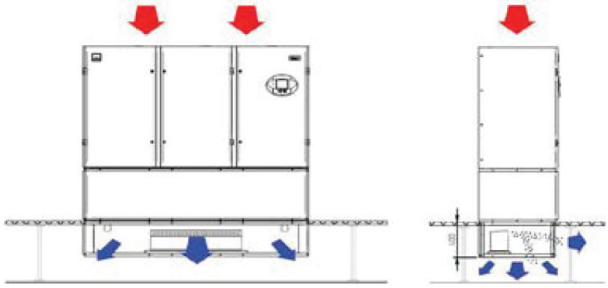
Assembly with the PDX unit

The humidifier is supplied mounted within a base module 400 mm high.

The base module with humidifier is supplied stand alone and it must be installed and connected with the **PDX** unit on field, in one of the following configurations:



On a raised floor



Under a raised floor

The sides and the back of the base module must be closed.

The front and bottom of the base module must be opened.

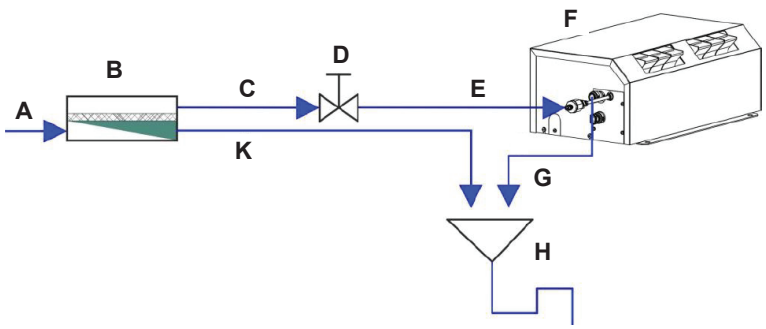
Therefore it is necessary to remove the frontal panel of the module.

A base frame, available on request, is required to support the base module (see *Annex F - Accessories*).

- Ensure 1 m of free space (without obstacles) on ultrasonic humidifier module outlet.
- For Extended Height unit, connect the fan module above the humidifier module and then the coil module above the fan module.

Connections

- Connect humidifier electrical cable, coming from the air conditioner, to the ultrasonic humidifier.
- Connect demineralization water supply, water drain, safety overflow and humidifier drain as shown in the following figure.



A	Drinking water supply (on site)
B	Demineralization system (not included with the humidifier)
C	Demineralized water inlet
D	Shut-off valve (delivered with the humidifier)
E	Plastic tube Ø 6/4 mm for demineralized water supply
F	Humidifier
G	Water overflow and discharge for plastic tube Ø 12 mm
H	Drainage (on site)
K	Concentrate

NOTICE

Demineralized water pipes must be flushed prior to commissioning the humidifier.

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 starts up automatically as soon as the **PDX** unit is switched on.
Operation	The adjustable parameters which determine the humidifier operation have already been factory-preset (see iCOM™ manual).

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.

NOTICE

Never use high pressure cleaners to clean the humidifier.

Use grease and oil-free materials only.

Never operate the humidifier without air supply.

NOTICE

If the humidifier is not used for a long period, the water must be drained off.

Periodical checks

- Check drain piping and trap for clogs.
- Check the wirings connections (inside the humidifier electric panel).
- Check the condition of the air intake filters. Clean them, if necessary.

Cleaning

Water tank	Use a clean, totally fat-free medium hard brush and clean water.
Transducers	Wipe with a soft, scratch-free cloth. Scaling or solid deposits on the transducers must be carefully removed. For that purpose, it is recommended to use 20 % formic acid. **NOTE** *Deposits are a direct consequence of inadequate water quality.*

Annex I - ATS (Automatic Transfer Switch)

Content

1 - Safety instructions

WARNING

Improper operations can cause injury or death.

NOTICE

Improper operations can cause product damage.

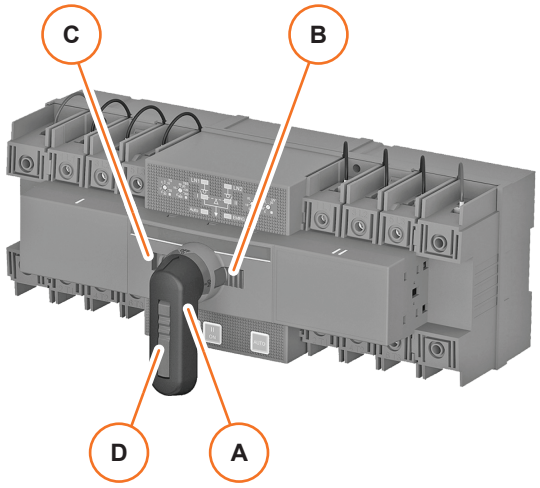
Read carefully the chapter *1. Safety*.

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

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 **PDX** 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.

Three types of ATS are available:

- Type 01: configurable through four potentiometers and DIP switches
- Type 02: Configurable through a controller
- Type 03: configurable through four potentiometers and DIP switches

3 - Specifications

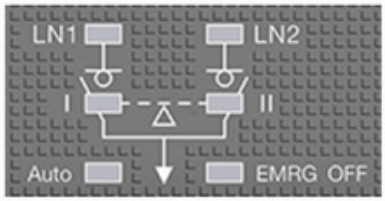
ATS type 01

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 manu¬ally 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

Button	Function	Remarks
I ON	Transfer to LN1	Only available in automatic mode and remote test mode
O OFF	Transfer to 0 position	
II ON	Transfer to LN2	
Auto	Select automatic mode, fault clearance and reset	

LEDs display



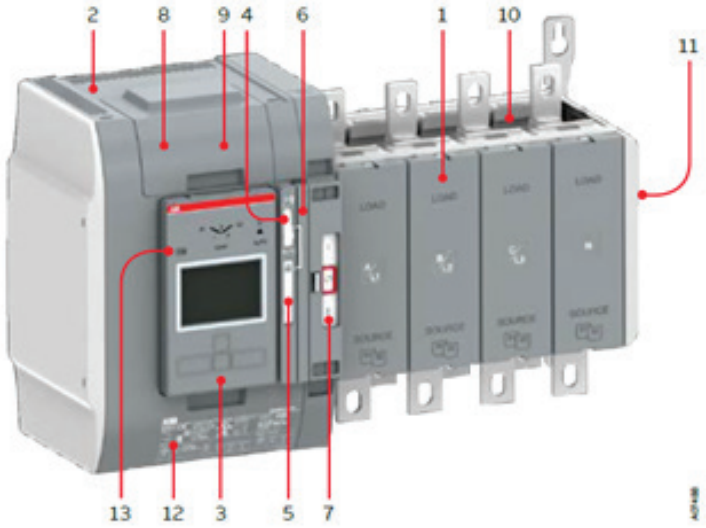
LED	Display	Status description
LN1/LN2	ON	Sourse available
	Blinking	Overvoltage, undervoltage or phase loss
	OFF	Source not available
I/II	ON	Switch I or II closed
	OFF	Switch I or II open
	Blinking	Switching failure
Auto	ON	Transfer switch in automatic mode
	Blinking	Transfer switch in test mode or 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.

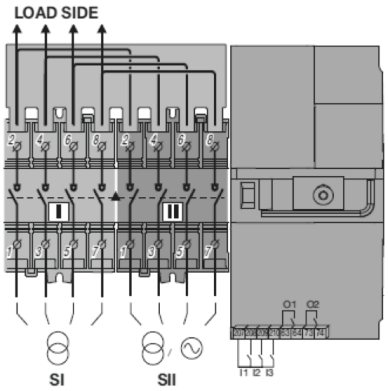
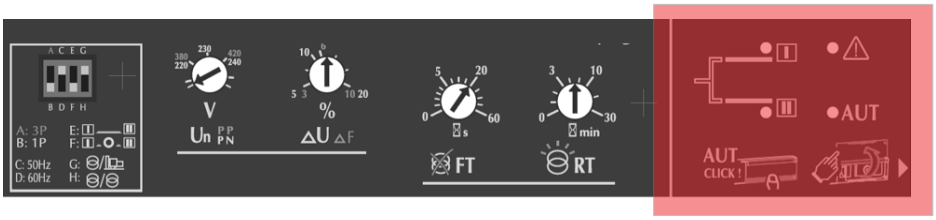
Terminal No.	Function
1, 2	Remote test: connection for at least 100 ms for the switch to enter the remote test mode.
3, 4	EMRG OFF: Input the 24VDC EMRG OFF signals for at least 1s until the switch transfers to the EMRG OFF position and the EMRG OFF LED is on. At this time, the switch cannot enter the 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 (see the No. 9 in section 4.3 for the generator stop delay setting).
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 contactz and therefore external voltage supply is required. 24VDC or up to 250VAC max. 3A AC1

ATS type 02

Power section	Fully integrated and interlocked transfer switch, with high electrical performance offering microprocessor control and monitoring.
Operation	Flexible operating mechanism enabling quick motorized transfer in automatic mode or locally in manual mode for emergency operations. A locking device ensures (in position "**O**") a secured isolation of the load.
General overview	  I - O - II (or II - O - I)

1 Transfer switch
2 Embedded ATS control unit and mechanism
3 DIP-switches, LCD or touch control interface (HMI) for configuration and automatic operation
4 Slide switch (Hand - Locking - AUTO) for selection of the operation mode
5 Padlocking the automatic transfer switch to prevent automatic and manual operation. Remark: Slide switch (Hand - Locking - AUTO) has to be in Locking-position
6 Handle for manual operation
7 Position indication
8 Terminals for control circuit connections
9 Place for Ekip-modules; communication, signaling and connectivity modules
10 Place for sensor module
11 Place for auxiliary contact blocks
12 The product identification label
13 Programming port, only for Ekip Programming and Ekip Bluetooth-modules

ATS type 03

Power section	Fully integrated and interlocked transfer switch, with high electrical performance offering microprocessor control and monitoring.
Operation	Flexible operating mechanism enabling quick motorized transfer in automatic mode or locally in manual mode for emergency operations. A locking device ensures (in position "**O**") a secured isolation of the load.
Measurement	Accuracy: frequency ±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 indicates the source availability, the fault and the state of the product as specified in the following table:

Source / State	LED ON	LED OFF	LED blinking
I	Source 1: Available	Source 1: missing or out of range	A timer is counting down or test mode
II	Source 2: Available	Source 2: missing or out of range	A timer is counting down or test mode
⚠	Fault	Product OK	Wait
AUT	Auto Mode	Manual Mode	Manual retransfer

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

Technical data

Ratings		63 A	125 A	200 A	160 A
Type		**Type 01**	**Type 01**	**Type 02**	**Type 03**
Frequencies		**50 – 60 Hz**	**50 – 60 Hz**	**50 – 60 Hz**	**50 – 60 Hz**
Thermal current I_{th} at 40°C [A]		63	125	200	160
Short-circuit capacity	Rated short-term withstand current: I_{CW} 1s [KA_{eff}]	2,5 @ 1sec	2,5 @ 1sec	18 @ 415V 0,1sec	4
	Rated short-term withstand current: I_{CW} 30ms [KA_{eff}]	Not available	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]	1200 – 1500	1200 – 1500	<500ms	180
	Duration of “Electrical Blackout” at U_n [ms]	Not available	Not available	<50ms	90
	I – O, O – I, II – O, O – II [ms]	500 - 1000	500 - 1000	1000	45
Connection cross-section	Minimum size [Cu mm^2] flexible and rigid	10	10	bolt size M8x25	10
	Maximum size [Cu mm^2] flexible and rigid	70	70	bolt size M8x25	70

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

Unit models	ATS Type	Rating
PI150 - 165	Type 02	200 A

4 - Installation

The **PDX** unit is delivered with the ATS already installed.

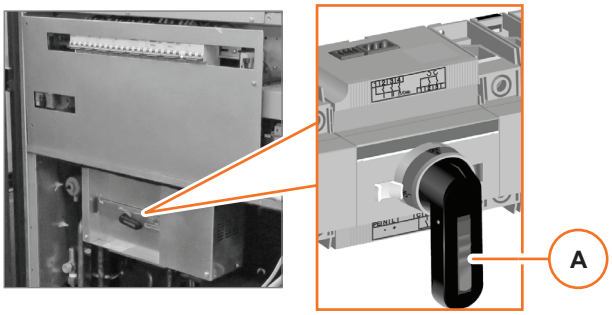
The only operation to be done on site is to connect the priority supply line and the secondary supply line to the ATS.

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 **PDX** 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 *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.

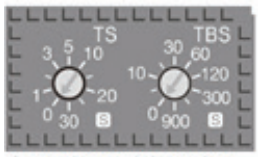


Figure 12. Rotary switch, Ts and TBs

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 %.

Figure 13. Rotary switch, OV and UV

Dip switch setting

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.

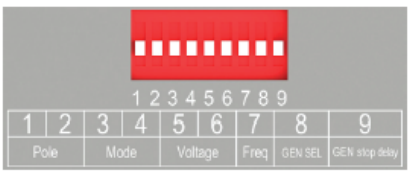


Figure 14. The 9-dip switch is used to set the working modes of transfer switch

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 = 240/415Vac	10 = 230/415Vac	11 = 220/380Vac	invalid setting
7	Frequency setting	0 = 60Hz 1 = 50Hz (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 = 240/415Vac
7	Frequency setting	1 = 50Hz (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%

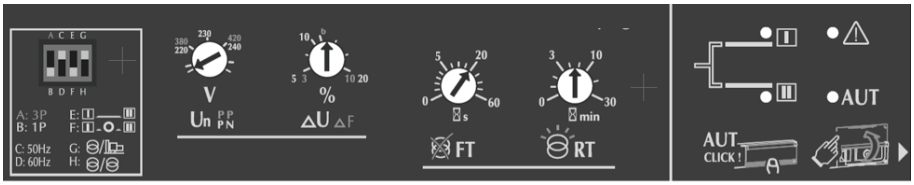
Configuration for type 02

Parameter		Setting Range
operation		
	automatic mode	OFF
	HMI Control Keys	Enabled
System parameters		
	source 1	Phase with Neutral (3ph4w)
	source 2	Phase with Neutral (3ph4w)
	rated voltage	400V
	Rated Frequency	50Hz
	Neutral Position	pole 4
	phase sequence	ABC
Device Parameters		
	In-phase Monitor	ENABLE OFF
	Synchronization DELAY	60 s
	Delay Times	
	transfer from S1 to S2 0…60 min (2* s)	3 sec

	Parameter	Setting Range
	transfer from S2 to S1 0…120 min (2* s)	300 sec
	Override S1 Fail 0...60 s (2* s)	2 sec
	Override S2 Fail 0...60 s (2* s)	2 sec
	Center-OFF 0*...300 s	0 sec
	Generator Stop 0*...60 min	0 sec
	Pre-transfer S1 to S2 0*...60 s	0 sec
	Post-transfer S1 to S2 0*...60 s	0 sec
	Pre-transfer S2 to S1 0*...60 s	0 sec
	Post-transfer S2 to S1 0*...60 s	0 sec
	Load Shed 0*...60 s	0 sec
Voltage & Frequency Setpoints	**S1 SET POINT**	
	S1 Drop-out Voltage	Upper Threshold 10%
		Lower Threshold 10%
	S1 Pick-up Voltage	Upper Threshold 10%
		Lower Threshold 10%
	S1 Drop-out Frequency	Upper Threshold 1%
		Lower Threshold 1%
	S1 Pick-up Frequency	Upper Threshold 1%
		Lower Threshold 1%
	S2 SET POINT	
	S2 Drop-out Voltage	Upper Threshold 10%
		Lower Threshold 10%
	S2 Pick-up Voltage	Upper Threshold 10%
		Lower Threshold 10%
	S2 Drop-out Frequency	Upper Threshold 1%
		Lower Threshold 1%
	S2 Pick-up Frequency	Upper Threshold 1%
		Lower Threshold 1%
Generator Exercisers		
	Exerciser 1 / 2 / 3 / 4	
	Status	Disabled
	function	no function
	duration	0....60 s
	time	Time of the exercising event
	date	Date of the exercising event
Application		
		S1-Transformer/S2-Generator*

Parameter		Setting Range
manual retransfer		off
Commit Transfer		off
Harmonics Phase		Disabled*
	MEASUREMENT	
	SWITCH DIAGNOSTICS	READ ONLY
	Parameter	**Setting Range**
	Standard I/O Settings	
	Function	Emergency Stop* (default in I 01)
		Remote Test ON Load* (default in I 02)
		Remote Test OFF Load* (default in I 03)
	contact type	**NO***
	System	
	Date	SELECT DATE
	Time	SELECT TIME
	Language	
	English	SET ENGLISH LANGUAGE
	Italian	
	French	
	German	
	Spanish	
	Russian	
	Chinese	
	New Password	
	Temperature Unit	
	Celsius*	Celsius*
	Fahrenheit	
	Display Contrast	
	10 - 100% (30 %*)	30%*

Configuration for type 03



- Open the Auto / Manual cover to set the DIP switches.

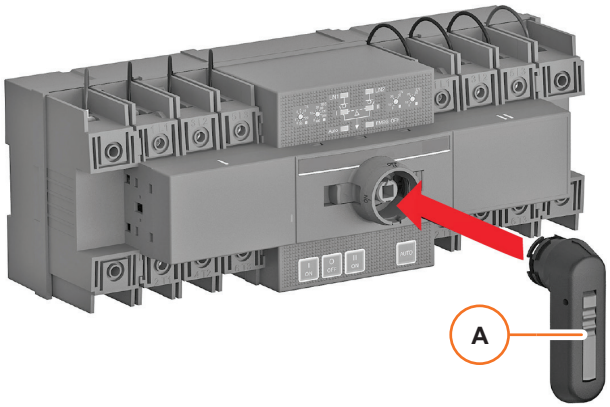
The ATS type 03 arrives pre-configured from the factory as described in the following table:

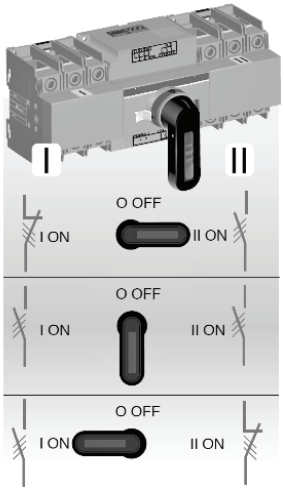
	Available configuration	Factory configuration
DIP switch 1	A: three phases B: single phase	A
DIP switch 2	C: 50 Hz D: 60 Hz	According to unit power supply
DIP switch 3	E: no stop in **0** position F: **2** seconds of stop in **0** position	E
DIP switch 4	G: Network – Genset H: Network – Network	H
Potentiometer 1	Adjustment potentiometers of the rated voltage threshold	230 – 400 V
Potentiometer 2	Adjustment potentiometers of the rated frequency threshold (as % of frequency and voltage)	10%
Potentiometer 3	Fault time, no commutation if the missing voltage time is less than the setting	3 sec
Potentiometer 4	Return time, minimum required time to return on the main/priority line	300 sec

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

5 - Operation

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.

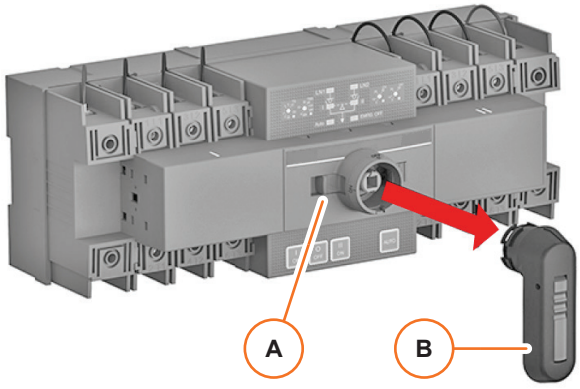
You may turn the handle to each of the following positions:

I - priority power supply

O - power supply disconnected

II - secondary (alternate) power supply

Automatic mode



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

Now the power supply is normal.

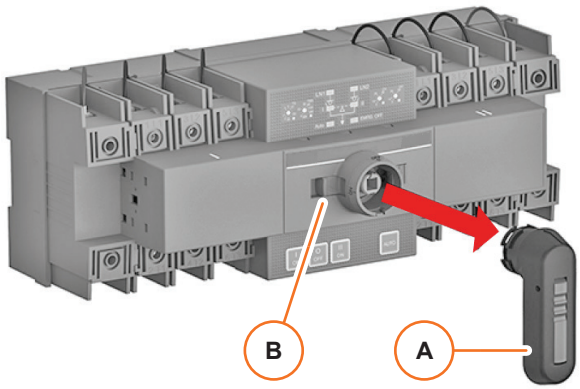
During the initial power-up the ATS will be in automatic mode and it will switch to the primary line.

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:

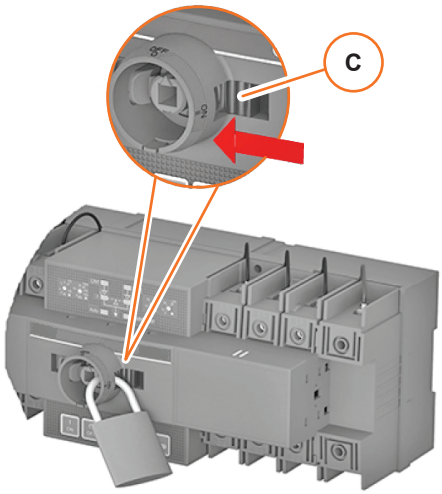
I - priority power supply

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.

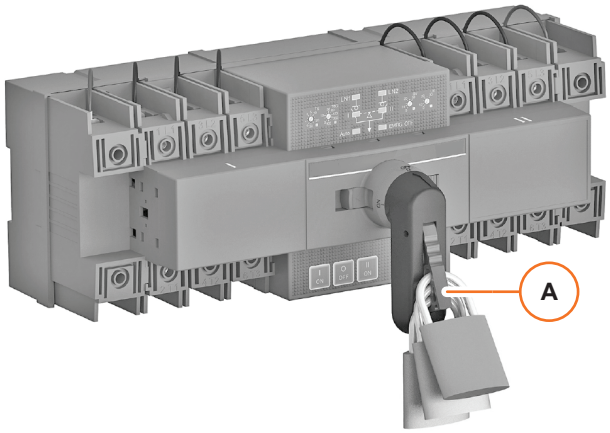


- Push the latch [**C**].
- Insert a padlock in the switch.

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 [**A**].
- 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.*

6 - Maintenance

Periodic checks and operations

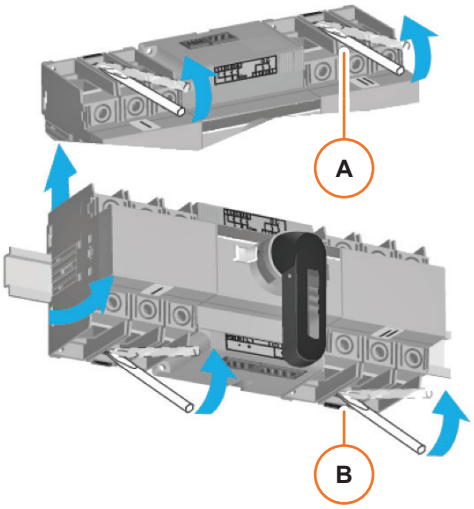
- Check if the electrical connections are tight.
- Tighten any loosen connection.

Replacement

The ATS fault is indicated by the LEDs as following:

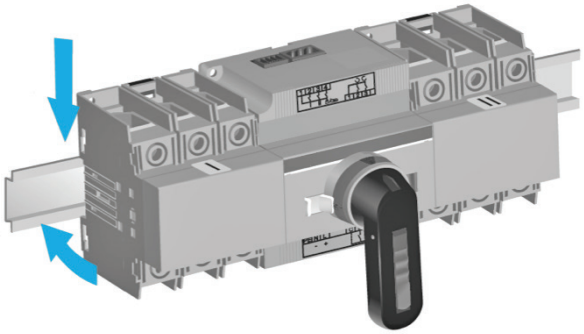
- ATS type 01: both LEDs are **OFF**.
- ATS type 03: the “Fault” LED IS **ON**

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 PDX 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
- For the ATS type 03: adjust the configuration settings.
- Connect the **PDX** unit to the power supply.
- Restart the **PDX** unit.

7 - Troubleshooting

ATS type 01

Symptom	Possible Cause	Check or remedy
Power supply functioning normally, but LED not ON	Control unit power supply terminal not connected with switch wiring terminal	Check and connect the switch wiring terminal
Transition failure in case of faulty power supply	• Switch not operating in “AUTO” mode • Both power supplies malfunctioning	Make sure the switch is working in “AUTO” mode. Make sure that both power supplies are not malfunctioning simultaneously.

ATS type 02

Alarms

Symptom	Possible Cause	Check or remedy
Locked, Alarm LED on	Lock input activated	Unlock
Switch not in AUTO mode, Alarm LED on	"Slide switch is in handle or lock position"	Turn slide switch into the AUTO position
Phases crossed	"Phase rotation of sources 1 and 2 are different"	"Connect the phases of both sources in the same order"
S1 undervoltage	Voltage of source 1 is under the threshold level set in parameter “Drop- out voltage, lower threshold“	"Check the correlation between power source and device configuration"
S1 overvoltage	Voltage of source 1 is over the threshold level set in parameter “Drop- out voltage, upper threshold“	"Check the correlation between power source and device configuration"
S1 phase missing	"One or two phases of source 1 are missing"	"Check the power source and connections"
S1 unbalance	Phases of source 1 are not symmetric	Check the power source
S1 phase rotation	"Phase rotation of source 1 is different from the value of parameter “Phase sequence“"	"Connect the phases according to the configuration"
S1 invalid frequency	Frequency of source 1 is out of range set in parameters “Drop-out frequency, upper threshold“ and “Drop-out frequency, lower threshold“	"Check the correlation between power source and device configuration"
S2 undervoltage	Voltage of source 2 is under the threshold level set in parameter “Drop- out voltage, lower threshold“	"Check the correlation between power source and device configuration"
S2 overvoltage	Voltage of source 2 is over the threshold level set in parameter “Drop- out voltage, upper threshold“	"Check the correlation between power source and device configuration"
S2 phase missing	"One or two phases of source 2 are missing"	"Check the power source and connections"
S2 unbalance	Phases of source 2 are not symmetric	Check the power source
S2 phase rotation	"Phase rotation of source 2 is different from the value of parameter “Phase sequence“"	"Connect the phases according to the configuration"

Symptom	Possible Cause	Check or remedy
Frequency Difference	"Frequency difference of voltage sources is greater than 3 Hz while in-phase monitor is on"	"Check the correlation between power source and device configuration"
S2 invalid frequency	Frequency of source 2 is out of range set in parameters “Drop-out frequency, upper threshold“ and “Drop-out frequency, lower threshold“	"Alarm is active and transfer operations disabled as long as the high current status remains"
High current alarm	"Measured current is higher than ten times the nominal value"	Reset alarm by pressing Auto button or via menu page Operation / Alarm Reset
"Open I failure, Alarm LED blinking"	"Switch transfer from position I to O or II failed"	Reset alarm by pressing Auto button or via menu page Operation / Alarm Reset
"Close I failure, Alarm LED blinking"	Switch transfer to position I failed	Reset alarm by pressing Auto button or via menu page Operation / Alarm Reset
"Open II failure, Alarm LED blinking"	"Switch transfer from position II to O or I failed"	Reset alarm by pressing Auto button or via menu page Operation / Alarm Reset
"Close II failure, Alarm LED blinking"	Switch transfer to position II failed	Switch service needed
Switch position alarm, Alarm LED on	More than one switch position indication inputs are activated	Switch service needed
Pole temperature alarm	Measured pole temperature is too high	Switch service needed
Contact wear alarm	Switch contact wear is near the limit that requires maintenance	Check connection
Local bus	"Communication between HMI and switch controller is off"	Check connection
Ethernet disconnected	Ethernet module not connected	"Alarm is active and disables transfer operations as long as the input is active"
Fire Fighting	Fire fighting input activated	Check power source
"Control Voltage Failure"	"Control voltage dropped during switch control"	Check power source
Control Voltage Low	"Switch control voltage is below the minimum"	Check parameter values
Configuration Error	Invalid configuration	Check configuration file
IEC 61850 Error	IEC 61850 failure	Check configuration
Ekip Com Hub Alarm	Ekip Com Hub failure	Ekip Com Hub failure

Warnings

Message	Reason
S1 and S2 not in sync	Voltage sources are not synchronized
Voltage Not Calibrated	Calibration data in power module is invalid or unavailable
Current Not Calibrated	Calibration data in current measurement module is invalid or unavailable
Pole temperature warning	Measured pole temperature is near the alarm level
Control Retry	Failed transfer sequence retry activated
Auto Control Disabled	Device is in manual operating mode
Local Bus	Module heartbeat error

Message	Reason
Configuration	Configuration session ports are open
RTC capacitor charging	Real time clock is not yet operational, date & time setting is disabled as long as this warning is active. RTC capacitor is charged from source voltage (not AUX) and takes about 10 minutes

ATS type 03

Symptom	Possible Cause	Check or remedy
The “Priority SOURCE availability” LED does not come ON	DIP switches not set correctly	Set the DIP switch according to electrical diagram
	Wrong nominal voltage	Measure the voltage across the terminals and report the value on the potentiometer
The “Emergency SOURCE availability” LED does not come ON	DIP switches not set correctly	Set the DIP switch according to electrical diagram
	Wrong nominal voltage	Measure the voltage across the terminals and report the value on the potentiometer
The product remains switched off after the “Priority SOURCE” is lost	The voltage across the power supply terminal of the emergency mode is not between 176 to 288 V_{ac}	Check it through a potentiometer
	In case of transformer/Genset, check that FT timer (Main Failure Timer) has finished counting down.	Check the setting of the failure timer.
The product remains switched off after the “Priority SOURCE” is lost	The product is in manual mode.	Make sure the switch is working in “AUTO” mode.
	The automatic operation is inhibited by an external control command.	Check the configuration of the remote control.
	The LED “AUT” and “Emergency SOURCE availability” are lit.	Check the power line status.
The product remains switched off after the “Priority SOURCE” is restored	The product is in manual mode.	Make sure that the switch is working in “AUTO” mode.
	The automatic operation is inhibited by an external control command.	Check the configuration of the remote control.
	The LED “Primary SOURCE Availability” is lit.	Check the power line status.
	The Main Return Timer (RT) could be set between 0 – 30 minutes	Check that RT is set correctly.
	“Manual retransfer” is activate.	Check the “Manual Retransfer” function.
Return to “Priority SOURCE” has been execute, but the “Emergency SOURCE” (for a generator) continues to operate	The product is in manual mode.	Make sure the switch is working in “AUTO” mode.
	CDT (cool down timer) has not finished counting down – Fixed time delay 4 minutes.	Check the stopwatch.
	The automatic operation is inhibited by an external control command.	Check the configuration of the remote control.

Symptom	Possible Cause	Check or remedy
The product cannot be switched over using the handle	Wrong rotation handle	Check the rotation handle
	The product is Padlocked	Check that the product is not padlocked
Automatic mode is not activated even when the cover is closed	The “AUT” LED is not lit	Check that the plastic pin is in place at the bottom of the cover. This pin activates the sensor which indicates the position of the cover (open or closed).

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