HEcu sistema

High efficiency condensing unit

CAREL

ENG

Installer manual

LEGGI E CONSERVA QUESTE ISTRUZIONI

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NO POWER & SIGNAL CABLES TOGETHER

READ CAREFULLY IN THE TEXT!

High Efficiency Solutions

Content

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1. INTRODUCTION

This guide is intended to provide support during installation and configuration of the Hecu sistema. For information on system design, see the OEM manual +0300023EN.

The document is divided into three parts:

1. Initial system configuration: a detailed explanation of each step and a complete practical example with comments.
2. Condensing unit and indoor refrigeration unit optimisation with CAREL MPXPRO controller.
3. Troubleshooting. A list of the most common problems and possible solutions.

Advanced system configuration includes the following CAREL products:
- pRack Hecu for controlling the condensing unit;
- power+ inverter for controlling DC compressors;
- EEV single-pole valves for the and liquid or vapour injection;
- MPXPRO for controlling the evaporator;
- EEV two-pole valves for superheat control.

With basic knowledge of these products, the full potential of the system can be exploited. Nonetheless, the solution has been designed so as to minimise the operations needed to modify the default values defined in the software.

It must be underlined that certain features of the system may involve optimisations that require certain values to be changed from the default settings. This document provides a guide to make such optimisation procedures simple and effective.

2. INITIAL SYSTEM CONFIGURATION

This chapter provides details on configuring the complete system, starting from the configuration of each individual unit, up to commissioning the integrated solution.

The procedure has been divided into three stages, which are typically carried out by different people at different times:

1. Condensing unit configuration. Typically performed by the manufacturer on completion of the production process.
2. Refrigerated unit configuration. This unit may already be configured by the manufacturer, or may require configuration in the field by the installer.
3. Integrated system configuration: condensing and refrigerated unit. Typically performed by the installer directly in the field.

A practical example is used to describe the complete procedure for the initial configuration of a medium temperature system fitted with backup compressor and connected to three refrigerated units.

2.1 Condensing unit configuration

The following diagram shows the various steps involved, which are then described in detail in the rest of the paragraph.

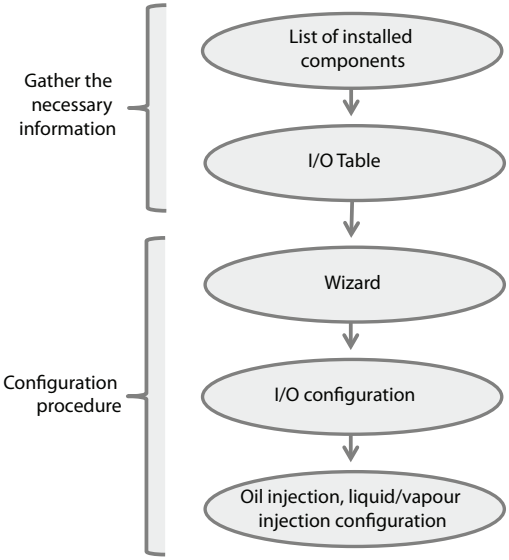


Fig. 2.a

2.1.1 Gather the necessary information

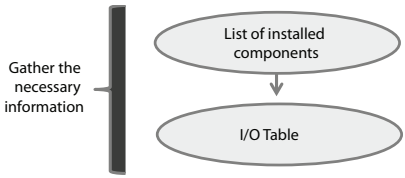


Fig. 2.b

Before configuring the condensing unit, all the information needed to correctly and quickly complete the procedure needs to be gathered.

2.1.2 List of installed components

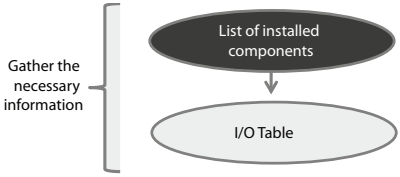


Fig. 2.c

Below is a list of the main components installed on the condensing unit. Knowledge of these components is essential when configuring the unit.

Information needed	Possible values	Example
Model of DC compressor	Technical leaflet +050001835 available at www.carel.com	ANB52FKPMTS
Model of power+ inverter	PSD1018400, PSD1024400, PSD1035420	PSD1024400
Backup compressor	INSTALLED/NOT INSTALLED	INSTALLED
Number of fans	1-2	1
Type of fans	ON-OFF, EC FAN 0-10V, PWM	EC FAN 0-10V
Type of oil injection valve	Capillary, solenoid, CAREL EEV	CAREL EEV
Type of oil separator	Standard separator, separator with double level sensor	Separator with double level sensor
Type of liquid (MT) or vapour (LT) injection valve	Capillary, solenoid, CAREL EEV	CAREL EEV

Tab. 2.a

2.1.3 I/O table

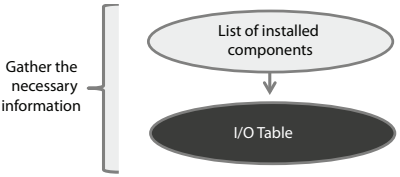


Fig. 2.d

Next it is essential to identify the table of digital and analogue inputs and outputs installed. The following general connection diagram is a practical example for preparing the unit wiring diagram that fully exploits the software pre-configurations available in the Hecu sistema.

General connection diagram

PAY ATTENTION TO THE POWER SUPPLY!

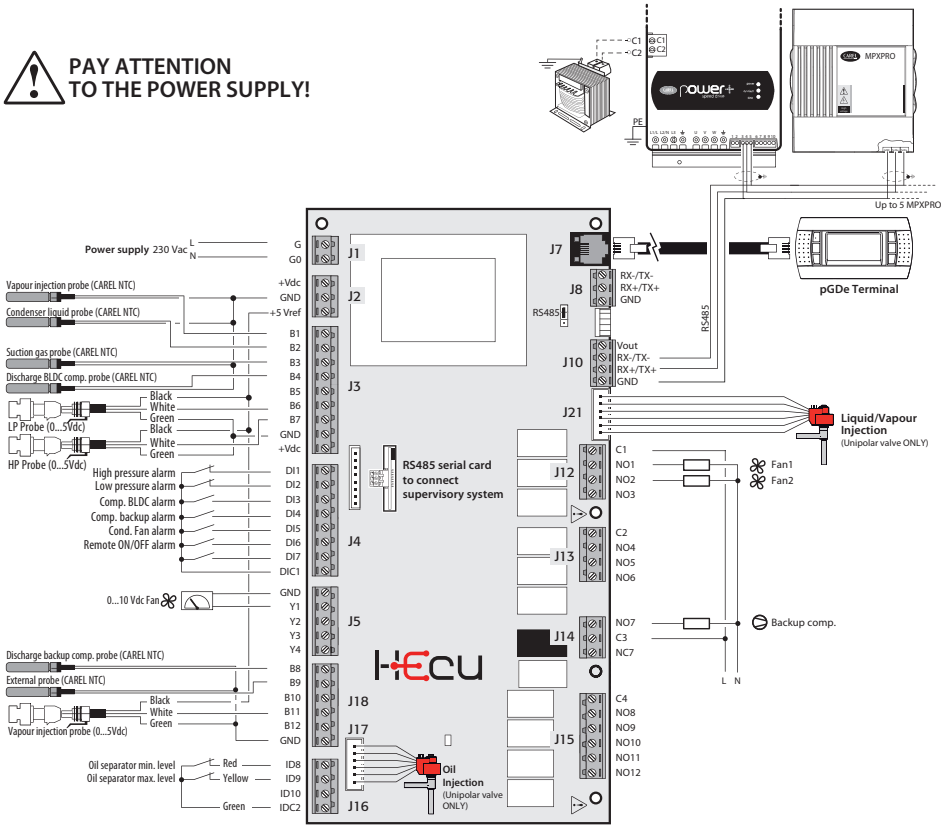


Fig. 2.e

(*) 4-20 mA pressure probes need to be connected with the white to the analogue input and the black to +Vdc, with green not used

Table of inputs and outputs configured:

I/O type	Description	Example position, type, logic, limits
Digital inputs	High pressure alarm	ID1, NO logic
	Low pressure alarm	ID2, NO logic
	BLDC comp. alarm	ID5, NO logic
	Backup comp. alarm	-
	Fan alarm	ID7, NO logic
	Remote ON-OFF	-
	Separator minimum oil level	ID8, NC logic
	Separator maximum oil level	ID9, NC logic
Analogue inputs	Steam injection temp. (LT)	-
	Liquid temp.	B2, NTC
	Suction temp.	B3, NTC
	BLDC discharge temp.	B4, HTNTC
	Suction press.	B6, 0-5Vdc, 0 to 17.3 barg
	Condensing press.	B7, 0-5Vdc, 0 to 45 barg
	Backup discharge temp.	B8, HTNTC
	Outside temp.	B9, NTC
	Steam injection press. (LT)	-
Digital outputs	Fan 1	-
	Fan 2	-
	Backup compressor	DO7, NO logic
Analogue outputs	Modulating fans	AO1, 0-10V

Tab. 2.b

2.1.4 Configuration procedure

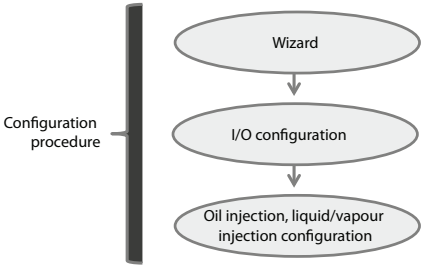


Fig. 2.f

The condensing unit configuration procedure is based on a series of guided questions, commonly referred to as a wizard. At the end of the wizard, the default input and output configurations are checked before configuring oil and liquid injection based on the components installed.

2.1.5 Wizard

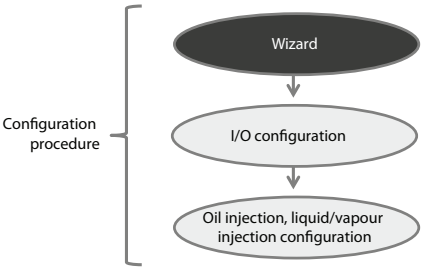
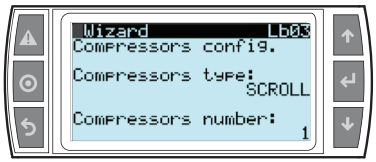


Fig. 2.g

When starting the unit for the first time, or after having downloaded the default values from the main menu i.d., the wizard will be displayed.

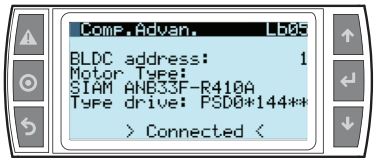
The procedure is analysed in the example shown below.

Procedure:	Example:
Screen Lb01: indicates the type of system, either medium or low temperature.	Select MEDIUM TEMPERATURE
Screen Lb03: indicates the type and number of compressors.	Select SCROLL and 1
Screen Lb04: indicates the type of modulating device associated with the compressor selected on the previous screen.	Select BLDC.



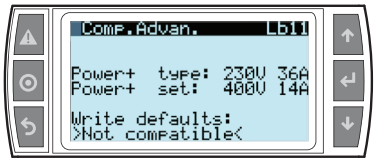
Procedure:

Screen Lb05: indicates the model of BLDC compressor and the serial address of the power+ inverter (always=1). This is used to understand whether the inverter is on and connected via serial with the pRack Hecu.



Example:
Select ANB52FKPMTS

Screen Lb11: indicates whether the model of inverter connected is compatible, and if so, automatically downloads some typical parameters relating to the model of compressor onto the inverter. The parameters can also be written manually by selecting "Yes" for Write default.



Select YES and wait for the default values to be downloaded.

Important: wait a few seconds for the automatic default download procedure to begin and then conclude.

Screen Lb07: indicates the set point and differential for controlling the compressors selected as default by CAREL based on the type of application and refrigerant used. The type of control is always proportional plus integral, and when exiting the wizard, control will be fixed set point only until communication with the showcases is configured, which allows the floating suction pressure set point function to be implemented.

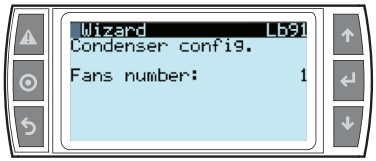
Leave the default values.

Screen Lb10: indicates that a backup compressor has been enabled in the event of alarms on the main compressor.

Select YES

Procedure:

Screen Lb91: indicates the number of fans. A maximum of 2 fans can be selected.



Example:
Select 1

Screen Lb92: indicates the type of fans, either ON-OFF or modulating (PWM or 0-10V).

Select 0-10V EC INVERTER FAN.

Screen Lb96 Lb97: indicates the type of control and the working set point and differential.

Leave the default values.

Screen Lb93: indicates the end of the wizard. Press ENTER to exit the procedure and configure the system based on the options selected previously.

Press ENTER

2.1.6 I/O configuration

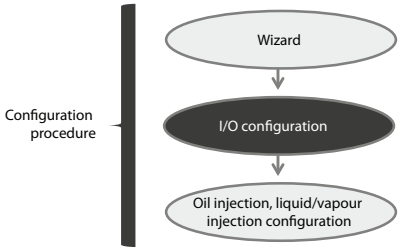


Fig. 2.h

At the end of the wizard, some of the I/Os defined as being essential for condensing unit control will be set by default in the recommended positions, as shown on the general connection diagram proposed by Carel. This default configuration needs to be checked, then adding any additional probes or changing the settings if choosing to modify the default configuration proposed by Carel.

These modifications can be made by going to the input/output→status .menu. The default value of the password for accessing the menu is 0000.

When checking and configuring the I/Os, it is recommended to carry out tests to verify correct operation and wiring.

Example:
Access the input/output→status menu, entering the password 0000.

The following I/Os will be configured automatically at the end of the wizard:

I/O type	Description	Example position, type, logic, limits
Digital inputs	-	-
Analogue inputs	Suction temp.	B3, NTC
	BLDC discharge temp.	B4, HTNTC
	Suction press.	B6, 0-5vdc, 0 to 17.3 barg
	Condensing press.	B7, 0-5vdc, 0 to 45 barg
	Backup discharge temp.	B8, HTNTC
Digital outputs	Backup compressor	DO7, NO logic
Analogue outputs	Modulating fans	AO1, 0-10V

Tab. 2.c

The following I/Os then need to be configured manually:

I/O type	Description	Example position, type, logic, limits
Digital inputs	High pressure alarm	ID1, NO logic
	Low pressure alarm	ID2, NO logic
	BLDC comp. alarm	ID5, NO logic
	Backup comp. alarm	ID6, NO logic
	Fan alarm	ID7, NO logic
	Separator minimum oil level	ID8, NC logic
	Separator maximum oil level	ID9, NC logic
Analogue inputs	Liquid temp.	B2, NTC
	Outside temp.	B9, NTC

Tab. 2.d

2.1.7 Oil injection, liquid/vapour injection configuration

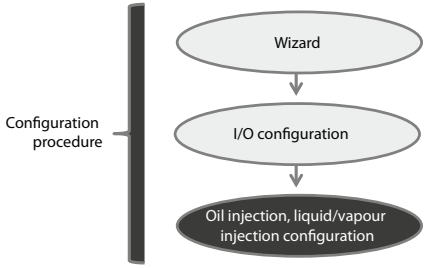


Fig. 2.i

Based on the design of the condensing unit, the following components may be installed:
- Standard oil separator or with double level sensor.
- Oil injection with capillary or Carel EEV.
- Liquid injection with capillary or solenoid valve or Carel EEV.

The configuration of these two functions can then be completed in the other function submenu, under items **"oil"** and **"injection"**.

For oil injection, the type of valve installed needs to be set:
- **"Capillary",** no configuration required;
- **"Solenoid"**, digital input configuration required. The default values for the ON and OFF time are then proposed;
- **"EEV comp speed"**, no configuration required. Proportional opening, from a minimum value to a maximum value in relation to DC compressor operating speed;
- **"EEV level mng"**, the two digital inputs from by advanced oil separator need to be configured. Calibrated opening based on an optimised algorithm, between the minimum and maximum opening values set by default.

For liquid injection (MT), the type of valve installed needs to be set:
- **"Capillary",** no configuration required;
- **"Solenoid"**, digital input configuration required. The default value of the activation threshold in relation to compressor discharge temperature is then proposed;
- **"EEV valve"**, no configuration required. Proportional opening, from a minimum value to a maximum value in relation to compressor discharge temperature. These values can be modified on **screen Fdab04.**

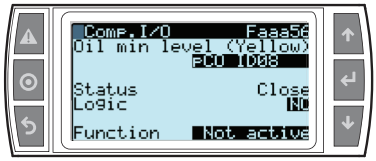
For vapour injection (LT), the type of valve installed will always be:
- **"EEV valve"**, requires installation of a temperature probe and a pressure probe on the economizer outlet for calculating superheat. These probes are already configured in default positions B1 and B11. Opening based on superheat at the by economizer outlet and, if needed, proportional from the current value to a maximum value in relation to compressor discharge temperature.

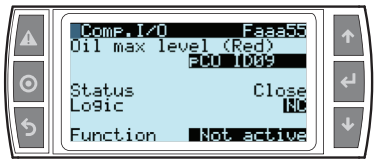
Example:
The oil separator installed is an advanced separator with double level sensor.
Access the OTHER FUNCTION→Oil menu.

In the input/output menu, set the digital inputs corresponding to the minimum oil level and to the maximum oil level.

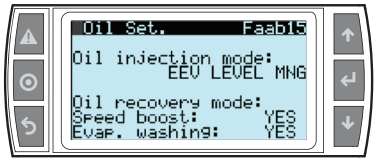
I/O type	Description		Example position, type, logic, limits
Digital inputs	Separator minimum oil level		ID8, NC logic
	Separator maximum oil level		ID9, NC logic

Tab. 2.e

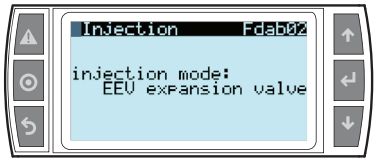




In the setting menu, set the type of valve. In the example shown, this a Carel EEV valve plus oil separator with double level sensor. Then select EEV LEVEL MNG.



Then go to OTHER FUNCTION→injection.



In the setting menu, set the type of valve. In the example shown, this a Carel EEV valve. Then select EEV EXPANSION VALVE.

Note: it is recommended to use the default values optimised by Carel for commissioning, evaluating the possibility of optimisation following a sufficiently long period of analysis.

2.2 Refrigerated unit configuration

In order to connect the condensing unit to the refrigerated unit, this must be fitted with an MPXPRO controller and an EEV electronic expansion valve.

The MPXPRO controller can be configured by the installer directly in the field, or by the showcase manufacturer. These two alternatives require two different procedures to be followed by the installer, as described below.

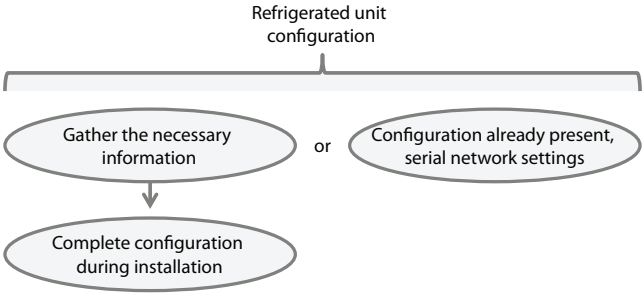


Fig. 2.j

2.2.8 Gather the necessary information

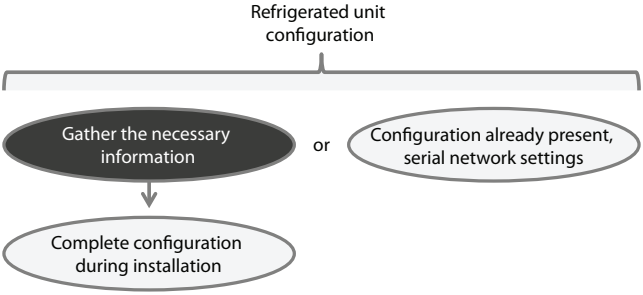


Fig. 2.k

The following general connection diagram is a practical example for preparing the refrigerated unit wiring diagram that fully exploits the software pre-configurations available on the MPXPRO controller.

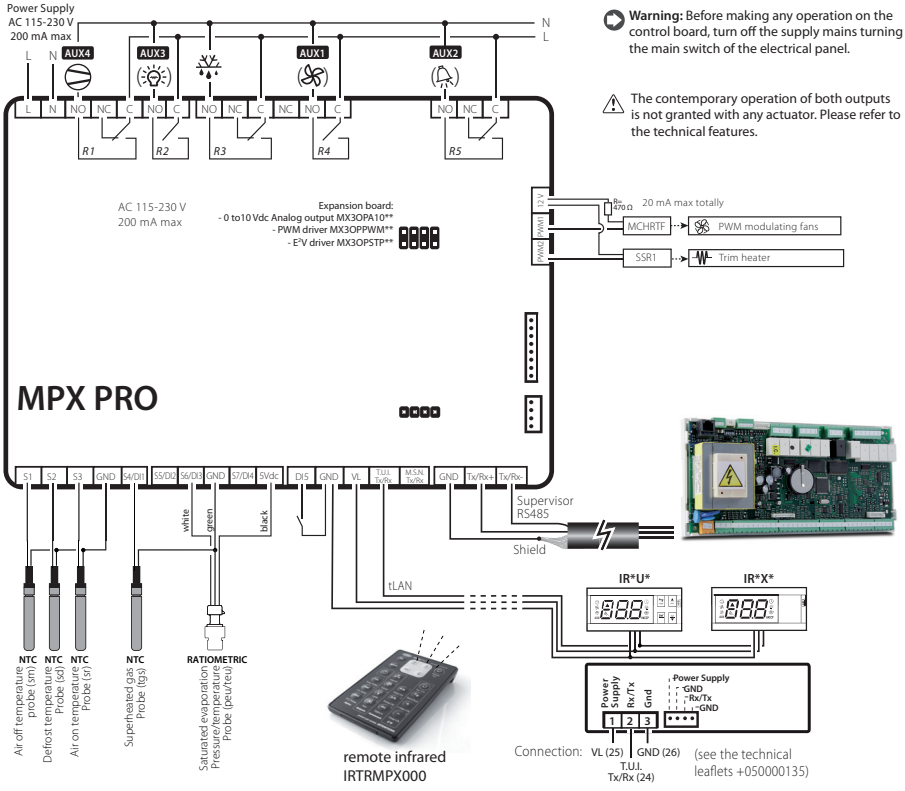


Fig. 2.l

The table below lists the information needed before configuring the refrigerated unit:

Information needed	Example
Number of units	3, same configuration
Type of refrigerant	R410a
Type of valve	CAREL EEV
Outlet temp. probe (Sm - Air OFF)	S1, NTC
Defrost temp. probe (Sd)	S2, NTC
Intake temp. probe (Sr - Air OFF)	S3, NTC
Superheated gas temp. probe (Tgs)	S4, NTC
Evaporation pressure (Peu/Teu)	S6, 0 to 5Vdc 0 to 17.3 barg

If each of the units has different probe configurations, it is recommended to complete the table separately for each unit. In the example shown, the three units have the same connection diagram.

2.2.9 Complete configuration during installation

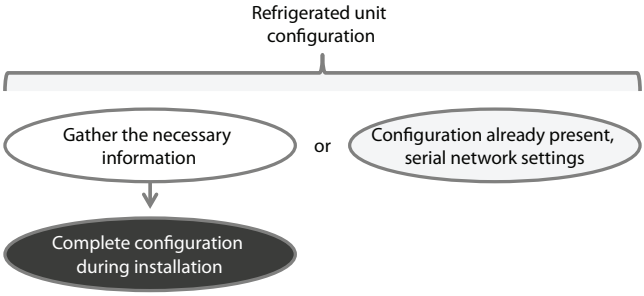


Fig. 2.m

Complete configuration of the MPXPRO is performed using the guided procedure shown when the controller is first started. This procedure needs to be completed on a user terminal connected to the MPXPRO

The guided configuration procedure can also be repeated at any time, powering off the controller, holding the "Prg" button and then powering it on again. Keep holding "Prg" until the value "0" is shown on the display, and confirm by pressing "Set".
This procedure deletes the previous settings saved on the controller.

The guided procedure starts with parameter "/P2" shown on the display.

Procedure:

/P2: Type of probe, group 2 (S4,S5)
Selects the type of temperature probe for inputs S4, S5.

Par.	Description	Def	Min	Max	UOM
/P2	Type of probe, group 2 (S4, S5) 0 = NTC Standard Range –50T90 °C 1 = PTC Standard Range –50T150 °C 2 = PT1000 Standard Range –50T150 °C 3 = NTC L243 Standard Range –50T90 °C	0	0	3	-

Example:

Select **"0"** and confirm by pressing **"Set"**.

Procedure:

/P3: Type of probe, group 3 (S6)

Selects the type of temperature or ratiometric pressure probe for input S6.

Par.	Description	Def	Min	Max	UOM
/P3	Type of probe, group 3 (S6) 0 = NTC Standard Range –50T90 °C 1 = PTC Standard Range –50T150 °C 2 = PT1000 Standard Range –50T150 °C 3 = NTC L243 Standard Range –50T90 °C 4 = 0 to 5 V ratiometric probe	0	0	4	-

Example:

Select **"4"** and confirm by pressing **"Set"**.

/Fd: Assign tGS (superheated gas temperature probe)

Assigns the probe used to measure the superheated gas temperature at the evaporator outlet.

Par.	Description	Def	Min	Max	UOM
/Fd	Assign tGS (superheated gas temperature)	0	0	11	-

Select **"4"** and confirm by pressing **"Set"**.

/FE: Assign PEu/tEu (saturated evaporation pressure/temperature probe)

Assigns the probe used to measure the saturated evaporation pressure/temperature, which by default is the probe connected to input S6. It is recommended to use the 0 to 5 Vdc ratiometric probe.

Par.	Description	Def	Min	Max	UOM
/FE	Assign PEu/tEu (saturated evaporation pressure/temperature probe), see /Fd	0	0	11	-

Select **"6"** and confirm by pressing **"Set"**.

/U6, /L6: Maximum / minimum value of probe S6

Parameters /L6 and /U6 are used to set the maximum and minimum limits for the range of measurement of the probe connected to input S6.

Par.	Description	Def	Min	Max	UOM
/U6	Maximum value of probe 6	9.3	/L6	160	barg, RH%
/L6	Minimum value of probe 6	-1.0	-20	/U6	barg, RH%

For /UL select **"17.3"** and confirm by pressing **"Set"**.
For /L6 select **"0"** and confirm by pressing **"Set"**.

P1: Type of expansion valve

MPXPRO can control the CAREL E2V electronic valve.
The CAREL electronic expansion valve is required in the Hecu sistema, and therefore this parameter must always be set to "2".

Par.	Description	Def	Min	Max	UOM
P1	Electronic valve 0 = not present 1 = PWM valve 2 = CAREL E2V valve	0	0	2	-

Select **"2"** and confirm by pressing **"Set"**.

Procedure:

PH: Type of refrigerant

The type of refrigerant is essential for calculating superheat. It is also used for calculating the evaporation and condensing temperature based on the pressure probe reading. The following table shows the refrigerants that are allowed and corresponding compatibility with the CAREL E2V valve.

Par.	Description			Def	Min	Max
PH	Type of refrigerant			3	0	25
	0 = Custom gas	9 = R600a	18= R423A			
	1 = R22	10 = R717	19= R407A			
	2 = R134a	11 = R744	20= R427A			
	3 = R404A	12 = R728	21= R245Fa			
	4 = R407C	13 = R1270	22= R407F			
	5 = R410A	14 = R417A	23 = R32			
	6 = R507A	15= R422D	24 = HTR01			
	7 = R290	16= R413A	25 = HTR02			
	8 = R600	17= R422A				

Example:

Select **"5"** and confirm by pressing **"Set"**..

In: Type of unit

Parameter In assigns the controller the function of Master or Slave. Hecu sistema only accepts MPXPRO master controllers, therefore this parameter must always be set to "1".

Par.	Description	Def	Min	Max	UOM
In	Type of unit: 0 = Slave; 1 = Master	0	0	1	-

Select **"1"** and confirm by pressing **"Set"**.

Sn: Number of slaves in the local network

This parameter tells the Master controller how many Slave controllers need to be managed in the local network. Hecu sistema only accepts MPXPRO master controllers, therefore this parameter must always be set to "0".

Par.	Description	Def	Min	Max	UOM
Sn	Number of slaves in the local network : 0 = no Slave	0	0	5	-

Select **"0"** and confirm by pressing **"Set"**.

H0: Serial or Master/Slave network address

Parameter H0 indicates the MPXPRO serial address.

Par.	Description	Def	Min	Max	UOM
H0	Serial or Master/Slave network address	199	0	199	-

Select **"11"** and confirm by pressing **"Set"** for the first unit.
Select **"12"** and confirm by pressing **"Set"** for the second unit.
Select **"13"** and confirm by pressing **"Set"** for the third unit.

The addresses must follow a logical order, starting from "11" and increasing sequentially.

Device	Address
MPXPRO 1	11
MPXPRO 2	12
MPXPRO 3	13
MPXPRO 4	14
MPXPRO 5	15

End procedure

Press "**Prg/mute**" for 5 seconds to exit the guided commissioning procedure.

Press and hold "Prg" for 5 seconds.

2.2.10 Configuration already present, serial network settings

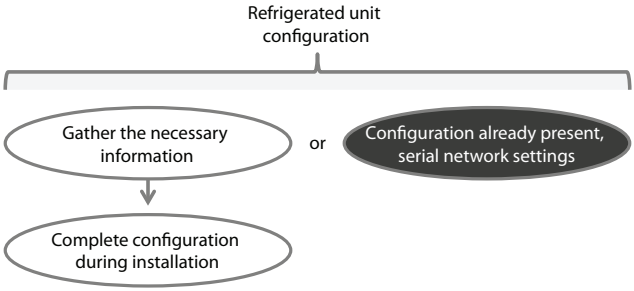


Fig. 2.n

If the MPXPRO controller has already been configured by the manufacturer, the serial address of each unit needs to be modified, as shown in the following diagram.
This will allow the devices to be recognised by the main condensing unit controller when setting up the serial network.

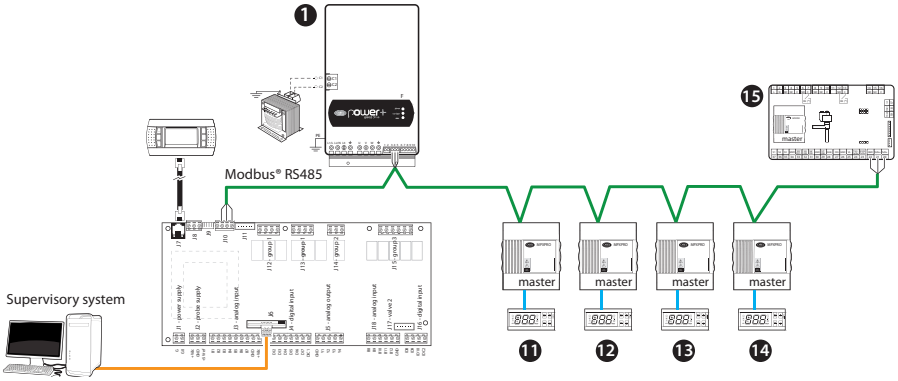


Fig. 2.o

The MPXPRO serial address can be modified as follows:

- press **"Prg"** and **"Set"** together for 5 seconds;
- enter the password **"33"** and press **"Set";**
- press **"Prg"** to access the menus;
- use the arrows to scroll to menu **"Cnf"** and enter by pressing **"Set";**
- use the arrows aux to scroll to parameter **"H0"** and enter by pressing "**Set";**
- use the arrows to scroll to the desired address and confirm by pressing **Set";**
- save and exit the menu by holding **"Prg"** for 5 seconds.

2.3 Integrated system configuration: condensing unit and refrigerated units

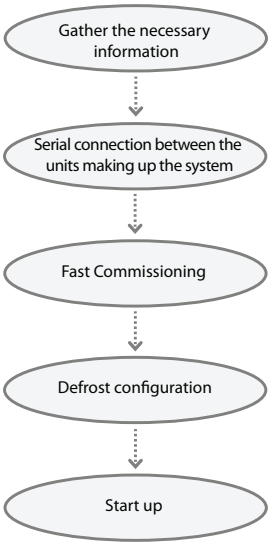


Fig. 2.p

Once having configured the condensing unit and the refrigerated unit, the integrated system needs to be configured before starting. This involves setting up the serial network and completing the Fast Commissioning procedure for setting the optimised default configuration of the Hecu sistema. Finally, after having evaluated the system operating conditions, the correct defrost mode needs to be set. The system can then be started.

2.3.11 Gather the necessary information

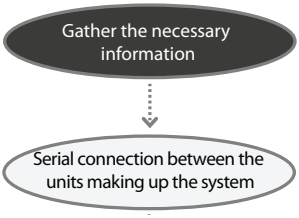


Fig. 2.q

The table below lists the information needed before configuring the integrated system of condensing unit plus refrigerated units:

Information needed		Example
Number of units		3
Capacity of each refrigerated unit		4000W, 4000W, 4000W
Set point of each refrigerated unit		5°C, 5°C, 5°C

2.3.12 Serial connection between the units making up the system

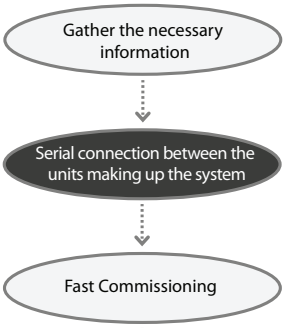


Fig. 2.r

The serial connection starts from terminal J10 on pRack Hecu and runs through the power+ inverter and all the MPXPRO controllers installed on the refrigerated units. The maximum number of MPXPRO controllers is 5, the limit for this application. The following recommendations must be heeded:

- connect the two twisted wires to the Tx/Rx+ and Tx/Rx- terminals;
- connect the single wire to the GND terminal;
- connect the shield to earth at one end only;
- use a shielded cable (e.g. Belden 3106A – AWG 22);
- For supervisor serial network connection only: connect a 120 Ω terminating resistor between the Tx/Rx+ and Tx/Rx- terminals on the last controller in the network (the one furthest away from pRack Hecu).

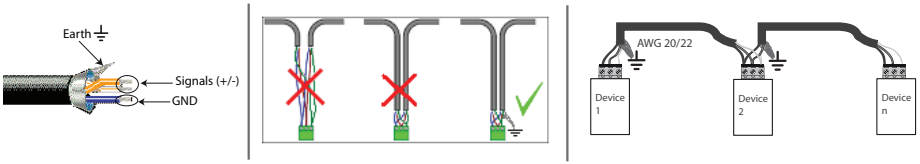


Fig. 2.s

2.3.13 Fast commissioning

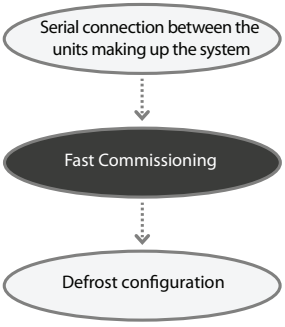


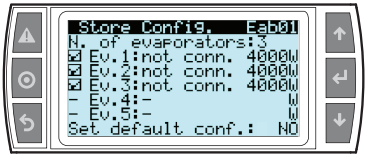
Fig. 2.t

The Fast Commissioning procedure is used to automatically the configure software functions that involve interaction between the condensing unit and the refrigerated units.

The procedure comprises the following steps:

4. select of the number of refrigerated units connected;
5. verify the connection;
6. set the capacity of each refrigerated unit;
7. download the default parameters.

The entire procedure is performed from the menu: EVAPORATORS->configuration, screen Eab01.



1. Select the number of refrigerated units

maximum of five refrigerated units can be selected. Once having selected the number of refrigerated units, a new row will be shown for each of these, with "V" checkmark on the left to indicate that the evaporator has been enabled.

Example:
Go to EVAPORATOR->configuration, screen Eab01 and select 3 for the number of evaporators

2. Verify evaporator connection

After having enabled the evaporators, wait a few seconds to make sure their status changes from "not conn." to "connected". If all the evaporators are connected, it means that the serial network has been configured correctly, otherwise check the physical connection of the devices with reference to the connection diagram shown previously, and check the serial addresses set on the MPXPRO controllers (parameter H0), according to the table also shown previously.

Example:
Wait for all 3 refrigerated units to change status from **"Not conn."** to **"connected"**.

3. Set the capacity of each evaporator

In order to maximise the results obtainable in terms of energy savings with the Floating Suction function, it is recommended to set the effective capacity of each evaporator.

Example:
Again in EVAPORATOR→configuration, screen Eab01, select 4000W for each evaporator.

4. Download the default parameters

Downloading the default parameters involves automatic configuration of the following functions:

Floating suction pressure set point: the default values enable compressor control with floating set point on screen Cab01. The minimum and maximum set point values will be displayed automatically, in accordance with the type of refrigerant and application selected, together with the proportional gain and integral time values required by the controller.

Olio Recovery Washing: the default values enable the evaporator oil recovery washing function on screen Faab15. The following parameters manage this function:

Par.	Description	Def
tON	Washing cycle duration	180sec
tOFF	Time between two washing cycles	180min
Mode	Sequential or same time	SINGLE CABINET AT TIME
Fixing time	Stabilisation time after washing	120sec

Tab. 2.f

Evaporator control parameters: the default values enable Smooth Lines evaporator control and involve the main evaporator control parameters on **screens Eab01, Eab02, Eab03**. These values are shown in the table below:

Par.	Description	Def
P3	Superheat set point	10
P4	Control valve: Proportional gain	8
P5	Control valve: Integral time	400
P6	Control valve: Derivative time	0
P7	Low superheat threshold	3
PSM	Enable Smooth Lines	Enable
Plt	Offset to stop control below set point (Smooth Lines)	4
Phs	Maximum superheat offset (Smooth Lines)	9
PSP	Smooth Lines: Proportional gain	3.0
PSI	Smooth Lines: Integral time	360.0
PSD	Smooth Lines: Derivative time	0.0

Tab. 2.g

Note: all the values indicated as defaults by the Fast Commissioning procedure can be modified so as to optimise operation of the entire system. It is recommended to change one parameter at a time and then evaluate the effects over a sufficient period.

Example:
Again in **EVAPORATOR→configuration**, **screen Eab01**, select YES for "Set default conf." and wait for the value to change back from YES to NO.

2.3.14 Defrost configuration

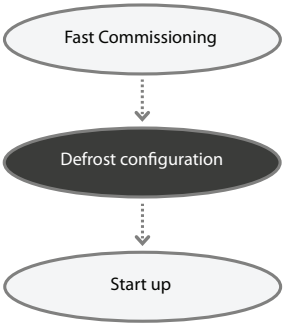


Fig. 2.u

For medium temperature applications, defrosting can be managed directly by pRack Hecu, which sets the condensing unit to operate at a settable pressure value considered sufficient to defrost the evaporators. The logic is described below.

Defrost with saturated temperature modulation

For the suction line, the floating set point is managed by pRack Hecu. To manage defrosts with saturated temperature modulation, the suction pressure set point is increased to a settable value.
The function performs a series of daily defrosts, defined by the ON time (Active Ton) and the OFF time (Not Active Toff). pRack Hecu automatically schedules all the defrost at regular intervals over 24 hours. This operation is illustrated in the following figure:

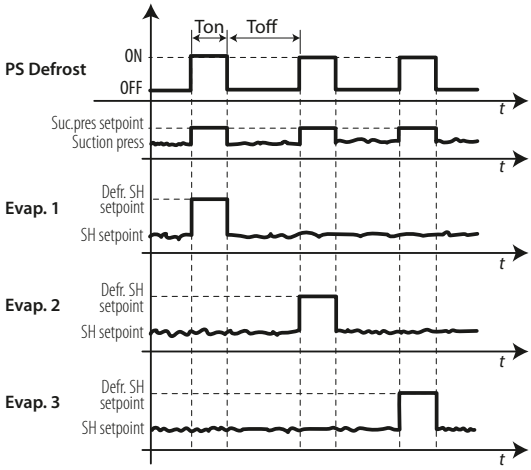


Fig. 2.v

Active Ton: time this type of defrost is active for
Not Active Toff: time this type of defrost is not active for

To make defrosting more effective, the superheat set point on each evaporator is sequentially increased to a settable value (defrost SH set point), as shown in the previous diagram.

The corresponding parameters are in the loop:
Other functions → Defrost → Control → screen Fbab02.

This type of defrost may not be sufficient for particularly humid environments where the refrigerated unit set point is too low.

Static defrost

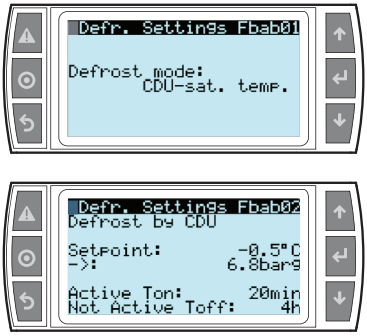
This function can be configured on MPXPRO. For further details, see manual +0300055EN.

Heater defrost

This function can be configured on MPXPRO. For further details, see manual +0300055EN.

Note: one type of defrost needs to be chosen.

Example:
In the **Other functions → Defrost → Control** menu, select the type of defrost: **"CDU sat temp."**
Then leave the default configuration parameters on screen **Fbab02**.



2.3.15 Start up

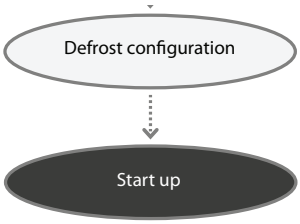


Fig. 2.w

The unit can now be started from **screen AC01**, under the "Unit Status" menu.

3. SYSTEM OPTIMISATION

At the end of the setup procedure, it is important to verify that the current configuration satisfies the specific features of the system. All the functions whose setup is based on the design of the individual unit are excluded from this procedure, as the manufacturer will be responsible for optimising such parameters. The focus here is on the functions that, due to the specific features of the system, will have a strong influence on operation of the system as a whole. It is suggested to use a supervisor for complete analysis of system operation, so as to effectively evaluate the changes made.
Below is a description of the main functions to be monitored, relating to:

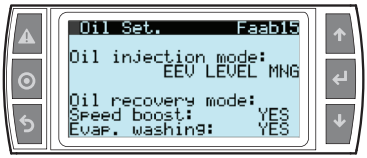
- pRack Hecu - condensing unit;
- MPXPRO - refrigerated unit.

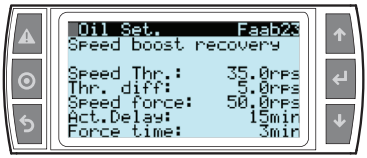
3.1 pRack Hecu optimisation

The main area that may require optimisation in the field concerns the software functions that manage oil return to the compressor: oil speed boost and oil recovery washing.

3.1.1 Oil speed boost

After having checked that the function is enabled on screen Faab15 (speed boost: YES), the parameters can be optimised on screen Faab23.





The following graph describes the logic of the function.

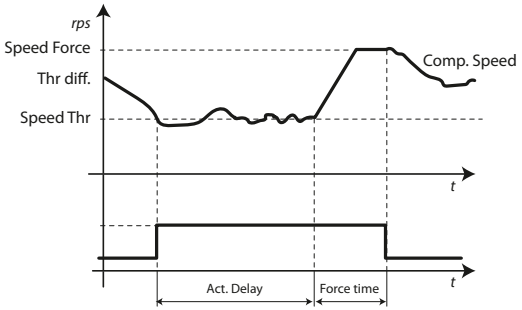


Fig. 3.a

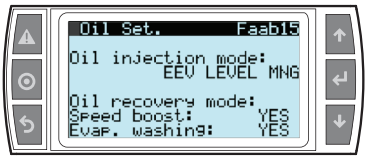
If the compressor remains for a settable time (Act. Delay) below a minimum threshold (Speed Thr.) plus a differential (Thr. Diff), its operating speed will be overridden for a set time (Force time) so as to guarantee oil return to the compressor (Speed force).

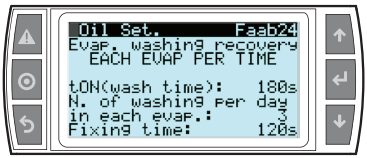
All these parameters are closely dependent on:
- compressor capacity;
- refrigerant;
- operating conditions: evaporation and condensing temperature;
- condensing unit superheat;
- number of refrigerated units connected;
- diameter of the piping.

Based on this information, the compressor manufacturer provides tables showing the critical speed (Speed Thr.) and critical time at such speed (Act. Delay). Again using the tables supplied by the compressor manufacturer, it will be possible to identify a speed that is sufficient to recover the oil and bring it back to the compressor (Speed force) and for how long the compressor needs to operate at this speed (Force time).

3.1.2 Oil recovery washing

After having checked that the function is enabled on **screen Faab15** (Evap. washing: YES), the parameters can be optimised on **screen Faab24**.





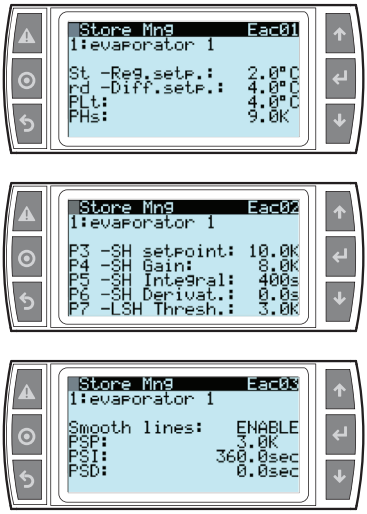
The washing frequency can be increased or decreased based on the quality of the final system.

tON is the duration of each single washing.
"N. of washing per day in each evap." is the number of washing per day for each evaporator.
Fixing time is the transition time at the end of each single washing to keep the system in stable condition.

The "Fixing time function" variable should be left at the optimised default value so as to stabilise the system at the end of a washing cycle, without significantly affecting overall operation.

3.2 MPXPRO optimisation

Once having connected the MPXPRO controllers to pRack Hecu, the control parameters will be as follows, screens Eac01, Eac02, Eac03.



3.2.1 Electronic valve control

The superheat control function calculates the valve position based on the current superheat reading and set point. PID control (Proportional, Integral, Derivative) is the sum of three distinct actions:

Proportional action (P)
Parameter K=proportional gain:
The proportional action opens or closes the valve by K steps when superheat increases or decreases by 1°C. Thus the greater the K the higher the response speed of the valve to variations in superheat. The proportional action is fundamental as it affects the speed of the valve in general.

However it only considers variations in superheat and not the variation in relation to the set point. If superheat does not vary significantly, the valve will remain stable and the superheat set point may not be reached.

Integral action (I)
Parameter Ti=integral time (sec):
The integral action is linked to time and moves the valve in proportion to the deviation of the superheat value from the set point. The greater the deviations, the more intense the integral action; in addition, the lower the value of the integral time (Ti), the more intense the action will be. The integral action is necessary to ensure that superheat reaches the set point

Derivative action (D)
Parameter Td=derivative time (sec):
The derivative action is linked to the speed of variation of the superheat value, that is, the gradient at which the superheat changes from instant to instant. It tends to react to any sudden variations, and has greater effect the higher the values of Td.

Selecting the superheat set point and control parameters

The superheat set point needs to be defined based on the design specifications of the controlled unit. Despite this, based on actual system conditions, this may be changed at any time. A low set point ensures better evaporator efficiency and a low air temperature can be reached more easily. In contrast, instability can be created in the system, with greater variations in superheat and liquid returning to the compressor. A high set point ensures high system stability and lower variations in superheat. However evaporator efficiency is penalised and the air temperature set point may not be reached.

Control parameter settings

- Proportional gain (from 3 to 30)
  Increasing the proportional gain K increases valve response speed and is recommended if the system is particularly perturbed or to make superheat control faster. If greater than 20, it may cause swings and instability.
- Integral time (from 40 to 400 sec)
  Increasing the integral time Ti improves stability but makes the valve slower to respond in reaching the set point. If less than 40 sec, it may cause swings and instability. If the system is already perturbed, high values (greater than 150 sec) are recommended to avoid creating further disturbance.
- Derivative time (from 0 to 10 sec)
  Increasing the derivative time Td improves valve response, in particular in perturbed systems, and reduced the amplitude of swings in superheat. If greater than 10 sec it may cause excessively fast response and consequently instability.

3.2.2 Smooth Lines optimisation

The Smooth Lines function is used to optimise evaporator capacity based on actual cooling demand allowing more effective and stable control of the refrigerated unit. This function completely eliminates traditional ON/OFF control, modulating unit temperature exclusively by using the electronic valve, adjusting the superheat set point with accurate PI control based on effective control temperature..

The main features are:

- the superheat set point for managing the electronic expansion valve can vary between a minimum (traditional set point P3) and maximum limit (P3+PHS: maximum offset) using PI control (pre-configured), based on the control temperature and how far this is from the corresponding set point St;
- the temperature inside the unit can fall slightly below the set point St, without stopping the main control, however simply closing the electronic valve;
- it is easy to use, as it is the instrument itself that automatically adapts control based on current operation, without requiring special parameter settings.

The main effects are:

- no swings in temperature and superheat when reaching the set point
- stable temperature and superheat control
- maximum energy savings by stabilising the load.

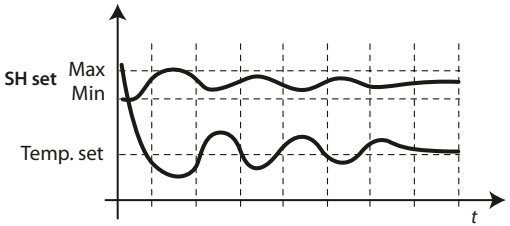


Fig. 3.b

Par	Description	Def	Min	Max	UM
PSM	Smooth Lines - Enable function	0	0	1	
PLt	Smooth Lines - Offset to stop control below set point	2.0	0.0	10.0	°C/°F
PHS	Smooth Lines - Maximum superheat offset	15.0	0.0	50.0	K

LowSH Low superheat protection

To prevent too low superheat values that may cause the return of liquid to the compressor or system instability (swings), a low superheat threshold can be defined, below which a special protection function is activated. When the superheat falls below the threshold, the system immediately enters low superheat status and activates a control action, in addition to normal control, with the aim of closing the electronic valve more quickly. In practice, the intensity of system "reaction" is increased. If the device remains in low superheat status for a certain period, a low superheat alarm is activated, with the display showing the message 'LSH'. The low superheat signal features automatic reset, when the condition is no longer present or the controller is switched off (standby). When low superheat is activated, any solenoid valves present can be forced closed (parameter P10).

Par.	Description	Def	Min	Max	UOM
P7	LowSH: low superheat threshold	7.0	-10.0	P3	K
P8	LowSH: integral time; 0 = function disabled	15.0	0.0	240.0	s
P9	LowSH: alarm delay; 0 = alarm disabled	600	0	999	s

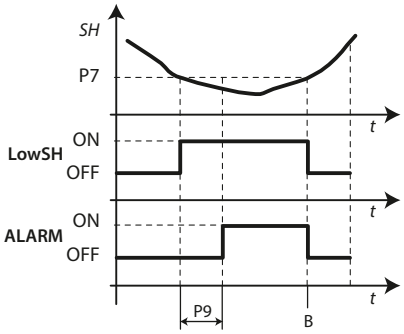


Fig. 3.c

Key

SH	Superheat		P7	Low SH protection threshold
LowSH	Low superheat protection		P9	Alarm delay
ALARM	Alarm		t	time

Note: a delta of 3K is recommended between the SH set point and the LowSH threshold.

4. TROUBLESHOOTING

Below is a list of alarm messages, the possible causes of the problems, and the recommended solutions..

ALARM MESSAGE	POSSIBLE CAUSE	PROPOSED SOLUTION
ALW28 High discharge gas temperature	Insufficient opening of the liquid injection valve.	Check the settings in the Other function/ Injection menu and increase the valve minimum and maximum opening parameters.
	Insufficient refrigerant charge.	Check the refrigerated unit and if necessary charge with refrigerant.
	The discharge temperature probe is placed too close to the compressor.	Check that the probe is installed at least 15-20 cm from the compressor discharge.
	The condenser is undersized.	
ALB16 Low suction pressure alarm **ALB01** Low common suction pressure by pressostat	Only a small number of refrigerated units are active and the procedure for starting the compressor at 50 rps for 3 minutes delivers excessive capacity.	Check the compressor times in the Compressor/configuration menu and lower the "min on time" to 60 seconds and keep the "min off time" at 180 seconds and the "min time to start same compressor" at 360 seconds.
		Make the opening of the valve more reactive by modifying the proportional gain "P4" for PID control of the valve in the Evaporator/Regulation menu.
		Configure the LOP function on the MPXPRO that prevents a decrease in evaporation pressure by increasing the opening of the valve with an integral time "PL2" when reaching a set evaporation temperature threshold "PL1". These parameters are found in the EVD menu on the MPXPRO.
ALW40-53-66-79-92 Store number: **OFFLINE**	If all the units are OFFLINE there may be a physical fault in the serial cable.	Check the serial network wiring.
	The addresses set on the MPXPRO controllers do not correspond to those set on pRack Hecu.	Check parameter "H0" on the MPXPRO controllers and that this effectively corresponds with the addresses set in the Evaporators/Configuration menu on pRack Hecu. The addresses of the MPXPRO controllers should range from 11 to 16 and must be sequential (if there are 3 MPXPRO controllers, the addresses will be 11, 12 and 13).

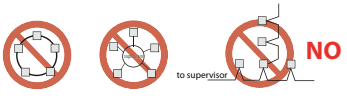
ALARM MESSAGE	POSSIBLE CAUSE	PROPOSED SOLUTION
ALB04 High condenser pressure alarm	The fans are broken.	Check the fan control parameters fans. Replace the fans if broken.
	The condenser is blocked	Clean the condenser.
ALB02 High common condenser pressure by pressostat	The transducer is broken	Replace the transducer.
ALW38-39 Low/High oil level fault	The oil sensor is broken.	Manually adjust the oil injection valve in the OTHER FUNCTION→Oil→Setting menu
	The separator oil level sensor wiring is incorrect	

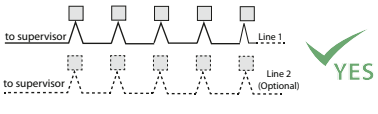
Tab. 4.a

5. COMMISSIONING CHECK LIST

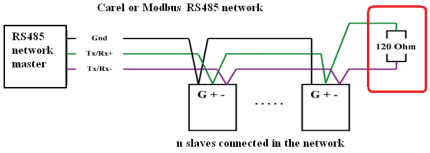
5.1 RS485 serial line

Wiring





❑ YES ❑ NO



❑ YES ❑ NO

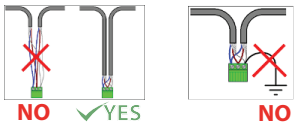
Keep the serial cables separate from power cables and valve cables

❑ YES ❑ NO

Cavo e connessioni - modello a 2 fili e a 3 fili

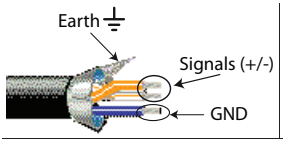
- 2 fili: twisted pair + shield Belden 8761 or 8762

❑ SI ❑ NO

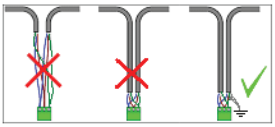


❑ YES ❑ NO

- 3 wires: 1 twisted pair + 1 single wire + shield, Belden 3106A (RECOMMENDED)

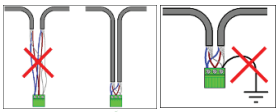


❑ SI ❑ NO

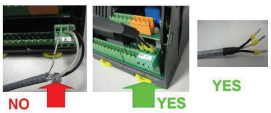


❑ YES ❑ NO

- Earth connection of the shield (for cable with 3 wires + shield)



❑ SI ❑ NO

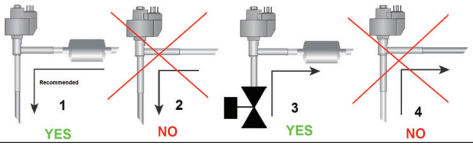


The length of the cable must not exceed 1000 m

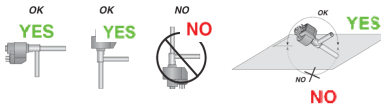
❑ YES ❑ NO

5.2 Showcases and cold rooms

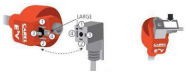
Electronic expansion valve installation



❑ 1 ❑ 2 ❑ 3 ❑ 4



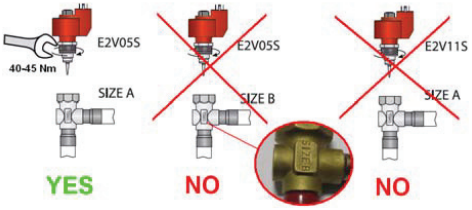
❑ YES ❑ NO



❑ YES ❑ NO

E2V Smart (check combination between body and cartridge and check tightening torque is 40-45Nm)

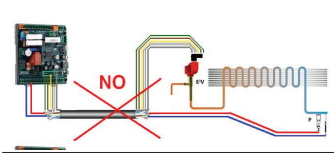
Identify the correct combination in the table below

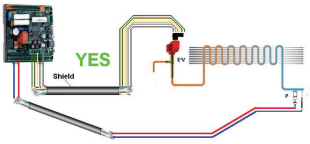


Valvola *Valve*	Taglia corpo *Body size*
E2V05S	SIZE A
E2V09S	SIZE A
E2V11S	SIZE B
E2V14S	SIZE B
E2V18S	SIZE B
E2V24S	SIZE C
E2V30S	SIZE C
E2V35S	SIZE D

❑ YES ❑ NO

Keep the valve wiring separate from the probe cables and do not share the same multicore cable

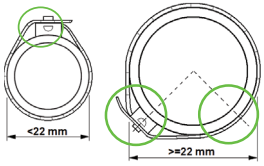




❑ YES ❑ NO

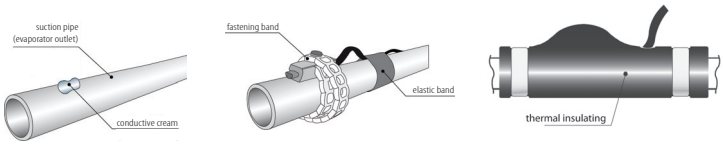
Probe installation

Intake probe position

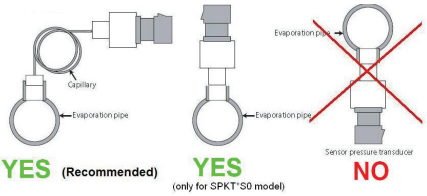


❑ YES ❑ NO

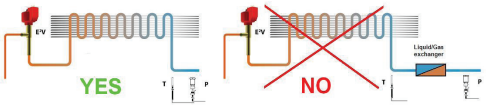
Intake probe installation



❑ YES ❑ NO



❑ YES ❑ NO



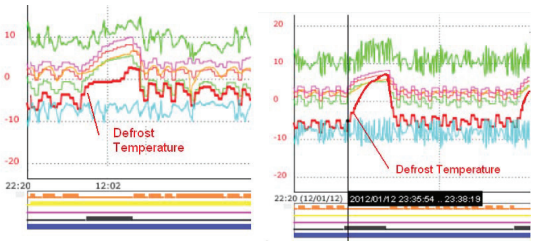
❑ YES ❑ NO

End defrost probe

The end defrost probe must be installed at the coldest point on the evaporator (ask the showcase manufacturer)

❑ YES ❑ NO

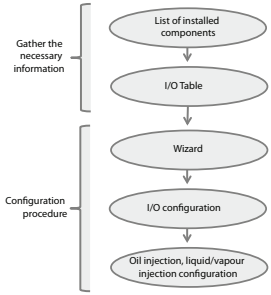
Defrost temperature trend during defrosting



❑ YES ❑ NO

6. APPENDICES

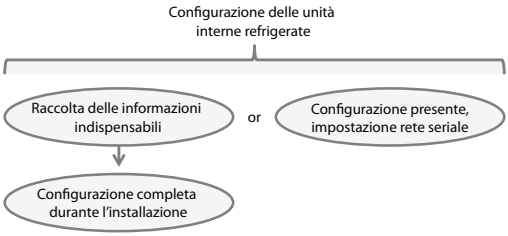
6.1 APPENDIX A: initial system configuration requirements procedure and form



Information needed	Possible values	Values
Model of DC compressor	Technical leaflet +050001835 available at www.carel.com	
Model of power+ inverter	PSD1018400, PSD1024400, PSD1035420	
Backup compressor	INSTALLED/NOT INSTALLED	
Number of fans	Maximum 2	
Type of fans	ON-OFF, EC FAN 0-10V, PWM	
Type of oil injection valve	Capillary, solenoid, CAREL EEV	
Type of oil separator	Standard separator, separator with double level sensor	
Type of liquid injection valve	Capillary, solenoid, CAREL EEV	

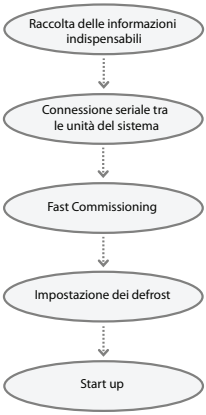
I/O type	Description	Position, type, logic, limit values
Digital inputs	High pressure alarm	
	Low pressure alarm	
	BLDC comp. alarm	
	Backup comp. alarm	
	Fan alarm	
	Remote ON-OFF	
	Separator minimum oil level	
	Separator maximum oil level	
Analogue inputs	Vapour injection temp. (LT)	
	Liquid temp.	
	Suction temp.	
	BLDC discharge temp.	
	Suction press.	
	Condensing press.	
	Backup discharge temp.	
	Outside temp.	
	Vapour injection press. (LT)	
Digital outputs	Fan 1	
	Fan 2	
	Backup compressor	
Analogue outputs	Modulating fans	

6.2 APPENDIX B: refrigerated unit configuration requirements procedure and form



Information needed	Values
Number of units	
Type of refrigerant	
Type of valve	
Outlet temp. probe (Sm - Air OFF)	
Defrost temp. probe (Sd)	
Intake temp. probe (Sr - Air OFF)	
Superheated gas temp. probe (Tgs)	
Evaporation pressure (Peu/Teu)	

6.3 APPENDIX C: integrated system (condensing unit + refrigerated unit) configuration requirements procedure and form



Information needed	Values
Number of units	
Capacity of each refrigerated unit	
Set point of each refrigerated unit	

CAREL

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