



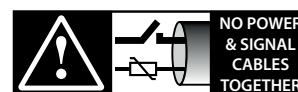
Heos PowerBoard

High efficiency solutions for Showcase



USER MANUAL

**LEGGI E CONSERVA
QUESTE ISTRUZIONI**
→ **READ AND SAVE
THESE INSTRUCTIONS** ←



**NO POWER
& SIGNAL
CABLES
TOGETHER**

READ CAREFULLY IN THE TEXT!

Heos PowerBoard

+0300145EN ENG

Up to date version available on

www.carel.com

GENERAL WARNINGS



CAREL bases the development of its products on decades of experience in HVAC, on continuous investments in technological innovations to products, procedures and strict quality processes with in-circuit and functional testing on 100% of its products, and on the most innovative production technology available on the market. CAREL and its subsidiaries/affiliates nonetheless cannot guarantee that all the aspects of the product and the software included with the product respond to the requirements of the final application, despite the product being developed according to start-of-the-art techniques. The customer (manufacturer, developer or installer of the final equipment) accepts all liability and risk relating to the configuration of the product in order to reach the expected results in relation to the specific final installation and/or equipment. CAREL may, based on specific agreements, act as a consultant for the successful commissioning of the final unit/application, however in no case does it accept liability for the correct operation of the final equipment/system. The CAREL product is a state-of-the-art product, whose operation is specified in the technical documentation supplied with the product or can be downloaded, even prior to purchase, from the website www.carel.com. Each CAREL product, in relation to its advanced level of technology, requires setup/configuration/programming/commissioning to be able to operate in the best possible way for the specific application. Failure to complete such operations, which are required/indicated in the user manual, may cause the final product to malfunction; CAREL accepts no liability in such cases. Only qualified personnel may install or carry out technical service on the product. The customer must only use the product in the manner described in the documentation relating to the product. In addition to observing any further warnings described in this manual, the following warnings must be heeded for all CAREL products:

- prevent the electronic circuits from getting wet. Rain, humidity and all types of liquids or condensate contain corrosive minerals that may damage the electronic circuits. In any case, the product should be used or stored in environments that comply with the temperature and humidity limits specified in the manual;
- do not install the device in particularly hot environments. Too high temperatures may reduce the life of electronic devices, damage them and deform or melt the plastic parts. In any case, the product should be used or stored in environments that comply with the temperature and humidity limits specified in the manual;
- do not attempt to open the device in any way other than described in the manual;
- do not drop, hit or shake the device, as the internal circuits and mechanisms may be irreparably damaged;
- do not use corrosive chemicals, solvents or aggressive detergents to clean the device;
- do not use the product for applications other than those specified in the technical manual.

All of the above suggestions likewise apply to the controllers, serial cards, programming keys or any other accessory in the CAREL product portfolio. CAREL adopts a policy of continual development. Consequently, CAREL reserves the right to make changes and improvements to any product described in this document without prior warning. The technical specifications shown in the manual may be changed without prior warning. The liability of CAREL in relation to its products is specified in the CAREL general contract conditions, available on the website www.carel.com and/or by specific agreements with customers; specifically, to the extent where allowed by applicable legislation, in no case will CAREL, its employees or subsidiaries/affiliates be liable for any lost earnings or sales, losses of data and information, costs of replacement goods or services, damage to things or people, downtime or any direct, indirect, incidental, actual, punitive, exemplary, special or consequential damage of any kind whatsoever, whether contractual, extra-contractual or due to negligence, or any other liabilities deriving from the installation, use or impossibility to use the product, even if CAREL or its subsidiaries/affiliates are warned of the possibility of such damage.

DISPOSAL

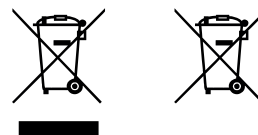


Fig. 1

Fig. 2

INFORMATION FOR USERS ON THE CORRECT HANDLING OF WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE)

The product is made up of metal parts and plastic parts. In reference to European Union directive 2002/96/EC issued on 27 January 2003 and related national legislation, please note that:

- WEEE cannot be disposed of as municipal waste and such waste must be collected and disposed of separately;
- the public or private waste collection systems defined by local legislation must be used. In addition, the equipment can be returned to the distributor at the end of its working life when buying new equipment;
- the equipment may contain hazardous substances: the improper use or incorrect disposal of such may have negative effects on human health and on the environment;
- the symbol (crossed-out wheeled bin) shown on the product or on the packaging and on the technical leaflet indicates that the equipment has been introduced onto the market after 13 August 2005 and that it must be disposed of separately;
- in the event of illegal disposal of electrical and electronic waste, the penalties are specified by local waste disposal legislation.

Warranty on materials: 2 years (from production date, excluding consumables).

Approval: the quality and safety of CAREL S.p.A. products are guaranteed by the ISO 9001 certified design and production system.



Separate as much as possible the probe and digital input cables from cables to inductive loads and power cables, so as to avoid possible electromagnetic disturbance. Never run power cables (including the electrical panel cables) and signal cables in the same conduits.

Key to the symbols:



Caution: to bring critical issues to the attention of those using the product.



Notice: to focus attention on important topics; in particular the practical application of the various product functions.



Dangerous voltage



Caution, hot surface.



Caution: this product is to be integrated and/or incorporated into the final apparatus or equipment. Verification of conformity to the laws and technical standards in force in the country where the final apparatus or equipment will be operated is the manufacturer's responsibility. Before delivering the product, Carel has already completed the checks and tests required by the relevant European directives and harmonised standards, using a typical test setup, which however cannot be considered as representing all possible conditions of the final installation.

Index

1. Introduction.....	7
1.1 Main features.....	7
1.2 Components and accessories.....	7
1.3 Layouts examples.....	8
2. Installation	11
2.1 General features.....	11
2.2 I/O specifications	11
2.3 Controller electrical and physical specifications	13
2.4 Built-in clock specifications	13
2.5 Terminals.....	13
2.6 Communication lines.....	14
2.7 12 A single-phase inverter PSD2	15
2.8 15 A 1 PH and 18 A 3 PH inverter PSD2	16
2.9 Temperature probes	18
2.10 Pressure probes (SPKT00**P0)	19
2.11 Pressure probes (SPKT00**8C0)	19
2.12 Unipolar E2V valves for R744	20
2.13 Unipolar E2V valves for R-290 and HFCs	20
2.14 General connection diagram	21
2.15 Installation.....	22
3. User interface.....	24
3.1 Introduction.....	24
3.2 Menu tree	26
4. Initial configuration.....	27
4.1 Mobile device	27
4.2 Computer	28
4.3 Managing and updating configurations.....	29
5. Functions	31
5.1 Inputs and outputs.....	31
5.2 Digital inputs	32
5.3 Control	37
5.4 Defrost	41
5.5 Evaporator fans	45
5.6 Condensation management	47
5.7 Anti-sweat heater or fan modulation.....	48
5.8 Electronic valve	49
5.9 Compressor	54
5.10 Generic functions.....	62
5.11 Multi-evaporator configuration.....	64
5.12 RTC management	66
5.13 Manual mode	66
5.14 Local network functions	67
6. Parameter table.....	68
6.1 Parameter table.....	68
7. Alarms and signals.....	79
7.1 Alarm management.....	79
7.2 Alarm parameters.....	80
7.3 Compressor	81
7.4 Troubleshooting	82
7.5 Alarm table	82
8. History of software revisions	86

1. INTRODUCTION

1.1 Main features

Heos PowerBoard is a control system for the complete management of MT showcases or cold rooms with a variable-capacity CO₂/HFC compressor and a water loop for cooling. The control board is designed for mounting on a DIN rail and is equipped with screw terminals for the showcase I/Os, and JST connectors for the refrigeration unit inputs, as well as built-in electronic expansion valve drivers. Heos PowerBoard can manage a main-secondary local network comprising up to 6 units (1 main and 5 secondary). Each controller can be equipped with its own display (AX4*) and for service or commissioning operations can be managed via app or PC software.

Main features:

- board with built-in driver for CAREL unipolar valve;
- modulation of cooling capacity by BLDC compressor with inverter;
- COP calculation and management;
- advanced superheat control with low superheat (LowSH), low evaporation temperature (LOP), high evaporation temperature (MOP) and low suction temperature (LSA) protection;
- defrost activated via keypad, digital input, network signal from main or supervisor;
- management of various types of defrosts: heater, reverse cycle, hot gas;
- smart defrost functions;
- coordination of network defrosts;
- management of cabinet lights and curtain;
- anti-sweat heater modulation;
- evaporator fan speed modulation;
- RS485 serial for BMS as standard;
- serial Ethernet for both BMS and main-secondary management.

1.2 Components and accessories

Part number	Description
HEC00001113E0	Heos Enhanced, no SW, 1xBMS opto, 2xFiled Bus no-opto display port, 1xEthernet, 5xRelay+1xSSR w/fuses, 3xExV unipolar
HEC00001311B0	Heos Basic, no SW, 1xBMS opto, display port, 1xEthernet, 5xRelay+1xSSR w/fuses, 1xExV unipolar
AX4000PS10020	AX4 Heos terminal, red display with NFC
AX4000PS20030	AX4 Heos terminal, white display with NFC, Bluetooth and buzzer
ACS00CB000020	Display cable JST-JST length 1.5m
ACS00CB000010	Display cable JST-JST length 3 m
PCOS004850	serial RS485 expansion card
PS20012204110	POWER+ 12 A, 200-240 Vac 1PH, IP20 PEC
PS20015204110	POWER+ 15 A, 200-240 Vac 1PH, IP20/IP44 PEC
PS20018404110	POWER+ 18 A, 380-480 Vac 3PH, IP20/IP44 PEC
PSACH10100	Coil for POWER+ 18 A
E2V**CS1C0	E2V-C 13-13 stainless steel valve, high pressure without stator
E2V**FSFC0	Exp valve E2V* 12-12 ODF
E2VSTA0320	Stator for unipolar E2V with 2 metre cable
NTC030HP00	NTC temperature probes, HP IP67, -50T50, 3 m long
NTC030HF01	NTC temperature probes, HF IP67, -50T90, strap-on, 3 m long, 10 pcs
NTC030HT41	NTC temperature probes, HT IP55, 0T150, 3 m long, 10 pcs
SPKT00D8C0	Pressure probes, 4-20mA 0-150 barg (0-2175 psig)
SPKT00H8C0	Pressure probes, 4-20mA 0-120 barg (0-1740 psig)
SPKC002310	3-wire cable, 2 m long, for SPKT pressure probes / Packard IP67 connector
SPKT0043P0	Pressure probe, 0-5V 0-17.3 barg (0-250 psig)
SPKT00B6P0	Pressure probe, 0-5V 0-45 barg (0-650 psig)

Tab. 1.a

1.3 Layouts examples

1.3.1 Layouts with RS485 network

Example of a single evaporator system

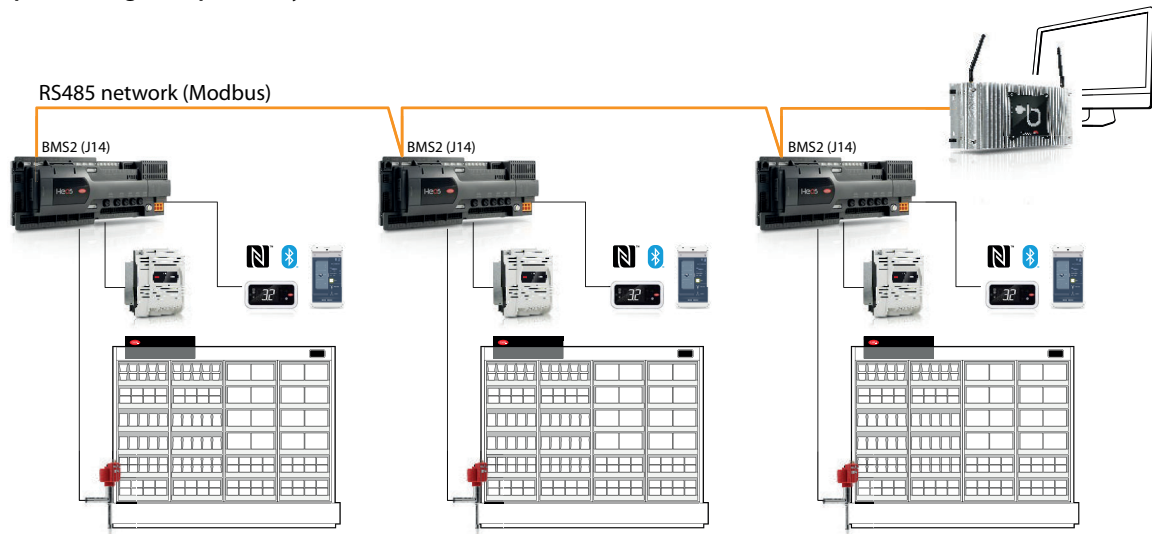


Fig. 1.a

Example of Multi-evaporator network

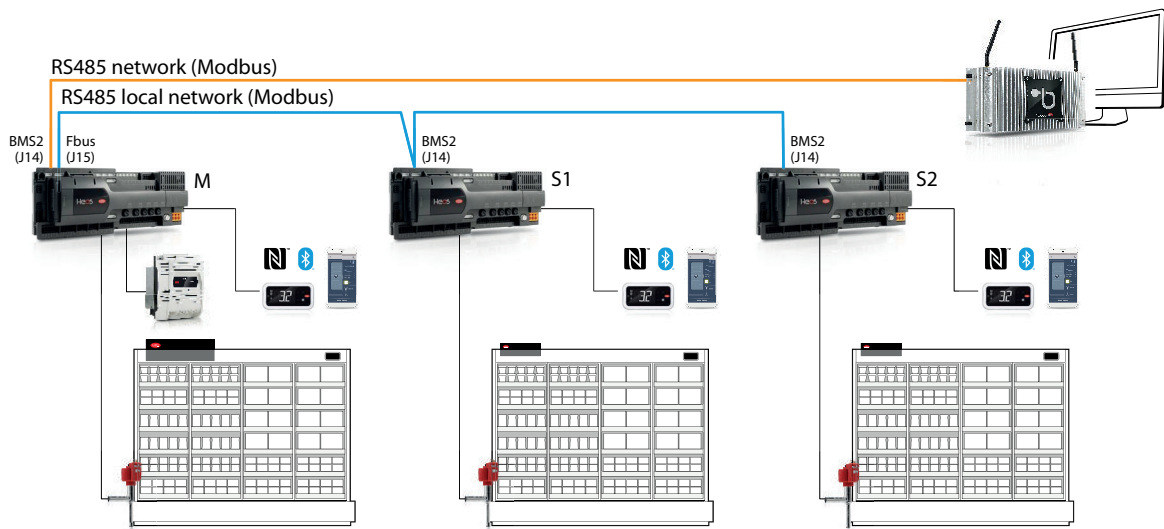


Fig. 1.b

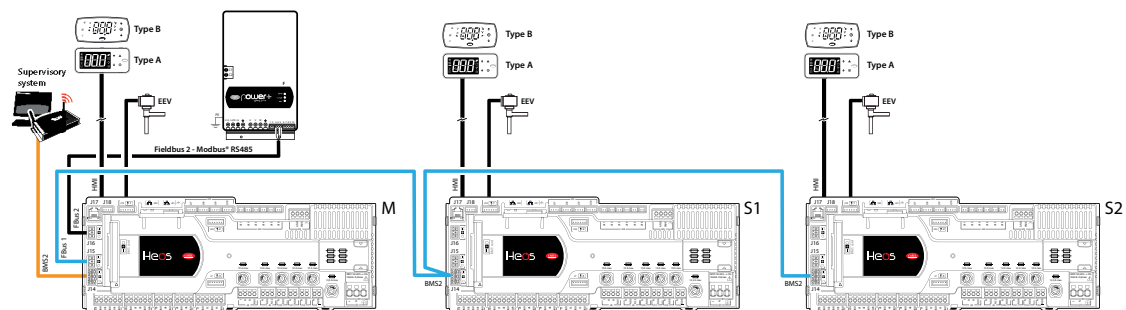


Fig. 1.c

Heos PRO board can be used as a secondary with a power board as a main. The secondary needs to have same software version of the main and it is required to use the "Secondary HeosBox" official software pack in the Heos PRO used as secondary. The file is available in the Heos confidential area on KSA.

Notice: the Heos Pro configured as a secondary of the Heos Power board, needs to be connected to the BMS1 terminal. See image below.

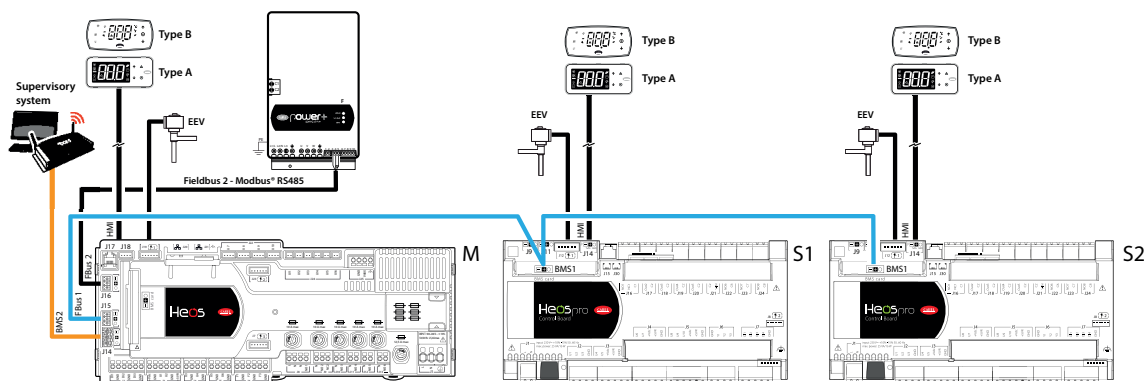


Fig. 1.d

In the product "Heos PRO" the BMS1 card is already included.

Example of Multi-evaporator network with third part supervisory system

More info about BMS1 on chapter 2.14.1. The bms1 card is not already included in the controller "Powerboard". It should be separately ordered

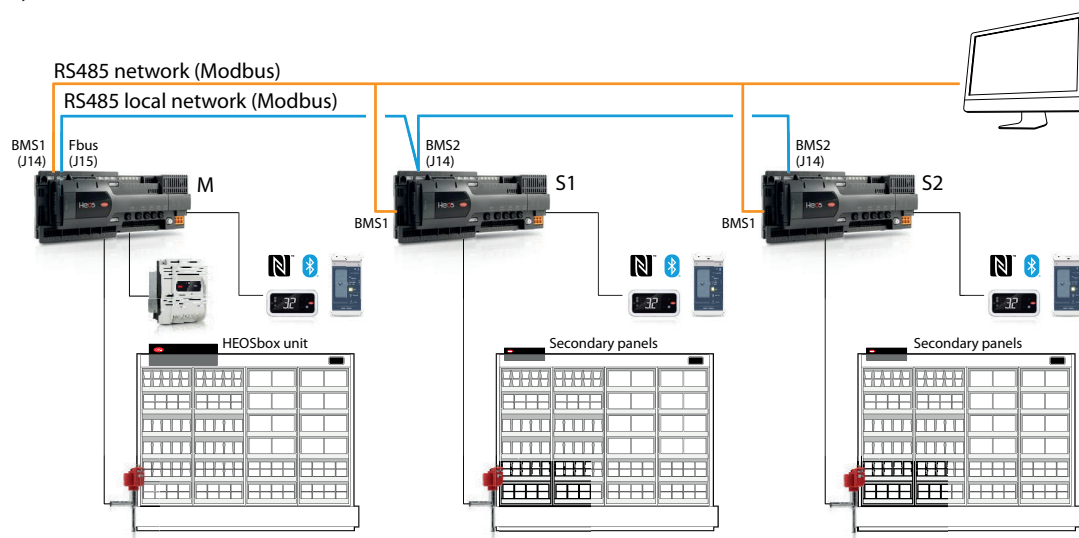


Fig. 1.e

1.3.2 Layouts with Ethernet network



Notice: the connection with Modbus supervisory system via Ethernet needs to use port 502 and address 1

Example of a single evaporator system

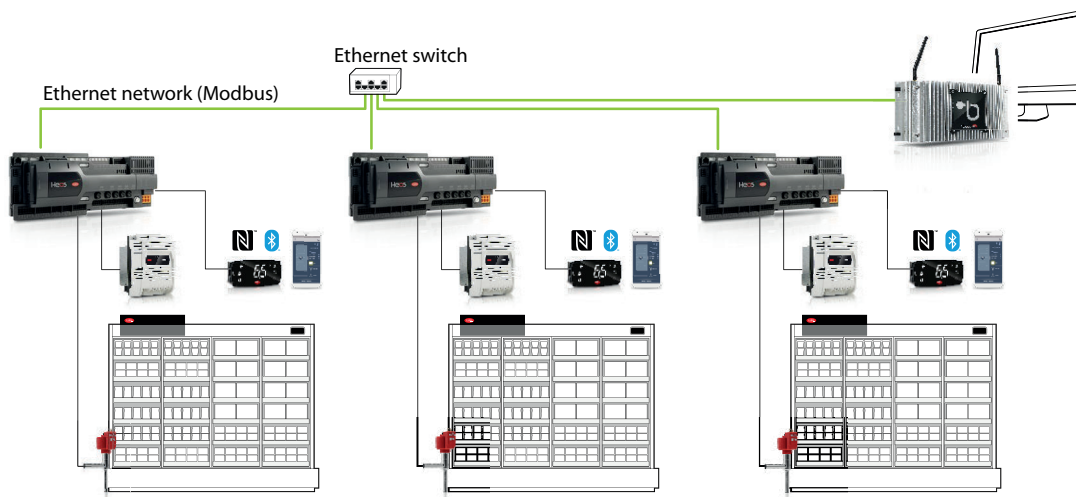


Fig. 1.f

Example of Multi-evaporator network

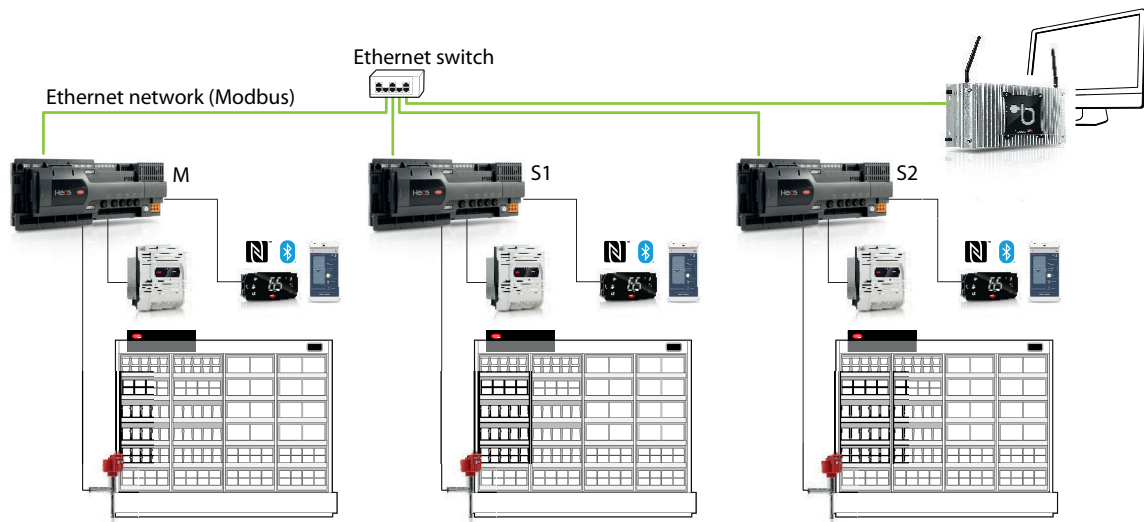


Fig. 1.g

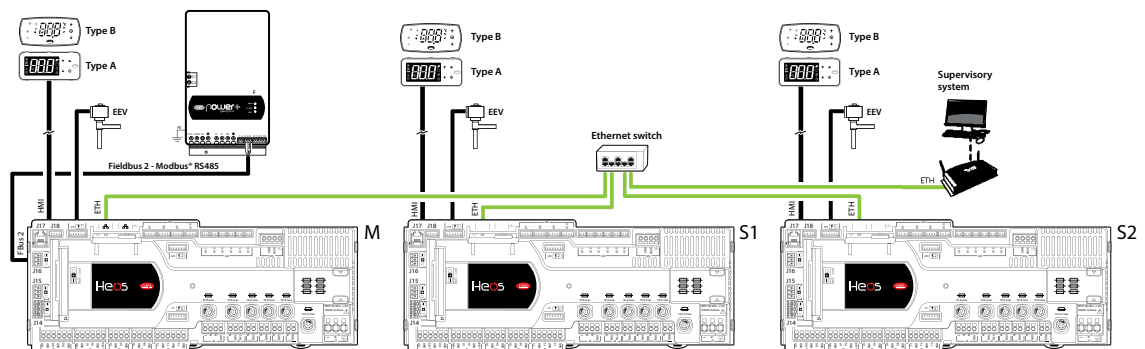


Fig. 1.h

Key

M	Main
S1, S2	Secondary

Here below the configuration main and secondary using Heos pro as secondary

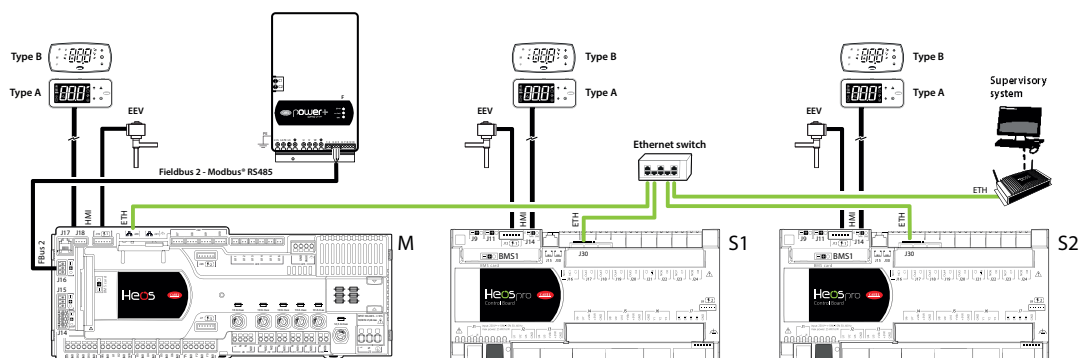


Fig. 1.i

2. INSTALLATION

2.1 General features

Operating conditions	
Storage temperature:	-40T70°C
Operating temperature:	-20T60 °C
Relative humidity:	up to 90% RH @40°C non-condensing
Physical specifications	
Dimensions	315 x 126 x 58 mm
Mounting	Can be attached to a standard TS35 DIN rail in accordance with IEC/EN 60715
Material/colour	Technopolymer/dark grey RAL7016
Other specifications	
Ingress protection (IEC 60529)	IP20
Pollution degree	3
Rated impulse voltage	Overvoltage category III
Software class and structure	Class A
Purpose of the control device	Operation control device
Control device construction	Incorporated
Class of protection against electric shock	To be incorporated in class I appliances
PTI of insulating material	Group IIIa material
Period of stress across the insulating parts	Long
Type of automatic action	Type 1.C [relay]
Type of disconnection or switching	Micro-switching
Heat and fire resistance category	Category D [UL94-V2]
Ball pressure test temperature:	125°C (in accordance with IEC 60695-2-10)
Glow wire test temperature:	850°C (in accordance with IEC 60695-2-11)
Regulations and certifications	
Certification	CE, UL
Electromagnetic compatibility	EN 61000-6-1 / EN 61000-6-2 / EN 55014-2 EN 61000-6-3 / EN 61000-6-4 / EN 55014-1
Electrical safety	UL 60730-1; IEC 60730-1

Other: Conformity with IEC/EN/UL 60335-15.2 sections 29, 30.

For use in applications with flammable refrigerants, the product has been verified and found to comply with the following requirements:

- Annex BB of IEC 60335-2-89:2019, referred to in clause 22.113; components that produce arcs or sparks during normal operation have been tested and found to comply with the requirements of UL/IEC 60079-15;
- IEC 60335-2-89:2019 (clause 22.114).

The surface temperatures of all components and parts have been measured and verified during the tests required by IEC 60335 clauses 11 and 19 and found to be no higher than 268°C.

The acceptability of this product in final applications where flammable refrigerants are used will need to be verified and tested in the final application.

Tab. 2.a

2.2 I/O specifications

Digital inputs	
Type	Digital inputs with voltage-free contacts
Number of digital inputs	3 (DI1, DI2, DI3)
Closed contact current	5 mA typical
Open contact voltage	12 Vdc ±10%
Analogue outputs	
Type	0...10Vdc
Number of analogue outputs	3 (Y1, Y2, Y3)
Maximum output current	10mA
Accuracy	± 2% of full scale
Universal channels	
Number of universal channels (U)	HECxxxxxxxBx: 6 (Basic version); HECxxxxxxxEx: 16 (Enhanced version)
Accuracy	± 0.3% of full scale; ± 0.5°C for passive temperature sensors e.g. NTC, NTC-HT, PTC, PT500, PT1000
Analogue/digital conversion	14 bits
Type	Configurable via software
U1-U6	CAREL NTC (-50T90°C), NTC HT (0T150°C)
U7-U10 ^(*)	PTC (600-2200Ω), PT500 (-100T300°C), PT1000 (-100T400°C) 0-1 V, 0-5 V, 0-10 V 0-5 V ratiometric 0-20 mA, 4-20 mA Max number: 4 [U1-U6] + 4 [U7-U10] Digital inputs with voltage-free contacts Analogue output 0-10 V Current: max. 2 mA
U11 U16 ^(*)	CAREL NTC (-50T90°C), NTC HT (0T150°C) PTC (600-2200Ω), PT500 (-100T300°C), PT1000 (-100T400°C) Digital inputs with voltage-free contacts Analogue output 0-10 V Current: max. 2 mA

^(*) Enhanced model HECxxxxxxxEx only.

Digital outputs

NO1	IEC: 6(6)A, 240Vac, 100k cycles UL: 6 A resistive, 240 Vac, 30k cycles; 6 FLA, 36 LRA, 240 Vac, 30k cycles Fuse rating: max. 10 A / standard configuration: 10A T
NO2, NC2	IEC NO2: 6(2) A, 240 Vac, 100k cycles IEC NC2: 4(2) A, 240 Vac, 100k cycles UL NO2: 6 A resistive, 240 Vac, 30k cycles; 5 FLA, 30 LRA, 240 Vac, 30k UL NC2: 4A resistive, 240 Vac, 6k cycles; Fuse rating: max. 10 A / standard configuration: 10A T
NO3	IEC: 6(6)A, 240Vac, 100k cycles UL: 6 A resistive, 240 Vac, 30k cycles; 6 FLA, 36 LRA, 240 Vac, 30k cycles SSR: 0.5 A, 240 Vac (optional) Fuse rating: max. 10 A / standard configuration: 10A T
NO4	IEC: 6(6)A, 240Vac, 100k cycles UL: 6 A resistive, 240 Vac, 30k cycles; 6 FLA, 36 LRA, 240 Vac, 30k cycles SSR: 0.5 A, 240 Vac (optional) Fuse rating: max. 10 A / standard configuration: 10A T
NO5	IEC: 6(6)A, 240Vac, 100k cycles UL: 6 A resistive, 240 Vac, 30k cycles; 6 FLA, 36 LRA, 240 Vac, 30k cycles Fuse rating: max. 10 A / standard configuration: 10A T
NO6	IEC: 7.7(4.5) A, 240 Vac, 100k cycles UL: 7.7 A resistive, 240 Vac, 30k cycles; 4.5 FLA, 27 LRA, 240 Vac, 30k cycles Fuse rating: max. 12.5A / standard configuration: 12.5A F

**Warnings:**

the total current that can be delivered by outputs NC2/NO2, NO3-NO6, in maximum load conditions, must not exceed 25 A;
each output is only protected against short circuits;

the fuses must be replaced by qualified personnel. The replacement parts must have the same specifications:

- 5x20mm cartridge and ceramic body;
- Breaking capacity 1,5kA;
- Conformity with IEC 60127-1.

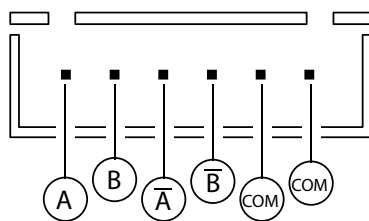
In compliance with the requirements described in the previous point, the use of fuses with ratings other than those supplied as standard is allowed, as long as the rating does not exceed the maximum declared for each output (see the Table).

Unipolar valve outputs

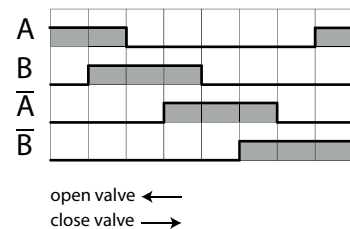
Type of control	Unipolar stepper
Maximum number of valve outputs	3
Maximum power for each valve	8W
Max. power supply / current	13 Vdc $\pm$ 5% / 0.35 A per winding
Winding resistance	40 Ω

Tab. 2.b

Connect the valve connector poles as follows:



A, $\bar{A}$: winding 1
B, $\bar{B}$: winding 2
COM: common device (13 Vdc $\pm$ 5%)



2.3 Controller electrical and physical specifications

Power supply

Power supply	Rated: 100-240 V~ ±10% 50/60 Hz Current: < 0.4 A @100V (no load on digital outputs) max. 25.4 A (with maximum controlled load)
+VDC	Power output to active sensors Max. number of sensors that can be powered by the controller: 6 Rated voltage: 12 Vdc ±10% Current delivered: max. 150 mA, overload protected
+5 VR	Power output to ratiometric sensors Max. number of sensors that can be powered by the controller: 6 Rated voltage: 5 Vdc ±5% Current delivered: max. 60mA, overload protected
VAUX	Auxiliary power output Rated voltage: 13Vdc ±5% Current delivered: max. 320mA, overload protected

Maximum connection size/length

J1 (**)	Flexible cable size: 1-6 mm ² Stripping length: 15mm
J2-J6(*), J8-J13(**), J25(*)	Length: Max 10 m Flexible cable size: 0.2-2.5 mm ² Stripping length: 10 mm bare cable / 8 mm with non-insulated lug
U7-U10 (***) U11-U16	Connection: JST XH series Cable size: 0.05-0.3 mm ² Length: Max 10 m
J7, J19, J23	Connection: JST XH series Length: 2 m without shielded cable / 6 m with shielded cable earthed at both ends (E2VCABS3U0, E2VCABS6U0)

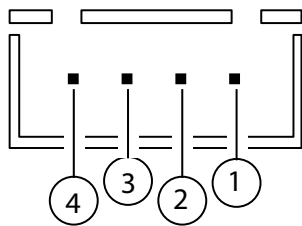
Tab. 2.c

(*) More than one wire can be connected to each pole using lugs.

(**) The size of the cable used for the main power supply and digital outputs depends on the final application, based on the maximum expected current draw. In accordance with the requirements of IEC/EN 60730-1, the minimum cable size according to the current is shown below:

- 1 mm² up to 10A
- 1.5 mm² from 10 A to 16 A
- 2.5mm² from 16A to 25A
- 4 mm² over 25 A

(***) Connect the sensor/actuator according to the following pin-out arrangement:



- 1: +Vdc power to active sensors
- 2: GND ground
- 3: +5VR power to ratiometric sensors
- 4: IN/OUT input/output signal

2.4 Built-in clock specifications

Real time clock	Yes, with backup battery. The battery is used only for correct functioning of the clock when the product is not powered.
Accuracy	5 ppm @25°C 50 ppm @0T50°C 80 ppm (-20T60°C)
Real time clock battery	Non-rechargeable lithium button battery, CR2032, 3 V
Battery life	Min. 5 years under normal operating conditions
Rules for battery replacement	Not replaceable. Contact Carel for replacement.

Tab. 2.d

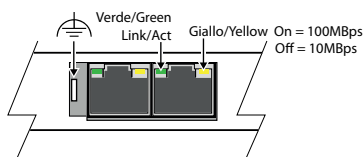

Warning: using the product at extremes of the operating temperature range will shorten battery life.

2.5 Terminals

The Carel AX4000PS20030 LED terminal must be connected to J18 or J17 using the cables listed in the part number table.

2.6 Communication lines

BMS2 serial interface J14	Type: RS485 with passive polarisation
	Insulation: Not present or functional, depending on the models
	Differential impedance: 1/4 unit load
	Connection: Removable screw terminal, 5.08 mm pitch
	Tightening torque: 0.6 Nm [5.30 lbf per in]
FieldBus1 serial interface FieldBus2 serial interface J15, J16	Cable lengths: 500 m with AWG 20-22 twisted pair shielded cable for Tx/Rx+ and Tx/Rx-.
	Shield earthed at both ends.
	Type: RS485 with active polarisation
	Insulation: Not present
	Differential impedance: 1/4 unit load
Display port serial interface J17, J18	Connection: Removable screw terminal, 3.81mm pitch
	Tightening torque: 0.25 Nm [2.2 lbf per in]
	Cable lengths: 500 m with AWG 20-22 twisted pair shielded cable for Tx/Rx+ and Tx/Rx-.
	Shield earthed at both ends.
	Type: RS485 with passive polarisation
Ethernet interface J20, J21	Connection: JST XH series or RJ11 telephone connector
	Cable lengths:
	2 m for domestic applications (in compliance with EN 55014-1) / unshielded cable.
	10 m in residential and industrial environments / unshielded cable.
	Ports: 1 with Auto MDI-X
Ethernet interface J20, J21	Baud rate: 10Base-T / 100Base-TX
	Connection: RJ45 8/8 shielded with LED
	Green LED = On: Link, Blink: Activity
	Yellow LED = Off: 10 Mbps, On: 100Mbps
	Cable lengths: 100 m between devices with STP CAT-5 cable



Notice: connect the male faston to earth (functional) using a corresponding 6.3 mm female connector without insulating capsule

Tab. 2.e

Description of the connectors

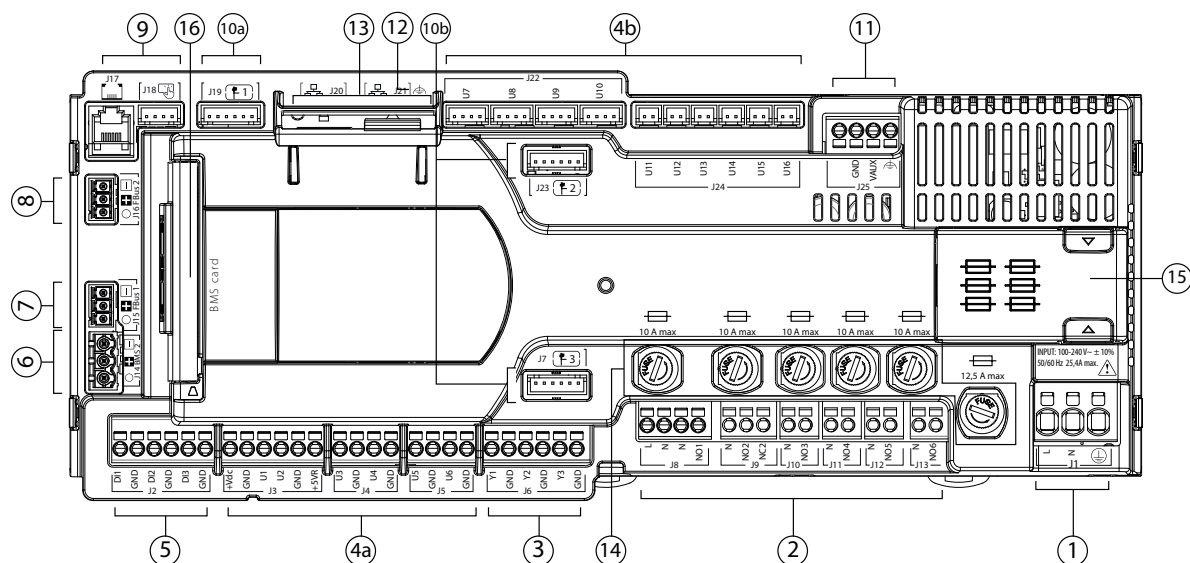


Fig. 2.a

Key

1	Power terminal	9	LED terminal interface (J17); pGD1 terminal interface (J18);
2	Digital outputs with voltage signal	10a	Unipolar valve 1 output
3	Analogue outputs 0-10 V	10b	Unipolar valve 2/3 output
4a	Universal analogue channels	11	AUX power output
4b	Universal analogue channels	12	Faston connector for Ethernet shield earth
5	Digital inputs with voltage-free contacts	13	Ethernet interface
6	BMS2 serial interface	14	Protection fuses
7	FieldBus1 serial interface	15	Spare fuse holder slot
8	FieldBus2 serial interface	16	Slot for BMS option

2.7 12 A single-phase inverter PSD2

For further details on the electrical and mechanical specifications, see technical leaflet +05001201E

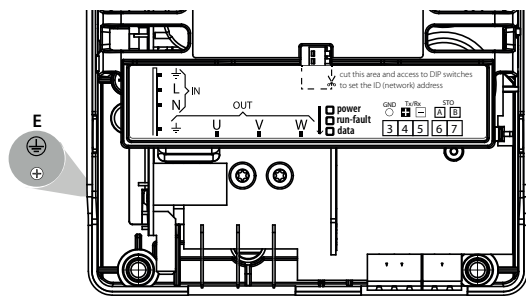


Fig. 2.b

Description of the terminals

Ref.	Description
L, N	Single-phase power input
PE (*)	Spade connectors
U, V, W	Motor output
PE (*)	Spade connectors
-DC	DC bus output
+DC	Spade connectors
GND (0V)	RS485/ModBus® connection
Tx/Rx+	3-pin plug-in terminals
Tx/Rx-	

Ref.	Description	
STO1	STO safety input	
STO2	2-pin plug-in terminals	
E	PE Earth screw	
F (LED)	POWER (green)	drive powered
	RUN (green)	drive running
	FAULT (red)	drive alarm
	DATA (yellow)	communication active

Tab. 2.f

(*) The earth connections inside the controller are electrically connected together and to the PE.



Caution:

- before carrying out any maintenance, disconnect the drive and the control circuits from the power supply by moving the main system switch to "off". Once having powered down the drive, wait at least 5 minutes before disconnecting the electrical cables;
- always make sure that the motor has come to a complete stop. Freely rotating motors may generate dangerous voltages across the Power+ terminals, even when this is not powered;

Rated values

The following table shows the rated input current and output current values, as well as the specifications for sizing the cables (cross-section, maximum length) and the fuses. The values refer to an operating temperature of 60°C and a switching frequency of 8 kHz, unless otherwise specified.

PSD10102BA

Rated input current at 230 V	19.2 to 16 A
Fuse or type B circuit breaker	25 A
Power cable size	4 mm ²
Rated output current	12 A
Rated output power at 230 V	3.8 kW
Maximum total dissipation	270 W
Maximum dissipation on the heat sink	150 W
Min. motor cable size	2.5 mm ²
Max. motor cable length	5 m

Tab. 2.g

Dimensions

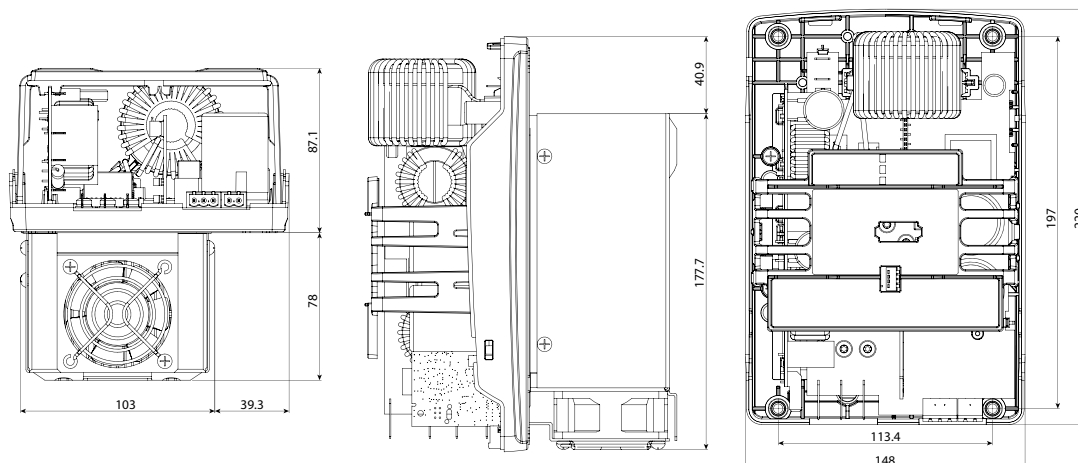


Fig. 2.c

Main technical specifications

Environmental conditions	Storage temperature		-40T60°C	
	Operating temperature		-20T60 °C	
	Humidity		< 95% RH non-condensing	
	Altitude		Maximum allowed: 2000 m above sea level Up to 1000 m asl without derating Derating in terms of maximum output current: 1% /100m	
	Environmental pollution level		3	
Power supply	Input voltage		200 240V / 105 -125V ± 10%, 50/60Hz, 1~	
Motor output	Output voltage		0 Input voltage	
	Output frequency		0 500 Hz	
	Frequency resolution		0.1 Hz	
	Maximum cable length		see paragraph 5.1 of the technical leaflet +0500120IE	
	Switching frequency		4, 6, 8 kHz	
Functions	Protection functions		Drive: short circuit, overcurrent, earth fault, overvoltage and undervoltage, overtemperature Motor: overload (150% Inom for 1 minute), stall System: loss of communication, Safety: STO (safe torque off), locked rotor	
	Control unit			
	Each drive must be connected in the network via Modbus® to a CAREL pCO or other manufacturer's controller that manages the drives with main/secondary logic.			
	Inputs	STO (safe torque off)	Voltage-free contact input, reinforced insulation (12 V SELV circuit): open contact voltage: <24 V closed contact current: 40 mA typical max. cable length 25 m	
Outputs	DCbus power supply for auxiliary devices		395 Vdc ± 10 Vdc, 1.9 A max for PS2**122***** models; max. cable length 1 m shielded cable, minimum cross-section 1 mm ²	
Interface data connection	Serial data connection		RS485, Modbus® protocol, maximum baud rate 19200 bit/s typical resistance in reception 96 KΩ (equal to 1/8 load unit, i.e. 1/256 of the maximum load applicable on the line)	
	Insulation		Reinforced (24 V SELV circuit)	
	Maximum length		100 m shielded cable	
	Ingress protection		IP00	
	Ball pressure test temperature		125°C	
	Construction		Device to be incorporated	
	Type of automatic action		PS200122***0* and PS200122***S* Functional PS200122***1* and PS200122***P* Safety	
Pulse voltage		4 kV (overvoltage category III)		
Conformity to standards	CE	Low voltage directive	2014/35/EU IEC 60730-1, IEC 60335-1 (sections 29 and 30), IEC 60335-2-34 (sections 19.101 and 19.103)	
		Compatibility directive electromagnetic	2014/30/EU EN 61800-3, ed.2.0: Adjustable speed electrical power drive systems. EMC requirements, including specific test methods. EN61000-3-2: Electromagnetic compatibility (EMC) Part 3-2: Limits Limits for harmonic current emissions (equipment input current <= 16 A per phase). EN61000-3-12: Electromagnetic compatibility (EMC) Part 3-12: Limits Limits for harmonic current emissions (equipment input current > 16 A and <=75 A per phase).	
	UL	UL 60730-1, UL 60335-1 (sections 29 and 30), UL 60335-2-34 (sections 19.101 and 19.103)		

Tab. 2.h

2.8 15 A 1 PH and 18 A 3 PH inverter PSD2

For further details on the electrical and mechanical specifications, see technical leaflet +0500125IE

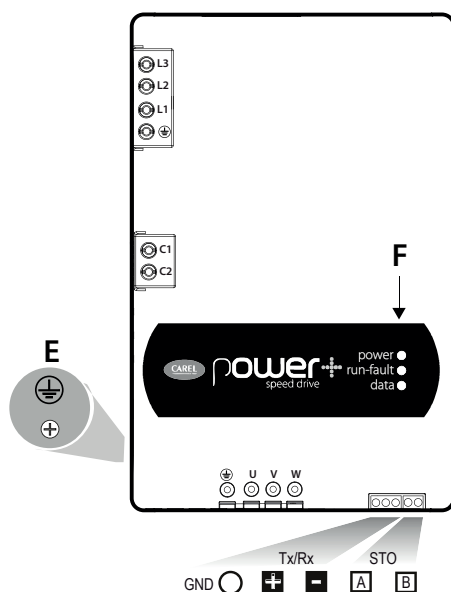


Fig. 2.d

Description of the terminals:

Ref.	Description	
L3, L2, L1	Three-phase power supply	
(*)		
(*)	Motor output	
U, V, W		
C1	Optional external choke	
C2		
GND	GND (0 V)	RS485/ModBus® connection
+	Tx/Rx+	three-pin plug-in connector
-	Tx/Rx-	

Ref.	Description	
A	STO safety digital input (**)	
B	2-pin plug-in connector	
E	PE earth screw	
F (LEDS)	POWER (green)	drive powered
	RUN (green)	drive running
	FAULT (red)	drive alarm
	DATA (yellow)	communication active

(*) The earth connections inside the controller are electrically connected together and to the PE.

(**) Voltage-free digital input: if not used, short-circuit with a jumper.

Notice: the RS485 and STO connections have reinforced insulation from the power supply.

Caution:

- in the European Union, all units that incorporate the drive must comply with the Machinery Directive 2006/42/EC. Specifically, the manufacturer of the unit is responsible for installing a main switch and conformity to standard EN 60204-1;
- for a fixed installation, according to local regulations in force, a circuit breaker may be required between the power supply and the drive;
- the drive must be connected to earth: the earth cable must be sized for the maximum fault current, which will normally be limited by fuses or a circuit breaker.

Rated values

The following table shows the rated input current and output current values, as well as the specifications for sizing the cables (cross-section, maximum length) and the fuses. The values refer to an operating temperature of 60°C and a switching frequency of 8 kHz, unless otherwise specified.

Models	15A 1PH	18A 3PH
Rated input current at 230 V (400 V 3 PH)	26 to 23 A	18.5 to 16.5 A
Fuse or type B circuit breaker	32 A	32 A
Power cable size	4 mm ²	4 mm ²
Rated output current	15 A	18 A
Rated output power at 230 V (400 V 3 PH)	5 kW	10.5 kW
Maximum total dissipation	320 W	320 W
Maximum dissipation on the heat sink	235 W	250 W
Min. motor cable size	4 mm ²	4 mm ²
Max. motor cable length	5 m	5 m

Tab. 2.i

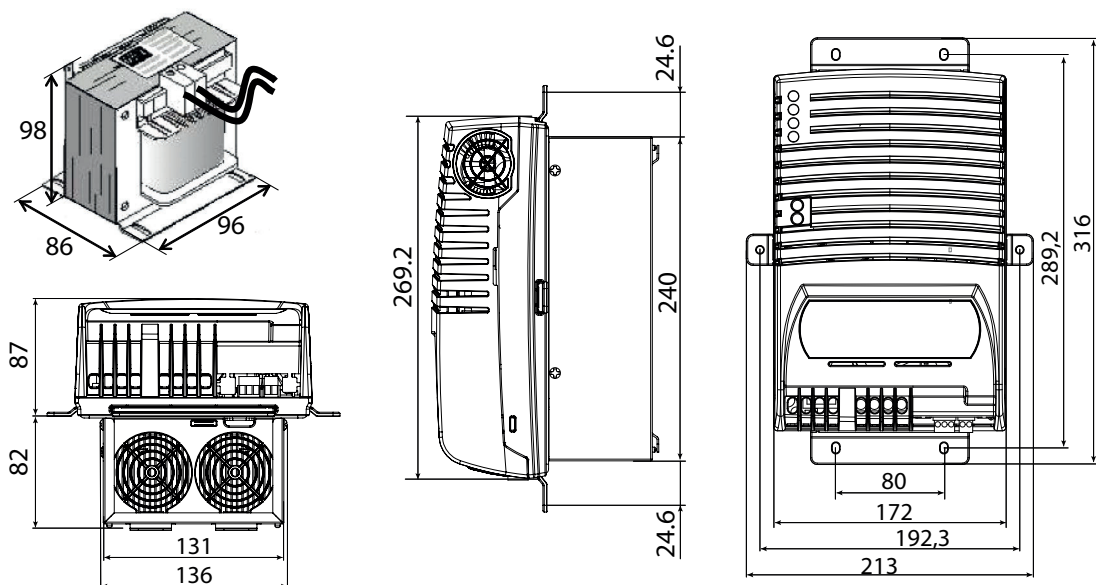
2.8.1 Dimensions (mm)


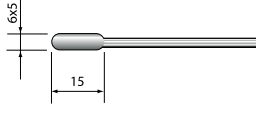
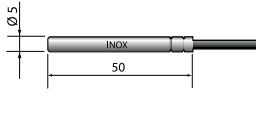
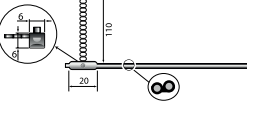
Fig. 2.e

Main technical specifications

Environmental conditions	Storage temperature	-40T60°C
	Operating temperature	-20T60°C
	Humidity	< 95% RH non-condensing
	Altitude	Maximum allowed: 2000 m above sea level Up to 1000 m asl without derating Derating in terms of maximum output current: 1% /100m
	Environmental pollution level	3
Power supply	Input voltage	PS2**183****, PS2**243****: 200 240Vac -10%/ +10%, 50 60Hz, 3 ~ PS2**184****, PS2**244****: 380 480Vac -10%/ +10%, 50 60Hz, 3 ~
	Output voltage	0 Input voltage
Motor output	Output frequency	0 500 Hz
	Frequency resolution	0.1 Hz
	Maximum cable length	see paragraph 5.1 of the technical leaflet +0500125IE
	Switching frequency	4, 6, 8 kHz
	Protection functions	Drive: short circuit, overcurrent, earth fault, overvoltage and undervoltage, over-temperature Motor: overload (150% Inom for 1 minute), stall System: loss of communication, Safety: STO (safe torque off), locked rotor
Control unit	Each drive must be connected in the network via Modbus® to a CAREL pCO or other manufacturer's controller that manages the drives with main/secondary logic.	
Inputs	STO (safe torque off)	Voltage-free contact input, reinforced insulation (24 V SELV circuit): open contact voltage: <24 V closed contact current: 40 mA typical max. cable length 25 m
	Serial data connection	RS485, Modbus® protocol, maximum baud rate 19200 bit/s Typical reception resistance 96 kohms, equal to 1/8 of unit load, i.e. 1/256 of maximum load applicable on the line
Interface connection data	Insulation	Reinforced (24 V SELV circuit)
	Maximum length	100 m shielded cable
Other	Ingress protection	IP00
	Ball pressure test temperature	125°C
	Construction	Device to be incorporated
Standards compliance	Type of automatic action	PS2*****0* and PS2*****S* models: Type 1 (functional control) PS2*****1* and PS2*****P* models: Type 2 (safety control)
	Pulse voltage	4 kV (overvoltage category III)
	CE	Low voltage directive 2014/35/EU IEC 60730-1, IEC 60335-1 (sections 29 and 30), IEC 60335-2-34 (sections 19.101 and 19.103)
		Electromagnetic compatibility directive 2014/30/EU EN 61800-3, ed. 2.0: Adjustable speed electrical power drive systems. EMC requirements, including specific test methods. EN61000-3-2: Electromagnetic compatibility (EMC) Part 3-2: Limits Limits for harmonic current emissions (equipment input current ≤ 16 A per phase). EN61000-3-12: Electromagnetic compatibility (EMC) Part 3-12: Limits Limits for harmonic current emissions (equipment input current > 16 A and ≤75 A per phase).
	UL	UL 60730-1, UL 60335-1 (sections 29 and 30), UL 60335-2-34 (sections 19.101 and 19.103). See par. "General features"

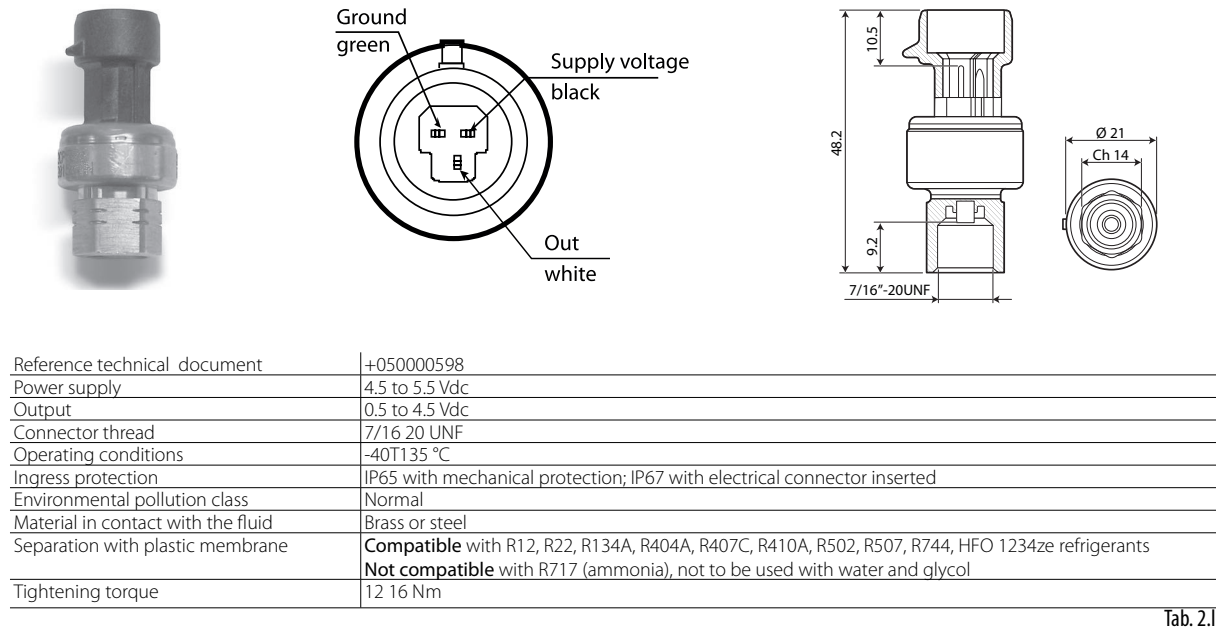
Tab. 2.j

2.9 Temperature probes

Models	NTC***HP00	NTC***HT41	NTC***HF01
Reference technical document	+030220655	+030220655	+030220655
Operating range	-50T105 °C in air / -50T50 °C in fluid	-0T150 °C in air	-50T105 °C
Connections	Stripped wire terminals, dimensions: 5±1 mm	Stripped wire terminals, dimensions: 6±1mm	Stripped wire terminals, dimensions: 6±1mm
Sensor	NTC 10 kΩ ±1% at 25 °C Beta 3435	NTC 50 kΩ ±1% at 25 °C Beta 3977	R(25 °C)= 10 kΩm 1%; Beta 3435
Dissipation factor (in air)	approx. 3 mW/°C	approx. 3 mW	3 mW
Thermal time constant (in air)	approx. 25 s	approx. 30 s	approx. 50 s
Sensor ingress protection	IP67	IP55	IP67
Sensor housing	Polyolefin	High temperature polyester dim. 20x5 mm	Thermoplastic with fixing tie
Class of protection against electric shock	Basic insulation for 250 Vac	Basic insulation for 250 Vac	Basic insulation for 250 Vac
Cat. of resistance to heat and fire	Flame retardant	In accordance with CEI 20-35	UL/HB cable
			
	temperature inside the showcase	discharge temperature	evaporation temperature gas cooler outlet temperature

Tab. 2.k

2.10 Pressure probes (SPKT00**P0)



2.11 Pressure probes (SPKT00**8C0)

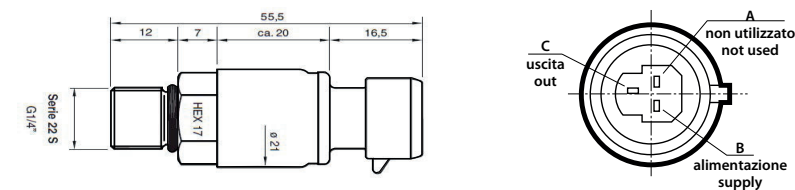


Fig. 2.f

Description of codes and models

Part number	Pressure psi		Pressure bars		Mod.	over range		Burst pressure		IP ⁽¹⁾
	4 mA	20 mA	4 mA	20 mA		psi	bar	psi	bar	
SPKT00D8C0	0	2175	0	150	Male	4360	300	7680	530	IP67
SPKT00H8C0	0	1740	0	120	Male	4360	300	7680	530	IP67

Notice: ⁽¹⁾ with connector plugged in; all sensors are sealed gauge

Technical specifications

reference technical document	+050000596
power supply	8-28 Vdc, ±20%
output	4 to 20 mA
mechanical fitting	¼" gas male (with water and oil resistant O-ring)
operating temperature	-40T100°C
storage temp.	-20T100°C
fluid temp. (average)	-20T100°C
linearity	± 1 %FS (0-50°C) temperature-compensated; ± 2 %FS (0-80°C); ± 4 %FS (-40 to 100°C)
protection rating	IP67 with connector plugged in
shock	20 g* sinusoidal, 11 msec
vibrations	5-2000 Hz / 10 g /, X/Y/ Z axes / 20 g sin 11 ms
environmental pollution	normal
insulation	at 50 V ≥ 10 MΩ
response time	(0 to 99%) < 10 msec
EMC	EN 61000-6-1/4 / EN 61326-2-3
electrical connections	Packard Plug
tightening torque	12 16 Nm
Compatible with all types of refrigerants.	

Tab. 2.m

Notice: FS = MAX output MIN output

2.12 Unipolar E2V valves for R744

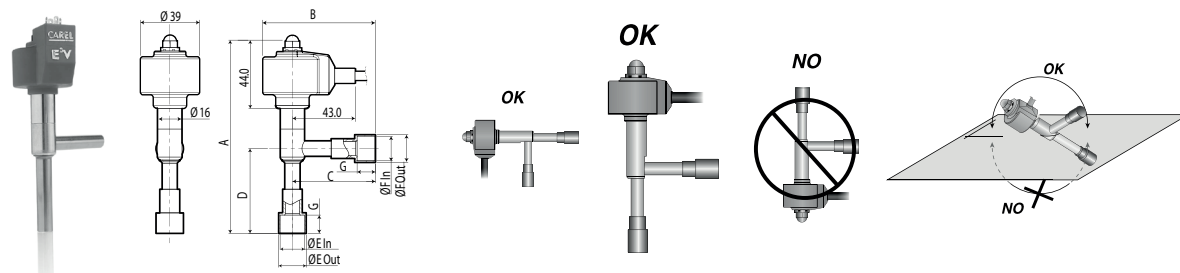


Fig. 2.g

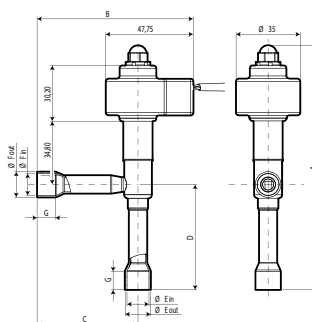
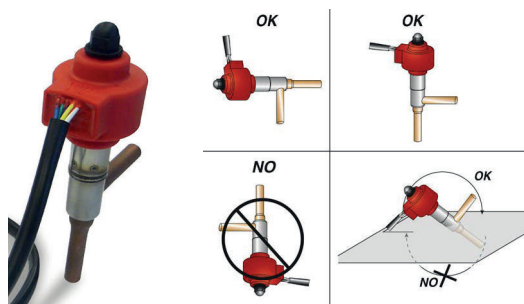
Valve type	A	B	C	D	E	F	G
E2V**CS1C*	125.8mm (4.95 inch)	82.3 mm (3.24 inch)	52.3 mm (2.06 inch)	53.3 mm (2.10 inch)	ID 13/OD 18 mm (in 0.51 out 0.71 inch)	ID 13/OD 18 mm (in 0.51 out 0.71 inch)	10 mm (0.39 inch)

Tab. 2.n

CAREL E2V-C operating specifications		CAREL E2V-U stator	
Compatibility	R22, R134a, R404A, R407C, R410A, R744, R507A, R417A	Reference technical document	+050001440
Maximum working pressure (MWP)	up to 140 barg (2030 PSig)	Power supply voltage	12 V
Maximum operating pressure differential (MOPD)	up to 120 bars (1740 PSI) for E2V24CS0** and E2V24CS1** 85 bars (1233 PSI)	Drive frequency	50 Hz
PED	Gr. 2, art. 3, par. 3	Phase resistance (25 °C)	40 Ohms ± 10%
Refrigerant temperature	-40T70 °C (-40T158 °F)	Ingress protection	IP67
Room temperature	-30T70 °C (-22T158 °F)	Connections	6 pin, cable length: 2 m
Contact CAREL for different operating conditions or alternative refrigerants.		Complete closing / control steps	500 / 480

Tab. 2.0

2.13 Unipolar E2V valves for R-290 and HFCs



Valve type	E2V**FSF** copper 12-12mm ODF
A	133.5mm (5.26inch)
B	85.4 mm (3.36 inch)
C	55.1 mm (2.17 inch)
D	57.5 mm (2.26 inch)
E	1n 12/Out 14 mm (1n 0.47/Out 0.55 inch)
F	1n 12/Out 14 mm (1n 0.47/Out 0.55 inch)
G	10 mm (0.39 inch)

CAREL E ² V-U operating specifications (+050001440)	
Compatibility	Group 1: R1234yf, R290, R600, R600a Group 2: R22, R134a, R404A, R407C, R410A, R417A, R507A, R744, R1234ze, R448A, R449A, R450A, R513A
Maximum operating pressure (MOP):	CE approval: 60 bars (870psi). UL approval: 45 bars (652 psi)
Maximum operating pressure differential (MOPD):	35 bars (508 psi); for E2V35 unipolar: 26 bars (377psi)
PED	Gr 1 & 2, art. 4, par. 3.
Refrigerant temperature	-40T70 °C (-40T158 °F)
Ambient temperature	-30T70 °C (-22T158 °F)

CAREL E2V-U stator (+050001440)	
Power supply voltage	12 V
Drive frequency	50 Hz
Phase resistance (25 °C)	40 Ohms ± 10%
Ingress protection	IP67
Step angle	15°
Linear movement/step	0.03 mm (0.0012 inch)
Connections	6-wire (AWG 18-22), cable length 1; 2; 0.3 m
Complete closing / control steps	500 / 480

Tab. 2.p

2.14 General connection diagram

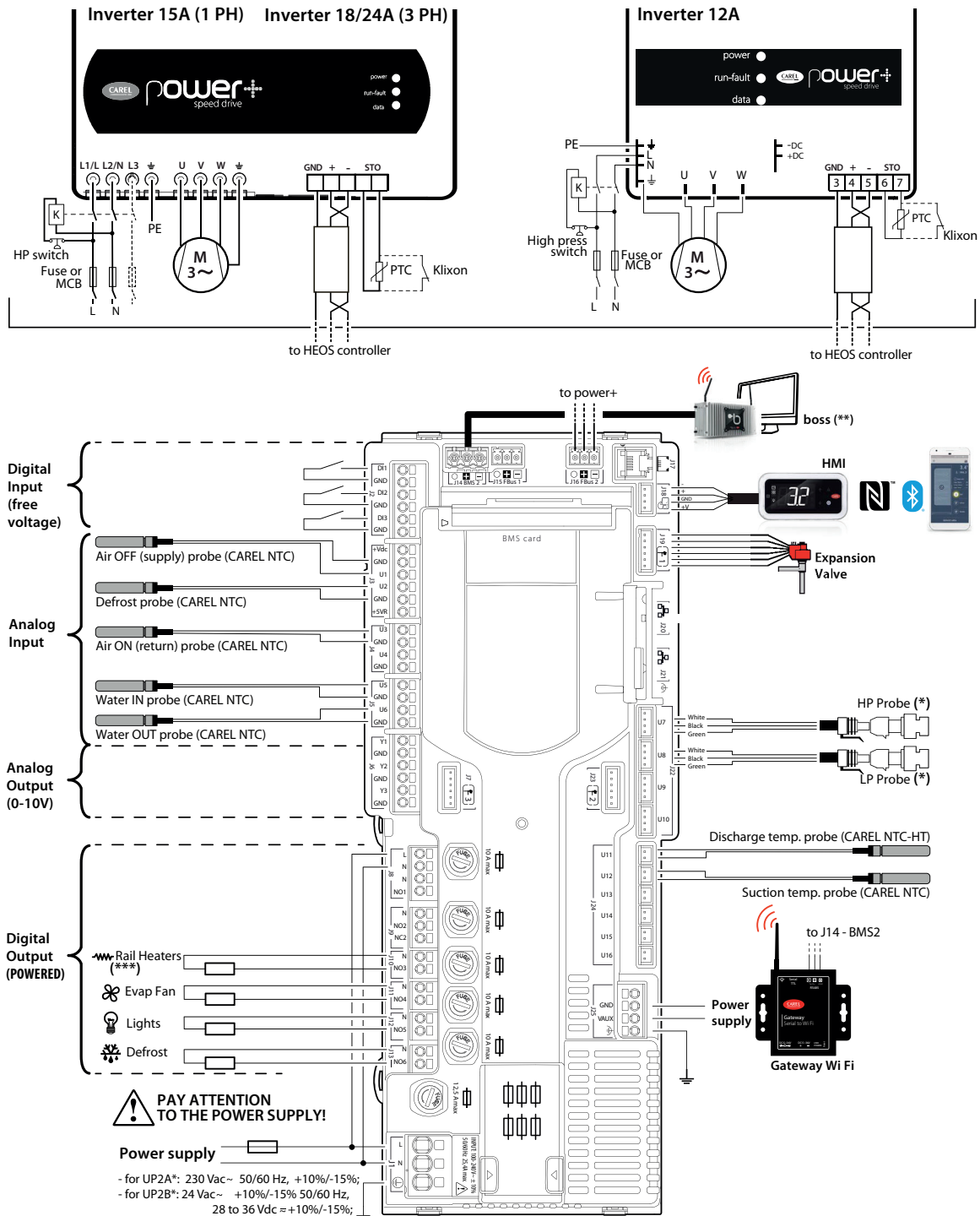


Fig. 2.h

(*) The 4-20 mA pressure probes are connected by attaching white to Ux and black to +Vdc, green is not used.

(**) Boss can also be connected via RS485 serial to J14, or via Ethernet network to J20 or J21. Alternative connection on BMS1 or ethernet port. See chapter 1.3

(***) SSR 230 Vac output, maximum switchable current 0.5 A.

Caution: if the PEC version inverters (with class B software structure) are not used, the thermal protection devices for overload and high pressure must act directly on the compressor actuator, and must therefore be wired in series with the compressor contactor coil control. For details on the types of cable to be used, see the Power+ technical leaflets.

Notice for the cable for main and secondary communication; Carel suggests:

- Twisted pair cable with shield
- Capacitance <100pF/m and impedance of 120Ω @100KHz
- Do not connect the shield to earth
- Example of suggest cables:
 - Belden 8761 (AWG22) up to 500m length
 - Belden 8762 (AWG20) above 500m length

2.14.1 Usage of the BMS1 card

The serial card is an option. Code: PCOS004850 and it is required to use BMS1 port

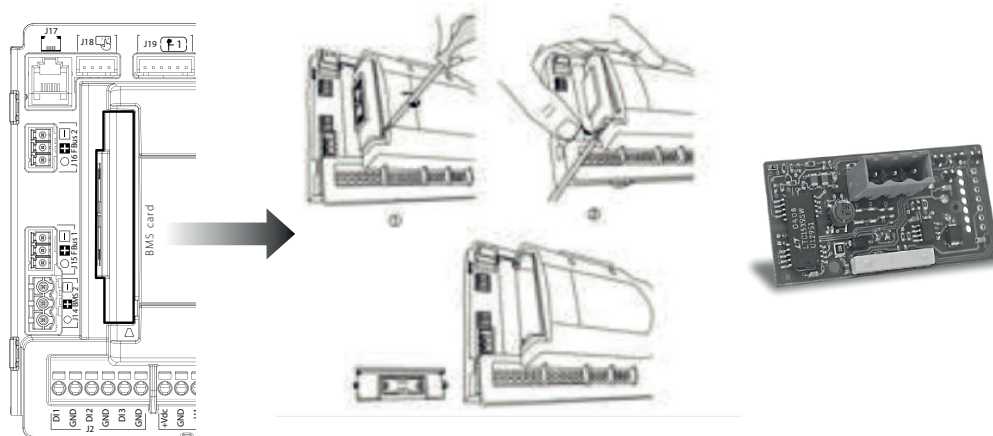


Fig. 2.i

If the BMS1 port is used to connect a supervisory system (it can be either Boss or other provider) it will be required to connect the serial line on each board

2.15 Installation

For installation proceed as follows, with reference to the wiring diagrams:

- before performing any operations on the control board, disconnect the main power supply by turning the main switch in the electrical panel OFF;
- avoid touching the control board, as electrostatic discharges may damage the electronic components;
- suitable electrical protection must be ensured by the manufacturer of the cabinet or by appropriate installation of the controller;
- for safety devices (e.g. circuit breakers), comply with the following requirements:
 - IEC 60364-4-41
 - Standards in force in the country
 - connection technical requirements of the power company
- if an inverter is used to drive the compressor with B or B+ residual current circuit breakers, these protection devices must always be installed upstream of the AC/A/F (see the figure below).

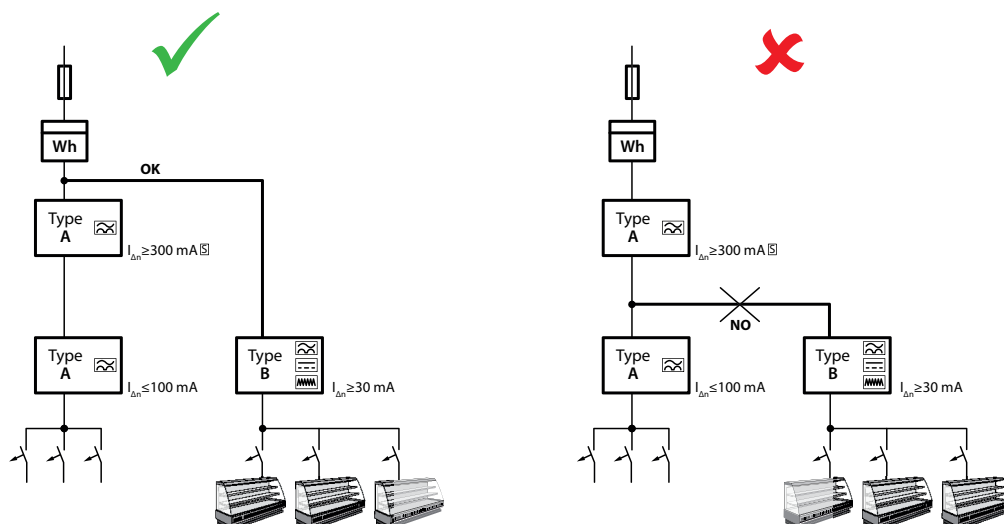


Fig. 2.j

In a TT or TN power network, the protection device can be used for several showcases, as shown in the example in the figure below.

POWER SUPPLY 3P+N 400V - 50/60Hz

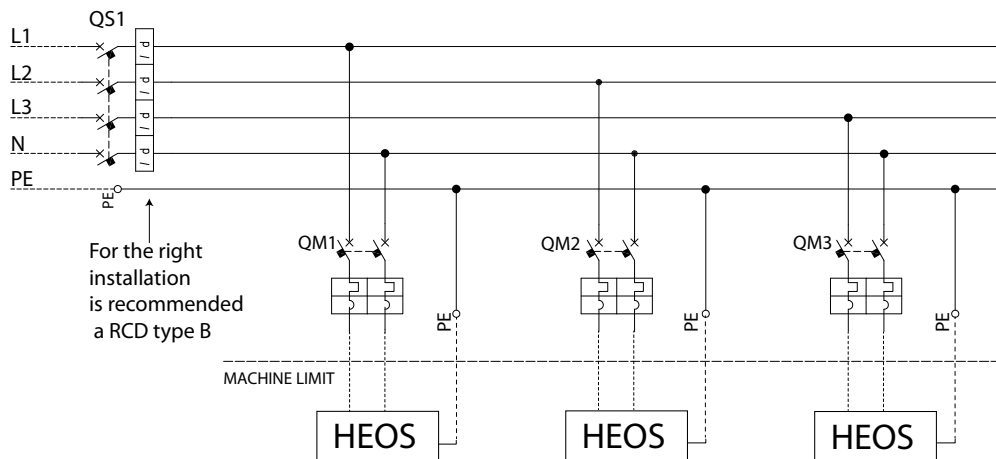


Fig. 2.k

Caution: the rating and tripping current of the residual-current circuit breaker must be sized based on the type of power network (TT, TN-C, TN-S) and the number of inverters connected.

- connect any digital inputs, $L_{max} = 10\text{ m}$;
- connect the temperature and pressure probe, $L_{max}=10\text{ m}$;
- connect the electronic expansion valve cable to J19, and the injection valve, if used, to J23;
- connect the inverter serial communication cable to terminal J16;
- connect the optional AX4*** terminal to connector J18;
- connect the power supply to controller and the inverter;
- program the controller using the guided commissioning procedure: see "Initial configuration".
- program the individual controllers using the Applica app or desktop program;
- connect the electrical loads to the relay outputs only after having programmed the controller. Always carefully evaluate the maximum capacity of the output relays, as specified in the Technical specifications;
- connect the supervisor serial line to connector J14 if using the RS485 serial line, or to J20 or J21 if using a dedicated Ethernet network.

Caution: avoid installing the controllers in environments with the following characteristics:

- relative humidity greater than 90% or with condensation;
- strong vibrations or knocks;
- exposure to water sprays;
- exposure to aggressive and polluting atmospheres (e.g.: sulphur and ammonia gases, saline mist, smoke) which may cause corrosion and/or oxidation;
- strong magnetic and/or radio frequency interference (thus avoid installation near transmitting antennae);
- exposure of the controllers to direct sunlight and to the elements in general.

Caution: the following warnings must be observed when connecting the controllers:

- incorrect connection to the power supply may seriously damage the controller;
- use cable ends suitable for the corresponding terminals. Loosen each screw and insert the cable ends, then tighten the screws and lightly tug the cables to check correct tightness;
- separate as much as possible the probe and digital input cables from cables to inductive loads and power cables, so as to avoid possible electromagnetic disturbance. Never run power cables (including the electrical panel cables) and probe signal cables in the same conduits;
- do not install the probe cables in the immediate vicinity of power devices (contactors, circuit breakers, etc.);
- reduce the path of probe cables as much as possible, and avoid spiral paths that enclose power devices.

Caution: If the PEC version inverters (with class B software structure) are not used, the thermal protection devices for overload and high pressure must act directly on the compressor actuator, and must therefore be wired in series with the compressor contactor coil control.

Notice: when connecting RS485 serial networks:

- connect the shield to the GND terminals on all the controllers;
- do not connect the shield to the earth in the electrical panel.
- use a shielded, twisted AWG20-22 cable (e.g. Belden 8761 or, for particularly critical environments in terms of electromagnetic disturbance, Belden 3106A);
- For the supervisor serial network connection only (J14): connect a $120\ \Omega$ terminating resistor between the Tx/Rx+ and Tx/Rx- terminals on the last controller in the network (the one furthest away the supervisor).

3. USER INTERFACE

3.1 Introduction

Heos PowerBoard uses the user terminal (P/N AX4000*) for displaying alarms and some key values, and for setting the main parameters. The terminal is fitted with a three-digit display with sign and decimal point, alarm buzzer, nine icons and a four-button keypad for navigating and setting the parameters. Moreover, the terminal features wireless connectivity and an NFC (Near Field Communication) or Bluetooth Low Energy interface, used for interaction with mobile devices (on which the CAREL "Applica" app has been installed, available for IOS and on Google Play for the Android operating system).



Notice:

- NFC connectivity is only compatible with the Applica app for the Android operating system;
- user levels: U=user, S=service, M=manufacturer, see the parameter table (chap. 6).

The unit of measure of the displayed values can be changed by setting parameter /5.

Code	Description	UOM
/5	Unit of measure 0=°C/barq 1=°F/psig	-

The buzzer is disabled by setting parameter H8.

Code	Description	UOM
H8	Buzzer: 0=No, 1=Yes	-

The information available on the user terminal and in the Applica app may vary according to the password entered and the configuration parameters set by the cooler manufacturer. See the parameter table (chap. 6).



Notice:

- the Service password also accesses the User parameters;
- if no button is pressed, after around 1 minute the terminal will automatically return to the standard display.

3.1.1 User terminal

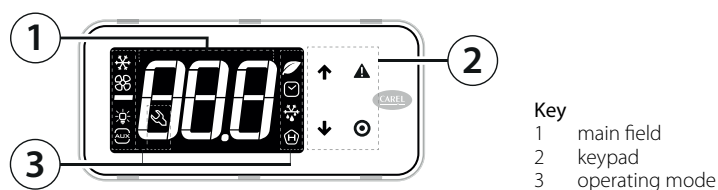


Fig. 3.a



Notice: the user terminal only offers access to user and service-level parameters. Manufacturer-level parameters are set using the Applica app or the configuration software. See the parameter table.

3.1.2 Keypad

Part number	Description
 UP DOWN	• Increase/decrease the value • Scroll direct access functions • LED on: scroll menu, parameters, direct access functions • LED flashing: set parameter values
PRG	• Pressed briefly: • Save value and return to the parameter code • Enter direct access function menu (from main screen) and activate/deactivate functions • Pressed and held (3 s): • Enter programming mode or return to previous level without saving • LED on: main screen/programming mode
ALARM	• Pressed briefly: display alarms • Pressed and held (3s): reset alarms • LED on/flashing: acknowledged/active alarm

Tab. 3.a



Notice: during navigation, the LED is on if the button is enabled, otherwise it is off.

3.1.3 Display

The icons provide information on device operation and/or the activation of certain functions, as shown in the table.

Icon	Function	ON	OFF	Flashing	Notes
	Compressor/ExV	Active	Not active	-	-
	Evaporator fans	Active	Not active	-	-
	Lights (local or network)	Active	Not active	-	-
	Aux. output/ Generic functions	Active	Not active	-	Switches on when the auxiliary output selected as the local or network auxiliary is activated and when a genetic function is active
	Service	Sensor alarm			Refer to the alarm table
	Defrost	Active	Not active	Request	Flashes when activation is prevented as it has been disabled externally or due to procedures in progress.
	Clock	Clean mode active	-	-	-
	Energy saving	Clean mode active	-	-	-
	Alarm	Alarm present and acknowledged	-	Alarm active	Flashing for alarms during normal operation (e.g. high/low temperature) or alarms from external digital input, immediate or delayed, both on the main and secondary controller

Tab. 3.b

3.1.4 Standard display

At start-up, the user terminal briefly shows "NFC", indicating that the NFC interface is available for communication with mobile devices, and then the standard display is shown. The display shows measurements in the range -50 and +150°C, according to the type of probe used. For 0 to 5 Vdc and active 0 to 10 Vdc or 4 to 20 mA probes the unit of measure is defined by the type of probe used. The decimal point can be disabled by setting a parameter (/6). Parameter /t1 is used to choose the variable to be shown on the display during normal operation:

Code	Description	UOM
/t1	Display on user terminal 0 = Terminal disabled 1 to 6 = Probe 1 to 6 7, 8 = Reserved 9 = Control probe 10 = Virtual probe 11 to 14 = Probe 11 to 14 15 = Control set point	-
/6	Display decimal point: 0=Yes, 1=No	-

Programming mode

The controller can be programmed in three levels, with access to different parameters based on the password entered (see the parameter table):

- user (password = 0);
- service (password = 22);
- manufacturer (password = 44).

The user terminal only offers access to user and service-level parameters.

To access the manufacturer parameters, use the "Applica" app or commissioning software.

Code	Description	UOM
PDU	User password	-
PDS	Service password	-
PDM	Manufacturer password	-

Procedure (from user terminal)

Use:

- PRG for 3 s to enter programming mode (see chap. 4 Initial configuration);
- UP and DOWN to navigate the menu and set the values;
- PRG to display the parameter value and save the changes;
- PRG (3s) or ESC to return to the higher level.

3.1.5 Direct functions

The following functions can be activated directly from the keypad or via the app:

Icon	Display	Description	Icon	Display	Description
	Lht	Cabinet light		dEF	Defrost
 + 	Cnt	Continuous cycle	 + 	CLn	Clean cabinet

Tab. 3.c

Procedure:



1. Go to the standard display;



2. Press PRG: Lht is displayed, the UP and DOWN buttons light up.
Press PRG to turn the light on/off: the icon will come on or go off.
Press DOWN to activate the next function (Cnt) or press Esc to exit;



3. Press PRG to activate the continuous cycle (Cnt). Press DOWN to activate the next function;



4. Follow the previous steps for all other functions;
5. Select Esc to exit;



6. The standard display is shown

3.2 Menu tree

 **Note:** the parameters displayed depend on the password entered. See "User interface" (chap. 2) and the parameters table (chap. 6); the manufacturer parameters (M) are accessible only from the Applica app or from the commissioning software. The parameters accessible on the Heos PowerBoard terminal are organised into a menu structure based on categories. In programming mode, the icons indicate the parameter category displayed, helping navigation.

Cat.	Parameters		Description	Access level
VIS	Sm	PPu	Read variables used for monitoring unit operation (sensors, superheat, valve opening, etc.) Notice: the variables will only be visible if configured	Password
	Sd	tGs		
	Sr	tEu		
	SA	PEu		
	SU	Sdt		
	Svt	Scp		
	SH			
CTL	ON	p3	Controller management parameters	Password
	St			
DEF	dI	dP1	Main defrost parameters	Password
	dt1	dP0		
ALM	AL	Ad	Alarm parameters: high and low temperature alarm threshold, alarm delay, alarm log Two submenus: thr: 1A1 2AL (visible if A1 = FALSE) 3AH (visible if A1 = FALSE) 4ALA (visible if A1 = TRUE) 5AHA (visible if A1 = TRUE) 6Ad hst: 1HS0 ... 10 HS9	Password
	AH			
CNF	H17	IP2	Configuration parameters: serial communication and IP	Password
	H19	IP3		
	H18	IP4		
	IP1			
ESC			Exit the menu	

Tab. 3.d

Functions without password required:

- Direct commands
- Active alarms
- Basic monitoring (Sm, Sd, Sv, Sd probes only)

Functions with password required

- Quick network setup
- Quick commissioning (control, EEV, defrost, etc.)

4. INITIAL CONFIGURATION

The Heos PowerBoard does not feature a configuration wizard. However, in order for the board to function, the compressor used needs to be configured. If the compressor configuration fails, the board will send a warning, alarm "ine". As the secondary boards in multi-evaporator systems do not manage a compressor, they do not need to be configured, and can be started using the default parameters, which will be loaded correctly when communication is established between the main and secondary boards. If no communication has been established between the main and secondary boards, the board sends the "MA-Lost communication with Main" warning. Heos PowerBoard includes a version for the "Heos Box Subcritical R-744" (P/N +0300140IE). Consequently, the following table distinguishes between the various situations that may arise when starting the system the first time:

Role	Type	Initial configuration	Feedback
Main	Heos Box Subcritical R-744	Switch the unit on. Configuration is automatic	-
Main	-	The compressor configuration needs to be loaded by the user	"ine" alarm shown if the inverter parameters are not set
Secondary	Heos Box Subcritical R-744	Configuration is automatic when the board recognises the main	"mno" alarm if the board has never communicated with the main
Secondary	-	Configuration is automatic when the board recognises the main	"mno" alarm if the board has never communicated with the main

Tab. 4.a



Notice:

- on the secondary boards, the default values are loaded when connecting to the main unit for the first time ("mno" alarm). Therefore, any configuration already loaded on the secondary boards will be overwritten. After this first connection, a different configuration can be downloaded onto the secondary boards.
- On main boards without the compressor configuration ("ine" alarm), the default values will be set after loading the compressor parameters. Any configuration already loaded on the board will be overwritten.

4.1 Mobile device

The "Applica" app can be used to configure the controller from a mobile device (smartphone, tablet), via NFC (Near Field Communication) or Bluetooth Low Energy (BLE). Heos PowerBoard is fitted with an internal clock for managing store opening hours. The opening and closing times can be set and this time band enabled for each day of the week using the Applica app.

Procedure (modify parameters):

1. download the CAREL "Applica" app;
2. (on the mobile device) enable communication and mobile data;
3. open Applica;
4. move the mobile device near to the user terminal again to recognise the configuration;
5. enter the password (*);
6. set the parameters as needed;
7. move the mobile device near to the user terminal again to upload the configuration parameters.

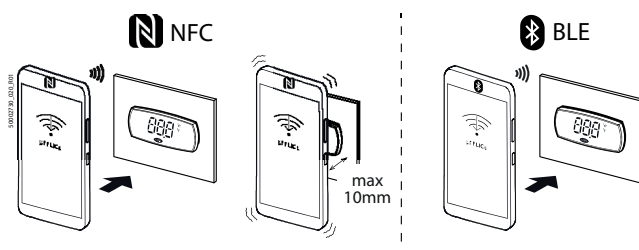


Fig. 4.a

(*) pre-assigned by the cooler manufacturer to allow maintenance only by authorised service technicians. See the parameter table (chap. 6).



Caution: during the first connection, Applica aligns itself with the software version on the Heos PowerBoard via a cloud connection; this means a mobile data connection is needed at least for this first connection.

Applica dashboard: the Heos PowerBoard has its own dashboard in the "Applica" smartphone app. The key features of the dashboard are:

- the dashboard on the home page is display only. No commands can be activated or parameters set.
- The dashboard on the home page shows real-time data when using a Bluetooth connection, with a delay that depends on the quality of the smartphone-controller connection, usually around 3-5 seconds.

4.2 Computer

IT IS possible to connect to Heos PowerBoard via computer, using the Applica Desktop application.

The following actions are possible:

- Load configurations (both parameters and compressor)
- Software (firmware) update

4.2.1 Connection

The configuration software (Applica Desktop) can be used to configure the commissioning parameters from a PC.

Procedure:

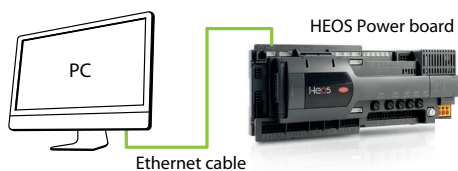


Fig. 4.a

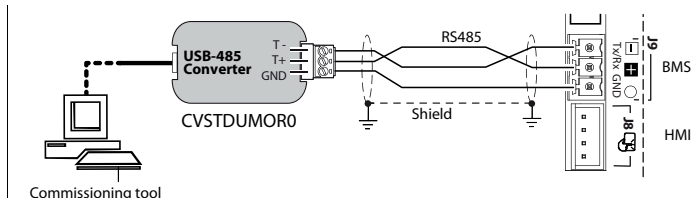


Fig. 4.b

1. Connect the PC to connector J14 (BMS2) or BMS card (BMS 1) via a USB/RS485 converter (P/N CVSTDUMOR0); any of the Ethernet connectors can also be used (see chap. 2). If an Ethernet port is used, the connection will be immediate thanks to the "auto detect" function; in this case Applica immediately identifies the board's IP address (the board must be connected to the same network as the computer).

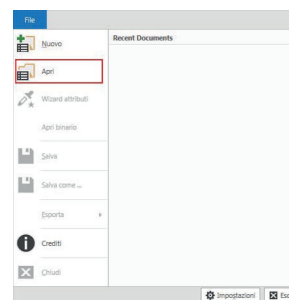


Fig. 4.c

2. After starting the software, open the project file provided by Carel;

In the "Target" tab add a "target", i.e. the Heos PowerBoard to communicate with.

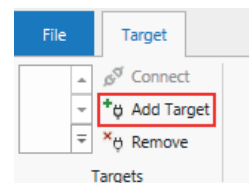


Fig. 4.d

The options for serial connection are:

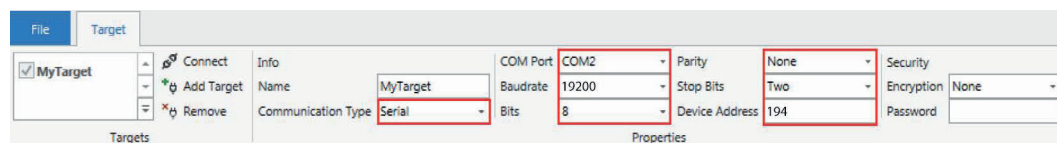


Fig. 4.e



Notice: it is not possible to connect via serial line if a Bluetooth connection via Applica is running.

Here the default values

BMS connection	
COM port	Up to user
Baudrate	19200
Bits	8

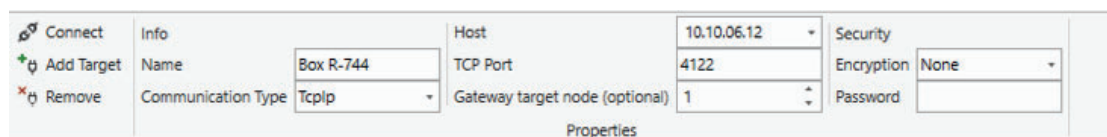
BMS connection	
Parity	None
Stop Bits	Two
Device address	194

The options for Ethernet connection:

In the commissioning tool is it possible to automatically detect all the devices in the same subnetwork of the PC (if the PC is not in the same subnetwork of the board, then the "detect" function will fail). In fact in "host" it will be possible to select "Detect".



Notice: it is not possible to connect via Ethernet if a Bluetooth connection via Applica is running



Here the default values

Ethernet	
Host	Detect
TCP Port	4122
Gateway target node	1



Notice: for the Ethernet connection there are 2 options

- A. the IP address is assigned by the DHCP server (default of the board).
- B. If there is no DHCP server in the network, the IP address must be manually assigned. First of all it is then necessary to set iPD=False (disable DHCP setting) then the IP address (with iPA parameter) and subnet mask (parameter iPS) should be set

1. Set the serial communication type and modify the connection parameters, as shown in the figure. Click "Connect": the list of parameters currently loaded on the controller is shown. The "Connect" icon changes to "Disconnect".



Notice:

- the serial port number (COM) may vary and depends on the devices actually connected to the computer;
- the connection with Modbus supervisory system via Ethernet needs to use port 502 and address 1.

For spare parts (P/N HEC00001113E0) the default values are different:

BMS connection	
COM port	User can decide
Baudrate	19200
Bits	8
Parity	None
Stop Bits	Two
Device address	1



Notice: on the spare part (P/N HEC00001113E0) the application/SW is version 1.2.4, with the configuration for compressor NY30 (the smallest Heosbox R-744 size). To change the unit configuration, download the official pack file for the specific Heos-box part number from the Heos confidential area on KSA. Instructions on how to perform the update are shown in chapter 4.3.

4.2.2 Setting the parameters

Once the connection has been made, the board parameters can be set. See the following example:

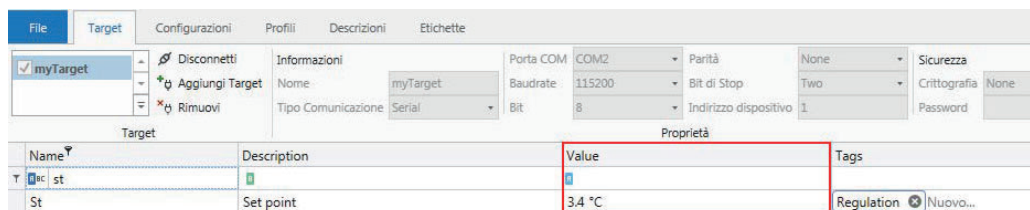


Fig. 4.f

In the "value" column, enter the desired value for the parameters being modified and confirm by pressing ENTER. Read the next paragraph for managing the configurations.

4.3 Managing and updating configurations

The Heos PowerBoard controller manages compressor parameters and the remaining parameters as separate configurations.

4.3.1 Managing the configurations

The board configurations can be managed using Applica mobile or desktop. For the desktop option, follow the steps described in paragraph 4.3.

To set the default parameters of the HeosBox subcritical R-744 units (P/N +0300140IT) two options are available:

1. use parameter "rSH" to start the default parameters of the unit.
2. restart the unit while pressing PRG on the display until a "0" is shown. Release the button and press PRG to confirm (this procedure resets the unit default values, or the preloaded configuration)

The default procedure overwrite the compressor parameters in the driver. This forces the STO to be open as part of the reset process. The procedure is shown on the display with a progress counter from 0 to 100 (see the table below with the key to the status on the display, referred to parameter "ids")

The Heos Box comes with the compressor parameters already installed, furthermore the compressor parameters are also embedded in the official binaries provided by Carel in the official Heos confidential area on KSA (contact your reference Carel branch to get the files).

The compressor parameters can not be copied and pasted when a configuration is created in Applica (Carel reserved users only can do this). Whenever the compressor selection needs to be modified, go to the Heos confidential area on KSA to get the official Heosbox binaries. The installation procedure is indicated on paragraph 4.3.2.

"ids" counter	Meaning	"ids" counter	Meaning
0	Procedure not requested or already completed	22	STO closed: this must be open to continue the procedure
10	downloading compressor parameters	23 to 98	downloading compressor safety parameters
20	compressor parameter download completed	99	compressor safety parameter download completed
21	compressor safety parameters invalid	100	Procedure completed

Tab. 4.b



Notice: "ids"=0 is distinguished between:

- If alarm "ine" (Power+ communication not enabled) is active and ids=0 means "Procedure not requested"
- If alarm "ine" (Power+ communication not enabled) is not active and ids=0 means "Procedure already completed"
- Ids=0 is always verified for secondary units

4.3.2 Updating the boards

The board can be updated using Applica mobile or desktop. During the upload process, these steps shall be respected (this process can only be performed with a "Manufacturer" profile):

- Login as "Manufacturer", password 44 (default value)
- If the unit is a Main then set the unit status as "off" via parameter "oN" and wait for the compressor to go to 0 rps (check variable "iSr"). If the unit is a Secondary, it is recommended to turn off the Main first.
- Save the configurations (if wanting to keep the same configuration. Otherwise this part can be skipped) making sure to use the latest Applica app or Applica desktop tools (see the notes below).
- If using a PC:
 - while the board is connected to the PC, save the configuration (an internet connection must be available while using Applica desktop, at least for the first connection)
 - Export the configuration to a folder on the PC. This step is important in order to recover the configuration once the unit has been updated.
- Valve during stand by must be at zero (psb=0), if this parameter is not zero then the procedure will be blocked. After the update it is possible to set the parameter back to psb>0 or just upload the old configuration that will set the previous value of psb. (It will no longer be necessary to set psb=0 updating from 1.1.3 to a higher version)
- Upload the board, with the specific file according to the compressor installed and the role (if the unit is a secondary), choosing between:
 - Bluetooth (via APP)
 - Applica (via PC, Ethernet or RS-485):
- After that, force the parameters reset via "rSH" parameter.
If bluetooth is used then:
Electrically reboot the board once the "rSH" procedure is over. Once the procedure is over, in the display will appear "err". It is necessary to wait 1 minute with the display showing "err" and then electrically reboot the board. Wait 1 minute before reconnecting the board via Bluetooth
- If the unit is a Main then the STO needs to be opened to copy the parameters (see "ids" on the manual) OR it is possible to skip this operation choosing between one of the 2 options:
 - Apply a special configuration called "Disable_uSafety_Trigger", available in the Heos confidential area on KSA
 - For Carel reserved users only: set reserved parameter "ManInstDef_uSafPrms_Trg" to "FALSE".
- Upload the previous configuration saved, making sure to use the latest Applica app or Applica desktop tools (see the notes below)
- If using a PC:
 - Connect to the board (note that the parameter reset performed in the previous step will force address H17 to the default value 194. Therefore, connect the board using address 194: Also note that parameters H17, H18, H19 for BMS2 and H0, H1, H2 for BMS1 will be reset to to the default values)
 - Import the configuration (from the folder where it was saved)
 - Apply the configuration
 - Set back the correct H17 address and/or the communication parameters (parameter H17, H18, H19 for BMS2 and H0, H1, H2 for BMS1)
- If the unit is a Main and if all the units that operates in the same main-secondary network are updated, then set the unit "on" via parameter "oN"



Notice: the controller is able to update the software in safe conditions. The unit is automatically turned off before downloading the software so if the compressor is running, it is forced to shutdown.

While the compressor is shutting down, a warning will be shown on the computer during the download. In the warning there are two buttons where it is possible to bypass, or cancel the software download. If choosing bypass, download starts immediately and the compressor will remain on during the update and this could be dangerous. We recommend to use the bypass only when it is strictly necessary.



Notice: make sure to update the unit using version 1.12.2504 of the Applica app or at least version 1.0.3359.39978 of Applica desktop (available in the Heos confidential area of KSA).

5. FUNCTIONS

5.1 Inputs and outputs

Heos PowerBoard is available in two versions:

- "Enhanced" version (for controlling units with compressor main configuration) up to 16 universal inputs;
- "Basic" version (for controlling units without compressor secondary Multi-evaporator configuration) up to 10 universal inputs.

Heos PowerBoard has been designed to control both a refrigeration unit and showcase at the same time. This affects the configurability of the universal channels, which are limited as follows:

- Group U1-U6: Maximum configurability. Settable as: NTC, NTC-HT, PT1000, 0-5Vdc, 0-10Vdc, 4-20mA, 0.5-4.5V, PT500, 0-1V, PTC Carel.
- Group U7-U10: Same configurability as group U1-U6, on JST connectors.
- Group U11-U16: Settable as NTC, NTC-HT, PT1000. Other probe types cannot be configured on these channels.

⚠ Caution: a maximum of four "4-20 mA current" sensors can be used (selectable on U1-U6) plus another four selectable on U7-U10.

5.1.1 Probes (analogue inputs)

Active probes (pressure) require the range of measurement to be defined, set by the relative minimum and maximum parameters for the function associated with the probe (see the parameter table chap. 6). To assign the function to each physical or serial probe, configure parameters /FA, /Fb, ... /Fy.

Assign probe functions (parameters /FA, /Fb, /Fc, /Fd, /Fe)

Par.	Description	Default channel R744
/FA	Assign air off temperature probe (SM)	3
/Fb	Assign defrost temperature probe (SD)	4
/Fc	Assign air on temperature probe (SR)	5
/Fd	Assign suction temperature probe (TGS)	11
/FE	Assign saturated evaporation pressure/temperature probe (PEU/TUE)	
/FF	Assign defrost temperature probe 2 (SD2)	
/FG	Assign auxiliary temperature probe 1 (Saux1)	
/FH	Assign auxiliary temperature probe 2 (Saux2)	
/FI	Assign ambient temperature probe (SA)	
/FL	Assign ambient humidity probe (SU)	
/FM	Assign glass temperature probe (SVT)	
/Fn	Assign dew point value (SDP) to a serial probe	
/Fo	Assign discharge temperature (*)	12
/Fs	Assign discharge pressure probe (*)	8
/Et	Assign suction pressure probe (SSP)	7
/Fu	Assign superheated gas temperature probe (SER)	
/Fv	Assign box outlet temperature probe (Sot)	
/Fw	Assign flash tank pressure probe (SFP)	
/Fy	Assign the gas cooler outlet temperature probe (SCT)	
/Fab	Assign water inlet temperature probe (SWI)	15
/FaC	Assign water outlet temperature probe (SWO)	16
/FAd	Assign liquid temperature probe (HFC refrigerant only)	

Tab. 5.a

Calibration (parameters /cA to /cy)

On Heos PowerBoard the values read by the probes can be calibrated by setting parameters /FA, ... /Fy, based on the different functions and some internal variables. In particular, parameters /cA, .../cy are used to increase or decrease the values read by the probes connected to the analogue inputs across the range of measurement. Parameter /cE, on the other hand, corrects the value of the saturated evaporation temperature calculated directly based on the evaporation pressure.

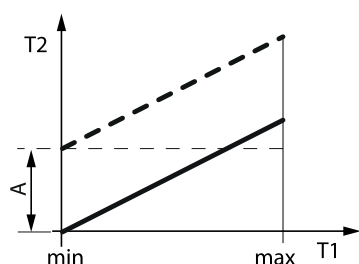


Fig. 5.a

Ref.	Description
T1	Outlet temperature read by the probe
T2	Outlet temperature (value calibrated by T1)
A	Offset (example: parameter /ac for outlet probe)
min, max	Field of measurement

Code	Description	UOM
/ca	Outlet temperature probe (Sm) calibration	°C (°F)
/cb	Defrost temperature probe (Sd) calibration	°C (°F)
/cc	Intake temperature probe (Sr) calibration	°C (°F)
/cd	Suction temperature probe (tGs) calibration	°C (°F)
/cE	Saturated evaporation pressure probe (PEu) calibration	barq (psig)
/cF	Defrost temperature probe 2 (Sd2) calibration	°C (°F)
/cG	Auxiliary temperature probe 1 (Saux1) calibration	°C (°F)
/cH	Auxiliary temperature probe 2 (Saux2) calibration	°C (°F)
/cl	Ambient temperature probe (SA) calibration	°C (°F)
/cL	Ambient humidity probe (SU) calibration	%rH
/cM	Glass temperature probe (Svt) calibration	°C (°F)
/cn	Dewpoint value (SdP) calibration	°C (°F)
/cp	Discharge temperature probe (Sdt) calibration	°C (°F)
/cs	Discharge pressure probe (Scp) calibration	bar (psi)
/Ct	Suction pressure probe (SSp) calibration	bar (psi)
/Cu	Evaporation temperature probe (SEr) calibration	°C (°F)
/Cv	Box outlet temperature probe (Sot) calibration	°C (°F)
/Cw	Flash tank pressure probe (SEP) calibration	bar (psi)
/cy	Condensing temperature probe (Sc) calibration	°C (°F)
/Cab	Water inlet temperature probe (SWI) calibration	°C (°F)
/CaC	Water outlet temperature probe (SWO) calibration	°C (°F)
/Cad	Liquid temperature probe (Liq) calibration	°C (°F)

/2: analogue probe measurement stability

Code	Description	UOM
/2	Analogue probe measurement stability	-

The setting of /2 defines the coefficient used to stabilise the temperature measurement. Low values assigned to this parameter allow a prompt response of the sensor to temperature variations; the reading however become more sensitive to disturbance.. High values slow down the response, but guarantee greater immunity to disturbance, that is, a more stable, precise and filtered reading.

5.2 Digital inputs

Heos PowerBoard manages three dedicated physical digital inputs plus universal channels that can be configured as digital inputs (see the introduction in chapter 8 for details on the universal channels). To associate a physical input to each available function, set parameters DIA, D1b, ... DI3 to the value relating to the physical and logical digital input (parameters r1A, r1B,...) as per the following table

Parameters	Description	Values		
D1x (A...)	Digital input channel	-1: Virtual digital input	0: not configured	1: DI1
r1x (A..)	Digital input logic	FALSE = direct logic	TRUE = reverse logic	2: DI2
Flx (A..)	Digital input status			3: DI3

Tab. 5.b



Notice: there is also the possibility to use a virtual digital input, broadcast via the RS485 local network from main to secondary.

This is useful, for example, for a curtain switch, as the units can switch from day to night operation and vice-versa without the need for additional wiring between the main and secondary units. The virtual digital input can be set on the main, via parameter A9, and will be broadcast to the secondary units by selecting "Virtual DI" (reverse logic does not affect the virtual DI).

For example, if one Heos controller is configured as the main and another as a secondary, DI1 on the main will be associated with the door switch, and its status will be shared with the secondary:

- on the main unit set parameter A9 on DI1;
- on the secondary, on the door switch input setup screen, select "Virtual DI".

Digital input functions

The functions summarised here are then described individually below

Par.	Description	Par.	Description
D1A	Remote alarm	D1n	Showcase cleaning
D1b	Delayed remote alarm	D1o	Change parameters set by digital input
D1c	Enable defrost	D1q	Door switch
D1d	Start defrost (start network defrost for M/S network)	D1r	Defrost mirror
D1F	Remote ON/OFF	D1s	Generic function alarm
D1G	Curtain/light switch day/night	D1AC	Lights
D1I	Assign input status monitoring digital input		

Tab. 5.c

Parameters r1A, r1b,..., r1s can be used to reverse the logic of the functions associated with the digital inputs.

Code	Description	UOM
r1A, r1b,..., r1s	Reverse digital input logic	-

Immediate external alarm (par. DIA)

Activation of the alarm causes:

- message "IA" shown on the display and ALARM flashing;
- activation of the buzzer (see par. H8);
- activation of the alarm relay (see par. DOB);
- control stops;
- defrost stopped immediately (if in progress).



Notice: when the compressor is switched off due to a remote alarm, the minimum compressor on time (parameter c3) is ignored.

Parameter AdE can be used to decide whether or not the compressor (and fans) switch off.

Code	Description	UOM
DIA	Assign digital input for immediate external alarm	-

Delayed external alarm (par. DIb)

The behaviour of this alarm is the same as for the immediate external alarm, with a delay in activation (parameter A11). If A11 is set to 0, the alarm is signal-only. The delayed external alarm is equivalent to the immediate external alarm ('DIA' = 1), except that this alarm is signalled after the time 'A11' from when it is detected (signal dA).

Code	Description	UOM
DIb	Assign delayed external alarm digital input see DIA	-

Enable defrost (par. DIc)

Used to disable any defrost calls. When the contact is open, all defrost calls are ignored. Par. d5 can be used to delay activation.



Notice: if the contact is open while a defrost is in progress, this is immediately stopped, the defrost icon flashes on the display indicating the defrost call is active (this starts again when the contact closes); this function may be useful to prevent defrosts on units exposed to the public during store opening hours.

Code	Description	UOM
DIc	Assign enable defrost digital input see DIA	-

Start defrost (par. DId)

Closing the digital contact starts a defrost, if enabled. For main/secondary networks, if the controller is the main, a network defrost will be activated (i.e. it will also affect all the secondary units if parameter d2 is set correctly on both main and secondary), while if it is a secondary unit, it will only be a local defrost. The defrost digital input can be used effectively to perform real time defrosts. Simply connect a timer to the multifunction digital input on the main unit and use d5 to delay the defrosts on the various secondary units and thus avoid current overloads.



Notice: if the defrost is disabled by another digital input configured as "enable defrost", the defrost calls are ignored.

Code	Description	UOM
DId	Assign start defrost digital input see DIA	-
d5	Defrost delay at power on 0 = delay disabled	min

Door switch (par. DIq)

The behavior on the various actuators is here summarized

Actuator	Single unit	Multievaporator unit
Fan	dFo	dFo
Valve	Standard regulation following also compressor status (dco)	Close in the cabinet with open door
Compressor	dCo	dCo

Door open:

- The compressor behaviour can be configured by setting "dco". The speed is maintained from when the door is opened until the door open alarm is triggered (after the time "Tdoor"). When the alarm is triggered, the compressor returns to normal control.
- lights forced on via parameter "dLo"
- The delayed alarm counter starts ("Tdoor" parameter) to show the door open alarm on the display
- high temperature alarms (Hi) are disabled for the time "Add". The fan behaviour can be configured by setting "dFo". The speed is maintained from when the door is opened until the door open alarm is triggered (after the time "Tdoor"). When the alarm is triggered, the fans return to normal control.



Notice: as soon as the door is opened, a door open warning is shown, during which the actions described are performed. After the time "Tdoor" has elapsed, the actual alarm is triggered and the unit returns to normal control to satisfy the cooling request.

For multi-evaporator systems:

the compressor request continues to be calculated, as parameter "dFo" is disabled for multi-evaporator systems.

Door closed:

- control resumed (compressor protection times are counted)
- light off (see par. DOE) with delay set by par. H14; fan control resumes, ALARM stops flashing ("dor")
- enable temperature alarms with delay Ad after bypass time defined by par. Add.

Code	Description	UOM
Dig	Assign digital input for door switch	-
dFo	Evaporator fan speed if door open -1: follow control; 0: off; 1-100: fixed speed	
dCo	Compressor speed with door open. -1: follow control; 0: off; 1-100: fixed speed	
dLo	Lights forced on with door open; False = No, True: Yes	
DOE	Assign light digital output see DOB	-
H14	Time light stays on after closing the door	min
Ad	Delay time for high and low temp. alarms (AH, AL)	min
Add	High temperature alarm bypass time for door open	min
Tdoor	Door open: alarm delay	min

Caution: check compatibility of disabling/delaying the alarm with the site's HACCP procedures.

Notice: if the door remains open for longer than the value of par. Tdoor, control resumes in any case. The light remains on, the measurement shown on the display flashes, the buzzer and the alarm relay are activated, and the temperature alarms are enabled with delay Ad.

The door opening functions can be extended as follows:

- The default values dFo, dCo, dLo=0 ensure the compressor and fan are switched off and the light is switched on when the door is opened.

Important: the default setting of dLo is FALSE, which means that the lights are off when the door is open

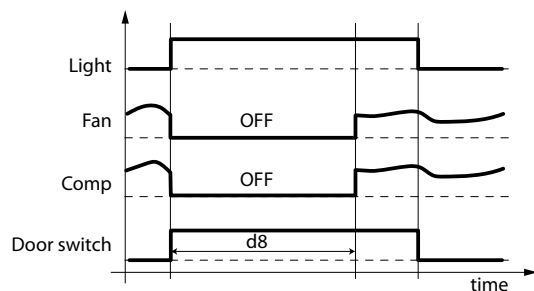


Fig. 5.b

When dFo and dCo 0, $\neq -1$; when the door is opened, the compressor and the fan are controlled at fixed speed.

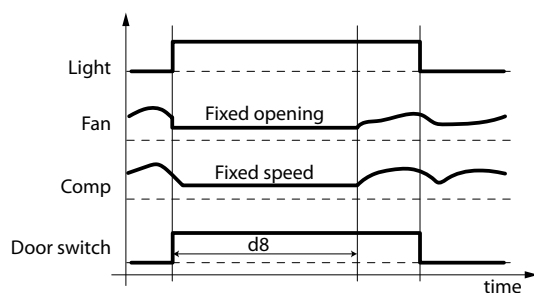


Fig. 5.c

When dFo and dCo = -1; when the door is opened, the compressor and the fan are controlled automatically (continuous).

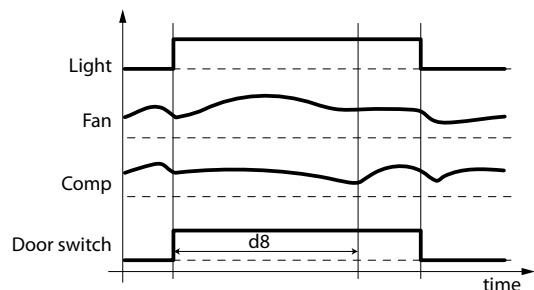


Fig. 5.d

Notice: parameter dCo only works for single evaporator units.

Remote ON/OFF (par. DIF)

Switch the controller off via the digital input. The display shows the value measured by the set probe (parameter /t1) alternating with the message OFF.

- if more than one input is configured as remote ON/OFF, the off status of any one of these switches the controller off;
- the buzzer and alarm relay are deactivated;
- the compressor protection times are observed.

When the controller is ON again, all the functions are reactivated, except for the defrost on start-up and compressor and evaporator fan delay at power on (par. c0).



Notice:

- the OFF command from digital input has priority over those from the keypad or supervisor;
- if the controller remains OFF for a longer time than the value set for parameter dl, a defrost is performed when the controller is switched on again.

Code	Description	UOM
DIF	Assign remote ON/OFF digital input see DIA	-
dl	Maximum interval between consecutive defrosts	h
c0	Delay to enable compressor and evaporator fans at power on	min

Lights

If the lights are controlled by time band, or by day/night status, this function has higher priority over the digital input.

Curtain switch (par. DIG)

The curtain switch is used to control the night/day status via a digital input.

When the switch is active (open if NC, closed if NO) the unit is in NIGHT status, when the switch is not active, it is in DAY status.

- During night status, the night-time set point Stn is used for control, calculated based on the set point St plus the offset defined by parameter r4 ($Stn = St + r4$). If r4 is negative, during night status the actual set point is decreased from the daytime set point.
- Furthermore, if necessary, the control probe is changed based on the setting of parameter r6 (0 = virtual probe, 1 = air on probe); the light is off if LHN = TRUE.
- During day status: normal operation resumes, set point = St, the virtual probe is used as a control probe; the light output is activated.

Parameter H9 can be used to associate night/day status with the activation/deactivation of the auxiliary output set as AUX or LIGHT.

Code	Description	UOM
DIG	Assign curtain switch digital input see DIA	-
H9	Output switched with time bands: 0 = Light; 1 = AUX	-
r4	Automatic night set point variation	°C (°F)
r6	Probe for night-time control: 0=virtual probe Sv, 1=intake probe Sr	-

Switch to clean status (par. Dln)

This function is used for cleaning the showcase. The controller stops, while the lights (depending on the value of parameter CLHt) and probe alarms are enabled. When the contact opens again, or after a maximum time (parameter CLt), control resumes. For units connected to the RS485-pLAN, it is possible to decide whether to synchronise the showcase cleaning command, via parameter dCLnE.

Selecting CLnE = TRUE, showcase cleaning can be started/ended from any unit in the RS485-LAN network (via digital input Dln <> 0), sending it to all the other units.



Notice:

- if the cleaning command signal is sent during a defrost, the defrost will be stopped and will resume after cleaning is finished.
- If a defrost is activated during cleaning, this will only start at the end of the cleaning cycle.

Clean status is an intermediate state between ON and OFF. The meaning of each status, OFF, ON and clean, is summarised in the following table:

	Unit OFF	Unit ON	Standby	Clean
Control	OFF	ON	OFF	OFF
Light	independent	independent	independent	independent
Probe alarms	enabled	enabled	enabled	enabled
Other alarms	disabled	enabled	enabled	disabled
User terminal	OFF	based on /t1	Stb	CLn

Tab. 5.d

Code	Description	UOM
Dln	Assign digital input for switching to clean mode see DIA	-
CLt	Max time for clean status	min

5.2.2 Analogue outputs

Heos PowerBoard has four dedicated analogue outputs (0-10 V Y1, Y2, Y3) plus universal channels that can be configured as analogue outputs (see the introduction in chapter 8 for details on the universal channels). The analogue outputs can be used to manage the functions summarised in the following table.

Code	Description	UOM
/AA	Assign analogue output for modulating evaporator fans	-
/Ab	Assign analogue output for modulating valve	-
/Ac	Assign analogue output for modulating anti-sweat heaters see /AA	-
/Ad	Assign analogue output for generic modulating function see /AA	-
/Ae	Assign analogue output for generic function see /AA	-
/AH	Assign analogue output for modulating condenser valve	-

5.2.3 Digital outputs

Heos PowerBoard has six dedicated digital outputs (NO1, ..., NO6) plus universal channels that can be configured as digital outputs (see the introduction in chapter 8 for details on the universal channels). To associate the digital outputs with the available functions, set parameters DOB, ... DOT to the value of the physical digital output, while parameters Fob, ... FOT assign the contacts' logical status.

 **Important:** observe the maximum allowable current limits on the relays. See the technical specifications table.

Digital output functions

The functions summarised here are then described individually below

Par.	Description
DOA	Solenoid (follows compressor ON status)
DOb	Alarm
DOc	Auxiliary
DOE	Light
DOF	MasterLight
DOG	Defrost
DOH	Defrost2
DOI	EvapFan
DOP	DrainHeat
DOQ	RailHeaters
DOS	GenericStage1
DOAA	HotGasDefrost
DOAB	Curtain
DOT	CondFan
DOAC	LiqInjection (HFC version only)

Tab. 5.e

Parameters rOb, ..., rOt can be used to reverse the logic of the functions associated with the digital inputs. Parameters Fo[x] are used to check the output status

Code	Description	UOM
rOb, ..., rOt	Digital output logic: 0=direct, 1=reverse	-

Alarm (par. DOB)

The relay associated with the alarm function can work as follows:
 normally de-energised: the relay is energised when an alarm occurs (rOb = 0);
 normally energised: the relay is de-energised when an alarm occurs (rOb = 1);

 **Notice:** operation with the relay de-energised (rOb = 1) when an alarm occurs ensures maximum safety when the alarm is due to a power failure or power cable disconnection.

Code	Description	UOM
DOb	Assign alarm digital output 0 = not configured 1 = digital output 1 (NO1) 2 = digital output 2 (NO2) 3 = digital output 3 (NO3)	-

Auxiliary (par. DOc)

The actuator can be activated/deactivated using a command from the supervisor and based on the changeover in day/night status (linked to the curtain switch or the setting of the time bands); activation/deactivation of the actuator is signalled by the AUX icon switching on/off. The AUX output to be activated or deactivated based on the night/day time band can be selected (see parameters tS1...8, tE1...8 and H9).

Code	Description	UOM
DOc	Assign digital output for auxiliary output see DOB	-
H9	Output switched with time bands 0 = Light 1 = AUX	-

Light (par. DOE)

The actuator can be activated/deactivated directly using the functions on the user terminal, using a command from the supervisor and based on the changeover in day/night status (linked to the curtain/door switch or the setting of the time bands); activation/deactivation of the actuator is signalled by the light icon switching on/off. The light output to be activated or deactivated based on the night/day time band can be selected (see parameters tS1...8, tE1...8 and H9).

Code	Description	UOM
DOE	Assign light digital output see DOB	-

Defrost (par. DOG)

The actuator is activated/deactivated based on the defrost settings (see the paragraph "Defrost"). Activation/deactivation of the actuator is signalled by the defrost icon switching on/off on the user terminal.

Code	Description	UOM
DOG	Assign defrost digital output see DOB	-

Evaporator fans (par. DOI)

Once the digital output has been selected, the evaporator fan on/off is signalled by the the evaporator fan icon switching on/off on the display. See the paragraph "Evaporator fans"

Code	Description	UOM
DOI	Assign evaporator fan digital output see DOB	-

Condensate drain heater (par. DOP)

During defrosting there may be frozen condensate on the bottom of the cabinet that prevents the water thawed from the evaporator from being drained correctly. The digital output can be configured to manage the condensate drain heater function. The heater is started on activation of the pump down stage and stays on throughout the defrost procedure, until the end of the dripping phase. The heater can be activated by selecting a digital output with par. DOP.



Notice: the heater must be protected against overheating (e.g. thermal protector).

Code	Description	UOM
DOP	Assign condensate drain heater digital output see DOB	-

Anti-sweat heater (par. DOQ)

Select the digital output for demisting the glass (control with fixed activation, see the paragraph "Anti-sweat heaters").

Code	Description	UOM
DOQ	Assign anti-sweat heater digital output see DOB	-

Generic stage function (par. DOS)

Select the digital output for configuring a generic stage function.

Code	Description	UOM
DOS	Assign generic stage function digital output see DOB	-

Evaporator fans (par. DOT)

Select the digital output for activation of the condenser fans (see paragraph "Condenser fans").

Code	Description	UOM
DOT	Assign condenser fan digital output see DOB	-

Hot gas defrost solenoid (par. DOAA)

Select the digital output for the hot gas injection solenoid during defrost (see paragraph "Hot gas defrost").

Code	Description	UOM
DOAA	Assign hot gas injection solenoid digital output see DOB	-

5.3 Control

The following figure shows the position of the intake probe (air on) Sr and the outlet probe (air off) Sm. The virtual probe Sv is a weighted average of these two, based on parameter /4, according to the following formula:

Code	Description	UOM
/4	Virtual probe composition: 0 = Air off probe Sm; 100 = Air on probe Sr	%



Notice: HACCP: parameter /4 can be set to change the temperature used for control and for display. This operation may be prohibited by HACCP procedures or require record keeping and authorisation.

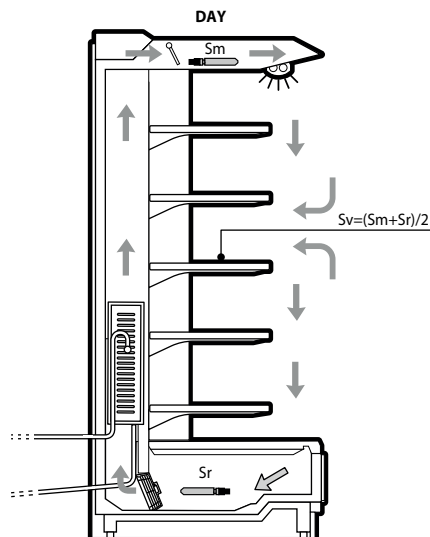
Example: vertical showcase

Fig. 5.e

Ref.	Description
Sm	Outlet probe
Sr	Intake probe
Sv	Virtual probe

During the day, most of the load in a refrigerated showcase is due to warm air that enters from the outside and mixes with the cold air inside. Control based on the intake probe, due to high temperature outside the showcase and the mixing of the air, may not manage to reach the set point. Displaying the intake temperature would show a temperature that is too high. Setting a set point that is too low for the intake probe Sr may cause the food to freeze. On the other hand, displaying the outlet temperature would show a temperature that is too low. Consequently, the display of the control probe, set point or virtual probe can be configured using parameter /t1.

On Heos PowerBoard, the temperature is controlled by modulating the compressor speed based on the cooling request, with proportional+integral+derivative (PID) control.

To ensure control stability, in addition to the working set point (St), the corresponding parameters need to be adjusted, namely proportional gain (cpr), integral time (ctl) and derivative time (cdt).

Par.	Description	UOM
cPr	Control proportional coefficient	%/°C
ctl	Control integral time	s
cdt	Control derivative time	s

How to calibrate the PID parameters:

The proportional coefficient setting (cPr) influences the instantaneous speed at which the system reacts to a variation in the control temperature: as the gain increases, system reactivity increases, vice-versa lower values will reduce the reaction speed. It should be noted that too-high proportional gain values may lead to instability and swings.

The most appropriate integral time setting (ctl) allows further modification (increase or decrease) to the compressor speed if the control temperature remains away from the working set point. Higher values lead to a slower response, conversely lower values lead to a faster response in compensation.

The derivative time setting (cdt) makes it possible to anticipate the reaction of the system in the event of sudden changes in working conditions (e.g. a significant change in the working set point). By default, the derivative time is disabled

Minimum and maximum set point values (parameters r1 and r2)

Parameters r1 and r2 are used to define the minimum and maximum limits for the control set point.

Code	Description	UOM
r1	Minimum set point	°C (°F)
r2	Maximum set point	°C (°F)

Night-time operation

During night-time operation the curtain on the display case is closed and consequently less cold inside air is mixed with warm outside air. Therefore, as a direct consequence, the thermal load decreases. The temperature of the air that cools the produce is near the outlet temperature, and therefore to avoid excessively low temperatures and reduce energy consumption, the set point needs to be increased at night, by setting parameter r4. Parameter r6 can then be used to possible the virtual probe Sv or intake probe (air on) Sr as the control probe. Night-time operation is activated using the curtain switch digital input, set with parameter DIG, signalling that the curtain has been lowered, or by setting the time bands (parameters tS1 to tS8 and tE1 to tE8) or from the supervisor. Night status is activated by switching the associated digital input from "Not active" to "Active". Conversely, the transition from "Active" to "Not active" reverts to day status. If, when the digital input is active, the supervisor or one of the other possible sources sends the signal to switch to day status, the controller switches status.

In other words, none of the sources has higher priority than the others, rather the status depends on the most recent command.

Code	Description	UOM
r4	Automatic night set point variation	°C (°F)
r6	Probe for night-time control: 0=virtual probe Sv, 1=intake probe Sr	-
tS1..8-d	Start time band 1 to 8 day: day see (td1...8-d)	d
tS1..8-time	Start time band 1 to 8: time	-
tE1..8-d	End time band 1 to 8 day: day see (td1...8-d)	d
tE1..8-time	End time band 1 to 8: time	-

Notice: HACCP: verify that modification of the night-time set point (parameter /4) is permitted by site HACCP procedures. If required, obtain the required authorisation and record the changes.

Variable	Daytime control	Night-time control	
		r6 = 0	r6 = 1
Control probe (Sreg)	Virtual probe (Sv)	Virtual probe (Sv)	Intake probe (Sr)
Set point	St	St+r4	

Tab. 5.f

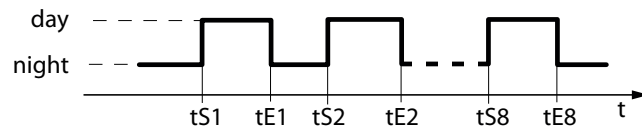


Fig. 5.f

During day status:

- Set point = St;
- light on;
- control on virtual probe Sv.

During night status:

- Set point = St + r4;
- light off;
- control on Sr (if r6=1) or on Sv (if r6=0).

Unit on and off status

Parameter ON is used to switch the controller ON/OFF. If there is a digital input configured as remote ON/OFF, this has higher priority than the supervisor command or the ON parameter.

Code	Description	UOM
ON	ON/OFF command 0=OFF, 1=ON	-

In this operating mode, the display shows the standard display, alternating with the message "OFF".

When OFF, the following are possible:

- access the parameters on the user terminal;
- activate remote ON/OFF;
- display the probe alarms (rE, E1, E2, E3, etc.) and errors Etc, Edc, alternating with the message OFF.

Notes on compressor protection times:

- When switching from ON to OFF and vice-versa, the controller always waits for the compressor protection times to elapse. The only exception is when the unit is forced off by parameter "o/F"

Control offset with probe error (parameter ro)

Heos PowerBoard in standard mode uses the virtual probe Sv for control, that is, the weighted average of the outlet (air off) and intake (air on) probe (see parameter /4). If one of the two probes making up the virtual probe is broken or has an error, parameter "ro" is used to continue normal control in controlled conditions, without the need for immediate intervention by maintenance personnel. The recommended value of "ro" is the temperature difference between the outlet probe and intake probe reading in steady operating conditions of the refrigeration unit:

$$r0 = |Sr - Sm|$$

Code	Description	UOM
ro	Control offset with probe error	°C (°F)

The following cases may occur:

- outlet probe Sm error: Heos PowerBoard starts control based on the intake (air on) probe Sr alone, considering a new set point (St*) determined by the formula:

$$St^* = |St + r0 \cdot \frac{(100/4')}{100}|$$

- intake probe Sr error: Heos PowerBoard starts control based on the outlet (air off) probe Sm alone, considering a new set point (St*) determined by the formula:

$$St^* = |St - r0 \cdot \frac{1/4'}{100}|$$

If night-time operation has been set with the intake probe as the control probe, the controller considers /4=100 and uses the outlet probe. The new set point becomes:

$$St^* = St - r0$$



Notice:

- if $r0=0$ the function is not active;
- for night-time operation the new set point is added to the value defined by $r4$ (= automatic night-time set point variation);
- in the event of errors on both probes, the controller switches to duty setting operation.

Example: Sm fault in daytime operation, with /4=50, $St=-4$, $Sr=0$, $Sm=-8$, $r0$ (recommended) = $0 - (-8) = 8$.

Then the new control probe will be Sr with:

$$St^* = St + r0 \cdot \frac{(100 - /4)}{100}$$

$$St^* = -4 + 8 \cdot (100 - 50) / 100 = 0.$$

If the fault is on Sr , the new control probe will be Sm with:

$$St^* = St - r0 \cdot \frac{/4}{100}$$

$$St^* = -4 - 8 \cdot 50 / 100 = -8.$$

ON time for duty setting operation (par. c4)

Duty setting is a special function used to maintain control in emergency situations with errors in the temperature control probes, until a service intervention. In the event of a temperature probe error, Heos PowerBoard uses the other probe available and adjusts the set point according to the setting of parameter $r0$. In the event of errors on both probes, the controller switches to a special mode called "duty setting". Control is activated at regular intervals, operating for a time equal to the value set for the duty setting parameter $c4$, and then switched off for a time equal to $c5$. The compressor speed is fixed at the value set for $cl3$.

Par.	Description	UOM
c13	Compressor capacity percentage with probe alarm	%
c4	Compressor on time in duty setting from probe alarm	min
c5	Compressor off time in duty setting from probe alarm	min

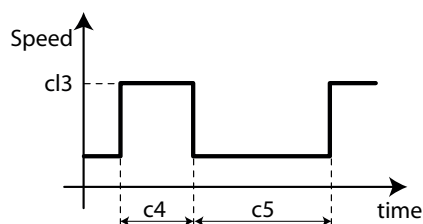


Fig. 5.g



Notice:

- With duty setting active, during the ON time the compressor icon remains on, while it is off during the OFF time.
- With duty setting active, the compressor protection times are counted.

The table below describes the possible fault situations relating to the control probes and the function that is activated.

Type of system	Control probe fault		Control	Par.
1 probe	Sm	Sr	Duty setting	c4
	•	•	Duty setting	c4
	•	•	control on Sr	$r0^{(*)}$
2 probes	•	•	control on Sm	$r0^{(*)}$
	•	•	Duty setting	c4

(*) $r0$ must be > 0 .

Tab. 5.g

A cut-off threshold (COF) can be enabled:

- in a stand-alone system, when reached the compressor switches off
- in multi-evaporator systems, the valve on the showcase in question is closed (see par. 5.11).
- If $COF > 0$ the function is active.

Delayed start up (rd)

It is possible to delay the compressor start up using the offset "rd". When the compressor request is enough to start the unit (see paragraph 5.9.1), the compressor will start only if the control temperature (see "/4" at chapter 5.3) value is at least the setpoint value ("St") plus the offset "rd".

5.4 Defrost

The controller can manage different types of defrosts, based on the setting of parameter "d0" (heater by temperature, hot gas by temperature, heater by time, hot gas by time, heater by time with temperature control):

The defrost can start based on:

- Controller scheduler parameters
- Supervisor scheduler parameters
- Digital input
- Offset function
- Advanced functions (parameter "dl", running time, sequential stops)

The defrost will then end (depending on parameter d0) based on:

- temperature threshold dt1 (in this case the defrost probe Sd is required). An alarm can be activated if the defrost ends when the maximum time (Ed1) is exceeded.
- time threshold dP1
- time and temperature threshold (in this case the defrost probe Sd is required). An alarm cannot be activated if the defrost ends when the maximum time (Ed1) is exceeded.

At the end of the defrost the dripping phase may begin (if dd>0), during which the compressor and the fans are off, followed by the post-dripping phase (if Fd>0), during which control resumes and the fans work based on the setting of parameter Fpd. The type of display on the user terminal during defrosting can be selected by setting parameter d6.



Notice: high temperature alarms can be disabled after defrosting by setting par. d8.

Code	Description	UOM
d0	Type of defrost 0 = heater by temperature 1 = hot gas by temperature 2 = heater by time 3 = hot gas by time 4 = heater by time with temperature control	-
dt1	End defrost temperature (read by Sd)	°C (°F)
dP1	Maximum defrost duration	min
d6	Display on terminals during defrost 0 = temperature alternating with "dEF" 1 = freeze display 2 = "dEF"	-
d8	Bypass high temperature alarm time after defrost	min
F3	Evaporator fans during defrost: 0=on, 1=off	-
Fd	Post-dripping time after defrost (fans off with control active)	min
Fpd	Evaporator fans during post-dripping: 0=on, 1=off	-



Notice:

- If the compressor is running and a defrost request is activated, the defrost remains pending until the compressor switches off. In this defrost stage, the defrost icon flashes and the heaters are off.
- If the compressor minimum on time has not yet elapsed, the defrost will wait until the end of this safety time.
- If the compressor is not running and a defrost request is activated, the defrost can start immediately.
- All of the above applies to defrosts that require the compressor to be stopped.
- If an alarm occurs during a defrost, this is stopped only for serious alarms. Otherwise the defrost continues (see chap. 7 Alarms).

5.4.1 Scheduling

Parameters td1 to td8 can be used to set up to 8 defrost events based on the controller clock (RTC) and to activate the Power Defrost (see the end of the paragraph). To set parameters td1 to td8, use the supervisor or the "Applica" app.

Code	Description	UOM
td1..8-d	Defrost 1 to 8 day 0 = event disabled 1 to 7 = Monday to Sunday 8 = Monday to Friday 9 = from Monday to Saturday 10 = Saturday & Sunday 11 = every day	d
td1..8-time	Defrost 1 to 8 start time (hh:mm)	-
td1..8-P	Defrost 1 to 8 enable power defrost: 0= normal, 1= power defrost	-

5.4.2 Heater defrost (d0 = 0, 2, 4): duty cycle

When the defrost starts, the compressor is stopped, following the shutdown ramp. The heaters are activated, the fans switch off and the expansion valve closes. At the end of the defrost, the heater switches off, and there is then a dripping period in which the compressor, valve and fans are off. This is followed by a post-dripping period, with the compressor and valve reactivated and the fans off. At the end of post-dripping time, normal control resumes.

The duty cycle shown here refers to the default values of parameters F2 and F3.

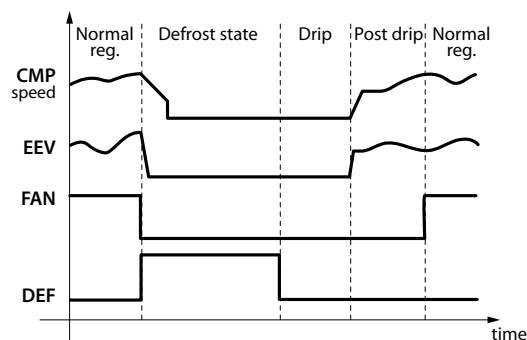


Fig. 5.h

Ref.	Description
CMP	Compressor
EEV	Electronic expansion valve
FAN	Fan
Drip	Dripping time
Post drip	Post dripping time
DEF	Defrost

The pump down phase is the period in which the evaporator is emptied of liquid refrigerant, and can be disabled by setting PDt=0. Operation of the fan during the pump down phase depends on parameters F2 and F3.

During the dripping phase the fan is always off, while during the post-dripping phase operation depends on the setting of parameter Fpd.

Code	Description	UOM
dd	Dripping time after defrost (fans off): 0 = no dripping	min
PDt	Type of pump down (0=none, 1=stop)	-
CPt	Maximum pump down time	s
F2	Evaporator fans with compressor off: 0 = see F0; 1 = always off	-
F3	Evaporator fans during defrost: 0=on, 1=off	-
Fd	Post-dripping time after defrost (fans off with control active)	min
cP1	Initial valve position when control starts	%
Pdd	Initial valve position maintenance time after defrost	min
dSb	Valve position during defrost	%
	1: according to the set type of defrost; 2: forced closed; 2-100: percentage opening	

The heater defrost by time with temperature control (d0=4) (figure below) activates the defrost output only if the defrost temperature (Sd) is less than the value of parameter dt1, and ends after the time defined by dP1.

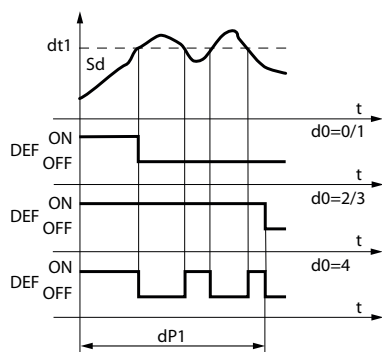


Fig. 5.i

Ref.	Description
t	Time
dt1	End defrost temperature
dP1	Maximum defrost duration
Sd	Defrost probe
DEF	Defrost

5.4.3 Advanced parameters

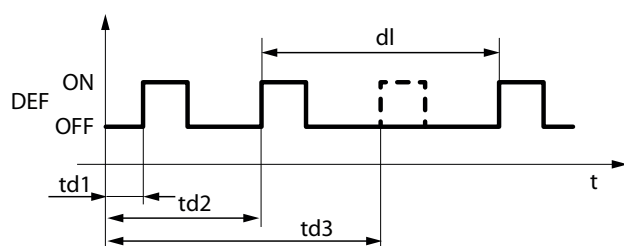
Maximum interval between consecutive defrosts (di)

Parameter dl is a safety parameter used to perform cyclical defrosts every "dl" hours. At the start of each defrost, irrespective of the duration, an interval starts being counted. If this interval exceeds dl without a defrost being performed, one is started automatically. The count is always active even if the controller is OFF.

If set on the main controller, the parameter affects the entire connected pLAN subnet, while if set on a secondary controller, it only has an effect locally.

Example: if the defrost programmed by time td3 is not carried out due to a fault in the RTC, a new defrost starts after the safety time dl.

Code	Description	UOM
dl	Maximum interval between consecutive defrosts	h



Ref.	Description
dl	Maximum interval between consecutive defrosts
td1...td3	Scheduled defrosts
t	Time
DEF	Defrost

Fig. 5.j

Staggered defrosts

The function is used to perform a series of daily defrosts by setting just the first using parameter td1 and then indicating the number of defrosts per day using parameter d1S. The controller automatically schedules all the defrosts to be performed at regular intervals over the 24 hours following the event defined by td1. The same applies to td2 and dS2.

Code	Description	UOM
d1S	Number of daily defrosts (td1)	-
d2S	Number of daily defrosts (td2) see d1S	-

Remember that the sub-parameter "d_" of td1 (td2) defines the defrost day, as follows:

d_ = Defrost day	
0 = event disabled	9 = from Monday to Saturday
1 to 7 = Monday to Sunday	10 = Saturday & Sunday
8 = Monday to Friday	11 = every day



Notice:

- if event td1 includes a series of days, the programming always ends at 24.00 on the last day. If event td1 includes one day only, the programming ends at 24.00 on the same day;
- if both td1 and td2 are set, when the defrost events overlap, only the sequence of defrosts that start first are performed..
- if normal defrosts and Power defrosts are requested at the same time, the latter are performed.

End defrost by timeout signal (par. r3)

For defrosts that end by temperature (d0=0/1), this enables the signal Ed1 if the defrost ends by timeout (dP1).

Code	Description	UOM
r3	End defrost signal by timeout: 0=disabled, 1=enabled	-

End defrost by temperature (par. dEP, dET)

For defrosts that end by temperature (d0=0/1), the signal dEa is not enabled if the defrost ends by timeout (dP1); dEa is only active if the threshold "dET" measured by probe "DEP" is exceeded

Defrost at power on (par. d4)

The defrost at power on has priority over the control request. On the main controller, defrost at power on will be a network defrost (based on to d2 and d3), while on the secondary controllers it will be a local defrost.

Code	Description	UOM
d4	Defrost at power on - FALSE = disabled; TRUE = enabled	-

Dripping time after defrost (par. dd)

This parameter is the time that the compressor and the evaporator fans stop following a defrost so as to allow the evaporator to drip. If dd=0 no dripping time is enabled, and at the end of the defrost control resumes immediately, without stopping the compressor and the fan, if active.

Code	Description	UOM
dd	Dripping time after defrost (fans off): 0 = no dripping	min

End defrost synchronised by Main (parameter d2).

This parameter determines whether, in a local network, at the end of the defrost the secondary waits for an end defrost signal from the network before restarting the cooling cycle.

When synchronised end defrost is enabled (d2 = 1), after the post-dripping time (if set), control resumes when the last unit has finished defrosting. The units that finish defrosting before the last one remain in the dripping phase (see the following figure); in this case, parameter dd (dripping time) must be greater than 0.

For main/secondary networks with synchronised end defrost, control resumes on all units when the last one reaches dt1 or the time dP has elapsed. The units awaiting defrost to end remain in the dripping phase or until the last unit finishes defrosting.

Code	Description	UOM
d2	End defrost synchronised by Main: 0 = not synchronised	-

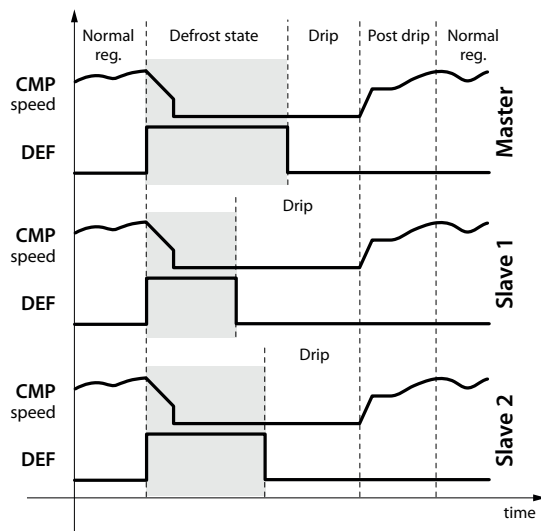


Fig. 5.k

Valve positioning during defrost (par. d5b)

A fixed position (as a percentage) can be set for valve opening throughout the defrost procedure, from the end of pump-down to the start of the dripping phase. The valve will behave as defined by parameters cP1 and Pdd starting from the post-dripping phase. The opening percentage is applied in all the types of defrost. The function is activated by setting parameter d5b to a value between 1 and 100; this value indicates the position of the valve as a % of the number of steps (not capacity).

Setting the parameter to 1, the valve is closed completely during defrost. Setting the parameter to 0, positioning is disabled and the valve will behave as defined for the type of defrost selected.

Code	Description	UOM
d5b	Valve position during defrost 0: as defined by the type of defrost 1: forced closed 2 to 100: opening percentage	%

Running time defrost (par. d10, d11)

Running time is a function that determines when the refrigeration unit needs defrosting. In particular, it is assumed that if the evaporator temperature measured by probe Sd remains continuously below a certain set threshold (d11) for a certain time (d10), the evaporator may be frozen and a defrost is activated. The time is reset if the temperature returns above the threshold. The probe used is set by parameter dA1. In addition, when switching on, the time dA2 must elapse before the running time procedure is activated.

Code	Description	UOM
dt1	End defrost temperature (read by Sd)	°C (°F)
dA1	Select probe used for running time defrost (0=Sd; 1=saturated converted (Ts _{sat}))	
dA2	Delay at start-up before activating running time defrost	min
d10	Defrost time in running time mode 0 = function disabled	min
d11	Defrost temperature threshold in running time mode	°C (°F)

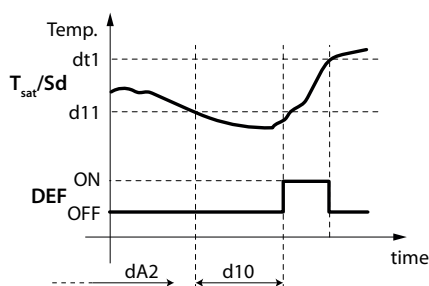


Fig. 5.l

Ref.	Description
Sd	Defrost probe
DEF	Defrost
Tsat	Saturation temperature converted from suction pressure



Notice: In the case of the main/secondary system, the running time defrost follows the logic set by parameter d3. Each unit in the main/secondary network will run its defrost based on the selected probe reading.

Sequential stops (par.dS1, dS2)

Sequential stop mode is especially useful for medium temperature refrigeration units, is based on the intelligent stopping of control to allow the evaporator to defrost naturally by the flow of ambient air only, without activating the defrost output. If the function is enabled (parameter dS1>0), two countdowns are activated during normal control:

OFFTIME: counts down during the stop time and on hold during control;

ONTIME: counts down during control and on hold during the stop time.

Two events may occur, with reference to the following figure:

- OFFTIME is reset (instant C): OFFTIME and ONTIME are reset with the values dS1 and dS2 and the defrost is considered completed. Control resumes;
- ONTIME is reset (instant A): OFFTIME is reset with the default value and the natural defrost starts, lasting the entire time dS1. At the end of the defrost (instant B), OFFTIME and ONTIME are reset with the values dS1 and dS2 and control resumes.

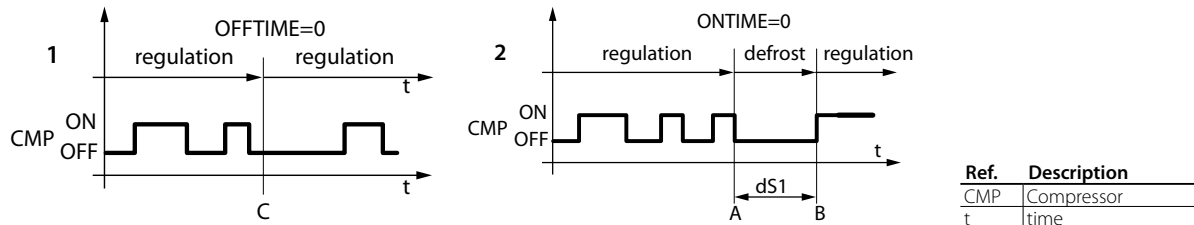


Fig. 5.m

Code	Description	UOM
dS1	Compressor off time in sequential stop defrost mode 0 = function disabled	min
dS2	Compressor operating time in sequential stop defrost mode	min

The purpose is to stop control and allow natural defrosts only when necessary. When control stops in sequential stop mode, the defrost icon will come on, the defrost status will be sent to the supervisor and the display will reflect the setting of parameter d6.



Notice: the setting of parameter F3 has no effect. Evaporator fan management depends on parameter F0.

Power defrost (par. ddt, ddP)

Power defrost is used to increase the end defrost threshold dt1 (dt2 for the second evaporator) and/or the maximum defrost duration dP1 (dP2 for the second evaporator). These increases allow more effective defrosts. Power defrosts are performed on each defrost call during night status or when suitably configured by the RTC parameters (sub-parameter P of parameters td1 to td8), so as to allow the user to choose the conditions that are most suitable for this special procedure. Power defrost is activated when at least one of the increases, ddt or ddP, has any value other than zero.



Notice: : When a power defrost is triggered at the same time of another normal defrost (e.g. scheduled defrosts), the power defrost has priority.

If a power defrost is triggered when a normal defrost is already running, the power defrost is ignored.

Code	Description	UOM
ddt	Additional end defrost temperature delta in power defrost mode	°C (°F)
ddP	Additional maximum defrost time delta in power defrost mode	min
td1..8-P	Defrost 1 to 8 enable power defrost: 0= normal, 1= power defrost	-

5.5 Evaporator fans

The evaporator fans can be set to always operate, or be managed when necessary, based on the temperature measured by any of the two probes connected to the Heos controller. The behaviour of the fan is set by par. F0:

F0 = 0 always on;

F0 = 1 off when the difference between the two probe values Sa and Sb (defined by parameters FSa and FSb) exceeds the threshold set for parameter F1;

F0 = 2 on/off based on probe Sa, defined by parameter FSa.



Notice: during the dripping phase, the evaporator fan is always off, while during the post-dripping phase operation depends on the setting of parameter Fpd.

Fixed-speed fans

The parameters used to manage fixed-speed fans are shown below.

Two Configuration examples:

- F0=1. Activation based on the difference between the evaporator temperature (FSa = 2) and the virtual probe value (FSb = 13)
- If F0 = 2, activation depends exclusively on the evaporator probe temperature (FSa = 2).

Code	Description	UOM
F0	Evaporator fan management 0 = always on 1 = activation based on Sa Sb (see F5a and F5b) 2 = activation based on Sa (Sa = first probe, Sb = second probe)	-
F1	Evaporator fan activation threshold (only if F0 = 1 or 2)	°C (°F)
Frd	Fan activation differential (including variable speed)	°C (°F)
FSa	First fan control probe	-
FSb	Second fan control probe see F5a	-

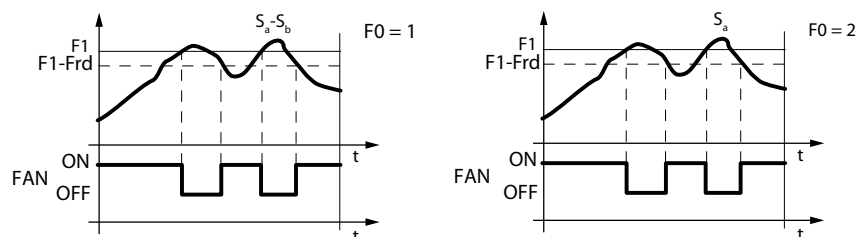


Fig. 5.n

The fans can be turned off in the following situations:

- when the compressor is off (parameter F2);
- during defrosts (parameter F3).

During the dripping time (parameter dd > 0) the fans are off, and during the post-dripping time (parameter Fd > 0), the evaporator fans are on or off depending on the value of parameter Fpd. This is useful to allow the evaporator to return to temperature after defrosting, thus avoiding blowing warm hot and moist air into the refrigerated environment. The evaporator fans can be forced on during control (parameter F2) and during defrosts (parameter F3).

Code	Description	UOM
dd	Dripping time after defrost (fans off): 0 = no dripping	min
F2	Evaporator fans with compressor off: 0 = see F0; 1 = always off	-
F3	Evaporator fans during defrost: 0=on, 1=off	-
Fd	Post-dripping time after defrost (fans off with control active)	min
Fpd	Evaporator fans during post-dripping: 0=on, 1=off	-

Variable-speed fans (EC fans)

The installation of variable-speed fans can be useful for optimising energy consumption. In this case, the fans are powered by the mains, while the control signal can come from the 0-10 V output.

The maximum and minimum fan speed can be set using parameters F6 and F7.

Frd in this case represents the temperature variation to switch the fan speed from minimum to maximum. If using the fan speed controller, F5 represents the temperature below which the fans are activated. There is a fixed hysteresis of 1°C for deactivation.

Code	Description	UOM
F5	Evaporator fan cut-off temperature (hysteresis 1°C)	°C (°F)

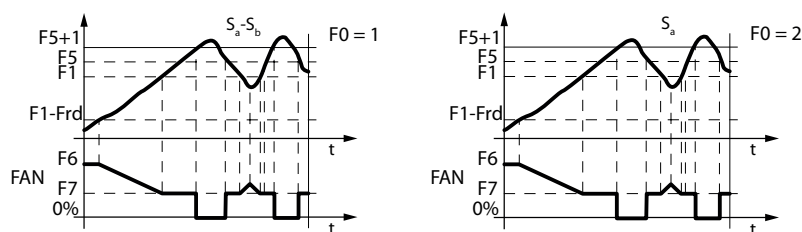


Fig. 5.o

The advanced parameters for the evaporator fans concern the minimum and maximum speed and the peak time.

Code	Description	UOM
F6	Maximum evaporator fan speed	%
F7	Minimum evaporator fan speed	%
F8	Evaporator fan peak time: 0 = Function disabled	s
F10	Evaporator fan override time at max speed: 0 = Function disabled	min

Ref.	Description
Sa	Probe set by parameter F5a
Sb	Probe set by parameter F5b
F1	Fan activation threshold
Frd	Differential
t	Time
FAN	Evaporator fans

Ref.	Description
Sa	Probe set by parameter F5a
Sb	Probe set by parameter F5b
Frd	Differential
t	Time
F5	Fan cut-off temperature
F1	Fan activation threshold
FAN	Evaporator fans

F6 is the maximum fan speed, expressed as a % of the output. For 0 to 10 V outputs, this represents the output voltage at full speed, as a percentage. The same applies to the minimum speed set for F7. The fan peak time F8 represents the operating time at maximum speed set using parameter F6 to overcome the mechanical inertia of the motor. F10 represents the fan running time at maximum speed during the peak time (F8). If the fan operates too long at low speed, ice may form on the blades; to avoid this, at intervals of every F10 minutes, the fan is switched on at maximum speed for the time set for parameter F8.

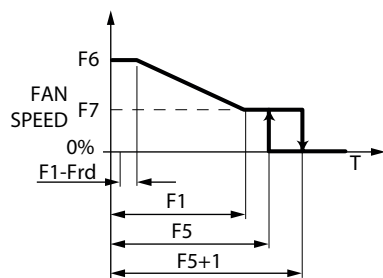


Fig. 5.p

Ref.	Description
T	temperature
F1	Fan activation threshold
Frd	Differential
F5	Fan cut-off temperature
F6	Maximum speed
F7	Minimum speed

5.6 Condensation management

The controller can also optimise the condensing stage (water or air-cooled) to improve system efficiency. Control is normally based on discharge pressure/temperature, however the water temperature can also be used. There are two main types of valves, two-way or three-way mixing valves. In some special cases (for example when indoor heat can be recovered) air-cooled condensers can also be used; in this case control is based on the condensing pressure/temperature. The controller distinguishes between air-cooled and water-cooled condensing stages based on the configured outputs.

Specifically:

- Air-cooled: fan output configuration (both digital "Dot" and modulating "/AE")
- Water-cooled: fan outlet probes are not configured.

The condensing temperature can be controlled either using valves (water) or fans (air), either modulating (0-10 V) or ON/OFF. For control based on the condensing control (according to what has been selected on "crs"), parameters Cts, CF0, CF1 can be adjusted to improve system stability.

Code	Description	UOM
CF0	Proportional gain for condensing stage control	-
CF1	Integral time for condensing stage control	s
Cts	Temperature set point used for condensing control (check CrS)	°C (°F)

Condensing stage control deactivation delay

Condensing stage control can continue for "cco" seconds after the compressor has stopped.

5.6.1 Air-cooled condenser

The configuration is selected as follows:

- on-off (fans only): the request is calculated using a P+I (proportional + integral) algorithm and when reaching "FCH", the digital output is activated, and then will be deactivated the request reaches "FCL".
- 0-10 V: the request is calculated using a P+I (proportional + integral) algorithm, with fan modulation in the range between FCL and FCH.

PWM: by configuring parameter PWM1_Type and/or PWM2_Type

Code	Description	UOM
/AE	Assign channel for modulating condensing fan output 0 = not configured 1 = Y1 2 = Y2	-
Dot	Assign channel for condensing fan digital output 0 = not configured 1 = NO1 2 = NO2 3 = NO3	-
FCL	Minimum condenser fan speed	%
FCH	Maximum condenser fan speed	%
PWM2_Type	Type of fan associated with output PWM2 (J3): 0: none 1: evaporator fan 2: condenser fan	-

Fan cleaning function

For air-cooled condensing stage control with fans that can rotate in both directions, a fan cleaning function can be activated. The logic involves reversing fan rotation for the first "cfr" seconds when defrosting (only when defrosting with the compressor off), so as to free the fan of any dust accumulated. The function requires a digital output ("DoAG")

5.6.2 Water-cooled condenser

Parameter "CrS" can be used to select:

- Saturated condensing temperature
- Temperature delta = Water out Water in
- Water outlet temperature
- Water inlet temperature

The actuator for water-cooled condenser control is managed by a 0-10 V signal (channel "/AH") with P+I (proportional + integral) logic.

Valve pre-positioning

The condensing stage control valve can be opened ("coo") for the time "cov" when control starts (after an event that had caused the compressor to stop or when starting the first time). At the end of the time set for "cov", the condensing stage control valve is modulated by the P+I control.

5.7 Anti-sweat heater or fan modulation

The anti-sweat heaters can be controlled in two ways:

- PI (proportional, integral): by comparing the dew point calculated based on the ambient temperature and humidity, and the temperature of the showcase glass, measured by a probe or estimated using the showcase outlet, intake and ambient temperature.
- Fixed activation (manual control).

The conditions for the activation of the algorithms are as follows:

Algorithm	Activation condition
PI	rHd > 0
fixed activation (manual control)	rHd = 0; rHt > 0

If the temperature read by the glass temperature probe is only estimated, PI control becomes proportional only. If both algorithms are activated, the PI algorithm has priority over fixed activation, which does not require the ambient temperature and humidity probes. There are a series of conditions whereby the PI algorithm stops operating and, if enabled, fixed activation control takes over. (In this case, alarm signal ACE is shown on the display).

Condition	Cause
Glass temperature probe not valid	physical probe not configured or faulty; the estimated glass temperature probe value cannot be used as the outlet probe or intake probe is not configured or is faulty or the ambient probe is broken or absent (*)
Dew point not valid	humidity probe and ambient temperature probe are both not configured or not working; the serial dew point value is not available

(*) If the intake (air on) probe is not configured or is faulty, only the outlet (air off) probe is used.

PI control

Inputs

The humidity (SU) and ambient temperature (SA) probes may be (see parameters /FL, /FI):

- connected locally to each controller;
- connected to the main, which automatically shares them with the secondary;
- sent from the supervisor via the serial probes.

Specifically: the supervisor can directly supply the dew point value (Sdp) using the serial probes (see parameter /Fn). The glass temperature probe (Svt) can be connected directly to each controller (see parameter /FM), or the value can be estimated. The estimate of the glass temperature probe reading is performed internally when: ambient temperature (SA), outlet temperature (Sm) and intake temperature (Sr) are available, and depends on parameters rHA, rHB and rHC. Parameters rHO and rHD determine the modulating output.

$Svt := (SA \cdot rHA) ((SA \cdot rHA \cdot Ti) \cdot rHB) / 100;$

$Ti := ((Sm \cdot rHC) + ((100 \cdot rHC) \cdot Sr))) / 100;$

Code	Description	UOM
rHa	Coefficient "a" for glass temperature formula	°C (°F)
rHb	Coefficient "b" for glass temperature formula	%
rHc	Coefficient "c" for glass temperature formula	%
rHo	Offset for anti-sweat heater modulation	°C (°F)
rHd	Differential for anti-sweat heater modulation	°C (°F)

where:

$Ti = Sm \cdot Gc + Sr \cdot (100 \cdot Gc) / 100$

If one of the probes is not available (SA or either Sm or Sr), only fixed activation control will be possible, according to parameters rHu and rHt.

Outputs

The analogue output for the anti-sweat heater function can be 0-10 Vdc (analogue output Y1, Y2, Y3) or PWM (SSR output). If the 0-10 Vdc output is used, the output voltage will vary according to the anti-sweat heater control activation percentage (see Figure 5.q). This output can be used, for example, to directly drive an FCS controller. If the SSR output is used, the output will be active for a time that is proportional to the function activation percentage (see Fig. 6.ak), with a period of rHt (manual anti-sweat heater activation period, settable between 10 min and 180 min). The anti-sweat heater control activation percentage (OUT) depends on the difference between the dew point calculated and the glass temperature probe value (measured or estimated), on the value of parameter rHo (offset), the value of parameter rHd (differential), the cut-off (rHC) and the hysteresis (rHB) (see the figure below).

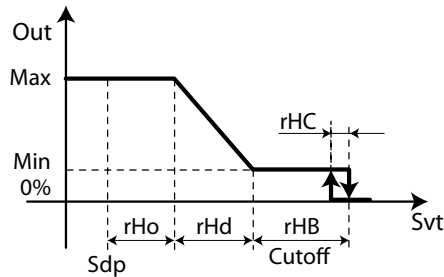


Fig. 5.q

Ref.	Description
Sdp	Dew point
rHo	Offset for anti-sweat modulation
rHd	Differential for anti-sweat heater modulation
OUT	Anti-sweat control
Svt	Glass temperature probe
Min	Minimum anti-sweat heater output value
Max	Maximum anti-sweat heater output value

Notice:

- Min: fixed minimum output of 10%; Max: fixed maximum output of 100%. The action is proportional only if the estimate of the glass temperature is used, and proportional and integral (Tint=240 s, constant) if the actual glass temperature probe is used. The aim of the integral action is to bring the glass temperature towards the set point (Sdp+rHo).
- If supervisor serial probes are used to broadcast the ambient temperature, humidity or dew point values, the heartbeat must be appropriately set on the "Dew point broadcast plug-in". This is used by the controller to understand whether the supervisor is continuing to send new values. If the controller does not receive any new values for more than the value set by parameter AS (default 30 minutes), alarm ACE is signalled and manual control is activated (fixed activation). This may be useful in the event of a supervisor power failure.
- Probe not updated alarms are normally displayed the first time the unit is switched on, i.e. when the variables have yet to be initialised.

Fixed activation control (manual control)

Control depends only on parameters rHu and rHt and follows the trend shown in the figure.

Code	Description	UOM
rHu	Manual anti-sweat heater activation percentage (of period "rHt") 0 = function disabled	%
rHt	Manual anti-sweat heater activation period 0 = function disabled	min

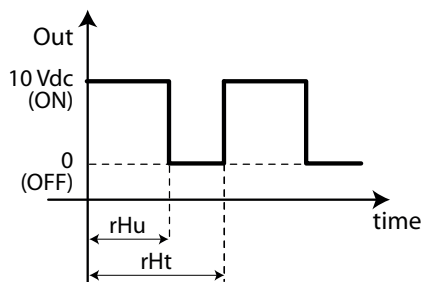


Fig. 5.r

Ref.	Description
rHu	Manual anti-sweat heater activation percentage
rHt	Manual anti-sweat heater activation period
OUT	Anti-sweat control

5.8 Electronic valve

The controller can manage Carel E2V unipolar valves (with 6-wire cable), however it cannot manage bipolar valves (with 4-wire cable).

The controller is designed to manage a single electronic expansion valve on a single evaporator, and therefore the following probes need to be installed and suitably configured:

- temperature probe to measure the superheated gas temperature at the compressor intake;
- pressure probe for measuring the saturated evaporation pressure/temperature at the evaporator outlet or the compressor intake.

For correct installation of the probes used to calculate superheat, see Carel manual +040010025.

5.8.1 Introduction

The controller manages the proportional opening of the electronic expansion valve, adjusting the flow of refrigerant in the evaporator, so as to maintain the superheat around the value set for advanced parameter P3 (superheat set point). The opening of the valve is controlled at the same time as yet independently of normal temperature control. When there is a cooling request (the compressor is running), control of the electronic valve is also activated, and is managed independently of the compressor speed.

If the superheat value read by the probes is greater than the set point, the valve is opened proportionally to the difference between the values. The speed of variation and the percentage of opening depend on the PID parameters set.

Opening is continuously modulated based on the superheat value, with PID control.



Notice: all the references relating to control of the electronic valve are based on the use of a CAREL E2V electronic expansion valve. The descriptions therefore consider the steps of the stepper motor used for this type of valve, for example, the maximum number of opening steps is 480.

Selection of the refrigerant depends on the chosen compressor.

Therefore, the refrigerant used does not need to be selected in the valve settings

Superheat set point (parameter P3)

The parameter that electronic valve control is based on is superheat, which effectively tells whether or not there is liquid at the evaporator outlet. Superheat is calculated as the difference between: superheated gas temperature (measured by a temperature sensor located at the end of the outlet tGS) and the saturated evaporation temperature (calculated based on the reading of a pressure transducer located at the evaporator outlet (PEu/tEu) and using the Tsat(P) conversion curve for each refrigerant)

Code	Description	UOM
P3	Superheat set point	K

SH = tGS tEu

SH = superheat (K)

tGS = superheated gas temperature (°C/°F);

tEu = saturated evaporation temperature, converted from the pressure (°C).

Parameters SH, tGS, tEu and PPU (valve opening percentage) are display only variables, used to monitor the refrigeration process.



Notice: the calculation of the superheat is selected according to parameter P25. Please see chapter 5.11

Initial valve position when control starts (parameter cP1)

Parameter cP1 is used to set the position of the valve as a percentage when control starts, for the time cP2. High values ensure intense and immediate cooling of the evaporator each time control starts, however may cause problems if the valve is oversized with reference to the unit's cooling capacity. Low values, on the other hand, allow a more gradual and slower action, yet also possible bottlenecks in the circuit, causing low pressure alarms. The values set therefore need to be consistent with the compressor start-up speed.

Code	Description	UOM
cP1	Initial valve position when control starts	%
cP2	Pre-positioning time	s

Opening in standby (parameter Psb)

Parameter Psb > 0 (opening in standby) sets the EEV valve as being always open at the number of steps set for in Psb when the compressor is off, i.e. when defrosting, controller off and unit in standby. If this function is used, pump down must not be enabled.

Code	Description	UOM
Psb	Number of valve opening steps in standby	steps

Initial valve position maintenance time after defrost (parameter Pdd)

At the end of a defrost, during the dripping phase, the expansion valve can be forced open to the initial value set for cP1 for a time equal to Pdd. This means greater immunity of the unit to return of liquid due to an excessively high evaporator temperature.

Code	Description	UOM
Pdd	Initial valve position maintenance time after defrost	min

PID control (parameters P4, P5, P6)

The opening of the electronic valve is controlled based on the difference between the superheat set point and the actual superheat calculated by the probes. The speed of variation, reactivity and the ability to reach the set point depend on three parameters:

- Kp = proportional gain, parameter P4;
- Ti = integral time, parameter P5;
- Td = derivative time, parameter P6.

The ideal values to be set vary depending on the applications and the utilities managed, nonetheless default values are proposed that allow good control in the majority of cases.

For further details, refer to classic PID control theory.

Code	Description	UOM
P4	Proportional gain	-
P5	Integral time: 0 = function disabled	s
P6	Derivative time: 0 = function disabled	s

- **P4:** this represents the amplification factor. Its action is directly proportional to the variation in superheat. It acts on the speed of the valve, in terms of steps/°C. The valve moves P4 steps for every degree centigrade variation in superheat, opening or closing whenever the superheat value increases or decreases respectively.
It also acts on the other control factors, and is valid in both normal control and with all emergency control functions.
High values ==> fast and reactive valve.
Low values ==> slow and less reactive valve.
- **P5:** this represents the time required by the controller to balance the difference between the set point and the actual superheat. In practical terms it limits the number of steps that the valve completes each second. It is only valid during normal control, the special functions in fact have their own integral time. High values==> slow and less reactive valve (e.g. 400)
Low values ==> fast and reactive valve P5 = 0 ==> integral action disabled
- **P6:** this represents the reaction of the valve to variations in superheat. It amplifies or reduces variations in superheat.
High values ==> rapid variations
Low values ==> limited variations
P6 = 0 ==> derivative action disabled

Manual valve positioning

PMP is used to enable/disable manual positioning of the valve. In manual positioning is enabled, this is used to set the manual opening of the electronic valve. The value is expressed in steps.

Code	Description	UOM
PMP	Enable manual expansion valve positioning: 0=disabled 1=enabled	-
PMu	Manual valve position in steps	steps

Superheat optimisation

This algorithm is designed to automatically modify the superheat at the evaporator to optimise unit energy saving.

Logic: Evaporator superheat optimisation is activated when the compressor request is between a minimum threshold (clu) and a maximum threshold (P24). The algorithm stops when the compressor request is higher than the maximum threshold (P24) for a settable time (P23), in which case the superheat set point returns to the nominal set point (P3). The superheat set point can vary between the nominal SH set point (P3) and a minimum set point (P17).

The superheat set point can be increased or decreased:

- decreased by 0.5K: If the superheat value read (SH) remains between SH-P19 and SH+P19 for a time equal to P21 in seconds;
- increased by 0.5: if the above condition is not satisfied within a time of P22 seconds.



Notice: whenever the superheat set point is modified by this logic, the logic will be interrupted for P20 seconds before resuming, to allow the unit to adapt to the new set point.

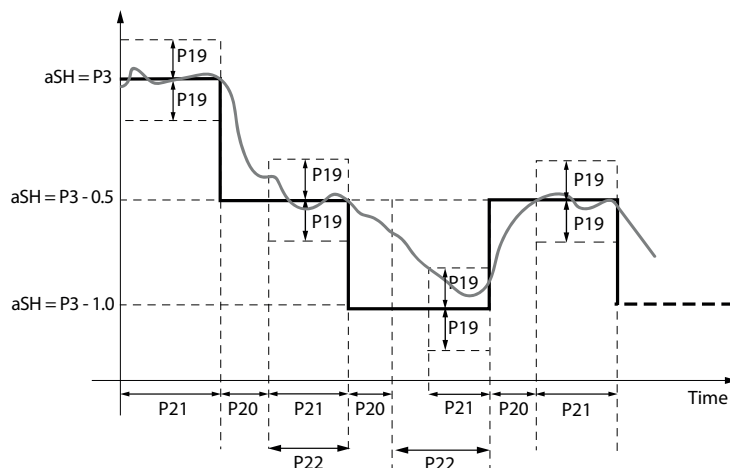


Fig. 5.s

Code	Description	UOM
P16	Enable superheat optimisation	-
P17	Minimum value for superheat optimisation	K
P19	Maximum gap to verify stability for SH evap. optimisation	K
P20	Pause time after change in value for SH evap. optimisation	s
P21	Stability time for SH evap. optimisation	s
P22	Instability time for SH evap. optimisation	s
P23	Maximum control request timeout for SH evap. optimisation	s
P24	Control request maximum limit for SH evap. optimisation reset	%

5.8.2 Protection functions

The control features unit protection functions that are activated via the expansion valve. Specifically:

- Low superheat protection
- Low suction temperature alarm
- High superheat signal (does not switch the unit off)
- MOP (Maximum operating pressure) function for high evaporation pressure control
- LOP (Low operating pressure) function for low evaporation pressure control

The LowSH, LOP, MOP protection alarms are only activated during control when the corresponding threshold is exceeded, and only if the delay time defined by the specific parameter has elapsed.

If a protection function is not enabled (integral time = 0 s), no alarm will be signalled.

If before the delay expires the protection control variable returns within the corresponding threshold, no alarm will be signalled (this is highly probable, as during the delay the protection function will have time to take effect).

If the alarm delay is set to 0 s, the alarm is disabled, while the protection functions still remain active. The alarms have automatic reset.

MOP, LOP: manual or automatic

Parameter PML (automatic reset by default) defines the MOP and LOP activation thresholds and alarm times, as follows:

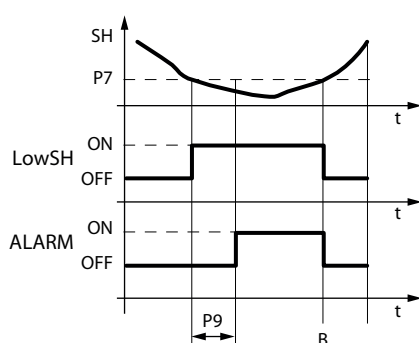
- Automatic (PML=0): the threshold values coincide with the compressor envelope limit for both main and secondary. The alarm times coincide with the out-of-envelope delay.
- Manual (PML=1): the values can be set manually and may differ between main and secondary. Refer to the description of parameters MOP and LOP in the specific paragraphs.

LowSH: low superheat threshold (par. P7)

When the superheat falls below the threshold P7, the system immediately goes into low superheat status, activating a control action in addition to normal control, with the aim of closing the electronic valve more quickly.

If the unit remains in low superheat status for the time P9, a low superheat alarm will be activated, with the message LSH shown on the display. The low superheat signal is automatically reset when the condition is no longer active or if the controller is switched off (standby). The low superheat threshold and alarm delay are set by parameter (P7 and P9).

Code	Description	UOM
P7	LowSH: low superheat threshold	K
P8	LowSH: integral time 0 = function disabled	s
P9	LowSH: alarm delay 0 = alarm disabled	s



Ref.	Description
SH	Superheat
LowSH	Low superheat protection
ALARM	Alarm
P7	LowSH protection threshold
P9	Alarm delay
t	Time

Fig. 5.t

LSA Low suction temperature

When the suction temperature falls below the threshold, after the set delay, an alarm is activated that closes the electronic valve. The alarm is reset when the suction temperature exceeds the set threshold plus the hysteresis.

Code	Description	UOM
P11	LSA: low suction temperature threshold	°C
P12	LSA: alarm delay 0 = alarm disabled	s

- P11 represents the suction temperature below which the alarm is activated, after the corresponding delay P12. The threshold for resetting the alarm is this threshold plus +3°C.
- P12 represents the alarm activation delay after exceeding the threshold P11.

When the alarm is activated, the following occur:

- message "LSA" shown on the display;
- buzzer activated

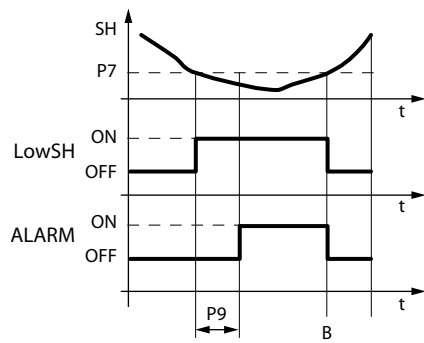


Fig. 5.u

Ref.	Description
T_SUCT	Suction temperature
P11	LSA: low suction temperature threshold
P12	LSA: alarm delay
t	Time
LSA	Protection

High superheat signal

To avoid excessively high superheat values, an alarm threshold and activation delay can be set. If the superheat exceeds the threshold, the system activates a warning, displaying the message "HSh". The high superheat signal features automatic reset, when the condition is no longer active or the controller is switched off (standby).

Code	Description	UOM
Pa	High superheat threshold	°C
Pb	High superheat signal delay	s

MOP: Maximum evaporation pressure

When starting or restarting a system, the compressor may not be able to satisfy the cooling demand. This may cause an excessive increase in the evaporation pressure and consequently the corresponding saturated temperature. When the evaporation pressure, expressed in degrees (saturated), rises above the threshold, after a certain settable time (PM3) the system enters MOP protection status: PID superheat control is stopped and the controller starts gradually closing the valve with an integral action to return the evaporation pressure below the set threshold (the lower the integral time PM2, the faster the valve closes). The protection function has been designed to allow a gradual return to normal operating conditions, that is, when the critical conditions have ended, the controller temporarily operates with a higher superheat set point until the function is automatically reset.

Code	Description	UOM
PM1	MOP: max saturated evaporation temperature threshold	°C
PM2	MOP: integral time 0 = function disabled	s
PM3	MOP: alarm delay 0 = function disabled	s

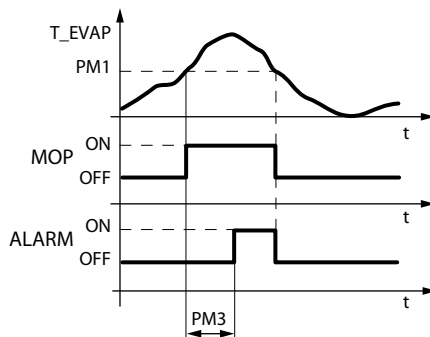


Fig. 5.v

Ref.	Description
T_EVAP	Evaporation temperature
MOP	MOP protection
ALARM	Alarm
PM1	MOP threshold
PM3	Alarm delay
t	Time

- PM1 represents the maximum evaporation pressure, expressed in degrees (saturated), above which the MOP protection and alarm are activated (each with its own delay times). There is a gradual return to normal operation, to avoid the critical situations arising again.
- PM2 represents the integral time for the maximum evaporation pressure protection function. This replaces the normal PID control during MOP status. (PM2 = 0 ==> MOP protection and alarm disabled)
- PM3 represents the alarm activation delay after exceeding the MOP threshold.

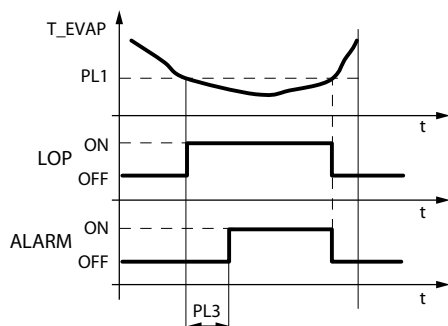
When the alarm is activated, the following occur:

- message "MOP" shown on the display
- buzzer activated
- shutdown due to alarm. The alarm features automatic reset when the evaporation pressure falls below the threshold PM1.

Notice: On a single evaporator unit, when the MOP alarm is activated, the compressor will be stopped. On multi-evaporator units, the MOP alarm does not stop the compressor.

LOP Minimum evaporation pressure

This function prevents the evaporation pressure from staying too low for too long. When the evaporation pressure, expressed in degrees (saturated), falls below the threshold, the LOP protection is activated, which adds an integral action to normal PID control (the lower the integral time PM2, the faster the valve closes), specifically devised to be more reactive as regards the opening of the valve. The PID control remains active to monitor superheat and avoid flooding the compressor (if the superheat read is higher than the threshold P3, LOP protection is activated, otherwise the priority remains superheat control). The LOP alarm is delayed from the activation of the protection function, both are reset automatically when the pressure value, in degrees (saturated), exceeds the threshold. The alarm does not stop control.



Ref.	Description
T_EVAP	Evaporation temperature
LOP	LOP protection
PL3	LOP: alarm delay
t	Time
LOP	Protection

Fig. 5.w

Code	Description	UOM
PL1	LOP: min saturated evaporation temperature threshold	°C
PL2	LOP: integral time	s
PL3	LOP: alarm delay 0 = function disabled	s

- PL1 represents the evaporation pressure, expressed in degrees (saturated), below which the LOP protection is activated. The protection function is deactivated immediately when the pressure exceeds this threshold.
- PL2 represents the integral constant used during activation of the LOP protection function. This integral time acts in addition to normal PID control. PL2 = 0 ==> LOP protection and alarm disabled.
- PL3 represents the alarm activation delay after exceeding the LOP threshold.

When the alarm is activated, the following occur:

- message "LOP" shown on the display;
- buzzer activated;
- the alarm features automatic reset when the evaporation pressure rises above the threshold PL1.

5.9 Compressor

The Heos PowerBoard controller drives the compressor using a Carel Power+ inverter. The thermodynamic and compressor timing parameters are an integral part of the controller software, so as to control the compressor while verifying that its operating conditions are always within the limits allowed by the manufacturer. The electrical parameters are written into the Power+ inverter firmware: these parameters allow sensorless control to manage the compressor effectively. Compressor selection involves configuration of all the thermodynamic and timing parameters on the Heos controller, writing of the parameter and initialisation of the electrical parameters on the Power+. Once the model has been selected and the parameters downloaded to the Power+, no other compressor parameters need to be set to start the unit.



Notice: the controller uses the Carel Power+ in the PEC (Protective Electronic Circuit) version. In this configuration, the first safety parameter (reset delay from STO closure) is 120 s.

Compressor selection:

The compressor cannot be selected during commissioning (via APPLICA), and is in fact chosen based on the configuration loaded onto the controller (see chap. 4 Initial configuration).

Carel Power+ driver replacement:

The Carel Power+ driver replacement procedure differs between the PEC and non-PEC configuration:

- PEC driver (HeosBox R-744 subcritical unit): once the driver has been replaced, the safety/PEC parameter configuration must be downloaded to the controller (this procedure requires the STO to be opened). This will not delete the existing unit parameter settings.
- Non-PEC driver: once the driver has been replaced, the controller will automatically write the parameters used to drive the compressor. No action is required by the user.



Notice: the safety parameters (PEC) can also be written using the unit reset procedure (parameter "rSH"). This restores the unit to the default settings (HeosBox default for HeosBox units, otherwise standard default).

5.9.1 Starting, stopping off and timings

The compressor starts whenever the request is equal to the minimum speed in the allowed range.

For example, if the compressor has a range of 20 to 80 rps, it will start when the request is 25%.

It stops when the request is equal to 0%. The on and off stages described here comprise a series of standard procedures, which are then listed in the following section.

Starting

The sequence of the steps for compressor start-up and control is shown below (see the figure below)

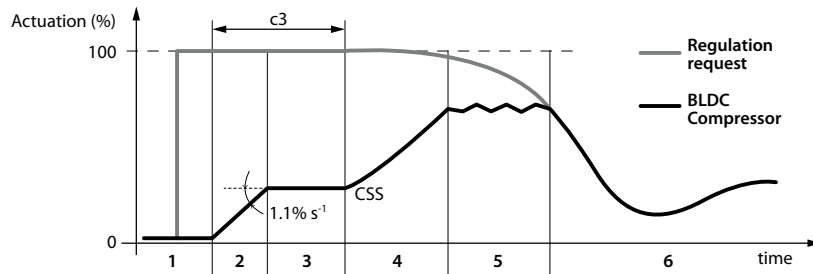


Fig. 5.x

3. Shutdown before starting. The minimum time that must elapse before the compressor restarts is equal to the higher of the minimum off time (c2) and the minimum time between two successive starts (c3). Compressor restart then depends on the request exceeding the minimum deliverable capacity;
4. Start-up ramp. The compressor increases speed linearly, until reaching the start-up speed, defined by parameter CSS;
5. Start-up phase. The compressor remains at speed CSS until time c1 has elapsed. This is a safety procedure designed to allow the oil to be distributed inside the compressor crankcase;
6. Control phase. The compressor speed is based on the showcase control request;
7. Example of protection activation: Low suction temperature protection. This occurs when the saturated evaporation temperature, converted from the evaporation pressure, reaches the threshold defined by parameter P11. The controller limits the compressor speed so as to keep the evaporation temperature above the value set for P11
8. Control phase. The control request and the compressor speed converge so as to keep the showcase temperature at the set point.

Shutdown

In the same way, the compressor shutdown phase is summarised in the figure below.

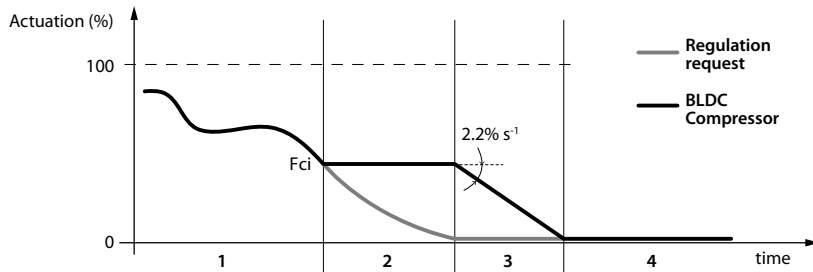


Fig. 5.y

- Control phase. Compressor speed is modulated so as to meet the control request;
- Minimum control request. When the minimum control request is reached, the compressor speed is kept constant at the value defined by parameter Fci. The compressor remains at the minimum speed until the request reaches 0%.
- Shutdown ramp. As soon as the request reaches 0%, the compressor begins to linearly decrease speed until stopping;
- Compressor OFF phase. When there is no control request, the compressor remains off. It will then remain off for at least the minimum OFF time. (c2)

Electronic valve behaviour

The behaviour of the electronic valve during the start-up, control and shutdown phases is shown in the figure below.

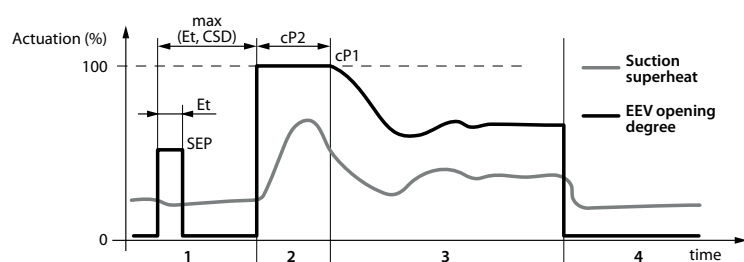


Fig. 5.z

- Equalisation phase (reference). The EEV remains open at the percentage defined by parameter SEP for the maximum time Et, in order to equalise the pressure. This first phase ends when the pressures are equalised.
- Pre-positioning phase. The electronic expansion valve remains at the pre-positioning percentage defined by parameter cP1, and remains there until the time cP2 has elapsed. At the beginning of this phase, the compressor starts.
- Control phase. The EEV modulates its opening so as to maintain the superheat value around the set point, defined by par. P3;
- Compressor shutdown. The electronic valve is closed completely.

Compressor timings

The following parameters are used to ensure correct compressor operation:

Code	Description	UOM
d9	Defrost priority over compressor protection times - 0/1 = protection times observed/protection times not observed	-
c0	Delay to enable compressor and evaporator fans at power on	min
c1	Minimum time between consecutive compressor starts	s
c2	Minimum compressor OFF time	s
c3	Minimum compressor ON time	s

- c0 is used to delay the start of control when the device is powered on. This is useful in the event of power failures, so that the controllers don't all start at the same time, avoiding potential problems of electrical overload.
- c1 sets the minimum time between two successive starts of the compressor, irrespective of the request. This parameter can be used to limit the maximum number of starts per hour;
- c2 sets the minimum compressor off time. The compressor will not be started again until the minimum time set has elapsed;
- c3 sets the minimum compressor activation time: the compressor will not be switched off until it has been on for at least the time set for c3;
- d9 disables the compressor protection times when defrosting:
d9 = 0: protection times are observed;
d9 = 1: protection times are ignored, defrosting has higher priority. The defrost is activated immediately and the compressor begins the shutdown procedure.

5.9.2 Compressor management procedures

The compressor is managed using standard procedures resulting from Carel's know-how:

- Start-up procedure
- Control of acceleration and deceleration ramps
- Equalising procedure
- Pressure increase control at start-up
- Pump down

Start-up procedure

When the compressor is requested to start, the start-up procedure is activated. The compressor speed is brought to a value that depends on the model (cIA) and kept constant, regardless of the control request, for a period of time corresponding to the minimum ON time (c3). Once this time has elapsed, the compressor speed will be based on the temperature control request.

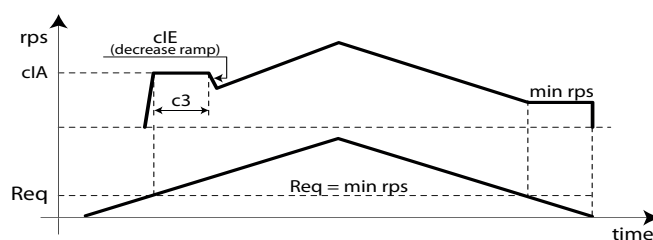


Fig. 5.aa

Equalising procedure

If, when the compressor start-up procedure is activated, the difference between the discharge pressure and suction pressure is higher than the maximum allowed for start-up (cdm), the equalisation procedure can be activated:

- Using the expansion valve; this procedure involves opening the valve to a set percentage (SEP) for a set time (Et).
- When the pressure differential is below cdm, the expansion valve is moved to the initial opening set for CP1; if equalisation via solenoid valve has been selected, this is closed and the compressor can be started.

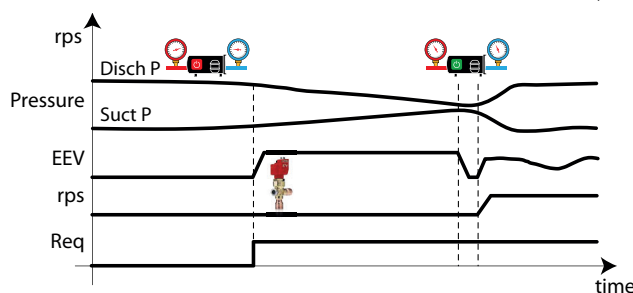


Fig. 5.ab

Code	Description	UOM
SEP	EEV pre-opening value for pressure equalisation	%
Et	Maximum EEV opening time during equalisation	s



Notice: if the equalisation process is not successful within the maximum equalisation time set (parameter Et), the failed equalisation alarm "dSd" will be activated. The alarm needs to be reset before repeating the equalisation procedure. The compressor will start in any case if the difference between pressures allows (regardless of whether or not the "dSd" alarm is active).

Pressure increase control at start-up

To check correct compressor rotation and a correct increase in the pressure differential, the latter is checked whenever the compressor is started. This involves measuring the increase in ΔP after a set time (cdd). If the increase is lower than the settable threshold (cdS), the compressor is switched off and the failed start-up alarm is signalled. This alarm has semi-automatic reset, and can be set using parameters "crd" and "cat".

Code	Description	UOM
cdd	Pressure delta control delay to verify compressor start	s
cdS	Minimum delta pressure to consider compressor started	bars
cdm	Maximum pressure delta for compressor start	bars
crd	Compressor restart delay after a start failure	s
cat	Max number of compressor start attempts	--

Pump down

The pump down procedure can be enabled by setting parameter PDt.

If enabled, it is activated every time the compressor switches off (defrost, temperature, off command).

Pump down is not performed when shutting down due to an alarm.

Code	Description	UOM
PDt	Type of pump down (0=none, 1=stop)	-

During pump down:

- the compressor speed is a function of the deviation from the pump down set point (LPd), where the compressor is at the set speed (cPP) when the suction pressure (SSP) is at the pump down threshold plus the offset (LPd + cPF), while it is off at the pump down threshold (LPd);
- the EEV valve is closed;
- the evaporator fan is off.

The compressor is stopped when the evaporation temperature reaches the limit defined by parameter LPd or when the maximum time CPt has elapsed.

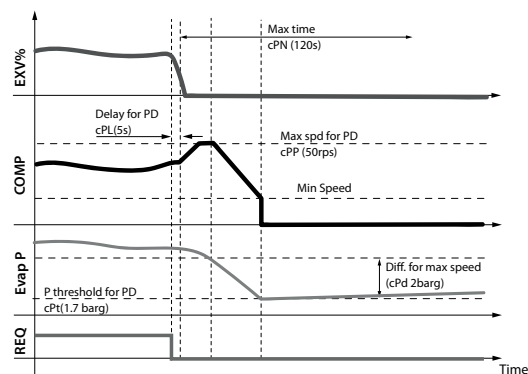


Fig. 5.ac

Pump down (if enabled) is completed before defrosting

Code	Description	UOM
CPt	Maximum pump down time	s
LPd	Evaporation pressure limit for pump down	barg (psig)



Notice: the pump down function is disabled when the compressor is turned off if one of the following condition is verified:

1. The unit is a Heosbox R-744 unit
2. The valve position during stand-by (psb parameter) is > 0

5.9.3 Compressor envelope management:

The envelope defines the operating range in which the compressor can work safely for an indefinite time. This can be represented graphically by drawing a number of boundaries, within which normal operating conditions must be maintained. The figure shows the envelope for Toshiba DA series horizontal compressors as an example.

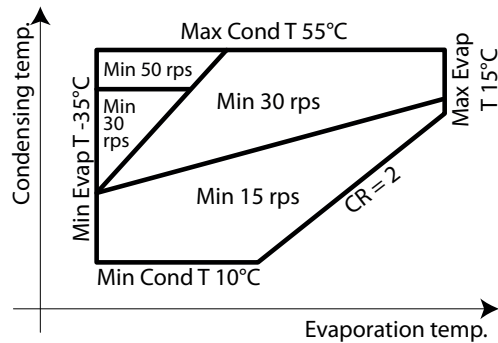


Fig. 5.ad

The boundaries of the envelope are represented by the:

- Minimum and maximum condensing temperature
- Minimum and maximum evaporation temperature
- Minimum and maximum compression ratio (CR)
- Maximum compressor current draw

Normal operating conditions are defined by:

- Evaporating pressure (or saturated temperature)
- Condensing pressure (or saturated temperature)
- Discharge temperature
- Rotation speed (rps)

The shape of the envelope can vary according to the compressor speed, and hence the normal operating conditions that are considered safe for the compressor. Consequently, a certain pair of operating pressures can be considered safe (inside the envelope) at a certain speed, and unsafe (outside of the envelope) at another speed.

As an example, taking the graph for Toshiba DA compressors:

the conditions $T_{cond} = 40^{\circ}\text{C}$ $T_{evap} = -10^{\circ}\text{C}$ are inside the envelope at a speed of 30 rpm, but are outside it at other speeds

Envelope protection activation

If the operating conditions are near the limits or outside of the envelope, the controller will adopt corrective actions (such as accelerations or decelerations) in order to keep the set point within the limits allowed by the manufacturer. In these cases, therefore, the actual compressor speed may not correspond to the required cooling capacity and the superheat may differ from the value set by the user. If the operating conditions remain outside of the envelope for a time exceeding the alarm threshold (60 s, not modifiable), the compressor will be switched off and an alarm signal will be activated, indicating the zone in which operation was outside of the envelope. The electronic valve is also involved in envelope control, through the MOP and LOP functions.

Compression ratio

When the operating conditions lead the compressor to work at a compression ratio lower than that allowed by the envelope, two automatic procedures are possible:

- MOP procedure by EEV (configurable): the valve closes, increasing the pressure differential and the compression ratio
- compressor acceleration (automatic based on the envelope): by increasing the speed, the compressor increases the pressure differential and thus the compression ratio.

Discharge temperature control

The discharge temperature is an important indicator of compressor health: continuous monitoring of this value allows procedures to be activated to keep it under control. Envelope control acts on the compressor speed and the opening of the expansion valve, as well as liquid injection, and is aimed at maintaining the discharge temperature within the allowed limits.



Notice: the liquid injection valve is only recommended for compressors with HFC refrigerants. The controller therefore prevents its use with different refrigerants.

The standard discharge temperature control strategy is, in order:

- Activate the liquid injection valve
- Then activate the EEV expansion valve
- Finally, reduce compressor speed
- If this is not sufficient, the high discharge temperature alarm will be triggered and control will stop. The "high discharge temperature (Hdt)" alarm is activated when the temperature rises above the threshold CHT and is deactivated when it falls below $\text{CHT} - 20^{\circ}\text{C}$.

Code	Description	UOM
LIV	Type of liquid injection valve	--
LIt	Liquid injection temperature threshold	°C
LIP	Liquid injection EEV proportional gain	--
LII	Liquid injection EEV integral time	s
LID	Liquid injection valve differential	°C
Llc	Liquid injection valve duty cycle	%
LIS	Duty cycle period	s
CHP	Set point for discharge temp. protection managed by EEV	°C
CHT	High discharge temperature alarm threshold (read only, from envelope)	°C
CHH	Differential for discharge temp. protection managed by EEV	K

Discharge temperature control via EEV

The following diagram illustrates this type of control and the corresponding limits.

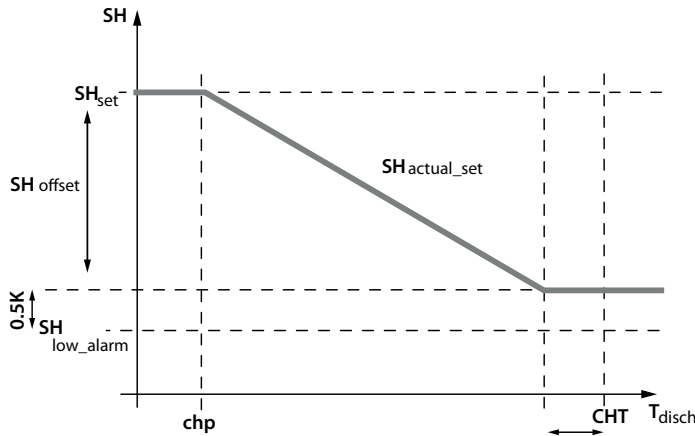


Fig. 5.ae



Notice: if the unit is set as “multi-evaporator” (regardless of whether it is main or secondary) with the “modulating superheat” function (PES) active, there will be two distinct phases:

- After exceeding the threshold “CHP-CHH”, there will be a gradual deactivation in modulating superheat within a maximum of 5 min.
- After 5 minutes in the previous phase, if the threshold “CHP” is exceeded, reduction of the superheat set point due to high discharge temperature will start.
- Modulating SH is reactivated when the discharge temperature returns below the threshold CHP CHH, with a 4 minute delay

The possible configurations of the liquid injection valve, which can be set using parameter “LIV”, are:

- LIV=0 electronic valve; in this case there will be continuous modulation of operation by P+I control, set by parameters Lip, Lii
- LIV=1 ON/OFF liquid injection valve that is activated when the discharge temperature exceeds a threshold, and deactivated when it returns below the threshold minus the differential Lid.

Minimum and maximum compressor speed management

If the default values of the minimum and maximum compressor speed need to be changed, the controller will not re-scale the compressor request percentage, as shown in the following example:

If the compressor has a maximum speed of 120 rps but this is then modified to 80 rps:

- Control request = 100% -> Compressor request = 66.7% -> Compressor speed 80 rps
- Control request = 50% -> Compressor request = 33.3% -> Compressor speed 40 rps

5.9.4 Oil recovery procedure

In the event of operation at low speed, with a low refrigerant flow-rate and speed, some refrigerants may have the risk of insufficient oil return to the compressor.

Two functions have been implemented to facilitate oil return:

- Speed boost;
- Evaporator washing.

These functions can be activated either together or separately, and are available for both single and multi-evaporator configurations.

Oil recovery procedure with speed boost

This involves momentary acceleration (at speed cIV) of the compressor for the time cIS each time the operating speed falls below a threshold (cIU) for a settable time (cIR).

There is also the possibility to manually start the oil recovery function with parameter "cIM".

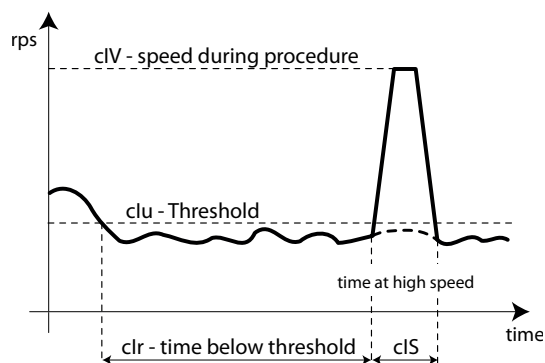


Fig. 5.af

Code	Description	UOM
cIP	Enable oil recovery function	--
cIR	Oil recovery time before activation	min
cIS	Oil recovery compressor speed override duration	min
cIU	Oil recovery min. compressor speed for activation	RPS
cIV	Oil recovery compressor override speed	%
cIM	Manual oil recovery activation	--

Oil recovery procedure with evaporator washing

For multi-evaporator configurations, the oil recovery procedure becomes (for single units, the procedure is equivalent to a single wash):

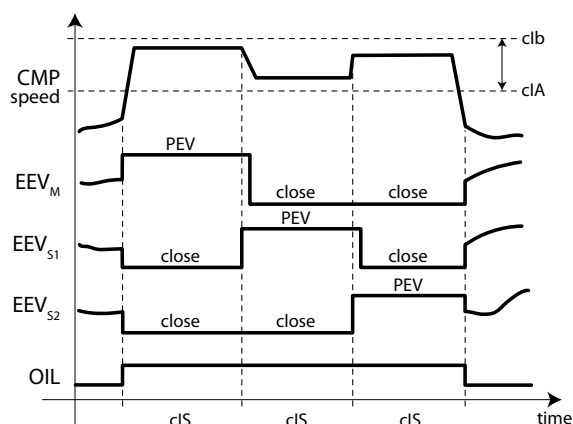


Fig. 5.ag

- The procedure can be activated in these cases (co3):
compressor speed (iSr) remains below the threshold "ciu" for the time "cir";
the showcase superheat (SH) remains below the threshold for the time "cir";
every co4 hours.
- The total procedure lasts the sum of the times $cOTx$ ($x = 1$ to 5) and is divided into equal steps corresponding to the number of evaporators.
- The evaporators are washed in sequence with the valve pre-positioned at co7, and then controlled based on the SH set point ($P3$) minus an offset (co8). The valves that are not in the washing phase stay closed or control the SH based on CO10
- The compressor speed:
 - varies between StartUp (CSS) and CSM (with envelope control active) based on the weight of the evaporator (cooling capacity). normal control



Notice:

- when the valves resume normal control at the end of the procedure, they return to the last saved position before the procedure).
- If the control temperature falls below the set point -4°C , the procedure ends, without delay for the showcase on which it occurs.

The transition from one step to the next occurs as follows:

- Showcase 1 ends the procedure;
- the valve on showcase 2 opens;
- the valve on showcase 1 closes after a delay (parameter CO5).

Code	Description	UOM
c01	Enable evaporator washing function	--
c02	Evaporator washing compressor speed 0: proportional to cooling capacity (PE2); 1: fixed (c0S1 to c0S6)	--
c03	Evaporator washing activation: 0 = compressor speed 1 = every x hours (c04) 2 = normal control	--
c04	Delay for evaporator washing activation	hours
c06	Manual washing activation on all units	--
c07	Valve opening for pre-positioning during evaporator washing	%
c08	SH set point offset during evaporator washing	K
c010	Close valve when the evaporator is not washing, during evaporator washing	--
c0t1..c0t6	Evaporator x (1 to 6) washing duration	s

5.9.5 Derating for high discharge pressure

To keep discharge pressure under control, the SW includes the following:

- Alarm from pressure probe (semi-automatic reset)
- Envelope high pressure limit (parameter MdP)
- Compressor derating

Code	Description	UOM
cse	Maximum compressor speed	rps
dr3	Minimum speed derating	rps
dr1	Derating activation threshold	barg
dr2	Maximum derating pressure	barg
HPt	High pressure alarm threshold from probe	barg

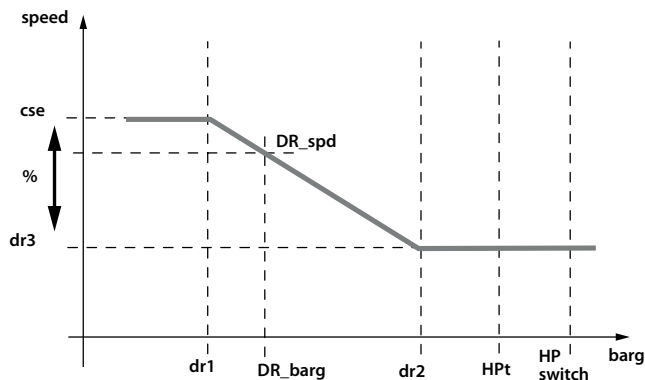


Fig. 5.ah

5.9.6 Oil lack prevent

This is a special logic developed for R744 applications, based on Carel know-how & experience.

This logic is active as a standard in HeosBox R-744 products. Can be activated / disabled by parameter oLe.

This logic is designed to prevent lack of oil in the compressor, though this logic cannot be a substitute for proper installation according to directions that ensure appropriate diameters of piping for oil return.

Carel reserves the right to void warranty on the Heosbox R744 in case this function is disabled.

The logic is based on two main safety thresholds:

- oLa: Compressor safety speed threshold to ensure the amount of oil discharged from the compressor is not excessive
- oLb: Superheat value threshold within which the evaporator is considered wet enough to guarantee the return of any oil discharged from the compressor (for any value of P25)

The logic (enabled by default in HeosBox product R-744) continuously checks whether the current superheat is greater than the threshold oLb. If so, if the current compressor speed is greater than the threshold oLa, then the compressor will be slowed down progressively (according to parameter oLf) to the threshold value oLa.

The above actions are carried out until the superheat value returns to values below the threshold oLb. Thereafter, the maximum allowable speed for the compressor is gradually restored (according to parameter oLg) to the maximum set in the system (value cse i.e., the minimum between parameter csg and CSM).

In the case of Multievacuator, it is sufficient that only one of the SHs of the different evaporators is above the threshold oLb to activate the compressor limiting function.



Notice: The function also includes an additional check on the stability of the read superheat value (for any value of P25, and in each bank of a multievacuator network). High values of superheat instability will activate the function in the only case where the compressor speed exceeds the parameter oLa.

Stability is measured as the derivative of superheat over time, defining a stability range between the minimum (parameter oLc) and maximum value of derivative (parameter oLd). If the derivative value is outside this range (measured derivative less than oLc or greater than oLd) the demand on the compressor is kept momentarily unchanged, allowing neither increases nor decreases from the current value. To turn this control off, simply set the parameters oLc and oLd to zero.

Code	Description	UoM
oLa	Compressor speed activation threshold for low oil prevention function	rps
oLb	Maximum SH value for low oil prevention function	K
oLc	Minimum derivative value on SH calc for low oil prevention function	K/s
oLd	Maximum derivative value on SH calc for low oil prevention function	K/s
oLe	Enable low oil prevention function	-
oLf	Deceleration speed for low oil prevention function	rps/s
oLg	Acceleration speed for low oil prevention function	rps/s

The following image shows the activation of the logic in two different scenarios, with compressor speed below the OLa value and above OLa.

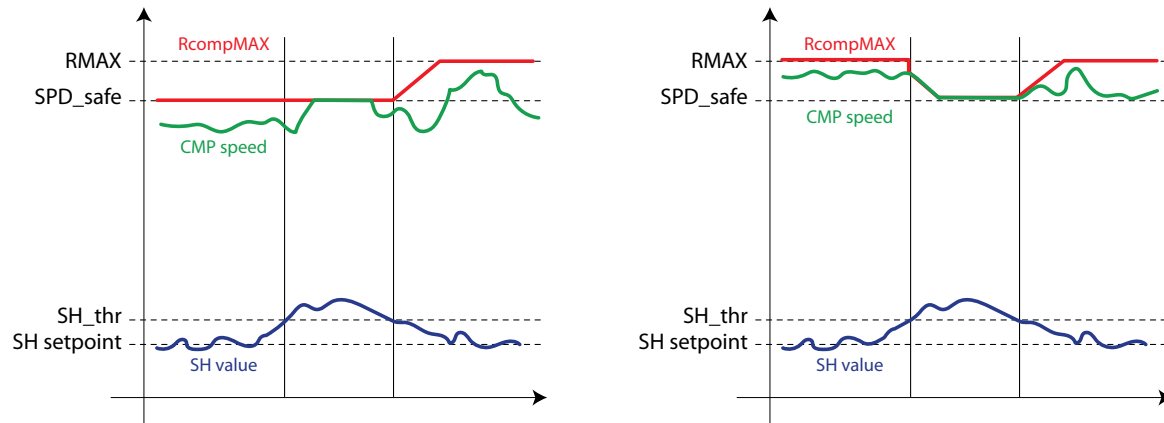


Fig. 5.ai

5.10 Generic functions

The controller can exploit the unused inputs and outputs to configure a "generic function". Each generic function can be enabled/disabled from the APPLICA app or SPARK program.

The following can be activated (maximum configuration):

- 1 generic function with On/Off output;
- 1 generic function with modulating output;
- 1 generic alarm function (signal only).

The generic function can be controlled based on:

- 1 specific probe, or
- difference between 2 suitably configured probes.



Caution: the controller cannot verify the consistency of the settings, if two analogue functions are mistakenly assigned to the same analogue inputs or the same digital output.

5.10.1 Enabling

The generic function can be enabled always, or when the unit is in a certain status.

Code	Description	UOM
GFS_E	Generic On/Off function: enable	-
	0 = Always 3 = Defrost 6 = Control (temperature control active)	
	1 = Unit ON 4 = Clean 7 = Open door	
	2 = Unit OFF 5 = Duty setting 8 = Active alarm	
GFM_E	Generic modulating function: enable see GFS_E	-
GFA_E	Generic alarm function: enable see GFS_E	-

Assign control probe

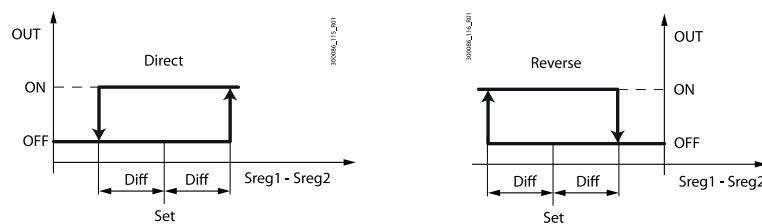
Select the control probes for the generic function.

Code	Description	UOM
GFS_1	0 : Not configured 1 : Outlet temperature (Sm) 2 : Defrost temperature (Sd) 3 : Intake temperature (Sr) 4 : Superheated gas temperature (tGS) 5 : Saturated evaporation pressure (PEu) 6 : Reserved 7 : Auxiliary 1 (Saux1) 8 : Auxiliary 2 (Saux2) 9 : Ambient temperature (SA) 10 : Ambient humidity (SU) 11 : Glass temperature (Svt) 12 : Dew point (SdP) 13 : Discharge temperature (Sdt) 14 : Condensing pressure (Scp) 15 : Suction pressure (SSp) 16..19: Reserved 20: Water inlet temperature (SWI) 21: Water outlet temperature (SWO) 22: Virtual probe (Sv) 23: Saturated evaporation temperature (tEu) 24: Superheat (SH) 25: Valve opening percentage (PPU)	-
GFS_2	Generic On/Off function: control probe 2 see GFS_1	-
GFM_1	Generic modulating function: control probe 1 see GFS_1	-
GFM_2	Generic modulating function: control probe 2 see GFS_1	-
GFA_1	Generic alarm function: control probe 1 see GFS_1	-
GFA_2	Generic alarm function: control probe 2 see GFS_1	-

5.10.2 On/Off output

Assign the digital output for the generic function, the type (direct/reverse) and the activation logic.

Code	Description	UOM
GFS_T	Generic On/Off function: type 0=Direct, 1=Reverse	-
GFS_S	Generic On/Off function: set point	-
GFS_D	Generic On/Off function: differential	-
DOS	Generic On/Off function: digital output: 0 = disabled 1 = NO1 2 = NO2 3 = NO3 4 = NO4	-
roS	Digital output logic for generic alarm function see rOb	-



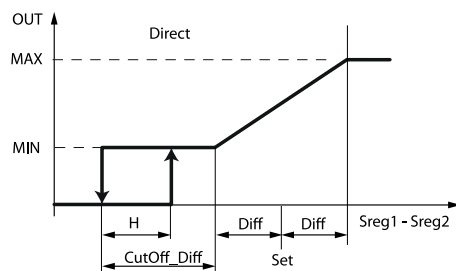
Ref.	Description
Set	Set point
Diff	Differential
Sreg1	Control probe 1
Sreg2	Control probe 2
OUT	Digital output

Fig. 5.aj

5.10.3 Modulating output

Assign the modulating output for the generic function and the type (direct/reverse). It is possible to use proportional control only or PID, as well as a cut-off differential with hysteresis.

Code	Description	UOM
GFM_T	Generic modulating function: type 0=Direct, 1=Reverse	-
GFM_S	Generic modulating function: set point	-
GFM_D	Generic modulating function: differential	-
GFM_Kp	Generic modulating function: proportional gain	-
GFM_Td	Generic modulating function: derivative time	-
GFM_Ti	Generic modulating function: integral time	-
GFM_CD	Generic modulating function: cut-off differential	-
GFM_H	Generic modulating function: hysteresis	-
GFM_Max	Generic modulating function: max output value	-
GFM_Min	Generic modulating function: min output value	-
/Ad	Generic modulating function: analogue output: 0 = disabled 1 = Y1 2 = Y2	-



Ref.	Description
Set	Set point
Diff	Differential
H	Hysteresis
Sreg1 Sreg2	Control probe1 Control probe 2
OUT	Digital output
CutOff_Diff	Cut-off differential

Fig. 5.ak

Alarm signal

The alarm can be signalled for two reasons:

- switching of the digital input, assigned by parameter DI5: the display shows "GHI"
- if the difference between the values of the control probes exceeds the high or low threshold: the display shows GHI or GLO respectively.

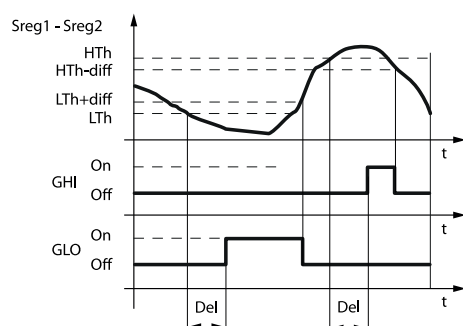


Notice: check that the alarm is generated by only one of the two causes:

GFA_AITYPE is used to set the type of alarm, normal or serious.

- normal = the unit continues operating with an active alarm;
- serious = control stops with an active alarm.

Code	Description	UOM
DI5	Assign digital input for generic alarm function	-
	0 = disabled	
	2 = digital input 2 (ID2)	
	4 = digital input 4 (ID4)	
	-1 = serial digital input	
	1 = digital input 1 (ID1)	
	3 = digital input 3 (ID3)	
	5 = digital input 5 (ID5)	
GFA_AIType	Alarm type: 0=signal 1=serious	
GFA_De	General alarm function: delay	-
GFA_D	Generic alarm function: differential	-
GFA_Hth	Generic alarm function: high temperature threshold	-
GFA_Lth	General alarm function: low temperature threshold	-



Ref.	Description
Lth	Low temperature threshold
HTh	High temperature threshold
diff	Differential
Del	Delay
t	Time
Sreg1 Sreg2	Control probe1 Control probe 2
GHI	High temperature alarm message
GLO	Low temperature alarm message

Fig. 5.al

5.11 Multi-evaporator configuration

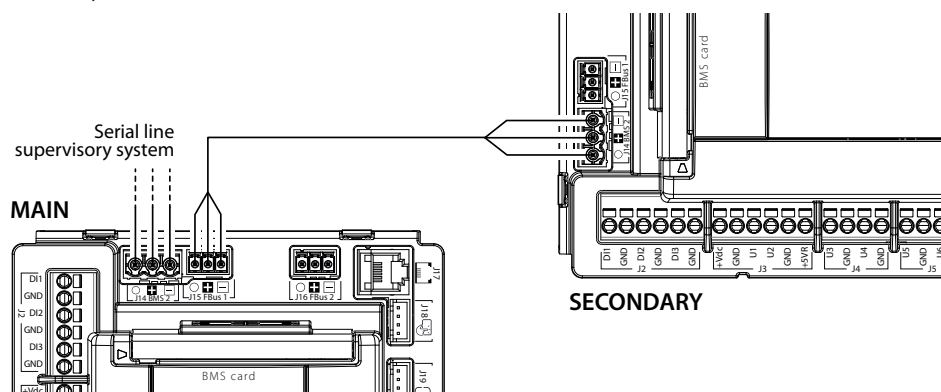
The controller can operate either stand-alone or in main-secondary multi-evaporator mode. In the latter mode, only the main unit will have a compressor and the other units will be able to control their own showcase.

Code	Description
In	Type of unit, 0 = Secondary, 1 = Main
Sn	Number of configured secondary devices
Pe2	Evaporator capacity (W)

Each evaporator must be assigned its own cooling capacity (PE2). Each board calculates its own request based on its own P+I, then the main board acquires all the requests and proportions them based on the capacity of each evaporator as a percentage of the total cooling capacity. To configure a multi-evaporator network, after having connected the boards, proceed as follows:

5.11.1 Serial connection

The RS485 connection must be made between Fieldbus 1 (main) J15 and BM2-J14 on the secondary units. The addresses must be consecutive between main and secondary (parameter H17=194 default value). Example: Main 194 -> Secondary 1 (195), Secondary 2 (196)



**Notice:**

1. Ethernet communication for main-secondary network is disabled by default. It shall be disabled in order to operate the serial line (on each board "eet" = 0).
2. The supervisory system can be used connecting the serial line of the supervisory to J14(BMS2) of the main. The secondary units do not need to be directly connect to supervisory system. The main unit automatically communicate the secondary information on the supervisory line

Code	Description
H0	BMS1 address
H1	BMS1 configuration (Stop bits and parity), 0 = Stop bit 1-parity none, 3 = Stop bit 2-parity even, 1 = Stop bit 2-parity none, 4 = Stop bit 1-parity odd, 2 = Stop bit 1-parity even, 5 = Stop bit 2-parity odd
H17	BMS2 address
H18	BMS2 configuration (Stop bits and parity), 0 = 1 stop bit-no parity, 3 = 2 stop bits-even parity, 1 = 2 stop bits-no parity, 4 = 1 stop bit-odd parity, 2 = 1 stop bit-even parity, 5 = 2 stop bits-odd parity
H19	BMS2 baudrate
H2	BMS1 baudrate, 0 = 1200, 2 = 4800, 4 = 19200, 6 = 57600, 1 = 2400, 3 = 9600, 5 = 38400, 7 = 115200

**Notice:**

- For example of layouts and the usage of BMS1 (optional card) see paragraph 1.3
- For details about the cable between main and secondary see paragraph 2.14

5.11.2 Ethernet connection

Ethernet communication for main-secondary network must be enabled on each board ("eet" = 1). The IP addresses of the boards must be consecutive. (first three numbers the same, last number +1, +2 ...), e.g. Main 192.168.1.100 Secondary1 192.168.1.101 Secondary2 192.168.1.102...

- if the board has one Ethernet port: each board must be connected to a switch/router.
- if the board has two Ethernet ports: the main board must be connected to the switch/router, and then all the boards (starting from the main) must be connected in series (input on one Ethernet port and continue the serial line with output on another Ethernet port) (reference)

The board IP addresses can be set in two ways:

- On the router (or DHCP server) set the IP address to be associated with the board's MAC address (DHCP must be active on the board, "iPD" = 1)
- assign a static IP to each board (iPD = 0), the IP address is parameter iPA. Each board must have the same subnet mask (iPS).

The following variables are available only on the HMI interface to correctly set the IP address. (example: 192.168.1.101 IP1= 192; IP2=168; IP3=1 ; IP4=101)

Code	Description	Code	Description
IP1	Ip Address: MSB byte	IP3	Ip Address: 3rd byte
IP2	Ip Address: 2nd byte	IP4	Ip Address: LSB byte



Notice: the supervisor connection via Ethernet does not need to be enabled by setting "eet", and is therefore always available

5.11.3 Superheat probes configuration

It is possible to share the suction pressure probe of the main unit to the secondary units. This is default of the controller (if no pressure probes are configured in the secondary, the value will be automatically read from the main). In case a secondary unit is required to use a local pressure probe then it is possible to configure it with "/FE" (Assign saturated evaporation pressure/temperature probe (PEU/TUE)).

The Heos controller manages up to 4 different probes to calculate the super heat:

- /FE: Assign saturated evaporation pressure/temperature probe (PEU/TUE)
- /Ft: Assign suction pressure probe (SSP)
- /Fu: Assign superheated gas temperature probe (SER)
- /Fd: Assign suction temperature probe (TGS)

Parameter P25 is designed to allow the user to select between 3 way of calculating the SH:

- P25=0 "Suction probes": Pressure (/Ft) and temperature (/Fd) are used for SH calculation.
- P25=1 "Evaporator probes": Pressure (/FE) and temperature (/Fu) are used for SH calculation
- P25=2: "Suction press. probe and Evaporation temp. probe": Pressure (/Ft) and temperature (/Fu) are used for SH calculation.
- P25=3: "auto". It is the default value of Main and secondary of the Heosbox R-744 product. The auto function allows to set the SH calculation as following:
 - If the unit is configured as secondary; SH is calculated as "P suction (/Ft (main)) + Tevap(/Fu)"
 - If the unit is configured as Main with "sn>0; SH is calculated as "P suction (/Ft (main)) + Tevap(/Fu)"
 - If the unit is configured as Main with "sn=0; SH is calculated as "P suction (/Ft (main)) + Tsuction(/Fd)"

P25=0 has been designed to be used in the single unit while P25=2 for the main and secondaries but all options are available and selectable for both single and multievacaporator.



Notice: An alarm will be displayed if any of the necessary probes for superheat calculation (according to P25) are missing.

5.11.4 Modulating superheat

The modulating superheat function (enabled using parameter PES) is used to control the temperature of showcases in a multi-evaporator network. When a showcase in this network reaches a control temperature lower than its set point, the showcase expansion valve will use a new superheat value, equal to the sum of its standard value (parameter P3) + the offset PE7. For example, if P3 = 8K and PE7 = 10K, the valve will be controlled so as to reach a superheat value of 18K. The purpose of this function is therefore (by applying a superheat offset) to reduce the valve opening if a showcase is too cold. To activate the function, set the offset PE7 to a value greater than 0 and set parameter PES = TRUE.

It is also possible to set a threshold for the control temperature beyond which the showcase will always close the valve (parameter COF).

This function can be managed in two modes (selectable via parameter PEB):

- best unit: that is, of all the showcases in the multi-evaporator network, the function will act on the showcase where the difference between the control set point and the control temperature is highest. Control will be shifted from one showcase to another when the conditions change, with a delay of PEA
- all: the modulating superheat function will act on all the showcases where it is enabled and requested.

Code	Description	UOM
PE7	Multi-evaporator superheat control offset	°C
PES	Enable modulating SH set point function	--

5.11.5 Duty setting with multi-evaporator

Activating duty setting mode on the main controller implies that the compressor management times set for the main controller are also used by all connected secondary controllers. The secondary will activate and deactivate expansion valve control based on compressor operation (ON or OFF). If a secondary is in duty setting mode (due to a probe error), the proportional component corresponding to the unit with the error will be equal to the value of parameter cl3, weighted according to the cooling capacity (PE2).

Cut-Off threshold:

A cut-off threshold (COF) can be enabled:

- in a stand-alone system, when reached the compressor switches off
- in multi-evaporator systems, the valve on the showcase in question is closed. If COF > 0 the function is active.

5.12 RTC management

The controller features a real time clock (RTC). The time/date can be set via the user interface, supervisor or smartphone app. The time/date set on the RTC can be synchronised:

- via app (see the section Smartphone app)
- from the supervisory system using the variables in the BMS table



Notice: for multi-evaporator systems, on the secondary units the real time clock is always updated by the main controller's real time clock.

Code	Description	UOM
y__	Year Clock settings by supervisor	year
M__	Month Clock settings by supervisor	month
d__	Day Clock settings by supervisor	day
h__	Hour Clock settings by supervisor	hour
m__	Minutes Clock settings by supervisor	min

5.13 Manual mode

While the unit is operating, it may be necessary to control operation manually, especially for maintenance purposes. In this case, certain devices or functions can be overridden (ON/OFF or % activation). This can be done from the APPLICA user interface, using a "service" user profile. For more in-depth service interaction, an appropriate app access profile is required.

Code	Description	UOM
PMP	Expansion valve: Enable manual mode (0/1 = No / Yes)	--
PMu	Expansion valve: manual position to be set	steps
MEC	Manual compressor mode: Enable (0/1 = No / Yes)	--
MC	Manual compressor mode: request	%
MEE	Manual evaporator fan mode: Enable (0/1 = No / Yes)	--
ME	Manual evaporator fan mode: request	%
MEP	Powerplus inverter manual mode: Enable (0/1 = No / Yes)	--
MP	Powerplus inverter manual mode: request	%
MrP	Powerplus inverter manual mode: Run stop command	--

The status of the digital and analogue outputs can also be overridden.

Code	Description	UOM
MO	Enable manual control of digital and analogue outputs (0/1 = No / Yes)	
MD1	NO1 Manual mode: value	
MD2	NO2 Manual mode: value	
MD3	NO3 Manual mode: value	
MD4	NO4 Manual mode: value	
MD5	NO5 Manual mode: value	
MD6	NO6 Manual mode: value	
ML1	NO1 Manual mode: logic (0 = Direct, 1 = Reverse)	
ML2	NO2 Manual mode: logic (0 = Direct, 1 = Reverse)	
ML3	NO3 Manual mode: logic (0 = Direct, 1 = Reverse)	
ML4	NO4 Manual mode: logic (0 = Direct, 1 = Reverse)	
ML5	NO5 Manual mode: logic (0 = Direct, 1 = Reverse)	
ML6	NO6 Manual mode: logic (0 = Direct, 1 = Reverse)	

Once manual mode has been enabled, a timer starts counting; when this reaches the value set for parameter MT (Maximum time before exiting manual mode (0 = no timeout)), the unit returns to normal operation and control resumes with the previous settings.

5.14 Local network functions

The controllers can be connected together to form a LAN (Local Area Network) with main/secondary configuration (including multi-evaporator systems).

The main purpose of the LAN is to provide communication and synchronise operation between a series of controllers (maximum 6: one main and five secondaries). As regards the supervisory system, the main acts as an electrical interface for the secondaries, and can be used to control all the devices in the local network.

Remote alarms sent from secondary to main

The unit configured as the main in a LAN signals the remote alarms from the secondary units with multi-evaporator configuration. In this case, the alarm is a generic "secondary alarm" and does not contain any details; these are however available directly on the secondary board in question. All networks are enabled by default to receive alarm signals from the secondary units. This function is especially useful for centralised alarm management on the main.

If the main detects an alarm on a secondary unit (probe error, high or low temperature error, etc.), the display shows the alarm signal "nX" (alternating with the temperature), where x = 1 to 5, LAN address of the secondary unit with the alarm.



Caution: if a secondary unit is offline, the alarm signal, even if previously activated, will not be shown.

Virtual DI

A virtual digital input can be used, broadcast from the main to the secondary units. The input can be physically connected to the main (A9>0) or controlled on the main via the supervisor (A9=-1).

To allow the secondary unit to receive the virtual digital input from the main, select "-1" for the secondary channel (relating to function to be associated with the virtual digital input).

Example

Light physical digital input connected to the supervisor and broadcast to the main and secondary units:

Main	Secondary
DIAC = -1	DIAC = -1
A9 = -1	

Light physical digital input connected to the main and broadcast to the secondary units:

Main	Secondary
DIAC = 1	DIAC = -1
A9 = 1	



Notice:

- In any case, the virtual digital inputs on the secondary units will always follow the virtual digital input on the main and cannot be set by the supervisor.
- If a secondary is not connected, the most recent status received from the local network is retained.
- When LAN communication is activated, at power on, the previous status of the virtual digital input needs to be set, in order to correctly initialise the required function. See the description of the digital inputs for the individual functions.

Remote pressure probes

The LAN structure (multi-evaporator configuration only) allows the value of the pressure probe to be sent across the network, with consequent savings both in terms of devices installed and installation times.

The main periodically sends the suction pressure probe reading to the secondaries.

The secondary units will use the local pressure probe (physical or serial) assigned by parameter /Ft to control the electronic expansion valve. If this local probe is not available, the secondary units will use the pressure probe reading sent by the main. If the pressure probe is not configured on the main, an alarm will be activated on the secondary unit and this cannot start.



Notice: If a secondary unit is not online, the pressure probe reading from the main is considered unavailable.

6. PARAMETER TABLE

Below is the table of the parameters that can be displayed on the terminal or can be modified using the commissioning software or APPLICA app. The APPLICA app and commissioning tools three predefined parameter access levels:

- User (U). Password: -
- Service (S) Password: 22. This also allows access to the "user (U)" parameters
- Manufacturer (M). Password: 44. This also allows access to the "service (S)" parameters

Code	Description	UOM
PDM	Manufacturer password	-
PDS	Service password	-
PDU	User password	-



Notice:

- the read-only parameters are not visible from the Applica app using NFC, as NFC memory cannot be overwritten frequently;
- to avoid any fraudulent activities, the default password values should be changed at the end of the commissioning procedure. For example, with the APPLICA app, parameters PDM, PDS and PDU can be used to set new passwords, with a maximum length of 8 characters, both alphanumeric and special.
- the display has only one access level (password 33) and only displays the parameters described in chapter 3.



Caution:

- the operation to reset the default values is not reversible, unless the unit configuration has been previously saved using the commissioning software/Applica app.
- Carel has selected a group of parameters that are reserved for Carel qualified users only. These parameters are neither visible nor modifiable by the user and in no way affect correct and ample configurability of the unit by the user.

6.1 Parameter table

Name	Description EN	Def.	Min	Max	UOM	Profiles
Alarms						
A0	High and low temp. alarm reset differential	2 (3.6)	0.1 (0.1)	20 (36)	°C (°F)	M, S
A1	Alarm thresholds (AL, AH) for set point St, 0 = Relative, 1 = Absolute	0	0	1		M, S, U
A11	Delay time for delayed external alarm	1	0	240	min	M, S
A12	Reset type for out-of-envelope alarm, 0 = Manual, 1 = Semi-automatic	1	0	1		M
A13	Number of retries if out-of-envelope alarm is set as semi-automatic	5	0	5		M
A14	Out-of-envelope alarm time range for semi-automatic reset	60	1	1440	min	M
A6	Configure comp. control during ext. alarm with fixed 15 min OFF time 0 = always OFF 100 = always ON	0	0	100	min	M, S
AA	Assign probe for high (AH) and low (AL) temperature alarms (0 = Not config.)	1	0	24		M, S
	0 = Not config., 9 = Ambient temp. (SA), 18 = Reserved					
	1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (SCt),					
	2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI),					
	3 = Air on (Sp), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO),					
	4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq),					
	5 = Reserved, 14 = Reserved, 23 = Virtual probe (Sv),					
	6 = Reserved, 15 = Reserved, 24 = Saturated suction temp. (TSP)					
	7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr),					
	8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (SOT),					
Ad	Delay time for high and low temp. alarms (AH, AL)	120	0	240	min	M, S
Add	High temp. alarm bypass time for door open	30	1	240	min	M, S
AdE	Priority of alarms from DIn, 0 = Normal, 1 = Serious	0	0	1		M
AH	High temperature alarm relative threshold	10 (50)	0 (32)	50 (122)	°C (°F)	M, S, U
AHA	High temperature alarm absolute threshold	50 (122)	-50 (-58)	50 (122)	°C (°F)	M, S, U
AL	Low temperature alarm relative threshold	4 (39.2)	0 (32)	50 (122)	°C (°F)	M, S
ALA	Low temperature alarm absolute threshold	-50 (-58)	-50 (-58)	50 (122)	°C (°F)	M, S
AS	Serial probe alarm delay for Dewpoint management	30	10	500	min	M, S, U
HPo	Number of retries if HP alarm is set as semi-automatic	5	2	10		M
HPP	High discharge pressure alarm time range for semi-automatic reset	60	0	999	min	M
HPr	Reset type for high discharge pressure alarm, 0 = Manual, 1 = Semi-automatic	1	0	1		M
HPt	High discharge pressure alarm threshold	71 (1029.7)	-1 (-14.5)	200 (2900.7)	bar (psi)	M
HPU	High discharge pressure alarm differential	3 (43.5)	0 (0)	20 (290.0)	bar (psi)	M
Htd	HACCP alarm delay 0 = monitoring disabled	0	0	240	min	M, S, U
LPE	Low suction pressure alarm delay at runtime	5	0	999	s	M, S
LPo	Number of retries if LP alarm is set as semi-automatic	5	2	10		M
LPP	Low suction pressure alarm time range for semi-automatic reset	60	0	999	min	M
LPr	Reset type for low suction pressure alarm, 0 = Manual, 1 = Semi-automatic	1	0	1		M
LPS	Low suction pressure alarm delay during compressor startup	30	0	999	s	M
LPt	Low suction pressure alarm threshold	11 (159.5)	-1 (-14.5)	20 (290.0)	bar (psi)	M
LPU	Low suction pressure alarm differential	3 (43.5)	0 (0)	20 (290.0)	bar (psi)	M
PAP	Time range for Power+ alarm reset	60	1	1440	min	M
PAR	No. of attempts performed for Power+ alarm reset	5	0	5		M
PAT	Type of Power+ alarm reset, 0 = Manual, 1 = Semi-automatic	1	0	1		M
Pb2	Valve position warning delay	10	1	255	min	M
Pb3	Superheat offset set point for low refrigerant charge warning	3 (5.4)	0 (0)	20 (36)	°C (°F)	M
Pb4	Low refrigerant charge warning delay	10	0	999	min	M
Tdoor	Door open: alarm delay	30	1	240	min	M
Analogue inputs						
/2	Analogue probe measurement stability	9	1	15		M, S
/cA	Air off temp. probe (Sm) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/Cab	Water inlet temperature probe (SWI) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S

Name	Description EN	Def.	Min	Max	UOM	Profiles
/CaC	Water outlet temperature probe (SWO) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/Cad	Liquid temperature probe (Liq) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/cb	Defrost temp. probe (Sd) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/cc	Air on temp. probe (Sr) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/cd	Suction temp. probe (tGs) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/cE	Evaporator pressure probe (PEu) calibration	0 (0)	-20 (-290.0)	20 (290.0)	bar (psi)	M, S
/cG	Auxiliary temp. probe (Aux) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/cH	Auxiliary temp. probe 2 (Aux2) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/ci	Ambient temp. probe (SA) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/Cj	Set point offset analogue input (StA) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/cL	Ambient humidity probe (SU) calibration	0	-20	20	%rH	M, S
/cM	Glass temp. probe (Svt) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/cn	Dewpoint value (Sdp) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/cp	Discharge temperature probe (Sdt) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/cs	Discharge pressure probe (Scp) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/Ct	Suction pressure probe (SSp) calibration	0 (0)	-20 (-290.0)	20 (290.0)	bar (psi)	M, S
/Cu	Evaporator temperature probe (SEr) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/Cv	Box outlet temperature probe (Sot) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/Cw	Flash tank pressure probe (SFP) calibration	0 (0)	-20 (-290.0)	20 (290.0)	bar (psi)	M, S
/Cy	Gas cooler outlet temperature probe (Sct) calibration	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
/FA	Assign air off temp. probe (Sm) (0 = Function disabled)	1	-4	wai		M, S
/Fab	Assign water inlet temperature probe (SWI) (0 = Function disabled)	0	-4	wai		M, S
/FaC	Assign water outlet temperature probe (SWO) (0 = Function disabled)	0	-4	wai		M, S
/Fad	Assign liquid temperature probe (Liq) (0 = Function disabled)	0	-4	wai		M, S
/Fb	Assign defrost temperature probe (Sd) (0 = Function disabled)	2	-4	wai		M, S
/Fc	Assign air on temperature probe (Sr) (0 = Function disabled)	3	-4	wai		M, S
/Fd	Assign suction temperature probe (tGs) (0 = Function disabled)	4	-4	wai		M, S
/FE	Assign saturated evaporation pressure/temperature probe (PEu/tEu) (0 = Function disabled)	0	-4	wai		M, S
/FG	Assign auxiliary temperature probe 1 (Saux1) (0 = Function disabled)	0	-4	wai		M, S
/FH	Assign auxiliary temperature probe 2 (Saux2) (0 = Function disabled)	0	-4	wai		M, S
/Fi	Assign ambient temperature probe (SA) (0 = Function disabled)	0	-4	wai		M, S
/Fj	Assign set point offset analogue input (StA) (0 = Function disabled)	0	-4	wai		M, S
/FL	Assign ambient humidity probe (SU) (0 = Function disabled)	0	-4	wai		M, S
/FM	Assign glass temperature probe (Svt) (0 = Function disabled)	0	-4	wai		M, S
/Fn	Assign dewpoint value (Sdp) to a serial probe (0 = Function disabled)	0	-4	0		M, S
/Fo	Assign discharge temperature (Sdt) (0 = Function disabled)	6	-4	wai		M, S
/Fs	Assign discharge pressure (Scp) (0 = Function disabled)	7	-4	wai		M, S
/Ft	Assign suction pressure probe (SSp) (0 = Function disabled)	5	-4	wai		M, S
/Fu	Assign superheated gas temperature probe (SEr) (0 = Function disabled)	0	-4	wai		M, S
/Fv	Assign box outlet temperature probe (Sot) (0 = Function disabled)	0	-4	wai		M, S
/Fw	Assign flash tank pressure probe (SFP) (0 = Function disabled)	0	-4	wai		M, S
/Fy	Assign gas cooler outlet temperature probe (Sct) (0 = Function disabled)	0	-4	wai		M, S
/LE	Saturated evap. pressure probe (PEu/tEu) minimum value	0 (0)	-1 (-14.5)	/UE	bar (psi)	M, S
/Lj	Set point offset minimum value	-5 (-9)	-20 (-36)	20 (36)	°C (°F)	M, S
/LL	Ambient humidity probe (SU) minimum value	10	10	/UL	%rH	M, S
/LS	Discharge pressure probe minimum value	0 (0)	-1 (-14.5)	/US	bar (psi)	M, S
/Lt	Suction pressure probe minimum value	0 (0)	-1 (-14.5)	/Ut	bar (psi)	M, S
/Lw	Flash tank pressure probe minimum value	0 (0)	-1 (-14.5)	/Uw	bar (psi)	M, S
/PA	Type of probe, air off temperature probe (Sm) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pab	Type of probe, water inlet temperature probe (SWI) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/PaC	Type of probe, water outlet temperature probe (SWO) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pad	Type of probe, liquid temperature probe (Liq) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pb	Type of probe, defrost temperature probe (Sd) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pc	Type of probe, air on temperature probe (Sr) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pd	Type of probe, suction temperature probe (tGs) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/PE	Type of probe, evaporator pressure probe (PEu) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	6	0	9		M, S
/PG	Type of probe, auxiliary temperature probe (Aux) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/PH	Type of probe, auxiliary temperature probe 2 (Aux2) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pi	Type of probe, ambient temperature probe (SA) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pj	Type of analogue input, set point offset (StA) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	4	0	9		M, S
/PL	Type of probe, ambient humidity probe (SU) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	4	0	9		M, S
/PM	Type of probe, glass temperature probe (Svt) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pn	Type of probe, dewpoint value (Sdp) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		

Name	Description EN	Def.	Min	Max	UOM	Profiles
/Po	Type of probe, discharge temperature probe (Sdt) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	5	0	9		M, S
/PS	Type of probe, discharge pressure probe (Scp) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	6	0	9		M, S
/Pt	Type of probe, suction pressure probe (SSp) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	6	0	9		M, S
/Pu	Type of probe, evaporator temperature probe (SEr) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pv	Type of probe, box outlet temperature probe (SOT) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/Pw	Type of probe, flash tank pressure probe (SFP) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	6	0	9		M, S
/Py	Type of probe, gas cooler outlet temperature probe (SCt) 0 = PT1000 2 = 0-5 V 4 = 0-10 V 6 = 0.5-4.5V 8 = 0-1 V 1 = NTC Standard Range 3 = 4-20 mA 5 = NTC-HT 7 = PT500 9 = PTC CAREL	1	0	9		M, S
/UE	Saturated evap. pressure probe (PEu/tEu) maximum value	90 (1305.3)	/LE	200 (2900.7)	bar (psi)	M, S
/Uj	Set point offset maximum value	5 (9)	-20 (-36)	20 (36)	°C (°F)	M, S
/UL	Ambient humidity probe (SU) maximum value	100	/LL	100	%RH	M, S
/US	Discharge pressure probe maximum value	90 (1305.3)	/LS	200 (2900.7)	bar (psi)	M, S
/Ut	Suction pressure probe maximum value	90 (1305.3)	/Lt	200 (2900.7)	bar (psi)	M, S
/Uw	Flash tank pressure probe maximum value	90 (1305.3)	/Lw	200 (2900.7)	bar (psi)	M, S

Analogue outputs

/AA	Assign channel for modulating evaporator fan output (0 = not configured)	0	0	wao		M, S
/Ab	Assign channel for modulating valve output (0 = not configured)	0	0	wao		M, S
/Ac	Assign channel for modulating anti-sweat heater output (0 = not configured)	0	0	wao		M, S
/Ad	Assign channel for generic modulating function (0 = not configured)	0	0	wao		M, S
/AE	Assign channel for modulating condenser fan output (0 = not configured)	0	0	wao		M, S
/AH	Assign channel for modulating condenser valve output (0 = not configured)	0	0	wao		M, S

Compressor

c0	Delay enable comp. and evap. fans at power-on	0	0	15	min	M, S
c1	Minimum time between consecutive starts of same compressor	360	0	999	s	M
c2	Compressor min OFF time	180	0	999	s	M
c3	Minimum compressor ON time	180	0	999	s	M
c4	ON time for duty setting operation 0 = compressor/valve always OFF 100 = compressor/valve always ON	3	0	100	min	M, S
c5	OFF time for duty setting operation 0 = compressor/valve always OFF 100 = compressor/valve always ON	3	0	100	min	M, S
cat	Max number of compressor start attempts	5	0	5		M
CBM	Activate MOP protection bypass at start-up for zone 6-7, 0 = No, 1 = Yes	1	0	1		M
cdd	Time to check DP variation at start-up to consider compressor started	20	0	999	s	M
cdm	Maximum pressure delta for compressor start	0.5 (7.2)	0 (0)	120 (1740.4)	bar (psi)	M
cds	Minimum delta pressure to consider compressor started	0.2 (2.9)	0.1 (1.4)	2 (29.0)	bar (psi)	M
CHH	Differential for discharge temp. protection managed by EVD	0.1 (0.1)	0.1 (0.1)	20 (36)	°C (°F)	M
CHP	Set point for discharge temp. protection managed by EVD	118 (244.4)	50 (122)	150 (302)	°C (°F)	M
cl3	Compressor capacity with control probe broken	50	0	100	%	M, S
CLC	Enable MOP also for low compression ratio (zone 8), 0 = Disabled, 1 = Enabled	1	0	1		M
cPF	Low pressure differential for pump down management	2 (29.0)	0.1 (1.4)	10 (145.0)	bar (psi)	M
cPP	Maximum speed allowed in pump down procedure	50	0	120	rps	M
CPt	Maximum pump-down duration	120	0	999	s	M, S
crd	Compressor restart delay after failed start	180	0	999	s	M
CSM	Compressor max custom speed (rps)	0	Fci	csq	rps	M
CSS	Compressor start-up speed	50	csc	cse	rps	M
ct	Compressor type, 0 = On/Off, 1 = BLDC	1	0	1		M
dco	Compressor capacity request with door open	-1	-1	100	%	M, S
dCP	Compressor capacity percentage during hot gas defrost	50	0	100	%	M, S
dr1	Compressor speed derating activation threshold for HP protection	66 (957.2)	0 (0)	dr2	bar (psi)	M
dr2	Max derating pressure for HP protection	70 (1015.2)	0 (0)	150 (2175.5)	bar (psi)	M
dr3	Compressor min speed derating for HP protection	30	csc	cse	rps	M
Fci	Compressor min custom speed (rps)	0	csf	CSM	rps	M
LPd	Pump down pressure threshold	13 (188.5)	0 (0)	45 (652.6)	bar (psi)	M, S
MdP	Custom envelope limit of maximum discharge pressure	0 (0)	0 (0)	150 (2175.5)	bar (psi)	M
MSP	Custom envelope limit of minimum suction pressure	0 (0)	0 (0)	150 (2175.5)	bar (psi)	M
oLa	Compressor speed activation threshold for low oil prevention function	80	csc	cse	rps	M
oLb	Maximum SH value for low oil prevention function	15 (27)	0 (0)	30 (54)	°C (°F)	M
oLc	Minimum derivative value on SH calc for low oil prevention function	-10	-999	0		M
oLd	Maximum derivative value on SH calc for low oil prevention function	10	0	999		M
oLe	Enable low oil prevention function, 0 = Disabled, 1 = Enabled	0	0	1		M
oLf	Deceleration speed for low oil prevention function	1	0	1	rps	M
oLg	Acceleration speed for low oil prevention function	0.5	0	1	rps	M
PDt	Pump down type, 0 = None, 1 = At stop	0	0	1		M
sfb1	Frequency band 1 that compressor has to skip	0	0	csq	rps	M
sfb2	Frequency band 2 that compressor has to skip	0	0	csq	rps	M
sfb3	Frequency band 3 that compressor has to skip	0	0	csq	rps	M
sff1	Frequency set point 1 that compressor has to skip	0	0	csq	rps	M
sff2	Frequency set point 2 that compressor has to skip	0	0	csq	rps	M
sff3	Frequency set point 3 that compressor has to skip	0	0	csq	rps	M

Compressor on/off

CLD	Compressors (on/off): delay time between two off requests	10	0	999	s	M
CLU	Compressors (on/off): delay time between two on requests	10	0	999	s	M
CLUn	Compressors (on/off): delay time between two on requests in night mode	10	0	999	s	M
CRo	Compressors (on/off): type of rotation, 1 = FIFO, 2 = LIFO, 3 = Timed	1	1	3		M
NC	Number of compressors (on/off)	1	1	3		M
PVd	Compressor (on/off): high discharge pressure prevention period	60	0	999	min	M
PVE	Compressor (on/off): enable high discharge pressure prevention, 0 = Disabled, 1 = Enabled	0	0	1		M
PVi	Compressor (on/off): high discharge pressure prevention differential	5 (9)	0 (0)	20 (36)	°C (°F)	M
PVL	Compressor (on/off): high discharge pressure prevention delay between steps	30	0	999	s	M
PVM	Compressor (on/off): high discharge pressure prevention maximum attempts	3	0	5		M

Name	Description EN	Def.	Min	Max	UOM	Profiles
PVP	Compressor (on/off): high discharge pressure prevention probe 0 = Not config., 9 = Ambient temp. (SA), 18 = Reserved 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (SCT), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Reserved, 14 = Reserved, 23 = Virtual probe (Sv), 6 = Reserved, 15 = Reserved, 24 = Saturated suction temp. (TSP), 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (SOT),	21	0	24		M
PVt_T	Compressor (on/off): high discharge pressure prevention threshold	40 (104)	0 (32)	145 (293)	°C (°F)	M
AtL	Reset type for low suction pressure switch alarm, 0 = Automatic, 1 = Semi-automatic, 2 = Manual	0	0	2		M
AtLn	Low suction pressure switch alarm time range for semi-automatic reset	60	0	999	min	M
LPL	Low suction pressure switch alarm delay	30	0	600	s	M
LPn	Number of retries if low suction pressure switch alarm is set as semi-automatic	5	2	10		M
DiA1	Assign compressor 1 (on/off) alarm digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
DiA2	Assign compressor 2 (on/off) alarm digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
DiA3	Assign compressor 3 (on/off) alarm digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
DiT	Assign compressor 1 (on/off) low suction pressure switch (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
DiTB	Assign compressor 2 (on/off) low suction pressure switch (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
DiTC	Assign compressor 3 (on/off) low suction pressure switch (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
riA1	Config. Compressor 1 (on/off) alarm switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
riA2	Config. Compressor 2 (on/off) alarm switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
riA3	Config. Compressor 3 (on/off) alarm switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
RiT	Config. compressor 1 (on/off) low suction pressure switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
RiTB	Config. compressor 2 (on/off) low suction pressure switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
RiTC	Config. compressor 3 (on/off) low suction pressure switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
DoA1	Assign compressor 1 (on/off) digital output (0 = Function disabled)	0	0	ndo		M
DoA2	Assign compressor 2 (on/off) digital output (0 = Function disabled)	0	0	ndo		M
DoA3	Assign compressor 3 (on/off) digital output (0 = Function disabled)	0	0	ndo		M
RoA1	Config. compressor 1 (on/off) digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
RoA2	Config. compressor 2 (on/off) digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
RoA3	Config. compressor 3 (on/off) digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
Condenser						
cco	Condenser delay off at compressor off	10	0	999	s	M, S
CF0	Proportional gain for condenser control	5	1	200		M, S
CF1	Integral time for condenser control	100	0	999	s	M, S
cfr	Reverse rotation timing (after defrost start)	0	0	999	s	M, S
coo	Condenser valve: prepositioning opening value	50	0	100	%	M
coS	Condenser valve: standby opening value	50	0	100	%	M
cov	Condenser valve: prepositioning duration	6	0	999	s	M
CrS	Temperature selection for condenser control 0 = Cond. Sat. Temp., 1 = Water Out-In temp., 2 = Water out temp., 3 = Water in temp., 4 = Gas cooler outlet temp.	0	0	4		M, S
crv	Enable condenser reverse output, 0 = Disabled, 1 = Enabled	0	0	1		M, S
CTL	Select pressure to temperature conversion type for the condenser pressure probe 0 = Average, 1 = Dew, 2 = Bubble	0	0	2		M, S
CtS	Temperature set point used for condensing control (check CrS)	20 (68)	10 (50)	55 (131)	°C (°F)	M, S
FCH	Modulating condenser: max. output value	100	FCL	100	%	M
FCL	Modulating condenser: min. output value	0	0	FCH	%	M
Connectivity						
bte	Bluetooth mode, 0 = Always off, 1 = Always on, 2 = Turned on by command (btc)	1	0	2		M
bto	Bluetooth activation time	60	1	999	min	M
eet	Enable Main Secondary network on Ethernet, 0 = Disabled, 1 = Enabled	0	0	1		M
H0	BMS1 address	194	1	247		M, S
H1	BMS1 configuration (Stop bits and parity): 0 = 1 stop bit-no parity, 1 = 2 stop bits-no parity, 2 = 1 stop bit-even parity, 3 = 2 stop bits-even parity, 4 = 1 stop bit-odd parity, 5 = 2 stop bits-odd parity	1	0	5		M, S
H17	BMS2 address	194	1	247		M, S
H18	BMS2 configuration (Stop bits and parity): 0 = 1 stop bit-no parity, 1 = 2 stop bits-no parity, 2 = 1 stop bit-even parity, 3 = 2 stop bits-even parity, 4 = 1 stop bit-odd parity, 5 = 2 stop bits-odd parity	1	0	5		M, S
H19	BMS2 baudrate: 0 = 1200, 1 = 2400, 2 = 4800, 3 = 9600, 4 = 19200, 5 = 38400, 6 = 57600, 7 = 115200, 8 = 375000	4	0	8		M, S

Name	Description EN	Def.	Min	Max	UOM	Profiles
H2	BMS1 baudrate: 0 = 1200, 1 = 2400, 2 = 4800, 3 = 9600, 4 = 19200	4	0	4		M, S
H4	FieldBus port baudrate (bit/s) 0 = 1200, 1 = 2400, 2 = 4800, 3 = 9600, 4 = 19200, 5 = 38400, 6 = 57600, 7 = 115200, 8 = 375000	4	0	8		M, S
H5	NFC management, 0 = Disabled, 1 = Enabled	1	0	1		M, S
in	Type of unit, 0 = Secondary, 1 = Main	1	0	1		M
PDM	Manufacturer password	44'				M
PDS	Service password	22'				M, S
PDU	User password	0'				M, S, U
Sn	Number of configured secondary devices	0	0	5		M

Control

/4	Virtual probe composition 0 = Air off (Sm) 100 = Air on (Sr)	0	0	100	%	M, S, U
cdt	PID control derivative time	0	0	999	s	M, S
CLHt	Force lights off during showcase cleaning, 0 = No, 1 = Yes	0	0	1		M, S
CLnE	Enable network showcase cleaning, 0 = Disabled, 1 = Enabled	1	0	1		M, S, U
ClT	Max time for clean status	0	0	999	min	M
Cod	Control cut-off delay	30	0	900	min	M
CoF	Control cut-off offset	3 (5.4)	0 (0)	99 (178.2)	°C (°F)	M
cPr	PID control proportional term	10	1	200		M, S
cti	PID control integral time	500	0	999	s	M
DMo_Hour	Dual mode: time before defrost event in which the offset is applied to the set point	0	0	20	h	M
DMo_SH	SH set point offset for dual mode T+SH algorithm	0	-15	15		M
DMo_St	Set point offset for dual mode T+SH algorithm	0	-10	10		M
H14	Time light stays on after closing the door	0	0	240	min	M, S
oN	Unit On/Off from keypad, 0 = Off, 1 = On	0	0	1		M, S, U
oNK	Enable unit On/Off from keypad, 0 = Disabled, 1 = Enabled	1	0	1		M
oNS	Enable unit On/Off from supervisor, 0 = Disabled, 1 = Enabled	1	0	1		M
r1	Min temp. set point	-50 (-58)	-50 (-58)	r2	°C (°F)	M
r2	Max temp. set point	50 (122)	r1	50 (122)	°C (°F)	M
r4	Automatic night-time set point variation	0 (0)	-50 (-90)	50 (90)	°C (°F)	M
r6	Probe for night-time control, 0 = Virtual probe Sv, 1 = Air on probe Sr	0	0	1		M
rd	Set point differential	2	0	50		M, S, U
rH6	Minimum output value for modulating anti-sweat heaters	10	0	rH7	%	M, S
rH7	Maximum output value for modulating anti-sweat heaters	100	rH6	100	%	M, S
rH9	Integral time for PI control of anti-sweat heater modulation (0=proportional only)	60	0	999	s	M, S
rHA	Coeff. A for glass temp. probe estimate	2 (3.6)	-20 (-36)	20 (36)	°C (°F)	M
rHb	Coeff. B for glass temp. probe estimate	22	0	100	%	M
rHC	Coefficient C for glass temperature probe estimate	80	0	100	%	M, S
rHd	Differential for anti-sweat heater mod.	0 (0)	0 (0)	20 (36)	°C (°F)	M
rHE	Hysteresis for anti-sweat heater modulation	1 (1.8)	0 (0)	10 (18)	°C (°F)	M, S
rHF	Cut-off for anti-sweat heater modulation	10 (18)	0 (0)	20 (36)	°C (°F)	M
rHo	Off set for anti-sweat heater mod.	2 (3.6)	-20 (-36)	20 (36)	°C (°F)	M
rHt	Manual anti-sweat heater activation period 0 = disabled	30	10	180	min	M
rHu	Manual anti-sweat heater activation percentage (of period rHt) 0 = disabled	70	0	100	%	M
ro	Control offset with probe error	5 (9)	0 (0)	20 (36)	°C (°F)	M
sbc	Subcooling value set by the user used for EER calculation	3 (5.4)	0 (0)	10 (18)	°C (°F)	M, S
St	Temp. control set point	50 (122)	r1	r2	°C (°F)	M, S, U

Day/Night

dLo	Force lights on with door open, 0 = No, 1 = Yes	0	0	1		M, S
LHN	Enable lights off at night, 0 = Disabled, 1 = Enabled	1	0	1		M, S
tE1-d	End time band 1 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tE1-time	Day/Night end time band 1 (hh:mm)	00:00:00				M, S, U
tE2-d	End time band 2 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tE2-time	Day/Night end time band 2 (hh:mm)	00:00:00				M, S, U
tE3-d	End time band 3 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tE3-time	Day/Night end time band 3 (hh:mm)	00:00:00				M, S, U
tE4-d	End time band 4 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tE4-time	Day/Night end time band 4 (hh:mm)	00:00:00				M, S, U
tE5-d	End time band 5 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tE5-time	Day/Night end time band 5 (hh:mm)	00:00:00				M, S, U
tE6-d	End time band 6 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tE6-time	Day/Night end time band 6 (hh:mm)	00:00:00				M, S, U
tE7-d	End time band 7 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tE7-time	Day/Night end time band 7 (hh:mm)	00:00:00				M, S, U
tE8-d	End time band 8 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tE8-time	Day/Night end time band 8 (hh:mm)	00:00:00				M, S, U

Name	Description EN	Def.	Min	Max	UOM	Profiles
tS1-d	Start time band 1 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tS1-time	Day/Night start time band 1 (hh:mm)	00:00:00				M, S, U
tS2-d	Start time band 2 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tS2-time	Day/Night start time band 2 (hh:mm)	00:00:00				M, S, U
tS3-d	Start time band 3 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tS3-time	Day/Night start time band 3 (hh:mm)	00:00:00				M, S, U
tS4-d	Start time band 4 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tS4-time	Day/Night start time band 4 (hh:mm)	00:00:00				M, S, U
tS5-d	Start time band 5 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tS5-time	Day/Night start time band 5 (hh:mm)	00:00:00				M, S, U
tS6-d	Start time band 6 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tS6-time	Day/Night start time band 6 (hh:mm)	00:00:00				M, S, U
tS7-d	Start time band 7 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tS7-time	Day/Night start time band 7 (hh:mm)	00:00:00				M, S, U
tS8-d	Start time band 8 - day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
tS8-time	Day/Night start time band 8 (hh:mm)	00:00:00				M, S, U
Defrost						
d0	Type of defrost: 0 = heater by temp., 1 = hot gas by temp., 2 = heater by time, 3 = hot gas by time, 4 = heater by time with temp. control	0	0	4		M, S
d10	Defrost time in Running time mode: 0 = function disabled	0	0	240	min	M, S
d11	Defrost temperature threshold in running time mode	-30 (-22)	-50 (-58)	50 (122)	°C (°F)	M, S
d13	Probe used for running time defrost, 0 = Defrost temperature, 1 = Saturated evaporation temperature, 2 = Saturated suction temperature	0	0	2		M, S
d14	Delay after unit start-up before allowing running time defrost procedure	30	0	480	min	M, S
d15	Number of daily defrosts (td1) 0 = Disabled, 4 = 6 h 0 min, 8 = 3 h 0 min, 12 = 2 h 0 min, 1 = 24 h 0 min, 5 = 4 h 48 min, 9 = 2 h 40 min, 13 = 1 h 0 min, 2 = 12 h 0 min, 6 = 4 h 0 min, 10 = 2 h 24 min, 14 = 30 min 3 = 8 h 0 min, 7 = 3 h 26 min, 11 = 2 h 11 min,	0	0	14		M, S
d2	End defrost synchronised by Main, 0 = Not synchronised, 1 = Synchronised	1	0	1		M, S
d25	Number of daily defrosts (td2) 0 = Disabled, 4 = 6 h 0 min, 8 = 3 h 0 min, 12 = 2 h 0 min, 1 = 24 h 0 min, 5 = 4 h 48 min, 9 = 2 h 40 min, 13 = 1 h 0 min, 2 = 12 h 0 min, 6 = 4 h 0 min, 10 = 2 h 24 min, 14 = 30 min 3 = 8 h 0 min, 7 = 3 h 26 min, 11 = 2 h 11 min,	0	0	14		M, S
d3	Disable send network defrost control (for Main), 0 = Enabled, 1 = Disabled	0	0	1		M
d4	Defrost at power-on, 0 = Disabled, 1 = Enabled	0	0	1		M, S
d5	Defrost delay on power-up or (for Secondary) after control from Main 0 = delay disabled	0	0	240	min	M, S
d6	Display on terminals during defrost, 0 = Temperature alternating with dEF, 1 = Freeze display, 2 = dEF	1	0	2		M, S
d7	Skip defrost, 0 = Disabled, 1 = Enabled	0	0	1		M, S
d8	Bypass high temp. alarm time after defrost	30	1	240	min	M, S
d9	Defrost priority over comp. protection times, 0 = Protection times observed, 1 = Protection times not observed	0	0	1		M, S
dd	Dripping time after defrost (fans off) 0 = no dripping	2	0	15	min	M, S
ddn	Defrost type in night mode, 0 = Normal defrost, 1 = Power defrost	1	0	1		M, S
ddP	Additional maximum defrost time delta in Power defrost mode	0	0	60	min	M, S
ddt	Additional end defrost temperature delta in Power defrost mode	0 (0)	-20 (-36)	20 (36)	°C (°F)	M, S
dEP	Select smart defrost end probe (0: function disabled) 0 = Not config., 9 = Ambient temp. (SA), 18 = Flash tank pressure (SFP) 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (SCT), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Saturated evap. pressure (PEu), 14 = Discharge pressure (Scp), 23 = Virtual probe (Sv), 6 = Reserved, 15 = Suction pressure (SSp), 24 = Saturated suction temp. (TSP) 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (SOT),	0	0	24		M
dET	Smart defrost end threshold	50	-99.9	99.9		M, S
di	Max interval between consecutive defrosts	8	0	240	h	M, S, U
dn	Nominal Skip defrost duration	75	0	100	%	M, S
do	Number of defrost cycles to perform at start-up before activating Skip Defrost function	7	1	9		M
dP0	Minimum defrost duration	0	0	dP1	min	M, S
dP1	Max defrost duration	45	1	240	min	M, S, U
dS1	Compressor off time in Sequential stop defrost mode 0 = function disabled	0	0	45	min	M
dS2	Compressor operating time in Sequential stop defrost mode	180	0	240	min	M
dSa	Valve position during hot gas defrost call (0 = valve positioned as defined for the type of defrost selected, 1 = valve forced closed, 2 - 100 = opening percentage)	0	0	100	%	M, S
dSb	Valve pos. during defrost: 0: valve positioned as defined by the type of defrost selected 1: valve forced closed 2 - 100: opening perc.	0	0	100	%	M, S

Name	Description EN	Def.	Min	Max	UOM	Profiles
dSc	Valve position during check end defrost with MOP alarm. (0 = valve positioned as defined for the type of defrost selected, 1 = valve forced closed, 2 - 100 = opening percentage)	0	0	100	%	M, S
dt1	End defrost temp. (read by Sd)	8 (46.4)	-50 (-58)	50 (122)	°C (°F)	M, S, U
Fd	Post dripping time after defrost (fans off with control active)	1	0	15	min	M
Fpd	Evap. fan post dripping management, 0 = On, 1 = Off	1	0	1		M
IoT_Dfr_DeltaFlex_Max	Max Flex value during defrost (IoT Analysis)	0.5 (32.9)			°C (°F)	M
IoT_Dfr_DeltaFlex_Min	Min Flex value during defrost (IoT Analysis)	-0.5 (31.1)			°C (°F)	M

Defrost scheduling

r3	End defrost signal by timeout, 0 = Disabled, 1 = Enabled	0	0	1		M
td1-d	Defrost 1 - Day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
td1-P	Defrost 1 - Enable power defrost, 0 = Normal defrost, 1 = Power defrost	0	0	1		M, S, U
td1-time	Defrost 1 - Start time (hh:mm)	00:00:00				M, S, U
td2-d	Defrost 2 - Day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
td2-P	Defrost 2 - Enable power defrost, 0 = Normal defrost, 1 = Power defrost	0	0	1		M, S, U
td2-time	Defrost 2 - Start time (hh:mm)	00:00:00				M, S, U
td3-d	Defrost 3 - Day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
td3-P	Defrost 3 - Enable power defrost, 0 = Normal defrost, 1 = Power defrost	0	0	1		M, S, U
td3-time	Defrost 3 - Start time (hh:mm)	00:00:00				M, S, U
td4-d	Defrost 4 - Day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
td4-P	Defrost 4 - Enable power defrost, 0 = Normal defrost, 1 = Power defrost	0	0	1		M, S, U
td4-time	Defrost 4 - Start time (hh:mm)	00:00:00				M, S, U
td5-d	Defrost 5 - Day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
td5-P	Defrost 5 - Enable power defrost, 0 = Normal defrost, 1 = Power defrost	0	0	1		M, S, U
td5-time	Defrost 5 - Start time (hh:mm)	00:00:00				M, S, U
td6-d	Defrost 6 - Day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
td6-P	Defrost 6 - Enable power defrost, 0 = Normal defrost, 1 = Power defrost	0	0	1		M, S, U
td6-time	Defrost 6 - Start time (hh:mm)	00:00:00				M, S, U
td7-d	Defrost 7 - Day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
td7-P	Defrost 7 - Enable power defrost, 0 = Normal defrost, 1 = Power defrost	0	0	1		M, S, U
td7-time	Defrost 7 - Start time (hh:mm)	00:00:00				M, S, U
td8-d	Defrost 8 - Day 0 = Disabled, 3 = Wednesday, 6 = Saturday, 9 = Monday to Saturday, 1 = Monday, 4 = Thursday, 7 = Sunday, 10 = Saturday and Sunday, 2 = Tuesday, 5 = Friday, 8 = Monday to Friday, 11 = Every day	0	0	11		M, S, U
td8-P	Defrost 8 - Enable power defrost, 0 = Normal defrost, 1 = Power defrost	0	0	1		M, S, U
td8-time	Defrost 8 - Start time (hh:mm)	00:00:00				M, S, U

Digital inputs

A9	Select digital input propagated from Main to Secondaries (only on Main) -1 = from supervisor 0 = Disabled 1 = ID1 2 = ID2 3 = ID3 4 = ID4 5 = ID5	0	-1	5		M
DiA	Assign immediate external alarm digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
DiAC	Assign light status digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
Dib	Assign delayed external alarm digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
Dic	Assign enable defrost digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M

Name	Description EN	Def.	Min	Max	UOM	Profiles
Did	Assign start defrost digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
DiF	Assign remote ON/OFF digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
DiG	Assign curtain switch digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
Dii	Assign input status monitoring digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
Din	Assign clean mode switch digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
Dio	Assign working parameter set change digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
Diq	Assign door status digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
Dir	Assign defrost according to DI status digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
Dis	Assign generic function alarm digital input (0 = Function disabled) -1 = Virtual DI 0 = Function disabled 1 = DI1 2 = DI2 3 = DI3 4 = DI4 (check 'ndi') 5 = U1 6 = U2 7 = U3 8 = U4 9 = U5 10 = U6 11 = U7 12 = U8 13 = U9 14 = U10 15 = U11 (check 'wai') 16 = U12 (check 'wai') 17 = U13 (check 'wai') 18 = U14 (check 'wai') 19 = U15 (check 'wai') 20 = U16 (check 'wai')	0	-1	20		M
riA	Config. immediate external alarm digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
riAC	Config. light status switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
rib	Config. delayed external alarm digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
ric	Config. enable defrost digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
rid	Config. start defrost digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
riF	Config. remote ON/OFF digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
riG	Config. curtain switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
rii	Config. input status monitoring digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
rin	Config. clean mode switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
rio	Config. working parameter set change digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
riq	Config. door status switch digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
rir	Config. defrost according to DI status digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M
ris	Config. generic function alarm digital input logic, 0 = Direct, 1 = Reverse	0	0	1		M

Digital outputs

DoA	Assign solenoid/comp. digital output (0 = Function disabled)	0	0	ndo		M
DoAA	Assign hot gas solenoid digital output (0 = Function disabled)	0	0	ndo		M
DoAC	Assign liquid injection digital output (0 = Function disabled)	0	0	ndo		M
DoAE	Assign curtain digital output (0 = Function disabled)	0	0	ndo		M
DoAG	Assign condenser fan reverse rotation (0 = Function disabled)	0	0	ndo		M
Dob	Assign alarm digital output (0 = Function disabled)	0	0	ndo		M
Doc	Assign auxiliary digital output (0 = Function disabled)	0	0	ndo		M
DoE	Assign light digital output (0 = Function disabled)	7	0	ndo		M
DoF	Assign light from main digital output (0 = Function disabled)	0	0	ndo		M
DoG	Assign defrost digital output (0 = Function disabled)	8	0	ndo		M
Doi	Assign evaporator fan digital output (0 = Function disabled)	6	0	ndo		M
DoP	Assign drain heater digital output (0 = Function disabled)	0	0	ndo		M
DoQ	Assign anti-sweat heater digital output (0 = Function disabled)	0	0	ndo		M
DoS	Assign stage generic function digital output (0 = Function disabled)	0	0	ndo		M
Dot	Assign condenser fan digital output (0 = Function disabled)	0	0	ndo		M
H9	Output switched with time bands, 0 = Light, 1 = AUX	0	0	1		M, S
roA	Config. solenoid/comp. digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roAA	Config. hot gas solenoid digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roAC	Config. liquid injection digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roAE	Config. curtain digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roAG	Config. condenser fan reverse rotation logic, 0 = Direct, 1 = Reverse	0	0	1		M
roB	Config. alarm digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roc	Config. auxiliary digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roE	Config. light digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roF	Config. light from main digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roG	Config. defrost digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roi	Config. fan digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M

Name	Description EN	Def.	Min	Max	UOM	Profiles
roP	Config. drain heater digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roQ	Config. anti-sweat heater digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
roS	Config. stage generic function digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M
rot	Config. condenser fan digital output logic, 0 = Direct, 1 = Reverse	0	0	1		M

Display

/5	User interface unit of measure, 0 = °C/barg, 1 = °F/psig	0	0	1		M, S
/6	Display decimal point, 0 = Enabled, 1 = Disabled	0	0	1		M, S
/t	Display signals / alarms on remote display, 0 = No, 1 = Yes	1	0	1		M, S
/t1	Display on user terminal 0 = Not config., 4 = S4 value, 8 = Reserved, 12 = S12 value, 1 = S1 value, 5 = S5 value, 9 = Control probe, 13 = S13 value, 2 = S2 value, 6 = S6 value, 10 = Virtual probe, 14 = S14 value, 3 = S3 value, 7 = Reserved, 11 = S11 value, 15 = Cont. set point	9	0	15		M, S
H6	Enable 7-seg UI keypad, 0 = Disabled, 1 = Enabled	1	0	1		M, S
H8	Terminal buzzer, 0 = Disabled, 1 = Enabled	1	0	1		M

EEV

cP1	Initial valve position when control starts	30	0	100	%	M, S
cP2	EEV control start delay	30	0	300	s	M, S
Et	Maximum EVD pre-opening time to equalise pressure (0 = equalisation disabled)	90	0	999	s	M, S
P1	Electronic valve, 0 = Not present, 1 = Driver OnBoard	1	0	1		M
P10	Enable unit power off for low superheat (LowSH) and/or low suction temperature (LSA) 0 = Disabled, 1 = Enabled	1	0	1		M, S
P11	LSA: low suction temp. threshold	-35 (-31)	-50 (-58)	30 (86)	°C (°F)	M, S
P12	LSA: alarm delay 0 = alarm disabled	120	0	300	s	M
P13	Low suction temperature differential	1 (1.8)	0 (0)	50 (90)	°C (°F)	M, S
P14	Enable valve alarm at end travel (blo), 0 = Disabled, 1 = Enabled	0	0	1		M
P16	Enable SH evap. optimisation, 0 = Disabled, 1 = Enabled	0	0	1		M, S
P17	Minimum value for SH evap. optimisation	4 (7.2)	0 (0)	P3	°C (°F)	M, S
P19	Maximum gap to verify stability for SH evap. optimisation	0.5 (0.9)	0 (0)	50 (90)	°C (°F)	M, S
P20	Pause time after change in value for SH evap. optimisation	60	0	9999	s	M, S
P21	Stability time for SH evap. optimisation	60	0	9999	s	M, S
P22	Instability time for SH evap. optimisation	180	0	9999	s	M, S
P23	Maximum control request timeout for SH evap. optimisation	300	0	9999	s	M, S
P24	Control request maximum limit for SH evap. optimisation reset	95	0	100	%	M, S
P25	Select probes for SH calculation 0 = Suction probes, 1 = Evaporation probes, 2 = Suction press. probe and Evaporation temp. probe, 3 = Automat-	3	0	3		M
P3	SH set point	7 (12.6)	0 (0)	30 (54)	°C (°F)	M, S, U
P4	Proportional gain for SH control	20	0	100		M
P5	Integral time for SH control 0 = function disabled	400	0	999	s	M
P6	Derivative time for SH control 0 = disabled	5	0	100	s	M
P7	LowSH: low SH threshold	2 (3.6)	0 (0)	30 (54)	°C (°F)	M, S
P8	LowSH: integral time 0 = disabled	10	0	999	s	M
P9	LowSH: alarm delay 0 = alarm disabled	120	0	300	s	M
Pa	High SH threshold	20 (68)	0 (32)	50 (122)	°C (°F)	M, S
Pb	High SH alarm delay	600	0	999	s	M, S
PE2	Evaporator capacity	500 (0)	0 (0)	15000 (20)	W (HP)	M
PE5	Multi-evaporator superheat control proportional gain	1	1	99.9		M
PE6	Multi-evaporator superheat control integral time	120	0	999	s	M
PE7	Multi-evaporator superheat control offset	3 (5.4)	0 (0)	20 (36)	°C (°F)	M
PEA	Change unit delay in SuperHeat mode	80	0	999	s	M
PEB	Modulating superheat mode, 0 = BEST, 1 = ALL EVAP.	1	0	1		M
PES	Enable modulating SH set point function, 0 = OFF, 1 = ON	1	0	1		M
PH	Type of refrigerant 0 = R22 6 = R290 12 = R1270 18 = R407A 24 = HTR02 30 = R442A 36 = R508B 1 = R134a 7 = R600 13 = R417A 19 = R427A 25 = R23 31 = R447A 37 = R452B 2 = R404A 8 = R600a 14 = R422D 20 = R245Fa 26 = HFO1234yf 32 = R448A 38 = R513A 3 = R407C 9 = R717 15 = R413A 21 = R407F 27 = HFO1234ze 33 = R449A 39 = R454B 4 = R410A 10 = R744 16 = R422A 22 = R32 28 = R455A 34 = R450A 40 = R458A 5 = R507A 11 = R728 17 = R423A 23 = HTR01 29 = R170 35 = R452A	10	0	40		M
PL1	LOP: minimum saturated operating temperature threshold	-38 (-36.4)	-50 (-58)	PM1	°C (°F)	M, S
PL2	LOP: integral time	10	0	999	s	M, S
PL3	LOP: alarm delay 0 = function disabled	250	0	300	s	M, S
PM1	MOP: maximum saturated operating temperature threshold	15 (59)	PL1	30 (86)	°C (°F)	M, S
PM2	MOP: integral time	20	0	999	s	M
PM3	MOP: alarm delay 0 = function disabled	240	0	300	s	M
PM6	MOP: max suction temp threshold used to stop MOP due to possible compressor overheating with reduced refrigerant flow	25 (77)	-50 (-58)	50 (122)	°C (°F)	M, S
PML	MOP - LOP: Threshold and alarm delay mode, 0 = Auto, 1 = Manual	0	0	1		M
PSb	Valve opening during standby	10	0	100	%	M, S
SEP	Electronic valve: pre-opening value for pressure equalisation	40	0	100	%	M

Evaporator

dFo	Evaporator fan speed with door open	-1	-1	100	%	M, S
F0	Evap. fan management, 0 = Always ON, 1 = Sa-Sb, 2 = Sa	0	0	2		M, S, U
F1	Evap. fan activation threshold (only if F 0 = 1 or 2)	-5 (23)	-50 (-58)	50 (122)	°C (°F)	M, S, U
F10	Evap. fan override time at max speed 0 = function disabled	0	0	240	min	M, S
F2	Evap. fans with comp. off, 0 = See F0, 1 = Always off	0	0	1		M, S, U
F26	Evaporator fans off time during curtain closing	60	0	999	s	M, S
F27	Evaporator fans off time during curtain opening	0	0	999	s	M, S
F3	Evap. fans during defrost, 0 = On, 1 = Off	0	0	1		M, S
F5	Evap. fan cut-off temperature (hyst. 1°C) (including variable speed)	50 (90)	F1	50 (90)	°C (°F)	M, S
F6	Maximum evaporator fan speed	80	F7	100	%	M, S
F7	Minimum evaporator fan speed	10	0	F6	%	M, S
F8	Evap. fan peak time 0 = function disabled	10	0	240	s	M, S
Frd	Evaporator fan activation differential (including variable speed)	2 (3.6)	0.1 (0.1)	20 (36)	°C (°F)	M, S

Name	Description EN	Def.	Min	Max	UOM	Profiles
F5a	First control probe for evaporator fan (0 = Not config.) 0 = Not config., 9 = Ambient temp. (SA), 18 = Flash tank pressure (SFP) 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (Sct), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Saturated evap. pressure (PEu), 14 = Discharge pressure (Scp), 23 = Virtual probe (Sv), 6 = Reserved, 15 = Suction pressure (SSp), 24 = Saturated suction temp. (TSP) 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (Sot),	2	0	24		M, S
F5b	Second control probe for evaporator fan (0 = Not config.) 0 = Not config., 9 = Ambient temp. (SA), 18 = Flash tank pressure (SFP) 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (Sct), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Saturated evap. pressure (PEu), 14 = Discharge pressure (Scp), 23 = Virtual probe (Sv), 6 = Reserved, 15 = Suction pressure (SSp), 24 = Saturated suction temp. (TSP) 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (Sot),	22	0	24		M, S
PTL	Select pressure to temperature conversion type for the suction pressure probe 0 = Average, 1 = Dew, 2 = Bubble	1	0	2		M, S

Functions manual control

MT	Maximum time before exiting manual mode (0 = no timeout)	240	0	999	min	M
----	--	-----	---	-----	-----	---

Generic functions

GFA_1	Generic alarm function: control probe 1 (0 = Not config.) 0 = Not config., 9 = Ambient temp. (SA), 18 = Flash tank pressure (SFP) 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (Sct), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Saturated evap. pressure (PEu), 14 = Discharge pressure (Scp), 23 = Virtual probe (Sv), 6 = Reserved, 15 = Suction pressure (SSp), 24 = Saturated suction temp. (TSP) 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (Sot),	0	0	24		M
GFA_2	Generic alarm function: control probe 2 (0 = Not config.) 0 = Not config., 9 = Ambient temp. (SA), 18 = Flash tank pressure (SFP) 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (Sct), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Saturated evap. pressure (PEu), 14 = Discharge pressure (Scp), 23 = Virtual probe (Sv), 6 = Reserved, 15 = Suction pressure (SSp), 24 = Saturated suction temp. (TSP) 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (Sot),	0	0	24		M
GFA_AType	Generic alarm function: type, 0 = Normal, 1 = Serious	0	0	1		M
GFA_D	Generic alarm function: differential	0	0	99.9		M
GFA_De	Generic alarm function: delay	0	0	30000	s	M
GFA_E	Generic alarm function: enable, 0 = Always, 1 = Unit on, 2 = Unit off, 3 = Defrost, 4 = Clean, 5 = Duty settings, 6 = Temp. control, 7 = Door open, 8 = Active alarm	0	0	8		M
GFA_HTh	Generic alarm function: high threshold	0	-50	200		M
GFA_LTh	Generic alarm function: low threshold	0	-50	200		M
GFM_1	Generic modulating function: control value 1 (0 = Not config.) 0 = Not config., 9 = Ambient temp. (SA), 18 = Flash tank pressure (SFP) 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (Sct), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Saturated evap. pressure (PEu), 14 = Discharge pressure (Scp), 23 = Virtual probe (Sv), 6 = Reserved, 15 = Suction pressure (SSp), 24 = Saturated suction temp. (TSP) 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (Sot),	0	0	24		M
GFM_2	Generic modulating function: control value 2 (0 = Not config.) 0 = Not config., 9 = Ambient temp. (SA), 18 = Flash tank pressure (SFP) 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (Sct), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Saturated evap. pressure (PEu), 14 = Discharge pressure (Scp), 23 = Virtual probe (Sv), 6 = Reserved, 15 = Suction pressure (SSp), 24 = Saturated suction temp. (TSP) 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (Sot),	0	0	24		M
GFM_CD	Generic modulating function: cut-off differential	0	0	20		M
GFM_D	Generic modulating function: differential	0	0	99.9		M
GFM_E	Generic modulating function: enable, 0 = Always, 1 = Unit on, 2 = Unit off, 3 = Defrost, 4 = Clean, 5 = Duty settings, 6 = Temp. control, 7 = Door open, 8 = Active alarm	0	0	8		M
GFM_H	Generic modulating function: hysteresis	0	0	20		M
GFM_kp	Generic modulating function: proportional gain	0	0	100		M, S
GFM_Max	Generic modulating function: maximum output value	0	0	100		M
GFM_Min	Generic modulating function: minimum output value	0	0	100		M
GFM_S	Generic modulating function: set point	0	-50	200		M
GFM_T	Generic modulating function: type, 0 = Direct, 1 = Reverse	0	0	1		M
GFM_Td	Generic modulating function: derivative time	0	0	100		M, S
GFM_Ti	Generic modulating function: integral time	0	0	900		M, S
GFS_1	Generic On/Off function: control probe 1 (0 = Not config.) 0 = Not config., 9 = Ambient temp. (SA), 18 = Flash tank pressure (SFP) 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (Sct), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Saturated evap. pressure (PEu), 14 = Discharge pressure (Scp), 23 = Virtual probe (Sv), 6 = Reserved, 15 = Suction pressure (SSp), 24 = Saturated suction temp. (TSP) 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (Sot),	0	0	24		M

Name	Description EN	Def.	Min	Max	UOM	Profiles
GFS_2	Generic On/Off function: control probe 2 (0 = Not config.) 0 = Not config., 9 = Ambient temp. (SA), 18 = Flash tank pressure (SFP) 1 = Air off (Sm), 10 = Ambient humidity (SU), 19 = Gas cooler outlet temp. (SCT), 2 = Defrost (Sd), 11 = Glass temp. (Svt), 20 = Water inlet temp. (SWI), 3 = Air on (Sr), 12 = Dewpoint (SdP), 21 = Water outlet temp. (SWO), 4 = Superheated gas (tGS), 13 = Discharge temp. (Sdt), 22 = Liquid temp. (Liq), 5 = Saturated evap. pressure (PEu), 14 = Discharge pressure (Scp), 23 = Virtual probe (Sv), 6 = Reserved, 15 = Suction pressure (SSp), 24 = Saturated suction temp. (TSP) 7 = Auxiliary 1 (Saux1), 16 = Evaporator temp. (SEr), 8 = Auxiliary 2 (Saux2), 17 = Box outlet temp. (SOT),	0	0	24		M
GFS_D	Generic On/Off function: differential	0	0	99.9		M
GFS_E	Generic On/Off function: enable, 0 = Always, 1 = Unit on, 2 = Unit off, 3 = Defrost, 4 = Clean, 5 = Duty settings, 6 = Temp. control, 7 = Door open, 8 = Active alarm	0	0	8		M
GFS_S	Generic On/Off function: set point	0	-50	200		M
GFS_T	Generic On/Off function: type, 0 = Direct, 1 = Reverse	0	0	1		M

Inverter

PMi	Request to install inverter defaults (uMotor), 0 = No, 1 = Yes	0	0	1		M
-----	--	---	---	---	--	---

IoT analysis

ENA	Anti-sweat heaters nominal power	0 (0)	0 (0)	10000 (13)	W (HP)	M
ENb1	Compressor 1 (on/off) nominal power	0 (0)	0 (0)	10000 (13)	W (HP)	M
ENb2	Compressor 2 (on/off) nominal power	0 (0)	0 (0)	10000 (13)	W (HP)	M
ENb3	Compressor 3 (on/off) nominal power	0 (0)	0 (0)	10000 (13)	W (HP)	M
ENd	Defrost heaters nominal power	0 (0)	0 (0)	10000 (13)	W (HP)	M
ENF	Evaporator fans nominal power	0 (0)	0 (0)	10000 (13)	W (HP)	M
ENi	Lights nominal power	0 (0)	0 (0)	10000 (13)	W (HP)	M

Liquid injection

LiC	Liquid injection duty cycle	100	0	100	%	M
Lid	Liquid injection off differential	5 (9)	0.1 (0.1)	20 (36)	°C (°F)	M
Lii	Liquid injection EEV integral time	100	1	999	s	M
LiP	Liquid injection EEV proportional gain	5	1	200		M
LiS	Liquid injection duty cycle time	30	0	60	s	M
Lit	Liquid injection temperature threshold	95 (203)	50 (122)	150 (302)	°C (°F)	M
LiV	Liquid injection valve type, 0 = EEV, 1 = Solenoid	0	0	1		M

Oil management

ciP	Enable oil recovery function, 0 = Disabled, 1 = Enabled	0	0	1		M
cir	Oil recovery time before activation	15	0	480	min	M
ciS	Oil recovery compressor speed override duration	3	0	10	min	M
ciu	Oil recovery min compressor speed for activation	35	cse	cse	rps	M
civ	Oil recovery compressor override speed	80	cse	cse	rps	M
co1	Enable evaporator washing function, 0 = Disabled, 1 = Enabled	0	0	1		M
co10	Close valve when evaporator is not washing, during evaporator washing mode, 0 = No, 1 = Yes	0	0	1		M
co2	Evaporator washing compressor speed mode, 0 = Proportional, 1 = Normal control	1	0	1		M
co3	Evaporator washing activation mode, 0 = Compressor speed, 1 = Every N hours, 2 = SH control	0	0	2		M
co4	Delay for evaporator washing activation	2	0	999	h	M
co7	Valve opening for prepositioning during evaporator washing	80	0	100	%	M
co8	SH set point offset during evaporator washing	4 (7.2)	0 (0)	20 (36)	°C (°F)	M
cos1	Evaporator washing - evaporator 1 maximum SH for activation	20	0	30		M
cos2	Evaporator washing - evaporator 2 maximum SH for activation	20	0	30		M
cos3	Evaporator washing - evaporator 3 maximum SH for activation	20	0	30		M
cos4	Evaporator washing - evaporator 4 maximum SH for activation	20	0	30		M
cos5	Evaporator washing - evaporator 5 maximum SH for activation	20	0	30		M
cos6	Evaporator washing - evaporator 6 maximum SH for activation	20	0	30		M
cot1	Evaporator washing duration, evaporator 1	70	1	999	s	M
cot2	Evaporator washing duration, evaporator 2	70	1	999	s	M
cot3	Evaporator washing duration, evaporator 3	70	1	999	s	M
cot4	Evaporator washing duration, evaporator 4	70	1	999	s	M
cot5	Evaporator washing duration, evaporator 5	70	1	999	s	M
cot6	Evaporator washing duration, evaporator 6	70	1	999	s	M

Transcritical (R-744 only)

cd1	Safety HP - High dead band	4 (58.0)	0 (0)	10 (145.0)	bar (psi)	M
cd2	Safety HP - Low dead band	2 (29.0)	0 (0)	10 (145.0)	bar (psi)	M
cd3	Safety HP - High differential	5 (72.5)	0 (0)	10 (145.0)	bar (psi)	M
cd4	Safety HP - Low differential	5 (72.5)	0 (0)	10 (145.0)	bar (psi)	M
cd5	Safety SH - Decreasing offset	0 (0)	0 (0)	50 (90)	°C (°F)	M
cd6	Safety SH - Increasing offset	0 (0)	0 (0)	50 (90)	°C (°F)	M
cd7	Safety SH - High dead band	10 (18)	0 (0)	50 (90)	°C (°F)	M
cd8	Safety SH - Low dead band	3 (5.4)	0 (0)	50 (90)	°C (°F)	M
cd9	Safety SH - High differential	5 (9)	0 (0)	50 (90)	°C (°F)	M
cda	Safety SH - Low differential	4 (7.2)	0 (0)	50 (90)	°C (°F)	M
cdb	Safety HP - Decreasing offset	3 (43.5)	0 (0)	10 (145.0)	bar (psi)	M
cdc	Safety HP - Increasing offset	5 (72.5)	0 (0)	10 (145.0)	bar (psi)	M
cdg	HPV control - Maximum pressure	110 (1595.4)	80 (1160.3)	200 (2900.7)	bar (psi)	M
cdh	Enable HP control during startup, 0 = Disabled, 1 = Enabled	0	0	1		M
cdi	HPV Control - T23	20 (68)	0 (32)	999.9 (1831.8)	°C (°F)	M
cdj	HPV Control - T12	31 (87.8)	0 (32)	999.9 (1831.8)	°C (°F)	M
cdk	Safety HP - Control duration at startup (after min. ON time)	5	0	99	min	M
cdn	HPV control - integral time	60	0	999	s	M
cdo	HPV control - subcooling delta	5 (9)	0 (0)	99.9 (179.8)	°C (°F)	M
cdP	HPV control - proportional gain	5	0	500		M
cdq	HPV control - critical pressure	82 (1189.3)	60 (870.2)	cdq	bar (psi)	M
cdr	EEV main control, 0 = SH, 1 = HP	0	0	1		M
cdV	HPV control - optimal pressure calculation mode, 0 = Automatic, 1 = Manual	0	0	1		M
cdx	HPV control - coefficient 1	2.5	0	10		M
cdy	HPV control - derivative time	0	0	999	s	M
cdz	HPV control - Pmin lim	0 (32)	-99.9 (-147.8)	99.9 (211.8)	°C (°F)	M
cfg	Model configuration					M, S, U

Tab. 6.a

7. ALARMS AND SIGNALS

7.1 Alarm management

7.1.1 Types of alarms

There are three types of alarms:

- **Warning:** Signal only These do not alter the behaviour of the unit and are not shown in rotation on the controller's display.
- **Normal:** Signal only These do not alter the behaviour of the unit, and are shown in rotation on the controller's display.
- **Serious:** These activate the compressor shutdown ramp and switch the unit OFF. The alarm will be shown in rotation on the controller's display.
- **Immediate and serious:** These stop the compressor immediately without the ramp and switch the unit OFF. The alarm will be shown in rotation on the controller's display.

7.1.2 Active alarms

Active alarms are signalled by the buzzer and the flashing of the ALARM button. Pressing ALARM will mute the buzzer and display the alarm code. Alarm activation is recorded in the alarm log. If the alarm is reset automatically, the ALARM button goes off, the alarm code is cleared from the list and the alarm reset event is recorded in the alarm log.

Alarm acknowledgement procedure:

3. press ALARM: the buzzer is muted, the alarm code is shown on the display;
4. press UP/DOWN to scroll through the list of alarms;
5. when finished, press ESC and then PRG to exit.

Alarm reset procedure:

A single alarm can be reset by pressing ALARM on the controller's display for more than 3 s. If the condition that generated the alarm is still present, the alarm will be reactivated.

7.1.3 Alarm log

When alarms are activated, the alarm code is shown on the display and at the same time the alarm icon (triangle) flashes and the buzzer is activated. If more than one error occurs, these are displayed in sequence. A maximum of 10 errors can be saved, in a FIFO list. The alarm log can be displayed via the supervisor, the APPLICA app with Bluetooth connection or on the user interface.

Procedure:

1. press PRG until displaying: "PSD";
2. enter the Password 33;
3. press UP/DOWN until reaching the ALM category; confirm by pressing PRG;
4. press UP/DOWN until displaying "HSt": a submenu is opened, where the UP and DOWN buttons can be used to scroll through the alarms, from HS0 to HS9;
5. select an alarm by pressing PRG and display the code, date, time, minutes and duration (if reset)
6. press ESC one or more times to return to the standard display.

Example:

"Hl" -> "y18" -> "m11" -> "d20" -> "h17" -> "m23" -> "65"

indicates that "Hl" (high temperature alarm) occurred on 20/11/2018 at 17:23 and lasted 65 minutes.

The alarm log can be deleted via APPLICA on a smartphone, with BLE connection, using the specific function on the alarm page ("Service" level access is required).



Notice:

- deletion of the alarm log is irreversible.
- a maximum of 32 alarms can be logged; once this limit is exceeded, any new events overwrite the oldest, which are then deleted.

7.1.4 Resetting the alarms

Alarms can be reset manually or automatically:

- **Manual:** the alarm is reset by pressing the ALARM button twice; the first time displays the corresponding alarm screen and mutes the buzzer, the second (pressed and held for at least 3 seconds) deletes the alarm (which is saved in the log). If the alarm is still active, it is not reset and the signal is shown again.
- **Automatic:** when the condition that caused the alarm ceases, the alarm is automatically reset, the LED comes on steady and the corresponding screen remains displayed until the ALARM button is pressed and held; the alarm is saved in the log.

For manual reset, the functions associated with the alarm will not be reactivated until the alarm is reset, while for automatic reset, the functions are reactivated as soon as the condition that caused the alarm ceases. See paragraph 7.5 for the list of alarms with automatic/manual reset.

7.2 Alarm parameters

The controller has specific alarms for each device managed:

- Showcase temperature alarms
- Compressor alarms
- Valve and refrigerant charge alarms

7.2.1 Showcase temperature

Probes used for temperature alarms

The high and low temperature alarms can be associated with two different probes (parameters Aa, Aa2).

Aa selects the probe to be used for measuring high and low temperature alarms with reference to the thresholds AL and AH, while Aa2 is used to select an additional probe with relative thresholds AL2 and AH2.

Code	Description	UOM																											
AA	Assign probe for high (AH) and low (AL) temperature alarms	-																											
	<table border="1"> <tr> <td>0: Not configured</td><td>8: Auxiliary 2 (Saux2)</td><td>16: Evaporator temp. (SEr)</td></tr> <tr> <td>1: Outlet (Sm)</td><td>9: Ambient (SA)</td><td>17: Box outlet temp. (Sot)</td></tr> <tr> <td>2: Defrost (Sd)</td><td>10: Ambient humidity</td><td>18: Reserved</td></tr> <tr> <td>3: Intake (Sr)</td><td>11: Glass temperature (Svt)</td><td>19: Gas cooler outlet temp. (SCt)</td></tr> <tr> <td>4: Superheated gas (tGS)</td><td>12: Dew point (SdP)</td><td>20: Water inlet temp. (SWI)</td></tr> <tr> <td>5: Reserved</td><td>13: Virtual probe (Sv)</td><td>21: Water outlet temp. (SWO)</td></tr> <tr> <td>6: Reserved</td><td>14: Saturated evaporation temperature (tEu)</td><td>22: Liquid temp. (Liq)</td></tr> <tr> <td>7: Auxiliary 1 (Saux1)</td><td>15: Reserved</td><td>23: Virtual probe (Sv)</td></tr> <tr> <td></td><td></td><td>24: Saturated suction temp. (TSP)</td></tr> </table>	0: Not configured	8: Auxiliary 2 (Saux2)	16: Evaporator temp. (SEr)	1: Outlet (Sm)	9: Ambient (SA)	17: Box outlet temp. (Sot)	2: Defrost (Sd)	10: Ambient humidity	18: Reserved	3: Intake (Sr)	11: Glass temperature (Svt)	19: Gas cooler outlet temp. (SCt)	4: Superheated gas (tGS)	12: Dew point (SdP)	20: Water inlet temp. (SWI)	5: Reserved	13: Virtual probe (Sv)	21: Water outlet temp. (SWO)	6: Reserved	14: Saturated evaporation temperature (tEu)	22: Liquid temp. (Liq)	7: Auxiliary 1 (Saux1)	15: Reserved	23: Virtual probe (Sv)			24: Saturated suction temp. (TSP)	
0: Not configured	8: Auxiliary 2 (Saux2)	16: Evaporator temp. (SEr)																											
1: Outlet (Sm)	9: Ambient (SA)	17: Box outlet temp. (Sot)																											
2: Defrost (Sd)	10: Ambient humidity	18: Reserved																											
3: Intake (Sr)	11: Glass temperature (Svt)	19: Gas cooler outlet temp. (SCt)																											
4: Superheated gas (tGS)	12: Dew point (SdP)	20: Water inlet temp. (SWI)																											
5: Reserved	13: Virtual probe (Sv)	21: Water outlet temp. (SWO)																											
6: Reserved	14: Saturated evaporation temperature (tEu)	22: Liquid temp. (Liq)																											
7: Auxiliary 1 (Saux1)	15: Reserved	23: Virtual probe (Sv)																											
		24: Saturated suction temp. (TSP)																											
AA2	Assign probe for high (AH2) and low (AL2) temperature alarms see AA	-																											

Low and high temperature alarms

- **Low:** AL (AH) determines the activation threshold for the low (high) temperature alarm LO (HI). The set value of AL (AH) is continuously compared against the value measured by the probe defined by parameter AA. Parameter Ad represents the alarm activation delay in minutes; the low temperature alarm (LO) is activated only if the temperature remains below the value of AL for a time longer than Ad.
- **High:** In the same way, the high temperature alarm (AH) is activated only if the temperature remains above the value of AH for a time longer than Ad.



Caution:

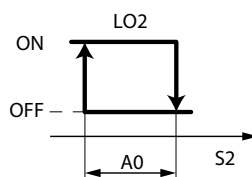
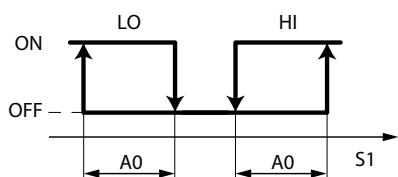
- the thresholds can be relative or absolute, depending on the value of parameter A1:
- A1 = 0: the value of AL indicates the deviation from the set point and thus the activation point for the low temperature alarm is: set point AL. If the set point changes, the activation point also changes automatically.
- A1 = 1: the value of AL indicates the absolute low temperature alarm threshold. If the set point changes, the activation point remains the same.
- The low temperature alarm is signalled by the buzzer and code LO on the display. The same applies to the high temperature alarm (HI), with AH instead of AL.

Code	Description	UOM
A0	High and low temperature alarm reset differential	°C (°F)
A1	Alarm thresholds (AL, AH) relative to the set point St or absolute: 0 = relative; 1 = absolute	-
A2	Alarm thresholds (AL2, AH2) relative to the set point St2 or absolute: 0 = relative; 1 = absolute	-
A6	Configure compressor control during external alarm (immediate or delayed) with fixed 15 min OFF time 0 = always OFF; 100 = always ON	min
A11	Delay time for delayed external alarm: 0 = Signal-only alarm	min
AL	Low temperature alarm threshold	°C (°F)
AH	High temperature alarm threshold	°C (°F)
Ad	Delay time for high and low temp. alarms (AH, AL)	min



Notice:

- the LO (LO2) and HI (HI2) alarms are reset automatically. A0 represents the hysteresis between the alarm activation and deactivation value;
- for delayed alarms from digital input (Dlb=3, code dA), the contact must remain open for a time greater than A11. When an alarm event occurs, a counter starts and generates an alarm when the minimum time A11 elapses. If during the count the value measured returns within the threshold or the contact closes, the alarm is not signalled and the count is reset. When a new alarm condition occurs, the count starts from 0 again. Parameter A6 has a similar meaning to parameter c4 (duty setting). If an external alarm occurs (immediate or delayed) the compressor works for a time equal to the value set for A6 and remains off for a fixed time of 15 minutes.



Ref.	Description
LO, LO2	Low temperature alarms
HI	High temperature alarms
S1, S2	Probes

Fig. 7.a

7.3 Compressor

This section includes the high and low pressure alarm thresholds, with the corresponding delays for low pressure alarms.

Low evaporation pressure alarm (LP)

A low evaporation pressure (LP) alarm can be configured that stops the unit when the evaporation pressure falls below the threshold LP_t for a settable time. Activation of the alarm can be differentiated between steady operation (LPE) and at compressor start-up (LPS), so as to manage any transients when the compressor starts. The type of alarm reset (LPr) can also be selected between manual and semi-automatic. When the alarm is activated, the message LP is shown on the display and in Applica, and the unit is stopped. For semi-automatic reset, the alarm is cleared when the evaporation pressure rises above the threshold $LP_t + LPU$, with a maximum number of events equal to LPo in the evaluation period LPP . Once the maximum number of events has been exceeded, the alarm requires manual reset.

Code	Description	UOM
LPE	Low evaporation pressure alarm delay in steady operation	s
LPo	Maximum number of automatic resets before switching to manual reset	-
LPP	Semi-automatic alarm reset attempt evaluation period	Min
LPr	Low evaporation pressure alarm reset FALSE = Manual, TRUE = Semi-automatic	-
LPS	Low evaporation pressure alarm delay at start-up	s
LPt	Low evaporation pressure alarm activation threshold	barg/psig
LPU	Low evaporation pressure alarm differential	barg/psig

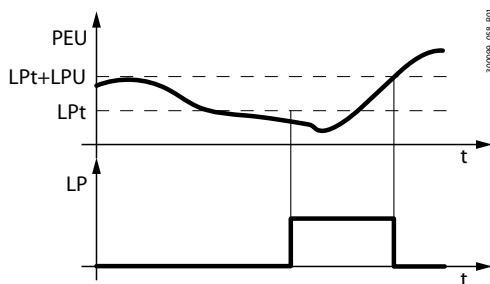


Fig. 7.b

High discharge pressure alarm (HP)

A high discharge pressure (HP) alarm can be configured to stop the unit when the discharge pressure exceeds the threshold HP_t . Activation of the HP alarm immediately stops the unit, with the message HP shown on the display and in Applica.

The type of alarm reset (HPr) can also be selected between manual and semi-automatic. For semi-automatic reset, the alarm is cleared when the discharge pressure falls below the threshold $HP_t - HPU$, with a maximum number of events equal to HPo in the evaluation period HPP . Once the maximum number of events has been exceeded, the alarm requires manual reset.

Code	Description	UOM
HPo	Maximum number of automatic resets before switching to manual reset	-
HPP	Semi-automatic alarm reset attempt evaluation period	Min
HPr	High discharge pressure alarm reset: FALSE = Manual, TRUE = Semi-automatic	-
HPt	High discharge pressure alarm activation threshold	barg/psig
HPU	High discharge pressure alarm differential	barg/psig

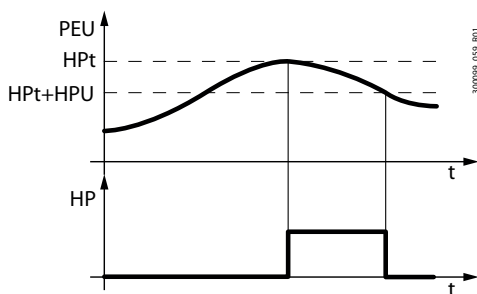


Fig. 7.c

7.3.1 Valve and refrigerant charge

Please refer to the corresponding chapter for the protection functions offered by the expansion valve, such as:

Low superheat protection

Low suction temperature alarm

High superheat signal (does not switch the unit off)

MOP (Maximum operating pressure) function for high evaporation pressure control

LOP (Low operating pressure) function for low evaporation pressure control

Enable valve alarm at end travel ('blo')

Parameter P14 is used to enable/disable the valve blocked alarm signal ("blo").

Code	Description	UOM
P14	Enable valve alarm at end travel ("blo") = 1, signal enabled	-

7.4 Troubleshooting

The Heos PowerBoard controller has a unit status monitoring variable ("StS"), useful for understanding the unit status/operation at any time. This variable is shown in the Applica dashboard on the home screen, and is available via supervisor and Applica desktop.

Unit status	StS	Unit status	StS
On	0	Pressure equalisation	14
Off due to alarm	1	Download configuration	15
Off from supervisor	2	Download binaries	16
Off from scheduler	3	Defaults running (if that the user has reset the defaults by parameter (rsh or rsc) or from the HMI, in this status the unit switches off in order to be able to safely restore the default values)	17
Off from digital input	4	Blackout safety (post electrical reboot safety delay)	18
Off from keypad	5	Valve initialisation (the valve completes extra steps at start-up with a forced closing cycle, so as to begin from a known position)	19
Cleaning	6	Compressor in manual mode	20
Door open	7	Compressor in minimum on status	21
Duty setting	8	Derating for high discharge pressure protection	22
Defrost	9	Pump down at power on	23
Oil speed boost	10	Pump down at shutdown	24
Evaporator wash	11	Oil lack prevention	25
Off from main	12	Envelope protection	26
Off from minimum off	13	No temperature request	27
		Regulation start delay	28
		Power defrost	29
		High pressure prevent	30

For defrost troubleshooting, a specific variable shows each phase of this process. The "DEF_Status" (Current defrost status) variable is described in the following table:

Cause of last shutdown	LCS	Cause of last shutdown	LCS
/	0	Broken pressure probes	12
From control	1	High discharge pressure alarm	13
Defrosting	2	High discharge pressure alarm (manual reset required)	14
From keyboard	3	Low suction pressure alarm	15
From keyboard force off	4	Low suction pressure alarm (manual reset required)	16
From supervisor	5	Low suction temperature alarm	17
From remote control	6	Low superheat alarm	18
Showcase cleaning	7	High discharge temperature alarm	19
Door open	8	Serious inverter alarm	20
Failed compressor start-up	9	Serious generic function alarm	21
Outside of envelope	10	Low delta pressure	22
Outside of envelope (manual reset required)	11	Serious alarm	23

For defrost troubleshooting, a specific variable shows each phase of this process. The "DEF_Status" (Current defrost status) variable is described in the following table:

Current defrost status	DEF_Status
Idle	0
Calling	1
In progress	2
Check end defrost	3
Dripping	4
End defrost sync	5
Post dripping	6

7.5 Alarm table

A guide (+040010010) is available for specifically troubleshooting the Carel PSD driver.

For the controller alarms, see the table below.

Code	Display	Delay	Reset	Action	Troubleshooting	Category
rE	Control probe broken or not connected	10s	Automatic	Duty Setting mode	- Check setting of parameter /4. - If /4 = 0, check connection of the air outlet temperature probe and check the status of the air outlet temperature probe. - If /4 = 100, check connection of the air intake temper. probe and check the status of the air intake temperature probe. - If /4 is between 1 and 99, check the connections and the status of both the outlet temperature probe and the intake temperature probe.	Normal

Code	Display	Delay	Reset	Action	Troubleshooting	Category
E1...E16	Probe U1...U16 fault	10s	Automatic	Depends on what function is associated with the channel U1...U16	- Check the probe connection on the channel U1...U16. - Check the status of the probe, refer to the electrical panel diagram.	Normal
ES1...ES4	Serial probe S1...S4 not updated	Immediate	Automatic		Check the serial connection between supervisory system and Main or Main to Secondaries.	Normal
LO	Low temperature alarm	Ad (120m)	Automatic	No action. The alarm is signal-only	Check the reading of the probe selected for parameter Aa and the thresholds AL, A1 and A0.	Normal
HI	High temperature alarm	Ad (120m)	Automatic	No action. The alarm is signal-only	Check the reading of the probe selected for parameter Aa and the thresholds AH, A1 and A0.	Normal
IA	Immediate external alarm	Immediate	Automatic	The compressor stops immediately (no pump down).	- Check status of input FIA. - Identify faults on the external device connected to the input set on DIA: Immediate external alarm.	AdE = FALSE: Normal AdE = TRUE: Serious immediate
dA	Delayed external alarm	A11 (1 min)	Automatic	The behaviour of the compressor depends on the setting of parameter AdE (if priority = high, the compressor stops immediately if priority = low, the compressor keeps operating)	- Check the status of input Flb. - Identify faults on the external device connected to the input set on Dlb.	AdE = FALSE: Normal AdE = TRUE: Serious immediate
dor	Door open for too long	Tdoor (30min)	Automatic	Control is resumed after Tdoor		Normal
Etc	Real time clock not updated	Immediate	Automatic	No action. The alarm is signal-only	Check the battery backup.	Normal
HSH	High superheat temperature alarm	Pb (600s)	Automatic	No action. The alarm is signal-only	- Check the correct reading of the probes for superheat calculation (tGS and tEu). - Check for malfunctions of the expansion valve (valve closed, valve left in manual PMP, PMu any obstructions, ...). - Check refrigerant charge in the circuit. The unit could be discharged, especially if there are LCA and bLo alarms. - Check the settings of parameters Pa, Pb.	Warning
LSH	Low superheat alarm	P9 (120s)	Automatic	The compressor stops immediately (no pump down).	- Check the correct reading of the probes for superheat calculation (tGS and tEu). - Check for malfunctions of the expansion valve (valve closed, valve left in manual PMP, PMu any obstructions, ...). - Check compressor status (ice on the outside). a possible sign of liquid in the compressor. - Check the settings of parameters P7, P8, P9. - Verify the amount of charge. If the condensing temperature is much higher than the temperature of the water loop (or the ambient air temperature for air-cooled units), it is likely that the charge is excessive. - Check whether the P+I control parameters P4, P5, P6 (valve PID control) slow down the response.	Serious immediate
LSA	Low suction temperature alarm	P12 (120s)	Automatic	The compressor stops immediately (no pump down).	- Check the status of the showcase (correct fan operation, set point). - Check the setting of valve control and operation parameters.	Serious immediate
MOP	MOP alarm	PM3 (240s)	Automatic	Single evaporator: no action. The alarm is signal-only Multi Evaporator: the compressor stops immediately (no pump down).	- Check the status of the showcase (correct fan operation, check expansion valve opening). - Check for malfunctions of the expansion valve (valve open, valve left in manual PMP, PMu any obstructions, ...). - Check setting of MOP parameters (PM1, PM2, PM3). - Check compressor capacity compared to total showcase cooling capacity (insufficient compressor capacity).	Main single evaporator and secondaries: Normal Main multi evaporator: Serious immediate
LOP	LOP alarm	PL3 (120s)	Automatic	No action. The alarm is signal-only	- Check the status of the showcase (correct fan operation, set point). - Check for malfunctions of the expansion valve (valve closed, valve left in manual PMP, PMu, any obstructions, ...). - Check setting of LOP parameters (PL1, PL2, PL3). - For LT showcases, check that the superheat set point P3 is not too high, as this can cause the evaporation pressure to exceed the envelope.	Normal
HGB	Hot gas valve blocked		Automatic	End hot gas defrost		Normal
bLo	Valve position warning	Pb2 (25min)	Automatic	No action. The alarm is signal-only	- Check correct operation of the expansion valve. - Check the setting of parameter Pb2.	Normal
MA	Lost communication with Main	Fixed 60s	Automatic	Failed synchronisation of functions. For multi-evaporator only, unit OFF	- Check the status (on/off) of the Main controller. - Check the RS485 connection wiring.	Serious
mno	Secondary has never gone online with main	Immediate	Automatic	No action. The alarm is signal-only		Normal
u1..u5	Lost communication with Secondary 1..5	Immediate	Automatic	Failed synchronisation of functions	- Check the status (on/off) of Secondary controller 1..5. - Check the RS485 connection wiring. - Check the setting of parameter Sn.	Normal
n1..n5	Alarms on Secondary 1..5	Immediate	Automatic	No action. The alarm is signal-only	Check alarm signal on Secondary board 1..5.	Normal
GHI	Generic function: MAX threshold exceeded alarm	GFA_De (0s)	Automatic	GFA_AlType = Normal ☒ No action. The alarm is signal-only GFA_AlType = Serious ☒ The compressor stops immediately (no pump down).	Check parameters GFA_Hth, GFA_E, GFA_D, GFA_1, GFA_2.	GFA_AlType = FALSE: Normal GFA_AlType = FALSE: Serious
GLO	Generic function: MIN threshold exceeded alarm	GFA_De (0s)	Automatic	GFA_AlType = Normal ☒ No action. The alarm is signal-only GFA_AlType = Serious ☒ The compressor stops immediately (no pump down).	Check parameters GFA_Lth, GFA_E, GFA_D, GFA_1, GFA_2.	GFA_AlType = FALSE: Normal GFA_AlType = FALSE: Serious
ACE	Check ambient probe configuration for dew point management		Automatic			Normal
CLn	Clean status warning	Immediate	Automatic	No action. The alarm is signal-only		Warning

Code	Display	Delay	Reset	Action	Troubleshooting	Category
Ed1	Defrost finished by timeout	dP1 (45min)	Automatic	No action. The alarm is signal-only	- Check the status of the showcase (correct fan operation, check expansion valve opening). - Check the position of the defrost probe. The probe must be positioned on the evaporator in the point where the last part of ice melts. - Make sure that dP1 has not been set too low. - Check the fan setting during defrost F3.	Warning
Mss	Suction pressure probe on the controller not configured	Immediate	Automatic	No action. The alarm is signal-only	Check parameter /Ft.	Warning
rEt	Retain written too often warning	Immediate	Automatic	No action. The alarm is signal-only		Warning
nfc	NFC memory written too often warning	Immediate	Automatic	No action. The alarm is signal-only		Warning
dFe	Default procedure error warning	Immediate	Automatic	No action. The alarm is signal-only		Warning
ine	Power+ communication not enabled	Immediate	Automatic	No action. The alarm is signal-only	compressor parameters may not be present. Download them again	Normal
A47	Power+ 1: Device Offline	Immediate	Automatic	Unit off	- Check Power+ inverter power supply. - Check RS485 connection wiring with the Power+ inverter. - Check the configuration of the dip switches on the Power+ inverter (see the Power+ manual if the positions of the dip switches are different). - Check the communication parameter H4.	Serious
dFd	Power+: default parameters writing in progress	Immediate	Automatic	The compressor stops immediately (no pump down).		Serious immediate
GAl	Power+ alarm	Immediate	Automatic	Unit off	- Check specific Power+ alarm troubleshooting. - If there isn't a specific alarm active, see iAc in manual + 0300048EN for inverter troubleshooting.	Serious immediate
A20	Power+ alarm 1: overcurrent	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A53	Power+ alarm 2: motor overload	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A54	Power+ alarm 3: motor overvoltage	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A55	Power+ alarm 4: motor undervoltage	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A41	Power+ alarm 5: driver over temperature	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A42	Power+ alarm 6: driver under temperature	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A21	Power+ alarm 7: over current HW	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A56	Power+ alarm 8: motor over temperature	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A57	Power+ alarm 9: Inverter IGBT module error	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A37	Power+ alarm 10: CPU error	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A45	Power+ alarm 11: parameter default	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A27	Power+ alarm 12: DC bus ripple	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A44	Power+ alarm 13: data communication fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A43	Power+ alarm 14: driver thermistor	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A58	Power+ alarm 15: autotune fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A59	Power+ alarm 16: driver disabled	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A60	Power+ alarm 17: motor phase	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A61	Power+ alarm 18: fan fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A33	Power+ alarm 19: speed fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A50	Power+ alarm 20: PFC failure	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A62	Power+ alarm 21: PFC over voltage	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A63	Power+ alarm 22: PFC under voltage	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A64	Power+ alarm 23: STO 23 survey fail	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A65	Power+ alarm 24: STO 24 survey fail	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A52	Power+ alarm 25: Earth fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A66	Power+ alarm 26: CPU sync error 1	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A67	Power+ alarm 27: CPU sync error 2	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A68	Power+ alarm 28: Drive overload	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A69	Power+ alarm 29: uSafety error	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A23	Power+ alarm 101 uSafety type 1: Amp measurement fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A24	Power+ alarm 102 uSafety type 1: Unbalanced current	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A78	Power+ alarm 103 uSafety type 1: Overcurrent	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal

Code	Display	Delay	Reset	Action	Troubleshooting	Category
A35	Power+ alarm 104 uSafety type 1: STO input open	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A36	Power+ alarm 105 uSafety type 1: STO circuit fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A79	Power+ alarm 106 uSafety type 1: No power supply	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A70	Power+ alarm 107 uSafety type 1: Motor driver error	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A71	Power+ alarm 109 uSafety type 1: Data comm. fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A80	Power+ alarm 110 uSafety type 1: Compressor stalled	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A72	Power+ alarm 111 uSafety type 1: DC overcurrent	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A29	Power+ alarm 112 uSafety type 1: DC A measurement fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A28	Power+ alarm 113 uSafety type 1: DC V out of range	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A73	Power+ alarm 114 uSafety type 1: DC V measurement fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A81	Power+ alarm 115 uSafety type 1: Supply undervoltage	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A74	Power+ alarm 116 uSafety type 1: Supply V measurement fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A30	Power+ alarm 201 uSafety type 2: DCbus overload	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A75	Power+ alarm 202 uSafety type 2: DCbus measurement fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A82	Power+ alarm 203 uSafety type 2: Drive overtemperature	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A83	Power+ alarm 204 uSafety type 2: Drive undertemperature	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A84	Power+ alarm 205 uSafety type 2: Temp. probe fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A76	Power+ alarm 206 uSafety type 2: CPU sync error	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
A38	Power+ alarm 207 uSafety type 2: Invalid PEC	Immediate	Automatic		Check driver troubleshooting in manual +040010010	Normal
A77	Power+ alarm 209 uSafety type 2: Control circuit fault	Immediate	Automatic	The compressor stops immediately (no pump down).	Check driver troubleshooting in manual +040010010	Normal
HDt	High discharge temperature	Immediate	Automatic	Compressor Off	- Check reading of discharge temperature probe /Fo. - Check the settings of parameters cHT, cHD.	Serious
SFA	Compressor start failure (visible only when the max number of attempts is reached)	Immediate	Automatic	The controller tries to start the compressor up to the maximum number of attempts cat. A manual alarm reset will then be needed to restart control	- Check Power+ 1 inverter motor phase connection. - Check the operation of the suction and discharge pressure probes in the circuit.	Serious
EnL	Out of envelope	60s	Automatic	Compressor off	- Zone 3: Possible excess charge and/or cooling water temperature too high. This alarm may not be a problem only in the case of occasional alarms during the pull down phase (i.e. after defrosting or when first switching on) with high water temperatures - Zone 5: Evaporator temperatures too high. Check evaporator thermal load - Zone 6: Water temperature at heat exchanger inlet possibly too cold (<15 °C). Check that the water loop control bypass is working correctly and it is therefore capable of keeping the water above 15 °C. - Zone 8: Water temperature at heat exchanger inlet possibly too cold (<10°C). Check that the water loop control bypass is working correctly and it is therefore capable of keeping the water above 15 °C. - Zone 9: Evaporation temperature too low. Check that the valve is not stuck in the closed position. For LT showcases, check that the superheat set point P3 is not too high, as this can cause the evaporation pressure to exceed the envelope. This alarm is not a problem in the case of occasional alarms during the "pull down" phase (i.e. after defrosting or when first switching on) on LT showcases.	Serious
LdP	Low pressure differential	Immediate	Automatic			Serious
dSd	Disable startup for high delta pressure	Et (90s)	Manual	Compressor off		Serious immediate
AHP	High pressure alarm	Immediate	Automatic	The compressor stops immediately (no pump down).	- Check the condensing pressure probe reading (Scp). - Check the settings of parameters HPt, HPU. - Check the condensing stage (fan operation and settings for air-cooled units or water loop temperature for water-cooled units, which must not be too high). - Check refrigerant charge. In the event of continuous high pressure alarms and valve quite closed and/or frequent low superheat alarms, charge may be excessive. - Verify check valve status (if present).	Serious immediate
ALP	Low pressure alarm	LPS (30s) LPE (5s)	Manual or semi-automatic (5 attempts) based on setting of LPo	Unit off	- Check the suction pressure probe reading (SSp). - Check the settings of parameters LPT, LPU. - Check expansion valve operation and settings.	Serious immediate
dEA	Last defrost ended early due to Smart End function	Immediate	Automatic after 120s	No action. The alarm is signal-only		Warning

Code	Display	Delay	Reset	Action	Troubleshooting	Category
dAd	Last defrost was avoided due to already high defrost temperature	Immediate	Automatic after 120s	No action. The alarm is signal-only		Warning
MMT	Manual mode switched off due to timeout	MT (240min)	Automatic after 120s	The alarm is signal-only and control resumes		Warning
LCA	Low refrigerant charge warning	Pb4 (10 min)	Automatic	No action. The alarm is signal-only	- Check correct operation of the expansion valve. - Check the setting of parameters Pb3 and Pb4. - Check the amount of refrigerant charged in the circuit. The circuit may be discharged.	Warning
HPv	High pressure prevention is running	Immediate	Automatic			Warning
HPb	High pressure prevention alarm with shutdown	Immediate	Manual			Serious
AC1	Compressor 1 alarm	Immediate	Automatic	Compressor 1 off		Normal
AC2	Compressor 2 alarm	Immediate	Automatic	Compressor 2 off		Normal
AC3	Compressor 3 alarm	Immediate	Automatic	Compressor 3 off		Normal
LP1	Compressor 1 low pressure switch alarm	LPL (30s)	Automatic	Compressor 1 off		Normal
LP2	Compressor 2 low pressure switch alarm	LPL (30s)	Automatic	Compressor 2 off		Normal
LP3	Compressor 3 low pressure switch alarm	LPL (30s)	Automatic	Compressor 3 off		Normal
MSH	Superheat probe missing warning	Immediate	Automatic	No action. The alarm is signal-only		Warning
MCP	Compressor probe broken or not configured alarm	Immediate	Automatic	Compressor off		Serious immediate
SHS	HP control with gas cooler temperature probe broken or not configured alarm	Immediate	Automatic	Valve HP control is disabled and valve SH control without HP protection is activated		Normal
WDo	Door open warning	Immediate	Automatic	No action. The alarm is signal-only		Warning

Tab. 7.a

8. HISTORY OF SOFTWARE REVISIONS

Version 1.0.7 (Refer to manual version 1.0)

- Very first product release. 2022.

Version 1.1.3 (Refer to manual version 1.1)

- Released in April 2023
- Skip frequency function added.

Version 1.2.4 (Refer to manual version 1.2)

- Released in December 2023
- Possibility added to disable Bluetooth and activate it with a command on the display
- Troubleshooting available on the Applica app.



CAREL INDUSTRIES - Headquarters

Via dell'Industria, 11 - 35020 Brugine - Padova (Italy)
Tel. (+39) 049.9716611 - Fax (+39) 049.9716600
e-mail: carel@carel.com - www.carel.com