HEcusistema CO_2

High efficiency condensing unit

CAREL

ENG OEM user manual

LEGGI E CONSERVA QUESTE ISTRUZIONI

READ AND SAVE THESE INSTRUCTIONS

NO POWER & SIGNAL CABLES TOGETHER

READ CAREFULLY IN THE TEXT!

Integrated Control Solutions & Energy Savings

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, acts as a consultant for the positive commissioning of the final unit/application, however in no case does it accept liability for the correct operation of the final equipment/system.

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- 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.

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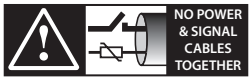
IMPORTANT



READ CAREFULLY IN THE TEXT!

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.

DISPOSAL

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

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.

Content

1. INTRODUCTION

1.1 General features

Hecu CO2 is a control system for complete management of R744 condensing units fitted with BLDC compressors. The serial connection between the condensing unit and the evaporators controlled by MPXPRO/UltraCella and CAREL EEV expansion valves represents one of the main features of this solution, contributing to the energy efficiency and reliability of the entire system. The control board is designed for DIN rail assembly and is fitted with plug-in screw terminals, as well as incorporating a driver for managing two electronic expansion valves. A user terminal (PGDe or pLDpro) is also available for service or commissioning the system.

Main features:

- Modulation of cooling capacity by BLDC compressor with inverter;
- Management of a fixed-speed backup compressor;
- Management of two modulating fans;
- Card with built-in driver for CAREL unipolar valves;
- Management of unipolar high-pressure valve (HPV);
- Management of unipolar flash gas valve (RPRV);
- Serial communication with evaporators (max 5);
- RS485 serial for BMS;
- Floating suction pressure set point;
- Floating condensing pressure set point;
- Advanced algorithm for calibrated oil injection to the compressor;
- Oil speed boost for oil return to the compressor;
- Oil recovery washing for oil return to the compressor;
- Vast configuration of defrost functions;
- Suction and discharge superheat control;
- Ample configuration of alarms.

1.2 Components and accessories

	Part number	Description
A	ECU70TS0C0	Hecu CO2 controller, 230Vac, RTC, 2 unipolar EEV, connector kit, no BMS, FLSMTDMCUTU
A	ECU70TS0D0	Hecu CO2 controller, 230Vac, RTC, 2 unipolar EEV, connector kit, no BMS, with plastic cover, FLSMTDMCUTU
A	ECU80TS0C0	Hecu CO2 controller, 24Vac, RTC, 2 unipolar eev, connector kit, no BMS, FLSMTDMCUTU
A	ECU80TS0D0	Hecu CO2 controller, 24Vac, RTC, 2 unipolar EEV, connector kit, no BMS, with plastic cover, FLSMTDMCUTU
A	PSD101021A	Power+ 10 A, 200-240 Vac 1Ph, IP00
A	PSD1012200	Power+ 12 A, 200-240 Vac 1Ph, IP20/IP44
A	PSD1016200	Power+ 16 A, 200-240 Vac 1Ph, IP20/IP44
A	PSD1018400	Power+ 18 A, 280-480 Vac 3Ph, IP20/IP44
A	PS20012204110	POWER+ 12 A, 200-240 Vac 1PH, IP20 PEC
A	PS20015204110	POWER+ 15 A, 200-240 Vac 1PH, IP20/IP44 PEC
A	PS20018404110	POWER+ 18 A, 380-480 Vac 3PH, IP20/IP44 PEC
A	PS20012204100	POWER+ 12 A, 200-240 Vac 1PH, IP20
A	PS20015204100	POWER+ 15 A, 200-240 Vac 1PH, IP20/IP44
A	PS20018404100	POWER+ 18 A, 380-480 Vac 3PH, IP20/IP44
A	PSACH10100	Coil for POWER+ 18 A
M	E2V**CS1C0	Electronic expansion valve E2V**-C 13-13 S. Steel high pressure without electrical coil
M	E2VSTA03*0	Unipolar stator coil with cable *m
M	E2VFIL0100	Filter kit for valve E2VBSF (conn. diam. 12 ODF) 10 pcs
M	SPKT00H8C0	Press.Trasd. 4-20 mA 0...120 barg (0...1740 psig) sealed gage 8-28V packard 1/4 gas male
M	SPKT00D8C0	Press.Trasd. 4-20 mA 0...150 barg (0…2175 psig) sealed gage 8-28V packard 1/4 gas male
A	SPKT00L1S0	Press.Trasd. 0-5V 0…90 barg sealed gage packard 1/4 gas F
M	SPKC002310	Cable AWG 3 wires l=2m for SPKT packard vulcanised - IP67
M	NTC0**HT41	IP55, ** m cable, 0T150 °c, multiple package (10 pcs)
M	NTC0**HF01	IP67, ** m cable, fast reading NTC probe strap-on plastic
O	NTC0**WH01	Wh NTC sensor IP68 -50T105 cable **m
A	PGDEH31FX0	pGDe terminal Hecu LOGO, pLAN version
A	PLD00GFP00	PLDPro LCD neutral, 132x64 pixels, pLAN version
M	S90CONN00*	Connection cable between terminal and pCO², l=*m
O	PCOS004850	Opto-isolated RS485 serial connection card for pCO sistema
O	PCOS00S030	Fastening bracket for RS485/Lon/RS232 serial card

Tab. 1.a

Key:

M	mandatory *(mandatory)*	A	mandatory / alternative	O	optional

Hecu CO2 system example

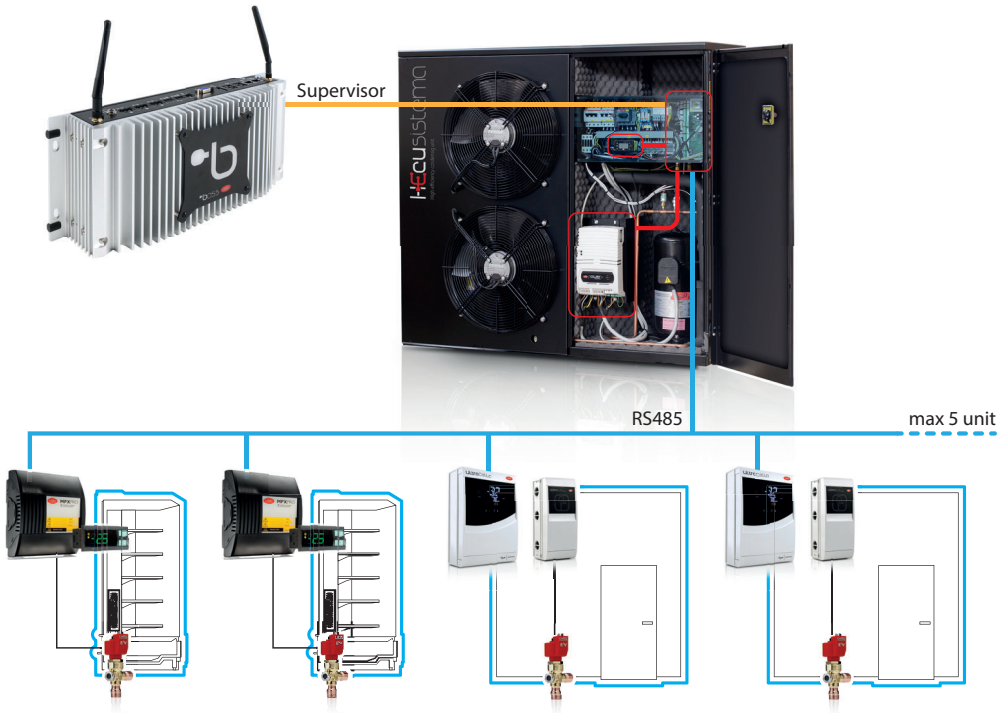


Fig. 1.a

2. INSTALLATION

2.1 Main board: description of the terminals

For further details on the electrical and mechanical specifications, see technical leaflet +050001590

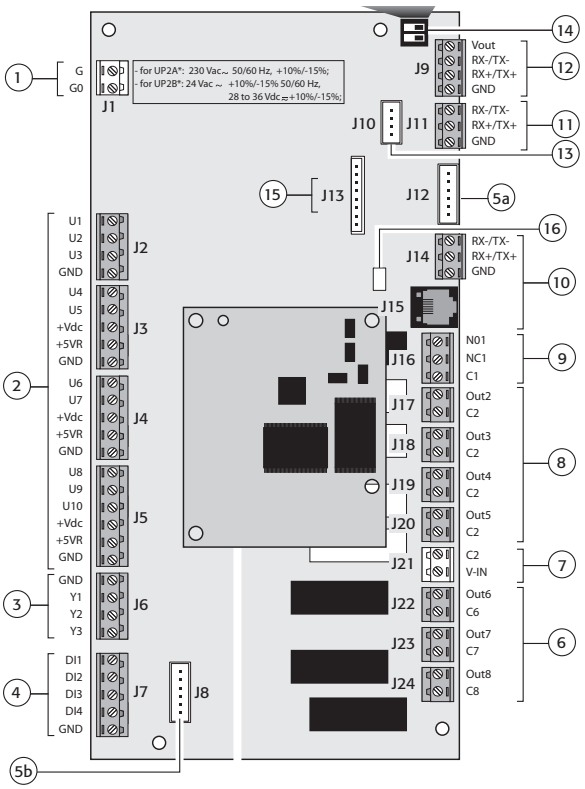


Fig. 2.a

Key:

1	Power 230 Vac for version with transformer (UP2A*********) Power 24 Vac for version without transformer (UP2B*********)		
2	Universal channels	9	Alarm digital output
3	Analogue outputs	10	pLAN serial connection
4	Digital inputs	11	BMS2 serial connection
5a	Valve 1 output	12	Fieldbus serial connection
5b	Valve 2 output	13	Connection for PLD terminal
6	Switching digital relay outputs	14	Dipswitch for settings
7	Voltage input for outputs 2, 3, 4, 5	15	BMS1 RS485 serial card
8	Digital outputs with voltage signal	16	Green power LED

Digital inputs	Type: digital inputs with voltage-free contacts
	Number of digital inputs (DI): 4
Analogue outputs	Type: 0 to 10 Vdc cont., PWM 0 to 10 V 50 Hz synch. with power supply, PWM 0 to 10 V frequency 100 Hz, PWM 0 to 10 V frequency 2 kHz
	Number of analogue outputs (Y): 3
Universal channels	Analogue/digital conversion bits: 14
	Type of input selectable from application: NTC, PT1000, PT500, PT100, 4 to 20 mA, 0 to 1 V, 0 to 5 V, 0 to 10 V, voltage-free contact **
	Type of output selectable from application: PWM 0/3.3 V 100 Hz synchronous with power supply PWM 0/3.3 V 100 Hz, PWM 0/3.3 V 2 kHz, 0 to 10 V analogue output Maximum current 2 mA
	Number of universal channels (U): 10
	Precision of passive probe reading: ± 0.5 C across entire temperature range; Precision of active probe reading: ± 0.3% across entire voltage range; Output precision: ± 2%
Digital outputs	Group 1, Switchable power R1: NO 1(1)A
	Group 2, Switchable power R3, R4, R5: NO NO 2(2)A
	Group 3, Switchable power R6, R7, R8: NO 6(6)A
	Maximum switchable voltage: 250Vac
	Switchable power R2 (SSR case mounting): 15 VA 110/230 Vac
	The relays in the same group have basic insulation between each other and therefore must have the same power supply Relays belonging to different groups have reinforced insulation and consequently a different power supply can be used
Unipolar valve outputs	Maximum power for each valve: 7 W
	Type of control: unipolar
	Valve connector: 6-pin, fixed sequence
	Power supply: 12 Vdc ±5%
	Maximum current: 0.3 A for each winding
	Minimum winding resistance: 40 Ω
	Maximum cable length: 2 m

Tab. 2.a

** max. 6 x 0 to 5 V rat. and 4 x 4 to 20 mA probes

Electrical and mechanical specifications of the controller

Power supply:

230 Vac, +10…-15% UP2A*********;
24 Vac +10%/-15% 50/60 Hz,
28 to 36 Vdc +10…-15% UP2B*********;
Maximum power input: 25 VA
Insulation between power supply and controller
• 230 Vac model: reinforced
• 24 Vac model: reinforced guaranteed by power transformer
Maximum voltage of connectors J1 and J16 to J24: 250 Vac;
Minimum size of digital output wires: 1.5 mm^2
Minimum size of all other connector wires: 0.5 mm^2

Power supplied

Type: +Vdc, +5VR, Vout for external power supplies
+Vdc: 26 Vdc ±15% for 230 Vac model power supply (UP2A*********),
21 Vdc ±5% for 24 Vac model power supply (UP2B*********)
Max current available +Vdc: 150 mA total, taken from all connectors, protected against short circuits
+5 VR: 5 Vdc ± 2%; maximum available current 60 mA, total taken from all connectors, protected against short circuits
Vout: 26 Vdc ±15% for 230 Vac model power supply (UP2A*********),
21 Vdc ± 5% Maximum current available (J9): 100 mA

Product specifications

Program memory (FLASH): 7 MB
Log memory: 4 MB
Internal clock precision: 100 ppm
Removable battery: Lithium button, CR2430, 3 Vdc
Battery lifetime: minimum 8 years

Terminal connections available

Type: all pGDe terminals with dedicated connector J15, PLD with dedicated connector J10
Max distance for pGDe terminal: 2 m via telephone connector J15, 50 m via AWG24 shielded cable
Maximum number of connectable terminals: one pGDe series terminal on J15 or J14; one PLD terminal on connector J10, selecting the tLAN protocol on card dipswitches

Communication lines available

Type: RS485, Master for FieldBus1, Slave for BMS 2, pLAN
No. and type of lines available:
1 line, not opto-isolated on connector J11 (BMS2).
1 line, not opto-isolated on connector J9 (FieldBus), if not used by the PLD terminal on connector J10.
1 line, not opto-isolated on connector J14 (pLAN), if not used by the pGDe terminal on connector J15.
1 optional line (J13), selectable from the Carel options available
Max. connection cable length: 2 m via unshielded cable, 500 m via AWG24 shielded cable

Maximum connection length

Universal digital inputs and anything else not specified: less than 10 m
Digital outputs: less than 30 m
Serial lines: see specifications in the corresponding sections

Operating conditions

Storage: -40T70 °C, 90% rH non-cond.
Operation: -40T70 °C, 90% rH non-cond.

Physical specifications

Dimensions: 13 DIN rail modules, 228 x 113 x 55 mm
Ball pressure test: 125 °C

Other specifications

Environmental pollution: level 2
Ingress protection: IP00
Class according to protection against electric shock: to be incorporated into Class I and/or II equipment
PTI250 for PCB insulation; PTI175 for other materials
Period of stress across the insulating parts: long
Type of action: 1C; 1Y for SSR versions
Type of disconnection or microswitching: microswitching
Heat and fire resistance category: category D (UL94 - V2)
Immunity against overvoltages: category II
Software class and structure: Class A
Do not touch or tamper with the device when powered

2.2 10A single-phase inverter

For further details on the electrical and mechanical specifications, see technical leaflet +0500076IE

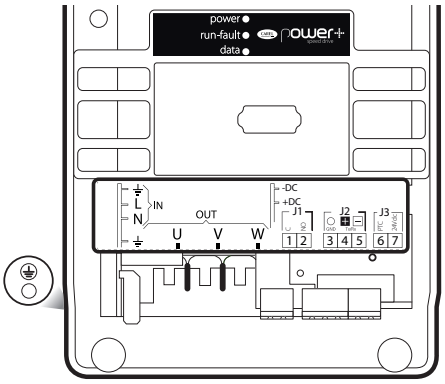


Fig. 2.b

Description of the terminals:

Ref.	Description	
L, N	Single-phase power input	
⏚ earth conn. (*)		
U, V, W	Motor output	
⏚ earth conn. (*)		
-DC	DC bus output	
+DC		
J1-1	C	Relay output (green connector)
J1-2	NO	
J2-3	0 V	RS485/ModBus® connection
J2-4	Tx/Rx+	
J2-5	Tx/Rx-	
J3-6	PTC	PTC input (black connector)
J3-7	24 Vdc	
E	PE ⏚	
F (LED)	POWER (green)	drive powered
	RUN/FAULT (green/red)	drive running / active alarm
	DATA (yellow)	communication active

Tab. 2.b

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

Important: 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;

Main technical specifications

Operating temperature	-20T60°C
Humidity	< 95% RH non-condensing
Environmental pollution level	Max 2
Input voltage	200 - 240V ± 10%, 50 - 60Hz, 1~
Output voltage	0 - Input voltage
Output frequency	0 - 500 Hz
Maximum length	5 m
Switching frequency	4, 6, 8 kHz
Protection functions	Drive: short circuit, overcurrent, earth fault, overvoltage and undervoltage, overtemperature
	Motor: overtemperature and overload (150% Inom for 1 minute)
	System: loss of communication
Frequency resolution	0.1 Hz
Inputs	1 motor protection input: PTC temp. or voltage-free contact, maximum current 10 mA, maximum length 25 m.
Outputs	1 relay: programmable output, voltage-free contact: 240 Vac, 1 A
Serial input	RS485, Modbus® protocol, max baud rate 19200 bit/s
24 Vdc auxiliary power supply	Double insulation, 10% precision, 50 mA max
Maximum length	100 m shielded cable
Ingress protection	IP00

Tab. 2.c

CE conformity:
2006/95/EC
EN 61800-5-1: Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy.
2004/108/EC
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 for harmonic current emissions (equipment input current <= 16A per phase).
EN61000-3-12: Electromagnetic comp. (EMC) Part 3-12: Limits - Limits for harmonic current emissions (equipment input current > 16 A and <=75 A per phase).

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	17 A
Fuse or type B circuit breaker	25 A
Power cable size	4 mm^2
Rated output current	10 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.d

Dimensions

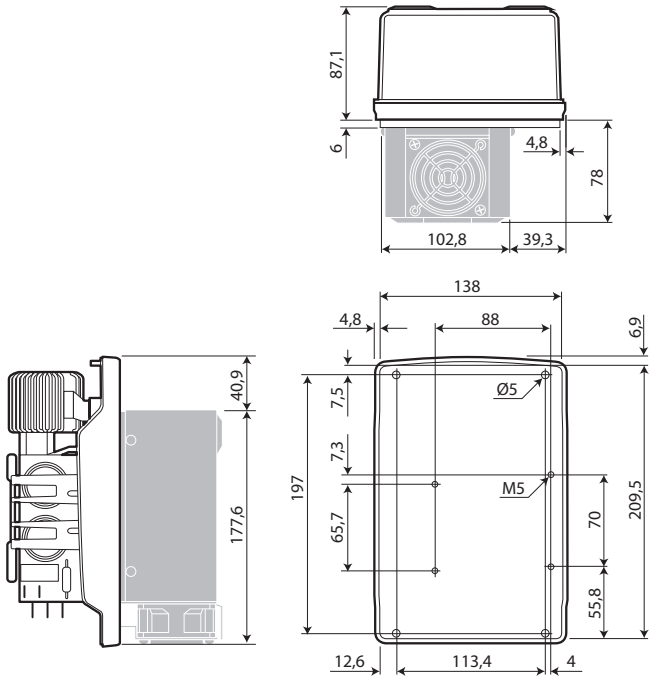


Fig. 2.c

2.3 12-16 A single-phase, 18-24 A three-phase inverter

For further details on the electrical and mechanical specifications, see technical leaflet +0500048IE

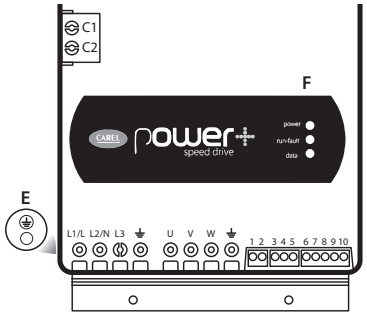


Fig. 2.d

Description of the terminals:

Ref.	Description	
L1/L, L2/N, L3 ⏚ earth conn. (*)	Three-phase power input	
L1/L, L2/N ⏚ earth conn. (*)	Single-phase power input	
U, V, W ⏚ earth conn. (*)	Motor output	
C1, C2	Terminals not used in PSD10**2 **, for optional DC choke on PSD10184** and PSD10244**	
1.2	Relay output	
3	0 V	RS485/ModBus® connection
4	Tx/Rx+	
5	Tx/Rx-	
6	PTC input	
7	24 Vdc	Auxiliary voltage
8	0V	
9	STOa	Safety digital input - Safe Torque Off (**)
10	STOb	
E	PE ⏚	
F (LED)	POWER (green)	drive powered
	RUN/FAULT (green/red)	drive running / active alarm
	DATA (yellow)	communication active

(*) The earth connections inside the controller are electrically connected together and to the PE.
(**) To enable the drive to operate, apply a voltage of 24 Vac/Vdc to the Safe Torque Off digital input. The polarity is indifferent for direct current power supply.

Main technical specifications

Reference technical document	+0500048IE
Operating temperature	-20T60°C
Humidity	< 95% RH non-condensing
Environmental pollution level	Max 2
Input voltage	200 - 240V ± 10%, 50 - 60Hz, 1~
Output voltage	0 - Input voltage
Output frequency	0 - 500 Hz
Maximum length	5 m
Switching frequency	4, 6, 8 kHz
Protection functions	**Drive:** short circuit, overcurrent, earth fault, overvoltage and undervoltage, overtemperature
	Motore: overtemperature and overload (150% Inom for 1 minute)
	System: Safe Torque OFF input, loss of communication
Frequency resolution	0.1 Hz
Inputs	1 motor protection input: PTC temp. or voltage-free contact, maximum current 10 mA, maximum length 25 m.
Outputs	1 relay: programmable output, voltage-free contact: 240 Vac, 1 A
Serial input	RS485, Modbus® protocol, max baud rate 19200 bit/s
24 Vdc aux. power supply	Double insulation, 10% precision, 50 mA max
Maximum length	100 m shielded cable
Ingress protection	IP20

Tab. 2.e

CE conformity:
2006/95/EC
EN 61800-5-1: Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy.
2004/108/EC
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 for harmonic current emissions (equipment input current <= 16A per phase).
EN61000-3-12: Electromagnetic comp. (EMC) Part 3-12: Limits - Limits for harmonic current emissions (equipment input current > 16A and <=75A per phase).

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.

model	PSD10122A0	PSD10162A0
Rated input current at 230 V	22 A	28 A
Fuse or type B circuit breaker	32 A	40 A
Power cable size	4 mm²	6 mm²
Rated output current	12 A	16A
Rated output power at 230 V	4.5 kW	6 kW
Maximum total dissipation	330 W	450 W
Maximum dissipation on the heat sink	190 W	250 W
Min. motor cable size	2.5 mm²	2.5 mm²
Max. motor cable length	5 m	5 m

Tab. 2.f

model	18A 3PH	24A 3PH
Rated input current at 400 V 3PH	23 A	30 A
Fuse or type B circuit breaker	32 A	40 A
Power cable size	4 mm²	6 mm²
Rated output current	18A	24A
Rated output power at 400 V 3PH	10.5 kW	14 kW
Maximum total dissipation	320 W	485 W
Maximum dissipation on the heat sink	250 W	380 W
Min. motor cable size	4 mm²	4 mm²
Max. motor cable length	5 m	5 m

Tab. 2.g

Dimensions

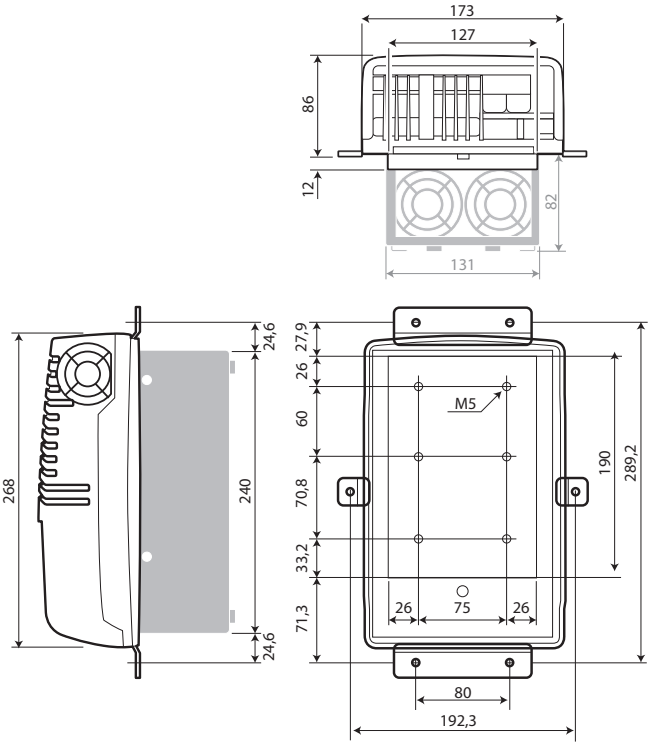


Fig. 2.e

2.4 12 A single-phase inverter PSD2

For further details on the electrical and mechanical specifications, see technical leaflet +0500120IE

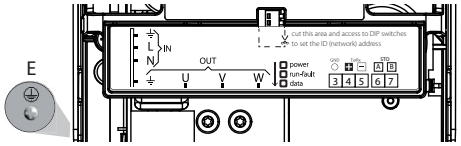


Fig. 2.f

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-		
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.h

(*) The earth connections inside the drive are wired together and to the PE.

Important:

- 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 mm²
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 mm²
Max. motor cable length	5 m

Tab. 2.i

Dimensions

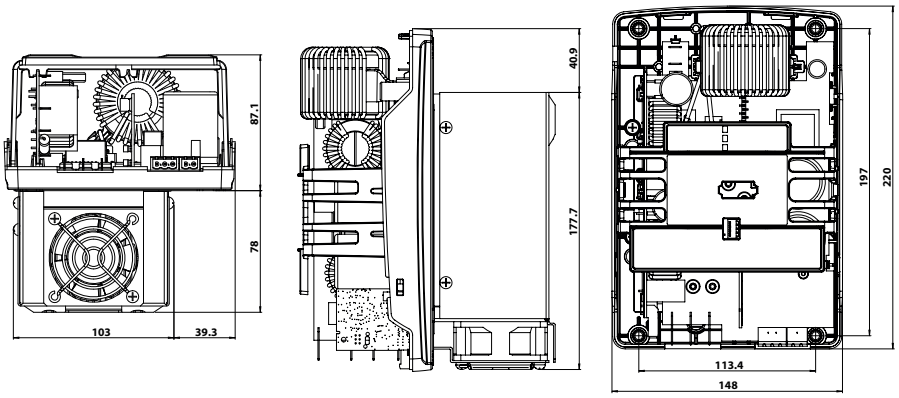


Fig. 2.g

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
	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 Master/ Slave 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.j

2.1 15 A 1 PH and 18 A 3 PH inverter PSD2

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

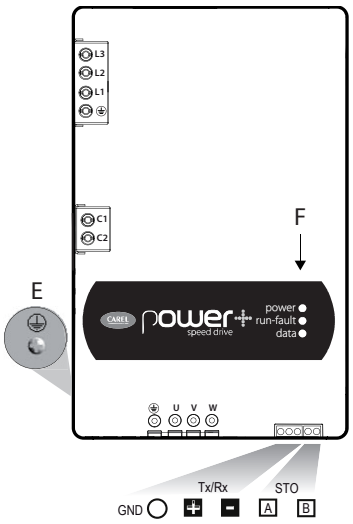


Fig. 2.h

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 three-pin plug-in connector
+	Tx/Rx+	
-	Tx/Rx-	
A	STO safety digital input (**) 2-pin plug-in connector	
B		
E	PE ⏚ earth screw	
F (LEDS)	POWER (green)	drive powered
	RUN (green)	drive running
	FAULT (red)	drive alarm
	DATA (yellow)	communication active

Tab. 2.k

(*) The earth connections inside the controller are wired together and to the PE.
(**) Voltage-free digital input: if not used, short-circuit with a jumper.

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

Important:

- 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.

model	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 mm²	4 mm²
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 mm²	4 mm²
Max. motor cable length	5 m	5 m

Dimensions (mm)

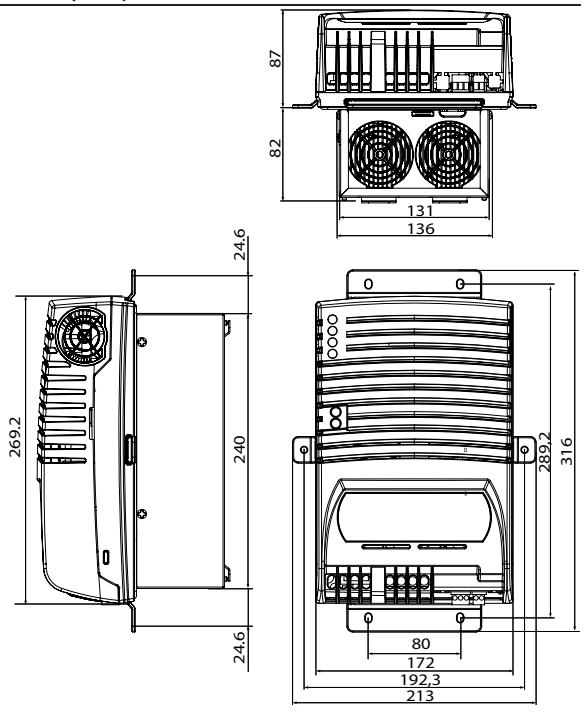


Fig. 2.i

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 ~
Motor output	Output voltage		0 - Input voltage
	Output frequency		0 - 500 Hz
	Frequency resolution		0.1 Hz
	Maximum cable length		see paragraph 5.1
	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 Master/Slave 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
Interface connection data	Serial data connection		RS485, Modbus® protocol, maximum baud rate 19200 bit/s Typical reception resistance 96 KΩ, equal to 1/8 of unit load, i.e. 1/256 of maximum load applicable on the line
	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
	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)
Standards compliance	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 chap. "UL requirements for installation".	

Tab. 2.l

Network address

The configuration and programming of the Power+ drive, as well as the run/stop commands and speed reference, are managed by a CAREL pCO controller or by any BMS (Building Management System) via RS485 serial connection with Modbus® protocol. The ModBus® network address can be set from 1 to 246, and this number comprises the basic address set by parameter, and the address set by the 4 dipswitches inside the drive, from 0 to 15. By changing the basic address, it is possible to cover the entire range of addresses.

Mod. add.	Description	Def	Min	Max	UOM	R/W
32	Basic address	1	1	232	-	R/W
120	Network address	-	1	246	-	R
121	Dipswitch address	-	0	15	-	R

Tab. 2.m

⚠ Important:
any changes to the device's serial address, either on the dipswitches or via the parameter, will only be effective when next powering on or resetting the device.

The configuration of the address set manually by the dipswitches on the drive is shown below.

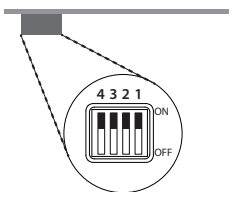


Fig. 2.j

⚠ Important: Before accessing the dipswitches, power off and wait for the LEDs to go off.

Dipswitch address

Dipswitches				Dipswitch address
1	2	3	4	
OFF	OFF	OFF	OFF	0
ON	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	2
…	…	…	…	…
ON	ON	ON	ON	15

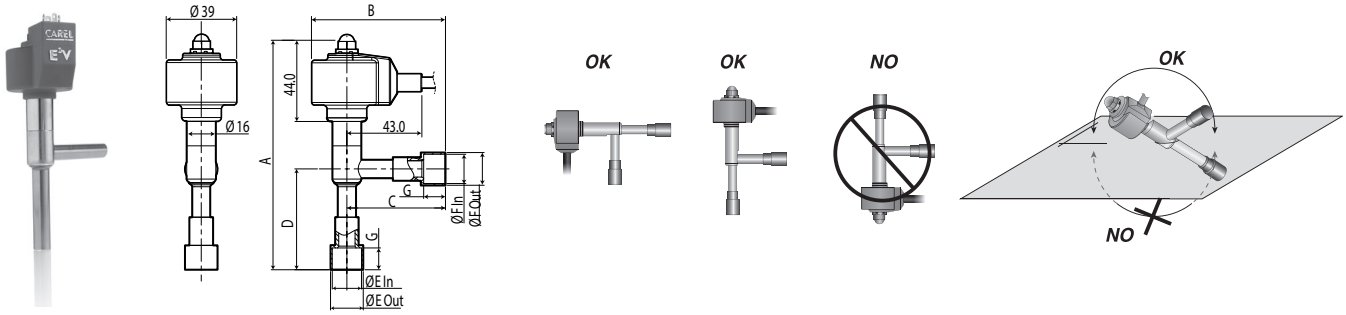
Tab. 2.n

⚠ **Warning**: if the address set by the dipswitches is between 0 and 14, the network address is the sum of the basic address and the dipswitch address, while baud rate and parity are set by the corresponding parameters.

If the dipswitch address is set to 15, communication mode is set to:
- 19200 bit/s; no parity; 2 stop bits; network address 1

regardless of the value of the corresponding parameters.
It is recommended to avoid setting the dipswitch address to 15 as a normal configuration.

2.5 Unipolar E2V valves for R744



Valve type	A	B	C	D	E	F	G
E2V**CS1C*	125.8mm (4.95 inch)	82.3 mm (3.24inch)	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)

CAREL E2V-C operating specifications	
Compatibility	R22, R134a, R404A, R407C,R410A, R744, R507A, R417A
Maximum working pressure (MWP)	up to 140 barg (2030 PSIg)
Maximum operating pressure differential (MOPD)	up to 120 bars (1740 PSI) for E2V24CS0** and E2V24CS1** 85 bars (1233 PSI)
PED	Gr. 2, art. 3, par. 3
Refrigerant temperature	-40T70 °C (-40T158 °F)
Room temperature	-30T70 °C (-22T158 °F)
Contact CAREL for different operating conditions or alternative refrigerants.	

CAREL E2V-U stator	
Reference technical document	+050001440
Power supply voltage	12 V
Drive frequency	50 Hz
Phase resistance (25 °C)	40 Ohms ± 10%
Ingress protection	IP67
Connections	6 pin, cable length: 2 m
Complete closing / control steps	500 / 480

Tab. 2.o

2.6 Pressure probes (SPKT00**8C0)

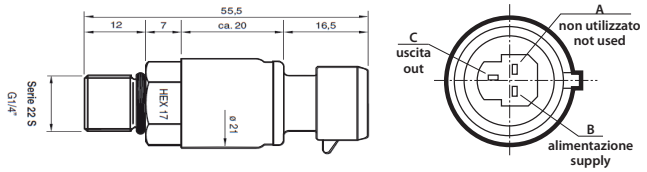


Fig. 2.a

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

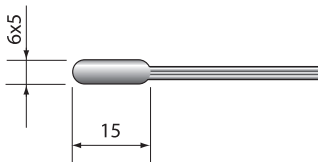
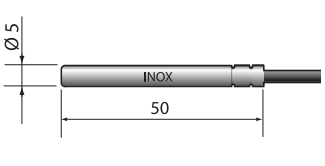
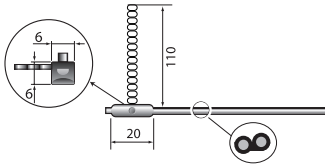
Note: (1): with connector plugged in; all sensors are sealed gauge

Technical specifications

reference technical document	+050000596
power supply	8-28 Vdc, ±20%
output	4 to 20 mA
mechanical fitting	¼" male gas (with circular gasket, resistant to water and oil)
operating temp.	-40T100°C
storage temp.	-20T100°C
fluid temp. (average)	-20T100°C
linearity	± 1% FS (0 to 50 °C) temperature compensated ± 2% FS (0 to 80 °C); ± 4% FS (-40 to 100 ° C)
ingress protection	IP67 with connector plugged in
shock	20 g* sinusoidal, 11 msec
vibrations	5 to 2000 Hz / 10 g /, X/Y/Z axes / 20 g sen 11 ms
environmental poll. level	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 force	12-16 Nm
Compatible with all types of refrigerant	

Note: FS = MAX output - MIN output

2.7 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 kOhm 1%; Beta 3435
Dissipation factor (in air)	approx. 3 mW/°C	approx. 3 mW	3 mW
Thermal constant over time (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
Heat and fire resistance cat.	Flame retardant	In accordance with CEI 20-35	UL/HB cable
			
	• inside showcase temperature	• discharge temperature	• evaporation temperature • gas cooler outlet temperature

Tab. 2.p

2.8 General connection diagram

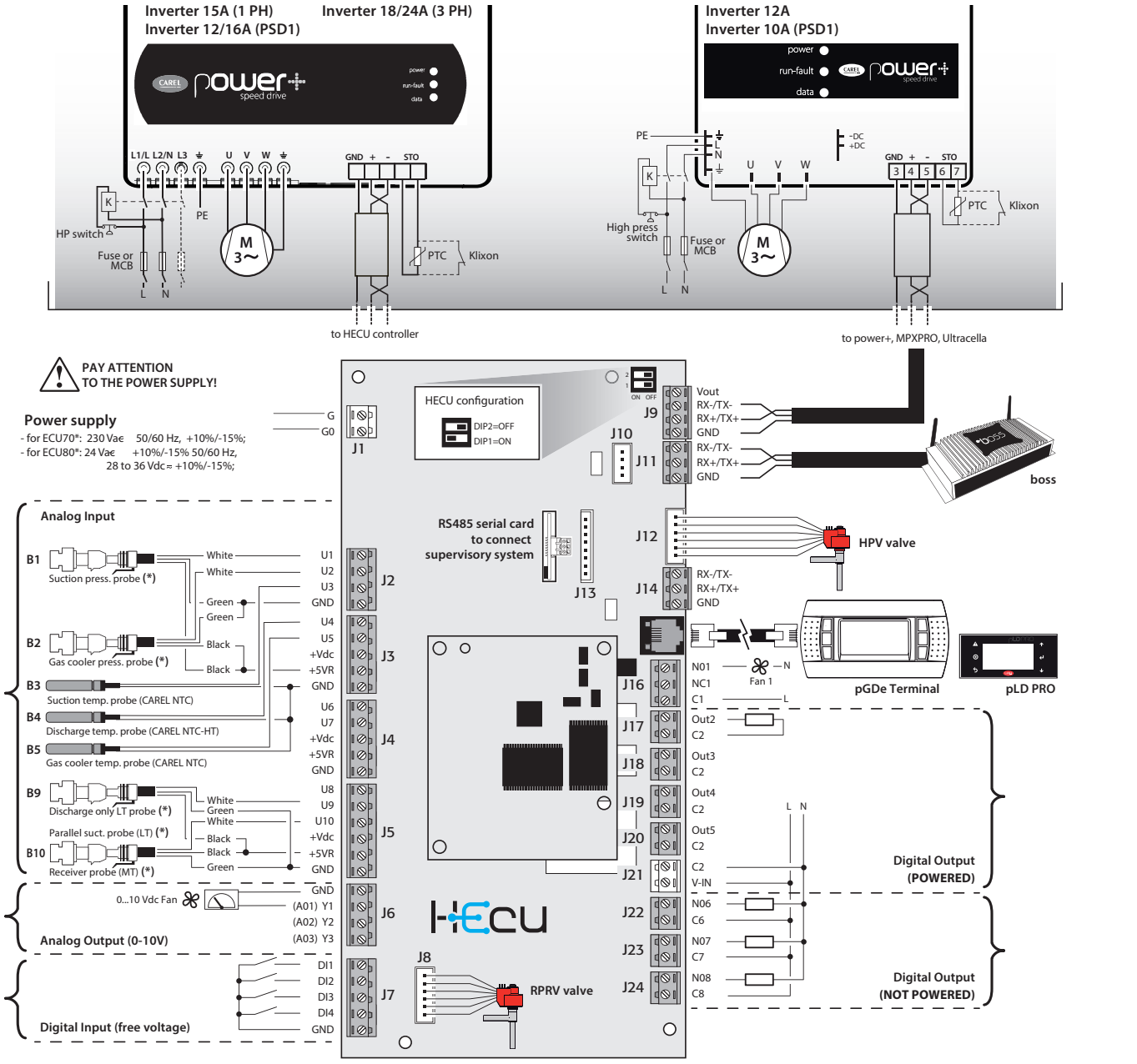


Fig. 2.k

(*) The 4-20 mA pressure probes must be connected with the white to Ux and the black to + Vdc, green is not used
(**) 230 Vac SSR output, maximum switchable power 15 VA

Important: 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 the types of cable to be used, see the power+ manual (+0300094EN).

I/O selection tables (example for MT unit)

Analogue inputs	Digital inputs	Analogue outputs	Digital outputs
Suction temperature	High pressure alarm	Modulating fans	Fan 1
Discharge temperature	Low pressure alarm		Fan 2
Outside temperature	BLDC compressor alarm		Equalising solenoid valve
Gas cooler outlet temperature	Fan alarm		
Suction pressure	Remote ON-OFF		
Gas cooler pressure			
Receiver pressure			

2.9 Functional diagrams

There are two configurations, one for medium temperature applications and one for low temperature applications. The main difference involves the double suction line required for low temperature applications; in this case, the RPRV (flash gas) valve is optional.
There are other alternative configurations that require a system to inject oil via an EEV (using an external driver) or capillary tube.

1. Medium temperature configuration

The configuration defined for medium temperature applications involves Hecu CO2 managing a DC compressor, with up to 2 on-off fans, an electronic expansion valve for gas cooler pressure control (HPV) and an electronic expansion valve for managing receiver pressure (RPRV). The serial network allows monitoring and interaction with up to 5 evaporators equipped with MPXPRO or UltraCella controllers, and a CAREL EEV electronic expansion valve.

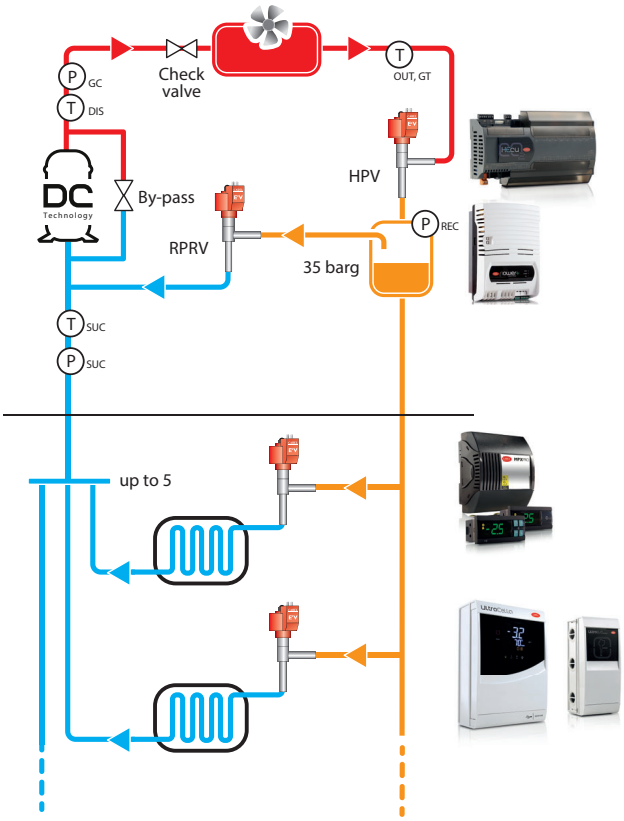


Fig. 2.l

Symbol	Description
TSUC	Suction temperature
PSUC	Suction pressure
TDIS	Discharge temperature
Tout,GC	Gas cooler temperature
PGC	Gas cooler pressure
PREC	Receiver pressure

2. Low temperature configuration

The configuration defined for low temperature applications involves Hecu CO2 managing two DC compressors (LT/DC and parallel), with up to 2 on-off fans, an electronic expansion valve for gas cooler pressure control (HPV) and an optional electronic expansion valve for managing receiver pressure (RPRV). It should be noted that in this configuration, the RPRV (flash gas) valve is optional, as receiver pressure control is managed by the parallel compressor.
The serial network allows monitoring and interaction with up to 5 evaporators equipped with MPXPRO or UltraCella controllers, and a CAREL EEV electronic expansion valve.

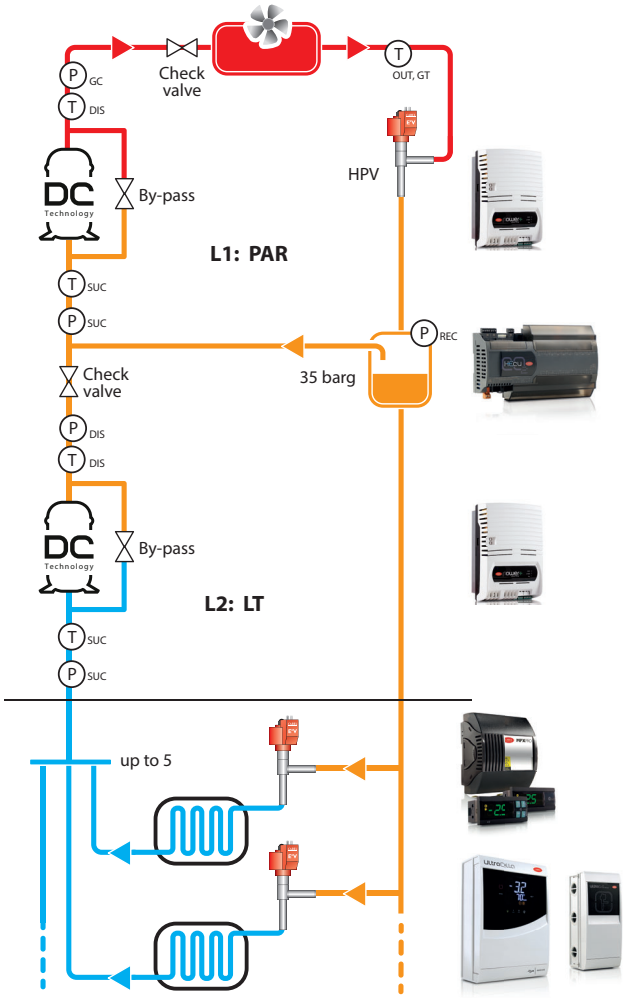


Fig. 2.m

Symbol	Description
TS,LT	Suction temperature LT
PS,LT	Suction pressure LT
TD,LT	Discharge temperature LT
PD,LT	Discharge pressure LT
TS,PAR	Suction temperature PAR
PS,PAR	Suction pressure PAR
TD,PAR	Discharge temperature PAR
Tout,GC	Gas cooler temperature
PGC	Gas cooler pressure
PREC	Receiver pressure

3. Serial network configuration

Hecu CO2 is fitted with a built-in RS485 Fieldbus serial port and optional RS485 BMS serial port. The RS485 Fieldbus serial line can be connected to 2 Power+ inverters and up to 5 MPXPRO/UltraCella controllers. The addresses are defined as shown in the following table. To simplify commissioning with the default settings, it is recommended to set the MPXPRO/UltraCella controllers with consecutive addresses, starting from address 11. The following table shows the default values of serial addresses for the connected MPXPRO/UltraCella controllers.

Device	Address
Power+	1
Power+	3
MPXPRO/UltraCella 1	11
MPXPRO/UltraCella 2	12

Device	Address
MPXPRO/UltraCella 3	13
MPXPRO/UltraCella 4	14
MPXPRO/UltraCella 5	15

Serial address 3 is used for the parallel compressor inverter when this is featured in the LT application.

Note: For LT units, the two inverter addresses must be 1 and 3. To set these addresses (1 and 3), the corresponding dipswitches are set to 0 and 2, which when added to the basic address (1) will give the final addresses 1 and 3 (see the paragraph "Network address" on page 13).

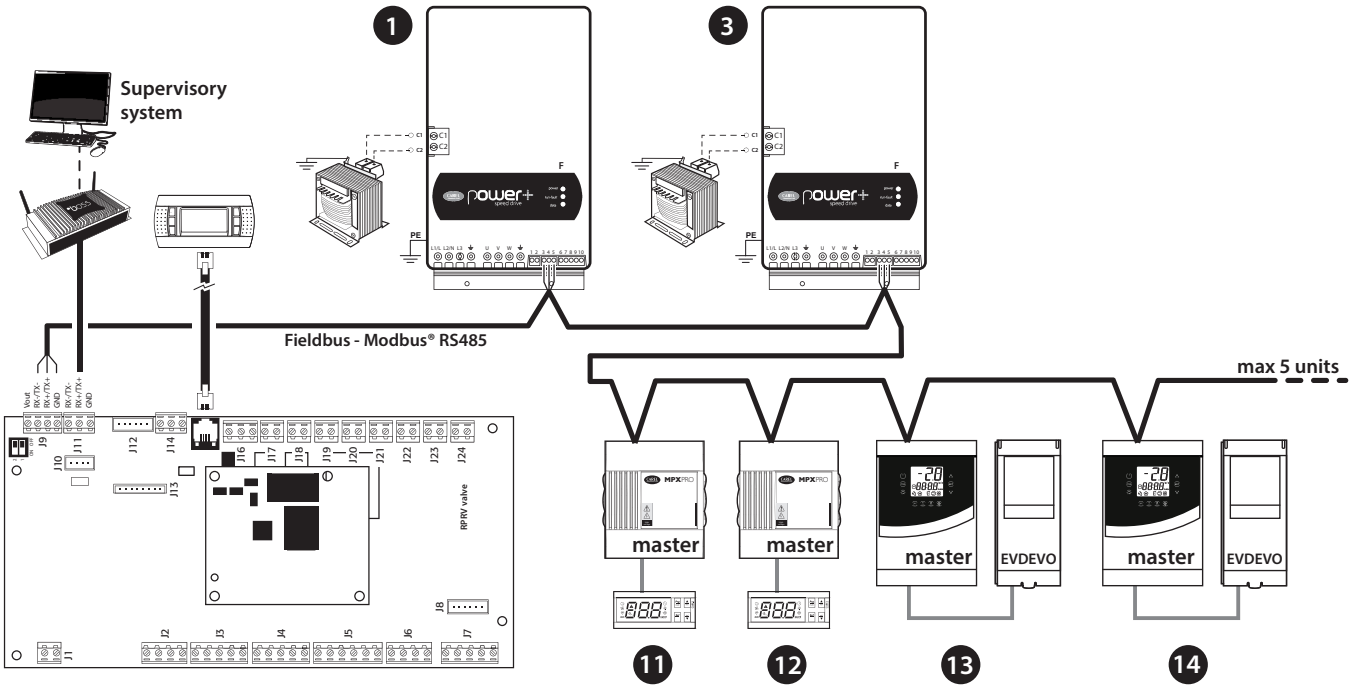


Fig. 2.n

Note: system communication is only compatible with MPXpro SW.

Important:

- A possible short circuit on the Fieldbus serial line will compromise operation of the system compressor.
- As there is no software control on the connected device (MPXpro, Ultracella), make sure during configuration to set these correctly, based on the physical address selected on the evaporator controller.
- To set the power+, MPXpro and UltraCella addresses, see the corresponding manuals.

Important: The system is only compatible with MPXpro SW revision ≥ 4.0 and UltraCella SW revision ≥ 2.0

2.10 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;
- the index of protection required for the application must be ensured by the manufacturer of the cabinet or by suitable assembly of the controller;
- if there are several condensing units connected to the same electrical panel, use a B or B+ residual current device when the compressors are controlled by inverter; these protection devices must always be installed always upstream of any AC/A/F RCDs (see the figure below):

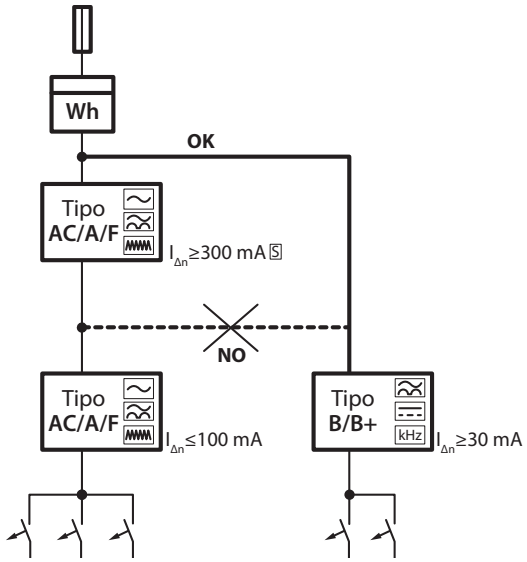


Fig. 2.o

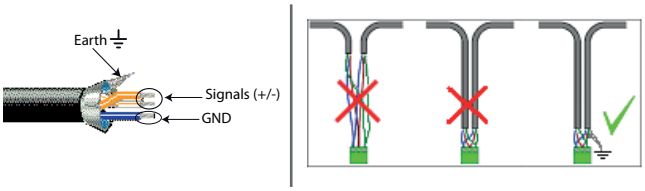
- connect any digital inputs, Lmax = 10 m;
- connect the temperature and pressure probes, Lmax = 10m;
- connect the electronic expansion valve cable the connectors J17 and J21;
- connect the inverter serial communication cable to terminal J10 (if featured);
- connect the PGDe terminal (required for commissioning) to connector J17;
- connect the power supply to the controller and the inverter, where featured;
- program the controller using the guided commissioning procedure: see the chapter on "Commissioning".
- connect the electrical loads to the relay outputs only after having programmed the controller. Carefully evaluate the maximum ratings of the relay outputs as indicated in the Technical specifications;
- connect the supervisor serial line to the optional BMS RS485 card.

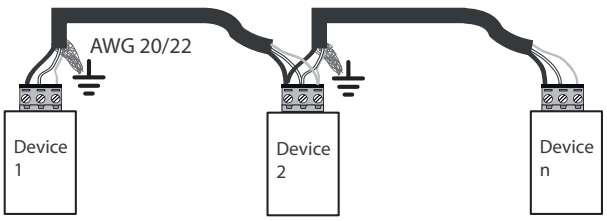
Important: avoid installing the controllers in environments with the following characteristics:
- relative humidity greater than 90% or with condensation;
- strong vibrations or knocks;
- exposure to water sprays;
- exposure to aggressive and polluting atmospheres (e.g.: sulphur and ammonia gases, saline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

Important: 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.

Important: Class A software structure: 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.

Note: serial connection starts from terminal J10 on Hecu CO2 and runs through the power+ inverter and all the MPXPRO controllers installed on the refrigerated units. The maximum number of MPXPRO controllers is 5, the limit for this application.
The following recommendations must be observed:
- connect the two twisted wires to the Tx/Rx+ and Tx/Rx- terminals;
- connect the single wire to the GND terminal;
- connect the shield to earth at one end only;
- use a shielded cable (e.g. Belden 3106A - AWG 22);
- For supervisor serial network connection only: connect a 120 Ω terminating resistor between the Tx/Rx+ and Tx/Rx- terminals on the last controller in the network (the one furthest away from Hecu).





3. USER INTERFACE

3.1 Graphic terminal

The Hecu CO2 user interface is the pGDE terminal, in the panel or built-in version. The functions associated with the 6 buttons on the pGDE terminal are the same on all screens, and are described in the table.

Functions of the 6 buttons

Button		Associated function
⚠	(ALARM)	Displays the list of active alarms and accesses the alarm log
◎		Used to enter the main menu tree
↩		Returns to the higher level screen
↑	(UP)	Scrolls a list upwards or increases the value highlighted by the cursor
↓	(DOWN)	Scrolls a list downwards or decreases the value highlighted by the cursor
↵	(ENTER)	Enters the selected sub-menu or confirms the set value

Tab. 3.a

The LEDs associated with the buttons have the following meaning.

Meaning of the LEDs

LED	Button	Meaning
Red	⚠	**Flashing:** active and unacknowledged alarms **Steady:** acknowledged alarms
Yellow	◎	Hecu CO2 on
Green	↩	Hecu CO2 powered

Tab. 3.b

3.2 Description on the display

There are three basic types of screens shown to the user:
- Main screen
- Menu screen
- Parameter display/setting screen

Main screen

The main screen is the screen that the Hecu CO2 software automatically returns to 5 minutes after the last button was pressed. An example of a main screen is shown in the figure, which highlights the fields and icons used:

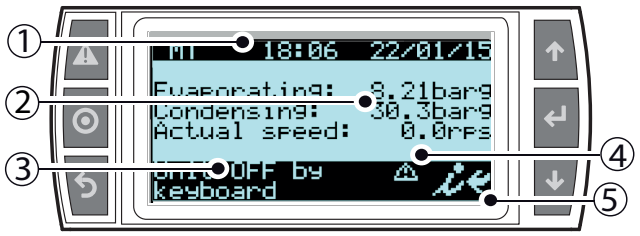


Fig. 3.a

1	Time and date
2	Main values
3	Unit status (unit off) or compressor and fan status (unit on)
4	Active alarm signals and manual operation status
5	Access to further information screens (menu branch Aa) by pressing ENTER ↵

Note:
- The information shown on the main screen varies according to the system configuration and the control value used (pressure or temperature).

Menu screen

An example of the menu screens is shown in the figure:

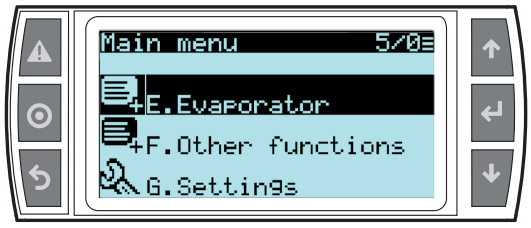


Fig. 3.b

The selected item number is shown in the top right corner. The ↑ & ↓ buttons are used to select the desired menu item, while ↵ accesses the selected item.

Parameter display/setting screen

An example of a parameter display/setting screen is shown in the figure, which highlights the fields and icons used:

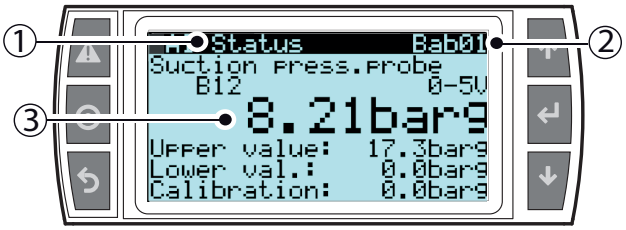


Fig. 3.c

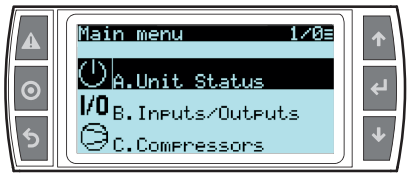
1	Menu branch identifier
2	Screen identifier
3	Parameters

The screen identifier uniquely identifies the menu branch and the screen: the first characters indicate the menu branch, while the last two alphanumeric digits identify the screen inside the menu; for example, screen Bab01 is the first screen in menu Bab

4. MENU DESCRIPTION

4.1 Main menu

To navigate the menu tree, use the following buttons:



- & : navigate sub-menus, screens and ranges of values and settings;
- : confirm and save the changes made;
- : return to the previous menu

	A.Unit Status	a.Main info	
		b.SetPoint	
		c.ON/OFF	
	B.Input/Output	a.Status	a.Dig.In.
			b.Analog In.
			c.Dig.Out
			d.Analog Out
		b.Manual man.	a.Dig.Out
			b.Analog Out
			c.USC.BLDC
			d.Vacuum
		c.Test	a.Dig.Out
			b.Analog Out
	C.Compressors	a.MT/LT compr.	a.I/O status
		b.PAR compr.(ONLY LT)	b.Regulation
			c.OP. hours
			d.Energy save
			e.Alarms
			f.Configuration
			g.Advanced
	D.Condensers		a.I/O status
			b.Regolation
			c.EEV
			d.Energy save
			e.Alarms
			f.Configuration
			g.Advanced
	E.Evaporators		a.Stato I/O
			b.Configuration
			c.Regulation
			d.EVD driver
	F.Other functions	a.Oil	a.I/O status
			b.Settings
		b.defrost	a.I/O status
			b.Settings
			c.info
		c.Economizer	a.I/O status
			b.Regulation
		d.Injection	a.I/O status
			b.Regulation
		e.Heat recovery	a.I/O status
			b.Regulation
		f.Gen. functions	a.Stages
			b.Modulation
			c.Alarms
			d.Time bands
			e.I/O status
		g.Chillbooster	a.I/O status
			b.Regulation
		h.Transcritical	a.I/O
			b.Settings
			c.EVOsettings
		i.DSS	a.I/O status
			b.Settings
	G.Configurations	a.Clock	a.Time bands
			b.Settings
		b.Language	
		c.BMS	
		d.Fieldbus	
		e.Password	
	H.Safety	a.History	
		b.Prevent	
		c.Alarm configuration	
	I.Info		
	L.Setup	a.Pre-configuration	not available
		b.Wizard	
		c.Advanced config.	not available
		d.Default	

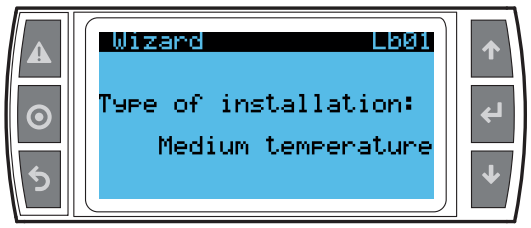
5. COMMISSIONING

5.1 Guided commissioning procedure

Hecu CO2 can be setup the first time from the pGDe or pLDpro user terminal. If the controller has not yet been configured, the user terminal shows the first screen in a guided configuration procedure, called the wizard. Otherwise, the same menu can be accessed from branch: L Setup >> b.wizard.

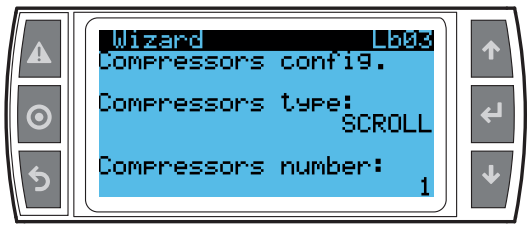
The main parameters needed for general configuration are shown one at a time. The wizard screens are all numbered in the top right corner; the following explanations refer to this number. To go from one screen to the next press ↓, to return to the previous screen press ↑.

Screen Lb01: indicates the type of system, medium or low temperature.



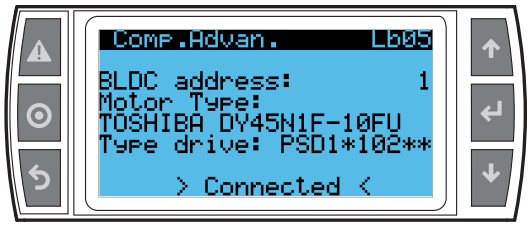
Screen Lb02: change unit of measure from SI (°C, barg) to Imperial (°F, psig).

Screen Lb03: indicates the type and number of compressors.

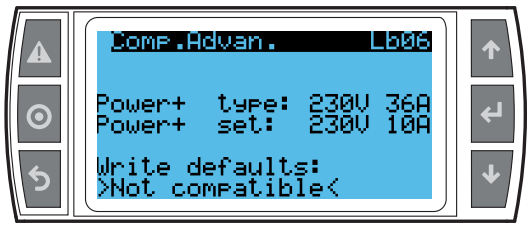


Screen Lb04: indicates the type of modulating device associated with the compressor selected in the previous screen.

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

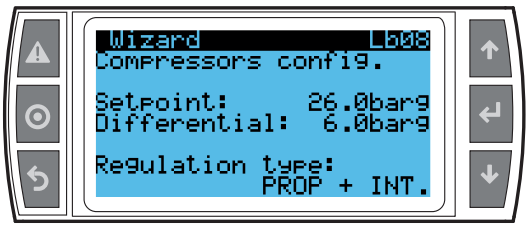


Screen Lb06: indicates whether the connected model of inverter is compatible and if so automatically downloads some typical compressor parameters to the inverter. The parameters can also be written manually by selecting "Yes" for Write default.

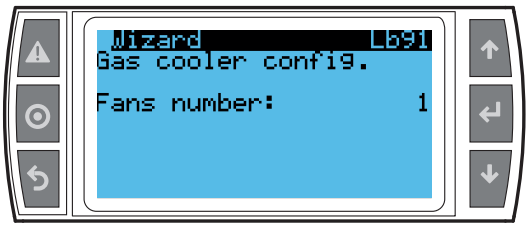


Screen Lb07: indicates compressor control based on pressure and the corresponding refrigerant.

Screen Lb08: indicates the compressor control set point and differential set as default by CAREL based on the type of application and the refrigerant. The type of control is always proportional and integral, and when exiting the wizard, control will be fixed set point only until configuring communication with the cabinets, when the floating suction pressure set point can be enabled.



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

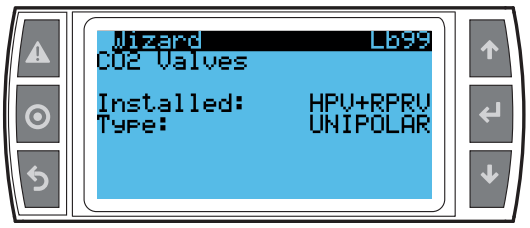


Screen Lb92: indicates the type of fans, ON-OFF, modulating PWM or 0-10 V.

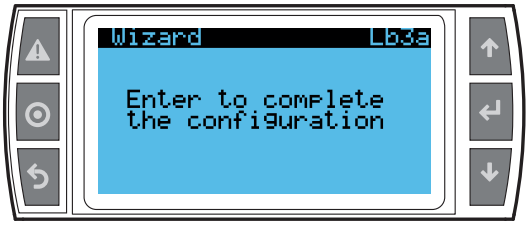
Screen Lb95: indicates gas cooler control based on temperature.

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

Screen Lb99: indicates which valves have been installed on the unit for management of CO2, and the type



Screen Lb3a: indicates the end of the wizard procedure. Pressing ENTER ends the procedure, and the system will be configured based on the options selected.



Important: wait a few seconds for the automatic default value download procedure to be completed.

6. FUNCTIONS

6.1 Unit ON/OFF

The unit can be switched on and off as follows:
- User terminal
- Supervisor
- Digital input

On-off from the user terminal and the configuration parameters are available under the main menu, branch Ac

On-off from the supervisor and from the digital input and start-up after a blackout (with specific delay, to avoid continuous starts and stops in the event of instability in the power supply) need be enabled.

On-off from the digital input is equivalent to an enabling signal, that is, if the digital input is Off the unit cannot be switched on in any other way, while if it is On, the unit can be switched on or off in any other way, with the same priority (the most recent has precedence, whatever the origin), as shown in the figure:

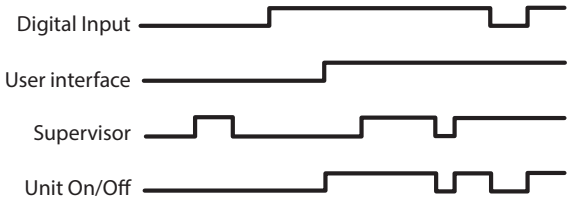


Fig. 6.a

Note: certain special conditions or functions in the Hecu CO2 software require the unit to be powered off:
- Configuration of certain parameters: e.g. inputs/outputs, configuration of compressors, inverter parameters.
- Installation of default parameters
- Manual management

6.2 BLDC compressor

A maximum of 2 BLDC compressors can be managed using the Power+ inverter. The type of compressor is selected under Compressors → Configuration (Cag01).

The BLDC compressor is managed via Modbus and works only if connected to a CAREL power+ inverter. If there is no communication with the inverter, the compressor will not be able to operate.

Below is the list of compressors that are currently available:

Medium and low temperature with PSD1 (R744)

Compressor	HPV	RPRV	Inverter	Capacity
	E2VSTA0310 unipolar stator			Tevap. = -10°C TGC = 32°C
TOSHIBA DY30	E2V09CS1C0	E2V11CS1C0	PSD101021A	0.3 - 2.8 kW
TOSHIBA DY45	E2V11CS1C0	E2V14CS1C0	PSD1012200	0.5 - 4.2 kW
TOSHIBA DY67	E2V14CS1C0	E2V18CS1C0	PSD1016200	0.7 - 6.3 kW
TOSHIBA RY100	E2V18CS1C0	E2V24CS1C0	PSD1018400	1.0 - 8.8 kW

Tab. 6.a

Medium and low temperature with PSD2 (R744)

Compressor	HPV	RPRV	Inverter	Capacity
	E2VSTA0310 unipolar stator			Tevap. = -10°C TGC = 32°C
TOSHIBA DY30	E2V09CS1C0	E2V11CS1C0	PS200122041*0	0.3 - 2.8 kW
TOSHIBA DY45	E2V11CS1C0	E2V14CS1C0	PS200122041*0	0.5 - 4.2 kW
TOSHIBA DY67	E2V14CS1C0	E2V18CS1C0	PS200152041*0	0.7 - 6.3 kW
TOSHIBA RY100	E2V18CS1C0	E2V24CS1C0	PS200184041*0	1.0 - 8.8 kW

Tab. 6.b

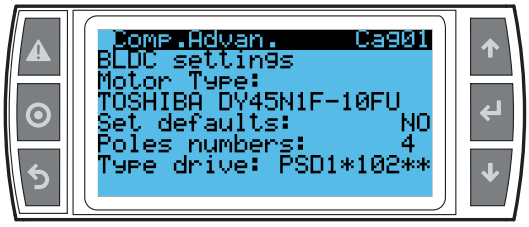
* =0: no PEC version; * =1: PEC version

Note: go to ksa.carel.com to check the updated list of compressors available, with reference to the "DC compressor availability table" +050001835.

Manual configuration

Hecu CO2 automatically downloads the optimised parameters for each model of compressor at the end of the wizard procedure.
If the model of compressor is changed or the power+ is replaced, the new system can be configured manually under **Compressors → Advanced →screen Cag01.**

Hecu CO2 and power+ must be powered and connected via serial; the address of power+ must be 1 (default).
The type of compressor is selected from the list of available compressors; the number of motor poles and the correct model of power+ are defined automatically.



Select YES for Set defaults and press ENTER.

If the model of power+ (as read by power+) is the same model or larger than the power+ selected based on the type of BLDC compressor, the default values can be written and Hecu CO2 can control the compressor. Otherwise, the message "Not compatible" will be shown.

Envelope management

The envelope is the set of operating points in which a compressor can operate safely for an indefinite time. This can be represented graphically by drawing the limits inside which the operating conditions must be maintained. The figure shows the envelope for the Toshiba DY/RY series compressors.

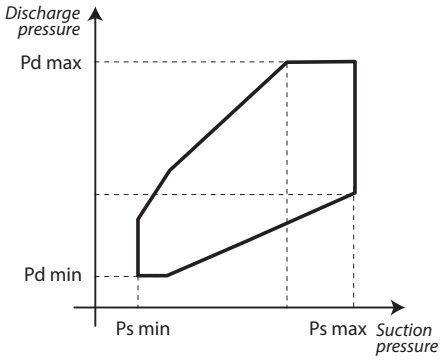


Fig. 6.b

The envelope limits consist of:
- Minimum and maximum discharge pressure
- Minimum and maximum suction pressure
- Minimum and maximum compression ratio (CR)
- Maximum current drawn by the compressor

The operating conditions are defined by:
- Suction pressure
- Discharge pressure
- Discharge temperature
- Rotation speed (rps)

The maximum discharge pressure can be limited due to construction requirements of the circuit; in this case, a limit will be applied to the maximum discharge temperature. The shape of the envelope can change as compressor speed varies, and with this the operating conditions that are considered safe for the compressor. It is therefore possible that a certain pair of operating pressures is considered safe (inside the envelope) at a certain speed, and unsafe (outside of envelope) at another speed.

If the operating conditions are close to the envelope limit or outside of this, the controller applies corrective actions in an attempt to keep the operating point inside the limits specified by the manufacturer. It is therefore possible that in such cases, the actual compressor speed does not correspond to the cooling capacity request of the temperature controller, that superheat is not maintained at the set point, or that the discharge pressure is not kept at the optimal value. If the operating conditions remain outside of the envelope for a time exceeding the alarm threshold (screen Cag55, default 60 s), the compressor is stopped and an out-of-envelope alarm is signalled.

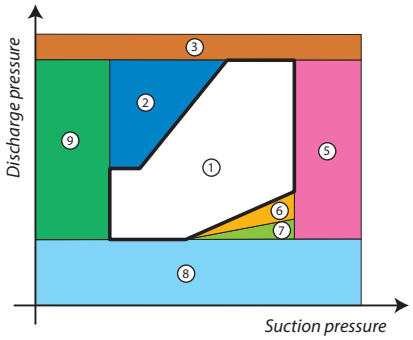


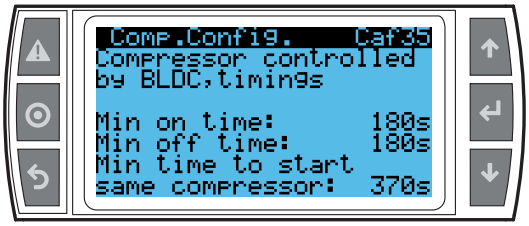
Fig. 6.c

The following zones are defined (see Figure 6.e):

1. Inside the envelope	6. Low compression ratio
2. High compression ratio	7. Low differential pressure
3. High discharge pressure	8. Low discharge pressure
5. High evaporation pressure	9. Low evaporation pressure

Timers

The timers include a minimum On time, a minimum Off time and a minimum time between two consecutive starts.
These parameters can be set on **screen Caf35:**



The logic is described in the following graph:

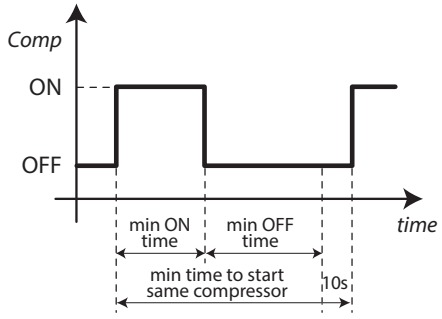
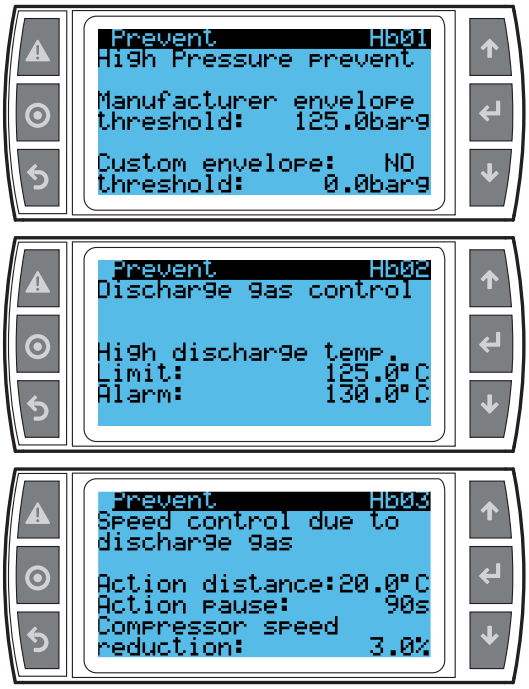


Fig. 6.d

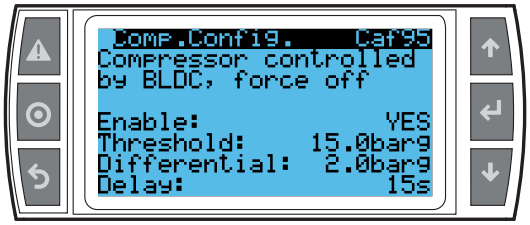
Compressor prevent function:

by managing the envelope, compressor "Prevent" actions can be applied to attempt to avoid shutdown due to the high discharge pressure and temperature thresholds.
The settings are made on the following screens:



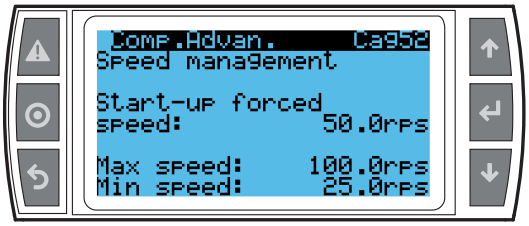
Force compressor OFF:

The compressor can be forced OFF if the suction pressure falls below the threshold for a set delay time; these parameters are set on the following screen:



Start-up

Hecu CO2 manages compressor start-up in the best way possible, adapting operating speed so as to guarantee that the desired conditions and excellent lubrication are reached very quickly.
For this reason, when starting the compressor is operated at a settable fixed speed (Cag52) for the minimum ON time, Fig. 6.c. During this stage, the out-of-envelope alarm is disabled, but speed control remains active if approaching or exceeding zone 2 (maximum compression ratio), 3 (maximum condensing pressure) or 4 (current limit).
The corresponding parameters are found under **Compressors → Advanced → screen Cag52:**



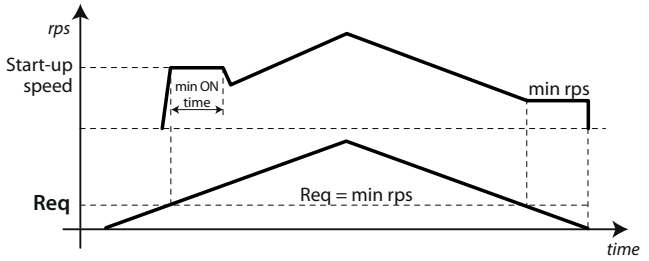
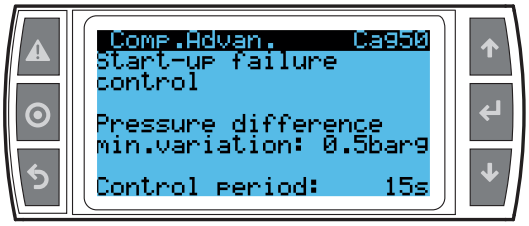
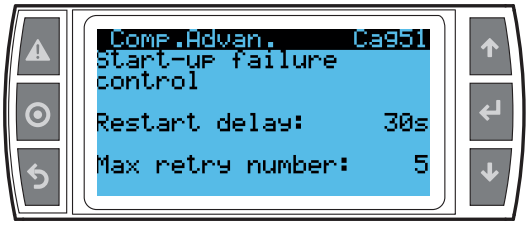


Fig. 6.e

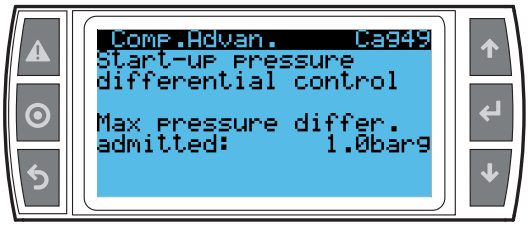
If after 15 seconds from when the compressor starts the pressure differential is less than 0.2 barg above the value measured on starting, Hecu CO2 stops the compressor and generates a "No compressor start-up" alarm. This alarm is automatically reset and Hecu CO2 tries to start the compressor five times after a 30 second delay. After the fifth attempt the alarm is no longer automatically reset.
The corresponding parameters are found under **Compressors → Advanced → screens Cag50, Cag51:**





Pressure differential during start-up

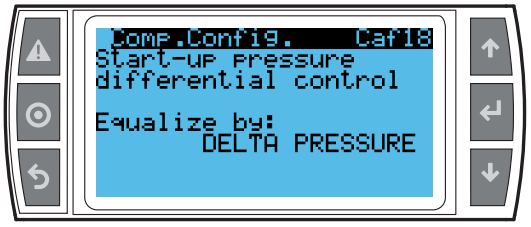
The BLDC compressor cannot start if the pressure differential is greater than a threshold defined by the compressor manufacturer. This limit depends on the maximum current delivered by the inverter. As soon as the pressure differential falls below the minimum threshold, the compressor can start.
The corresponding parameters are found under **Compressors → Advanced → screen Cag49:**

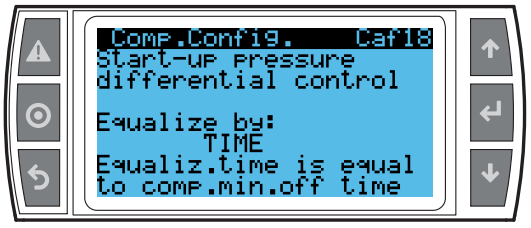


When the pressure differential is below 1 barg – 0.5 barg (fixed value), the compressor is ready to start.

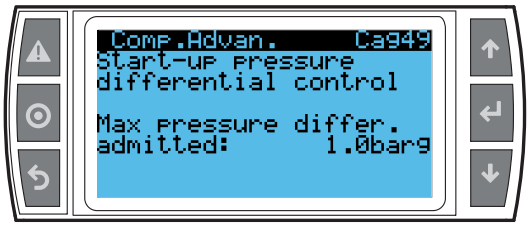
Equalisation

Hecu CO2 makes it possible to equalise the pressure across the compressor, simplifying condensing unit start-up. The equalisation mode can be selected on screen Caf18: either "DELTA PRESSURE" or "TIME".

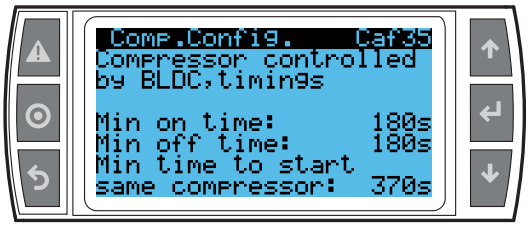




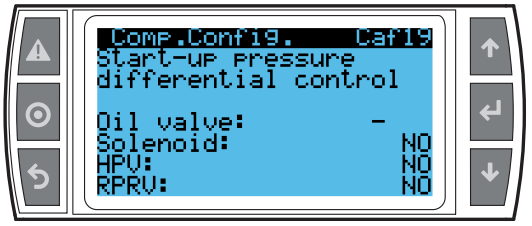
If equalisation is based on the pressure differential (delta), the controller measures the DeltaP between compressor suction and discharge pressure. When the differential is below the value set on screen Cag49, the compressor is enabled to start.

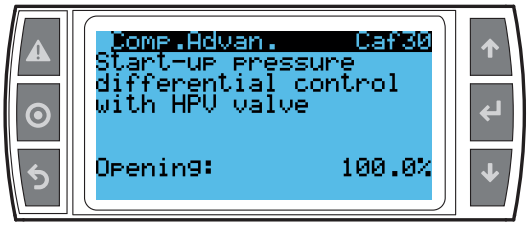


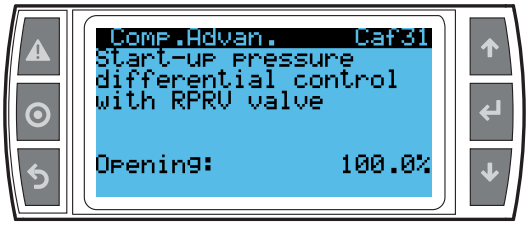
In the event of timed equalisation, the controller will not measure the pressure differential but rather will enable the compressor to start after a fixed equalisation time, equal to the minimum compressor off time, which can be set on screen Caf35.



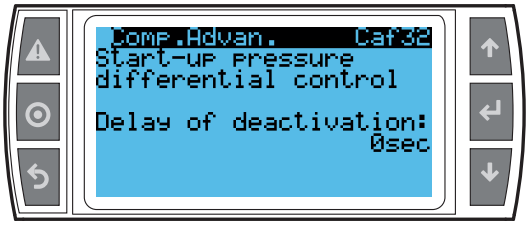
The valves used for equalisation and the percentage of opening to be maintained during the procedure can be set on screen Caf19. For Hecu CO2, the following valves can be selected: HPV, RPRV and bypass solenoid.







After compressor start-up, a delay can be set on screen Caf32 for closing the selected equalisation valves.



For the LT configuration, LT compressor equalisation can only be managed using the bypass solenoid valve.

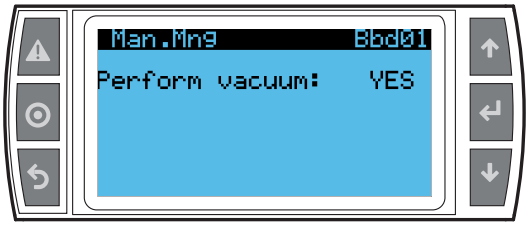
DSH control

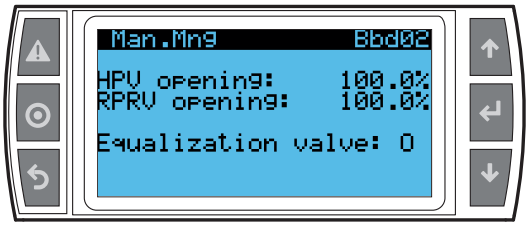
Hecu CO2 controls superheat on the compressor discharge line at the same time as superheat on the suction line.

If suction superheat is less than 0K and discharge superheat is less than 10K, a countdown starts to set off the corresponding alarm (DSH Low Liquid Flowback).
The alarm activation delay can be set on **screen Cae41** and can be differentiated for different stages of operation: compressor start-up, steady operation, defrost/washing active.

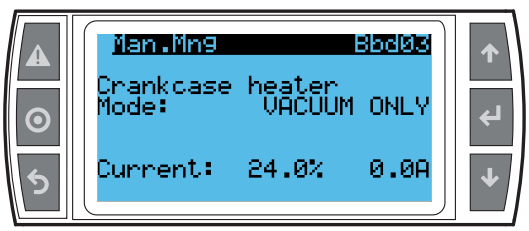
Vacuum function:

A manual procedure is available to evacuate the system; to do this, follow the steps described in the Manual Management Branch (Bbdxx).



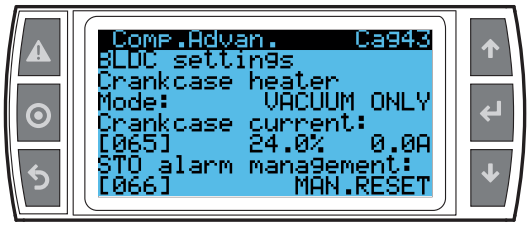


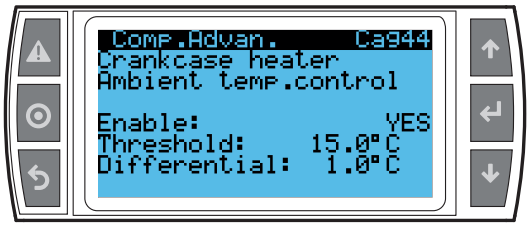
During this procedure, the compressor crankcase can be preheated (see the crankcase heating function), however at the end the initial configuration needs to be reset, on screen Bbd03 or Cag43.



Compressor crankcase heater:

Crankcase heating for BLDC compressors is required when the system is being evacuated and oil lubrication is reduced due the presence of water droplets, or when the compressor is off at low outside temperatures. This function can be activated even without using an external heater, but rather exploiting a special function implemented in the inverter that controls the compressor.
The function is selected on the following screens:





Screen Cag44 is used to deactivate the function based on the outside/ambient temperature; if "COMP OFF" mode is selected on screen Cag43.
For Toshiba compressors, the recommended values to be set for the Crankcase current (Cag43) must be between the minimum and maximum values shown in the following table:

Compressor model	Crankcase set % (min)*	Winding heat 3PH [W]	Crankcase set % (max)*	Winding heat 3PH [W]
Toshiba DY30	39	15	74	55
Toshiba DY45	39	15	74	55
Toshiba DY67	35	13	67	47
Toshiba RY100	24	15	46	55

Tab. 6.c

(*) The crankcase current percentage value and the three-phase heat generated in the motor windings (minimum and maximum) are calculated at an ambient temperature of 25°C.
The current value to be applied can be adjusted depending on the outside temperature, considering that it is not possible to exceed a temperature of 55°C in the rotor windings when the unit is off.

6.3 Compressor control

Control can be proportional or proportional + integral (P, P+I). The corresponding parameters are found under **Compressors → Control → screen Cab14.**

The set point is in the centre of the band. Proportional control is illustrated in the following figure:

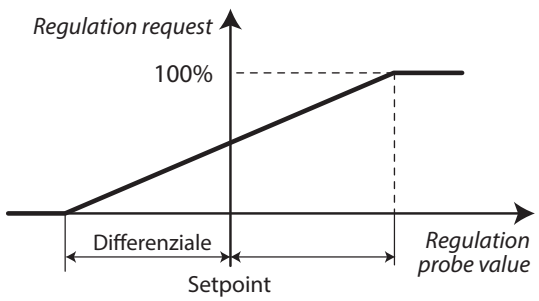


Fig. 6.f

With proportional + integral control, the integral time is summed to the effect of proportional control, giving a null control error in steady operation. This type of control is illustrated in the following figure:

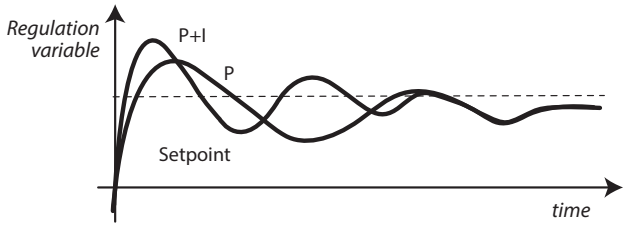


Fig. 6.g

The integral action depends on time and the deviation from the set point. The integral time represents how fast integral control is implemented:
- Low values bring fast actions yet more instability
- High values bring slower actions and more stability

The values should not be set too low, to avoid system instability.

Two types of control can be set, in loop
Compressors → Control → screen Cab01
- Fixed set point
- Floating set point

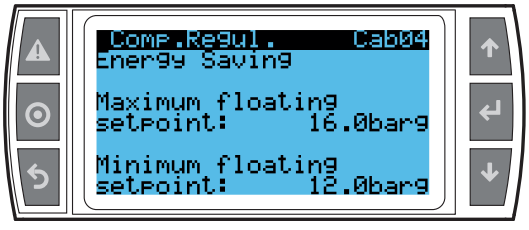
Floating set point

This software function is available by exploiting serial communication with the evaporators. Serial communication allows information to be exchanged in real time between the main Hecu CO2 controller and the MPXPRO devices.

Note: the MPXPRO controllers installed on the evaporators implement the Smooth Lines function (see MPXPRO manual +0300055). This function significantly reduces the number of ON-OFF cycles in traditional control by modulating the evaporator temperature using an electronic expansion valve and adapting the superheat set point using appropriate PI control based on the effective control temperature.

This function can be enabled and configured manually or automatically.
- The automatic procedure involves the Fast Commissioning operation described in chapter 7, which automatically configures the control parameters on both the condensing unit and the evaporators, using the default values optimised by CAREL, yet amply modifiable.
- To configure the function manually, make sure that there is a serial connection with the MPXPRO controllers on the evaporators, and choose the type of control on **screen Cab01**. The Smooth Lines function will then need to be configured on the MPXPRO controllers, as described in the next chapter.

The unit floating suction pressure set point can vary between a settable minimum and maximum value. The minimum and maximum limits for the floating set point are shown on **screen Cab04**, in line with the limits set on **screen Cab02.**



Hecu CO2 uses an advanced algorithm to adapt the condensing unit suction pressure set point based on the request from each evaporator, then weighing it according to evaporator capacity. Significant variations in request due to certain evaporator operating states, such as defrost, are managed by Hecu, maintaining fine, stable control.

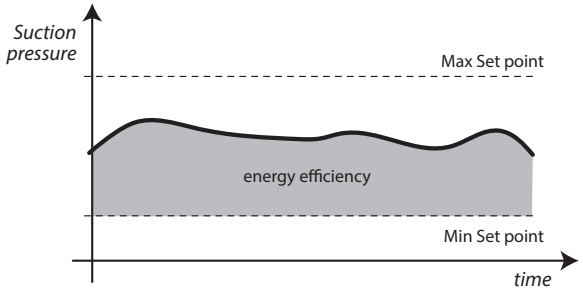
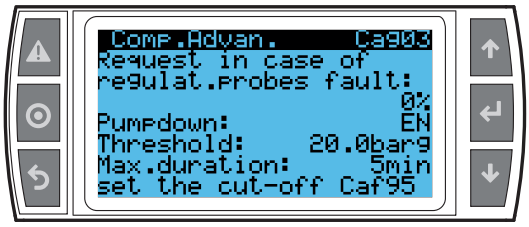


Fig. 6.h

The floating set point will then be managed using proportional + integral control, the parameters of which can be set on **screen Cab14**.

Pumpdown

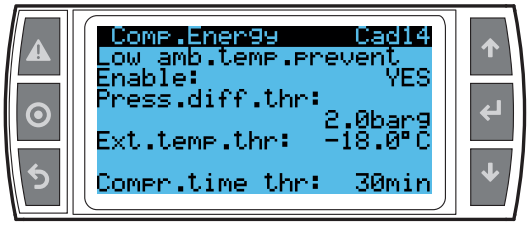
The compressor OFF function by pumpdown can be enabled on screen Cag03. This function keeps the compressor on until the pumpdown pressure threshold is reached, within the maximum time set on the same screen.



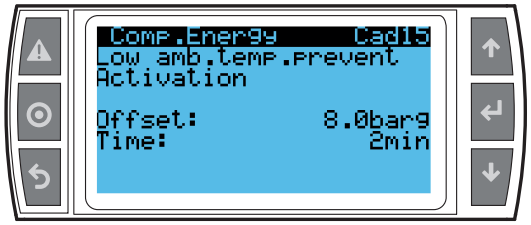
Low ambient (outside) temperature prevention:

This function prevents the unit from stopping due to low outside temperatures.
The function can be activated if all of the following conditions are true:
1. Enabling selected
2. The evaporator request is greater than 0% (MPXPRO or ULTRACELLA connected) or "Enable compressor from DI" is ACTIVE or the differential pressure threshold (Prec - Psuc) is less than the set value (default 2 bars).
3. The outside temperature is less than the value set (default -18°C)
4. The compressor request is = 0% and the compressor speed is = 0 for longer than the set time (default 30 minutes)

The settings are made on the following screen

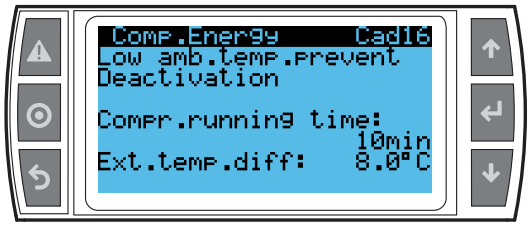


When the function is activated:
1. The compressor set point is decreased by a settable value (default 8 bars) within the time set on the same screen



The function can be deactivated when at least one of the following conditions is true:

1. Compressor control OFF
2. Active compressor alarms
3. The cut-off threshold has been reached (P suction < cut-off threshold)
4. The evaporator request is equal to 0% (from MPXPRO or ULTRACELLA) or "Enable compressor from DI" is NOT ACTIVE (OFF due to control)
5. The compressor has been active for longer than a settable timeout (default 10 minutes)
6. The suction pressure is greater than the operating set point
7. The outside temperature is greater than the set threshold (default -18°C) + the differential (default 8°C) set on the following screen



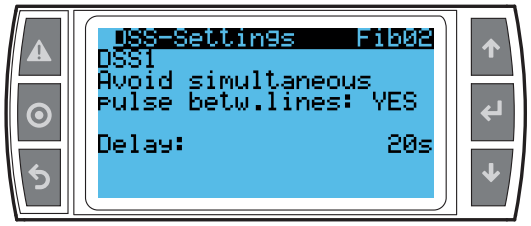
When the function is deactivated:
The compressor set point is reset to its normal value over a set time (default 2 min, see time on screen Cad15).

6.4 Compressor management on LT units (DSS and independent)

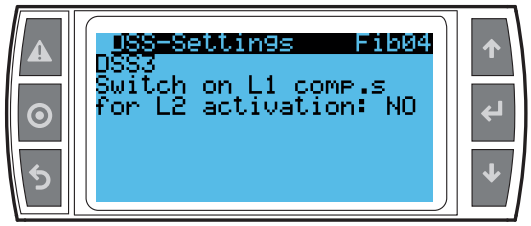
Management with DSS1 and DSS3

This involves synchronised management of the compressors. It is recommended to activate both DSS1 and DSS3 so as to avoid simultaneous compressor starts and optimise operation of the LT stage in all operating conditions.
Below is a description of the functions that can be set:

DSS1: screen Fib02
This function prevents the two compressors from starting simultaneously. Once the required percentage for activation has been reached, the LT compressor waits for the parallel compressor to start, and then is turn started after a set delay.



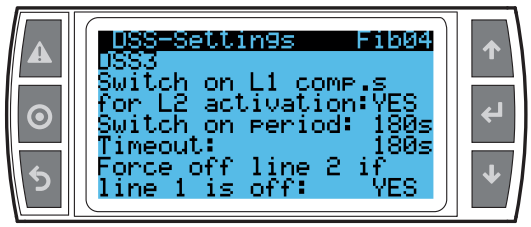
DSS3: screen Fib04
Start the parallel compressor (L1) when starting the LT compressor (L2). If NO is selected, the parallel compressor cannot start without a request.



When DSS1 is enabled, the following parameters remain hidden on screen Fib04:

- Switch on period: 180s (hidden). During this period, the parallel compressor request is forced to 50% to allow it to be started;
- Timeout: 180s (hidden). The LT compressor waits for the parallel compressor to start, however is switched on in any case after the set timeout has elapsed;
- Force off line 2 if line 1 is off: YES (hidden). The LT compressor (L2) is switched off when the parallel compressor (L1) is switched off.

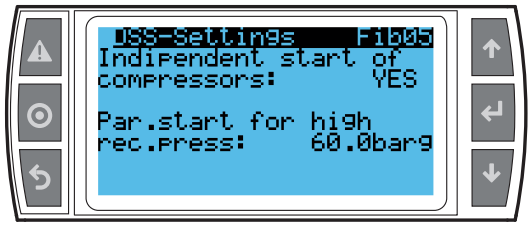
When DSS1 is NOT enabled, the following parameters can be modified on screen Fib04:



- Switch on period: 0-999s (def 180, this is the time that the parallel compressor request is forced to 50% to allow it to start);
- Timeout: 0-999s (def. 180s; this is the time that the LT compressor waits for the parallel compressor to start, after the set timeout it is switched on in any case);
- Force off line 2 if line 1 is off: NO/YES.
  - YES → forces the LT compressor off if the parallel compressor cannot start.
  - NO → forces the LT compressor off if there is an alarm on the parallel compressor.

Independent management

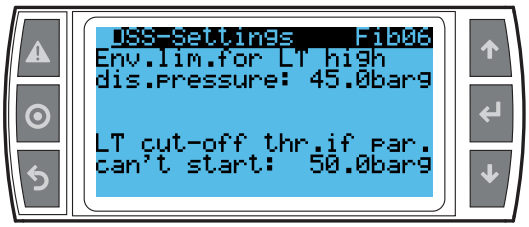
Activating independent management on screen Fib05 automatically disables DSS1 and DSS3, and the compressors can be switched on/off independently, based on their own request. Some safety logic ***s*** also guaranteed.
Below is a description of the functions that can be set.



By selecting YES, functions DSS1 and DSS3 are automatically disabled and:

- the LT compressor can start even if activation of the parallel compressor is NOT requested;
- the LT compressor cannot start if the parallel compressor is off due to timing or alarms;
- the Parallel compressor is not activated if the LT compressor is not operating (no LT required, LT compressor off due to timing or alarms).

Safety functions (active only if "Independent start of compressors" is set to YES):



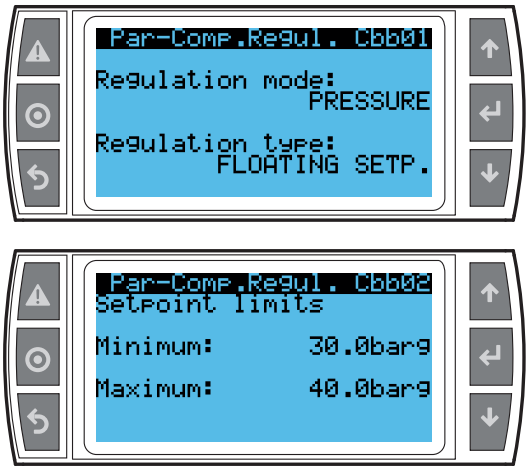
Par. start for high rec. pressure:	Force the parallel compressor on in the event of high pressure in the receiver even if the LT compressor is switched off due to no request or alarms (default threshold: 60 barg, settable).
Env. lim. for LT high dis. pressure:	High pressure prevention based on the LT compressor envelope. Sets the condensing/discharge pressure limit at the selected value, recommended threshold 45 barg (settable). When the LT compressor discharge pressure exceeds the set threshold, the controller begins to reduce compressor speed in order to return to normal operating conditions (i.e. inside the envelope). If the discharge pressure remains above the set threshold, the compressor can be switched off due to the envelope alarm (after the standard timeout for the envelope alarm). Threshold=0barg → function not active.
LT cut-off thr. If par. can't start:	Cut-off due to LT compressor high pressure. The function is activated when the parallel compressor is off due to timing or alarms (default 50 barg, settable).

Tab. 6.d

Parallel compressor: floating set point

The receiver pressure and therefore the parallel compressor set point is calculated according to the following relationship:

$$P_{rec} = \sqrt{P_{suc,LT} \cdot P_{out,GC}}$$

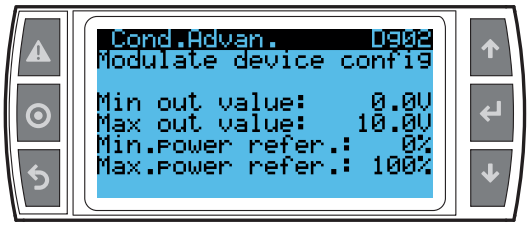


6.5 Fans

Hecu CO2 can manage up to two fans with a speed modulation device, which may be an inverter or a PWM phase control device. In the same way as for the compressors, fan control can be proportional or proportional plus integral, based on pressure or temperature.

Fan operation with modulating device

If the fans are controlled by a modulating device, the meaning of the parameters that associate the minimum and maximum values of the device's modulating output and the minimum and maximum capacity of the modulating device on screens Dg01 and Dg02 is illustrated in the following examples.



Example 1: minimum modulating output value 0 V, maximum value 10 V, minimum modulating device capacity 0%, maximum value 100%.

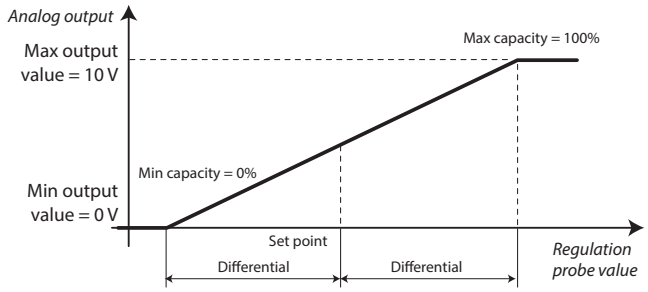


Fig. 6.i

Example 2: minimum modulating output value 0 V, maximum value 10 V, minimum modulating device capacity 60 %, maximum value 100%.

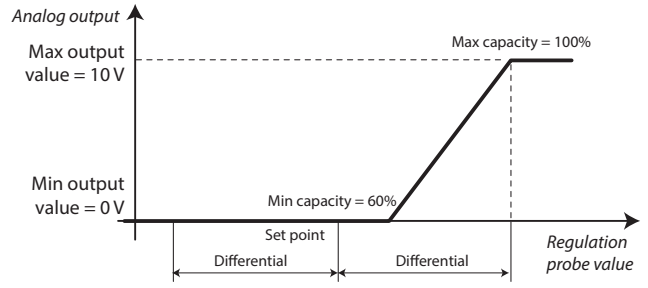


Fig. 6.j

Example 3: minimum modulating output value 2 V, maximum value 10 V, minimum modulating device capacity 60 %, maximum value 100%.

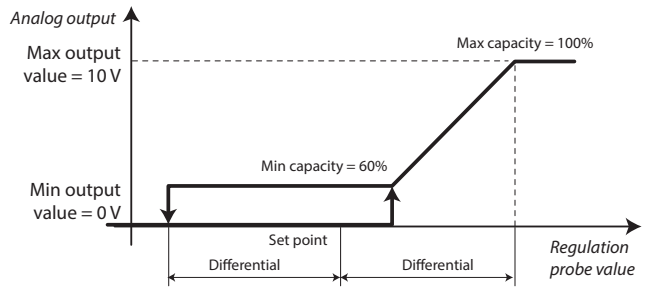


Fig. 6.k

Cut-off

Hecu CO2 manages a cut-off control function for the fans; the function can be enabled and the related parameters set in main menu branch Db05. The operating principle of the cut-off function is shown in the figure:

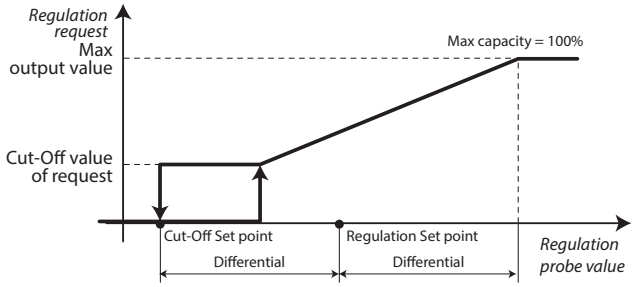
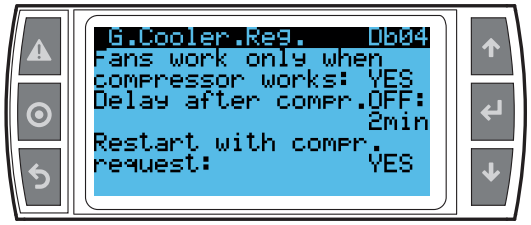


Fig. 6.l

A percentage of the control request and a cut-off set point can be set. When the control request reaches the set cut-off value, this value is kept constant until the control value falls below the cut-off set point, after which it falls to 0 % and remains there until the request exceeds the cut-off value again.

Fans with compressor OFF

The fans can be stopped after a delay from when the compressor is switched OFF. Furthermore, they can be restarted before the compressor starts, when the request is increasing. These settings are made on screen Db04.



Speed up

Hecu CO2 can manage the speed up function, used to overcome the initial inertia of the fans. The function can be enabled and the related parameters set in main menu branch Dg13.
If speed up is enabled, a start time can be set in which the fan speed is forced to 100%. If the outside temperature sensor is used, moreover, a threshold can be set (with reset differential) below which speed up is disabled, so as to not drastically lower the condensing pressure at start-up.

Floating condensing pressure set point

For the condenser line, the floating set point (enabled on screen Dd05) is based on the outside temperature. The floating condensing pressure set point is achieved by adding a constant programmable value to the outside temperature and limiting the resulting value between a settable minimum (Db02) and the set point defined on screen Dd06, as shown in the figure:

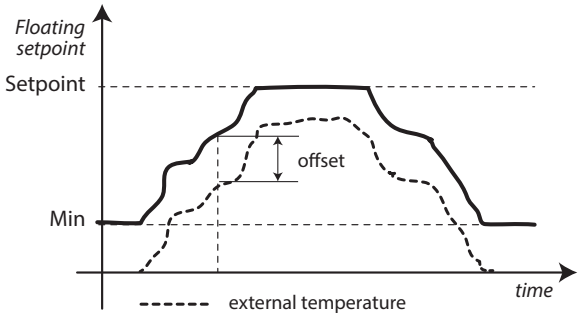


Fig. 6.m

6.6 Oil management

Oil injection

Oil return is a critical factor when using BLDC compressors. Hecu CO2 can manage three different solutions for injecting return oil to the compressor. The related configurations can be set on **screen Fab15**.

Capillary valve

The simplest solution is to use a capillary valve, with fixed opening, calibrated based on rated conditions. This solution however creates inefficiencies, by injecting or less oil than required by the compressor.

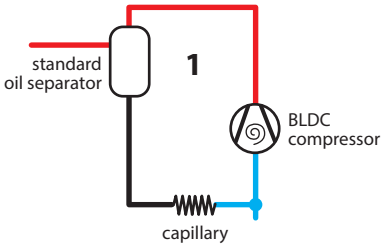


Fig. 6.n

Electronic expansion valve (EEV COMP SPEED)

This solution involves a CAREL expansion valve. Valve opening is calibrated based on the BLDC compressor operating conditions, adjusted proportionally based on compressor speed.
A standard oil separator can be installed to exploit this function. The control algorithm is represented in the following graph, and the parameters can be configured on **screen Fab18**.

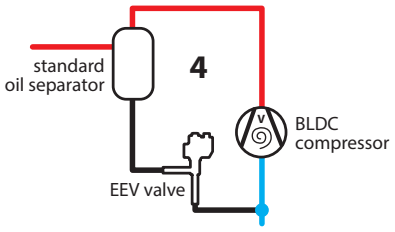


Fig. 6.o

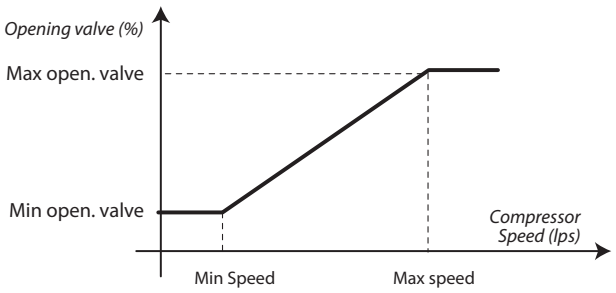


Fig. 6.p

Electronic expansion valve (EEV LEVEL MNG)

This solution involves a CAREL expansion valve. The valve opening is calibrated based on normal system operating conditions. This solution is very efficient from an energy viewpoint, as it injects the exact quantity of oil needed by the compressor. In order to use this function, an advanced oil separator needs to be installed, featuring a level sensor that defines three states via two digital inputs, configurable on **screens Faa55, Faa56**. An advanced algorithm calculates valve opening based on the time that elapses between the various states, comparing this against the previous measurements. The objective is to replicate the oil level inside the compressor by measuring the amount in the separator and keeping this level stable over time.

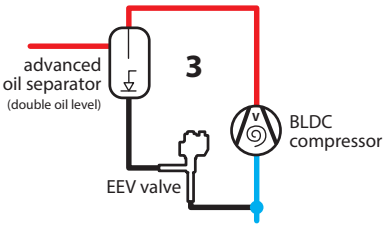


Fig. 6.q

On **screen Fab20**, two preventive thresholds can be set for the high and low oil level (Emergency HL and LL). If the oil remains at this level for the set time, the valve will open to the maximum (HL) or minimum (LL), moving at 1 step/sec.

Electronic expansion valve controlled by external driver (EEV COMP SPEED)

This solution features an expansion valve driven by an external driver (EVDevo, EVD mini), configured as a positioner that receives the 0...10 V control signal from the Hecu unit.
This is exploited when integrated drivers for the oil valve cannot be used on Hecu CO2 as they are reserved for transcritical valves. Valve opening is calibrated based on the BLDC compressor operating conditions (MT or LT, not parallel), adjusted proportionally based on compressor speed.
A standard oil separator can be installed to exploit this function.
The parameters can be configured from screens Bad14 for assigning the analogue output, and Fab15 to enablòe the function.

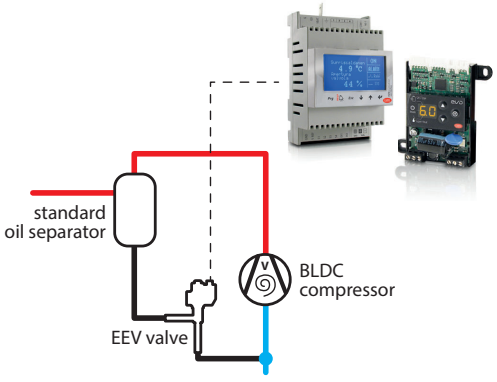
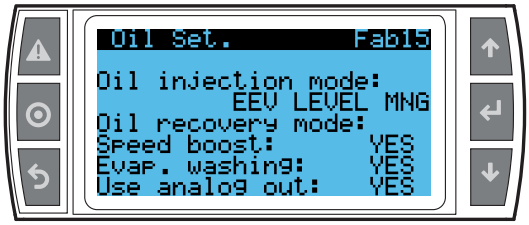


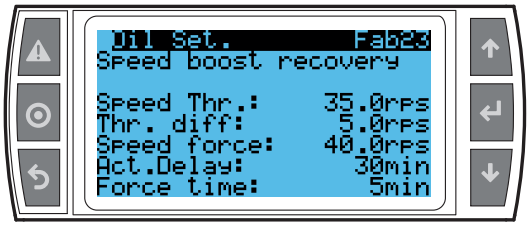
Fig. 6.r

Oil speed boost

This function boosts the return of oil by operating the compressor at a fixed speed for a set time, thus recovering the oil spread along the refrigerant circuit.
This override function is activated if the following conditions are true, see **screens Fab15, Fab23**:

- Speed boost: YES
- Compressor speed < minimum threshold
- The previous conditions remain for a set time





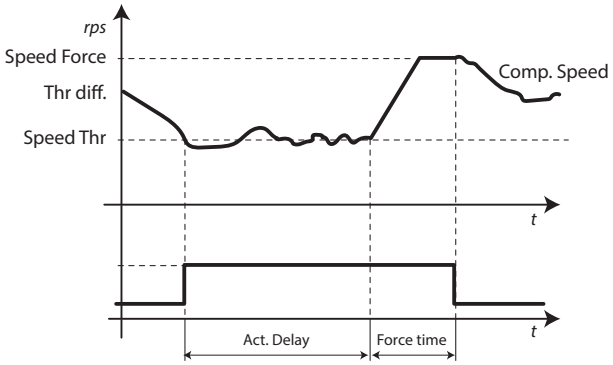


Fig. 6.s

Oil Recovery Washing

Another function available on Hecu CO2 to assist oil return to the compressor involves washing the evaporators. **This function uses serial communication between Hecu CO2 and the MPXPRO controllers, and the electronic expansion valves on the evaporators**. The oil recovery washing function sets the superheat set point to 0K for a settable time t1 [default 3 minutes] in order to retrieve the oil spread along the refrigerant circuit; the valve will thus open further, "washing" the evaporator and flushing the accumulated oil back the compressor.

Note: to make this function more effective, the electronic expansion valve on the evaporator opens fully at the start of the recovery washing cycle and then its position is controlled automatically based on the new superheat set point.

td is the time at the end of a washing cycle for which compressor speed remains fixed, and valve opening returns to the same position as prior to activation of the function [default 2 minutes]. If this value is set to 0, at the end of a washing cycle the system will restart without overriding compressor speed and keeping the valve at the previous opening position for a set time. During a washing cycle, the following conditions are set:

- Oil recovery washing: ON
- Smooth Line: OFF
- P3: 0K
- P7: -10K
- St: -50°C

The following diagram explains operation and control of the electronic expansion valve and the superheat set point:

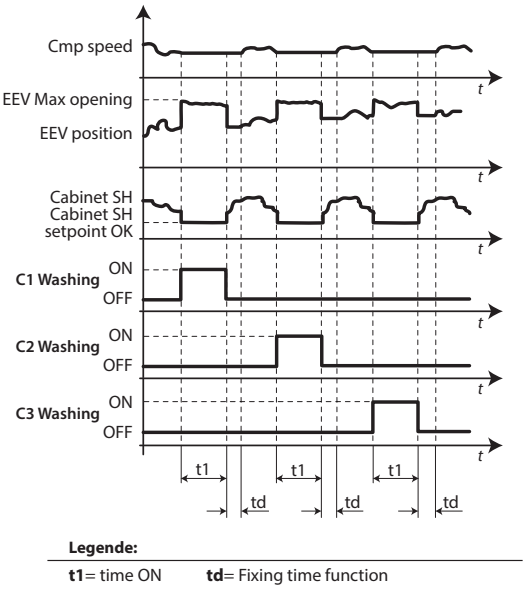
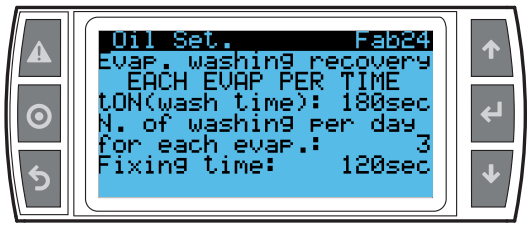


Fig. 6.t

Washing of individual cabinets can be configured exclusively in sequential mode.

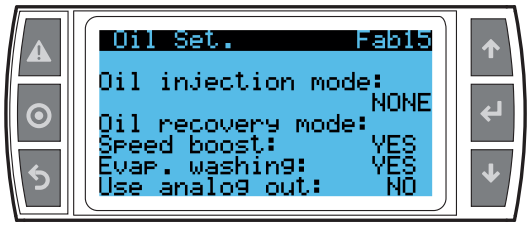


tON is the duration of each single washing cycle. "N. of washing per day in each evap." is the number of washing cycles per day for each evaporator. Fixing time is the transition time at the end of each single washing cycle to keep the system in stable conditions.
If using evaporators managed by non-Carel controllers (third party devices), a digital output can be used, as described in the following paragraph.

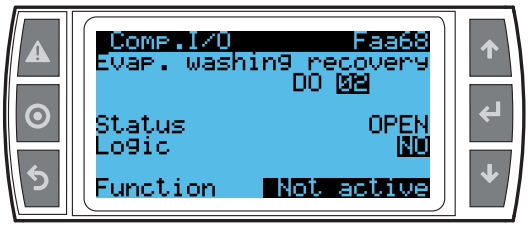
Digital output for cabinet washing

The purpose of this function is to exploit the "Hecu wash" function to enable a digital output that can be used to "wash" evaporators with third-party controllers.

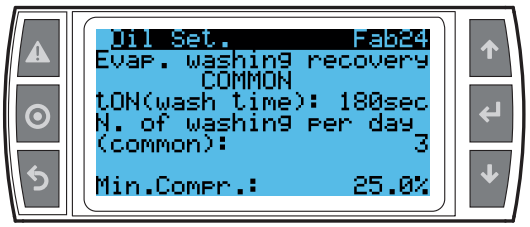
To activate this function, the evaporators with MPX/UltraCella controllers must not be enabled, then on screen Fab15 enable the washing cycles as shown below:



Then select the digital output on screen Faa68.



The DO will be used by third-party controllers (evaporators) to activate cabinet set point compensation: for example, from 5°C to -50°C. This action will open the expansion valve and at the same time the superheat control will remain active to avoid the return of liquid on the unit's suction line. The number of wash cycles is selected on the following screen.

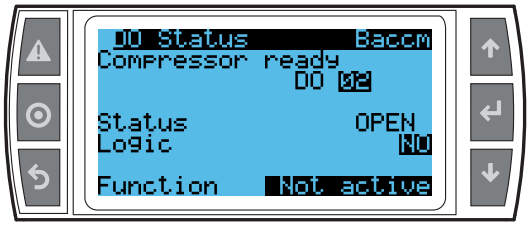


Note: this function will be less effective than the one Carel provides via serial connection of the evaporators managed by MPXPRO and UltraCella controllers.

Compressor "ready" digital output

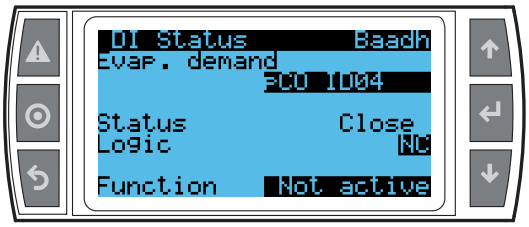
On screen Baccm, a digital output can be selected that is activated when the compressor is "ready". This means that it is able to deliver its cooling capacity.
On stand-alone units, this can be used as a "control" digital input on the cabinets to improve control/synchronization between the condensing unit and the evaporators.
The function is NOT active when:

- The compressor is off due to timers (minimum Off time or timer between starts)
- The compressor is off due to cut-off
- On LT units, if the compressor is off due to the DSS function
- The compressor is off due to an alarm, with the following exceptions (to prevent the unit from shutting down):
  - Low suction pressure alarm
  - Low SH



Evaporator requests

To roughly synchronise the condenser unit with evaporators managed by third-party controllers (for example, when defrosting),
a digital input can be configured (on screen Baadh). This means that the compressor does not start until the DI is activated, even if the suction pressure is higher than the set point.
The DI is configured on the following screen:
Screen Baadh



6.7 HPV valve management

Management of the HPV valves, which separates the high pressure part of the system from the medium pressure part, determines the transcritical and subcritical operating mode of the unit. In transcritical mode, the valve is controlled so as to obtain maximum efficiency, while in subcritical mode subcooling is controlled.
The HPV valve has proportional + integral (PI) control, with the set point based on an optimal gas cooler pressure value calculated using the gas cooler pressure and temperature, as described below. Enabling HPV valve management means also enabling system transcritical mode.

The HPV valve can be managed directly by Hecu CO2 via the driver integrated into the controller. The algorithm for calculating the HPV valve control set point can be optimised or customised by the user, using the parameter settings.

Optimised set point calculation

The optimised set point is calculated as shown in the figure.

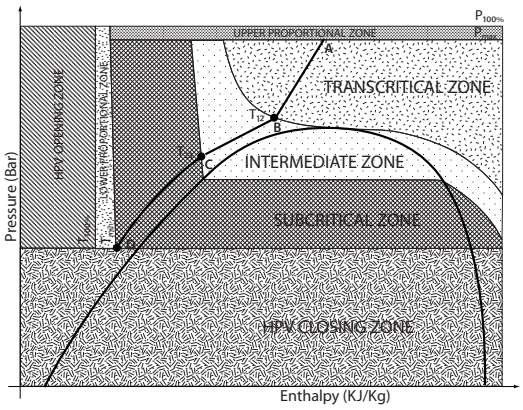


Fig. 6.u

The HPV valve is managed according to the area identified, based on the gas cooler outlet temperature and pressure values. To define the zones, the two pressure values $P_{100\%}$ and P_{max}, the two temperatures T_{12}, T_{23} relative to points B and C in the figure, and the two temperatures T_{min} and $T_{100\%}$ need to be set. In the following diagram, T_{gc} and P_{gc} refer to the gas cooler temperature and pressure.
The behaviour of the HPV valve in the different zones is as follows:

- **Transcritical zone**, identified by $T_{gc} \geq T_{12}$ and $P_{gc} \leq P_{max}$: the valve works with proportional + integral (PI) control so as to maintain the maximum COP, determined by the optimal pressure P_{opt} calculated as a function of the gas cooler outlet temperature T_{ogc}.
- **Subcritical zone**, identified by $T_{min} \leq T_{gc} \leq T_{23}$: the valve works with PI control so as to keep subcooling constant.
- **Transition zone**, identified by $T_{23} \leq T_{gc} \leq T_{12}$: the valve works with PI control, with a pressure set point identified as the intersection of the two points B and C in the figure, obtained by calculating the optimal pressures at the limit of the transcritical and subcritical zones. This area has the purpose of avoiding discontinuity in the transition between the two zones.
- **Upper proportional zone**, defined by $P_{max} < P_{gc} < P_{100\%}$: the valve works with proportional control only between the opening reached at pressure P_{max} and the maximum opening at pressure $P_{100\%}$. If the pressure decreases, the opening of the HPV valve remains constant until it returns into the transcritical zone, where control resumes as described previously.
- **Lower proportional zone**, defined by $T_{100\%} < T_{gc} < T_{min}$: the valve works with proportional control only between the opening reached at temperature T_{min} and the maximum opening at temperature $T_{100\%}$. If the pressure increases, the opening of the HPV valve remains constant until it returns into the subcritical zone, where control resumes as described above. This operating mode can be disabled by parameter.

Custom set point calculation

The custom set point differs from optimised control in that the curve in the subcritical phase is a straight line and is defined by the user, and therefore the bands and the set point can be customised by the user. The behaviour in the remaining bands is as described for the optimised algorithm.

HPV valve auxiliary functions

HPV valve management includes some auxiliary functions:

- **Pre-positioning**: when switching the unit ON, the HPV valve remains in a fixed position set by parameter for a set time, so as to be able to quickly increase the pressure in the receiver. This procedure is reactivated whenever the unit switches OFF or the HPV valve is reset to the minimum position when all of the compressors stop (opt.).
- **Close valve with compressors off**: if all of the medium temperature compressors are switched off, the HPV valve can move to the minimum opening when OFF, which can be set by parameter. When a compressor restarts, valve control resumes, with the pre-positioning procedure described in the previous point.
- **Minimum and maximum opening values**: the minimum opening when OFF (from keypad, digital input or supervisor) and when ON can be differentiated, while there is only one maximum opening value.
- **Maximum percentage variation**: the valve movement cannot exceed the set maximum percentage variation per second.
- **Set point filter**: the HPV valve control set point is calculated taking into account the average of the last ***n*** samples (maximum 99), so as to avoid sudden variations due to the high variability of the gas cooler outlet temperature.
- **Minimum set point**: a minimum value can be set for the HPV valve set point; the set point can never fall below this value, regardless of the parameters entered, so as to protect the compressors.
- **Set point deviation alarm**: if the gas cooler pressure remains too far away from the calculated set point for too long (settable threshold and delay), an alarm can be signalled.

Receiver pressure control using the HPV valve

If the receiver pressure falls below the set minimum operating pressure threshold, the dynamic set point calculated for the HPV valve can be adjusted, so as to increase the pressure inside the receiver. An offset proportional to the deviation from the minimum threshold is subtracted from the calculated set point, so that opening the HPV valve further increases the pressure in the receiver. The offset is directly proportional to the deviation from the minimum operating threshold, as shown in the figure:

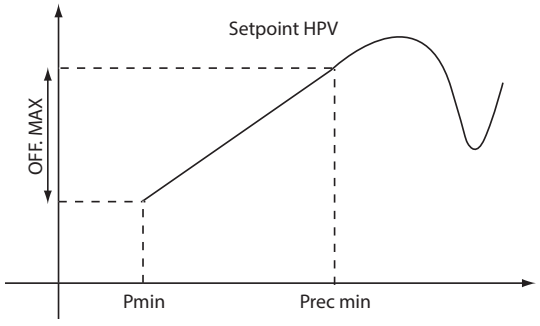


Fig. 6.y

Vice-versa, if the receiver pressure rises above the set maximum operating pressure threshold, the dynamic set point calculated for the HPV valve can be adjusted, so as to decrease the pressure inside the receiver.

An offset proportional to the deviation from the maximum threshold is added to the calculated set point, so that closing the HPV valve further decreases the pressure in the receiver.

The offset is directly proportional to the deviation from the maximum operating threshold, as shown in the figure:

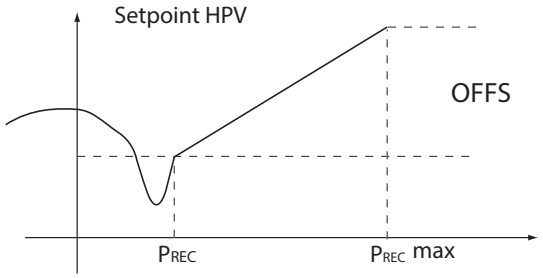


Fig. 6.v

Summary of HPV valve inputs, outputs and parameters

Below is a summary of the inputs/outputs and parameters used, together with the corresponding configuration screens. For details, see Appendix A.1.

Summary of HPV valve inputs, outputs and parameters

	Screen	Description
Analogue inputs	Bab07, Da39	Gas cooler pressure
	Bab10	Gas cooler outlet temperature
	Bab09, Da40	Gas cooler backup pressure
	Bab15	Backup outside temperature
Digital inputs	Baade, Fha04	HPV valve alarm
Analogue outputs	Bad02, Fha06	Valve HPV output
Digital outputs	---	---
Parameters		
Set	Fhb01	Enable HPV valve management, i.e. enable transcritical operating mode
		Select the type of algorithm to be applied for calculating the pressure set point
Definition of the zones	Fhb05-06	$P_{100\%}$ upper pressure limit
		P_{max} pressure for the definition of the upper proportional zone
		P_{critic} optimum pressure calculated at the transition temperature between the intermediate zone and the transcritical zone
		T_{12} limit temperature between transcritical zone and intermediate zone
		T_{23} limit temperature between intermediate zone and subcritical zone
		T_{min} temperature for the definition of the lower proportional zone
	Fhb07	$T_{100\%}$ temperature for the definition of the valve complete opening zone
		Subcooling delta for optimised control
		Coefficient for determining the custom curve
Parameters		
Control	Fhb08	Proportional gain for proportional + integral HPV valve control
		Integral time for proportional + integral HPV valve control
Safety features	Fhb02	Minimum HPV valve opening with unit ON
		Minimum HPV valve opening with unit OFF
	Fhb04	HPV valve opening at start-up during pre-positioning
		Pre-positioning duration
	Fhb09	Enable filter action on HPV valve set point
		Number of samples
	Fhb13	HPV valve safety position
	Fhb14	Offset to be applied to the outside temperature in the event of a gas cooler temperature probe error
	Fhb15	Enable HPV valve safety procedures
	Fhb16	High receiver pressure threshold
		Maximum receiver pressure allowed
		Maximum offset to be added to the HPV set point when the receiver pressure exceeds the high pressure threshold
	Fhb17	Low receiver pressure threshold
		Minimum receiver pressure allowed
		Maximum offset to be subtracted from the HPV set point when the receiver pressure falls below the low pressure threshold
Safety features	Fhb18	HPV valve closing enabled when all line 1 compressors are off
		HPV valve closing delay when all line 1 compressors are off
	Fhb20	Enable the warning function when the gas cooler pressure is too far away from the set point for the set time
		Difference between gas cooler pressure and set point to generate the warning
		Delay time before generating the warning
	Fhb03	Maximum HPV valve opening
		Maximum variation per second allowed for HPV valve output
	Fhb30	Maximum HPV valve control set point
		Enable valve position (delay threshold)
	Fhb10	Minimum HPV valve control set point
		Enable low temperature control (lower proportional zone)

Tab. 6.e

6.8 RPRV valve management

The RPRV valve is managed with PI control so as to keep the pressure inside the CO_2 receiver at the set point.
The RPRV valve can be managed directly by Hecu CO2 via the driver integrated into the controller.

RPRV valve auxiliary functions

RPRV valve management includes some auxiliary functions:

- **Pre-positioning**: when switching the unit ON, the RPRV valve remains in a fixed position set by parameter for a set time, so as to be able to quickly increase the pressure in the receiver. This procedure is reactivated whenever the unit switches OFF or the RPRV valve is reset to the minimum position when all of the compressors stop.
- **Close valve with compressors off**: if all of the medium temperature compressors are switched off, the RPRV valve can move to the minimum opening when ON, which can be set by parameter. When a compressor restarts, valve control resumes, with the pre-positioning procedure described in the previous point.
- **Minimum and maximum opening values**: the minimum opening when OFF (from keypad, digital input or supervisor) and when ON can be differentiated, while there is only one maximum opening value.
- **Maximum percentage variation**: the valve movement cannot exceed the set maximum percentage variation per second.
- **Maximum receiver pressure**: a maximum value can be set for the receiver pressure, beyond which an alarm is signalled and the unit can be shutdown. Shutdown is optional and can be enabled by parameter.

Summary of RPRV valve inputs, outputs and parameters

Below is a summary of the inputs/outputs and parameters used, together with the corresponding configuration screens. For details, see chapter 6 and Appendix A.1.

Summary of RPRV valve inputs/outputs and parameters

	Screen	Description
Analogue inputs	Bab66, Fha01	RPRV receiver pressure probe
Digital inputs	Baadf, Fha05	RPRV valve alarm
Analogue outputs	Bad03, Fha07	RPRV valve output
Digital outputs	---	---
Parameters		
Set	Fhb21	Enable RPRV valve management
Control	Fhb25	CO_2 receiver pressure set point
		Proportional gain for proportional + integral RPRV valve control
		Integral time for proportional + integral RPRV valve control
Parameters		
Safety features	Fhb22	Minimum RPRV valve opening with unit ON
		Minimum RPRV valve opening with unit OFF
	Fhb23	RPRV valve opening at start-up during pre-positioning
		Pre-positioning duration
	Fhb24	Maximum RPRV valve opening
		Maximum variation per second allowed for RPRV valve output
	Fhb26	HPV valve safety position
	Fhb27	RPRV valve closing enabled when all line 1 compressors are off
		RPRV valve closing delay when all line 1 compressors are off
	Fhb28	High receiver pressure alarm threshold
		High receiver pressure alarm differential
		High receiver pressure alarm delay
		Type of high receiver pressure alarm reset
		Enable compressor shutdown with receiver high pressure alarm
	Fhb31	Maximum RPRV valve control set point
		Enable valve position (delay threshold)

Tab. 6.f

6.9 Generic functions

Hecu CO2 can use the free inputs / outputs and certain internal variables for a number of generic functions.
The following generic functions are available for each board:
- 5 stages
- 2 modulation functions
- 2 alarms

Each function can be enabled/disabled by digital input and on the user interface. The generic functions can be enabled and the related parameters set in main menu branch Ff To be able to use the free inputs, these first need to be configured as generic from probes A to E (analogue inputs) and general inputs from F to J (digital inputs), consequently a maximum of five analogue inputs and five digital inputs can be used. After having configured the generic probes, the associated variables can be used as control variables, and the digital inputs as variables for enabling the functions. As well as the generic probes and inputs, other internal variables in the Hecu CO2 software can be used, depending on system configuration.

Examples:
for analogue variables:
- Suction pressure
- Condensing pressure
- Saturated suction temperature
- Saturated condensing temperature
- Suction temperature
- Discharge temperature
- % of compressors on
- % of fans on
- Superheat
- Subcooling
- Liquid temperature
- % of compressor request
- % of fan request

for digital variables:
- High suction pressure alarm
- Low suction pressure alarm
- High condensing pressure alarm
- Heartbeat

Each generic function can be assigned a unit of measure and a description. Below are descriptions of how the three types of generic functions work.

Stages

Hecu CO2 can manage up to five stage functions, with either direct or reverse operation. In both cases, a set point and a differential can be defined; operation of the corresponding output is shown in the figure below, for both cases:

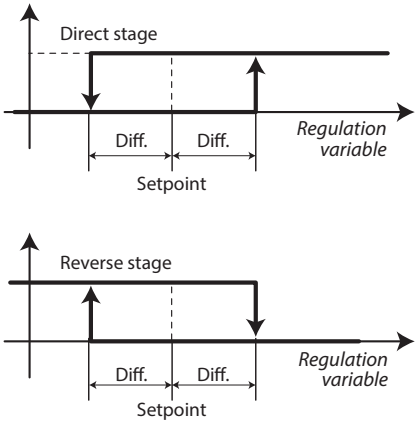


Fig. 6.w

If a variable has been set to enable the function, the output connected to the stage will be active when the enabling variable is active.
For each stage, there is a high alarm threshold and a low alarm threshold, both absolute values. For each alarm, the activation delay and priority can be configured.

Modulation

Hecu CO2 can manage two modulation functions, with either direct or reverse operation. In both cases, a set point and a differential can be defined; operation of the corresponding output is shown in the figure for direct operation, with the cut-off function also enabled:

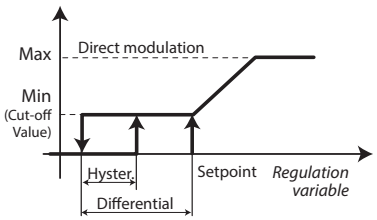


Fig. 6.x

If a variable has been set to enable the function, the output connected to the stage will be active when the enabling variable is active. For each modulation function, there is a high alarm threshold and a low alarm threshold, both absolute values. For each alarm, the activation delay and priority can be configured. A minimum and maximum value of the modulation output can also be set, and the cut-off function enabled, which works as shown in the previous figure.

Alarms

Hecu CO2 can manage two alarm functions, by configuring the digital variable to be monitored, the activation delay, the priority and an optional description. Each generic alarm function can be associated with a digital output for activating external devices when the alarm occurs. One example of a generic alarm functions is detecting gas leaks.

6.10 Default value management

Hecu CO2 can manage two different sets of default values:
- user defaults
- Carel defaults

Either of the two sets can be activated from the main menu branch I.d.

Important: after having reset the default values, the Hecu CO2 board needs to be powered off and on again.

Saving and restoring user default values

Hecu CO2 can save on the controller the exact configuration set by the user and then reload it at any time.
All of the set values are saved, therefore loading the user defaults restores the exact same conditions of the Hecu CO2 controller at the moment the values were saved.

Note: only one user default configuration can be saved, therefore if saving the values another time, the new values overwrite the previous ones.

Important:
- the procedure for resetting the Carel default values involves clearing the Hecu permanent memory, therefore the operation is irreversible;
- the user values cannot be reloaded if updating the Hecu software; for further details please see Chap. 9, which describes how to save the parameters for different versions of the software.

Loading the Carel default values

The values pre-defined by Carel can be loaded at any time, restoring the Hecu CO2 default settings, and therefore repeating the start-up procedure described previously.

Important: he procedure for resetting the Carel default values involves clearing the Hecu permanent memory, therefore the operation is irreversible.

Note: to repeat the Wizard, the Carel default values first need to be reset.

7. FAST COMMISSIONING

Once the condensing unit has been configured, the MPXPRO/UltraCella controllers installed on the evaporators then need to be configured, and subsequently the entire system representing the combination of both.
The Fast Commissioning function is an automatic procedure that assists the installer in the final configuration of the entire system: condensing unit connected via serial with up to five MPXPRO/UltraCella controllers, as described in par. 7.4.

7.1 MPXPRO configuration (SW version ≥ 4.0)

General connection diagram

It is recommended to follow the general connection diagram shown here, so as to simplify the subsequent controller configuration stage by exploiting many of the pre-defined parameters.

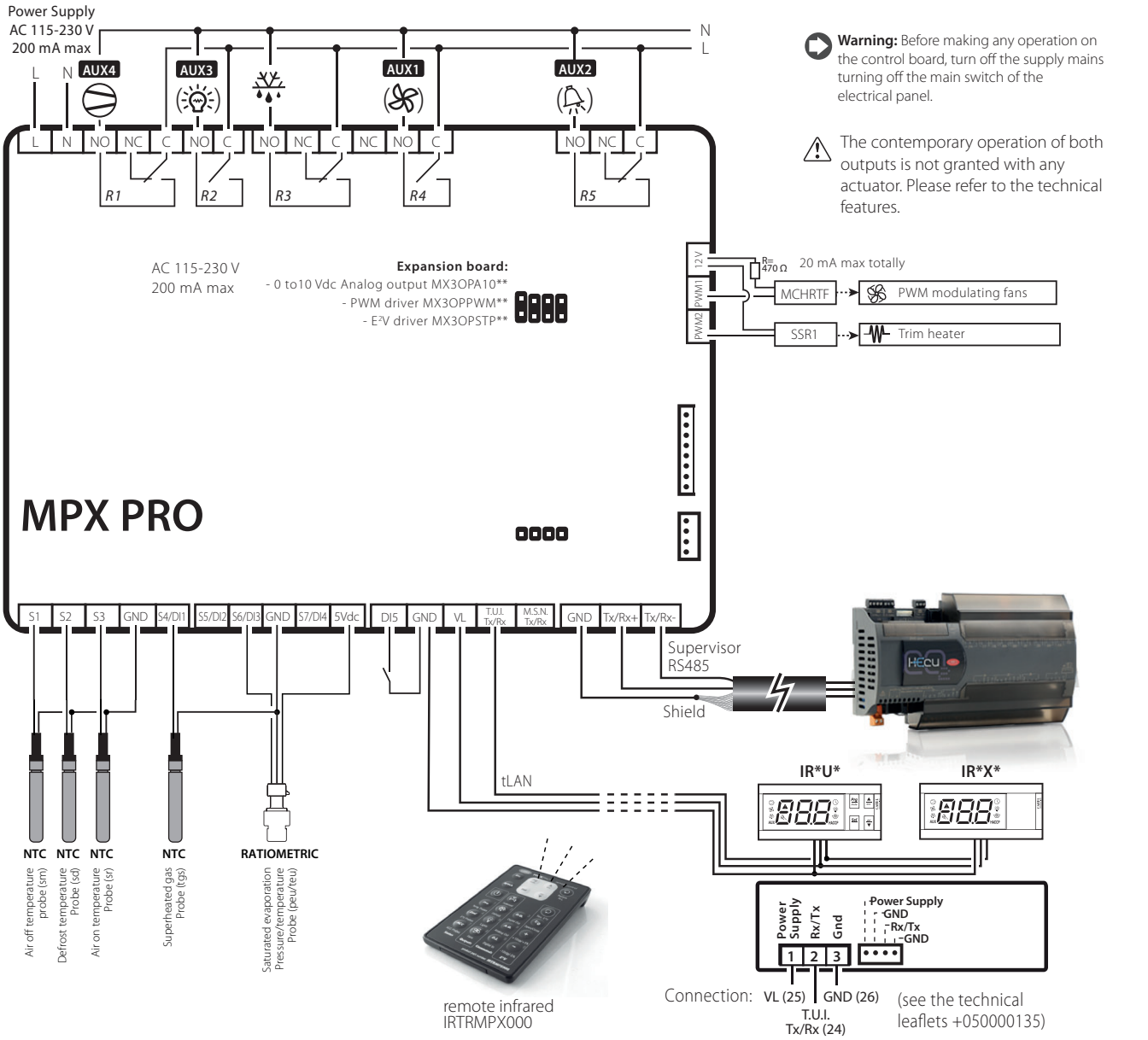


Fig. 7.a

Once the wiring has been completed, simply follow the wizard that is displayed when the MPXPRO devices are switched on for the first time. Details of this procedure are shown below; for further information see the MPXPRO manual + +0300055EN rel. 1.4 of 16/02/2015..

Important: in order to configure the entire system, first check that the cabinets are equipped with MPXPRO controllers and the corresponding EEV electronic expansion valve module.

Guided commissioning procedure

When first started, MPXPRO opens a guided procedure that helps the user set the main parameters for the configuration of the electronic valve and the serial network.

Commissioning parameters

Par.	Description
/P2	Type of probe, group 2 (S4, S5)
/P3	Type of probe, group 3 (S6)
/Fd	Assign tGS (superheated gas temperature probe)
/FE	Assign PEu/tEu (saturated evaporation pressure/temperature probe)
/U6	Maximum value of probe 6
/L6	Minimum value of probe 6
P1	Electronic valve
PH	Type of refrigerant
In	Type of unit
Sn	Number of slaves in the local network
H0	Serial or Master Slave network address

Tab. 7.a

The parameters can be set from the user terminal or the remote control. If using the remote control, a terminal with display and infrared (IR) port is required.

After powering on the controller:
1. the first parameter is displayed: /P2 = type of probe, group 2 (S4, S5)
2. press Set to display the parameter value;
3. press UP/DOWN to modify the value;
4. press Set to confirm, the "spanner" icon is no longer shown, indicating that the setting has been performed;
5. press UP and repeat steps 2, 3 & 4 for the subsequent parameters; /P3, /Fd, /FE, /U6, /L6, P1, PH, In, Sn, H0;
6. press Prg/mute for 5 s to exit the guided commissioning procedure.

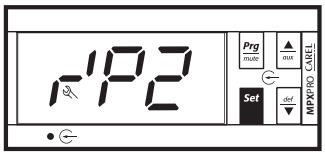


Fig. 7.r

/P2: Type of probe, group 2 (S4, S5)

This is used to select the type of temperature probe to be used for inputs S4 and S5.

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

Tab. 7.b

Note: the NTC L243/PTC/PT1000 probes can only be configured on the full optional models or with EEV driver. To assign the functions of the other probes, see parameters /FA, /Fb, /Fc, /Fd, /FE, /FF, /FG, /FH, /FI, /FL, /FM. For calibration, see parameters /c4, /c5.

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

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

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

Tab. 7.c

Note: the NTC L243/PTC/PT1000 probes can only be configured on the full optional models or with EEV driver.

/Fd: Assign tGS (superheated gas temperature probe)

This is used to assign the measurement of the superheated gas temperature at the evaporator outlet to the selected probe.

Par.	Description		Def	Min	Max	UOM
/Fd	Assign tGS (superheated gas temperature)		0	0	11	-
	0 = Function disabled	6 = Probe S6				
	1 = Probe S1	7 = Probe S7				
	2 = Probe S2	8 = Serial probe S8				
	3 = Probe S3	9 = Serial probe S9				
	4 = Probe S4	10 = Serial probe S10				
	5 = Probe S5	11 = Serial probe S11				

Tab. 7.d

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

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

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

Tab. 7.e

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

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

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

Tab. 7.f

P1: Type of electronic expansion valve

MPXPRO can control the CAREL E²V electronic expansion valve.
The CAREL electronic expansion valve is required for the Hecu CO2, and therefore this parameter must always be set to "2".

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

Tab. 7.g

PH: Type of refrigerant

The type of refrigerant is essential for calculating the superheat value. In addition, it is used to calculate the evaporation and condensing temperature based on the pressure probe reading. The following table shows the refrigerants that are allowed and corresponding compatibility with the CAREL E²V valve. In this case, the value must be set for CO2, i.e. PH=11.

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

Tab. 7.h

In: Type of unit

This parameter In assigns the function of Master or Slave to the controller. Hecu CO2 only accepts MPXPRO master controllers, therefore this parameter must always be set to "1".

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

Tab. 7.a

Sn: Number of slaves in the local network

This parameter tells the Master controller how many Slave controllers it needs to manage in the local network. Hecu CO2 only accepts MPXPRO master controllers, therefore this parameter must always be set to "0".

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

Tab. 7.b

H0: Serial or Master Slave network address

Parameter H0 indicates the MPXPRO serial address.

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

Tab. 7.i

The addresses must obey the following logic:

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

End of procedure

Press Prg/mute for 5 s to exit the guided commissioning procedure.

7.2 Ultracell configuration (SW version ≥ 2.0)

General connection diagram

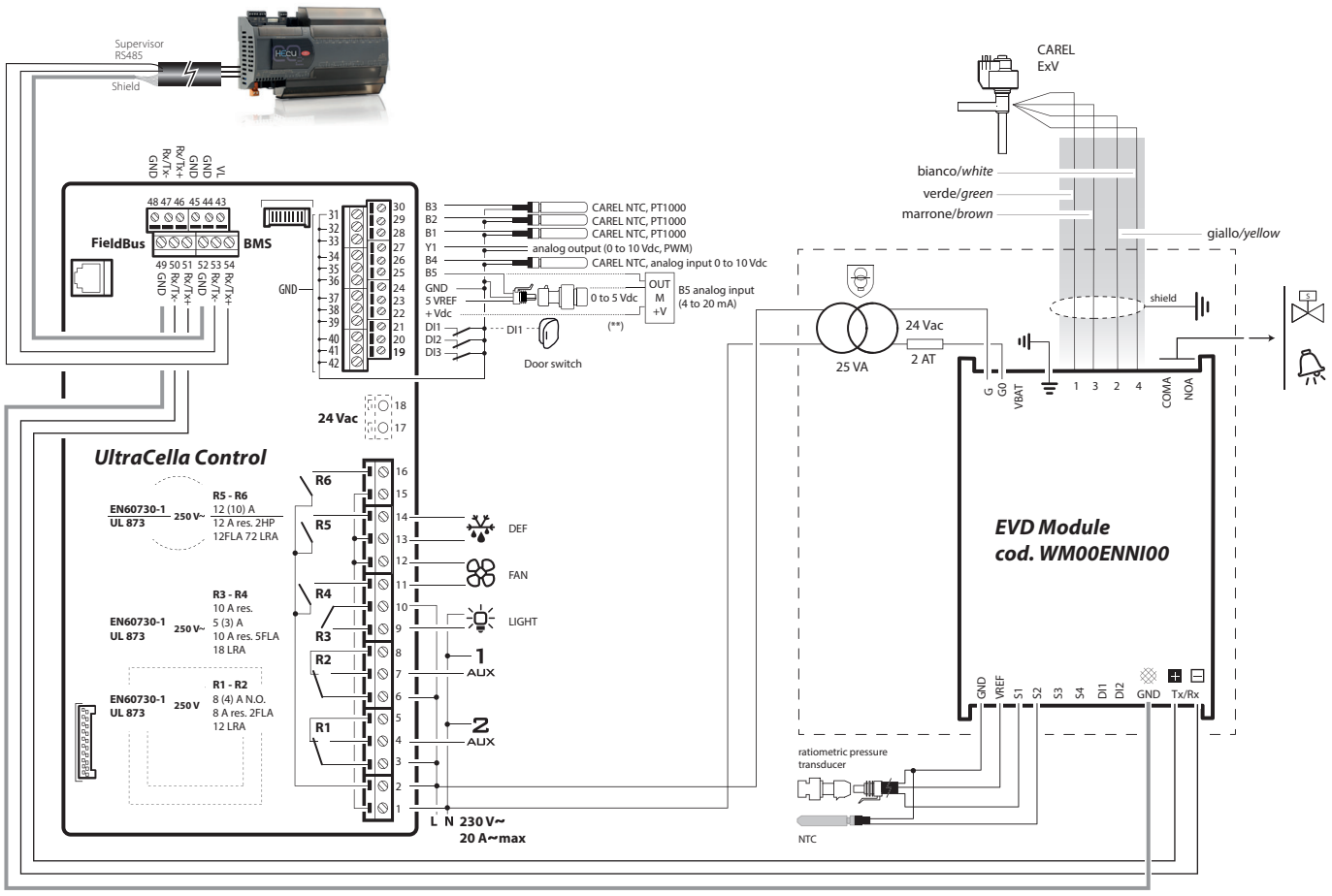


Fig. 7.b

Once the wiring has been completed, simply follow the wizard that is displayed when the Ultracella devices are switched on for the first time. Details of this procedure are shown below; for further information see the UltraCella manual +0300083EN.

Important: in order to configure the entire system, first check that the cold rooms are equipped with UltraCella controllers and the corresponding EEV electronic expansion valve module.

Commissioning with UltraCella Service terminal

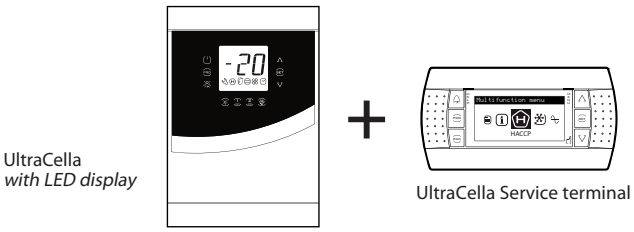


Fig. 7.c

If the UltraCella controller has never been configured, as soon as the terminal is connected, the wizard is shown automatically. The Wizard menu can also be accessed to repeat the guided commissioning procedure.

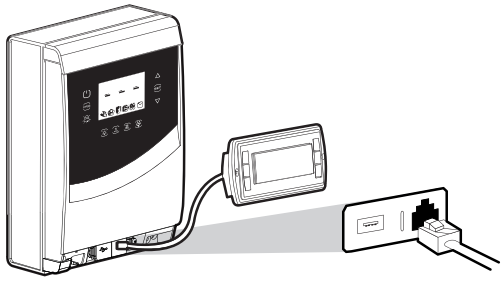


Fig. 7.d

Remove the bottom faceplate and connect the UltraCella Service Terminal to the controller.

Initial configuration

When starting for the first time, once the Service Tool is connected, the wizard is shown automatically. Select the desired language and then answer the questions to set the other parameters.

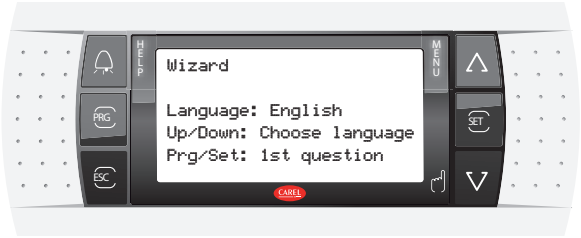


Fig. 7.e

Repeated commissioning procedure

The commissioning procedure can be repeated by accessing the Wizard menu.

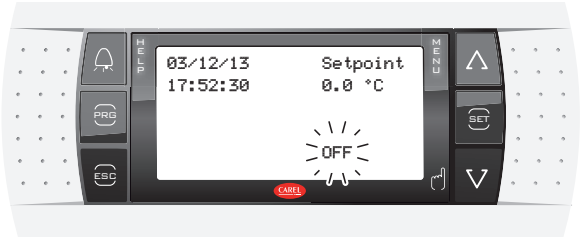


Fig. 7.f

1.Switch the controller OFF (press DOWN and select the On/Off icon; press Set twice and then UP to switch the controller OFF; press Esc twice to exit)

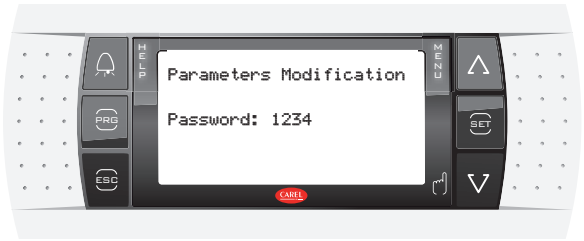


Fig. 7.g

2. To enter Programming mode: press Prg and enter the password: 1234

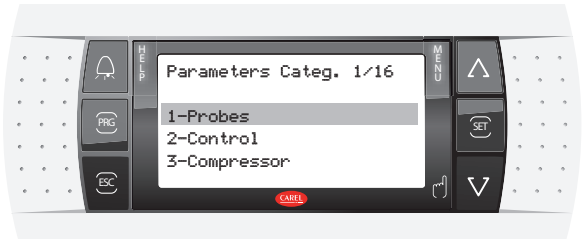


Fig. 7.h

3. Press DOWN until reaching the "Wizard" menu

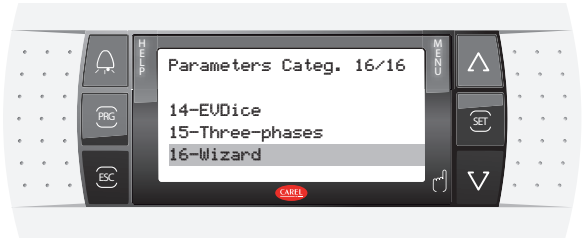


Fig. 7.i

4. Confirm by pressing Set

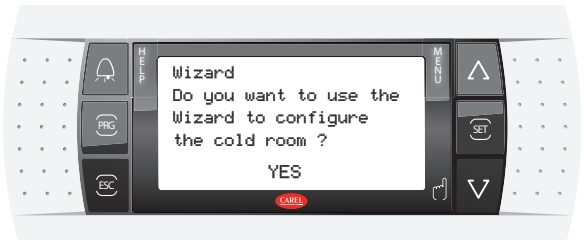


Fig. 7.j

5. Press Up and Set to enter the guided commissioning procedure.

Commissioning: main functions

Table of commissioning parameters

Par	Description	Cat.	Def	Min	Max	UOM
St	Set point	CtL	0	r1	r2	°C/°F
rd	Differential	CtL	2.0	0.1	20	°C/°F
/P	Type B1…B3	Pro	0	0	2	-
/A2	B2 configuration	Pro	1	0	3	-
/A3	B3 configuration	Pro	0	0	5	-
/P4	Type B4	Pro	0	0	2	-
/A4	B4 configuration	Pro	0	0	4	-
/P5	Type B5	Pro	0	0	1	-
/A5	B5 configuration	Pro	0	0	5	-
A5	Digital input 2 configuration (DI2)	ALM	0	0	15	-
A9	Digital input 3 configuration (DI3)	ALM	0	0	15	-
d0	Type of defrost	dEF	0	0	3	-
dt1	End defrost temperature, main evaporator	dEF	4.0	-50.0	200.0	°C/°F
dP1	Maximum defrost duration	dEF	30	1	250	min
dd	Dripping time after defrosting	dEF	2	0	30	min
Fd	Post dripping time	Fan	1	0	30	min
F3	Evaporator fans during defrost 0/1=on/off	Fan	1	0	1	-
c12	Compressor safety time, door switch 0 = door management disabled	doL	5	0	5	min
d8d	Compressor restart time, door switch	doL	30	c12	240	min

Par	Description	Cat.	Def	Min	Max	UOM
A3	Disable door switch 0=enabled 1=disabled	doL	1	0	1	-
tLi	Light off delay	doL	120	0	240	min
A4	Light management 0 = door switch + light button 1 = light button	doL	0	0	1	-

Tab. 7.j

H0: Serial address

Parameter H0 indicates the UltraCella serial address.

Par.	Description	Def	Min	Max	UOM
H0	Serial address	199	0	199	-

Tab. 7.k

The addresses must obey the following logic:

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

While the other parameters that select the protocol are:
- H7 = 0 Carel protocol
- H7 = 1 Modbus protocol

H7 must be = 1, while the other parameters retain the default settings, and are:

Par.	Description	Def	Min	Max	UOM
H10	BMS baud rate bit/s 0 1200 5 38400 1 2400 6 57600 2 4800 7 76800 3 9600 8 115200 4 19200 9 375000	4	0	9	-
H11	Number of BMS stop bits 1 1 stop bit 2 2 stop bit	2	1	2	-
H12	BMS parity 0 none 1 odd 2 even	0	0	2	-

Note: To make the change active, the unit must be switched off and on again.

Cold room temperature control

Cold room temperature is managed by modulating the electronic expansion valve.

Probe configuration

The UltraCella controllers have a maximum of five analogue inputs, three of which can be configured as temperature probes (NTC probes, high temperature NTC probes, PT1000), the fourth as a temperature probe or 0-10 V input, the fifth can be configured as a 4-20 mA or 0-5 Vrat input.

Analogue inputs	Type
B1 B2 B3	NTC10 kΩ at 25°C, range -50T90°C, NTC extended range, NTC50 kΩ at 25°C, range 0T150°C; PT1000, 1000 Ω at 0°C, range -50T90°C
B4	NTC10 kΩ at 25°C, range -50T90°C, NTC extended range, NTC50 kΩ at 25°C, range 0T150°C 0 to 10 V
B5	4 to 20 mA 0 to 5 Vrat 0.5 to 4.5 Vrat

Tab. 7.l

The parameter settings are listed below.

Par.	Description	Def	Min	Max	UOM
/P	Type B1…B3 0 = NTC Standard Range -50T90°C 1 = NTC Enhanced Range 0T150°C 2 = PT1000	0	0	2	-
/P4	Type B4 0 = NTC Standard Range -50T90°C 1 = NTC Enhanced Range 0T150°C 2 = 0 to 10 V	0	0	2	-
/P5	Type B5 0 = 4 to 20 mA 1 = 0 to 5 Vrat 2= 0.5 to 4.5 Vrat	0	0	2	-

Assign functions of probes B1, B2, B3, B4, B5

Inside the cold room, the controller can use the following probes:
- outlet:
- intake;
- defrost, placed on the evaporator, preferably where ice remains the longest;

Probe B1 is configured as an ambient temperature probe and its function cannot be changed.

Par.	Description	Def	Min	Max	UOM
/A2	B2 configuration 0 Absent 1 Defrost probe 1 (Sd1) 2 Intake probe (Sr) 3 Generic temperature probe 2	1	0	3	-
/A3	B3 configuration 0 Absent 1 Defrost probe 2 (Sd2) 2 Cond. probe (Sc) 3 Defrost probe 1 (Sd1) 4 Ambient probe (SA) 5 Generic temperature probe 3	0	0	5	-
/A4	B4 configuration 0 Absent 1 Ambient temperature probe (SA) 2 Humidity probe 3 Generic temperature probe 4 4 Generic humidity probe 4	0	0	4	-
/A5	B5 configuration 0 Absent 1 Humidity probe 2 Generic temperature probe 5 3 Generic humidity probe 5 4 Generic pressure probe 5 5 Condensing pressure probe (Scp)	0	0	5	-

For probe B4, if configured as a 0 to 10 V input (/P4 = 2) and for probe B5, the logical values to be used by the controller corresponding to the physical full scale readings can be assigned.

Par.	Description	Def	Min	Max	UOM
/4L	Minimum value of probe 4 (0 to 10 V input only)	0	-50.0	/4H	-
/4H	Maximum value of probe 4 (0 to 10 V input only)	100.0	/4L	200.0	-
/5L	Minimum value of probe 5	0	-50.0	/5H	-
/5H	Maximum value of probe 5	100.0	/5L	999	-

Example: if a pressure sensor with 4 to 20 mA output is connected to input B5 with the range -1 to 9.3 bars, set
- /5L = -1,0
- /5H = 9,3

In this case, when the probe reads 12 mA, the value associated with the reading of B5 will be 4.1 (mid scale).

Probe reading correction

The values read by the probes can be corrected by adding or subtracting an offset from the measurement, set by parameters /c1 to /c5.

Par.	Description	Def	Min	Max	UOM
/c1	B1 offset	0	-20.0	20.0	°C/°F
/c2	B2 offset	0	-20.0	20.0	°C/°F
/c3	B3 offset	0	-20.0	20.0	°C/°F
/c4	B4 offset	0	-20.0	20.0	°C/°F/ rH%
/c5	B5 offset	0	-20.0	20.0	°C/°F/ rH%/ bar/ psi

The offset may be subject to HACCP requirements. In this case, the offset should be calculated using a calibrated instrument. Changing these parameters that affect the values measured and displayed may not be permitted. If in doubt, check with the food safety manager or the site manager.

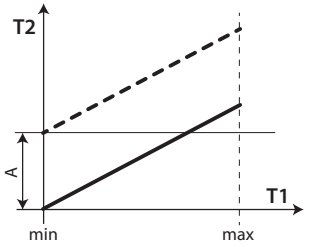


Fig. 7.k

Key

T1	Temperature read by the probe
T2	Temperature read by the probe after correction with the offset
A	Offset value
min, max	Field of measurement

HACCP - IMPORTANT

Modifying the parameters that affect temperature measurement and display may not be allowed in certain applications or may require specific authorisation due to HACCP system requirements. If in doubt, check with the food safety manager or the site manager.

Digital inputs

Note: digital input 1 (DI1) is used for the door switch by default, however this can be configured for DI2 and DI3

If the door switch is not used (for example, connected to DI1), it can be disabled by setting A3=1 and A11=5 (default value) or another function can be associated with DI1, see Table 4b.

Par.	Description	Def	Min	Max	UOM
A3	Disable door switch 0= enabled 1= disabled	1	0	1	-

If A3=0 and the door switch is not connected, the controller will activate the "door open" icon. To prevent incorrect messages being displayed, set A3=1 or short-circuit pin 21 (DI1) to one of the GND pins.

Multiple contacts can be connected to the multifunction digital inputs to activate different types of functions, such as alarm, start/stop defrost, low pressure switch, etc.

Important: to guarantee the safety of the unit in the event of serious alarms, all the electromechanical safety devices necessary to ensure correct operation must be provided on the unit itself.

Function of digital inputs DI1, DI2 and DI3

PARAMETERS A11, A5, A9

Selection	Contacts	
	OPEN	CLOSED
0 = Not active	-	-
1 = immediate external alarm	active	not active
2 = Do not select	-	-
3 = enable defrost	not enabled	enabled
4 = start defrost	not active	active
5 = Door switch	active	not active
6 = Remote ON/OFF	OFF	ON
7 = Change set point (r4-r5) from switch	not active	active
8 = low pressure switch	low pressure status	normal status
9 = Do not select	-	-
10 = Do not select	-	-
11 = Do not select	-	-
12 = AUX output activation	deactivated	activated
13 = Do not select	-	-
14 = continuous cycle activation	Open contact (deactivation)	Closed contact (activation)
15 = alarm from generic function (DI2 and DI3 only)	active/not active	active/not active
16 = start/stop defrost	stop	start
17 = serious alarm	active	not active

Tab. 7.m

The parameter settings for A5 and A9 are described below.

1 = Immediate external alarm

Application: external alarm that requires immediate activation (for example, high pressure alarm or compressor thermal overload). Activation of the alarm:

1. • shows the message on the display ('IA');
   • activates the buzzer, if enabled;
   • activates the alarm relay, if selected;
2. involves the following actions on the actuators:
   • fans: continue to operate according to the fan parameters ("F").

Note: if more than one input is configured as an immediate alarm, the alarm is generated when one of the inputs opens.

2 = Do not select
3 = Enable defrost

Application: any defrost request received when the contact is open will remain pending until the contact closes.

A11/A5/A9 = 3

Contact	Defrost
Open	Not enabled
Closed	Enabled (defrost start is still determined by the controller)
Closed with active defrost	When the digital input is opened, the defrost is immediately stopped and the unit restarts normal operation (without performing the dripping or post-dripping phases). The LED starts flashing to indicate that the defrost request is pending, waiting for the next enabling signal (closing of the contact), when the defrost will be performed completely.

Tab. 7.n

Note: this function may be useful to prevent defrosts on units exposed to the public during store opening hours.

4 = Start defrost from external contact

Application: this function is useful for carrying out synchronised defrosts on several units, or manual defrosts controlled by an external contact. To do this, simply connect a mechanical or electronic timer to the selected digital input. Several units can be connected to the same timer, setting different values for parameter d5 (defrost delay from multifunction input) to avoid simultaneous defrosts.

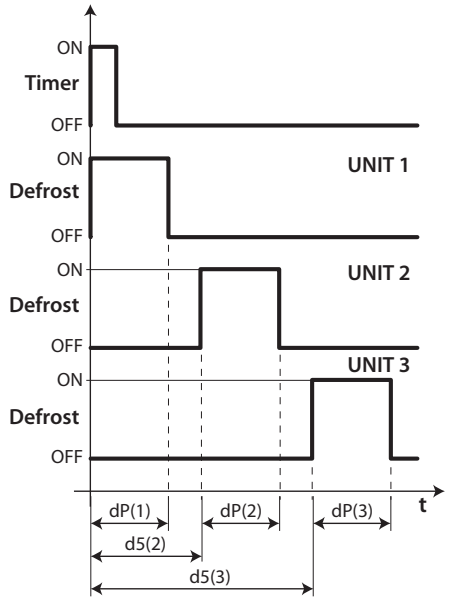


Fig. 7.l

Key

dP	Maximum defrost duration
UNIT 1…3	Unit 1…3
d5	Defrost delay from digital input
t	Time

5 = door switch (see parameter A3)

6 = remote On/Off

The digital input can also be programmed as a remote ON/OFF switch. When the controller is OFF:

- the temperature is displayed alternating with the message "OFF"; the internal timer related to parameter dI is updated. If dI expires whe the unit is OFF, the controller runs a defrost when restarting;
- the auxiliary relays set as AUX and light remain active, while the other auxiliary outputs are deactivated;
- the buzzer and alarm relay are deactivated;
- the controller does not perform any control actions, defrost, continuous cycle, temperature alarms or any other functions.

When the controller restarts, all of the functions are reactivated, except for:

- defrost on start-up;
- fan delay on start-up.

Note: ON/OFF from external digital input has priority over the keypad and supervisor input.

7, 8, 9, 10, 11 = Do not select

12 = Auxiliary output

By setting H1/H5 = 2, the corresponding output, AUX1/AUX2, is activated by the AUX1/AUX2 button or by the digital input, if configured. In addition, a digital input DI1, DI2 or DI3 (set A11, A5 or A9 = 12) can be used to control AUX1 or AUX2.
In this case, the button and the digital input have the same priority for activation.

13 = Do not select

14 = Continuous cycle activation

Activation: contact switches from open to closed;
Deactivation: contact switches from closed to open.

15 = Alarm from generic function

Digital inputs DI2 and DI3 can be associated with specific alarms using the generic functions, and can be active when the input is open or closed (see the paragraph on Generic functions).

16 = start/stop defrost from external contact

Application: an external device is used to start the defrost (on closing the digital input) and subsequently stop it (on opening the digital input). When the digital input opens, the dripping time set for parameter dd must then elapse.

Note:

- if following the start of the defrost, the digital input does not open before the time dP1 elapses, the defrost will terminate by time and alarm Ed1 will be displayed (defrost ended by timeout.
- opening the digital input does not start the defrost only if the defrost probe (e.g. B2) temperature is greater than dt1 (end defrost temperature on main evaporator).
- if a separate defrost is configured on two evaporators (d13=1) and start/stop defrost from external contact is set, both evaporators are defrosted at the same time.

17 = serious alarm

Application: external alarm that causes the immediate deactivation of the outputs on UltraCella (except those configured as a light/alarm) so as to prevent a dangerous situation. This can be used, for example, to stop the compressor following activation of an external protection device.
Activation of the alarm causes:

- shows the message on the display ('SA');
- activates the buzzer, if enabled;
- activates the alarm relay, if selected;

Involves the following actions on the actuators:

- immediate deactivation of all the outputs (relays), except for those configured as lights and/or alarms.

Note: if more than one digital input is configured as a serious alarm, the alarm is generated when one of the inputs opens.

Type of defrost

UltraCella can manage the following types of defrost, depending on the setting of parameter d0:

0. heater by temperature;
1. hot gas by temperature;
2. heater by time:
3. hot gas by time.

For further explanations, see chap. 6.

Par.	Description	Def	Min	Max	UOM
d0	Type of defrost 0 Heater by temperature 1 Hot gas by temperature 2 Heater by time 3 Hot gas by time	0	0	3	-
dt1	End defrost temperature, main evaporator	4.0	-50.0	200.0	°C/°F
dP1	Maximum defrost duration	30	1	250	min

Evaporator fans

During the dripping time (parameter dd > 0) and post dripping time (parameter Fd > 0), the evaporator fans are always off. This is useful to allow the evaporator to return to normal temperature after defrosting. The evaporator fans can be forced on during control (parameter F2) and during defrosts (parameter F3). See chap. 6.

Par.	Description	Def	Min	Max	UOM
dd	Dripping time after defrost (fans off)	2	0	30	min
F2	Evaporator fans with compressor off	30	0	60	-
F3	Evaporator fans during defrost 0/1 = on/off	1	0	1	-
Fd	Post dripping time (fans off)	1	0	30	min

Light management

The light can be managed:

- by the door switch (if A3 = 0) and/or light button;
- only by the light button.

The parameters involved are shown below.

Par.	Description	Def	Min	Max	UOM
tLi	Light on with door open	120	0	240	min
A4	Light management 0 Door switch + light button 1 Light button	0	0	1	-

Note: if the controller is OFF, the light output is controlled only by the light button. If the controller is ON, the light is controlled by door switch + light button or light button only, according to the setting of parameter A4.

Door switch + light button

If A4 = 1, the light is switched on/off only by the light button. The door status, open or closed, is ignored. If A4 = 0, when the cold room door is open, the light is always on. When the door is closed, the light can be switched on or off using the light button. Once on, the light will automatically switch off after the time set for Li.

LIGHT MANAGEMENT BY DOOR SWITCH AND LIGHT BUTTON

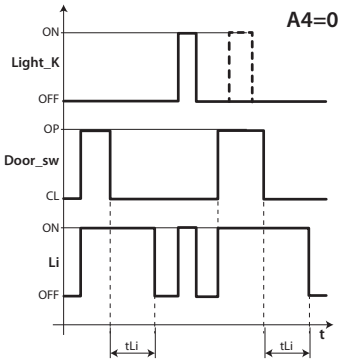


Fig. 7.m

Key

Light_k	Light button
Li	Light
Door_sw	Door switch
tLi	Light off delay
t	time

7.3 Ultra EVD EVO module commissioning

EVD EVO driver configuration from UltraCella

Connect UltraCella to the EVD module via serial, as shown in the wiring diagram in Figure 7.c, and refer to the following parameter table for configuration of the EVD EVO driver. The module will become active when enabled by UltraCella, setting P1 = 1.

If connected via serial, the driver parameters can be displayed only (not modified) by the local EVD EVO display. Once the driver has been enabled (parameter P1=1), its parameter settings will be sent by UltraCella, in accordance with the parameter table below (only modifiable from UltraCella); any parameters previously configured on the EVD EVO display will be overwritten.

Par.	Description	Def	Min	Max	UOM
P1	Enable communication with EVD EVO module 1 = EVD module enabled	1	0	1	-

EVD EVO parameter table

The following parameters relating to the EVD EVO driver can be configured from UltraCella

Category: EVO

Par.	Description	Def	Min	Max	UOM
P1	Enable communication with EVD EVO module 0/1=disabled/enabled	0	0	1	-
P1t	Type of probe S1 0 0-5 V rat. 2 4-20 mA remote 1 4-20 mA 3 4-20 mA external	0	0	3	-
P1M	Maximum value of probe S1	12.8	-20	200	bar/psi
P1n	Minimum value of probe S1	-1	-20	200	bar/psi
PVt	Typeof valve 1 Carel exv	1	1	22	-
PH	Type of refrigerant 1 R744	3	1	40	-
PrE	Type of main control 1 cabinet/cold room with remote rack 2 cabinet/cold room with on-board comp. 3 perturbed cabinet/cold room 4 subcritical CO_2 cabinet/cold room	2	1	4	-
P0	EVD Modbus address	198	1	247	-
P3	Superheat set point	10	-72	324	K
P4	Proportional gain	15	0	800	-
P5	Integral time	150	0	999	sec
P6	Derivative time	2	0	800	sec
P7	LowSH: low superheat threshold	3	-72	324	K
P8	LowSH: integral time	600	0	800	sec
P9	LowSH: low superheat alarm delay	600	0	999	sec
PL1	LOP: low evap. temperature threshold	-50	-60	200	°C/°F
PL2	LOP: integral time	600	0	800	sec
PL3	LOP: low evaporation temperature alarm delay	600	0	999	sec
PM1	MOP: max evap. pressure threshold	50	-60	200	°C/°F
PM2	MOP: integral time	600	0	800	sec
PM3	MOP: max evap. pressure alarm delay	10	0	999	sec
cP1	Initial valve position when control starts (percentage)	50	0	100	%
Pdd	Post defrost delay (single driver only)	10	0	60	min
PSb	Valve position in standby	0	0	100	steps
PMP	Enable manual positioning	0	0	1	-
PMu	Manual valve position	0	0	999	steps
Pnr	Reset EVD setting 0 -> 1 Reset all EVD EVO parameters	0	0	1	-
PLt	Stop smooth lines offset	2.0	0.0	10.0	°C/°F
PHS	Maximum smooth lines offset	15.0	0.0	50.0	°C/°F
PSP	Smooth lines proportional coefficient	5.0	0.0	100.0	°C/°F
PSI	Smooth lines integral time	120	0	1200	s
PSd	Smooth lines derivative time	0	0	100	s
PSM	Enable smooth lines (0=NO - 1=YES)	0	0	1	/

Note: set parameters P1=1, P1M and P1n with the values of the connected probe, PrE=1, PH=11 (R744)

7.4 Connecting MPXPRO/Ultracella controllers to Hecu

Once having completed the configuration of the MPXPRO/UltraCella controllers, the serial network needs to be connected, as shown in the following diagram:

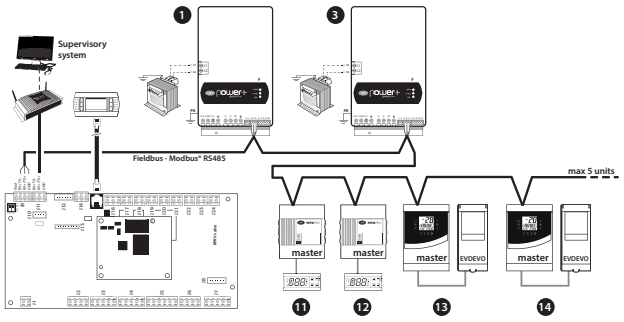
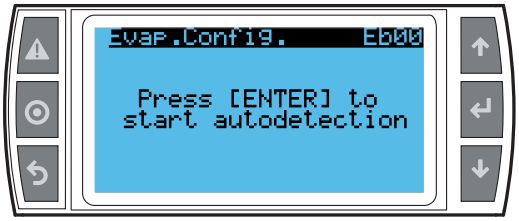


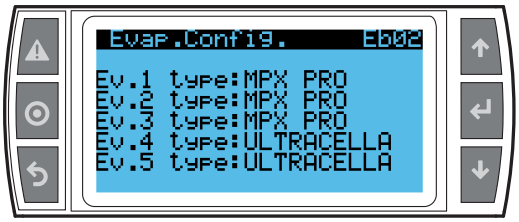
Fig. 7.n

To subsequently configure the entire system made up of the Hecu CO2 and MPXPRO/UltraCella controllers, see the Fast Commissioning procedure described in detail below.

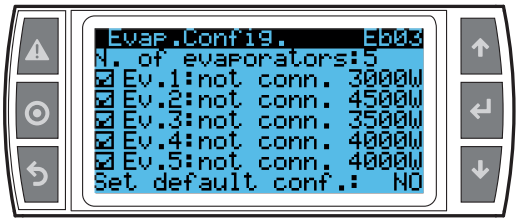
Fast commissioning

Go to screen Eb00 to start the AutoSetup procedure for the UltraCella/MPXPRO controllers connected to HECU. At the end of the procedure, screen Eb02 is displayed.





Then on screen Eb03, the capacities can be set for each evaporator, so as to maximise energy savings with the Floating Suction function



The default parameters are then downloaded, so as to automatically configure the following functions:

- Floating suction pressure set point (par. 6.3): the default values enable compressor control with floating set point on screen **Cab01**. The minimum and maximum set point values will be displayed automatically, in accordance with the type of refrigerant and application selected, together with the proportional gain and integral time values required by the controller and already shown in paragraph 6.3.
- Oil Recovery Washing (par. 6.6): the default values enable the evaporator oil recovery washing function on **screen Fab24**. The following parameters manage this function:

Par.	Description	Def
tON	Washing cycle duration	180sec
tOFF	Time between two washing cycles	180min
Mode	Sequential or together	One cabinet at a time
Fixing time	Stabilisation time after washing	120sec

Tab. 7.o

- **Evaporator control parameters:** the default values enable the Smooth Lines evaporator control function and involve the main control parameters for the evaporators, in **screens Ecxx**. The main values are shown in the following table:

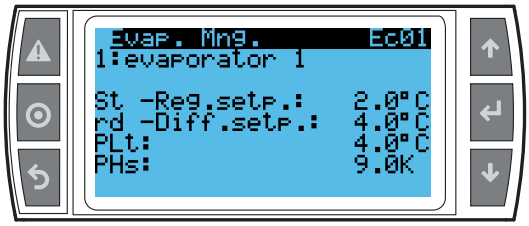
Par.	Description	Def
P3	Superheat set point	10
P4	Valve control: Proportional gain	8
P5	Valve control: Integral time	400
P6	Valve control: Derivative time	0
P7	Low superheat threshold	3
PSM	Enable Smooth Lines	Enable
Plt	Offset to stop control below set point (Smooth Lines)	4
Phs	Maximum superheat offset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

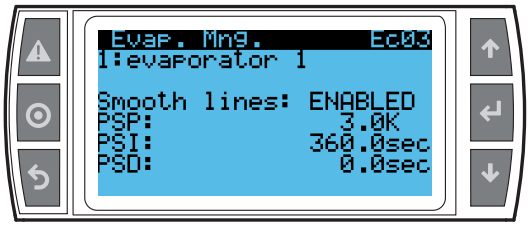
Tab. 7.p

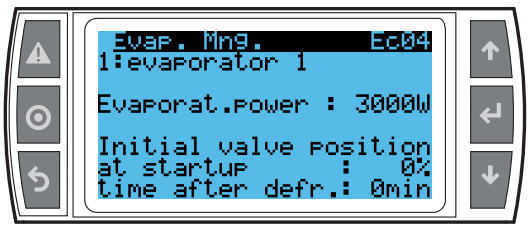
Note: all of the values indicated as defaults by the Fast Commissioning procedure can be modified to optimise overall system operation. It is recommended to change one parameter at a time and then evaluate the effects for at least 10 minutes.

MPXPRO/UltraCella control

Once having connected the MPXPRO controllers to Hecu, the control parameters will be on screens Ec01-02-03-04 for the first evaporator.







Electronic valve control

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

Proportional action (P) parameter K=proportional gain:
The proportional action opens or closes the valve by K steps when superheat increases or decreases by 1°C. Thus the greater the K the higher the response speed of the valve to variations in superheat. The proportional action is fundamental as it affects the speed of the valve in general.
However it only considers variations in superheat and not the variation in relation to the set point. If superheat does not vary significantly, the valve will remain stable and the superheat set point may not be reached.

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

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

Selecting the superheat set point and control parameters

The superheat set point needs to be defined based on the design specifications of the controlled unit. Despite this, based on actual system conditions, this may be changed at any time. A low set point ensures better evaporator efficiency and a low air temperature can be reached more easily. In contrast, instability can be created in the system, with greater variations in superheat and liquid returning to the compressor.

A high set point ensures high system stability and lower variations in superheat. However evaporator efficiency is penalised and the air temperature set point may not be reached.

As regards the control parameters, the following can be used as a guide:

Proportional gain (from 3 to 30)

Increasing the proportional gain K increases valve response speed and is recommended if the system is particularly perturbed or to make superheat control faster. If greater than 20, it may cause swings and instability.

Integral time (from 40 to 400 sec)

Increasing the integral time Ti improves stability but makes the valve slower to respond in reaching the set point. If less than 40 sec, it may cause swings and instability. If the system is already perturbed, high values (greater than 150 sec) are recommended to avoid creating further disturbance.

Derivative time (from 0 to 10 sec)

Increasing the derivative time Td improves valve response, in particular in perturbed systems, and reduced the amplitude of swings in superheat. If greater than 10 sec it may cause excessively fast response and consequently instability.

Smooth Lines function

The smooth lines function optimises evaporator capacity based on actual cooling demand, allowing more effective and stable control of the showcase. This function completely eliminates traditional on/off control cycles, modulating the temperature exclusively using the electronic valve; superheat set point is controlled through a precise PI control algorithm based on the actual control temperature. The main features are:

- The superheat set point for managing the electronic expansion valve can vary between a minimum (traditional set point P3) and maximum limit (P3 + PHS: max. offset) using PI control (pre-configured), based on the controller temperature and how far this is from the corresponding set point St
- The temperature inside the cabinet/showcase can fall slightly below the set point St, without stopping the main control, however simply closing the electronic valve
- Temperature control (and consequently the solenoid valve relay) therefore remains active at all times, while the electronic expansion valve stops the flow of refrigerant into the evaporator
- It is easy to use, as it is the controller itself that automatically adapts control based on current operation, without requiring special parameter settings

The main effects are:

- No swings in temperature and superheat due to the set point being reached
- Stable temperature and superheat control
- Maximum energy savings due to load stabilisation

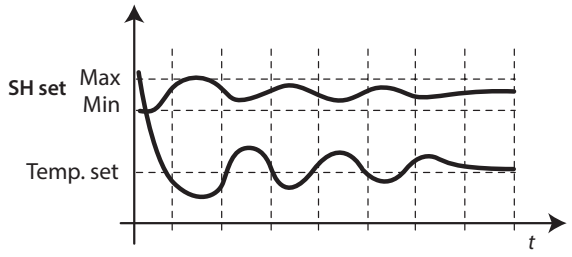


Fig. 7.o

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

LowSH Low superheat protection.

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

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

Tab. 7.c

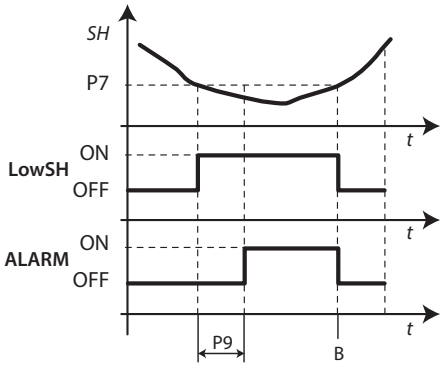


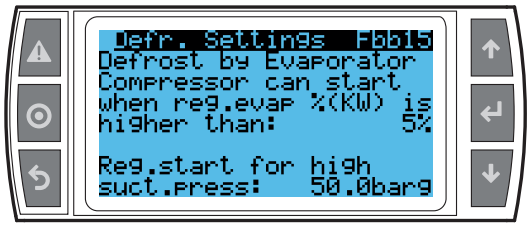
Fig. 7.p

Key

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

Defrosting evaporators connected via serial line

The purpose of this function is to prevent the compressor from starting when one or more evaporators are defrosting. When the compressor stops (due to control, alarm, ...) if the "available" capacity is higher than the threshold (% of total capacity), the compressor can start normally, otherwise it stays off until the evaporators finish defrosting or the suction pressure is higher than a settable safety threshold.



8. SIGNALS AND ALARMS

Hecu CO2 can manage both alarms relating to the status of the digital inputs and to system operation. For each alarm, the following are controlled:
- Actions on the devices, if necessary
- Output relays (one global and two with different priorities, if configured)
- The red LED on the terminal and the buzzer, where featured
- The type of acknowledgement (automatic, manual, semi-automatic)
- Any activation delay

The complete list of alarms, with the related information as described above, is available in the Alarm table.

8.1 Alarm management

All alarms feature the following behaviour:
- When an alarm is activated, the red LED flashes and the buzzer is activated (where featured); the relay corresponding to the global alarm and any alarms with high priority is activated (if configured)
- Pressing (Alarm), the red LED stays on steady, the buzzer is muted and the alarm screen is shown
- If there is more than one active alarm, these can be scrolled using (Up) (Down). This situation is signalled by an arrow at the bottom right on the screen
- Press (Alarm) again for at least 3 seconds manually acknowledges the alarms, which are cleared from the display unless others are active (they are saved in the log)

Priority

For certain alarms, the alarm output relays can be configured according to two types of priority:
- R1: serious alarm
- R2: normal alarm

The corresponding relays, once configured, are activated when an alarm with the corresponding priority occurs. For other alarms, priority is fixed and associated by default to one of the two relays.

Reset/acknowledgement

The alarms can be acknowledged manually, automatically or semi-automatically:
- Manual: the alarm is acknowledged by pressing (Alarm), twice, the first time displays the corresponding alarm screen and mutes the buzzer, the second (extended, for at least 3 seconds) cancels 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 alarm condition ceases, the alarm is automatically acknowledged, the LED comes on steady and the corresponding screen remains displayed until (Alarm) is pressed and held; the alarm is saved in the log.
- Semi-automatic: the alarm is acknowledged automatically, until reaching a maximum number of activations in a set period. When the number reaches the maximum setting, the alarm then needs to be acknowledged manually.

For manual acknowledgement, the functions associated with the alarm will not be reactivated until the alarm is acknowledged , while for automatic acknowledgement, the functions are reactivated as soon as the alarm condition ceases.

Log

The alarm log can be accessed:
- from branch H.a of the main menu
- by pressing (Alarm) and then (Enter) when there are no active alarms
- by pressing (Enter). After having scrolled all of the alarms.

The alarm log screens show:
1. Order of activation (no. 01 is the oldest alarm)
2. Time and date the alarm was activated
3. Short description
4. Main values at the moment the alarm occurred (suction pressure and condensing pressure)

Note: a maximum of 50 alarms can be logged; after this limit any new events overwrite the oldest ones, which are therefore deleted.

8.2 Compressor alarms

The number of alarms can be chosen for each compressor, in the configuration phase (wizard) or subsequently in branch C.a.e of the main menu.

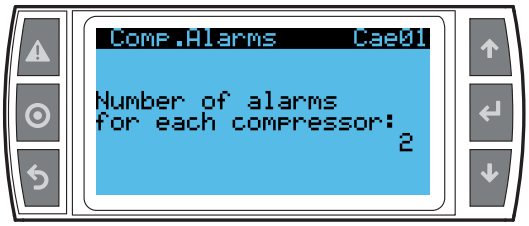


Fig. 8.a

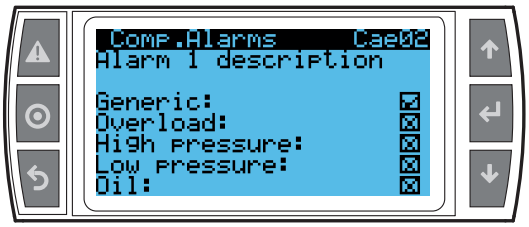
After having selected the number of alarms (maximum 2), each alarm can be assigned a description, choosing from the options shown in the table, output relay, type of reset, delay and priority. The effect of the alarm on the devices is fixed and involves stopping the compressor, except for the oil warning.

Possible descriptions for compressor alarms

Reciprocating or scroll
Generic
Overload
High pressure
Low pressure
Oil

Tab. 8.a

A possible screen for choosing the description of the alarm is shown in the figure:



Tab. 8.b

After having selected the 'generic' description, no other description can be selected. In general, the descriptions are divided into 4 groups:
- generic
- others (overload, oil, high pressure, low pressure)

After having selected a description pertaining to one group, no descriptions from other groups can be selected for that alarm.
For example, the selection may be generic, or alternatively overload + oil. Each alarm will have its own unique alarm screen, and this will include all the descriptions associated with that alarm.

According to the number of alarms selected, the descriptions shown in the table will be associated by default.

Default descriptions based on the number of alarms

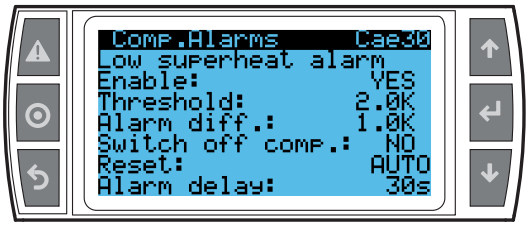
Number of alarms	Descriptions
1	Generic
2	Overload
	HP-LP
3	Overload
	HP-LP
	Oil
4	Overload
	HP
	LP
	Oil

Tab. 8.d

Note: an oil alarm can be interpreted as an oil level warning. When the alarm is activated, an attempt is made to restore the level for a set time before signalling the alarm and stopping the compressor.
If a modulating device is used to drive the compressors, additional alarms are provided:
- compressor inverter warning, common for the entire suction line, when using inverters
- oil crankcase temperature alarm, high discharge temperature.

Low superheat alarm

The low superheat alarm can also be enabled for parallel compressors, in addition to the standard SSH-DSH alarm.
The alarm can be enabled and the settings made on the following screen:



The alarm threshold is the same as the one used for the SSH_DSH alarm.

8.3 Pressure alarms

Hecu CO2 can manage pressure alarms from a pressure switch or probe, according to the following diagram.

Alarms from pressure switch:
- Low suction pressure
- High condensing pressure

Alarms from probe:
- Low suction pressure
- High suction pressure
- Low condensing pressure
- High condensing pressure

One possible example for the low pressure alarms is shown in the figure:

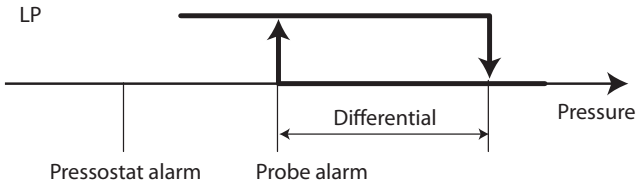


Fig. 8.b

Pressure alarms from pressure switch

The parameters corresponding to these alarms can be set in branch G.c.a/G.c.b of the main menu.

Low suction pressure from pressure switch

The low suction pressure alarm from pressure switch has the effect of stopping all the compressors without observing the various times, therefore when the digital input configured as the low pressure switch is activated, all the compressors on the line affected are stopped immediately.
This alarm features semi-automatic reset, and both the monitoring time and the number of activations in the specified period can be set. If the number of activations is higher, reset becomes manual.
In addition, the delay after which the alarm is activated on both start-up and during operation can be set.
The delay at start-up only applies to unit start-up and not compressor power-on.

High condensing pressure from pressure switch

The high condensing pressure alarm from pressure switch has the effect of stopping all the compressors without observing the various times and forcing the fans on at maximum speed, therefore when the digital input configured as the high pressure switch is activated, all the compressors on the line affected are stopped immediately and the fans operate at maximum output.
This alarm features manual or automatic reset, as configured by the user.
The delay after which the alarm is activated can also be set.

Pressure alarms from probe

The parameters corresponding to these alarms can be set in branch C.a.e of the main menu for suction pressure, and D.a.e for condensing pressure.

For these types of alarms, reset is automatic and the activation threshold and differential can be set, as well as the type of threshold, which may be absolute or relative to the control set point. The figure shows an example of setting the threshold to relative.

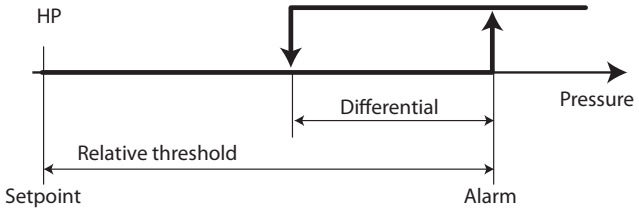


Fig. 8.c

Note: for temperature control, the alarms from probe are managed based on temperature even when pressure probes are fitted.

The effects of the different pressure alarms from probe are described below.

Low suction pressure from probe

The low suction pressure alarm from probe has the effect of stopping all the compressors without observing the times.

High suction pressure from probe

The high suction pressure alarm from probe has the effect of forcing all the compressors on, ignoring the control times, but observing the compressor protection times.

Low condensing pressure from probe

The low condensing pressure alarm from probe has the effect of stopping all the fans without observing the times.

High condensing pressure from probe

The high condensing pressure alarm from probe has the effect of forcing all the fans on and stopping all the compressors, ignoring the times.

8.4 Anti liquid return MPX valve alarm

For alarms that stop the compressor, if the "anti liquid return MPX valve" function is enabled, the evaporator valves will be forced closed. This function can be enabled on **screen Cag65**.

In the event of a low pressure switch alarm, the valves will not be forced closed, so as to allow the system to restart.

Below is the list of alarms that stop the compressor and close the valve:
- High pressure
- HP prevent lock (5 attempts)
- Low SH
- High receiver pressure
- SSH-DSH
- High or low oil level
- Leak alarm
- CO2 alarm

8.5 High pressure prevention

Hecu CO2 can manage the high discharge pressure prevention actions, involving:
- overriding the compressors and fans

Prevent by overriding the compressor and fans

The parameters corresponding to this function can be set in branch G.c.a/G.c.b of the main menu.

The effect of this type of prevention action is to force on all the fans at maximum speed and the BLDC compressor on at minimum speed.

An activation threshold can be set, which is always absolute, as well as the deactivation differential.

Furthermore, the evaluation time and number of activations allowed in a defined time period can also be set. If the number of activations is higher than set, reset becomes manual.

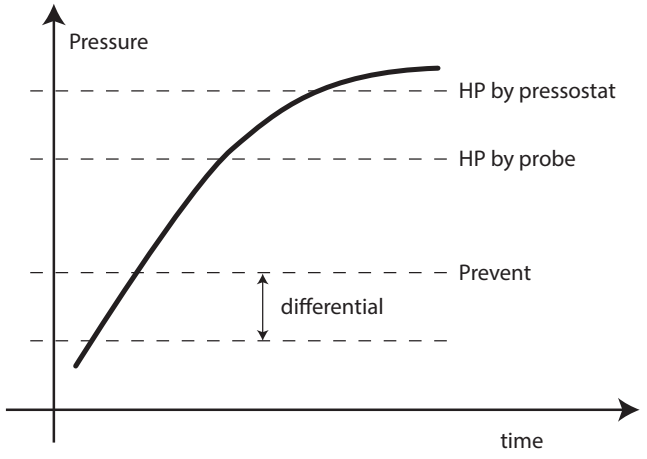


Fig. 8.d

8.6 MPXPRO/UltraCella alarms

The MPXPRO and/or UltraCella alarms are sent remote to the Hecu CO2 user interface, which also forwards them to the supervisor for management/logging.

8.7 Alarm table

Screen index	Display	Description	Serious alarm	Alarm	Delay	Reset
ALU02	Control probe absent	At least one of the main probes is not configured correctly: P_suc, P_GC, T_out_GC, P_ric	x		Not present	Auto
ALA01	Discharge temperature probe broken or disconnected	Compressor discharge temperature probe faulty or not configured correctly		x	Not present	Auto
ALA02	Gas cooler pressure probe broken or disconnected	Gas cooler pressure probe faulty or not configured correctly		x	Not present	Auto
ALA03	Outside temperature probe broken or disconnected	Outside gas cooler temperature probe faulty or not configured correctly		x	Not present	Auto
ALA04	Generic probe A on board 1 broken or disconnected	Generic probe A faulty or not configured correctly		x	Not present	Auto
ALA05	Generic probe B on board 1 broken or disconnected	Generic probe B faulty or not configured correctly		x	Not present	Auto
ALA06	Generic probe C on board 1 broken or disconnected	Generic probe C faulty or not configured correctly		x	Not present	Auto
ALA07	Generic probe D on board 1 broken or disconnected	Generic probe D faulty or not configured correctly		x	Not present	Auto
ALA08	Generic probe E on board 1 broken or disconnected	Generic probe E faulty or not configured correctly		x	Not present	Auto
ALA24	Suction pressure probe broken or disconnected	Compressor suction pressure probe faulty or not configured correctly	x		Not present	Auto
ALA25	Suction temperature probe broken or disconnected	Compressor suction temperature probe faulty or not configured correctly		x	Not present	Auto
ALA43	Gas cooler out temp.probe broken	Gas cooler outlet temperature probe faulty or not configured correctly	x		Not present	Auto
ALA44	Receiver pressure probe broken or disconnected	Receiver pressure probe faulty or not configured correctly	x		Not present	Auto
ALA46	Vapour injection pressure probe broken or disconnected	Vapour injection pressure probe faulty or not configured correctly (LT only)	x		Not present	Auto
ALA47	Vapour injection temperature probe broken or disconnected	Vapour injection temperature probe faulty or not configured correctly (LT only)	x		Not present	Auto
ALA55	Parallel line suction pressure probe broken or disconnected	Parallel compressor suction pressure probe faulty or not configured correctly		x	Not present	Auto
ALA 56	Parallel line suction temperature probe broken or disconnected	Parallel compressor suction temperature probe faulty or not configured correctly		x	Not present	Auto
ALA57	LT line discharge pressure probe broken or disconnected	LT compressor discharge pressure probe faulty or not configured correctly	x		Not present	Auto
ALA58	Parallel line discharge temperature probe broken or disconnected	Parallel compressor discharge temperature probe faulty or not configured correctly		x	Not present	Auto
ALB01	Common low pressure switch alarm	Low pressure switch on the suction line trips below the threshold (number of automatic resets / in min.)	x		Hc02	Hc03
ALB02	Common high condensing pressure switch alarm	High pressure switch on the condensing line trips above the threshold	x		Hc01	Auto/manual
ALB03	Low condensing pressure alarm	P_GC falls below a threshold set on De07	x		De03	Auto
ALB04	High condensing pressure alarm	P_GC exceeds a threshold set on De06	x		De01	Auto
ALB05	Liquid level alarm	Low liquid level alarm from DI with consequent low pressure inside the receiver		x	Hc04	Auto
ALB06	Common oil differential alarm	Low oil level in receiver alarm from DI Open solenoid valve installed between oil separator and receiver to increase oil level		x	Hc04	Auto
ALB07	Fan common overload	Fan overload alarm from DI		x	De05	Auto/manual

Action	Troubleshooting
Unit switched off	Check control probes *
No control action Corresponding functions disabled: - T_dis control by Hb02 - speed control based onT_dis by Hb03	Check T_dis probe *
No control action The HPV valve is set to a safety percentage on Fhb13	Check P_GC probe *
Corresponding functions disabled: - control switches to T_out in case of P_GC fault on Dg14 - gas cooler speed up on T_out on Dg13	Check T_out *
Corresponding functions disabled - if probe A is faulty or not correctly configured, the generic function associated with it will no longer be active	Check generic an.input A *
Corresponding functions disabled - if probe B is faulty or not correctly configured, the generic function associated with it will no longer be active	Check generic an.input B *
Corresponding functions disabled - if probe C is faulty or not correctly configured, the generic function associated with it will no longer be active	Check generic an.input C *
Corresponding functions disabled - if probe D is faulty or not correctly configured, the generic function associated with it will no longer be active	Check generic an.input D *
Corresponding functions disabled - if probe E is faulty or not correctly configured, the generic function associated with it will no longer be active	Check generic an.input E *
A fixed percentage of speed can be set in the event of faulty or disconnected probe on Cag03	Check P_suc probe *
No control action	Check T_suc probe *
Fan shutdown	Check T_out_GC probe *
No control action The RPRV valve is set to a safety percentage on Fhb26	Check P_ric probe *
No control action Vapour injection disabled	Check P_vap_inj probe *
No control action Vapour injection disabled	Check T_vap_inj probe *
No action on the parallel compressor Parallel compressor stops for control	Check P_suc_par probe *
No action on the parallel compressor	Check T_suc_par probe *
Parallel compressor shutdown	Check P_dis_LT probe *
No action on the parallel compressor	Check T_dis_LT probe *
Compressor shutdown	• Check operation, type and setting of evaporator expansion valves (e.g. valve stuck closed) • Check mechanical pressure switch safety thresholds
Compressor shutdown	• Check operation, type and setting of evaporator expansion valves (e.g. valve stuck open) • Check mechanical pressure switch safety thresholds • Check HPV valve setting and operation
Fans forced to 0% while the alarm is active	• Check fans and corresponding alarm settings • Check correct mechanical operation of the fans (wiring, configuration,..) • Check correct positioning and operation of P_GC probe (compare reading on display against pressure gauge reading) • Check correct compressor operation (possible presence of liquid, excessive refrigerant charge, compressor sizing, ...)
Fans forced to 100% while the alarm is active	• Check fans and corresponding alarm settings • Check correct mechanical operation of the fans (wiring, configuration,..) • Check correct positioning and operation of P_GC probe (compare reading on display against pressure gauge reading) • Check correct compressor operation (low refrigerant charge, compressor sizing,..) • Check HPV valve setting and operation
/	• Check refrigerant charge in the circuit, recharge is necessary • Check pressure in the receiver
/	• Check oil level in the circuit • Check operation of solenoid valve between separator and oil receiver • Possible oil trapped in the evaporators
/	• Check fan settings and configuration • Check fan sizing in relation to the application • Check correct mechanical operation of the fans (wiring, configuration,..) • Check HPV valve setting and operation

Screen index	Display	Description	Serious alarm	Alarm	Delay	Reset
ALB15	High suction pressure	Suction pressure exceeds a threshold set on Cae24		x	Cae25	Auto
ALB16	Low suction pressure	Suction pressure below a settable threshold		x	Cae27	Auto
ALB22	Oil sensor level broken or disconnected	Oil level sensor faulty or not configured correctly (LT only) The alarm is activated when neither of the two sensors is active from DI	x		10 s	Auto
ALC01	Alarm 1 compressor 1	Alarm from DI for BLDC compressor set on Cae02 (generic, overload, high pressure, low pressure, oil)		x	Cae04	Auto/manual
ALC02	Alarm 2 compressor 1	Alarm from DI for BLDC compressor set on Cae05 (generic, overload, high pressure, low pressure, oil)		x	Cae07	Auto/manual
ALC26	Alarm 1 parallel compressor	Alarm from DI for parallel compressor set on Cbe02 (generic, overload, high pressure, low pressure, oil)	x		Cbe04	Auto/manual
ALC27	Alarm 2 parallel compressor	Alarm from DI for parallel compressor set on Cbe05 (generic, overload, high pressure, low pressure, oil)	x		Cbe07	Auto/manual
ALC51	CO2 level alarm	Refrigerant leakage outside of the circuit signalled by DI		x	Hc06	Auto
ALC51	Leak detector alarm	Refrigerant leakage in the circuit signalled by DI	x		Hc05	Auto
ALF01	Fan overload	Alarm from DI for one or two fans when fan common overload is disabled on De05		x	De05	Auto/manual
ALG01	AI_Clock	Alarm due to problem reading controller clock		x		
ALG02	Extended memory error	Faulty controller alarm	x			
ALG11	High thermostat 1…5 alarms	High temperature (pressure) alarm for generic function 1 to 5		x	Ffa09-13-17-21-25	Auto
ALG15	Low thermostat 1…5 alarms	Low temperature (pressure) alarm for generic function 1 to 5		x	Ffa09-13-17-21-25	Auto
ALG19	High modulating 1-2 alarms	High temperature (pressure) alarm for generic modulating function 1 or 2		x	Ffb08-Ffb14	Auto
ALG23	Low modulating 1-2 alarms	Low temperature (pressure) alarm for generic modulating function 1 or 2		x	Ffb09-Ffb15	Auto
ALG27	Generic 1-2 normal alarms	Generic alarm 1 or 2		x	Ffc07, Ffc09	Auto
ALG28	Generic 1-2 serious alarms	Serious generic alarm 1 or 2	x		Ffc07, Ffc09	Auto
ALT01	Compressor working hours	Operating hours exceeded for the compressor(s) selected on Cac13 Compressor operating time shown in Cac01		x	Not present	Manual
ALT07	HPV valve alarm	HPV valve alarm from DI settable on Fha04 and HPV brought to safety position (Fhb10)		x	Not present	Auto
ALT08	RPRV valve alarm	RPRV valve alarm from DI settable on Fha05 and RPRV brought to safety position (Fhb23)		x	Not present	Auto
ALT15	Low superheat alarm	Low SH alarm settable on Cae30		x	Cae30	Auto/manual
ALT19	DSH Low liquid flowback	SH less than 0 K and DSH at discharge less than 10 K for a time set on Cae41		x	Cae41	Auto/manual
ALT20	HPV Valve position warning	The HPV valve is at an opening percentage higher than a certain threshold settable on Fhb27		x	Fhb27	Auto
ALT21	RPRV Valve position warning	The RPRV valve is at an opening percentage higher than a certain threshold settable on Fhb28		x	Fhb28	Auto
ALT17	HPV set point warning Gas cooler press. too low/high, deviation from current set point	P_GC is higher or lower than a differential set on Fhb17 in relation to the current set point		x	Fhb17	Auto
ALT18	High receiver pressure alarm	Receiver pressure higher than a settable threshold (Fhb25)		x	Fhb25	Auto
ALW10	Low superheat warning	The SH value as shown on Aa01 is less than a threshold set on Cae30 Warning before the alarm is activated, with a delay that can be set on Cae30		x	Not present	Auto
ALW24	Power plus device offline	BLDC compressor inverter not present or not connected	x		30-90s	Auto
ALW25	Power+ inverter alarm	Inverter alarm n.xx; ALW25 indicates the type of alarm generated by the inverter		x	Not present	Auto
ALW26	Compressor start failure	The differential between compressor discharge and suction pressure does not increase by a certain value in a set period of time. Minimum variation in pressure difference and time period can be set on Cag50	x		Cag50	Auto for 0-9 attempts

Action	Troubleshooting
/	• Check correct compressor operation (presence of liquid, excessive refrigerant charge, compressor sizing,..) • Evaporators with valves fully open at the same time (e.g. MOP set incorrectly on MPXPRO, valves stuck open,..)
Compressor shutdown, set on Cae27	• Check correct compressor operation (incorrect sizing, low refrigerant charge,..) • Evaporators with valves closed and compressors running (valves stuck closed,..)
LT compressor and parallel compressor shutdown	• Check the two level sensors (low, high) • Check wiring and electrical panel connections • Check DI configuration
Compressor shutdown	• Check BLDC compressor operation based on the type of alarm • Type of alarm signalled settable on screen Cae02
Compressor shutdown	• Check BLDC compressor operation based on the type of alarm • Type of alarm signalled settable on screen Cae05
Parallel compressor shutdown	• Check parallel compressor operation based on the type of alarm • Type of alarm signalled settable on screen Cbe02
Parallel compressor shutdown	• Check parallel compressor operation based on the type of alarm • Type of alarm signalled settable on screen Cbe05
Compressor shutdown, settable on Hc06	• Check circuit piping • Check refrigerant charge level in the circuit
Compressor shutdown and fan on settable on Hc05	• Check piping, valves and circuit components • Check correct compressor operation
One or both fans shut down, depending on the configuration	• Check fan connections and correct fan operation • Fan sizing not suitable for the system • Excessive refrigerant charge in the circuit
Actions involving the clock no longer configured	
Unit shutdown	Change board
/	Check the set probe *
/	Check the set probe *
/	Check the set probe *
/	Check the set probe *
/	Check the set probe *
/	Check the set probe *
/	• Check operating hour threshold on screen Cac13 • Reset operating hours on screen Cac14
HPV brought to set safety position when alarm from DI activated	• Check the device connected to the DI
RPRV brought to set safety position when alarm from DI activated	• Check the device connected to the DI
Compressor shutdown, set on Cae30	• Check the correct reading of the probes set for SH (P_suct and T_suct) • Check compressor status (frost on the outside) • Check liquid return from evaporators (SH reading on MPXPRO and UC)
Compressor shutdown	• Check correct compressor operation (presence of liquid, refrigerant charge, sizing,..) • Check evaporator valve operation and status (valves blocked, incorrect configuration, wiring,..) • Check MPXPRO/UC setting (probe operation and positioning, correct parameter configuration, compare probe reading against pressure gauge reading)
/	• Check status of P_GC and T_out_GC probes (type, wiring, correct positioning,..) • Check correct mechanical operation of the fans (wiring, configuration, sizing in relation to the application,..) • Check HPV valve setting, operation and installation (mechanical operation, sizing in relation to the application, correct opening/closing) • Check warning threshold setting
/	• Check status of P_ric probe (type, wiring, correct positioning,..) • Check RPRV valve setting, operation and installation (mechanical operation, sizing in relation to the application, correct opening/closing) • Check warning threshold setting
/	• Check status of T_out_GC probe (type, wiring, correct positioning,..) • Check mechanical operation of the fans (wiring, configuration, sizing in relation to the application,..) • Check warning threshold setting
Compressor shutdown, set on Cae42	• Check RPRV valve setting, operation and installation (mechanical operation, sizing in relation to the application, correct opening/closing) • Check synchronisation with external driver (wiring and connections, configurations,..) • Sizing of the receiver in relation to the application • Charge in the circuit
Low superheat warning signal No control action	• Check the correct reading of the probes set for SH (P_suct and T_suct) • Check compressor status (frost on the outside) • Check liquid return from evaporators (SH reading on MPXPRO and UC)
Compressor shutdown	• Check inverter power supply • Check phase connection between compressor and inverter (wiring and connections) • Check STO • Check configuration of inverter parameters (baud rate, parity, number of bits)
Compressor shutdown	• Check inverter operation and status • Check list of alarms in the inverter manual (explanation of the alarms that may occur on the inverter)
Compressor shutdown with manual reset after n restart attempts	• Check compressor connections to the inverter (swapped phases, wiring and incorrect connections,..) • Check correct compressor operation (liquid in the compressor, excessive charge in the circuit,..) • Check evaporator valve status (valves stuck open) • Check positioning, installation and correct operation of P_GC probe (positioning before the check valve at the compressor discharge, checking the values are read correctly) • Check positioning, installation and correct operation of P_suct probe

Screen index	Display	Description	Serious alarm	Alarm	Delay	Reset
ALW27	Envelope alarm	Compressor operation outside of the envelope		x	Cag55	Auto
ALW28	High discharge gas temperature	Compressor discharge temperature exceeds a threshold set on Hb02	x		Not present	Auto
ALW29	Compressor low pressure differential (insufficient lubrication)	Difference between BLDC compressor suction and discharge pressure too low		x	Cag55	Auto
ALW30	Inverter model not compatible (Power+ only)	Selected inverter model not compatible with the type of compressor set on Cag02		x	Not present	Auto
ALW37	Alarm stores (generic)	Generic alarm evaporator 1 to 5 ALW37 shows the evaporators with active alarms		x	Not present	Auto
ALW40-53-66-79-92	Store 1…5 offline	Evaporator 1 to 5 configured by Hecu but MPXPRO/UC device not connected via Fieldbus or offline		x	Not present	
ALW41-54-67-80-93	Store 1…5: Low temperature alarm	Low temperature alarm for the probe set on MPXPRO/UC evaporator 1 to 5		x	from MPXPRO/UC (Ad)	Auto
ALW42-55-68-81-94	Store 1…5: High temperature alarm	High temperature alarm for the probe set on MPXPRO/UC evaporator 1 to 5		x	from MPXPRO/UC (Ad)	Auto
ALW43-56-69-82-95	Store 1…5: Low temperature alarm 2	Low temperature alarm for the probe set only on MPXPRO evaporator 1 to 5		x	from MPXPRO (Ad2)	Auto
ALW44-57-70-83-96	Store 1…5: High temperature alarm 2	High temperature alarm for the probe set only on MPXPRO evaporator 1 to 5		x	from MPXPRO (Ad2)	Auto
ALW45-58-71-84-97	Store 1…5: Defrost timeout	End defrost procedure by timeout signal, evaporator 1 to 5		x	from MPXPRO/UC (dP1, dP2)	Auto
ALW46-59-72-85-98	Store 1…5: Low superheat alarm	SH evap. 1 to 5 below the threshold; control is activated to rapidly close the valve and prevent liquid from returning to the compressor		x	from MPXPRO (P9)	Auto
ALW47-60-73-86-99	Store 1…5: Low suction temperature alarm	Suction temperature (t_gs) 1 to 5 below threshold, with the risk of liquid returning to the compressor		x	from MPXPRO (P12)	Auto
ALW48-61-74-87-ALZ00	Store 1…5: MOP alarm	Evap. pressure in cabinet 1 to 5 above the threshold (parameter PM1 on MPXPRO); control is activated (parameter PM2) to rapidly close the valve		x	from MPXPRO (PM3)	Auto
ALW49-62-75-88-ALZ01	Store 1…5: LOP alarm	Evap. pressure in cabinet 1 to 5 below the threshold (parameter PL1 on MPXPRO); control is activated (parameter pL2) to rapidly open the valve		x	from MPXPRO (PL3)	Auto
ALW50-63-76-89-ALZ02	Store 1…5: stepper driver communication error	Incorrect setting of parameter P1 on MPXPRO 1 to 5, which must be set to 2 (management of Carel E2V electronic valve is required)		x	from MPXPRO (P1)	
ALW51-64-77-90-ALZ03	Store 1…5: stepper motor error	Electronic valve not properly installed		x		
ALW52-65-78-91-ALZ04	Store 1…5: installation or config problems on EEV driver	Valve 1 to 5 end of travel alarm. Valve blocked alarm ("Blo") signalled on MPXPRO		x		
ALZ06	Liquid return from MPX 1…5 offline during flush	MPX 1 to 5 offline alarm during washing		x		
ALZ07	Warning: no DO configured for vapour injection flow in BLDC	No DO configured for the vapour injection function for BLDC compressor in LT applications or for parallel compressor, set on Fda07	x		Not present	Auto
ALZ08	Carel EXV valve not configured on MPXPRO The unit will switch off in 10 hours	Valve managed by MPXPRO/UC is not a Carel E2V electronic valve.	x			
ALP01	Power + n.2 (n.3) offline	Parallel compressor inverter not present or not connected		x	30-90s	Auto
ALP02	Power+ n2 (n.3) alarm	Inverter no. 2 (no. 3) alarm n.xx Alarm screen ALW25 indicates the type of alarm generated by the inverter		x	Not present	Auto
ALP03	Parallel compressor start failure	The differential between discharge (P_GC) and suction pressure for the parallel compressor (P_ric) does not increase by a certain value in a period of time set on Cbg50	x		Cbg50	Auto for 0 to 9 attempts

Action	Troubleshooting
Compressor shutdown, with a reduction in speed set on Cag54	• Check positioning, installation and correct operation of P_GC probe (positioning before the check valve at the compressor discharge, checking the values are read correctly) • Check positioning, installation and correct operation of P_suct probe; 8 operating zones outside of envelope • Check correct compressor operation (charge, sizing, presence of liquid,..)
Compressor shutdown	• Check installation and correct operation of the temperature probe (wiring, electrical connections and comparison against pressure gauge reading) • Check compressor (enabling the liquid injection function if the discharge temperature is too high, connections to the inverter) • Check charge in the circuit (low charge)
Compressor shutdown	• Check correct compressor operation (charge, sizing, presence of liquid,..) • Check positioning, installation and correct operation of P_GC probe (positioning before the check valve at the compressor discharge, checking the values are read correctly) • Check positioning, installation and correct operation of P_suct probe • Metallic noise made by compressor due to lack of lubrication by the oil
Compressor does not start	• Check the inverter model installed against the model required by the compressor in the system on screen Cag02
/	• Check evaporator configuration on screen Eab00 and then on Hecu (number of evaporators, sizing, type of controller installed,..) • Check Fbus connection (connections, wiring, polarity,..) • Check MPXPRO/UC status (check configuration on the controller, serial address parameter H0; if necessary, repeat commissioning procedure)
/	• Check evaporator configuration on screen Eab00 and then on Hecu (number of evaporators, sizing, type of controller installed,..) • Check Fbus connection (connections, wiring, polarity,..) • Check MPXPRO/UC status (check configuration on the controller, serial address parameter H0; if necessary, repeat commissioning procedure)
Signal-only alarm - No action	• Check cabinet/showcase status (correct fan operation, set point) • Check MPXPRO/UC setting (configuration and setting of control probes)
Signal-only alarm - No action	• Check cabinet/showcase status (correct fan operation, set point) • Check MPXPRO/UC setting (configuration and setting of control probes)
Signal-only alarm - No action	• Check cabinet/showcase status (correct fan operation, set point) • Check MPXPRO setting (configuration and setting of control probes)
Signal-only alarm - No action	• Check cabinet/showcase status (correct fan operation, set point) • Check MPXPRO setting (configuration and setting of control probes)
Signal-only alarm - No action	• Check cabinet/showcase status (correct fan operation, set point) • Check MPXPRO setting (configuration and setting of control probes)
Signal-only alarm - No action	• Check t_gs and p_ev probes (type, wiring, installation position, probe limits, reading compared against mechanical device) • Check alarm settings • Check E2V valve operation (correct opening/closing, check that it is not stuck open) • Compare the SH value read by Hecu to check correct probe operation
Signal-only alarm - No action	• Check t_gs probe (type, wiring, installation position, probe limits, reading compared against mechanical device) • Check alarm settings • Check E2V valve operation (correct opening/closing, check that it is not stuck open)
Signal-only alarm - No action	• Check cabinet/showcase status (correct fan operation, set point) • Check MOP settings (PM parameters on MPXPRO) • Check compressor capacity in relation to total system cooling demand (insufficient compressor capacity) • Check useful when commissioning the system
Signal-only alarm - No action	• Check cabinet/showcase status (correct fan operation, set point) • Check compressor capacity in relation to total system cooling demand (insufficient compressor capacity) • Check LOP settings (PL parameters on MPXPRO)
Signal-only alarm - No action	• Check parameter P1 (this must be set to 2) on MPXPRO in relation to the valve installed on the evaporator (this must be the Carel E2V electronic valve)
Signal-only alarm - No action	Check electronic valves on the respective cabinets
Signal-only alarm - No action	Check parameter P14 on MPXPRO
Compressor shutdown	• Check Fbus connection (connections, wiring, polarity,..) • Check MPXPRO/UC status (check configuration on the controller, serial address parameter H0; if necessary, repeat commissioning procedure)
Signal-only alarm - No action	• Check DO setting for LT compressor on screen Fda07 • Check DO setting for parallel compressor on screen Fda08
Unit shutdown in 10 hours	Check parameter P1 (this must be set to 2) on MPXPRO in relation to the valve installed on the evaporator (this must be the Carel E2V electronic valve)
Parallel compressor shutdown	• Check inverter power supply • Check phase connection between compressor and inverter (wiring and connections) • Check STO • Check configuration of inverter parameters (baud rate, parity, number of bits)
Parallel compressor shutdown	• Check positioning, installation and correct operation of P_GC probe (positioning before the check valve at the compressor discharge, checking the values are read correctly) • Check positioning, installation and correct operation of P_ric probe; 8 operating zones outside of envelope • Check correct compressor operation (charge, sizing, presence of liquid,..)
Parallel compressor shutdown with manual reset after n restart attempts	• Check compressor connections to the inverter (swapped phases, wiring and incorrect connections,..) • Check correct compressor operation (liquid in the compressor, excessive charge in the circuit,..) • Check positioning, installation and correct operation of P_GC probe (positioning before the check valve at the compressor discharge, checking the values are read correctly) • Check positioning, installation and correct operation of P_ric probe

Screen index	Display	Description	Serious alarm	Alarm	Delay	Reset
ALP04	Parallel compressor envelope alarm	Compressor operation outside of the envelope		x	Cbg55	Auto
ALP05	Parallel compressor high discharge gas temperature	The parallel compressor discharge temperature exceeds a certain threshold set on Hb04		x	Not settable	Auto
ALP06	Parallel compressor low pressure differential (insufficient lubrication)	Difference between parallel compressor suction and discharge pressure too low		x	Cbg55	Auto
ALP07	Parallel compressor inverter model not compatible (power+ only)	Selected inverter model for parallel compressor not compatible with the type of compressor used		x		

(*) probe type, wiring, probe installation position, probe limit settings, comparison of value displayed against physical instrument (pressure gauge,..)

Action	Troubleshooting
Compressor shutdown, with speed reduction set on Cbg54	• Check positioning, installation and correct operation of P_GC probe (positioning before the check valve at the compressor discharge, checking the values are read correctly) • Check positioning, installation and correct operation of P_ric probe; 8 operating zones outside of envelope • Check correct compressor operation (charge, sizing, presence of liquid,..)
Parallel compressor shutdown	• Check t_dis_par probe (type, wiring, installation position, probe limits, reading compared against mechanical device) • Check alarm threshold setting on screen Hb04
Parallel compressor shutdown	• Check correct compressor operation (charge, sizing, presence of liquid,..) • Check positioning, installation and correct operation of P_GC probe (positioning before the check valve at the compressor discharge, checking the values are read correctly) • Check positioning, installation and correct operation of P_ric probe • Metallic noise made by compressor due to lack of lubrication by the oil
Parallel compressor does not start	Check the inverter model installed against the model required by the compressor in the system on screen Cbg02

Tab. 8.c

9. SOFTWARE UPDATE

9.1 Uploading/updating the software

The following methods can be used to update the firmware and acquire the log files on pCO controllers:
- SmartKey programming key;
- pCO manager tool, a program installed on a PC.

Smart key

The PCOS00AKY0 key is an electronic device used to program and service the pCO sistema family controllers. PCOS00AKY0 simplifies data transfer between the controllers installed and a personal computer by exploiting the high capacity flash memory for storing software applications, BIOS and variable logs. The pCO is connected directly via the telephone connector using the cable supplied, while to transfer the data to a personal computer, the USB adapter code PCOS00AKC0 is required. The power supply comes either via the USB port on the PC or from the controller, therefore no external power supply is needed.

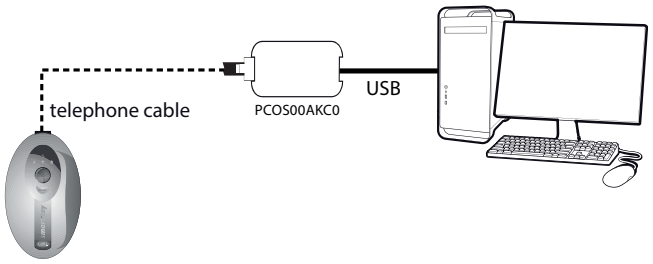


Fig. 9.a

For the operating instructions, see par. 9.1.

Operating instructions

Fig. 9.b

Programming the Smart Key via Personal Computer

The operating modes described in the table below can be configured using a program on a PC. The program can also load the software to the key or transfer logged data from the controller to the hard drive.

Type	Function	Mode button
B	Update software from key to pCO (BIOS, application program, parameters,...)	Disabled
C*	Copy software from pCO to pCO (BIOS, application program, parameters,...)	Switches the key from write mode to read mode
D	Read logs	Disabled
E	Read logged data and software from pCO (BIOS, application program, parameters,...)	Disabled
F	Read logs	Disabled
G	Copy from pCO to pCO and read logs	Switches the key to write mode, read mode and read logs mode

*: Default mode

Tab. 9.a

The key is factory-programmed in read/write mode (type C) so that it can be used immediately to transfer software from one controller to another. When the key is connected to the personal computer, the symbols have the following meanings:

↑ ↓	Flashing	Waiting for connection to PC
	Alternating	When connected to PC indicates data transfer in progress

The programming key is compatible starting from BIOS version 3.43 and BOOT version 3.01. For more detailed information on programming the key, see to the pCO Manager manual.

Using the Smart Key with the pCO/µPC programmable controllers

Switch off the pCO, remove any peripherals connected in the pLAN and plug the key into the telephone connector on the controller. When switching on again, all the symbols light up momentarily and the buzzer emits a beep. A few seconds later the key becomes operational. This waiting period is indicated by the flashing of ↑ ↓. The controller then enters programming mode and the start button is on steady; press the button to start data transfer

Important:
- if the key is type B, C or G (in write mode) pressing the start button will immediately delete the software already loaded on the pCO.
- Do not remove the key while data is being transferred to the key itself, as the file being transferred will be lost and the corresponding space will not be restored. To restore the original capacity all the files will need to be deleted. If the key is type "C" or "G", simply perform a new application read operation.

Meanings of buttons/symbols

↑ ↓	Flashing: the key is connecting to the pCO; during this phase, which may last a few seconds, the start button is disabled
start	Flashing: the key has detected the pCO and is checking the access rights
start+↑	On steady: pressing the start button will start writing the software to the pCO
start+↓	On steady: pressing the start button will start reading the software from the pCO
start+	On steady: pressing the start button will start reading the logs from the pCO
mode	On steady: for type C or G keys, pressed for 1 second switches from read to write mode

Tab. 9.b

If the key is type C or G, pressing mode for 1 s switches from read mode to read logs (G only) or write mode; the symbols ↑ (write to pCO), ↓ (read from pCO), (read logs) reflect the selected mode. If the key is not type C or G, the mode key is disabled and the light is off. The start button starts the read or write operation, which will be indicated by the flashing of the corresponding symbol (↑ or ↓), at a frequency proportional to progress. When the operation is completed, the buzzer will sound intermittently for 2 seconds. Pressing the start button again will make the buzzer sound without repeating the operation; to repeat the operation, the key must first be unplugged. In the event of an error, the symbol comes on in combination with the other LEDs. The following table can be used to find the cause of the problem.

Errors before pressing the START button

⚠ + ↑ + ↓	flashing	Communication error: no response from the pCO or: Key firmware version incompatible
⚠ +mode	on steady	Password error
⚠ +mode	flashing	Incompatible key type
⚠ + ↑	on steady	The key is missing one or more required files (memory empty; no kit for the type of pCO connected)
⚠ + ↑ +start	on steady + start flashing	Incompatibility between the software on the key and the pCO HW
⚠ + ↑ +mode	on steady + mode flashing	Incompatibility between application program and pCO HW (program size)
⚠ + ↑ + 📄	on steady	No logged data on the pCO
⚠	on steady	Key type not programmed

Tab. 9.c

Errors after pressing the START key

⚠ +start+ ↑ +buzzer	flashing and buzzer on pulsing	The write command failed
⚠ +start+ ↓ +buzzer	flashing and buzzer on pulsing	The read command failed
⚠ +start+ 📄 +buzzer	flashing and buzzer on pulsing	The read logs command failed
⚠ + ↑ + 📄	on steady + 📄 flashing	Incompatibility between log configuration and pCO HW (no dedicated flash memory). This error does not affect the writing of the other files
⚠ + 📄	on steady	Insufficient space to read logged data
⚠	flashing	Generic error

Tab. 9.d

pCOmanager: operating instructions

pCO Manager is a program for managing all configuration, debugging and maintenance operations on CAREL pCO sistema devices. It can be installed as a stand-alone program or integrated into the 1tool programming environment.

Installing pCOmanager

Go to http://ksa.carel.com, and in the pCO sistema section select pCO_manager. After accepting the general terms and conditions for the free software license, a window will open for downloading the pCO_manager.zip file. Install the program on the computer.

PC - pCO controller connection

The computer's USB port must be connected to a cable with USB/RS485 converter, and this must in turn be connected via telephone cable to the pLAN port on the pCO.

Fig. 9.c

When the pCO_manager program is opened, a screen is displayed, showing the connection settings at the top right. Select:

1. local connection;
2. baud rate: Auto;
3. device search: Auto (pLAN).

As regards the port number, follow the instructions shown in the Wizard for automatic identification (e.g. COM4).

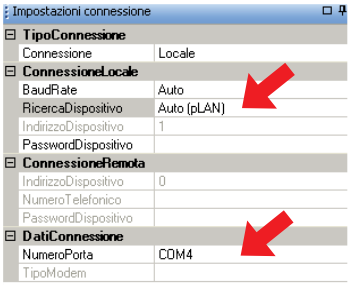


Fig. 9.d

Power the controller off and on again, and run the connect command to make the connection; when connected, the ONLINE icon will be shown flashing in the bottom left corner.

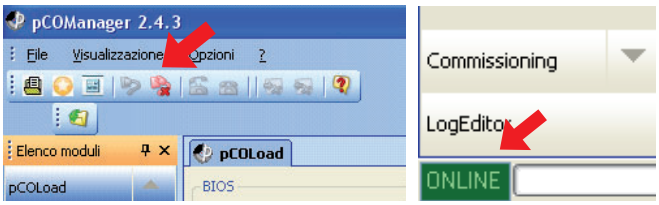


Fig. 9.e

Application program installation

- Select the directory where the application program files are located, and run the Upload command to load this onto the pCO controller.

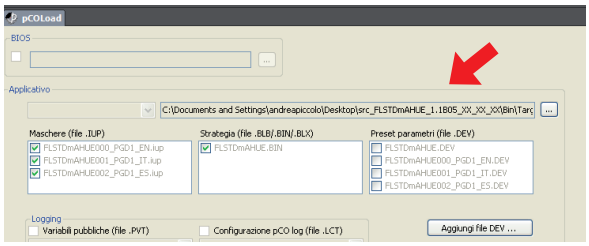


Fig. 9.f

Commissioning

- Use the mouse to select commissioning at the bottom left. A new work environment will be opened.

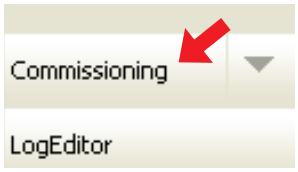


Fig. 9.g

- Run the "configure device" command to display all of the application variables. These can be selected based on the categories shown at the bottom.

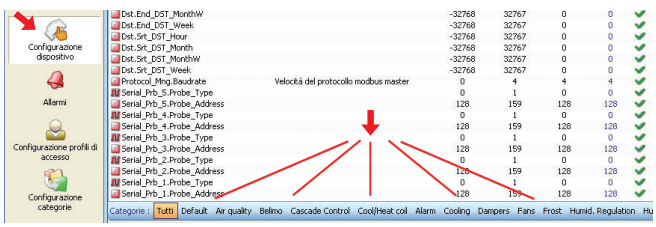


Fig. 9.h

Changing a parameter

Choose the category of parameters and then the parameter to be set: this is highlighted by a blue line (e.g. recovery.recovery_type).

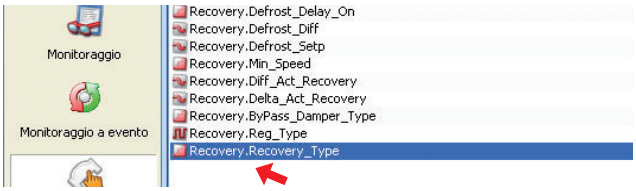


Fig. 9.i

1. Double click the mouse on the **read** column. A window is displayed for entering the new parameter value.

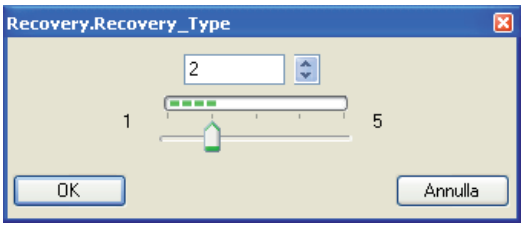


Fig. 9.j

2. Write the new value (e.g. 3) and select OK. The new value is displayed in the written column. To write the parameter to the pCO controller, click the right mouse button and run the write selected command. The new value is displayed, confirm the value in the written column.

Default	Letto	Scritto
120	120	120
1	1	1
5,0	5,0	5,0
60	60	60
3,0	3,0	3,0
0	0	0
100	100	100
120	120	120
4,0	4,0	4,0
-1,0	-1,0	-1,0
20	20	20
0,3	0,3	0,3
0,5	0,5	0,5
1	1	1
0	0	0
1	3	3

Fig. 9.k

Finally, run the Save command to generate the project .2cw file.

Commissioning tool: basic concepts

Note: the following paragraphs are taken from the pCOmanager program online help; refer to this for any further details.

The commissioning tool is real-time configuration and monitoring software used to check the operation of an application program installed on a pCO, for commissioning a pCO, debugging and maintenance.
This tool can be used to set the configuration parameters, modify the values of volatile and permanent variables, save the trends of the main unit values to a file, manually manage the unit I/Os using simulation files, and monitor/reset the alarms on the unit where the device is installed.
The commissioning operations first require configuration of the work environment, typically the task of the designer. The active 1tool project is automatically loaded by the pCO Manager. The commissioning tool configuration functions allow the designer to decide which variables will be included in the monitoring/log/trend/event monitoring activities, to organise variables into categories, and to set groups of configuration parameter. Users who use the commissioning tool during maintenance operations will already have access to the required variables, and will be able to refer to pre-set configuration values.

Support files

At the end of the application program design phase, 1tool generates several files during compilation; two of these are required for commissioning:
- <applicationName>.2CF (variable descriptor);
- <applicationName>.2CD (descriptor of categories and access profiles).

In addition to these files, the <applicationName>.DEV file can also be managed, which contains the pre-set unit parameters. After having completed commissioning, either for configuration or monitoring, the user can generate the following files:
- <applicationName>.2CW (descriptor of categories, access profiles, monitoring groups);
- <CommissioningLogFileName>.CSV (file used for the commissioning log, with the data of the variables logged during monitoring).

The commissioning configuration phase thus requires the following files: .2CF, 2CD and where possible the .DEV file, which can be imported and exported.
For the monitoring phase, in addition to the above files, the .2CW file may be needed, with the definition of the specific work environment. The commissioning log file is a simple output file.

pCO Load: basic concepts

pCOLoad is the module that manages:
- uploading to flash memory (ProgKeyX device or key installed on the pCO);
- uploading to NAND memory on certain devices;
- downloading logs, .DEV file and P memory (from flash memory).
- downloading NAND memory files, if present.

The following files are exchanged with the pCO flash memory:
- Boot.BIN (download reserved, upload enabled from menu);
- Bios.BIN (download reserved);
- <applicationName>.BLB (download reserved);
- <applicationName>.BIN (download reserved);
- <applicationName>.DEV;
- <applicationName>.GRT (upload only, from which the .GRP is extracted);
- <applicationName>.IUP;
- <applicationName>.LCT;
- <applicationName>.PVT;
- <pCOlogName>.BIN, <pCOlogName>.CSV, <pCOlogName_GRAPH>.CSV (only if logs have been configured, download only).

The following files are exchanged with the pcO NAND memory:
- All of the files that the pCO can autonomously copy to the flash memory (see the previous list);
- External files (e.g.: PDF, .doc for documentation).

LogEditor: basic concepts

LogEditor is the module used to configure pCO device logs (pCO log). Configuring pCO logs involves defining a number of sets of variables for specifying which variables should be logged, the logging method (by frequency or by event) and the guaranteed minimum number of records required. Configuration is based on a binary file (.PVT – Public Variable Table), which is generated by 1Tool and contains the descriptive data of the variables that can be logged. All the log configurations so defined are saved in the .LCT (Log Configuration Table) binary file, which must be uploaded to the pCO together with the .PVT file. Log configuration data is also saved in a file that can be used only by LogEditor – the .LEF file, which must be saved to be edited with LogEditor when necessary. LogEditor can be used even when the device is not connected.
Once the files for logging are uploaded to the pCO, the pCO saves the logged data in the following files:
- a .BIN file containing all the data in binary format;
- a .CSV file containing the same data but in a generic format with comma separated values;
- a *_GRAPH.CSV file with the same data, to be used for graphs.

9.2 Software revision history

New version 3.0.012

Notes:

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