ENG

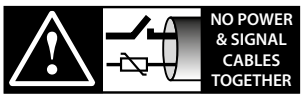
µRack

Solution for condensing units and compact compressor racks

USER MANUAL

LEGGI E CONSERVA QUESTE ISTRUZIONI

READ AND SAVE THESE INSTRUCTIONS



READ CAREFULLY IN THE TEXT!

µRack
+0300026EN - ENG
Up to date version available on
www.carel.com

GENERAL WARNINGS

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

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

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

DISPOSAL

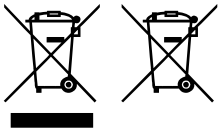


Fig. 1 Fig.2

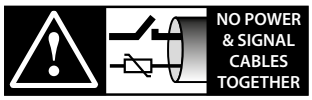
DISPOSAL: INFORMATION TO USERS

Please read and keep.

With reference to European Union directive 2012/19/EU issued on 4 July 2012 and related national legislation, please note that:

1. Waste Electrical and Electronic Equipment (WEEE) cannot be disposed of as municipal waste but must be collected separately so as to allow subsequent recycling, treatment or disposal, as required by law;
2. users are required to take Electrical and Electronic Equipment (EEE) at end-of-life, complete with all essential components, to the WEEE collection centres identified by local authorities. The directive also provides for the possibility to return the equipment to the distributor or retailer at end-of-life if purchasing equivalent new equipment, on a one-to-one basis, or one-to-zero for equipment less than 25 cm on their longest side;
3. this equipment may contain hazardous substances: improper use or incorrect disposal of such may have negative effects on human health and on the environment;
4. the symbol (crossed-out wheeled bin – Fig.1) even if, shown on the product or on the packaging, indicates that the equipment must be disposed of separately at end-of-life;
5. if at end-of-life the EEE contains a battery (Fig. 2), this must be removed following the instructions provided in the user manual before disposing of the equipment. Used batteries must be taken to appropriate waste collection centres as required by local regulations;
6. 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.



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.

Key to the symbols:

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

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

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

Index

1. INTRODUCTION

µRack is the Carel solution for the complete management of small compressor racks, for synchronous control of medium and low temperatures. The maximum configuration manages up to 2 suction lines and 6 compressors in total (4+2) ([1]). The distinctive feature of µRack is complete control of high efficiency units through the management of modulating devices, combined with control logic to optimise overall system efficiency, including the special floating condenser and floating suction functions. The user terminal, which allows wireless connectivity with mobile devices, can be purchased separately on some models, while on others it is built-in. CAREL's APPLICA app, available on Google Play for the Android operating system and Apple store for iOS, makes it easier to configure parameters and commission the unit in the field.

µRack CO_2 is the version designed for systems that use R744 gas (CO_2) in transcritical operation. It features logic for the control and management of the typical aspects of CO_2, i.e. gas cooler pressure via a high pressure relief valve (HPV) and receiver pressure via the flash gas valve (FGV).

Notice: unlike the versions for HFC/HFO, µRack CO_2 manages a single suction line with up to four compressors.

1.1 Main functions

Ref.	Description
Main features	Up to two suction lines and six compressors in total (4MT + 2BT) for the HFC/HFO versions; one suction line and four compressors for the CO_2 versions; max one modulating device per line
	Management of a common condensing stage with up to 4 ON/OFF or inverter-driven fans
Hardware	BASIC model for panel mounting: management of ON-OFF compressors, 0-10 V inverter compressors and Digital Scroll™ compressors with external SSR connected to a 0-10 V output
	MEDIUM model for DIN rail mounting: management of ON-OFF compressors, 0-10 V inverter compressors and Digital Scroll™ compressors with external SSR connected to a 0-10 V output
	ADVANCED model for DIN rail mounting: management of ON-OFF, inverter and Digital Scroll™ compressors via built-in SSR
	CO_2 model for DIN rail mounting: management of ON-OFF, inverter and Digital Scroll™ compressors via built-in SSR
User interface	7-segment, 2-row LED display, communication via APPLICA app (compatible with NFC and Bluetooth LE) for mobile devices
Temperature control	Max two suction lines - dead band
	Max two suction lines - PID
	Condensing stage - dead band
	Condensing stage - PID
Compressor rotation	FIFO, LIFO or timed
Compressor management	Hermetic/semi-hermetic compressors, with capacity control (maximum 2 steps)
	Generic scroll compressors
	Compressors with external inverter via 0-10 V signal
	Digital Scroll™ compressors via built-in or external SSR (0-10 V output signal from controller)
Oil management	Oil recovery function (extended operation at part load)
Prevent	Prevention of compressor operating limits in relation to suction and condensing pressure
	High discharge temperature prevention
	Low superheat prevention with modulating compressor protection
Alarms (see "Alarms")	Management of automatic and manual reset according to alarm severity
	Alarm log (up to 20 events): alarm and reset date and time recorded
Connectivity/supervision	2 RS485 serial ports, Fieldbus and BMS
Modbus® RTU	Baud rate up to 115200 bit/s
	Frame configurable by parity (none, even, odd) and stop bits (1 or 2); databits fixed at 8 bits.

Tab. 1.a

1.2 Models

Part number	Mounting	Connectivity	Compressor management:	Notes
U20R00MRK0280	panel	NFC	On-Off and Inverter **	BASIC version, built-in display
U20R00MRK0380	panel	NFC + BLE	On-Off and Inverter **	BASIC version, built-in display
U20R00MRK0290	DIN rail	NFC	On-Off and Inverter **	MEDIUM version, built-in display
U20R00MRK0390	DIN rail	NFC + BLE	On-Off and Inverter **	MEDIUM version, built-in display
U20R00MRK0300 *	DIN rail	-	On-Off, Inverter and Digital Scroll™	ADVANCED version, no display, built-in SSR
U00000MRT0400 *	DIN rail	-	On-Off and Inverter **	CO_2 version, no display

Tab. 1.b

(*) To be combined with the display (Table 1.c)
(**) Digital Scroll™ compressors only with external SSR relays connected to 0-10 V outputs

1 The only limitation to configuration depends solely on the availability of I/Os on the controller.

1.3 Accessories

1.3.1 µRack user terminal

The user terminal, built-in on the panel models or available separately, includes the display and keypad, comprising four buttons that, when pressed alone or combined with other buttons, access the operations available for the "User" and "Service" profiles (see the paragraph on "Commissioning"). Connectivity - NFC or NFC + Bluetooth (BLE) based on the model - allows interaction with mobile devices and simplifies unit commissioning (after having installed the CAREL "Applica" app, available on Google Play for the Android operating system and Apple store for iOS, see chapters "Commissioning" and "User interface"). For assembly, see the technical leaflet +0500146IE.

Fig. 1.a

P/N	Description
AX2000PD20030	Display (NFC+ BLE)
ACS00CB000020	Connection cable L=1.5 m
ACS00CB000010	Connection cable L=3 m

Tab. 1.c

1.3.2 Connector kit and wired connectors

Fig. 1.b

P/N	Description
UCHCONP010	Cable and connector kit for µRack panel MOLEX/FREE 100 cm
UCHCOND010	Cable and connector kit for µRack DIN MEDIUM and ADVANCED MOLEX/FREE 100 cm
UARCOND010	Cable and connector kit for µRack DIN CO_2 MOLEX/FREE 100 cm
UCHCONP000	Connector kit for µChiller / µRack panel MOLEX
UCHCOND000	Connector kit for µChiller / µRack DIN MOLEX

Tab. 1.d

1.3.3 Temperature sensors

NTC sensors for measuring the temperatures in the user circuit, the outdoor air or source, and the refrigeration circuit. NTC**HT sensors are recommended for discharge temperature measurement.

Fig. 1.c

Part number	Type	Range	Reference
NTC060HF01	10 kΩ ±1% @25°C, IP67	-50 to 90°C strap-on	A
NTC060HP00	10 kΩ ±1% @25°C, IP67	-50 to 50 °C (105°C in air)	B, black wire
NTC060HT00	50 kΩ ±1% @25°C, IP67	-30 to 100°C 95% rH in air (150°C in a dry environment)	C, white wire

Tab. 1.e

Notice: see manuals +040010025 (ITA- ENG) /+040010026 (FRE-GER) for guidelines on installing the sensors on the unit.

1.3.4 Pressure sensors

Active probes for measuring:
1. evaporation pressure in the circuit, used to control superheat and the operating limits;
2. condensing pressure in the circuit, to control the condensing stage and manage the operating limits.

See technical leaflet +050000488.

Fig. 1.d

Part number	Type	Application	Range
SPKT0*13P*	0.5 to 4.5 Vrat	LP R407C, R290	-1 to 9.3/-14.5 to 134.9 barg/psig
SPKT0*43P*	0.5 to 4.5 Vrat	LP R410A, R32	0 to 17.3/0 to 250.9 barg/psig
SPKT0*33P*	0.5 to 4.5 Vrat	HP R407C, R290	0 to 34.5/0 to 500.4 barg/psig
SPKT0*B6P*	0.5 to 4.5 Vrat	HP R410A, R32	0 to 45/0 to 652.7 barg/psig
SPKT0011C*	4-20 mA	LP R407C, R290	0 to 10/0 to 145.0 barg/psig
SPKT0041C*	4-20 mA	LP R410A, R32	0 to 18.2/0 to 264 barg/psig
SPKT0031C*	4-20 mA	HP R407C, R290	0 to 30/0 to 435.1 barg/psig
SPKT00B1C*	4-20 mA	HP R410A, R32	0 to 44.8/0 to 649.8 barg/psig
SPKT00D8C0	4-20 mA	HP R744	0 to 150/0 to 2175.6 barg/psig
SPKT00G1C*	4-20 mA	LP R744	0 to 60 /0 to 870.2 barg/psig
SPKC00*310	IP67 connection cable		L= 2 to 12 m
SPKC00*311	IP67 connection cable - 50 pcs		L= 0.65 to 1.3 m

Tab. 1.f

1.3.5 Local supervision by boss micro

Fig. 1.e

boss micro is CAREL's family of IoT supervisors to enable monitoring and local or remote supervisory services for HVAC/R systems with up to 15 units.
Compact, standard installation inside an electrical panel and a local LED interface with immediate indication of communication status make boss micro easy to install in the field, without the need for experts in connectivity products.
boss micro can be used to display/modify the main values and alarms on µRack.

Notice: the "Safe Restore" function for CO_2 applications is not available on boss micro.

1.3.6 USB/RS485 converter (CVSTDUMOR0)

Fig. 1.f

Electronic device used to connect a PC to the µRack RS485 network via the USB port.
See technical leaflet +050000590.

1.3.7 Electronic expansion valve driver (EVD0000T*)

Fig. 1.g

Bipolar stepper motor electronic expansion valve driver used to control HPV and FGV valves; to be used in combination with the CO_2 version. See manual +0300006EN.

1.3.8 Ultracap module (EVD0000UC0)

Fig. 1.h

The module, mounted on a DIN rail, guarantees temporary power to the driver in the event of a power failure, for enough time to close the HPV and FGV valves. See manual +0300006EN.

2. INSTALLATION

2.1 Warnings

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

- temperature and humidity that do not comply with the ambient operating conditions (see "Technical specifications");
- strong vibrations or knocks;
- exposure to water sprays or condensate;
- 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);
- wide and rapid fluctuations in ambient temperature;
- exposure to direct sunlight, the weather in general and dust (formation of corrosive patina with possible oxidation and reduction of insulation).

2.2 Panel version

2.2.1 Dimensions - mm (in)

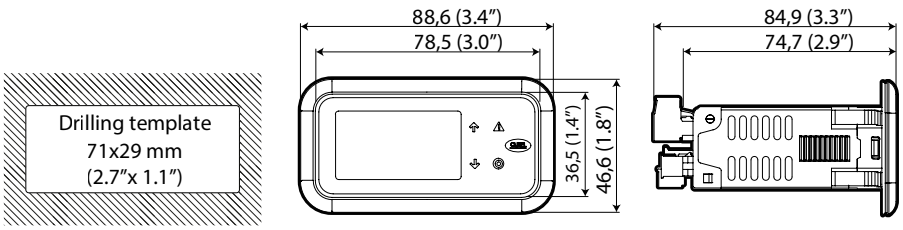


Fig. 2.a

2.2.2 Mounting

Caution: before carrying out any maintenance, disconnect the controller from the power supply by moving the main system switch to "off".

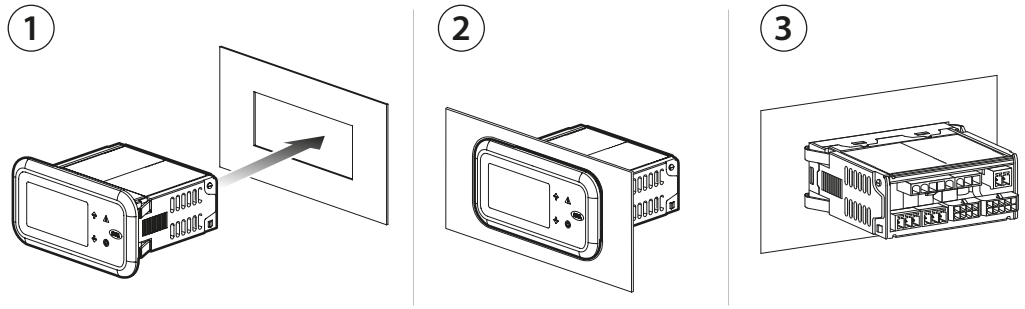


Fig. 2.b

1. Place the controller in the opening, pressing lightly on the side anchoring tabs.
2. Then press on the front until fully inserted (the side tabs will bend, and the catches will attach the controller to the panel).

Caution: IP65 front protection is guaranteed only if the following conditions are met:
- maximum deviation of the rectangular opening from flat surface: ≤ 0.5 mm;
- thickness of the electrical panel sheet metal: 0.8-2 mm;
- maximum roughness of the surface where the gasket is applied: ≤ 120 µm.

Notice: the thickness of the sheet metal (or material) used to make the electrical panel must be adequate to ensure safe and stable mounting of the product.

2.2.3 Removal

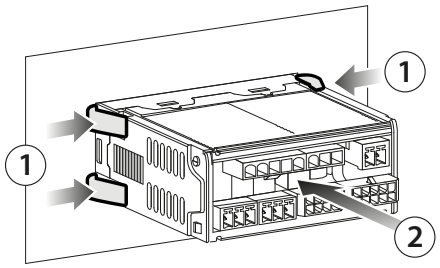


Fig. 2.c

1. Open the electrical panel from the rear and press the anchoring tabs and then the controller to remove it.
2. Exert slight pressure on the controller until it is removed.

Caution: the operation does not require the use of a screwdriver or other tools.

2.3 DIN rail version

2.3.1 Dimensions - mm (in)

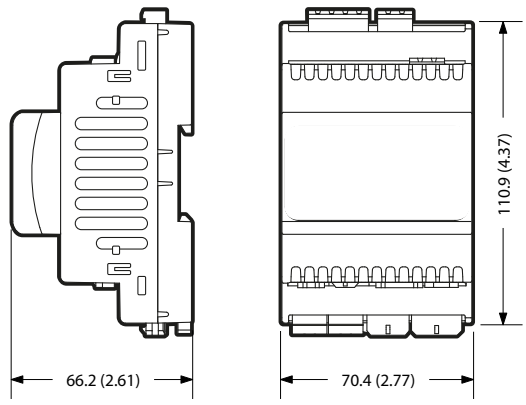


Fig. 2.d

2.3.2 Mounting

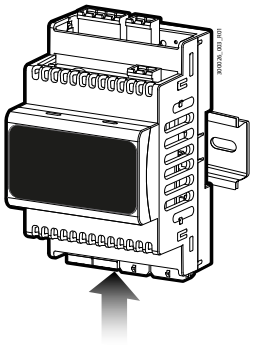


Fig. 2.e

Apply slight pressure to the controller resting on the DIN rail until the rear tab clicks into place.

2.3.3 Removal

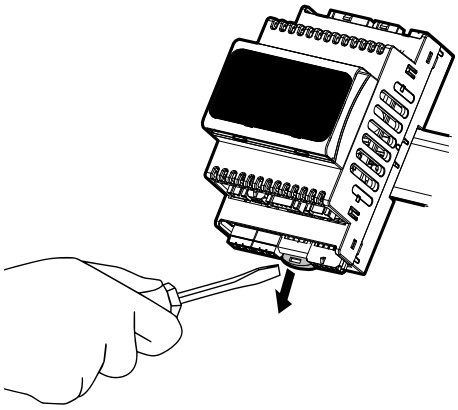


Fig. 2.f

Use a screwdriver as a lever in the hole to lift and release the tab. The tab is held in the locked position by return springs.

2.3.4 User terminal connection

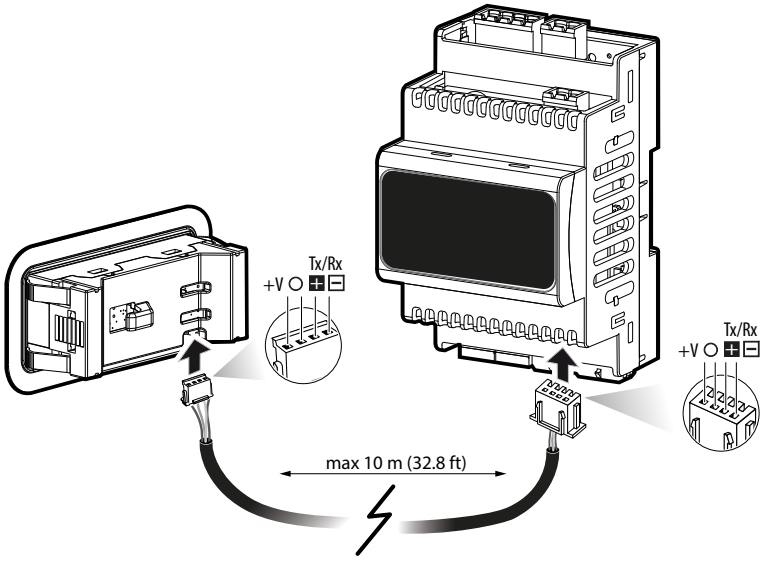


Fig. 2.g

The figure shows the connection of the external display for the ADVANCED and CO_2 versions. It is recommended to use the appropriate connection cables with pre-fitted connectors, as shown in paragraph 1.3.
See technical leaflet +0500146IE.

2.4 Electrical installation

Caution: before carrying out any maintenance, disconnect the controller from the power supply by moving the main system switch to "off".

2.4.1 Description of the terminals

Panel model

Basic

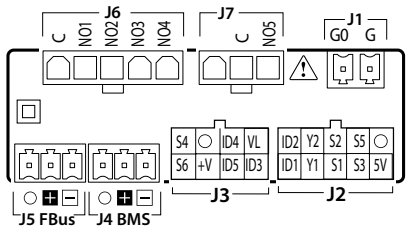


Fig. 2.h

DIN rail model

Medium

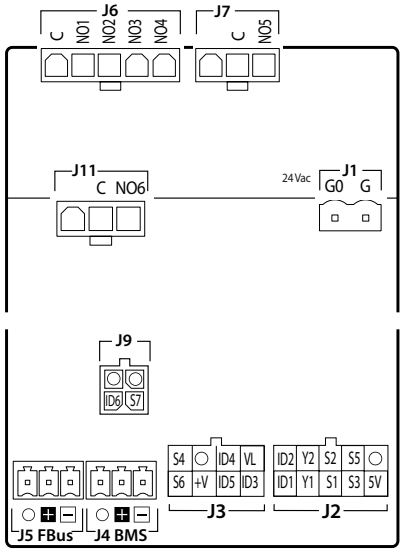


Fig. 2.i

Advanced

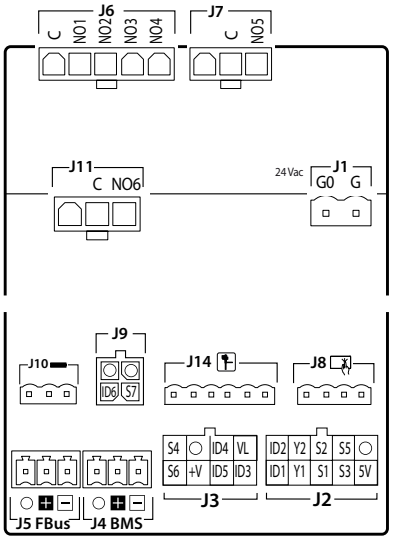


Fig. 2.j

CO_2

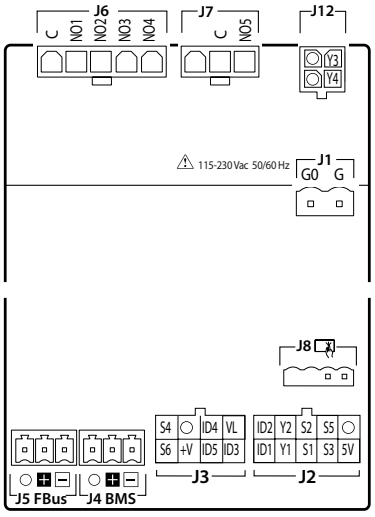


Fig. 2.k

Ref.		Description
J1	G0	Power supply
	G	Power supply: reference
J2	5V	Ratiometric probe power supply
	S3	Analogue input 3
	S1	Analogue input 1
	Y1	Analogue output 1
	ID1	Digital input 1
	O	GND: reference for probes, digital inputs and analogue outputs
	S5	Analogue input 5
	S2	Analogue input 2
	Y2	Analogue output 2
	ID2	Digital input 2
J3	ID3	Digital input 3
	ID5	Digital input 5
	+V	Power supply to 4-20 mA active probes
	S6	Analogue input 6
	VL	Not used
	ID4	Digital input 4
	O	GND: reference for analogue and digital inputs
	S4	Analogue input 4
J4	-	BMS serial port (RS485): Rx-/Tx-
	+	BMS serial port (RS485): Rx+/Tx+
	O	BMS serial port (RS485): GND
J5	-	Fieldbus serial port (RS485): Rx-/Tx-
	+	Fieldbus serial port (RS485): Rx+/Tx+
	O	Fieldbus serial port (RS485): GND

Ref.		Description
J6	C	Common for relays 1, 2, 3.4
	NO1	Digital output (relay) 1
	NO2	Digital output (relay) 2
	NO3	Digital output (relay) 3
	NO4	Digital output (relay) 4
J7	C	Common for relay 5
	NO5	Digital output (relay) 5
J8 (**) (***)	-	Unit terminal connector (AX2000PD20030)
J9 (*) (**)	S7	Analogue input 7
	ID6	Digital input 6
	O	GND: reference for analogue and digital inputs
	O	GND: reference for analogue and digital inputs
J10 (**)	G	Power supply for Ultracap module
	G0	Power supply reference for Ultracap module
	Vbat	Emergency power supply from Ultracap module
J11 (*) (**)	-	
	C	Common for relay/SSR 6
	NO6	Digital output relay/SSR 6
J12 (***)	Y3	Analogue output 3
	Y4	Analogue output 4
	O	GND: analogue output reference
	O	GND: analogue output reference
J14 (**)	-	Carel unipolar ExV valve connector (currently not used by specific features)

Tab. 2.g

(*) DIN MEDIUM models only
(*) DIN ADVANCED models only
(***) DIN CO_2 models only

2.5 Probe/digital input connection

Passive temperature probes

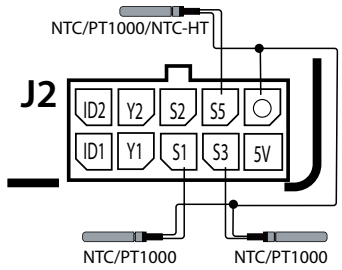


Fig. 2.l

0-5 V ratiometric pressure probes

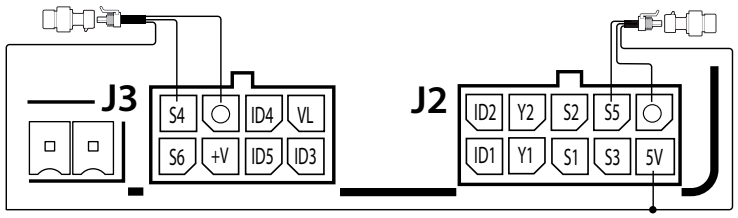


Fig. 2.m

0-10 Vdc probes

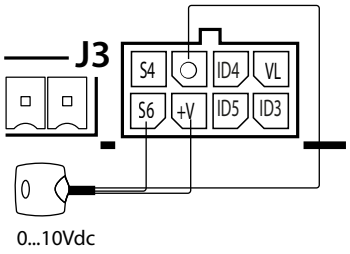


Fig. 2.n

4-20 mA probes

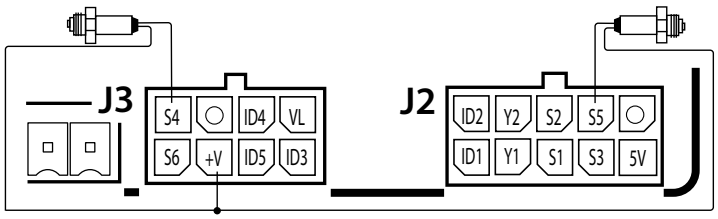


Fig. 2.o

Digital inputs

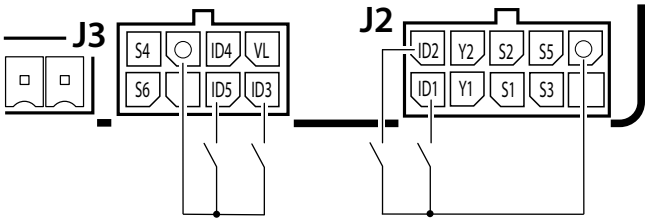


Fig. 2.p

Notice: O= GND

2.6 Analogue and digital output connections

Analogue outputs

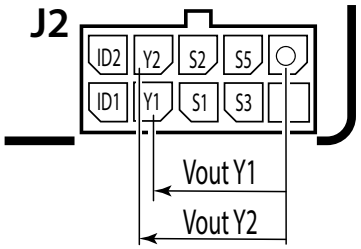


Fig. 2.q

Digital outputs

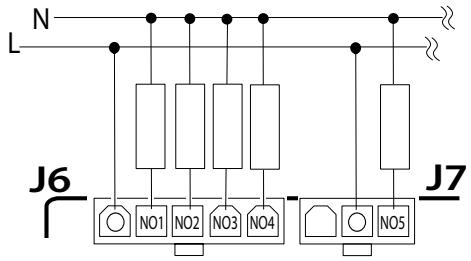


Fig. 2.r

Notice: O= GND

2.7 Valve driver connection for µRack CO2

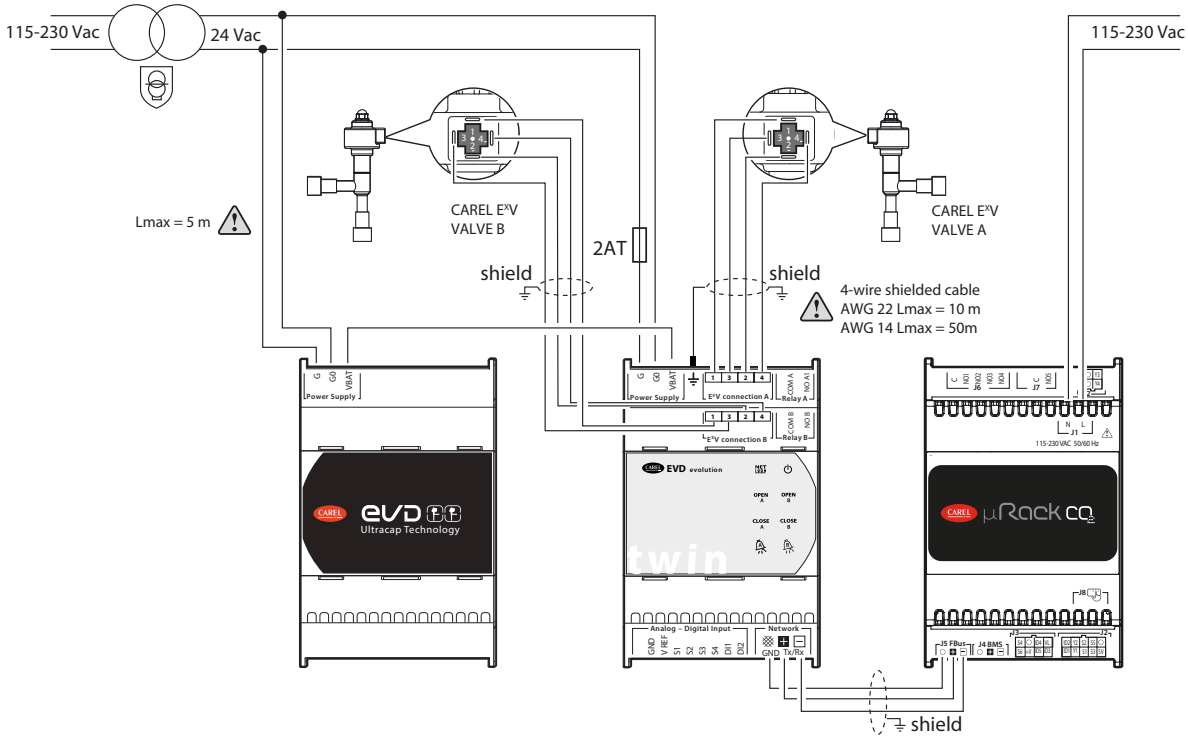


Fig. 2.s

See manual +0300006EN for details.

2.8 Serial port connections

For serial connections (FBus and BMS ports), the cables used must be suitable for the RS485 standard (shielded twisted pair, see the specifications in the following table).

Device	Serial port	Lmax (m)	Wire/wire capacitance (pF/m)	Resistance on last device	Max no. devices on bus	Data rate (bit/s) **
Valve driver	FBus	10	<90	-	2 valve drivers	19200
Supervisor/PC	BMS	500	<90	120 Ω	246 (*)	19200

(*) The maximum number of devices depends on the Client device used in the network and the use of signal amplifiers.
(**) Can be modified by parameter

Caution:

- connect a 120 Ω terminating resistor between the Tx/Rx+ and Tx/Rx- terminals on the last controller on the RS485 line.
- with two-wire cable+shield, connect the shield (braid) to the controller GND, do not earth GND;
- with three-wire cable+shield, earth the shield (braid), connect the third wire to the controller GND, do not earth GND.

2.8.2 Serial port configuration

The BMS port communication parameters can be set using parameters H0, H1 and H2. By default, µRack leaves the factory with serial address 181, baud rate 19200 bit/s, 2 stop bits and no parity. For the Fieldbus port that the EVD driver is connected to, the baud rate can be set using parameter H4, while the rest of the configuration is fixed at 1 stop bit 1, and no parity. The Modbus® protocol is used.

User	Code	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
S	H0	BMS serial address	181	1	247	-	•	•
S	H1	BMS serial port configuration (stop bits and parity) 0= 1 stop bit, no parity; 2= 1 stop bit, even parity; 4= 1 stop bit, odd parity; 1= 2 stop bits, no parity; 3= 2 stop bits, even parity; 5= 2 stop bits, odd parity	1	0	5	-	•	•
S	H2	BMS port speed (baud rate): 0= 1200 2= 4800 4= 19200 6= 57600 1= 2400 3= 9600 5= 38400 7= 115200	4	0	8	bit/s	•	•
S	H4	Fieldbus port speed (baud rate): 0= 1200 2= 4800 4= 19200 6= 57600 1= 2400 3= 9600 5= 38400 7= 115200	4	0	8	bit/s	-	•

Tab. 2.h

2.9 Positioning inside the panel

The position of the controller in the electrical cabinet must be chosen so as to guarantee correct physical separation from the power components (solenoids, contactors, actuators, inverters, ...) and the connected cables. Proximity to such devices/cables may create random malfunctions that are not immediately evident. The structure of the panel must allow the correct flow of cooling air.

2.10 Electrical installation

Caution: When laying the wiring, "physically" separate the power part from the control part. The proximity of these two sets of wires will, in most cases, cause problems of induced disturbance or, over time, malfunctions or damage to the components. The ideal solution is to house these two circuits in two separate cabinets. Sometimes this is not possible, and therefore the power part and the control part must be installed in two separate areas inside the same panel.
For the control signals, it is recommended to use shielded cables with twisted wires. If the controller cables have to cross over the power cables, the intersections must be as near as possible to 90 degrees, always avoiding running the controller cables parallel to the power cables.

Pay attention to the following warnings:

- use cable ends suitable for the corresponding terminals. Loosen each screw and insert the cable ends, then tighten the screws. When the operation is completed, slightly tug the cables to check they are sufficiently tight;
- separate as much as possible the probe signal, digital input and serial line cables from the cables carrying inductive loads and power cables to avoid possible electromagnetic disturbance. Never run power cables (including the electrical 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 or similar);
- reduce the path of the probe cables as much as possible, and avoid spiral paths that enclose power devices;
- avoid touching or nearly touching the electronic components fitted on the boards to avoid electrostatic discharges (extremely damaging) from the operator to the components;
- do not secure the cables to the terminals by pressing the screwdriver with excessive force, to avoid damaging the controller: maximum tightening torque: 0.22-0.25 N•m.
- For applications subject to considerable vibrations (1.5 mm pk-pk 10/55 Hz), secure the cables connected to the controller around 3 cm from the connectors using cable ties;
- all the extra low voltage connections (analogue and digital inputs, analogue outputs, serial bus connections, power supplies) must have reinforced or double insulation from the mains network.

2.11 Positioning of probes/components

HFC models

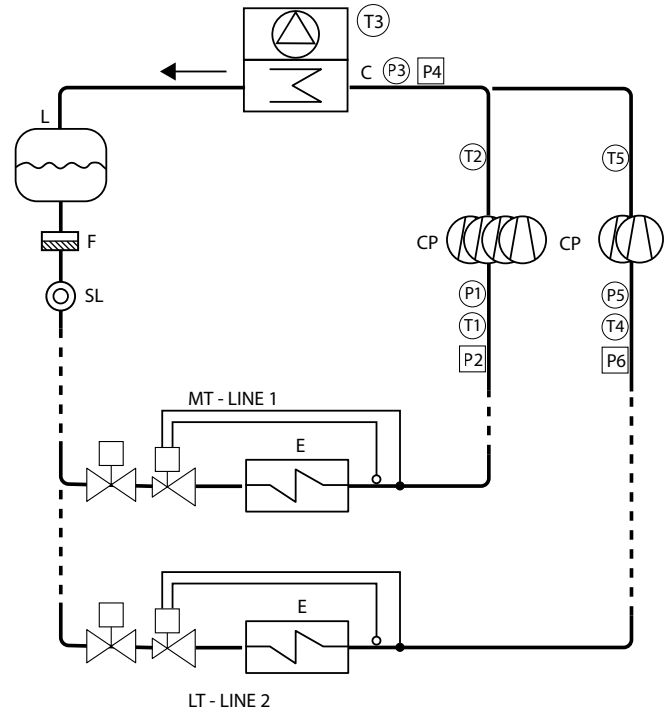


Fig. 2.t

Ref	Description
CP	Compressors
C	Condenser
E	Evaporators
F	Filter-drier
L	Liquid receiver
SL	Liquid sight glass
P1	Line 1 suction pressure
T1	Line 1 suction temperature
P2	Line 1 low pressure switch
T2	Line 1 discharge temperature
P3	Condensing pressure
T3	Outside temperature
P4	High pressure switch

Tab. 2.i

CO_2 models

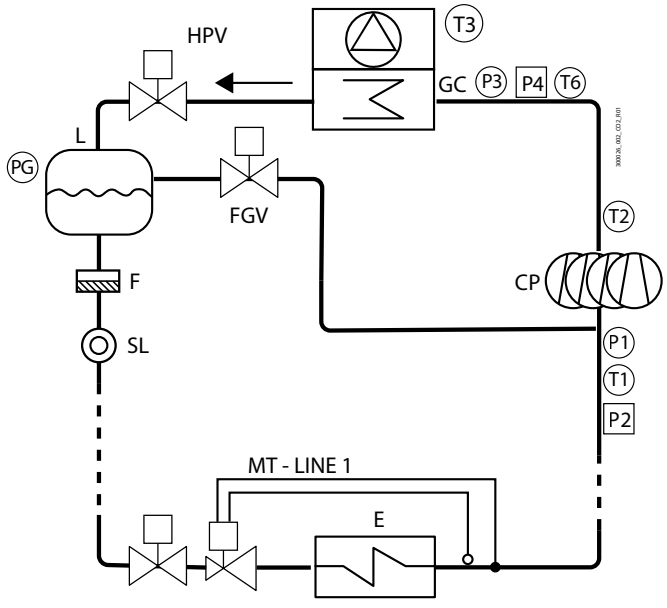


Fig. 2.u

Ref	Description
CP	Compressors
GC	Gas cooler
E	Evaporators
F	Filter-drier
L	Liquid receiver
SL	Liquid sight glass
P1	Line 1 suction pressure
T1	Line 1 suction temperature
P2	Line 1 low pressure switch
T2	Line 1 discharge temperature
P3	Gas cooler pressure
T3	Outside temperature
P4	High pressure switch
T4	Line 2 suction temperature
P5	Line 2 suction pressure
T5	Line 2 discharge temperature
P6	Line 2 low pressure switch
T6	Gas cooler temperature

Tab. 2.j

2.12 Input/output configuration

Information on how to configure the µRack inputs and outputs is shown below.

2.12.1 Analogue inputs

The µRack analogue inputs are divided into groups, according to the type of probe connected; each group can be configured using specific parameters, all of the probes in each group must be the same type, mixed configurations are not allowed in the same group. The groups and the list of parameters used to configure the different analogue inputs are shown below:

Group	Sensor	Configuration parameter	Compatibility	Default
GRP1	S1 S2 S3	/P1	0= PT1000; 1= NTC	NTC
GRP2	S4 S5	/P2	1= NTC; 2= 0-5 V; 3= 4-20 mA; 5= NTC HT; 6= 0.5-4.5 Vrat	4-20 mA
GRP3	S6	/P3	0= PT1000; 1= NTC; 2= 0-5 V; 3= 4-20 mA; 4= 0-10 V; 5= NTC HT; 6= 0.5-4.5 Vrat	NTC HT
GRP4*	S7*	/P4	1= NTC	NTC
GRP5**	S1 EVD, S3 EVD	/P8	3= 4-20 mA; 6= 0.5-4.5 Vrat	0.5-4.5 Vrat
GRP4**	S2 EVD, S4 EVD	/P9	1= NTC; 5= NTC HT	NTC

Tab. 2.k

(*) available only in the ADVANCED version.
(**) available only in the CO2 version.

Using the appropriate channel configuration parameters for the analogue inputs, the position of the signal to be read can be configured freely, choosing between the available inputs, with the only limit being the type of probe. The value 0 is used to disable the specific input:

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	/2	Analogue probe measurement stability (filter) 1 = probe reading not delayed ... 15 = maximum probe reading delay	9	1	15	-	•	•
S	/F3	Assign outside temperature probe channel. **BASIC, MEDIUM and ADVANCED models**: 0= function disabled; 1= S1; 2= S2; …; 6= S6; 7= S7 (ADV. only) **CO2 model:** 0= function disabled; 1= S1; 2= S2; …; 6= S6; 12= S2 EVD; 14 S4 EVD	0	0	7 (14)	-	•	•
S	/FD	Assign line 1 suction temperature probe channel – see /F3	3	0	7 (14)	-	•	•
S	/FDB	Assign line 2 suction temperature probe channel – see /F3	0	0	7	-	•	-
S	/Fi	Assign room temperature probe channel – see /F3	0	0	7 (14)	-	•	•
S	/FG	Assign generic probe channel – see /F3	0	0	7 (14)	-	•	•
S	/Fo	Assign line 1 discharge temperature probe channel – see /F3	6	0	7 (14)	-	•	•
S	/Fob	Assign line 2 discharge temperature probe channel – see /F3	0	0	7	-	•	-
S	/FS	Assign condensing pressure probe channel – see /F3	5	0	7 (13)	-	•	•
S	/FT	Assign line 1 suction pressure probe channel – see /F3	4	0	7 (13)	-	•	•
S	/FTB	Assign line 2 suction pressure probe channel – see /F3	0	0	7	-	•	-
S	/Fw	Assign receiver pressure probe channel – see /F3	0	0	(13)	-	-	•
S	/Fy	Assign gas cooler outlet temperature probe channel – see /F3	0	0	(14)	-	-	•
S	/C3	Outside temperature probe calibration	0.0	-99.9/-179	99.9/179	Δ°C/Δ °F	•	•
S	/CD	Suction temperature probe calibration, line 1	0.0	-99.9/-179	99.9/179	Δ°C/Δ °F	•	•
S	/CDB	Suction temperature probe calibration, line 2	0.0	-99.9/-179	99.9/179	Δ°C/Δ °F	•	-
S	/Ci	Room temperature probe calibration	0.0	-99.9/-179	99.9/179	Δ°C/Δ °F	•	•
S	/CG	Generic probe calibration	0.0	-99.9/-179	99.9/179	Δ°C/Δ °F	•	•
S	/Co	Discharge temperature probe calibration, line 1	0.0	-99.9/-179	99.9/179	Δ°C/Δ °F	•	•
S	/Cob	Discharge temperature probe calibration, line 2	0.0	-99.9/-179	99.9/179	Δ°C/Δ °F	•	-
S	/CS	Condensing temperature probe calibration	0.0	-99.9/-1448 (*)	99.9/1448 (*)	Δbarg/Δpsig	-	•
S	/CT	Suction pressure probe calibration, line 1	0.0	-99.9/-1448 (*)	99.9/1448 (*)	Δbarg/Δpsig	•	•
S	/CTB	Suction pressure probe calibration, line 2	0.0	-99.9/-1448 (*)	99.9/1448 (*)	Δbarg/Δpsig	•	-
S	/LS	Condensing pressure probe lower limit	-1/-14.5 (0/0)	-1/-14.5	/US	barg/psig	•	•
S	/LT	Suction pressure probe lower limit, line 1	-1/-14.5 (0/0)	-1/-14.5	/UT	barg/psig	•	•
S	/LTB	Suction pressure probe lower limit, line 2	-1/-14.5	-1/-14.5	/UTB	barg/psig	•	-
S	/Lw	Receiver pressure probe lower limit	0/0	-1/-14.5	/Uw	barg/psig	-	•
S	/US	Condensing pressure probe upper limit	34.5/500 (60/870)	/LS	150/2175 (*)	barg/psig	•	•
S	/UT	Suction pressure probe upper limit, line 1	9.3/134 (150/2175 *)	/LT	60/870 (150/2175 *)	barg/psig	•	•
S	/UTB	Suction pressure probe upper limit, line 2	9.3/134	/LTB	60/870	barg/psig	•	-
S	/Uw	Receiver pressure probe upper limit	60/870	/Lw	150/2175 (*)	barg/psig	-	•

Tab. 2.l

(*) these values may not be displayed correctly on the 7-segment display, as the display limits are -999/999.

Parameter /2 can be used to filter the probe readings. Higher values of /2 give a more stable value yet a longer delay.

The reading of each probe can be adjusted by an offset, set using the corresponding '/C**' parameters.
The minimum and maximum pressure probe values can be set using parameters '/L**' and '/U**'.

Notice:

- a possible overlap of multiple inputs on the same physical channel cannot be identified by the controller, therefore the unit manufacturer needs to verify the correct probe settings; if abnormal behaviour is found, carefully check the configuration of the inputs and outputs;
- the maximum value of the probe channel assignments depends on the model of controller being configured.

2.12.2 Digital inputs

There are five digital inputs on the µRack digital BASIC and CO_2 models, and six on the MEDIUM and ADVANCED versions. Below is the list of parameters used to configure the digital inputs; setting the value 0 disables the specific input:

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	DiA	Assign external alarm digital input (0 = function disabled; 1 = ID1, 2 = ID2; …; 5 = ID5; 6 = ID6, MEDIUM and ADVANCED versions only)	0	0	6 (5)	-	•	•
S	DiA1	Assign compressor 1 alarm digital input, line 1 - see DiA	1	0	6 (5)	-	•	•
S	DiA2	Assign compressor 2 alarm digital input, line 1 - see DiA	2	0	6 (5)	-	•	•
S	DiA3	Assign compressor 3 alarm digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	DiA4	Assign compressor 4 alarm digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	DiAA	Assign compressor 1 alarm digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	DiAB	Assign compressor 2 alarm digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	DIb	Assign delayed external alarm digital input - see DiA	0	0	6 (5)	-	•	•
S	DiF (*)	Assign remote On/Off digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	DiFB (*)	Assign remote On/Off digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	DiLv	Assign liquid level digital input - see DiA	0	0	6 (5)	-	•	•
S	DIS	Assign generic alarm digital input - see DiA	0	0	6 (5)	-	•	•
S	DiSC	Assign set point compensation digital input - see DiA	0	0	6 (5)	-	•	•
S	DiT	Assign low pressure digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	DiTB	Assign low pressure digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	DivA	Assign fan 1 digital input - see DiA	3	0	6 (5)	-	•	•
S	DivB	Assign fan 2 digital input - see DiA	4	0	6 (5)	-	•	•
S	DivC	Assign fan 3 digital input - see DiA	0	0	6 (5)	-	•	•
S	DivD	Assign fan 4 digital input - see DiA	0	0	6 (5)	-	•	•
S	DiY	Assign high pressure digital input - see DiA	5	0	6 (5)	-	•	•
S	RiA	External alarm digital input logic (0 = reverse; 1 = direct)	1	0	1	-	•	•
S	RiA1	Compressor 1 alarm digital input logic, line 1 - see RiA	1	0	1	-	•	•
S	RiA2	Compressor 2 alarm digital input logic, line 1 - see RiA	1	0	1	-	•	•
S	RiA3	Compressor 3 alarm digital input logic, line 1 - see RiA	1	0	1	-	•	•
S	RiA4	Compressor 4 alarm digital input logic, line 1 - see RiA	1	0	1	-	•	•
S	RiAA	Compressor 1 alarm digital input logic, line 2 - see RiA	1	0	1	-	•	-
S	RiAB	Compressor 2 alarm digital input logic, line 2 - see RiA	1	0	1	-	•	-
S	rIb	Delayed external alarm digital input logic - see RiA	1	0	1	-	•	•
S	RiF	Remote On/Off digital input logic, line 1 - see RiA	1	0	1	-	•	•
S	RiFB	Remote On/Off digital input logic, line 2 - see RiA	1	0	1	-	•	-
S	RiLv	Liquid level digital input logic - see RiA	1	0	1	-	•	•
S	rIS	Generic alarm digital input logic - see RiA	1	0	1	-	•	•
S	RiSC	Set point compensation digital input logic - see RiA	1	0	1	-	•	•
S	RiT	Low pressure digital input logic, line 1 – see RiA	1	0	1	-	•	•
S	RiTB	Low pressure digital input logic, line 2 – see RiA	1	0	1	-	•	-
S	RivA	Fan 1 digital input logic - see RiA	1	0	1	-	•	•
S	RivB	Fan 2 digital input logic - see RiA	1	0	1	-	•	•
S	RivC	Fan 3 digital input logic - see RiA	1	0	1	-	•	•
S	RivD	Fan 4 digital input logic - see RiA	1	0	1	-	•	•
S	RiY	High pressure digital input logic - see RiA	1	0	1	-	•	•

Tab. 2.m

(*) To use one input to switch off both lines, parameters DiF and DiFB can be configured on the same channel.

Notice:

- any conflicts between several inputs on the same physical channel must be verified by the manufacturer of the unit; if undesired behaviour is seen, carefully check the configuration of the inputs and outputs;
- the maximum value of the digital inputs depends on the selected hardware.

The digital input logic can be set using the corresponding 'Ri' parameters.'

2.12.3 Analogue outputs

Below is the list of parameters used to configure the analogue outputs:

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	/AbP	Assign analogue output for gas cooler low temperature bypass: 0= function disabled; 1 = analogue output 1 (Y1); 2= analogue output 2 (Y2). 3= analogue output 3 (Y3, CO_2 model only); 4= analogue output 4 (Y4, CO_2 model only).	0	0	4	-	-	•
S	/AD	Assign analogue output for generic modulating function - see /AbP	0	0	2 (4)	-	•	•
S	/AE	Assign analogue output for inverter fan - see /AbP	0	0	2 (4)	-	•	•
S	/Ai	Assign inverter compressor 1 analogue output, line 1 – see /AbP	0	0	2 (4)	-	•	•
S	/AiB	Assign inverter compressor 1 analogue output, line 2 – see /AbP	0	0	2	-	•	-
S	/AL	Assign analogue output for HPV valve – see /AbP	0	0	4	-	-	•
S	/AM	Assign analogue output for HPV valve – see /AbP	0	0	4	-	-	•
S	Ao1M	Maximum output value for Y1	10	Ao1n	10	-	•	•
S	Ao1n	Minimum output value for Y1	0	0	Ao1M	-	•	•
S	Ao2M	Maximum output value for Y2	10	Ao2n	10	-	•	•
S	Ao2n	Minimum output value for Y2	0	0	Ao2M	-	•	•
S	Ao3M	Maximum output value for Y3	10	Ao3n	10	-	-	•
S	Ao3n	Minimum output value for Y3	0	0	Ao3M	-	-	•
S	Ao4M	Maximum output value for Y4	10	Ao4n	10	-	-	•
S	Ao4n	Minimum output value for Y4	0	0	Ao4M	-	-	•

Tab. 2.n

The minimum and maximum values of outputs Y1, Y2, Y3 and Y4 can be set using parameters Ao1M, Ao1n, Ao2M, Ao2n, Ao3M, Ao3n, Ao4M, Ao4n.

Notice: any conflicts between several inputs on the same physical channel must be verified by the manufacturer of the unit; if undesired behaviour is seen, carefully check the configuration of the inputs and outputs.

2.12.4 Digital outputs

Below is the list of parameters used to configure the digital outputs:

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	DoA1	Assign compressor 1 line 1 digital output (0= function disabled; 1= NO1, 2= NO2; …; 5= NO6; 6= NO6, excluding CO_2 model)	1	0	6 (5)	-	•	•
S	DoA2	Assign compressor 2 digital output, line 1 - see DoA1	2	0	6 (5)	-	•	•
S	DoA3	Assign compressor 3 digital output, line 1 - see DoA1	0	0	6 (5)	-	•	•
S	DoA4	Assign compressor 4 digital output, line 1 - see DoA1	0	0	6 (5)	-	•	•
S	DoAA	Assign compressor 1 digital output, line 2 - see DoA1	0	0	6	-	•	-
S	DoAB	Assign compressor 2 digital output, line 2 - see DoA1	0	0	6	-	•	-
S	DoB	Assign global alarm digital output - see DoA1	5	0	6 (5)	-	•	•
S	DobP	Assign digital output for gas cooler low temperature bypass - see DoA1	0	0	5	-	-	•
S	DoH	Assign serious alarm digital output - see DoA1	0	0	6 (5)	-	•	•
S	DoJ1	Assign liquid alarm digital output, line 1 - see DoA1	0	0	6 (5)	-	•	•
S	DoJ2	Assign liquid alarm digital output, line 2 - see DoA1	0	0	6	-	•	-
S	DoL1	Assign compressor 1 capacity control digital output 1, line 1 (*) - see DoA1	0	-2	6 (5)	-	•	•
S	DoL2	Assign compressor 1 capacity control digital output 2, line 1 - see DoA1	0	0	6 (5)	-	•	•
S	DoM1	Assign compressor 1 capacity control digital output 1, line 2 (*) - see DoA1	0	-2	6	-	•	-
S	DoS	Assign generic step function digital output - see DoA1	0	0	6 (5)	-	•	•
S	DoT	Assign fan 1 digital output - see DoA1	3	0	6	-	•	•
S	DoT2	Assign fan 2 digital output - see DoA1	4	0	6	-	•	•
S	DoT3	Assign fan 3 digital output - see DoA1	0	0	6	-	•	•
S	DoT4	Assign fan 4 digital output - see DoA1	0	0	6	-	•	•
S	RoA1	Compressor 1 line 1 digital output logic (0 = NO; 1= NC)	0	0	1	-	•	•
S	RoA2	Compressor 2 digital output logic, line 1 - see RoA1	0	0	1	-	•	•
S	RoA3	Compressor 3 digital output logic, line 1 - see RoA1	0	0	1	-	•	•
S	RoA4	Compressor 4 digital output logic, line 1 - see RoA1	0	0	1	-	•	•
S	RoAA	Compressor 1 digital output logic, line 2 - see RoA1	0	0	1	-	•	-
S	RoAB	Compressor 2 digital output logic, line 2 - see RoA1	0	0	1	-	•	-
S	RoB	Global alarm digital output logic - see RoA1	0	0	1	-	•	•
S	RoH	Serious alarm digital output logic - see RoA1	0	0	1	-	•	•
S	RoJ1	Liquid alarm digital output logic, line 1 - see RoA1	0	0	1	-	•	•
S	RoJ2	Liquid alarm digital output logic, line 2 - see RoA1	0	0	1	-	•	-
S	RoL1	Compressor 1 unloader digital output 1 logic, line 1 - see RoA1	0	0	1	-	•	•
S	RoL2	Compressor 1 unloader digital output 2 logic, line 1 - see RoA1	0	0	1	-	•	•
S	RoM1	Compressor 1 unloader digital output 1 logic, line 2 - see RoA1	0	0	1	-	•	-
S	RoS	Generic step function digital output logic - see RoA1	0	0	1	-	•	•
S	RoT	Fan 1 digital output logic - see RoA1	0	0	1	-	•	•
S	RoT2	Fan 2 digital output logic - see RoA1	0	0	1	-	•	•
S	RoT3	Fan 3 digital output logic - see RoA1	0	0	1	-	•	•
S	RoT4	Fan 4 digital output logic - see RoA1	0	0	1	-	•	•

Tab. 2.o

(*) For Digital Scroll™ modulating compressors, the unloader output must be configured on an SSR output (ADVANCED model), or alternatively external SSR relays with an input voltage compatible with the 0-10 V outputs Y1 and Y2 can be connected (BASIC, MEDIUM and CO_2 models). Parameter values -1 and -2 correspond to analogue outputs 1 and 2 respectively.

The digital output logic can be set using the corresponding 'Ro' parameters.'

Notice: the maximum value of the digital outputs depends on the selected hardware.

3. CONFIGURATION TOOLS

3.1 APPLICA app

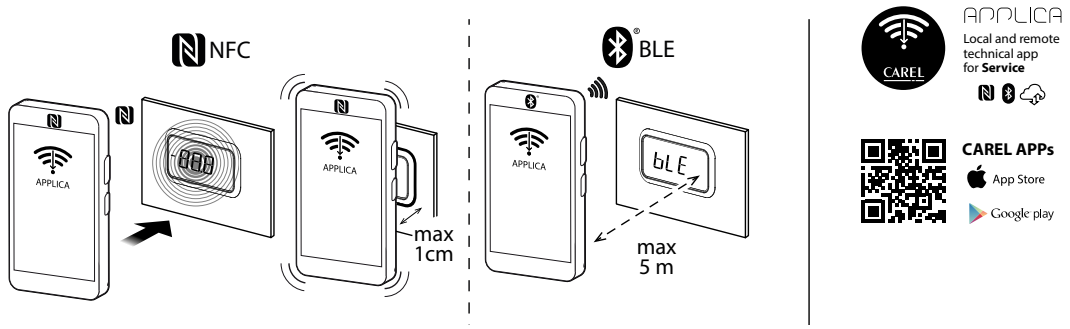


Fig. 3.a

The APPLICA app can be used to configure the controller from a mobile device (smartphone, tablet), via NFC (Near Field Communication) and Bluetooth (BLE). Users can both configure the commissioning parameters and set groups of preset parameters according to specific needs (recipes). Supported devices: Android 7, iOS 11; Bluetooth™ 4.0, and higher.

Once APPLICA has been installed and opened, proceed as follows:
- For NFC devices, move the mobile device near to the µRack user terminal (the position of the NFC antenna on the mobile device must be identified in order to place it over the display): wait for the signal that the device has been read.
- For Bluetooth devices, select the "SCAN BLUETOOTH" option, then choose the device from the list.

Notice:
- make sure the NFC or Bluetooth™ antennas are activated on your mobile device.
- Some smartphones may experience problems if location is not enabled.
- During Bluetooth™ connection, the µRack user terminal is disabled and shows the message "bLE".

3.1.1 APPLICA: save configuration

APPLICA can save the unit configuration and then apply it to other units.

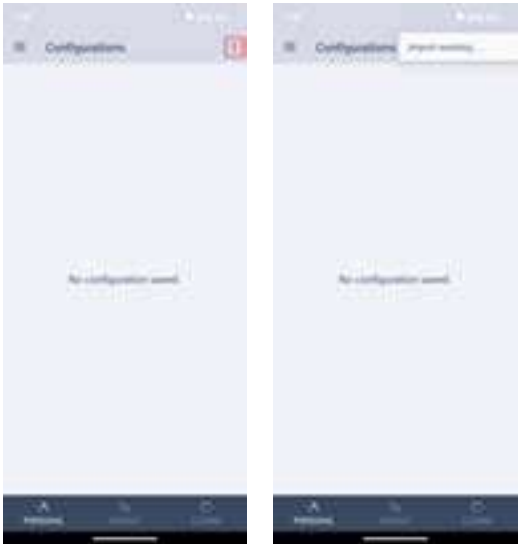
Save configuration procedure:
1. open APPLICA on the mobile device;
2. access the controller via NFC or Bluetooth, using the "Service" or "Manufacturer" profile credentials;
3. select the "Save configuration" button at the top right;
4. enter the configuration name, then click OK.

3.1.2 APPLICA: import/export configuration

APPLICA can import and export previously saved configurations.

Import configuration procedure:

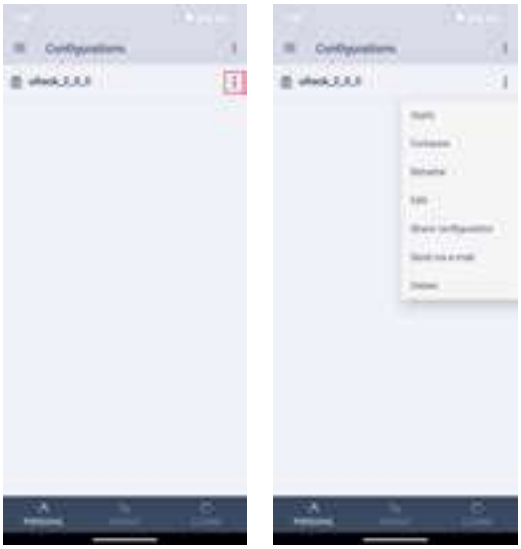
1. open APPLICA on the mobile device;
2. access the controller via NFC or Bluetooth, using the "Service" or "Manufacturer" profile credentials;
3. access the "Configurations" section from the hamburger menu;



4. click the toolbar menu button at the top right, then click "Import existing";
5. choose and select the configuration to be imported from the phone's file manager.

Export configuration procedure:

1. open APPLICA on the mobile device;
2. access the controller via NFC or Bluetooth, using the "Service" or "Manufacturer" profile credentials;
3. access the "Configurations" section from the hamburger menu;
4. the previously saved configurations will be displayed, click the toolbar menu button for the configuration to be exported;



5. select the "Share configuration" button and choose how to share the configuration.

3.2 APPLICA Desktop

APPLICA Desktop is a program intended for manufacturers and installers of units fitted with the µRack controller. It can be downloaded from ksa.carel.com. APPLICA Desktop offers the possibility to:

- access the controller using the assigned profile;
- create configurations;
- apply configurations;
- clone a unit configuration, i.e. copy all of the unit's parameter values;
- complete commissioning;
- complete troubleshooting in the event of errors on the unit.

Notice:

- APPLICA Desktop can be used as an alternative to the APPLICA app, and requires an internet connection;
- For the physical connection to the BMS port on µRack, use the USB/RS485 converter P/N CVSTDUMOR0

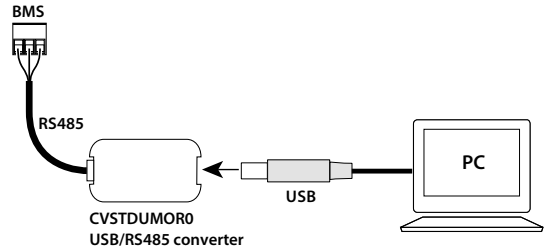


Fig. 3.b

3.3 Spark: configuration and commissioning software

Spark is configuration software for laptops that provides the following functions:

- configure access and password levels;
- change parameter sets and create custom read/write lists to upload to the device;
- add languages and parameter descriptions;
- view the trends of physical quantities in real time, with the possibility to save data in Excel format.

In order to carry out the operations mentioned above, a specific "workspace" (extension .spark) is required; this can be downloaded from ksa.carel.com.

Notice: the workspace is specific for each firmware version; the correct combination of file-controller firmware version is required for correct communication.

For the electrical connection, use the USB/RS485 converter CVSTDUMOR0.

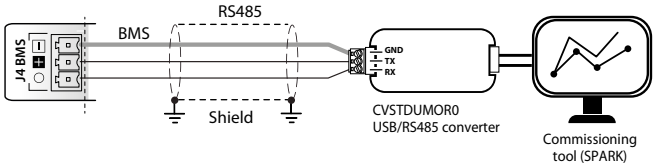


Fig. 3.c

For models without BMS port option, the USB/ID converter BXOPZIOWD000 can be used, connecting to digital input ID2 and completing the specific procedure on Spark.

3.4 Sparkly: command-line configuration and commissioning software

Sparkly is the command-line version of the configuration tool, and can be used for configuring and commissioning µRack. Contact CAREL for support.

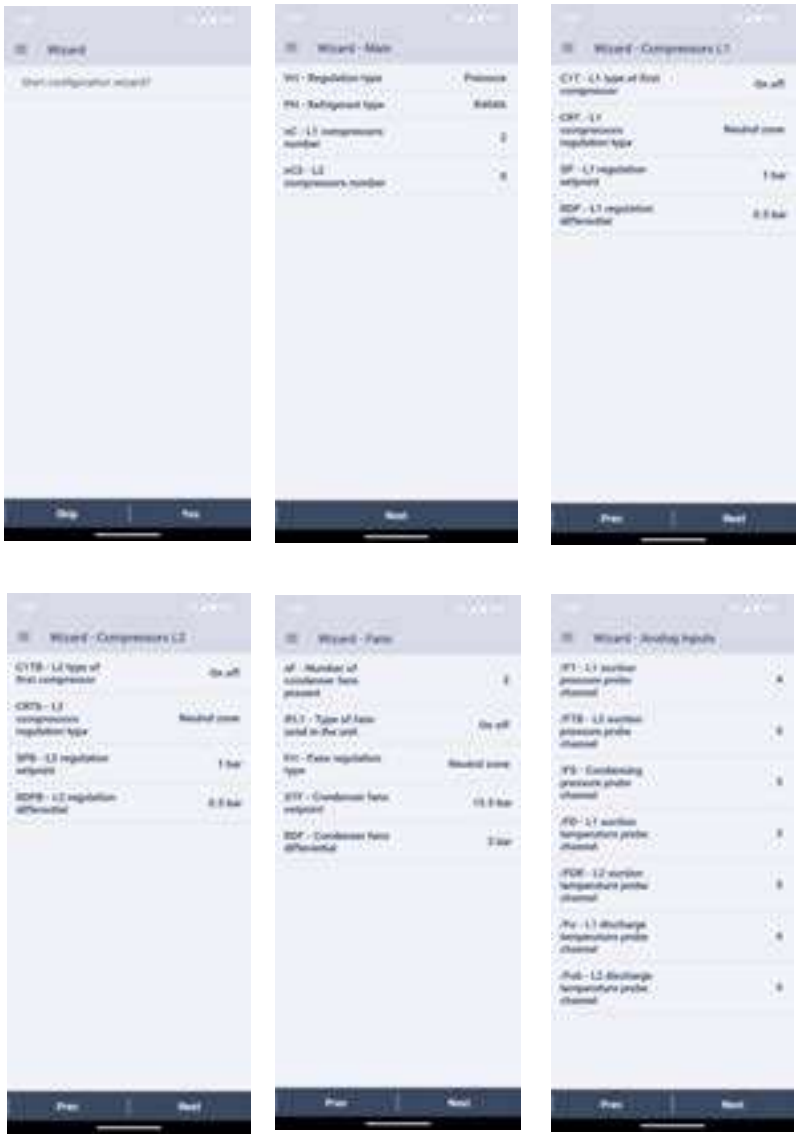
4. COMMISSIONING

Once the electrical connections have been completed (see "Installation") and the power supply has been connected, the operations required for commissioning the controller depend on the type of interface used, however essentially involve setting the initial configuration parameters and where necessary the date/time. The parameters can be set on a smartphone (via APPLICA app), using configuration software (APPLICA desktop, Spark, Sparkly) or from the user terminal. The parameters to be imported are shown under "Unit set-up parameter list".

4.1 Via smartphone

4.1.1 APPLICA: Configuration wizard

1. If the unit has not yet been configured, when connecting to the controller from a mobile device, a prompt will be shown to start the "Wizard" procedure. If the procedure is not started, selecting "Skip", the default configuration is automatically applied and the Homepage will be displayed;
2. Complete the unit configuration by pressing the PREV / NEXT buttons to scroll through all of the configuration parameter pages;

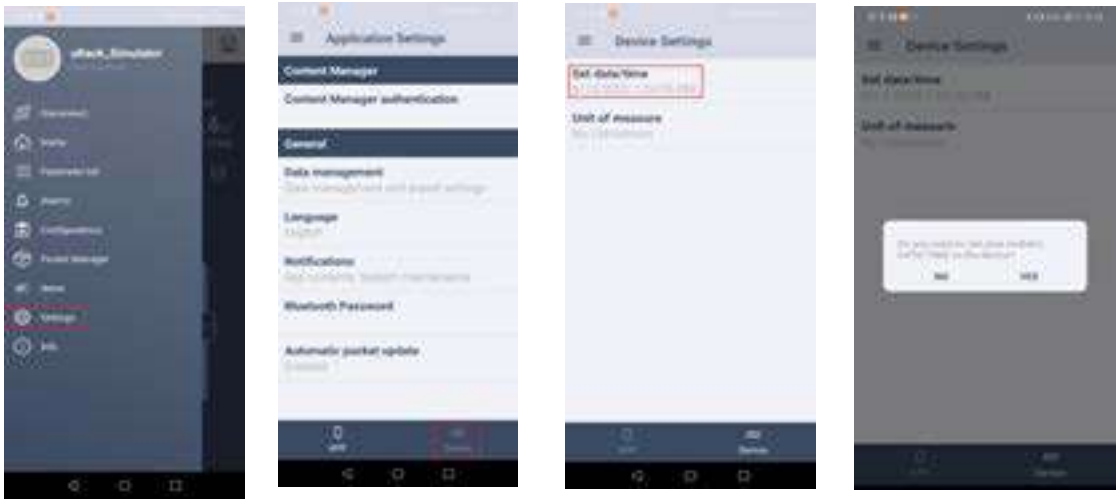


3. Apply the parameters configured via NFC/Bluetooth to the controller.

Notice: for NFC connection only, at the end of the procedure the mobile device will need to be moved closer to the controller in order to save the parameter configuration.

4.1.2 APPLICA: date and time setting

APPLICA includes a feature for setting the date and time on µRack in just one simple step, copying the values from the mobile device.



Procedure:
1. open APPLICA on the mobile device;
2. access the controller via NFC or Bluetooth, entering your profile credentials;
3. access the menu on the command bar at the top left;
4. select "set date/time":
5. confirm;
6. with an NFC connection, move the device near to the user terminal to write the copied values.

Notice: with a Bluetooth connection, the values are copied on confirmation.

4.2 Via PC (serial/USB) with configuration tool

4.2.1 APPLICA Desktop: commissioning

1. Connect to the BMS port on the µRack controller, as shown in Figure 3.b
2. Open APPLICA Desktop; a window will be opened with the right part of the top bar as shown in the figure

Fig. 4.a

3. Select "Add target" and assign it a meaningful name (e.g. "µRack")
4. In the "COM Port" field, enter the COM port used for the USB connection to the USB/RS485 converter. The COM port depends on the USB port used; to find it, click on "Windows Tools", "Device Manager", then "COM port"
5. Configure the connection parameters (Default: Baudrate=19200, Bits=8, Parity=None, Stop Bits=Two, Device address=181) as indicated in the figure (the data are saved automatically)
6. Select "Connect" to connect to the µRack (which must be powered on)
7. Enter your profile credentials
8. Set the commissioning parameters

Fig. 4.b

Fig. 4.c

4.2.2 APPLICA Desktop: date and time setting

APPLICA Desktop can set the date and time on µRack in just one simple step, copying the values from the PC to the controller.

Fig. 4.d

Procedure:

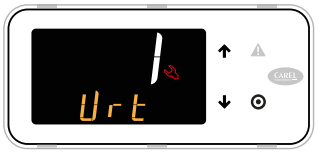
1. Once connected, select "Set date&time";
2. In the pop-up window, confirm synchronisation of the time and date on µRack with the PC

Fig. 4.e

4.3 Via user terminal

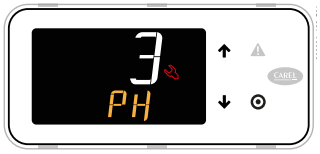
Procedure:

1. Power on the controller and wait for the display to show the first parameter Vrt (control based on temperature or pressure);
2. press PRG to enable parameter setting (the value will flash);

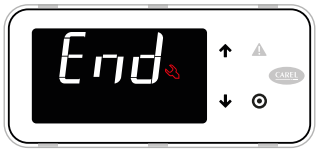


3. press UP/DOWN to modify the value;

4. press PRG to save the value (the value will stop flashing and the red service icon will go off);



5. press UP/DOWN to go to the next parameter;
6. repeat points 2 to 5 for all commissioning parameters;



7. press PRG to end the configuration procedure (wizard); once all the parameters have been configured ("service" icon no longer displayed), pressing PRG ends the configuration procedure (wizard);

8. wait for the standard display to be shown.

4.4 Unit set-up parameter list

4.4.1 Unit parameters

Notice: follow the order shown in the table to configure the Unit set-up parameters.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	vrt	Control by pressure or temperature (0= pressure; 1= temperature)	0	0	1	-	•	•
M	PH	Type of refrigerant used in the unit 0: Custom (*) | 8: R600 | 16: R413A | 24: HTR01 | 32: R447A | 40: R454B 1: R22 | 9: R600a | 17: R422A | 25: HTR02 | 33: R448A | 41:R458A 2: R134a | 10: R717 | 18: R423A | 26: R23 | 34: R449A | 42: R407H 3: R404A | 11: R744 | 19: R407A | 27: HFO1234yf | 35: R450A | 43: R454A 4: R407C | 12: R728 | 20: R427A | 28: HFO1234ze | 36: R452A | 44: R454C 5: R410A | 13: R1270 | 21: R245Fa | 29: R455A | 37: R508B | 45: R470A 6: R507A | 14: R417A | 22: R407F | 30: R170 | 38: R452B | 46: R515B 7: R290 | 15: R422D | 23: R32 | 31: R442A | 39: R513A | 47: R466	3 (11)	0	47	-	•	-
M	nC	Number of compressors on line 1	2	0	4	-	•	•
M	C1T	First compressor type, line 1: 0= ON-OFF | 2= Digital Scroll™ | 4= three stages 33/66/100 1= inverter | 3= two stages 50/100	0	0	4	-	•	•
S	CRT	Compressor control type, line 1 (0= P+I; 1= dead band)	1	0	1	-	•	•
U	SP	Control set point, line 1	1/14.5 (26/377)	SPL	SPH	barg/psig	•	•
S	RDP	Control differential, line 1	0.5/7.2	0	20/290	Δbarg/Δpsig	•	•
M	nC2	Number of compressors, line 2 (0= line 2 not present)	0	0	2	-	•	-
M	C1TB	First compressor type, line 1 – see C1T	0	0	4	-	•	-
S	CRTb	Compressor control type, line 2 (0= P+I; 1= dead band)	1	0	1	-	•	-
U	SPB	Control set point, line 2	1/14.5	SPLB	SPHB	barg/psig	•	-
S	RDPB	Control differential, line 2	0.5/7.2	0	20/290	Δbarg/Δpsig	•	-
M	nF	Number of fans	2	0	4	-	•	•
M	IFL1	Type of fans used on the unit (0= ON/OFF 1= Inverter)	0	0	1	-	•	•
S	Frt	Fan control type (0= P+I; 1= dead band)	1	0	1	-	•	•
U	STF	Condenser fan control set point	15.5/224 (40/580)	STFL	STFH	barg/psig	•	•
S	RDF	Condenser fan control differential	3/43.5	0	20/290	Δbarg/Δpsig	•	•
S	HEn	Enable EVD driver (0 = disabled; 1 = enabled)	1	0	1	-	-	•
M	Ehp	Enable HPV (0 = disabled; 1 = enabled)	1	0	1	-	-	•
M	Efg	Enable FGV (0= disabled; 1= enabled)	1	0	1	-	-	•

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	vLr	EVD driver valve association: 0 Single EVD, valve A -> HPV 1 Single EVD, valve A -> FGPV 2 Twin EVD, valve A -> FGV, valve B -> HPV 3 Twin EVD, valve A -> HPV, valve B -> FGV	3	0	3	-	-	•
M	P1	Type of EVD driver, valve A: 0= custom (*) / 18= Danfoss ETS 400 1= CAREL EXV / 19= Two CAREL EXVs connected together 2= Alco EX4 / 20= Sporlan SER(I)G,J,K 3= Alco EX5 / 21= Danfoss CCM 10-20-30 4= Alco EX6 / 22= Danfoss CCM 40 5= Alco EX7 / 23= Danfoss CCM T 2-4-8 6= Alco EX8 330Hz recommended by CAREL / 24= Disabled 7= Alco EX8 500Hz to Alco specifications / 25= CAREL E2J17AS1N0 ejector 8= Sporlan SEI 0.5-11 / 26= CAREL E2J23AT1N0 ejector 9= Sporlan SER 1.5-20 / 27= CAREL E3J26AT2N0 ejector 10= Sporlan SEI 30 / 28= CAREL E3J33AU2N0 ejector 11= Sporlan SEI 50 / 29= CAREL E3J39AV3N0 ejector 12= Sporlan SEH 100 / 30= CAREL E6J50AV3N0 ejector 13= Sporlan SEH 175 / 31= Danfoss CCMT 16 14= Danfoss ETS 12.5-25B / 32= Danfoss CCMT 24 15= Danfoss ETS 50B / 33= Danfoss CCMT 30 16= Danfoss ETS 100B / 34= Danfoss CCMT 42 17= Danfoss ETS 250 / 35= Danfoss Colibri	1	0	35	-	-	•
M	P1B	Type of EVD driver, valve B	1	0	35	-	-	•

Tab. 4.a

(*) to set the custom valve type, please see the CAREL manual +0300006EN.

4.4.2 I/O configuration

For the description of the following parameters, see the chapter on Input/output configuration in of this document

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	/F3	Assign outside temperature probe channel **BASIC, MEDIUM and ADVANCED models:** 0= function disabled; 1= S1; 2= S2; …; 6= S6; 7= S7 (ADVANCED only) **CO2 model:** 0= function disabled; 1= S1; 2= S2; …; 6= S6; 12= S2 EVD; 14 S4 EVD)	0	0	7 (14)	-	•	•
S	/FD	Assign line 1 suction temperature probe channel – see /F3	3	0	7 (14)	-	•	•
S	/FDB	Assign line 2 suction temperature probe channel – see /F3	0	0	7	-	•	-
S	/Fo	Assign line 1 discharge temperature probe channel – see /F3	6	0	7 (14)	-	•	•
S	/Fob	Assign line 2 discharge temperature probe channel – see /F3	0	0	7	-	•	-
S	/FS	Assign condensing pressure probe channel – see /F3	5	0	7 (14)	-	•	•
S	/FT	Assign line 1 suction pressure probe channel – see /F3	4	0	7 (14)	-	•	•
S	/FTB	Assign line 2 suction pressure probe channel – see /F3	0	0	7	-	•	-
S	/Fw	Assign receiver pressure probe channel – see /F3	0	0	14	-	-	•
S	/Fy	Assign gas cooler outlet temperature probe channel – see /F3	0	0	14	-	-	•
S	DiA	Assign external alarm digital input: 0 = function disabled; 1 = ID1, 2 = ID2; …; 5 = ID5; 6 = ID6, **MEDIUM and ADVANCED versions only**	0	0	6 (5)	-	•	•
S	DiA1	Assign compressor 1 alarm digital input, line 1 - see DiA	1	0	6 (5)	-	•	•
S	...	(Number of compressors based on the configuration)	-	-	-	-	•	•
S	DiT	Assign low pressure digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	DiTB	Assign low pressure digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	DivA	Assign fan 1 digital input - see DiA	3	0	6 (5)	-	•	•
S	...	(Number of fans based on the configuration)	-	-	-	-	•	•
S	DiY	Assign high pressure digital input - see DiA	5	0	6 (5)	-	•	•
S	DoA1	Assign compressor 1 digital output, line 1: 0= function disabled; 1= NO1, 2= NO2; …; 5= NO6; 6= NO6, **excluding CO_2 model**	1	0	6 (5)	-	•	•
S	...	(Number of compressors based on the configuration)	-	-	-	-	•	•
S	DoB	Assign global alarm digital output - see DoA1	5	0	6 (5)	-	•	•
S	DoH	Assign serious alarm digital output - see DoA1	0	0	6 (5)	-	•	•
S	DoT	Assign fan 1 digital output - see DoA1	3	0	6	-	•	•
S	...	(Number of fans based on the configuration)	-	-	-	-	•	•
S	/Ai	Assign inverter compressor 1 analogue output, line 1 – see /AbP	0	0	2 (4)	-	•	•
S	/AiB	Assign inverter compressor 1 analogue output, line 2 – see /AbP	0	0	2	-	•	-
S	/AE	Assign analogue output for inverter fan - see /AbP	0	0	2 (4)	-	•	•

Tab. 4.b

(*) The maximum value depends on the model.

5. USER INTERFACE

5.1 Introduction

µRack uses the user terminal to display the alarms, the main variables and to set the unit set points (User level) and manual functions (Service level). The terminal has a 7-segment LED display with two rows: the top row is 3-digit plus sign and decimal point; the bottom row is 4-digit plus sign (this can also display the hour format -hh:mm and date - MM:DD). There is a buzzer, 14 operating icons and 4 buttons for scrolling and setting the parameters. The terminal has NFC (Near Field Communication) and Bluetooth™ (versions without BLE are available) connectivity for interaction with mobile devices (on which the Carel APPLICA app has been installed, available on Google Play for the Android operating system and Apple store for iOS).

Notice: access levels: U=User; S=Service; M=Manufacturer See the parameter table.

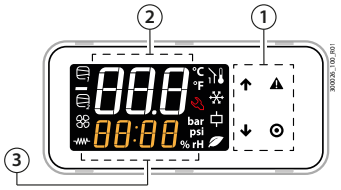
The unit of measure on the display can be changed via parameter /5, accessed at a Service level, including in the direct access functions menu.

User	Code	Description	Def.	Min	Max	UOM	HFCs	CO_2
S	/5	Unit of measure - 0=°C/barg 1=°F/psig	0	0	1	-	•	•
U	H8	Enable buzzer	1	1	-	0	•	•

Tab. 5.a

The information and parameters accessible from the terminal and from the APPLICA app depend on the access level and the unit configuration parameters.

5.2 User terminal



Key:

1	Keypad
2	Main field
3	Device status and operating mode icons

Fig. 5.a

Notice: the user terminal only allows access to certain parameters at the User and Service levels: to access all of the Service and Manufacturer parameters, use the Carel APPLICA app or the configuration and APPLICA Desktop commissioning software.

5.2.1 Keypad

Button	Description	Function
	UP	• When scrolling: go to the previous parameter • In programming mode: increase the value
	DOWN	• When scrolling: go to the next parameter • In programming mode: decrease in value **Main menu:** • pressed briefly twice: display the unit dashboard
	Alarm	• Pressed briefly: display active alarms and mute buzzer • Pressed and held (3 s): reset alarms
	PRG	• Pressed and held (3 s): access the programming menu **When scrolling:** • access parameter programming mode: • pressed briefly: confirm value • pressed and held (3 s): return to the main menu

Tab. 5.b

5.2.2 Icons

The icons indicate the device operating status and operating modes, as shown in the following table.

Icon	Function	On	Flashing
	Compressor status, line 1	At least 1 compressor on	Prevent or limit capacity due to active safety procedure
	Compressor status, line 2 (excluding CO_2 model)	At least 1 compressor on	Prevent or limit capacity due to active safety procedure
	Condenser fan status	At least 1 fan on	High pressure prevention
	Crankcase heater	Active	-
	Operating mode	Floating condenser active	-
		Low superheat or liquid return	Active safety procedure for low superheat protection
		Floating suction active	-
	Service	Request on exceeding operating hour threshold; wizard in progress	Serious alarm, service required by qualified personnel; compressors or fans in manual mode

Tab. 5.c

5.3 Standard display

At start-up, the user terminal briefly shows "NFC", indicating that the terminal NFC interface is available for communication with mobile devices, then the software version (e.g.: µRack 1.0), and then the standard display is shown. The standard display shows:

- on the top row: the suction pressure/temperature on line 1;
- on the bottom row: the condensing pressure/temperature or, if configured, the suction pressure/temperature on line 2 (excluding CO_2 model).

Notice: "bLE" flashes on the display during "Bluetooth" communication.

5.3.1 Dashboard – 7-segment display

From the main menu, press DOWN twice and confirm by pressing PRG when the message "SYN" is shown, so as to access information on the status of the devices and the temperature, superheat value, etc. on the two lines:

- "CL1" current compressor capacity on line 1, followed by the status of each compressor in the line;
- "CL2" current compressor capacity on line 2, followed by the status of each compressor in the line (excluding CO_2 model);
- "FAn" current capacity of the condenser fans;
- "TGS" suction temperature line 1;
- "SHL1" superheat line 1.
- "tGSb" line 2 suction temperature (excluding CO_2 model);
- "SHL2" line 2 gas superheat (excluding CO_2 model);
- "SCP" gas cooler pressure (CO_2 model only);
- "HPV" HPV valve opening percentage (CO_2 model only);
- "SFP" receiver pressure (CO_2 model only);
- "FGV" FGV valve opening percentage (CO_2 model only);

Example

1. Go to the standard display
2. Press DOWN twice

3. Press PRG to access the dashboard

4. Display the current capacity of line 1 as a %

5. Press DOWN: CL1 indicates the status of the individual compressors on line 1: (_) compressor off, (o) compressor at part load and (O) compressor on at maximum capacity

6. Press DOWN to view the other information

7. To return to the standard display, press PRG (corresponding to ESC)

5.3.2 Programming mode

Go to the standard display and press PRG for 3 seconds to enter programming mode. The controller can be programmed in two levels, with access to different parameters based on the password entered (see the parameter table):
The user profile is accessed by confirming the default password 00, with reduced parameter visibility.

Code	Description	Def.	UOM	Min	Max	Lev.
PDM	Manufacturer password	77	-	0	999	M
PDS	Service password	44	-	0	999	S
PDU	User password	0	-	0	999	U

Tab. 5.d

The passwords are valid for access from the display, from the APPLICA Mobile app and the APPLICA Desktop app.

Procedure

Press:

- PRG to access the parameters with password protection;
- UP and DOWN to scroll and set the parameters;
- PRG to change the parameter value and save the changes;
- PRG (3 s) or ESC to return to the standard display.

1. Go to the standard display

2. Press PRG until the first digit of the password flashes; set the value, press PRG. The second digit now flashes; enter the other digits to complete the password.

3. Press PRG: if the password is correct, the first parameter category is shown: Unl (=Unit Status)

4. Press PRG: the first parameter is displayed: ON (Manual control pump 1)

5. Press PRG: the value flashes; press UP/DOWN to change the value; PRG to confirm.

6. Press UP/DOWN to display the other parameters.

7. Press PRG for 3 sec or alternatively, in the parameter level select ESC and press PRG to return to the parameter categories

5.3.3 Programming menu

First level	Second level

Category Unl (Unit status): all the parameters relating to the unit status.

Category IO (Inputs/outputs): all the parameters relating to the configuration of the inputs and outputs

DIn	Digital inputs
Ain	Analogue inputs
dO	Digital outputs
AO	Analogue outputs
MAn	Manual mode
tSt	Test mode
ESC	Return to the previous level

Category CL1 (Compressors on line 1): all the parameters relating to the configuration and control of the compressors on line 1.

rEG	Control
CFG	Configuration
ALM	Alarms
ESU	Energy saving
ESC	Return to the previous level

First level		Second level	
	Category CL2 (Compressors on line 2): all the parameters relating to the configuration and control of the compressors on line 2 **(excluding CO_2 model)**	rEG	Control
		CFG	Configuration
		ALM	Alarms
		ESU	Energy saving
		ESC	Return to the previous level
	Category FAn (Condenser fans): all the parameters relating to the configuration and control of the condenser fans	rEG	Control
		CFG	Configuration
		ALM	Alarms
		ESU	Energy saving
		ESC	Return to the previous level
	Category HPv (HPV valve): all the parameters relating to the operation of the HPV valve (CO_2 model only)		
	Category FGv (FGV valve): all the parameters relating to the operation of the FGV valve (CO_2 model only)		
	Category OtH (Other functions): all the parameters relating to the accessory functions for the compressors or other devices on the unit	OIL	Oil recovery
		dSS	Double line synchronisation
		ESC	Return to the previous level
	Category SAF (Safety): all the parameters concerning unit safety	ALM	Alarms
		Prv	Prevention
		LOG	Logs
		ESC	Return to the previous level
	Category StG (Settings): all the parameters relating to configuration of the controller for communication or RTC	CLO	Clock
		PSd	Password
		bMS	BMS
		FbS	FieldBus
		ESC	Return to the previous level
	Press PRG for 3 sec or alternatively, in the parameter level select ESC and press PRG to return to the parameter categories		

Notice:

- a higher level password also allows access to the parameters enabled by a lower level password; for example, the service password also provides access to the user parameters;
- if no button is pressed, after around 3 minutes the terminal will automatically return to the standard display and the password will need to be entered again to access parameter programming.

6. FUNCTIONS

6.1 Unit ON/OFF

The unit can be switched on and off from:
- User terminal (parameters on and onb)
- Supervisor
- Digital input (parameters DiF and DiFB)
- Serious alarm

For switching off, all these actions have the same priority, therefore one single request is sufficient to switch the unit off, while for switching on, all the actions are required to switch the unit on. On-Off from user terminal and via digital input are separate for line 1 and line 2; if both lines are off, the condensing stage is also off, while one suction line needs to be on for the condensing stage to be activated.

Notice: µRack is also able to manage units with only one condensing line, in which case parameter F31 needs to be set to 0 and parameter 'on' is used to switch it on/off from the keypad.

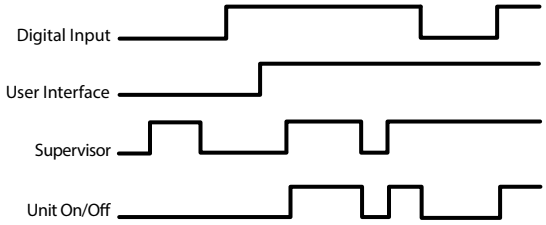


Fig. 6.a

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	DiF	Assign remote On/Off digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	DiFB	Assign remote On/Off digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	F31	Fans ON with compressors ON (0= fans ON also with compressor OFF; 1= fans ON when at least one compressor is ON)	0	0	1	-	•	•
U	on	Line 1 On/Off from keypad (0= Off; 1= On)	0	0	1	-	•	•
U	onb	Line 2 On/Off from keypad - see on	0	0	1	-	•	-
S	ONK	Enable On/Off from keypad (0= disabled; 1= enabled)	1	0	1	-	•	•
S	ons	Enable On/Off from supervisor (0= disabled; 1= enabled)	0	0	1	-	•	•

Tab. 6.a

On-Off from keypad and from the supervisor can be enabled using parameters ONK and ons.

6.2 Control

µRack can control the refrigerant saturated suction pressure or temperature for each group of compressors on the unit, as configured using parameter Vrt. The conversion from pressure to saturated temperature is performed considering the type of refrigerant used on the unit, set using parameter PH. All the control probes can be installed on any channel if compatible with the type of probe. See "Installation". Control can be P + I or dead band, as set using parameters CRT and CRTb.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	CRT	Compressor control type, line 1 (0 = P+I; 1 = dead band)	1	0	1	-	•	•
S	CRTb	Compressor control type, line 2 (0 = P+I; 1 = dead band)	1	0	1	-	•	-
M	PH	Type of refrigerant used in the unit 0:Custom / 8: R600 / 16: R413A / 24: HTR01 / 32: R447A / 40: R454B 1: R22 / 9: R600a / 17: R422A / 25: HTR02 / 33: R448A / 41: R458A 2: R134a / 10: R717 / 18: R423A / 26: R23 / 34: R449A / 42: R407H 3: R404A / 11: R744 / 19: R407A / 27: HFO1234yf / 35: R450A / 43: R454A 4: R407C / 12: R728 / 20: R427A / 28: HFO1234ze / 36: R452A / 44: R454C 5: R410A / 13: R1270 / 21: R245Fa / 29: R455A / 37: R508B / 45: R470A 6: R507A / 14: R417A / 22: R407F / 30: R170 / 38: R452B / 46: R515B 7: R290 / 15: R422D / 23: R32 / 31: R442A / 39: R513A / 47: R466	3 (11)	0	47	-	•	-
S	RDP	Control differential, line 1	0.5/7.2	0	20/290	Δbarg/Δpsig	•	•
S	RDP_T	Control differential, line 1, expressed as a temperature	5/9	0	99.9/179	Δ°C/Δ °F	•	•
S	RDPB	Control differential, line 2	0.5/7.2	0	20/290	Δbarg/Δpsig	•	-
S	RDPB_T	Control differential, line 2, expressed as a temperature	5/9	0	99.9/179	Δ°C/Δ °F	•	-
U	SP	Control set point, line 1	1/14.5 (26/377)	SPL	SPH	barg/psig	•	•
U	SPt	Control set point, line 1, expressed as a temperature	1/33.8	SPL_T	SPH_T	°C/°F	•	•
U	SPB	Control set point, line 2	1/14.5	SPLB	SPHB	barg/psig	•	-
U	SPBt	Control set point, line 2, expressed as a temperature	1/33.8	SPLB_T	SPHB_T	°C/°F	•	-
S	vrt	Pressure or temperature control (0= pressure; 1= temperature)	0	0	1	-	•	•

Tab. 6.b

The set points can be limited between a minimum and a maximum value that can be set using parameters SPH, SPH_T, SPHB, SPHB_T, SPL, SPL_T, SPLB, SPLB_T.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	SPH	Control set point maximum limit, line 1	9.3/134 (60/870)	SPL	/UT	barg/psig	•	•
M	SPH_T	Control set point maximum limit, line 1, expressed as a temperature	20/68	SPL_T	150/302	°C/°F	•	•
M	SPHB	Control set point maximum limit, line 2	9.3/134	SPLB	/UTB	barg/psig	•	-
M	SPHB_T	Control set point maximum limit, line 2, expressed as a temperature	20/68	SPLB_T	150/302	°C/°F	•	-
M	SPL	Control set point minimum limit, line 1	0.1/1.4 (0/0)	/LT	SPH	barg/psig	•	•
M	SPL_T	Control set point minimum limit, line 1, expressed as a temperature	-50/-58	-50/-58	SPH_T	°C/°F	•	•
M	SPLB	Control set point minimum limit, line 2	0.1/1.4	/LTB	SPHB	barg/psig	•	-
M	SPLB_T	Control set point minimum limit, line 2, expressed as a temperature	-50/-58	-99.9/-147	SPHB_T	°C/°F	•	-

Tab. 6.c

6.2.1 P + I control

The operating principle is normal proportional or proportional + integral (P, P+I) control. The control set point SP is central, and therefore for proportional control only, operation can be schematised as shown in the following figures:

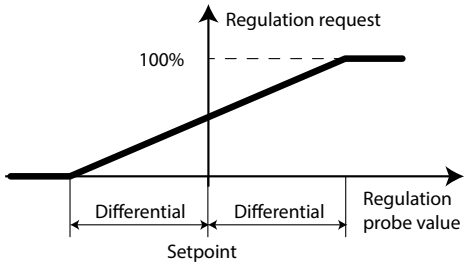


Fig. 6.b

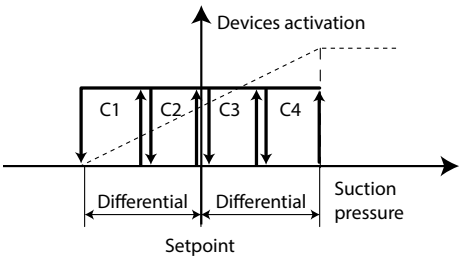


Fig. 6.c

For P+I control, the integral action is summed to the effect of the proportional action described above, making it possible to have a null control error in steady operation, as shown in the figure:

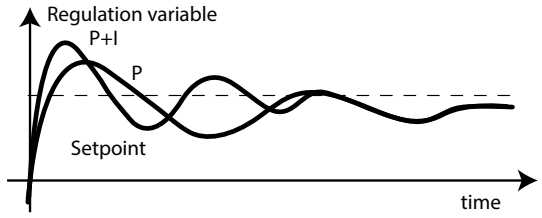


Fig. 6.d

The integral action depends on time and the deviation from the set point. The request will be modified if the control value remains away from the set point for a certain time. The integral time setting Cti represents the rate at which integral control is implemented:

- low values mean a faster response and more intense control actions;
- higher values mean a slower response and more stable control.

It is recommended to not set the integral time too low, in order to avoid instability.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	Cti	P+I control integral time, line 1	600	0	999	s	•	•
S	CTiB	P+I control integral time, line 2	600	0	999	s	•	-

Tab. 6.d

6.2.2 Dead band control

The operating principle is schematised in the following figure:

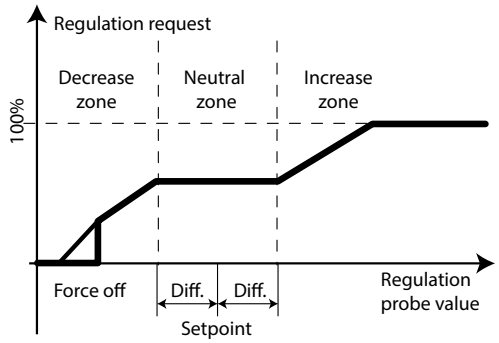


Fig. 6.e

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	CRC	Force off threshold for dead band control, line 1	-1/-14.5 (0/0)	-1/-14.5	60/870 (150/2175 *)	barg/psig	•	•
S	CRC_T	Force off threshold for dead band control, line 1, expressed as a temperature	-45/-49	-99.9/-147	150/302	°C/°F	•	•
S	CRCB	Force off threshold for dead band control, line 2	-1/-14.5	-1/-14.5	60/870	barg/psig	•	-
S	CRCB_T	Force off threshold for dead band control, line 2, expressed as a temperature	-45/-49	-99.9/-147	150/302	°C/°F	•	-
S	RDP	Control differential, line 1	0.5/7.2	0	20/290	Δbarg/Δpsig	•	•
S	RDP_T	Control differential, line 1, expressed as a temperature	5/9	0	99.9/179	Δ°C/Δ °F	•	•
S	RDPB	Control differential, line 2	0.5/7.2	0	20/290	Δbarg/Δpsig	•	-
S	RDPB_T	Control differential, line 2, expressed as a temperature	5/9	0	99.9/179	Δ°C/Δ °F	•	-
U	SP	Control set point, line 1	1/14.5 (26/377)	SPL	SPH	barg/psig	•	•
U	SPt	Control set point, line 1, expressed as a temperature	1/33.8	SPL_T	SPH_T	°C/°F	•	•
U	SPB	Control set point, line 2	1/14.5	SPLB	SPHB	barg/psig	•	-
S	SPBt	Control set point, line 2, expressed as a temperature	1/33.8	SPLB_T	SPHB_T	°C/°F	•	-

Tab. 6.e

Inside the dead band, the capacity request sent by the controller is constant, with a value that is assumed will allow the set point to be maintained in those specific operating conditions, and while inside the dead band, no device is switched off or on. In the decrease zone, the request decreases at a rate that depends on the distance from the set point; vice-versa in the increase zone, it increases proportionally.
The following settings are available:

- Fixed times: the request decreases or increases constantly over time.
- Variable times: the request generally decreases or increases faster (based on the settings) as the distance from the set point increases.

Notice: the previous figure refers to increase and decrease with fixed times.

For dead band control, the parameters shown in the figure need to be set:

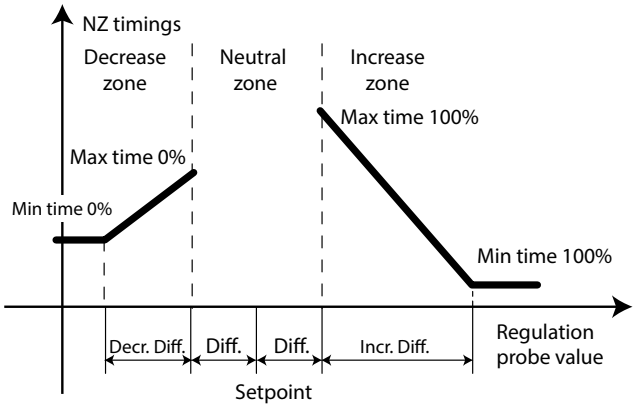


Fig. 6.f

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	CRM	Maximum time in which the requested capacity reaches 100% with dead band control, line 1	60	CRn	999	s	•	•
S	CRMB	Maximum time in which the requested capacity reaches 100% with dead band control, line 2	60	CRnB	999	s	•	-
S	CRn	Minimum time in which the requested capacity reaches 100% with dead band control, line 1	60	0	CRM	s	•	•
S	CRnB	Minimum time in which the requested capacity reaches 100% with dead band control, line 2	60	0	CRMB	s	•	-
S	CRP	Minimum time in which the requested capacity reaches 0% with dead band control, line 1	10	0	CRQ	s	•	•
S	CRPB	Minimum time in which the requested capacity reaches 0% with dead band control, line 2	10	0	CRQB	s	•	-
S	CRQ	Maximum time in which the requested capacity reaches 0% with dead band control, line 1	60	CRP	999	s	•	•
S	CRQB	Maximum time in which the requested capacity reaches 0% with dead band control, line 2	60	CRPB	999	s	•	-
S	RDD	Decrease differential for dead band control, line 1	0.5/7.2	0.5/7.2	20/290	barg/psig	•	•
S	RDD_T	Decrease differential for dead band control, line 1, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	•
S	RDDB	Decrease differential for dead band control, line 2	0.5/7.2	0.5/7.2	20/290	barg/psig	•	-
S	RDDB_T	Decrease differential for dead band control, line 2, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	-
S	RDi	Increase differential for dead band control, line 1	0.5/7.2	0.5/7.2	20/290	barg/psig	•	•
S	RDi_T	Increase differential for dead band control, line 1, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	•
S	RDiB	Increase differential for dead band control, line 2	0.5/7.2	0.5/7.2	20/290	barg/psig	•	-
S	RDiB_T	Increase differential for dead band control, line 2, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	-

Tab. 6.f

In addition to the decrease and increase differentials RDD, RDD_T, RDDB, RDDB_T, RDi, RDi_T, RDiB, RDiB_T, four times need to be set, two for each zone CRM, CRMB, CRN, CRnB, CRP, CRPB, CRQ, CRQB, which represent the maximum and minimum time to reach a request equal to 0% or 100%, for decrease and increase respectively.

Tutorial: the decrease/increase times (minimum and maximum) represent the time required to transition from maximum to minimum capacity and vice-versa, and not the time between deactivation and activation of the individual device. For example, with four devices of equal capacity, an increase time of 180 s means that one device is activated every 45 s. In the case shown in the figure, the control request decreases/increases slowly upon exiting the dead band, while it decreases/increases quickly the further away from the dead band; in this way, the system response is faster when the conditions are less in equilibrium.

Notice: to use fixed times, set the maximum and minimum decrease/increase time to the same value. In this case, the control request decreases/increases constantly in accordance with the deactivation/activation differential.

6.2.3 Dead band modulation

µRack features a special function for operation in the dead band when modulating devices are available (e.g. inverter). The function can be enabled via parameter MnE.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	MnE	Enable modulation in the dead band (0 = disabled; 1 = enabled)	1	0	1	-	•	•

Tab. 6.g

Modulation in the dead band allows the request to be varied proportionally inside the dead band, with the aim of entering the decrease zone at the minimum request and the increase zone at the maximum request, making it possible to immediately deactivate/activate a device when exiting the dead band. In this way, the system can stay longer inside the dead band without activating or deactivating any device. An example of operation is shown in the figure:

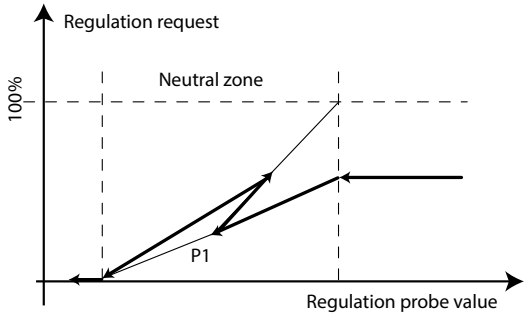


Fig. 6.g

Upon entering the dead band, the µRack software calculates how the request should vary in order to exit the dead band at minimum or maximum capacity, and applies one of the two values according to the trend in the variation of the control variable. For example, at point P1 in the figure, the trend of the two calculated requests is represented by the thin line segments, with a "reversal" of the request because at that point, the value of the control variable began to increase again.

Notice: on exiting the dead zone, the request is neither at the minimum or maximum value if the timings do not permit the modulating device to follow the request.

6.2.4 Emergency control in the event of probe faults

In the event where the main control probes are not working, fixed control request values can be used, set using parameters DPc, DPcb, DFc.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	DFc	Capacity request during condenser emergency operation	70	0	100	%	•	•
S	DPc	Capacity request during line 1 emergency operation	70	0	100	%	•	•
S	DPcb	Capacity request during line 2 emergency operation	70	0	100	%	•	-

Tab. 6.h

6.3 Compressors

µRack can manage up to two suction lines with different types of compressors and capacity modulation devices, adopting the most common types of device rotation and controlling both the start-up modes and safety timings for each type compressor, as well as some accessory functions. The compressor functions are enabled and the corresponding parameters are set on the display or via Applica. These features and functions are described in detail below.

Notice: µRack CO_2 manages a single suction line with up to four compressors.

6.3.1 Permitted compressor configurations

µRack can manage different types of compressors, as well as a capacity modulation device on each suction line, which may differ according to the type of compressor:

Compressor	Modulation device
Reciprocating	0-10V inverter, Capacity steps (max 2)
Scroll	0-10V inverter, Digital Scroll™

Tab. 6.i

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	C1T	First compressor type, line 1 0= ON-OFF 1= inverter 2= Digital Scroll™ 3= two steps 50-100 4= three steps 33-66-100	0	0	4	-	•	•
M	C1TB	First compressor type, line 2 – see C1T	0	0	4	-	•	-
S	EC1	Enable compressor 1 line 1 (0: disabled; 1: enabled)	1	0	1	-	•	•
S	EC1B	Enable compressor 1 line 2 – see EC1	1	0	1	-	•	-
S	EC2	Enable compressor 2 line 1 – see EC1	1	0	1	-	•	•
S	EC2B	Enable compressor 2 line 2 – see EC1	1	0	1	-	•	-
S	EC3	Enable compressor 3 line 1 – see EC1	1	0	1	-	•	•
S	EC4	Enable compressor 4 line 1 – see EC1	1	0	1	-	•	•
M	nC	Number of compressors, line 1	2	0	4	-	•	•
M	nC2	Number of compressors, line 2 (0= line 2 not present)	0	0	2	-	•	-

Tab. 6.j

Notice: only one modulation device on each suction line

The controller can manage up to six compressors in the HFC/HFO versions (BASIC, MEDIUM and ADVANCED models) and four in the CO_2 version (CO_2 model), distributed as follows: a maximum of four compressors on the first suction line, and two compressors on the second suction line. All the possible combinations within the limits described above are valid. Example:

- 3 compressors on line 1 and 1 compressor on line 2
- 2 compressors on line 1 and 1 compressor on line 2
- 1 compressor on line 1 and 2 compressors on line 2
- 4 compressors on line 1

Once configured, each compressor can be disabled using parameters EC1, EC2, EC3, EC4, EC1B, EC2B, useful, for example, during maintenance.

Notice: verify that the controller has enough I/Os available for the configuration.

6.3.2 Rotation

µRack can manage three different types of device rotation, based on the setting of parameter Cro:

- FIFO rotation (First In First Out): the first device to start will also be the first to stop
- LIFO rotation (Last In First Out): the last device to start will be the first to stop
- Timed: the device with the lowest number of operating hours starts and the device with the highest number of operating hours stops

Example: FIFO rotation, four identical compressors without capacity control. The activation thresholds are 25, 50, 75 and 100 %.

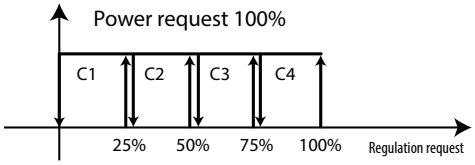


Fig. 6.h

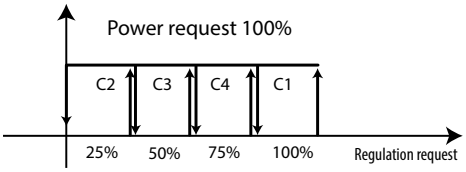


Fig. 6.i

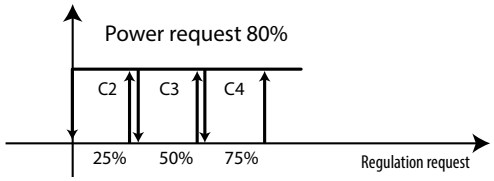


Fig. 6.j

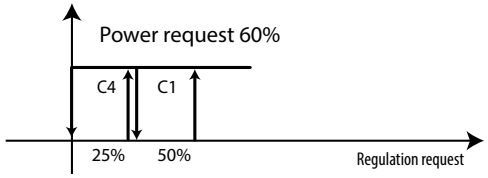


Fig. 6.k

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	Cro	Compressor rotation type (0=FIFO, 1=LIFO, , 2=Time)	0	0	2	-	•	•

Tab. 6.k

µRack also manages the delay times between the compressors switching on and off and between steps or compressors.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	CLD	Delay between OFF requests for steps/compressors on line 1	10	0	999	s	•	•
M	CLDB	Delay between OFF requests for steps/compressors on line 2	120	0	999	s	•	-
M	CLU	Delay between ON requests for steps/compressors on line 1	30	0	999	s	•	•
M	CLUB	Delay between ON requests for steps/compressors on line 2	10	0	999	s	•	-

Tab. 6.l

6.3.3 Rotation with modulation devices

µRack can manage compressor rotation even when there is a capacity modulation device (inverter or Digital Scroll™). The type of modulating device is selected using parameters C1T and C1TB. The modulating device is always the first to switch on and the last to switch off, regardless of the type of rotation, while the other devices switch on or off according to the type of rotation selected.

Notice: the compressor with the modulation device is always set as the first compressor.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	CS1	Capacity of the first compressor, line 1	10	0	999	kW	•	•
M	CS1B	Capacity of the first compressor, line 2	10	0	999	kW	•	-
M	CS2	Capacity of the second compressor, line 1	10	0	999	kW	•	•
M	CS2B	Capacity of the second compressor, line 2	10	0	999	kW	•	-
M	CS3	Capacity of the third compressor, line 1	10	0	999	kW	•	•
M	CS4	Capacity of the fourth compressor, line 1	10	0	999	kW	•	•

Tab. 6.m

The trend in capacity supplied by the modulating device depends on the capacity of the corresponding compressor relative to the other compressors. There are three possible cases:

- compressors all of the same capacity and modulating device with a range of capacity modulation equal to or greater than the compressor capacity
- compressors all of the same capacity and modulating device with a range of capacity modulation less than the compressor capacity
- compressors of different capacities

In the first case, the modulating device can continuously cover the range of variation of the control request, while in the second case there will be some discontinuous variations. The behaviour in the third case is variable, and depending on the capacities involved, refer back to one of the two previous cases. To configure the compressor capacity when controlled by an inverter, the minimum and maximum operating frequencies need to be set, corresponding to the minimum and maximum value of the analogue output and the rated capacity delivered at the rated frequency (50 Hz); in this way, µRack can calculate the capacity delivered by the inverter compressor and use this value for control. Furthermore, for inverters the variation in capacity delivered can be limited by setting the increase and decrease times.

Example of range of capacity variation of the modulating device greater than the compressor capacity: two compressors without capacity control, 20 kW each, modulating device with variable capacity between 30 and 60 kW. The figure shows the trend for a control request that increases and then decreases continuously between 0 and 100%. It can be seen how the capacity delivered can exactly follow the capacity requested, except when the capacity is lower than the minimum capacity of the modulating device.

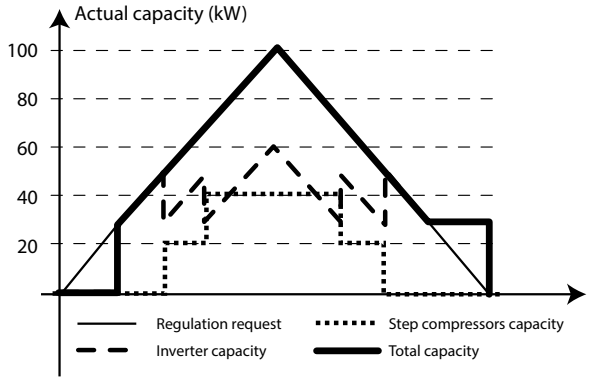


Fig. 6.l

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	cMF	Maximum inverter control frequency, line 1	50	cnF	150	Hz	•	•
M	cnF	Minimum inverter control frequency, line 1	30	0	cMF	Hz	•	•
M	CRF	Nominal inverter control frequency, line 1 (**Notice:** the capacity CS1 refers to this frequency)	50	1	150	Hz	•	•
M	cMFB	Maximum inverter control frequency, line 2	50	cnFB	150	Hz	•	-
M	cnFB	Minimum inverter control frequency, line 2	30	0	cMFB	Hz	•	-
M	CRFB	Rated inverter control frequency, line 2 (note: CS1B capacity refers to this frequency)	50	1	150	Hz	•	-
M	iCD	Inverter deceleration time from 100% to 0% speed (line 1)	60	1	360	s	•	•
M	iCDB	Inverter deceleration time from 100% to 0% speed (line 2)	60	1	360	s		
M	iCU	Inverter acceleration time from 0% to 100% speed (line 1)	100	1	360	s	•	•
M	iCUB	Inverter acceleration time from 0% to 100% speed (line 2)	100	1	360	s	•	-

Tab. 6.n

6.3.4 Safety times

µRack manages, for each compressor, the following common safety times:
- Minimum ON time C3: this is always considered, with the exception of when an alarm is activated that is configured to stop the compressor
- Minimum OFF time C2
- Minimum time between consecutive starts of C1

It is also possible to set a start delay time after a blackout c0, to avoid false starts.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	c0	Start delay after blackout	0	0	999	-	•	•
M	C1	Minimum time between two consecutive starts of each compressor on line 1	360	0	999	s	•	•
M	C1B	Minimum time between two consecutive starts of each compressor on line 2	360	0	999	s	•	-
M	C2	Minimum OFF time for each compressor on line 1	120	0	999	s	•	•
M	C2B	Minimum OFF time for each compressor on line 2	120	0	999	s	•	-
M	C3	Minimum ON time for each compressor on line 1	10	0	999	s	•	•
M	C3B	Minimum ON time for each compressor on line 2	10	0	999	s	•	-

Tab. 6.o

6.3.5 Liquid injection into the compressor

µRack manages the liquid injection function for compressor protection. Downstream of the condenser (gas cooler for CO2 systems), liquid is taken in from the receiver, expanded and then injected into the compressor suction line, so as to lower the superheat and consequently the compressor discharge temperature.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	DoJ1	Assign liquid alarm digital output, line 1 - see DoA1	0	0	6 (5)	-	•	•
S	DoJ2	Assign liquid alarm digital output, line 2 - see DoA1	0	0	6	-	•	-
S	Lj1	Discharge temperature threshold to activate liquid injection, line 1	115/239	0/32	200/392	°C/°F	•	•
S	Lj2	Discharge temperature threshold to activate liquid injection, line 2	115/239	0/32	200/392	°C/°F	•	-
S	rj1	Differential to activate liquid injection, line 1	5/9	0	50/90	Δ°C /Δ°F	•	•
S	rj2	Differential to activate liquid injection, line 2	5/9	0	50/90	Δ°C /Δ°F	•	-
S	RoJ1	Liquid alarm digital output logic, line 1 - see RoA1	0	0	1	-	•	•
S	RoJ2	Liquid alarm digital output logic, line 2 - see RoA1	0	0	1	-	•	-

Tab. 6.p

The liquid injection function can be activated for each suction line, therefore µRack uses two digital outputs on the HFC models and one digital output in the CO2 model, which are assigned via parameters Doj1 and DOj2, with the corresponding activation logic that can be set using parameters ROj1 and ROj2.

Liquid injection works as shown in the figure:
- it is activated when the discharge temperature exceeds a threshold that can be set using parameters Lj1 and Lj2, for the two lines respectively;
- it is deactivated when the temperature falls below the thresholds Lj1 and Lj2 by a differential that can be set using parameters rj1 and rJ2.

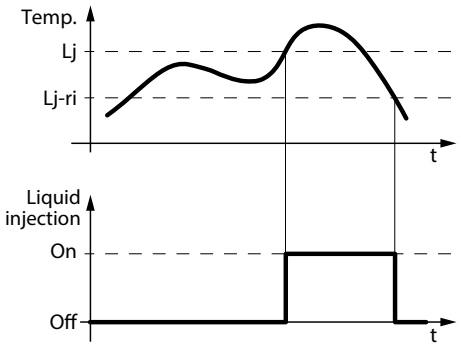


Fig. 6.m

Notice:
- liquid injection is only possible if at least one compressor on the line is on; in the event of alarms that shut down the compressors, the function is deactivated.
- If the compressor discharge temperature probe is broken, the function is deactivated.

Liquid injection can be implemented with direct feed into the compressor, or with a liquid separator on the suction line.

With direct feed into the compressor, the cooled liquid is injected directly into the suction line by a dedicated liquid injection valve for each compressor.

The liquid injection valve must open only if the corresponding compressor is on, and therefore the manufacturer must ensure it is electrically connected in series with the liquid injection function digital output and the compressor digital output; in this way, when liquid injection is activated, the function will only apply to the compressors that are on.

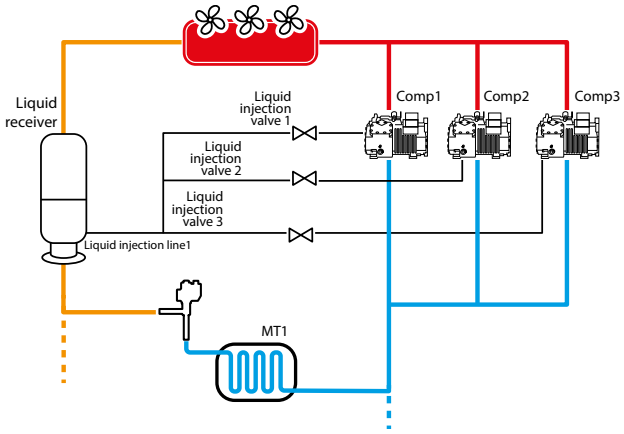


Fig. 6.n

With a liquid separator on the suction line, the cooled liquid is stored in a tank before being injected into the compressors on the suction side. This allows the use of a single liquid injection valve for all the compressors. The dedicated liquid injection valve must open only if at least one compressor is on; the manufacturer must ensure an electromechanical connection that works accordingly.

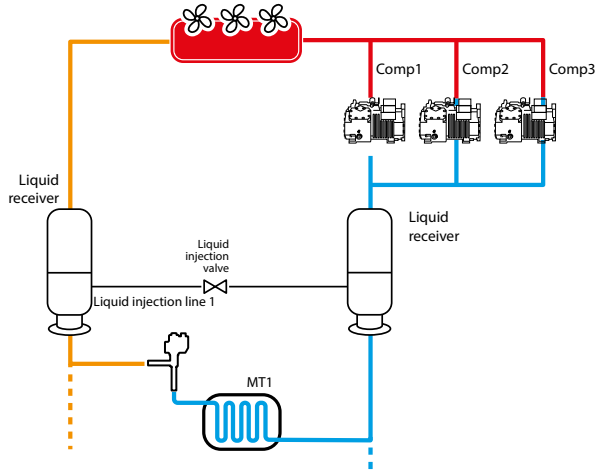


Fig. 6.o

6.3.6 Digital Scroll™ compressors

µRack can use a Digital Scroll™ compressor (one on each line) as a modulating device for the suction lines. This type of compressor features specific operation and control by µRack, as described below. The corresponding parameters can only be used using specific configurations available in Applica. Capacity modulation is obtained by opening/closing a valve with PWM modulating signal; when the valve is ON, the compressor delivers minimum capacity, while when the valve is OFF the compressor delivers maximum capacity. In the description and figures below, ON and OFF refer to the compressor status, while operation of the valve is the exact opposite:

Notice:

- the minimum capacity that can be delivered by the Digital Scroll™ compressors is Min. ON time/Max cycle time= 2/20= 10%;
- in the event of high pressure prevention by activating/deactivating the devices, the Digital Scroll™ compressor delivers the minimum capacity.

Start-up procedure

µRack manages the start-up procedure for Digital Scroll™ compressors, which is represented in the figure:

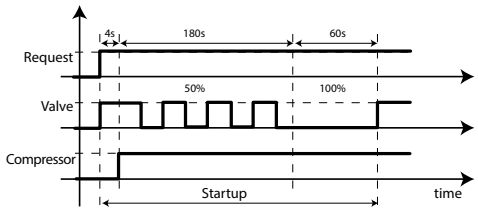


Fig. 6.p

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	dGA	Default valve cycle time – Digital Scroll™ line 1	12	0	65535	s	•	•
M	dGAB	Default valve cycle time – Digital Scroll™ line 2	12	0	65535	s	•	-
M	dGB	Default valve OFF time – Digital Scroll™ line 1	10	0	65535	s	•	•
M	dGBB	Default valve OFF time – Digital Scroll™ line 2	10	0	65535	s	•	-
M	dGC	Default valve ON time – Digital Scroll™ line 1	2	0	65535	s	•	-
M	dGCB	Default valve ON time – Digital Scroll™ line 2	2	0	65535	s	•	-
M	dGd	Maximum valve cycle time – Digital Scroll™ line 1	20	0	65535	s	•	•
M	dGdB	Maximum valve cycle time – Digital Scroll™ line 2	20	0	65535	s	•	-
M	dGE	Maximum valve OFF time – Digital Scroll™ line 1	20	0	65535	s	•	•
M	dGEB	Maximum valve OFF time – Digital Scroll™ line 2	20	0	65535	s	•	-
M	dGF	Maximum valve ON time – Digital Scroll™ line 1	18	0	65535	s	•	•
M	dGFB	Maximum valve ON time – Digital Scroll™ line 2	18	0	65535	s	•	-
M	dGG	Minimum valve cycle time – Digital Scroll™ line 1	12	0	65535	s	•	•
M	dGGB	Minimum valve cycle time – Digital Scroll™ line 2	12	0	65535	s	•	-
M	dGH	Minimum valve OFF time – Digital Scroll™ line 1	2	0	65535	s	•	•
M	dGHB	Minimum valve OFF time – Digital Scroll™ line 2	2	0	65535	s	•	-
M	dGI	Minimum valve ON time – Digital Scroll™ line 1	0	0	65535	s	•	•
M	dGIB	Minimum valve ON time – Digital Scroll™ line 2	0	0	65535	s	•	-
M	dGL	Starting capacity – stage 1 – Digital Scroll™ line 1	0	0	100	%	•	•
M	dGLB	Starting capacity – stage 1 – Digital Scroll™ line 2	0	0	100	%	•	-
M	dGM	Starting capacity – stage 2 – Digital Scroll™ line 1	50	0	100	%	•	•
M	dGMB	Starting capacity – stage 2 – Digital Scroll™ line 2	50	0	100	%	•	-
M	dGn	Starting capacity – stage 3 – Digital Scroll™ line 1	100	0	100	%	•	•
M	dGnB	Starting capacity – stage 3 – Digital Scroll™ line 2	100	0	100	%	•	-
M	dGo	Starting time – stage 1 – Digital Scroll™ line 1	4	0	65535	s	•	•
M	dGoB	Starting time – stage 1 – Digital Scroll™ line 2	4	0	65535	s	•	-
M	dGP	Starting time – stage 2 – Digital Scroll™ line 1	180	0	65535	s	•	•
M	dGPB	Starting time – stage 2 – Digital Scroll™ line 2	180	0	65535	s	•	-
M	dGQ	Starting time – stage 3 – Digital Scroll™ line 1	60	0	65535	s	•	•
M	dGQB	Starting time – stage 3 – Digital Scroll™ line 2	60	0	65535	s	•	-

Tab. 6.q

Data provided by the compressor manufacturer:

- minimum ON time 2 s
- maximum cycle time 20 s
- optimal cycle time 12 s

There are three stages:

1. equalisation: the PWM valve is activated for 4 s, to bring the compressor to minimum capacity;
2. activation of the compressor at 50% capacity for 3 minutes;
3. operation at 100% for 1 minute.

During the start-up procedure, the control request is ignored, and only at the end of the procedure does the capacity delivered begin to reflect the request. If the request is cancelled during start-up, the compressor switches off at the end of the procedure, and therefore the minimum ON time for this type of compressor is fixed at 244 s. The start-up procedure is completed when the compressor starts the first time, while it is disabled at subsequent restarts, unless the compressor has been off for a settable time. After this time has elapsed, the procedure is repeated at next start-up.

Notice: the Digital Scroll™ compressor safety times are defined by the manufacturer, and are:

- Minimum ON time; 244 s (start-up procedure)
- Minimum OFF time: 180 s
- Minimum time between restarts: 360 s

Caution: for Digital Scroll™ modulating compressors, the unloader output must be configured on an SSR output, or alternatively external SSR relays with an input voltage compatible with the 0-10 V outputs Y1 and Y2 can be connected.
See "Input and output configuration".

6.3.7 Low superheat protection

µRack can preserve correct compressor operation by promptly recognising liquid return from the system and implementing preventive protection actions.

The protection algorithm features two activation thresholds that can be set in terms of superheat value, i.e. the difference between the suction temperature measured by the corresponding temperature sensor, and the converted saturated temperature read by the pressure sensor. The protection acts independently on the two suction lines and is always active.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	AtS	Type of low superheat alarm reset, line 1 (0= automatic; 1= manual; 2= semi-automatic)	1	0	2	-	•	•
M	AtSb	Type of low superheat alarm reset, line 2 (0= automatic; 1= manual; 2= semi-automatic)	1	0	2	-	•	-
S	Lhdb	Emergency delay for superheat protection, line 2	5	0	60	s	•	-
S	LshA	Emergency threshold for superheat protection	2	-20	LshP	K	•	•
S	LshC	Emergency control (duty cycle) activation time in a fixed period of 10 minutes	4	0	10	min	•	•
S	Lshd	Emergency delay for superheat protection, line 1	5	0	60	s	•	•
S	LshP	Safety threshold for superheat protection	6	LshA	20.	K	•	•

Tab. 6.r

The first safety threshold (LshP) guarantees limited operation, safeguarding the modulating compressor by switching it OFF, always is compliance with the safety times. Safety mode is activated after a delay that can be set using parameter LSP (LSPb for line 2) and is deactivated as soon as the line suction superheat exceeds the threshold value (LshP) + 1K differential.

Notice: the modulating compressor that is switched off is replaced by another in rotation (see chap. 5.2.2) so as to satisfy the control request. For the modulating compressor to be restarted, there needs to be a higher capacity request than the current capacity delivered, otherwise another compressor needs to first be stopped by the controller and then, when the capacity request next increases, this will be the first to start due to the normal priority.

Emergency mode is activated when the superheat value falls below the threshold (LshA) for a time greater than the set delay (Lshd). Alarm LSH or LS2 is activated (see details in paragraph 8.3), stopping control of the line in question during this dangerous situation. Alarm reset can be configured as automatic, manual or semi-automatic, as set using parameters AtS and AtSb.

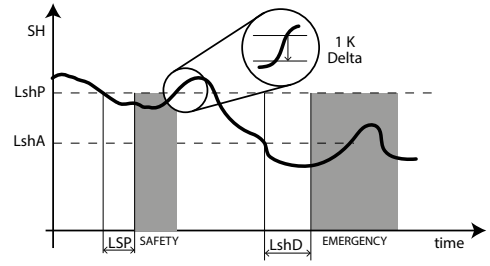


Fig. 6.q

An intermittent operating mode can be configured for the time the alarms remain active so as to ensure service continuity, pending a thorough check of the system to identify the cause of the malfunction.
This intermittent mode can be configured using parameter LshC, parameter which expresses the time in which the capacity set for DPc is requested (DPcb for line 2) in a 10-minute period, as shown in the figure.

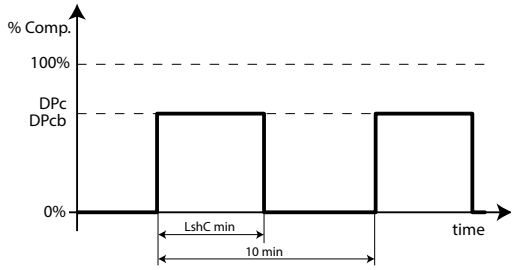


Fig. 6.r

Notice: the function is always active with a delay that can be set separately for each control line; to disable the protection, set parameters LshA and LshP to -20.0 K

6.3.8 High pressure prevention

µRack can manage the high condensing pressure prevention function, which acts by overriding the compressors and fans. When the high condensing pressure (HPv) prevent alarm is triggered, the function starts all the fans at maximum speed and stops all the compressors, except for the minimum capacity step, without waiting for the control times yet respecting the compressor protection times. Minimum capacity step refers to one compressor for compressors without unloader and without modulating devices, or the minimum capacity step for compressors with unloader (e.g. 25%), or the minimum capacity that the modulating device can deliver for inverter or Digital Scroll™ compressors and compressors with stage modulation. In addition to the activation threshold (PVt), which is always absolute, a delay can be set between deactivation of one compressor and the next (cLdP), except for the minimum capacity step set. Furthermore, the evaluation time (PVd) can also be set; this is the period of time in which five prevention activations are allowed. If there are more than five activations in the set time, the prevent alarm reset becomes manual.

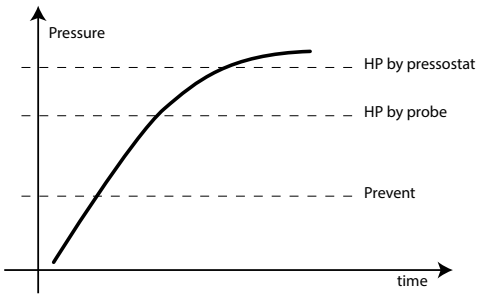


Fig. 6.s

The protection parameters are summarised in the following table:

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	cLdP	High discharge pressure prevention, OFF delay between compressors	30	0	999	s	•	•
S	LSP	Safety delay for superheat protection, line 1	5	0	60	s	•	•
S	LSPb	Safety delay for superheat protection, line 2	5	0	60	s	•	-
M	Pvd	High discharge pressure prevention, evaluation time	5	0	999	min	•	•
M	Pvt	High discharge temperature prevention, threshold	18/261 (100/1450*)	-1/-14.5	150/2175 (*)	barg/psig	•	•
M	Pvt_T	High discharge temperature prevention, threshold expressed as a temperature	55/131 (41/105)	-99.9/-147	150/302	°C/°F	•	-

Tab. 6.s

6.3.9 Oil recovery

µRack can optimise recovery of the oil that during normal operation exits the compressor crankcase. In particular, when refrigerant flow-rate control technologies are used, when the gas speed returning to the compressor is low for an extended time, this is not sufficient to carry the oil that accumulates in the system piping. The controller continuously checks the status of the active compressors to start the recovery procedure if the percentage of active capacity is lower than a threshold, set for parameter orn (ornb for line 2). The procedure is divided into four different phases:

Phase	Description
1 - Delay	Analysis by the controller: if compressor capacity remains below the threshold beyond the delay time orU (orUB), the active oil recovery phase begins. No changes to normal control during this phase
2 - Pause	The compressors on the line are switched off for the time set by parameter orP (orPb), respecting the safety times
3 - Recovery	The compressors are all started for the time set by parameter orF (orFb), at maximum capacity for capacity-control or modulating devices. Any of the safety procedures may be activated to interrupt the recovery in progress.
4 - Stabilisation	Normal control resumes, and due probable excess capacity delivered in the previous phase, the controller may stop the compressors; to avoid control errors, complete shutdown is avoided, keeping the unit at the minimum deliverable capacity for the time set by parameter orA (orAb).

Tab. 6.t

The behaviour described above can be represented as shown in the chart:

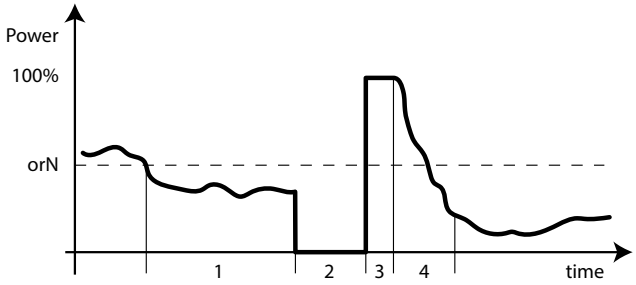


Fig. 6.t

The parameters relating to oil recovery are listed here:

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	orA	Stabilisation time for oil recovery – line 1	600	0	9999	s	•	•
S	orAb	Stabilisation time for oil recovery – line 2	600	0	9999	s	•	-
S	orF	Force ON time for oil recovery - line 1	300	0	9999	s	•	•
S	orFb	Force ON time for oil recovery - line 2	300	0	9999	s	•	-
S	orn	Minimum compressor capacity for oil recovery – line 1 (0= disabled)	40	0	100	%	•	•
S	ornb	Minimum compressor capacity for oil recovery – line 2 (0= disabled)	40	0	100	%	•	-
S	orP	Pause time for oil recovery - line 1	600	0	9999	s	•	•
S	orPb	Pause time for oil recovery - line 2	600	0	9999	s	•	-
S	orU	Delay time for oil recovery – line 1	60	0	999	min	•	•
S	orUb	Delay time for oil recovery – line 2	60	0	999	min	•	-

Tab. 6.u

6.3.10 Pump down

When there is a request to switch off the compressors, µRack manages the pump down procedure, so as to empty refrigerant gas from the evaporators.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	CPL	End pump down threshold for line 1	1/14.5	-1/-14.5	SP	barg/psig	•	•
S	CPLB	End pump down threshold for line 2	1/14.5	-1/-14.5	SPB	barg/psig	•	-
S	CPT	Maximum pump down duration, line 1 (0 = pump down disabled)	0	0	60	min	•	•
S	CPTB	Maximum pump down duration, line 2 (0 = pump down disabled)	0	0	60	min	•	-

Tab. 6.v

During pump down, the minimum capacity step of the compressors on the line remains active until the suction pressure reaches the threshold CPL (CPLB for line 2) or when the maximum duration CPT is reached (CPTB for line 2), depending on which condition occurs first. If the pump down duration is set to zero, the procedure is disabled.

6.4 Fans

µRack can manage a common condensing line with the possibility to directly control up to four fans, set using parameter nF, or a speed modulation device (inverter or phase control).

Notice: if a speed modulation device is used and there are multiple fans in parallel, the control signal is the same for all fans; if separate alarms are configured, the alarm relating to fan 1 is the only one that can stop control, the others are signal only. Even if multiple digital outputs are configured, only the first is activated if the modulation device is used.

The controller guarantees uniform wear on the components by implementing the most common types of rotation on the devices, and protects them by controlling both the starting modes and some additional functions.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	EF1	Enable fan 1 (0= disabled; 1= enabled)	1	0	1	-	•	•
S	EF2	Enable fan 2 – see EF1	1	0	1	-	•	•
S	EF3	Enable fan 3 – see EF1	1	0	1	-	•	•
S	EF4	Enable fan 4 – see EF1	1	0	1	-	•	•
S	FRo	Fan rotation type (0= FIFO, 1= LIFO)	0	0	1	-	•	•
M	IFL1	Type of fan 1 (0= ON/OFF; 1=Inverter)	0	0	1	-	•	•
M	nF	Number of condenser fans	2	0	4	-	•	•

Tab. 6.w

Once configured, each fan can be disabled using parameters EF1, EF2, EF3, EC4, useful, for example, during maintenance.

6.4.1 Fan control

µRack manages - as described in par. 6.2 – different types of proportional band or dead band control. For HFC models, control can be based directly on the values measured by the pressure sensor, or by converting to saturated temperature values, depending on the setting of parameter vrt. For CO_2 models, control can be based on the gas cooler pressure or outlet temperature, depending on the setting of parameter vrtF.

Notice:

- on HFC models, parameter vrtF is read-only and corresponds to the setting of vrt;
- on CO_2 models, control based on the temperature requires the corresponding probe to be set using parameter /Fy; in fact, in the transcritical zone, there is no longer correspondence between pressure and saturated temperature.

For details on the type of control, see par. 5.1; the features relating to the fans only are described below.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	DFc	Capacity request during condenser emergency operation	70	0	100	%	•	•
S	FRC	Force off threshold for dead band fan control	0/0	-1/-14.5	150/2175 (*)	barg/psig	•	•
S	FRC_T	Force off threshold for dead band fan control, expressed as a temperature	-45/-49	-99.9/-147	150/211	°C/°F	•	•
S	FRM	Maximum time in which the requested capacity reaches 100% with dead band fan control	60	FRn	999	s	•	•
S	FRn	Minimum time in which the requested capacity reaches 100% with dead band fan control	20	0	FRM	s	•	•
S	FRP	Minimum time in which the requested capacity reaches 0% with dead band fan control	10	0	FRQ	s	•	•
S	FRQ	Maximum time in which the requested capacity reaches 0% with dead band fan control	60	FRP	999	s	•	•
S	Frt	Fan control type (0= P+I; 1= dead band)	1	0	1	-	•	•
S	FTI	Integral time for P+I condenser fan control	600	0	999	s	•	•
S	RDF	Condenser fan control differential	3/43.5	0	20/290	Δbarg/ Δpsig	•	•
S	RDF_T	Condenser fan control differential, expressed as a temperature	15/27	0	99.9/179	Δ°C/Δ°F	•	•
S	RDFD	Decrease differential for condenser fan dead band control	0.5/7.2	0.5/7.2	20/290	Δbarg/ Δpsig	•	•
S	RDFD_T	Decrease differential for condenser fan dead band control, expressed as a temperature	0.5/0.9	-99.9/179	99.9/179	Δ°C/Δ°F	•	•
S	RDFi	Increase differential for condenser fan dead band control	0.5/7.2	0.5/7.2	20/290	Δbarg / Δpsig	•	•
S	RDFi_T	Increase differential for condenser fan dead band control, expressed as a temperature	0.5/0.9	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
U	STF	Condenser fan control set point	15.5/224 (40/580)	STFL	STFH	barg/psig	•	•
M	STFH	Condenser fan control set point maximum limit	25/362	STFL	/US	barg/psig	•	•
M	STFH_T	Condenser fan control set point maximum limit, expressed as a temperature	55.5/77	STFL_T	150/211	°C/°F	•	•
M	STFL	Condenser fan control set point minimum limit	1/14.5 (0/0)	/LS	STFH	barg/psig	•	•
M	STFL_T	Condenser fan control set point minimum limit, expressed as a temperature	-45/-49	-99.9/-147	STFH_T	°C/°F	•	•
U	STFT	Condenser fan control set point, expressed as a temperature	15.5/59.9	STFL_T	STFH_T	°C/°F	•	•
S	vrtF	Fan control based on gas cooler pressure or temperature (0= pressure; 1= temperature)	0	0	1		Read-only	•

Tab. 6.x

Fan operation linked to the compressors

Operation of the fans can be linked to the operation of the compressors by setting a parameter F31, in which case the fans are activated only if at least one compressor is ON

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	F31	Fans ON with compressors ON 0= fans ON also with compressor OFF 1= fans ON when at least one compressor is ON	0	0	1	-	•	•

Tab. 6.y

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 is illustrated in the following examples.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	FHC	Condenser fan inverter maximum speed	100	FLC	100	%	•	•
M	FLC	Condenser fan inverter minimum speed	20	0	FHC	%	•	•
S	FLo	Minimum condenser fan inverter output	40	0	100	%	•	•

Tab. 6.z

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

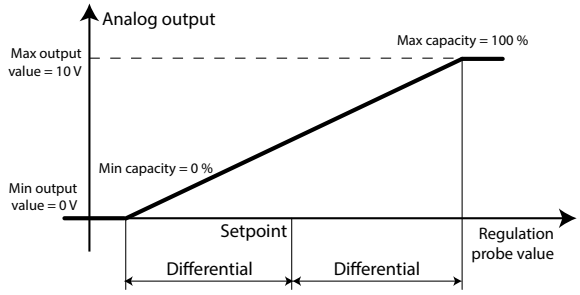


Fig. 6.u

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

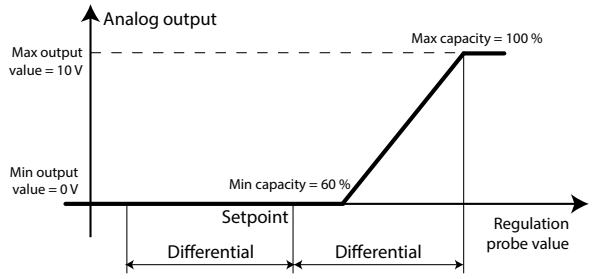


Fig. 6.v

Example 3: minimum modulating output value 20% (2 V), maximum value 100% (10 V), minimum modulating device capacity 60 %, maximum value 100 %.

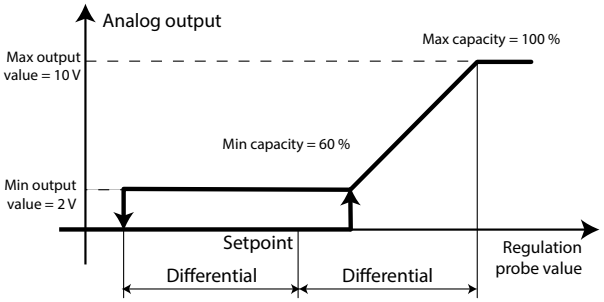


Fig. 6.w

The minimum and maximum values of the output are linked to the analogue output configured for the output signal, each channel has a minimum parameter Ao1n, Ao2n, Ao3n, Ao4n and a maximum parameter Ao1M, Ao2M, Ao3M, Ao4M that can be set as necessary.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	Ao1M	Maximum output value for Y1	10	Ao1n	10	-	•	•
S	Ao1n	Minimum output value for Y1	0	0	Ao1M	-	•	•
S	Ao2M	Maximum output value for Y2	10	Ao2n	10	-	•	•
S	Ao2n	Minimum output value for Y2	0	0	Ao2M	-	•	•
S	Ao3M	Maximum output value for Y3	10	Ao3n	10	-	-	•
S	Ao3n	Minimum output value for Y3	0	0	Ao3M	-	-	•
S	Ao4M	Maximum output value for Y4	10	Ao4n	10	-	-	•
S	Ao4n	Minimum output value for Y4	0	0	Ao4M	-	-	•

Tab. 6.aa

The 0-10 V signal can be delayed by setting the corresponding parameters iFU and lGd, so as to avoid abrupt changes in capacity due to system transients. µRack allows the increase or decrease control signal times to be set separately. The delay time refers to a sudden variation in control request from a starting state of 0% (0 V) to 100% (10 V); in this case, the output signal will gradually increase and reach the value of 100% (10 V) only after the time set using parameter iFU; the same applies to a decrease and the corresponding parameter lFd.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	IFd	Condenser fan inverter deceleration time from 100% to 0% speed	10	0	360	s	•	•
M	iFU	Condenser fan inverter acceleration time from 0% to 100% speed	2	0	360	s	•	•

Tab. 6.ab

6.4.2 Rotation

µRack manages fan rotation in the same way as described for the compressors, and therefore, parameter Fro can be set to enable LIFO, FIFO and timed rotation. Furthermore, a modulating device can be managed, set using parameter IFL1. The substantial difference compared to the compressors involves the possibility of managing different sizes and obviously capacity control, which are not available for the fans. Furthermore, µRack can specifically manage fans driven by inverter. In fact, there can be only one modulating fan, or several fans can be controlled in parallel (all at the same speed) without rotation. Finally, two delay can also be set for the fans, between ON and OFF in rotation, using parameters FLD and FLU.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	Fro	Fan rotation type (0= FIFO, 1= LIFO)	0	0	1	-	•	•
M	IFL1	Type of fan 1 (0= ON/OFF; 1= Inverter)	0	0	1	-	•	•
S	FLD	Switch OFF delay between fans with rotation OFF request	2	0	999	s	•	•
S	FLU	Switch ON delay between fans with rotation ON request	2	0	999	s	•	•

Tab. 6.ac

6.4.3 Fan speed up

µRack can manage the speed up function, used to overcome the initial inertia of the fans. If speed up is enabled (parameter FSU), a start time can be set in which the fan speed is forced to 100%. If the outside temperature probe is used, moreover, a threshold FSE can be set (with a fixed 5°C reset differential) below which speed up is disabled, so as to not drastically lower the condensing pressure at start-up.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	FSE	Minimum outside temperature threshold for disabling modulating fan speed up	0/32	-50/-58	50/122	°C/°F	•	•
S	FSt	Speed up time when starting the fan	5	0	60	s	•	•
S	FSU	Enable modulating fan speed up: 0= disabled; 1= enabled	0	0	1	-	•	•

Tab. 6.ad

6.5 Energy saving

µRack can activate energy saving functions by modifying the suction and condensing stage set points. Two different offsets can be applied to both the suction and condensing stage set points, which can be activated by:

- Digital input
- Time band

These two offsets can be used, for example, for the closing period and for winter. When the digital input set via parameter DiSC is activated, the values set for parameters SPE, SPEb and Cto are added to the two suction line and condensing stage set points. Similarly, inside the daily time band set using parameters SSh, SSn and SEh, SEn, the offsets SPo, SPob and CtE are added to the set points. The two effects are independent and can superimpose each other, as shown in the figure.

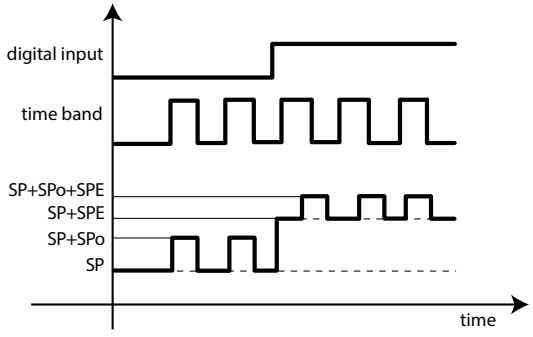


Fig. 6.x

In addition to set point compensation via digital input and time bands, two further energy saving functions can be used: floating suction and condensing set points.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	CtE	Fan control set point offset for compensation by time band	0	-9.9/-143	9.9/143	Δbar/Δpsig	•	•
S	CtE_T	Fan control set point offset for compensation by time band, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	Cto	Fan control set point offset for compensation by digital input	0	-9.9/-143	9.9/143	Δbar/Δpsig	•	•
S	Cto_T	Fan control set point offset for compensation by digital input, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	SPE	Control set point offset for time bands, line 1	0	-9.9/-143	9.9/143	Δbarg/ Δpsig	•	•
S	SPE_T	Control set point offset for time bands, line 1, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	SPEb	Control set point offset for time bands, line 2	0	-9.9/-143	9.9/143	Δbarg/ Δpsig	•	-
S	SPEb_T	Control set point offset for time bands, line 2, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	-
S	SPo	Control set point offset for compensation by digital input, line 1	0	-9.9/-143	9.9/143	Δbar/Δpsig	•	•
S	SPo_T	Control set point offset for compensation by digital input, line 1, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	SPob	Control set point offset for compensation by digital input, line 2	0	-9.9/-143	9.9/143	Δbar/Δpsig	•	-
S	SPob_T	Control set point offset for compensation by digital input, line 2	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	-
U	SEh	End time band, hours	7	0	23	h	•	•
U	SEM	End time band, minutes	30	0	59	min	•	•
U	SSh	Start time band, hours	17	0	23	h	•	•
U	SSM	Start time band, minutes	30	0	59	min	•	•

Tab. 6.ae

6.5.1 Floating suction set point

For the suction line, the floating set point function uses a specific algorithm managed by a CAREL supervisor (boss family). If the floating suction set point is enabled using parameter FLE (FLEb for line 2), the suction set point set by the user is adjusted by the supervisor, between a minimum and a maximum that can be set using parameters FLL (FLLb) and FLH (FLHb). Operation is illustrated in the following figure:

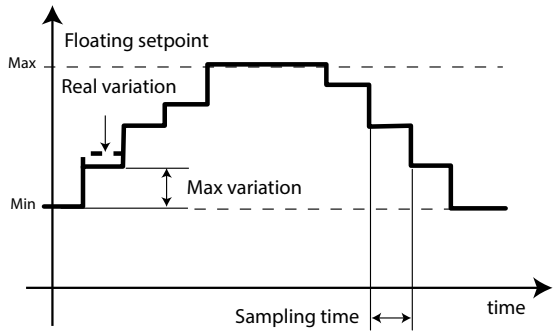


Fig. 6.y

The set point is calculated by the supervisor and acquired by the µRack controller at time intervals set by parameter FLt (FLtb). The maximum allowed variation for the set point in each sampling period can be set, and if the acquired value differs from the previous one by more than the maximum variation allowed, the variation is limited to the maximum. In the event where the supervisor is disconnected, after 10 minutes (fixed) the µRack controller begins to decrease the set point at intervals that can be set using parameter FLr (FLrb), with variations equal to the maximum variation allowed for each sampling period, until reaching the minimum set point allowed for the floating suction function.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	FLE	Enable floating suction set point, line 1 (0 = disabled; 1 = enabled)	0	0	1	-	•	•
S	FLEb	Enable floating suction set point, line 2 (0 = disabled; 1 = enabled)	0	0	1	-	•	-
S	FLL	Minimum floating suction set point, line 1	0	SPL	FLH	barg/psig	•	•
S	FLH	Maximum floating suction set point, line 1	0	FLL	SPH	barg/psig	•	•
S	FLH_T	Maximum floating suction set point, line 1, expressed as a temperature	0/32	FLL_T	SPH_T	°C/°F	•	•
S	FLHb	Maximum floating suction set point, line 2	0	FLLb	SPHB	barg/psig	•	-
S	FLHb_T	Maximum floating suction set point, line 2, expressed as a temperature	0/32	FLLb_T	SPHB_T	°C/°F	•	-
S	FLL	Minimum floating suction set point, line 1	0	SPL	FLH	barg/psig	•	•
S	FLL_T	Minimum floating suction set point, line 1, expressed as a temperature	0/32	SPL_T	FLH_T	°C/°F	•	•
S	FLLb	Minimum floating suction set point, line 2	0	SPLB	FLHb	barg/psig	•	-
S	FLLb_T	Minimum floating suction set point, line 2, expressed as a temperature	0/32	SPLB_T	FLHb_T	°C/°F	•	-
S	FLM	Floating suction set point maximum variation, line 1	0.1/1.5	0	9.9/143	Δbarg/Δpsig	•	•
S	FLM_T	Floating suction set point maximum variation, line 1, expressed as a temperature	1/1.8	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	FLMb	Floating suction set point maximum variation, line 2	0.1/1.5	0	9.9/143	Δbarg/Δpsig	•	-
S	FLMb_T	Floating suction set point maximum variation, line 2, expressed as a temperature	1/1.8	-99.9/-179	99.9/179	Δ°C/Δ°F	•	-
S	FLr	Floating suction set point reduction time, line 1	0	0	999	min	•	•
S	FLrb	Floating suction set point reduction time, line 2	0	0	999	min	•	-
S	FLt	Floating suction set point sampling time, line 1	0	0	999	min	•	•
S	FLtb	Floating suction set point sampling time, line 2	0	0	999	min	•	-

Tab. 6.af

Notice: if the floating suction set point is active, any set point compensation by scheduler or activation of a digital input is ignored.

6.5.2 Floating condensing pressure set point

For the condensing line, the floating set point function is based on the outside temperature read by the probe connected to the µRack controller. If the floating condensing pressure set point is enabled via parameter FLcE, the set point is obtained by adding a settable constant value FLcd to the outside temperature, and limiting the value obtained between the minimum set point STFL_T and the actual set pojnt STFT, as illustrated in the figure:

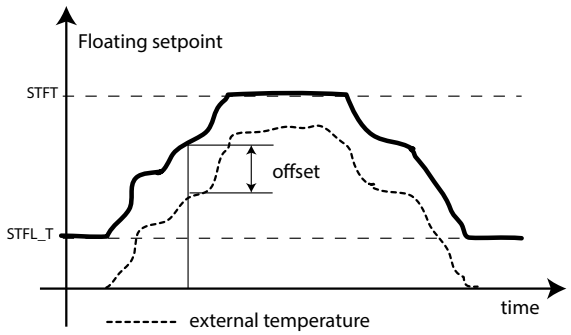


Fig. 6.z

Notice: for control by pressure, the set point is converted and limited between STFL and STF.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	FLcd	Temperature offset for floating condensing set point	10/18	-40/-72	150/270	Δ°C/Δ°F	•	•
S	FLcE	Enable floating condensing set point (0= disabled; 1= enabled)	0	0	1	-	•	•
U	STF	Condenser fan control set point	15.5/224 (40/580)	STFL	STFH	barg/psig	•	•
M	STFH_T	Condenser fan control set point maximum limit, expressed as a temperature	55.5/77	STFL_T	150/211	°C/°F	•	•
M	STFL_T	Condenser fan control set point minimum limit, expressed as a temperature	-45/-49	-99.9/-147	STFH_T	°C/°F	•	•
M	STFH	Condenser fan control set point maximum limit	25/362	STFL	/US	barg/psig	•	•
M	STFL	Condenser fan control set point minimum limit	1/14.5 (0/0)	/LS	STFH	barg/psig	•	•
U	STFT	Condenser fan control set point, expressed as a temperature	15.5/59.9	STFL_T	STFH_T	°C/°F	•	•
S	vrt	Pressure or temperature control (0= pressure; 1= temperature)	0	0	1	-	•	•
S	vrtF	Fan control based on gas cooler pressure or temperature (0= pressure; 1= temperature)	0	0	1		Read only	•

Tab. 6.ag

Notice: in the event where set point compensation from scheduler, digital input or supervisor is also active, the new set point is first calculated by adding the relative offsets and the value obtained is the maximum possible value of the floating condennsing pressure set point.

6.6 Manual device management

Operation of the individual actuators fitted on the unit can be switched from automatic to manual. For digital outputs, the options are ON or OFF, while analogue outputs can be set from 0 to 100%; the default values are all Auto.
After a time that can be set using parameter MT, device management returns to automatic mode.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	Mc1	Manual mode, compressor 1 line 1 ON/OFF compressor (0= automatic; 1= OFF; 2= ON) Compressor with 0-50-100% steps (0= automatic; 1= OFF; 2= 50%; 3= 100%). Compressor with 0-33-66-100% steps (0= automatic; 1= OFF; 2= 33%; 3= 66%; 4= 100%) Compressor with inverter or Digital Scroll™ (0= automatic; 1= OFF; 2= 2%, ..., 100= 100%)	0	0	100	-	•	•
S	Mc1b	Manual mode, compressor 1 line 2 – see Mc1	0	0	100	-	•	-
S	Mc2	Manual mode, compressor 2 line 1 (0= automatic, 1= OFF, 2= ON)	0	0	2	-	•	•
S	Mc2b	Manual mode, compressor 2 line 2 – see Mc2	0	0	2	-	•	-
S	Mc3	Manual mode, compressor 3 line 1 – see Mc2	0	0	2	-	•	•
S	Mc4	Manual mode, compressor 4 line 1 – see Mc2	0	0	2	-	•	•
S	MEF	Manual mode, fan 1: ON/OFF fan 0= automatic; 1= OFF; 2= ON) Fan with inverter (0= automatic; 1= OFF; 2= 2%, ..., 100= 100%)	0	0	100	-	•	•
S	MEF2	Manual mode, fan 2 (0= automatic; 1= OFF; 2= ON)	0	0	2	-	•	•
S	MEF3	Manual mode, fan 3 (0= automatic; 1= OFF; 2= ON)	0	0	2	-	•	•
S	MEF4	Manual mode, fan 4 (0= automatic; 1= OFF; 2= ON)	0	0	2	-	•	•
S	MT	Maximum manual mode/test time (0 = no timeout)	60	0	999	min	•	•
S	PMU	HPV valve manual mode (0= automatic; 1= OFF; 2= 2%, ..., 100= 100%)	0	0	100	-	•	-
S	PMUB	FGV valve manual mode (0= automatic; 1= OFF; 2= 2%, ..., 100= 100%)	0	0	100	-	•	-

Tab. 6.ah

These operations bypass temperature control, but not the alarm thresholds set to protect unit safety; in general, these operations are used to test the individual actuators during installation. Parameters Mc1, Mc1b and MEF parameters that override the status of modulating devices or devices with modulation steps have a precise meaning that is based on the unit configuration:

Devices	Modulation	Parameter value description
Compressors	ON/OFF	0= AUTO, 1= OFF, 2= ON
	Unloaders	0= AUTO, 1= OFF, 2= STEP 1, 3= STEP 2, 4= STEP 3
	0-10 V inverter or Digital Scroll™	0= AUTO, 1= OFF, 2...100 -> 2% ...100%
Condenser fans	ON/OFF	0= AUTO, 1= OFF, 2= ON
	0-10 V inverter	0= AUTO, 1= OFF, 2...100 -> 2% ...100%

Tab. 6.ai

Manual operation of the devices is described below:

Devices	Notes
Compressors	Safety times taken into account All compressor alarms are enabled
Condenser fans	Speed-up disabled

Tab. 6.aj

Manual mode of any device is notified on the display by the flashing red spanner icon and the text 'MAn'.

6.7 Test outputs

The digital and analogue outputs on µRack can be activated in test mode. After a time that can be set using parameter MT, the outputs are controlled automatically again, based on the specific associated function.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	MA1	Analogue output 1 value in test mode	0	0	100	%	•	•
S	MA2	Analogue output 2 value in test mode	0	0	100	%	•	•
S	MA3	Analogue output 3 value in test mode	0	0	100	%	-	•
S	MA4	Analogue output 4 value in test mode	0	0	100	%	-	•
S	MD1	Digital output 1 value in test mode	0	0	1	-	•	•
S	MD2	Digital output 2 value in test mode	0	0	1	-	•	•
S	MD3	Digital output 3 value in test mode	0	0	1	-	•	•
S	MD4	Digital output 4 value in test mode	0	0	1	-	•	•
S	MD5	Digital output 5 value in test mode	0	0	1	-	•	•
S	MD6	Digital output 6 value in test mode	0	0	1	-	•	-
S	ML1	Digital output 1 logic in test mode (0= NO; 1= NC)	0	0	1	-	•	•
S	ML2	Digital output 2 logic in test mode (0= NO; 1= NC)	0	0	1	-	•	•
S	ML3	Digital output 3 logic in test mode (0= NO; 1= NC)	0	0	1	-	•	•
S	ML4	Digital output 4 logic in test mode (0= NO; 1= NC)	0	0	1	-	•	•
S	ML5	Digital output 5 logic in test mode (0= NO; 1= NC)	0	0	1	-	•	•
S	ML6	Digital output 6 logic in test mode (0= NO; 1= NC)	0	0	1	-	•	-
S	MT	Maximum manual mode/test time (0 = no timeout)	60	0	999	min	•	•

Tab. 6.ak

Caution: this operating mode not only bypasses control, but also all the safety features, and must be used only for checking the outputs in test mode, carried out by qualified and adequately trained personnel.

Output test mode is indicated on the display by the flashing red spanner icon and the text 'MAn'.

6.8 Settings

6.8.1 Clock

µRack is equipped with an internal clock that keeps the time and date for all of the corresponding functions (see chap. 8 for details on the hardware).
The current date and time can be set, and the day of the week can be displayed corresponding to the date set via APPLICA or supervisor. The transition to summer/winter time is managed based on the time zone set using the commissioning tool (see chap. 3 for details on commissioning).
If the clock card is not working, an alarm is generated and the associated functions are no longer available; the alarms and log stored in the controller's memory will refer to the default date 1/1/1970.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
U	d__	Date/time setting from supervisor, day	1	1	31	-	•	•
U	h__	Date/time setting from supervisor, hours	0	0	23	h	•	•
U	M__	Date/time setting from supervisor, month	1	1	12	-	•	•
U	m__	Date/time setting from supervisor, minutes	0	0	59	min	•	•
U	y__	Date/time setting from supervisor, year	20	20	99	-	•	•

6.9 Default value management

The default values shown in this manual for each parameter and that can be modified by the user are permanently stored in the controller. The default values can be restored using a dedicated procedure on the seven-segment display or by loading the "Default" configuration on APPLICA Desktop or smartphone.

Procedure with seven segment display

1. Power off the controller
2. Press PRG on the display
3. Power on the controller while still holding PRG
4. Release PRG when the message "rSC" is shown on the display

Procedure with APPLICA (smartphone or PC)

1. Open the APPLICA app on smartphone or PC
2. Connect to the device via NFC or Bluetooth (smartphone) or using the CVSTDUMOR0 converter (PC)
3. Enter the credentials provided
4. Select the "parameter list" item from the menu and select parameter rSC
5. Apply the value TRUE

Alternatively, select the "Configurations" item from the menu, select the "Default" item and apply the configuration values to the connected controller.

6.10 Generic functions

µRack can exploit unused inputs and outputs to configure one or more generic functions. Each generic function can be enabled/disabled from the APPLICA app or SPARK configuration software.

The following can be activated:
- 1 generic function with On/Off output;
- 1 generic function with modulating output;
- 1 generic alarm function (set as warning or serious alarm).

The generic function can be controlled based on:
- 1 specific probe, or
- difference between 2 suitably configured probes, or
- minimum, maximum or average between 2 suitably configured probes.

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

6.10.1 Enabling

The generic functions can be enabled as always active or during a certain unit operating status, as set by parameters GFS_, GFM_E, GFA_E.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	GFA_E	Generic alarm function, enable 0= always; 1= unit On; 2= unit Off; 3= control On; 4= compressor On; 5= external alarm from digital input; 6= unit Off due to alarm; 7= high pressure alarm; 8= low pressure alarm, line 1; 9= low pressure alarm, line 2 (excluding CO_2 model); 10= high pressure prevention active; 11= general alarm active; 12= generic warning active; 13= all compressors OFF	0	0	13	-	•	•
S	GFM_E	Generic modulating function, enable - see GFA_E	0	0	13	-	•	•
S	GFS_E	Generic stepped function, enable - see GFA_E	0	0	13	-	•	•

Tab. 6.al

Notice: "Compressor ON" enabling applies to both lines at the same time.

Assign control probe

µRack allows up to 2 control probes to be selected for each generic function, from those available, using parameters GFS_1, GFS_2, GFM_1, GFM_2, GFA_1, GFA_2. Furthermore, for generic functions with on/off or modulating output, the control variable can also be the difference between the two of the configured probes, the maximum or minimum value or the average between the two, as set using parameters GFS_F and GFM_F.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	GFA_1	Generic alarm function, control probe 1 0= not configured; 1= suction pressure, line 1 (SSP); 2= suction pressure, line 2 (SSPB); 3= condensing pressure (SCP); 4= ambient temperature (SA); 5= outside temperature (SE); 6= discharge temperature, line 1 (SDT) 7= discharge temperature, line 2 (SDTb); 8= suction temperature, line 1 (TGS); 9= suction temperature, line 2 (TGSB); 10= generic temperature (SG) 11=gas cooler temperature (CO_2 model only); 12=receiver pressure (CO_2 model only)	0	0	10 (12)	-	•	•
S	GFA_2	Generic alarm function, control probe 2 - see GFA_1	0	0	10 (12)	-	•	•
S	GFM_1	Generic modulating function: control probe 1 - see GFA_1	0	0	10 (12)	-	•	•
S	GFM_2	Generic modulating function: control probe 2 - see GFA_1	0	0	10 (12)	-	•	•
S	GFM_F	Generic modulating function, control variable: 0= GFM_1 – GFM_2; 1= minimum between GFM_1 and GFM_2; 2= maximum between GFM_1 and GFM_2; 3= average between GFM_1 and GFM_2.	0	0	3	-	•	•
S	GFS_1	Generic stepped function, control probe 1- see GFA_1	0	0	10 (12)	-	•	•
S	GFS_2	Generic stepped function, control probe 2- see GFA_1	0	0	10 (12)	-	•	•
S	GFS_F	Generic stepperd function, control variable – see GFM_F	0	0	3	-	•	•

Tab. 6.am

Notice: the generic probe set using parameter /FG can be configured as a temperature probe, setting parameters /P1 and /P4 appropriately.

6.10.2 On/Off output

The operating principle of the generic On/Off function is shown in the figure. A set point GFS_S and a differential GFS_D can be set for the activation of the digital output configured using parameter DoS. The activation logic can be direct or reverse, as configured using parameter GFS_T.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	DOS	Assign generic step function digital output - see DoA1	0	0	6 (5)	-	•	•
S	GFS_D	Generic stepped function, differential	0	0	99.9	-	•	•
S	GFS_F	Generic stepperd function, control variable – see GFM_F	0	0	3	-	•	•
S	GFS_S	Generic stepped function, set point	0	-50	200	-	•	•
S	GFS_T	Generic stepped function, control type – see GFM_T	0	0	1	-	•	•

Tab. 6.an

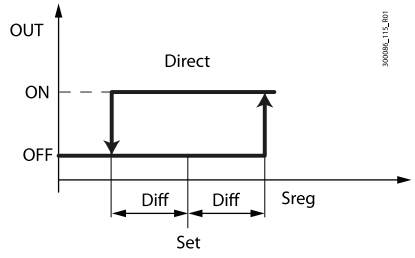


Fig. 6.aa

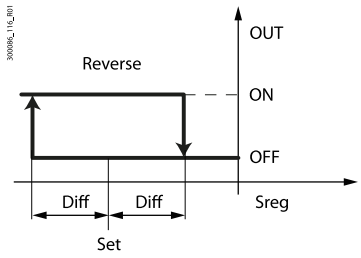


Fig. 6.ab

Ref.	Description
Set	Set point
Diff	Differential
Sreg	GFS_1 - GFS_2 or maximum, minimum or average between GFS_1 and GFS_2
OUT	Digital output

Tab. 6.ao

6.10.3 Modulating output

The operation of the modulating function is shown in the figure. A set point GFM_S and a differential GFM_D can be set for the activation of the modulating output configured using parameter /Ad. The activation logic can be direct or reverse, as configured using parameter GFS_T (direct operation only is shown in the figure). Control can be proportional only or PID, setting parameters GFM_Kp, GFM_Td and GFM_Ti accordingly. A cut-off differential GFM_CD can also be set, with a hysteresis GFM_H, and the output can be limited between a minimum GFM_Min and a maximum GFM_Max.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	/AD	Assign analogue output for generic modulating function - see /AbP	0	0	2 (4)	-	•	•
S	GFM_CD	Generic modulating function: cut-off differential	0	0	20	-	•	•
S	GFM_D	Generic modulating function, differential	0	0	99.9	-	•	•
S	GFM_F	Generic modulating function: control function 0= GFM_1-GFM_2 1= Minimum value between GFM_1 and GFM_2 2= Maximum value between GFM_1 and GFM_2 3= Average value between GFM_1 and GFM_2	0	0	3	-	•	•
S	GFM_H	Generic modulating function, hysteresis	0	0	20	-	•	•
S	GFM_Kp	Generic modulating function, proportional gain	0	0	100	-	•	•
S	GFM_Max	Generic modulating function, maximum output value	0	0	100	-	•	•
S	GFM_Min	Generic modulating function, minimum output value	0	0	100	-	•	•
S	GFM_S	Generic modulating function, set point	0	-50	200	-	•	•
S	GFM_T	Generic modulating function, control type (0 = direct, 1 = reverse)	0	0	1	-	•	•
S	GFM_Td	Generic modulating function, derivative time	0	0	100	-	•	•
S	GFM_Ti	Generic modulating function, integral time	0	0	900	-	•	•

Tab. 6.ap

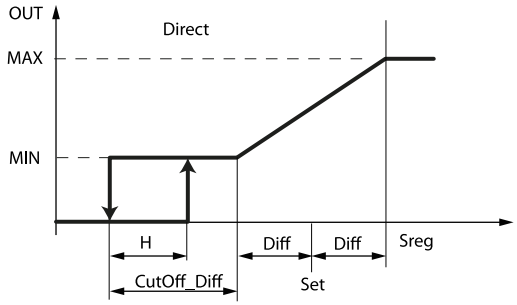


Fig. 6.ac

Ref.	Description
Set	Set point
Diff	Differential
H	Hysteresis
Sreg	GFM_1 - GFM_2 or maximum, minimum or average between GFM_1 and GFM_2
OUT	Digital output
CutOff_Diff	Cut-off differential

Tab. 6.aq

6.10.4 Generic alarm

The generic alarm can be activated for two reasons, after the delay (GFA_De):

1. switching of the digital input, assigned by parameter DIs: the display shows "GHI"
2. if the difference between the values of the control probes GFA_1 - GFA_2 exceeds the high or low threshold GFA_Hth or GFA_Lth: the display shows GHI or GLO respectively.

Notice:

- check that the alarm is generated by only one of the two causes;
- the generic alarm can be configured as a warning or a serious alarm by setting parameter GFA_AlType.

The generic alarm function reset can be configured as: automatic (default), semi-automatic or manual, as set by parameter GFA_r. For semi-automatic reset, it is possible to set the number of occurrences GFA_n of the alarm and corresponding time interval GFA_P before requiring manual reset directly on the display, via supervisor or APPLICA. When a generic alarm occurs, the µRack controller can stop control, reduce capacity or force the fans to maximum speed, based on the setting of parameter GFA_AA. The figure shows the behaviour of this alarm.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	DIs	Assign external alarm digital input (0 = function disabled; 1 = ID1, 2 = ID2; …; 5 = ID5; 6 = ID6, MEDIUM and ADVANCED versions only)	0	0	6 (5)	-	•	•
S	GFA_AA	Generic alarm function, action taken: 0= no action; 1= stop control; 2= reduce capacity, 3=fans at max speed	0	0	3	-	•	•
S	GFA_AlType	Generic alarm function, alarm type (0= signal only; 1= serious alarm)	0	0	1	-	•	•
S	GFA_D	Generic alarm function, differential	0	0	99.9	-	•	•
S	GFA_De	Generic alarm function, delay	0	0	30,000	s	•	•
S	GFA_Hth	General alarm function, high threshold	0	-50	200	-	•	•
S	GFA_Lth	General alarm function, low threshold	0	-50	200	-	•	•
S	GFA_n	Generic alarm function, number of attempts before switching from semi-automatic to manual	0	0	99	-	•	•
S	GFA_P	Generic alarm function, evaluation period for switching from semi-automatic to manual	0	0	999	min	•	•
S	GFA_r	Generic alarm function, reset type: 0= automatic; 1= semi-automatic; 2= manual	0	0	2	-	•	•

Tab. 6.ar

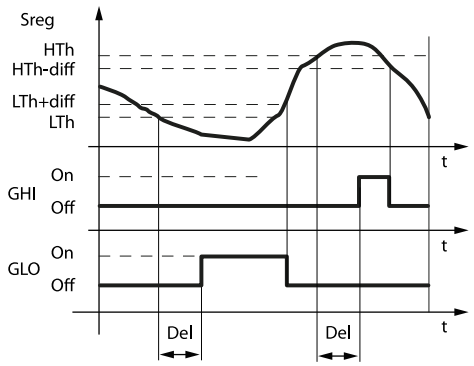


Fig. 6.ad

Ref.	Description
Lth	Low temperature threshold
HTh	High temperature threshold
diff	Differential
Del	Delay
t	Time
Sreg	GFA_1 - GFA_2
GHI	Display alarm on exceeding the high threshold
GLO	Display alarm on exceeding the low threshold

Tab. 6.as

Example

Display of the generic alarm when exceeding the thresholds.

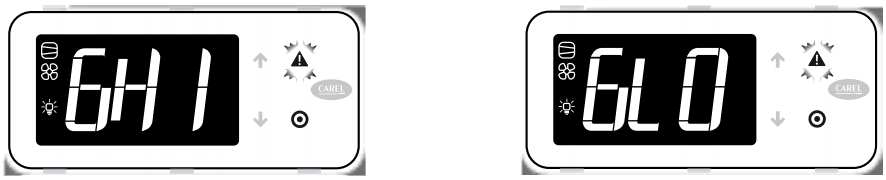


Fig. 6.ae

Generic warning function (prevent)

Before the generic alarm function is activated, a warning signal with automatic reset can also be enabled. Parameters GFA_1 and GFA_2 define the activation conditions for both functions. The meaning of the other parameters is exactly the same as the corresponding parameters for the generic alarm function.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	GFA_WA	Generic alarm function, action taken on warning 0= no action 1= stop control 2= reduce capacity 3= fans at max speed	0	0	3	-	•	•
S	GFA_WD	Generic alarm function, warning differential	0	0	99.9	-	•	•
S	GFA_WDe	Generic alarm function, warning delay	0	0	30000	s	•	•
S	GFA_We	Generic alarm function, enable warning: 0= disabled; 1= enabled	0	0	1	-	•	•
S	GFA_WHth	General alarm function, high warning threshold	0	-50	200	-	•	•
S	GFA_WLth	General alarm function, low warning threshold	0	-50	200	-	•	•

Tab. 6.at

6.11 HPV management

The µRack CO_2 model optimises the performance of CO_2 units by managing a high pressure valve (HPV). Management of the HPV, which separates the high pressure and medium pressure sections of the system, determines whether the system operates in transcritical or subcritical mode. In transcritical mode, the valve is controlled with the aim of achieving the highest efficiency, while in subcritical mode, the valve controls subcooling. The HPV features PID control, with the set point being the optimal gas cooler pressure value calculated based on the gas cooler temperature, as described below. The control request is converted into valve steps and sent to an external EVD evolution driver used as a valve positioner.

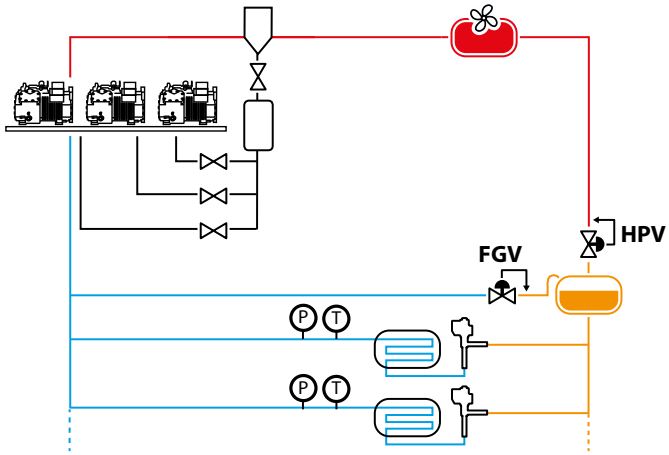


Fig. 6.af

Ref.	Description
HPV	High pressure valve
FGV	Flash gas valve

Tab. 6.au

User	Code	Description	Def.	Min.	Max.	UOM	HFCs	CO2
S	/CS	Condensing pressure probe calibration (gas cooler)	0.0	-99.9/-1448 (*)	99.9/1448 (*)	Δbarg/Δpsig	•	•
S	/Cy	Gas cooler temperature probe calibration	0.0	-99.9/-179	99.9/179	Δ°C/Δ°F	-	•
S	/FS	Assign condensing pressure probe channel (gas cooler) – see /F3	5	0	7 (14)	-	•	•
S	/Fy	Assign gas cooler temperature probe channel – see /F3	0	0	14	-	-	•
S	/LS	Condensing pressure probe lower limit (gas cooler)	-1/-14.5 (0/0)	-1/-14.5	/US	barg/psig	•	•
S	/US	Condensing pressure probe upper limit (gas cooler)	34.5/500 (60/870)	/LS	150/2175 (*)	barg/psig	•	•
M	cdq	Maximum pressure	115/1667 (*)	cdq	150/2175 (*)	barg/psig	-	•
M	cdi	Limit temperature between zone 2 and 3	20.0/68	6.0/42.8	cdj	°C/°F	-	•
M	cdj	Limit temperature between zone 1 and 2	31.0/87.8	cdi	50/122	°C/°F	-	•
M	cdo	Subcooling delta in subcritical mode	3.0	0	10	K	-	•
M	cdz	Minimum pressure	34.0/493	0	99.9/1449 (*)	barg/psig	-	•
M	Ehp	Enable HPV (0 = disabled; 1 = enabled)	1	0	1	-	-	•

Tab. 6.av

The set point is calculated as illustrated in the figure, where the three operating zones are also shown:

1. Transcritical;
2. Intermediate;
3. Subcritical.

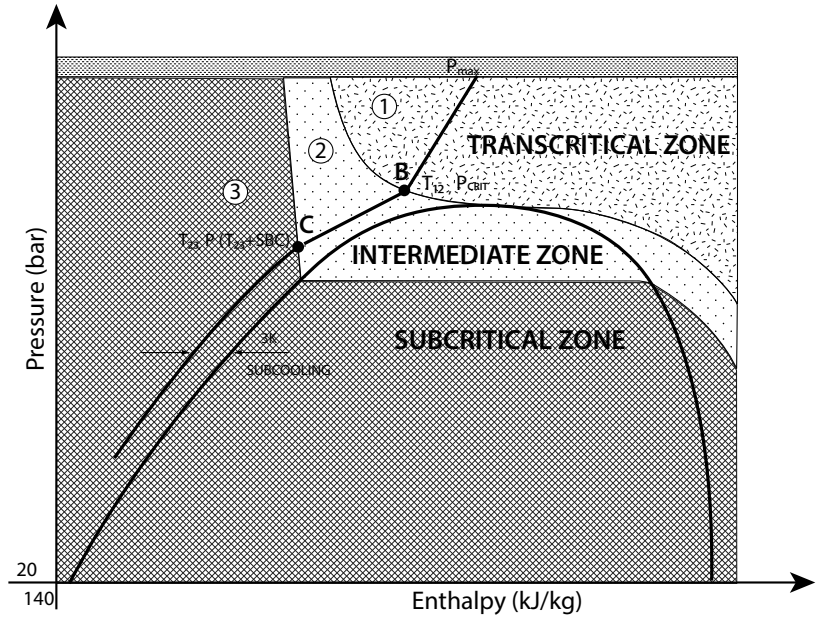


Fig. 6.ag

Ref.	Description
T_{12}	Transcritical zone limit temperature
P_{CRIT}	Critical pressure
T_{23}	Subcritical zone limit temperature
$P(T_{23}+SBC)$	Subcritical zone limit pressure
P_{max}	Maximum pressure

Tab. 6.aw

To define the zones, the two temperature values T_{12} and T_{23} need to be set, corresponding to points B and C in the figure (parameters cdj and cdi). Hereinafter, SCt and SCP are used to indicate the gas cooler temperature and pressure. Behaviour of the HPV in the various zones is shown below:

- **Transcritical zone**, where SCt ≥ cdj and SCP ≤ cgd: the valve works with PID control in order to achieve the highest COP, which is done by bringing the gas cooler pressure to the optimal cdE value, calculated based on the gas cooler outlet temperature and the evaporation temperature (if available).
- **Subcritical zone**, where SCt ≤ cdi: the valve works with PI control in order to keep subcooling constant.
- **Transition zone**, where cdi ≤ SCt ≤ cdj: the valve works with PID control, using a pressure set point identified as the intersection of points B and C in the figure, obtained by calculating the optimal pressures at the limit of the transcritical and subcritical zones. This zone has the purpose of avoiding discontinuities in the transition between the two zones.

When the pressure exceeds the higher threshold set by parameter cdg, the optimal set point cdE is decreased by SCP-cdg, in order to quickly open the valve, while the minimum set point Stn is applied when reaching the lower threshold.

Once the optimal set point has been calculated for the various zones, this is limited between the minimum and maximum pressure values (parameters cdg and cdz) and used for PID control, with proportional gain cdP, integral time cdn and derivative time cdy.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	cdn	HPV PID parameters, integral time Ti	60	0	999	s	-	•
S	cdP	HPV PID parameters, proportional gain Kp	5	0	500	%/°C	-	•
S	cdy	HPV PID parameters, derivative time Td	0	0	999	s	-	•

Tab. 6.ax

Notice: if the gas cooler outlet temperature probe is faulty, but the outside temperature probe is available and working, the latter value can be used, with an offset rhv added to calculate the optimal set point.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	rhv	Offset to be applied to the outside temperature in the event of a faulty gas cooler temperature probe	0	0	99.9/179	Δ°C /Δ°F	-	•

Tab. 6.ay

The HPV opening request can also be used to drive an analogue output as feedback on operation, or to drive the valve via a 0-10 V signal.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	/AL	Assign analogue output for HPV feedback	0	0	4	-	-	•

Tab. 6.az

6.11.1 HPV accessory functions

HPV management includes a number of accessory functions.

Prepositioning: when the unit is switched ON, the HPV remains in a fixed position set by parameter PSb for a time set by parameter cP2, so as to be able to quickly increase the receiver pressure. This procedure is reactivated every time the unit is switched OFF or the HPV returns to the minimum position when all the compressors shut down (optional).

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	cP1	Cooling capacity ratio	50	0	100	%	-	•
S	cP2	HPV prepositioning duration	6	0	999	s	-	•
M	PSb	HPV position in standby	0	0	100	%	-	•

Tab. 6.ba

The number of valve steps for prepositioning is calculated according to the following formula:

Steps = (maximum steps-minimum steps) * Psb/100 * cP1/100 + minimum steps

The calculation is shown below for cP1=100%:

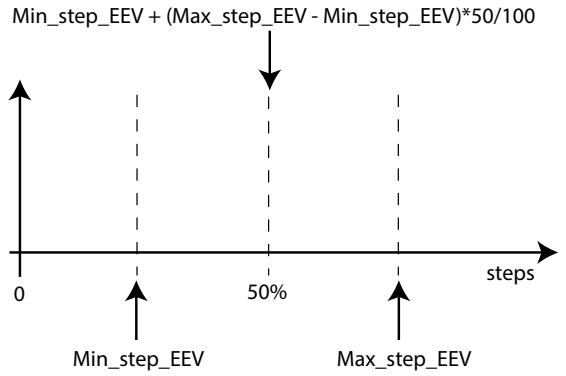


Fig. 6.ah

Valve closing with compressors off: if all the compressors are off due to no request, parameter cvE can be used to position the HPV at the minimum opening in OFF status, set by parameter PSb. When at least one compressor is switched back on, the valve resumes control, with the prepositioning procedure described in the previous point. When the compressors are switched off, there is a delay of cvt before the valve closes.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	cvE	Enable HPV closing with compressors OFF	1	0	1	-	-	•
M	cvt	HPV closing delay with compressors OFF	10	0	999	s	-	•

Tab. 6.bb

Minimum and maximum opening values: the minimum opening value PSb in OFF status (from keypad, digital input or supervisor) can be differentiated from the minimum value PSo in ON status, while the maximum opening value MPS is the same in both cases. The minimum opening value in OFF status coincides with the value in standby.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	MPS	Maximum HPV opening value	100	0	100	%	-	•
M	PSo	Minimum HPV opening value in ON status	0	0	100	%	-	•

Tab. 6.bc

Maximum percentage variation: the valve movement cannot exceed the maximum percentage variation per second set for StMB.

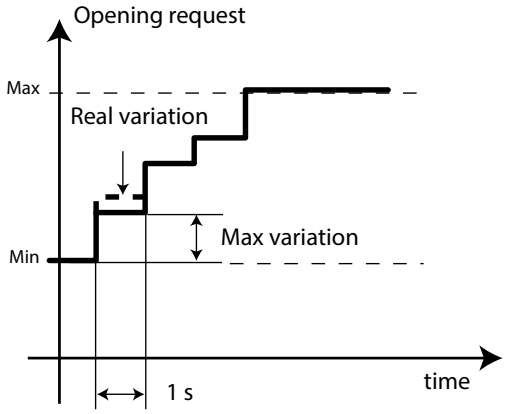


Fig. 6.ai

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	StM	Maximum HPV % variation per second	10	0	100	%/s	-	•

Tab. 6.bd

Set point filter: the HPV control set point can be calculated taking into account the average of the last SnC samples (maximum 99), so as to avoid sudden variations due to the high variability of the gas cooler outlet temperature. Samples are taken each program cycle.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	SnC	Number of samples for HPV set point filter (1=filter disabled)	1	1	99	-	-	•

Tab. 6.be

Minimum set point: a minimum HPV set point Stn can be set; the set point can never fall below this value, regardless of the parameters entered, so as to protect compressor operation.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	Stn	Minimum HPV set point	34.0 /493	cdz	cdg	barg/psig	-	•

Tab. 6.bf

Distance from set point alarm: if the gas cooler pressure remains above the calculated set point plus the threshold Pb1 for at least the time Pb2, an alarm signal (vPA) can be sent. If Pb1 = 0, the alarm is disabled.

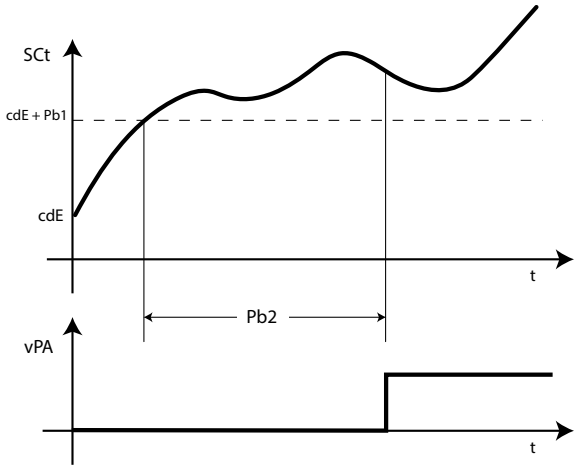


Fig. 6.aj

Notice: the alarm is activated only when the gas cooler pressure probe is configured and functioning and the line is active.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	Pb1	Distance from HPV set point alarm threshold	1	0	9.9/143	Δ barg/Δ psig	-	•
S	Pb2	Distance from HPV set point alarm delay	10	0	255	min	-	•

Tab. 6.bg

6.11.2 Receiver pressure control using the HPV

If receiver pressure control using the HPV is enabled via parameter Ew, the pressure in the receiver SFP is compared against the lower and upper limits Ltw and Utw; if the limits are exceeded, an attempt is made to bring the pressure back within the limits, adjusting the opening of the valve by adding or subtracting an offset to/from the control set point. If the receiver pressure falls below the minimum operating pressure threshold Ltw, an offset proportional to the distance from the minimum threshold Ltw is subtracted from the calculated set point; in this way the HPV is opened further to increase the receiver pressure. The offset is directly proportional to the distance from the minimum operating threshold and is at the maximum value cdb when the pressure reaches the lower limit /Lw, as illustrated in the figure.

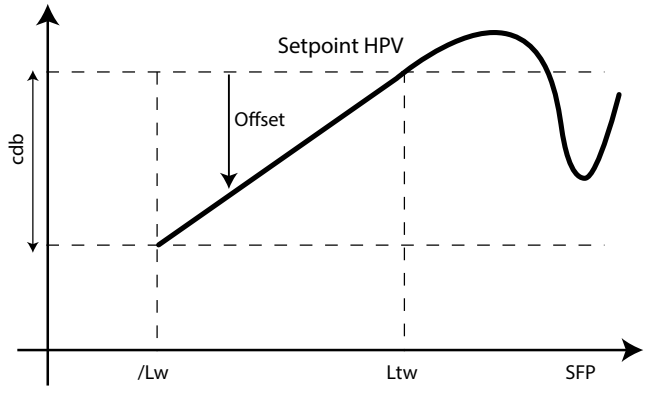


Fig. 6.ak

Vice versa, if the receiver pressure rises above the maximum operating pressure threshold Utw, an offset proportional to the distance from the maximum threshold Utw is added to the calculated set point; in this way the HPV is closed further to decrease the receiver pressure. The offset is directly proportional to the distance from the maximum operating threshold and is at the maximum value cdc when the pressure reaches the upper limit /Utw, as illustrated in the figure.

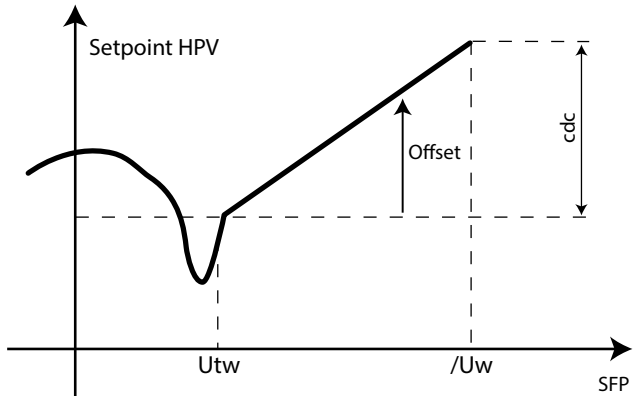


Fig. 6.al

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	/Cw	Gas receiver pressure probe calibration	0.0	-99.9/-1448 (*)	99.9/1448 (*)	Δbarg/Δpsig	-	•
S	/Fw	Assign receiver pressure probe channel – see /F3	0	0	14	-	-	•
S	/Lw	Minimum receiver pressure	0/0	-1.0/-14.5	/Uw	barg/psig	-	•
S	/Uw	Maximum receiver pressure	60/870	/Lw	150/2175 (*)	barg/psig	-	•
S	cdb	Maximum offset to subtract from the HPV set point	10.0/145	-99.9/-1449 (*)	99.9/1449 (*)	Δ barg/Δ psig	-	•
S	cdc	Maximum offset to add to the HPV set point	10.0/145	-99.9/-1449 (*)	99.9/1449 (*)	Δ barg/Δ psig	-	•
S	Ew	Enable safety procedure with HPV (0=disabled, 1=enabled)	0	0	1	-	-	•
S	Ltw	Receiver low pressure threshold	32.0/464	-1.0/-14.5	150/2175	barg/psig	-	•
S	Utw	Receiver high pressure threshold	40.0/580	-1.0/-14.5	150/2175	barg/psig	-	•

Tab. 6.bh

6.12 FGV management

The µRack CO_2 model can manage a flash gas valve (FGV), if enabled by parameter Efg. This valve is used to keep the pressure inside the CO_2 tank at the set point SPg. Control is by PID, and the proportional gain, integral time and derivative time can be set using parameters fgP, fgi and fgd. The control request is converted into valve steps and sent to an external EVD evolution driver used as a valve positioner.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	/Lw	Minimum receiver pressure	0/0	-1.0/-14.5	/Uw	barg/psig	-	•
S	/Uw	Maximum receiver pressure	60/870	/Lw	150/2175 (*)	barg/psig	-	•
M	Efg	Enable FGV (0= disabled; 1= enabled)	1	0	1	-	-	•
S	fgd	FGV PID parameters, derivative time Td	0	0	999	s	-	•
S	fgi	FGV PID parameters, integral time Ti	60	0	999	s	-	•
S	fgP	FGV PID parameters, proportional gain Kp	20	0	100	%/°C	-	•
S	Ltw	Receiver low pressure threshold	32.0/464	-1.0/-14.5	150/2175	barg/psig	-	•
S	SPg	FGV set point	35.0/507	-1.0/-14.5	150/2175	barg/psig	-	•
S	Utw	Receiver high pressure threshold	40.0/580	-1.0/-14.5	150/2175	barg/psig	-	•

Tab. 6.bi

The FGV opening request can also be used to drive an analogue output as feedback on operation, or to drive the valve via a 0-10 V signal.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	/AM	Assign analogue output for FGV feedback	0	0	4	-	-	•

Tab. 6.bj

6.12.3 FGV accessory functions

FGV management includes a number of accessory functions.

Prepositioning: when the unit is switched ON, the FGV remains in a fixed position set by parameter cooB for a time set by parameter covB, so as to be able to quickly increase the receiver pressure. This procedure is reactivated every time the unit is switched OFF or the FGV returns to the minimum position when all the compressors shut down (optional).

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	cooB	FGV opening during prepositioning	50	0	100	%	-	•
S	covB	FGV prepositioning duration	6	0	999	s	-	•

Tab. 6.bk

Valve closing with compressors off: if all the compressors are off, parameter cvEB can be used to position the FGV at the minimum opening in OFF status, set by parameter PSbB. When at least one compressor is switched back on, the valve resumes control, with the prepositioning procedure described in the previous point. When the compressors are switched off, there is a delay of cvtB before the valve closes.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	cvEB	Enable FGV closing with compressors OFF	1	0	1	-	-	•
M	cvtB	FGV closing delay with compressors OFF	10	0	999	s	-	•
M	PSbB	FGV position in standby	0	0	100	%	-	•

Tab. 6.bl

Minimum and maximum opening values: the minimum opening value PSbB in OFF status (from keypad, digital input or supervisor) can be differentiated from the minimum value PSoB in ON status, while the maximum opening value MPSB is the same in both cases. The minimum opening value in OFF status coincides with the value in standby.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	MPSB	Maximum FGV opening value	100	0	100	%	-	•
M	PSoB	Minimum FGV opening value in ON status	0	0	100	%	-	•

Tab. 6.bm

Maximum percentage variation: the valve movement cannot exceed the maximum percentage variation per second set for StMB. For details, see the similar HPV accessory function.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	StMB	Maximum HPV % variation per second	10	0	100	%/s	-	•

Tab. 6.bn

Maximum receiver pressure: A maximum receiver pressure value HPGs can be set, above which an alarm (HPG) alarm is generated; the unit may shut down if set by parameter HPGE. The alarm delay can be set using parameter HPGt; reset is automatic when pressure value SFP falls below HPGs-HPGd.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	HPGs	Receiver maximum pressure alarm threshold	45.0/652	-1.0/-14.5	150/2175 (*)	barg/psig	-	•
S	HPGd	Receiver maximum pressure alarm differential	5./72.5	0.0	9.9/143	Δbarg/Δpsig	-	•
S	HPGt	Receiver maximum pressure alarm delay	30	0	9999 (*)	s	-	•
S	HPGE	Unit shutdown with maximum receiver pressure alarm (0=disabled; 1=enabled, the unit shuts down)	1	0	1	-	-	•

Tab. 6.bo

Distance from set point alarm: if the tank pressure remains above the calculated set point plus the threshold Pb1B for at least the time Pb2B, an alarm signal (vPB) can be sent. If Pb1B = 0, the alarm is disabled.

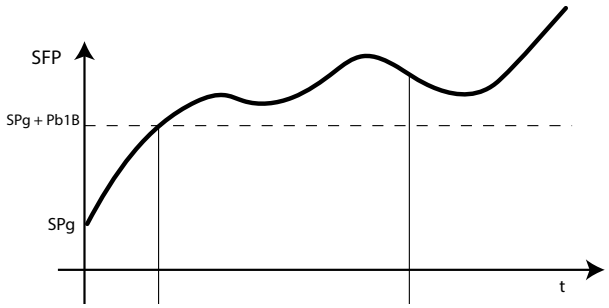


Fig. 6.am

Notice: the alarm is activated only when the tank pressure probe is configured and functioning and the line is active.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	Pb1B	Distance from FGV set point alarm threshold	1	0	9.9/143	Δ barg/Δ psig	-	•
S	Pb2B	Distance from FGV set point alarm delay	10	0	255	min	-	•

Tab. 6.bp

6.13 Gas cooler bypass for low temperature

The µRack CO_2 model can activate a gas cooler bypass valve in the event of low temperatures, making it possible to reach the required operating temperature more quickly in cold climates by excluding the gas cooler from the refrigerant circuit.

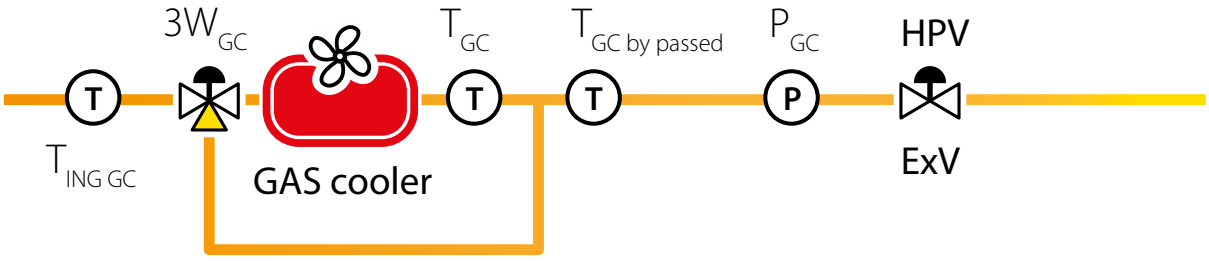


Fig. 6.an

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
S	/AbP	Assign analogue output for gas cooler low temperature bypass: 0= function disabled; 1= analogue output 1 (Y1); 2= analogue output 2 (Y2). 3= analogue output 3 (Y3, CO_2 model only); 4= analogue output 4 (Y4, CO_2 model only).	0	0	4	-	-	•
S	/Cy	Gas cooler temperature probe calibration	0.0	-99.9/-179	99.9/179	Δ°C/Δ°F	-	•
S	/Fy	Assign gas cooler temperature probe channel – see /F3	0	0	14	-	-	•
DobP	DobP	Assign analogue output for gas cooler low temperature bypass - See DoA1	0	0	5	-	-	•
S	GBE	Enable gas cooler bypass for low temperature	0	0	1	-	-	•
S	GBM	Gas cooler bypass for low temperature 100% activation threshold	20/68	-99.9/-147	99.9/179	°C/°F	-	•
S	GBn	Gas cooler bypass for low temperature 0% activation threshold	25/77	-99.9/-147	99.9/179	°C/°F	-	•

Tab. 6.bq

If the function is enabled by setting parameter GBE and the gas cooler temperature probe is functioning correctly, the µRack controller compares the gas cooler temperature against the two thresholds GBn and GBM, and activates an analogue or digital valve via the outputs configured using parameters /AbP and DObP, as shown in the figure:

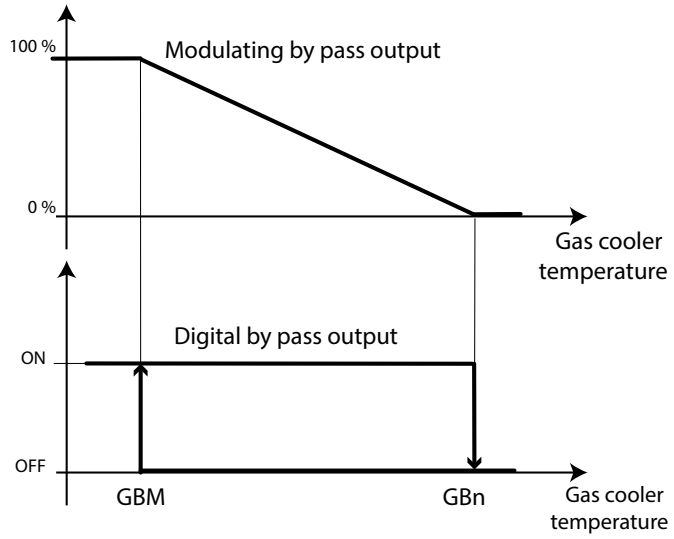


Fig. 6.ao

7. PARAMETER TABLE

Notice:

- Access levels: U = User; S = Service; M = Manufacturer; The user level allows access without a password from the app and with the default password 00 from the user terminal; for the other levels the default passwords are 44 and 77 respectively, from both the app and the terminal. If a parameter is visible for one level, it is also visible to the higher levels.
- Display: the dash indicates that the parameter cannot be accessed from the user terminal but rather only via the app or commissioning tool, otherwise the code represents the menu branch (see "Programming menu" for details).
- R/W = read/write parameters; R = read-only parameters.
- The parameter code shown in the apps and in the commissioning tools; on the 7-segment display, some letters may be displayed in upper/lower case, for example "B" -> "b", "T"-> "t", etc.
- Visibility: some parameters are visible on the 7-segment display based on the value of other parameters.
- Values marked with a (*) may not be displayed correctly on the 7-segment display, as the display limits are -999/999.
- For parameters that have different values for the HFC and CO_2 models, the values shown in brackets refer to the CO_2 model.

7.1 Unit

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
U	Unl	/5	-	Unit of measure (0= °C/barg; 1= °F/psig)	0	0	1	-	•	•
S	Unl	c0	-	Delay when restarting after blackout	0	0	999	-	•	•
U	Unl	H8	-	Enable buzzer (0= disabled; 1= enabled)	1	0	1	-	•	•
M		MT		Maximum manual mode/test time (0 = no timeout)	60	0	999	min	•	•
U	Unl	on	ONK= 1	Line 1 ON/OFF from keypad (0= OFF; 1= ON)	0	0	1	-	•	•
U	Unl	onb	ONK= 1, nC2 > 0	Line 2 ON/OFF from keypad - see on	0	0	1	-	•	-
S	Unl	ONK	-	Enable ON/OFF from keypad (0= disabled; 1= enabled)	1	0	1	-	•	•
S	StG -> BMS	ons	-	Enable ON/OFF from supervisor (0= disabled; 1= enabled)	0	0	1	-	•	•
M	Unl	PH	-	Type of refrigerant used in the unit 0: Custom / 10: R717 / 20: R427A / 30: R170 / 40: R454B 1: R22 / 11: R744 / 21: R245Fa / 31: R442A / 41: R458A 2: R134a / 12: R728 / 22: R407F / 32: R447A / 42: R407H 3: R404A / 13: R1270 / 23: R32 / 33: R448A / 43: R454A 4: R407C / 14: R417A / 24: HTR01 / 34: R449A / 44: R454C 5: R410A / 15: R422D / 25: HTR02 / 35: R450A / 45: R470A 6: R507A / 16: R413A / 26: R23 / 36: R452A / 46: R515B 7: R290 / 17: R422A / 27: HFO1234yf / 37: R508B / 47: R466 8: R600 / 18: R423A / 28: HFO1234ze / 38: R452B 9: R600a / 19: R407A / 29: R455A / 39: R513A	3 (11)	0	47	-	•	•
M	StG -> PSd	PDM	-	Manufacturer password	77	000	999	-	•	•
S	StG -> PSd	PDS	-	Service password	44	000	999	-	•	•
U	StG -> PSd	PDU	-	User password	00	000	999	-	•	•
M	-	rSC	-	Reset to CAREL default values	0	0	1	-	•	•
S	-	vrt	-	Control by pressure or temperature (0= pressure; 1= temperature)	0	0	1		•	•
S	-	vrtF	-	Fan control based on gas cooler pressure or temperature (0= pressure; 1= temperature)	0	0	1		Read only	•
M	-	WD	-	Wizard procedure (0 = completed; 1 = not completed)	1	0	1	-	•	•

Tab. 7.a

7.2 Compressors

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
Configuration										
M	CL1 -> CFG	C1	nC > 0	Minimum time between two consecutive starts of each compressor on line 1	360	0	999	s	•	•
M	CL2 -> CFG	C1B	nC2 > 0	Minimum time between two consecutive starts of each compressor on line 2	360	0	999	s	•	-
M	CL1 -> CFG	C2	nC > 0	Minimum OFF time for each compressor on line 1	120	0	999	s	•	•
M	CL2 -> CFG	C2B	nC2 > 0	Minimum OFF time for each compressor on line 2	120	0	999	s	•	-
M	CL1 -> CFG	C3	nC > 0	Minimum ON time for each compressor on line 1	10	0	999	s	•	•
M	CL2 -> CFG	C3B	nC2 > 0	Minimum ON time for each compressor on line 2	10	0	999	s	•	-
M	CL1 -> CFG	C1T	nC > 0	First compressor type, line 1 0= ON-OFF / 2= Digital Scroll™ / 4= 3 steps 33/66/100 1= inverter / 3= 2 steps 50/100	0	0	4		•	•
M	CL2 -> CFG	C1TB	nC > 0	First compressor type, line 2 (see C1T)	0	0	4		•	-
M	CL1 -> CFG	CLD	nC > 0	Delay between OFF requests for steps/compressors on line 1	10	0	999	s	•	•
M	CL2 -> CFG	CLDB	nC2 > 0	Delay between OFF requests for steps/compressors on line 2	120	0	999	s	•	-
M	CL1 -> CFG	CLU	nC > 0	Delay between ON requests for steps/compressors on line 1	30	0	999	s	•	•
M	CL2 -> CFG	CLUB	nC2 > 0	Delay between ON requests for steps/compressors on line 2	10	0	999	s	•	-
M	CL1 -> CFG	cMF	nC > 0, C1T = 1	Maximum inverter control frequency, line 1	50	CnF	150	hz	•	•
M	CL2 -> CFG	cMFB	nC2 > 0, C1TB= 1	Maximum inverter control frequency, line 2	50	CnFB	150	hz	•	-
M	CL1 -> CFG	cnF	nC > 0, C1T= 1	Minimum inverter control frequency, line 1	30	0	CMF	hz	•	•

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
M	CL2 -> CFG	cnFB	nC2 > 0, C1TB = 1	Minimum inverter control frequency, line 2	30	0	CMFB	hz	•	-
S	CL1 -> CFG	CPL	nC > 0, CPT > 0	End pump down threshold for line 1	1/14.5	-1/-14.5	SP	barg/ psig	•	•
S	CL2 -> CFG	CPLB	nC2 > 0, CPT > 0	End pump down threshold for line 2	1/14.5	-1/-14.5	SPB	barg/ psig	•	-
S	CL1 -> CFG	CPT	nC > 0	Maximum pump down duration, line 1 (0 = pump down disabled)	0	0	60	min	•	•
S	CL2 -> CFG	CPTB	nC2 > 0	Maximum pump down duration, line 2 (0 = pump down disabled)	0	0	60	min	•	-
M	CL1 -> CFG	CRF	nC > 0, C1T= 1	Rated inverter control frequency, line 1 (note: CS1 capacity refers to this frequency)	50	1	150	hz	•	•
M	CL2 -> CFG	CRFB	nC2> 0 C1TB= 1	Rated inverter control frequency, line 2 (note: CS1B capacity refers to this frequency)	50	1	150	hz	•	-
M	CL1 -> CFG	Cro	nC > 0	Compressor rotation type (0 = FIFO; 1 = LIFO; 2 = time)	0	0	2	-	•	•
M	CL1 -> CFG	CS1	nC > 0	Capacity of the first compressor, line 1	10	0	999	kW	•	•
M	CL2 -> CFG	CS1B	nC2 > 0	Capacity of the first compressor, line 2	10	0	999	kW	•	-
M	CL1 -> CFG	CS2	nC > 0	Capacity of the second compressor, line 1	10	0	999	kW	•	•
M	CL2 -> CFG	CS2B	nC2 > 0	Capacity of the second compressor, line 2	10	0	999	kW	•	-
M	CL1 -> CFG	CS3	nC > 0	Capacity of the third compressor, line 1	10	0	999	kW	•	•
M	CL1 -> CFG	CS4	nC > 0	Capacity of the fourth compressor, line 1	10	0	999	kW	•	•
S	CL1 -> CFG	DPc	-	Capacity request during line 1 emergency operation	70	0	100	%	•	•
S	CL2 -> CFG	DPcb	-	Capacity request during line 2 emergency operation	70	0	100	%	•	-
S	CL1 -> CFG	EC1	nC > 0	Enable compressor 1 line 1 (0 = disabled; 1 = enabled)	1	0	1	-	•	•
S	CL2 -> CFG	EC1B	nC2 > 0	Enable compressor 1 line 2 – see EC1	1	0	1	-	•	-
S	CL1 -> CFG	EC2	nC > 0	Enable compressor 2 line 1 – see EC1	1	0	1	-	•	•
S	CL2 -> CFG	EC2B	nC2 > 0	Enable compressor 2 line 2 – see EC1	1	0	1	-	•	-
S	CL1 -> CFG	EC3	nC > 0	Enable compressor 3 line 1 – see EC1	1	0	1	-	•	•
S	CL1 -> CFG	EC4	nC > 0	Enable compressor 4 line 1 – see EC1	1	0	1	-	•	•
M	CL1 -> CFG	iCD	nC > 0, C1T = 1	Inverter deceleration time from 100% to 0% speed (line 1)	60	1	360	s	•	•
M	CL2 -> CFG	iCDB	nC2 > 0, C1TB= 1	Inverter deceleration time from 100% to 0% speed (line 2)	60	1	360	s	•	-
M	CL1 -> CFG	iCU	nC > 0, C1T = 1	Inverter acceleration time from 0% to 100% speed (line 1)	100	1	360	s	•	•
M	CL2 -> CFG	iCUB	nC2 > 0, C1TB= 1	Inverter acceleration time from 0% to 100% speed (line 2)	100	1	360	s	•	-
S	-	Lj1	-	Discharge temperature threshold to activate liquid injection, line 1	115/239	0/32	200/392	°C/°F	•	•
S	-	Lj2	-	Discharge temperature threshold to activate liquid injection, line 2	115/239	0/32	200/392	°C/°F	•	-
M	CL1 -> CFG	nC	-	Number of compressors, line 1	2	0	4	-	•	•
M	CL2 -> CFG	nC2	-	Number of compressors, line 2 (0= line 2 not present)	0	0	2	-	•	-
S	OtH -> OIL	orA	nC > 0	Stabilisation time for oil recovery, line 1	600	0	9999	s	•	•
S	OtH -> OIL	orAb	nC2 > 0	Stabilisation time for oil recovery, line 2	600	0	9999	s	•	-
S	OtH -> OIL	orF	nC > 0	Force ON time for oil recovery, line 1	300	0	9999	s	•	•
S	OtH -> OIL	orFb	nC2 > 0	Force ON time for oil recovery, line 2	300	0	9999	s	•	-
S	OtH -> OIL	orn	nC > 0	Minimum compressor capacity for oil recovery, line 1 (0 = disabled)	40	0	100	%	•	•
S	OtH -> OIL	ornb	nC2 > 0	Minimum compressor capacity for oil recovery, line 2 (0 = disabled)	40	0	100	%	•	-
S	OtH -> OIL	orP	nC > 0	Pause time for oil recovery, line 1	600	0	9999	s	•	•
S	OtH -> OIL	orPb	nC2 > 0	Pause time for oil recovery, line 2	600	0	9999	s	•	-
S	OtH -> OIL	orU	nC > 0	Delay time for oil recovery, line 1	60	0	999	min	•	•
S	OtH -> OIL	orUb	nC2 > 0	Delay time for oil recovery, line 2	60	0	999	min	•	-
S	-	rj1	-	Differential to activate liquid injection, line 1	5/9	0	50/90	Δ°C/Δ°F	•	•
S	-	rj2	-	Differential to activate liquid injection, line 2	5/9	0	50/90	Δ°C/Δ°F	•	-

Control

S	CL1 -> rEG	CRC	nC > 0, CRT = 1	Force off threshold for dead band control, line 1	-1/-14.5 (0/0)	-1/-14.5	60/870 (150/ 2175*)	barg/ psig	•	•
S	CL1 -> rEG	CRC_T	nC > 0, CRT = 1, vrt = 1	Force off threshold for dead band control, line 1, expressed as a temperature	-45/-49	-99.9/- 147	150/302	°C/°F	•	•
S	CL2 -> rEG	CRCB	nC2 > 0, CRT = 1	Force off threshold for dead band control, line 2	-1/-14.5	-1/-14.5	60/870	barg/ psig	•	-
S	CL2 -> rEG	CRCB_T	nC2 > 0, CRT = 1, vrt = 1	Force off threshold for dead band control, line 2, expressed as a temperature	-45/-49	-99.9/- 147	150/302	°C/°F	•	-
S	CL1 -> rEG	CRM	nC > 0, CRT = 1	Maximum time in which the requested capacity reaches 100% with dead band control, line 1	60	CRn	999	s	•	•
S	CL2 -> rEG	CRMB	nC2 > 0, CRTB = 1	Maximum time in which the requested capacity reaches 100% with dead band control, line 2	60	CRnB	999	s	•	-
S	CL1 -> rEG	CRn	nC > 0, CRT = 1	Minimum time in which the requested capacity reaches 100% with dead band control, line 1	20	0	CRM	s	•	•
S	CL2 -> rEG	CRnB	nC2 > 0, CRTB = 1	Minimum time in which the requested capacity reaches 100% with dead band control, line 2	20	0	CRMB	s	•	-
S	CL1 -> rEG	CRP	nC > 0, CRT = 1	Minimum time in which the requested capacity reaches 0% with dead band control, line 1	10	0	CRQ	s	•	•
S	CL2 -> rEG	CRPB	nC2 > 0, CRT = 1	Minimum time in which the requested capacity reaches 0% with dead band control, line 2	10	0	CRQB	s	•	-
S	CL1 -> rEG	CRQ	nC > 0, CRT = 1	Maximum time in which the requested capacity reaches 0% with dead band control, line 1	60	CRP	999	s	•	•
S	CL2 -> rEG	CRQB	nC2 > 0, CRT = 1	Maximum time in which the requested capacity reaches 0% with dead band control, line 2	60	CRPB	999	s	•	-
S	CL1 -> rEG	CRT	nC > 0	Compressor control type, line 1 (0 = P+I; 1 = dead band)	1	0	1		•	•
S	CL2 -> rEG	CRTb	nC2 > 0	Compressor control type, line 2 (0 = P+I; 1 = dead band)	1	0	1		•	-
S	CL1 -> rEG	Cti	nC > 0, CRT = 0	P+I control integral time, line 1	600	0	999	s	•	•
S	CL2 -> rEG	CTiB	nC2 > 0, CRT = 0	P+I control integral time, line 2	600	0	999	s	•	-

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
M		MnE		Enable modulation in dead band (0 = disabled; 1= enabled)	1	0	1	-	•	•
S	CL1 -> rEG	RDD	nC > 0, CRT = 1	Decrease differential for dead band control, line 1	0.5/7.2	0.5/7.2	20/290	Δbarg/ Δpsig	•	•
S	CL1 -> rEG	RDD_T	nC > 0, CRT = 1, vrt = 1	Decrease differential for dead band control, line 1, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	•
S	CL2 -> rEG	RDDB	nC2 > 0, CRT = 1	Decrease differential for dead band control, line 2	0.5/7.2	0.5/7.2	20/290	Δbarg/ Δpsig	•	-
S	CL2 -> rEG	RDDB_T	nC2 > 0, CRT = 1, vrt = 1	Decrease differential for dead band control, line 2, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	-
S	CL1 -> rEG	RDi	nC > 0, CRT = 1, vrt = 1	Increase differential for dead band control, line 1	0.5/7.2	0.5/7.2	20/290	Δbarg/ Δpsig	•	•
S	CL1 -> rEG	RDi_T	nC2 > 0, CRT = 1, vrt = 1	Increase differential for dead band control, line 1, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	•
S	CL2 -> rEG	RDiB	nC2 > 0, CRT = 1	Increase differential for dead band control, line 2	0.5/7.2	0.5/7.2	20/290	Δbarg/ Δpsig	•	-
S	CL2 -> rEG	RDiB_T	-	Increase differential for dead band control, line 2, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	-
S	CL1 -> rEG	RDP	nC > 0	Control differential, line 1	0.5/7.2	0	20/290	Δbarg/ Δpsig	•	•
S	CL1 -> rEG	RDP_T	nC > 0, vrt = 1	Control differential, line 1, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	•
S	CL2 -> rEG	RDPB	nC2 > 0	Control differential, line 2	0.5/7.2	0	20/290	Δbarg/ Δpsig	•	-
S	CL2 -> rEG	RDPB_T	nC2 > 0, vrt = 1	Control differential, line 2, expressed as a temperature	5/9	0	99.9/179	°C/°F	•	-
U	CL1 -> rEG	SP	nC > 0	Control set point, line 1	1/14.5 (26/377)	SPL	SPH	barg/ psig	•	•
U	CL2 -> rEG	SPB	nC2 > 0	Control set point, line 2	1/14.5	SPLB	SPHB	barg/ psig	•	-
U	CL2 -> rEG	SPBt	nC2 > 0, vrt = 1	Control set point, line 2, expressed as a temperature	1/33.8	SPLB_T	SPHB_T	°C/°F	•	-
S	-	SPE	-	Control set point offset for time bands, line 1	0	-9.9/-143	9.9/143	Δbarg/ Δpsig	•	•
S	-	SPE_T	-	Control set point offset for time bands, line 1, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	-	SPEb	-	Control set point offset for time bands, line 2	0	-9.9/-143	9.9/143	Δbarg/ Δpsig	•	-
S	-	SPEb_T	-	Control set point offset for time bands, line 2, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	-
M	CL1 -> rEG	SPH	nC > 0	Control set point maximum limit, line 1	9.3/134 (60/870)	SPL	/UT	barg/ psig	•	•
M	CL1 -> rEG	SPH_T	nC2 > 0, vrt = 1	Control set point maximum limit, line 1, expressed as a temperature	20/68	SPL_T	150/302	°C/°F	•	•
M	CL2 -> rEG	SPHB	nC2 > 0	Control set point maximum limit, line 2	9.3/134	SPLB	/UTB	barg/ psig	•	-
M	CL2 -> rEG	SPHB_T	nC2 > 0, vrt = 1	Control set point maximum limit, line 2, expressed as a temperature	20/68	SPLB_T	150/302	°C/°F	•	-
M	CL1 -> rEG	SPL	nC > 0	Control set point minimum limit, line 1	0.1/1.4 (0/0)	/LT	SPH	barg/ psig	•	•
M	CL1 -> rEG	SPL_T	nC2 > 0, vrt = 1	Control set point minimum limit, line 1, expressed as a temperature	-50/-58	-99.9/-147	SPH_T	°C/°F	•	•
M	CL2 -> rEG	SPLB	nC2 > 0	Control set point minimum limit, line 2	0.1/1.4	/LTB	SPHB	barg/ psig	•	-
M	CL2 -> rEG	SPLB_T	nC2 > 0, vrt = 1	Control set point minimum limit, line 2, expressed as a temperature	-50/-58	-99.9/-147	SPHB_T	°C/°F	•	-
S	CL1 -> rEG	SPo	nC > 0	Control set point offset for compensation by digital input, line 1	0	-9.9/-143	9.9/143	Δbarg/ Δpsig	•	•
S	CL1 -> rEG	SPo_T	nC > 0, vrt = 1	Control set point offset for compensation by digital input, line 1, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	CL2 -> rEG	SPob	nC2 > 0	Control set point offset for compensation by digital input, line 2	0	-9.9/-143	9.9/143	Δbarg/ Δpsig	•	-
S	CL2 -> rEG	SPob_T	nC2 > 0, vrt = 1	Control set point offset for compensation by digital input, line 2	0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	-
U	CL1 -> rEG	SPt	nC > 0, vrt = 1	Control set point, line 1, expressed as a temperature	1/33.8	SPL_T	SPH_T	°C/°F	•	•

Manual operation

S	CL1 -> CFG	Mc1	nC > 0	Manual mode, compressor 1 line 1 ON/OFF compressor: 0 = automatic operation; 1 = OFF; 2 = ON Compressor with 0-50-100% steps: 0 = automatic operation; 1 = OFF; 2 = 50%; 3 = 100% Compressor with 0-33-66-100% steps: 0 = automatic operation; 1 = OFF; 2 = 33%; 3 = 66%; 4 = 100% Compressor with inverter or Digital scroll™: 0 = automatic operation; 1 = OFF; 2 = 2%, ...; 100 = 100%	0	0	100		•	•
S	CL2 -> CFG	Mc1b	nC2 > 0	Manual mode, compressor 1 line 2 – see Mc1	0	0	100	-	•	-
S	CL1 -> CFG	Mc2	nC > 0	Manual mode, compressor 2 line 1 (0 = automatic, 1= OFF, 2= ON)	0	0	2	-	•	•
S	CL2 -> CFG	Mc2b	nC2 > 0	Manual mode, compressor 2 line 2 – see Mc2	0	0	2	-	•	-
S	CL1 -> CFG	Mc3	nC > 0	Manual mode, compressor 3 line 1 – see Mc2	0	0	2	-	•	•
S	CL1 -> CFG	Mc4	nC > 0	Manual mode, compressor 4 line 1 – see Mc2	0	0	2	-	•	•
M		MT		Maximum manual mode/test time	60	0	999	min	•	•

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
Energy saving										
S	CL1 -> ESv	FLE	-	Enable floating suction set point, line 1 (0 = disabled; 1 = enabled)	0	0	1	-	•	•
S	CL1 -> ESv	FLEb	-	Enable floating suction set point, line 2 (0 = disabled; 1 = enabled)	0	0	1	-	•	-
S	CL1 -> ESv	FLH	-	Maximum floating suction set point, line 1	0	FLL	SPH	barg/ psig	•	•
S	CL1 -> ESv	FLH_T	vrt = 1	Maximum floating suction set point, line 1, expressed as a temperature	0/32	FLL_T	SPH_T	°C/°F	•	•
S	CL2 -> ESv	FLHb	-	Maximum floating suction set point, line 2	0	FLLb	SPHB	barg/ psig	•	-
S	CL2 -> ESv	FLHb_T	-	Maximum floating suction set point, line 2, expressed as a temperature	0/32	FLLb_T	SPHB_T	°C/°F	•	-
S	CL1 -> ESv	FLL	-	Minimum floating suction set point, line 1	0	SPL	FLH	barg/ psig	•	•
S	CL1 -> ESv	FLL_T	vrt = 1	Minimum floating suction set point, line 1, expressed as a temperature	0/32	SPL_T	FLH_T	°C/°F	•	•
S	CL2 -> ESv	FLLb	-	Minimum floating suction set point, line 2	0	SPLB	FLHb	barg/ psig	•	-
S	CL2 -> ESv	FLLb_T	vrt = 1	Minimum floating suction set point, line 2, expressed as a temperature	0/32	SPLB_T	FLHb_T	°C/°F	•	-
S	CL1 -> ESv	FLM	-	Floating suction set point maximum variation, line 1	0.1/ 1.5	0	9.9/143	Δbarg/ Δpsig	•	•
S	CL1 -> ESv	FLM_T	vrt = 1	Floating suction set point maximum variation, line 1, expressed as a temperature	1/1.8	-99.9/- 179	99.9/179	Δ°C/Δ°F	•	•
S	CL2 -> ESv	FLMb	-	Floating suction set point maximum variation, line 2	0.1/ 1.5	0	9.9/143	Δbarg/ Δpsig	•	-
S	CL2 -> ESv	FLMb_T	vrt = 1	Floating suction set point maximum variation, line 2, expressed as a temperature	1/1.8	-99.9/- 179	99.9/179	Δ°C/Δ°F	•	-
S		FLr		Floating suction set point reduction time, line 1	0	0	999	min	•	•
S		FLrb		Floating suction set point reduction time, line 2	0	0	999	min	•	-
S	CL1 -> ESv	FLt	-	Floating suction set point sampling time, line 1	0	0	999	min	•	•
S	CL2 -> ESV	FLtb	-	Floating suction set point sampling time, line 2	0	0	999	min	•	-
Digital Scroll™										
M	-	dGA	-	Default valve cycle time – Digital Scroll™ line 1	12	0	65535	s	•	•
M	-	dGAB	-	Default valve cycle time – Digital Scroll™ line 2	12	0	65535	s	•	-
M	-	dGB	-	Default valve OFF time – Digital Scroll™ line 1	10	0	65535	s	•	•
M	-	dGBB	-	Default valve OFF time – Digital Scroll™ line 2	10	0	65535	s	•	-
M	-	dGC	-	Default valve ON time – Digital Scroll™ line 1	2	0	65535	s	•	•
M	-	dGCB	-	Default valve ON time – Digital Scroll™ line 2	2	0	65535	s	•	-
M	-	dGd	-	Maximum valve cycle time – Digital Scroll™ line 1	20	0	65535	s	•	•
M	-	dGdB	-	Maximum valve cycle time – Digital Scroll™ line 2	20	0	65535	s	•	-
M	-	dGE	-	Maximum valve OFF time – Digital Scroll™ line 1	20	0	65535	s	•	•
M	-	dGEB	-	Maximum valve OFF time – Digital Scroll™ line 2	20	0	65535	s	•	-
M	-	dGF	-	Maximum valve ON time – Digital Scroll™ line 1	18	0	65535	s	•	•
M	-	dGFB	-	Maximum valve ON time – Digital Scroll™ line 2	18	0	65535	s	•	-
M	-	dGG	-	Minimum valve cycle time – Digital Scroll™ line 1	12	0	65535	s	•	•
M	-	dGGB	-	Minimum valve cycle time – Digital Scroll™ line 2	12	0	65535	s	•	-
M	-	dGH	-	Minimum valve OFF time – Digital Scroll™ line 1	2	0	65535	s	•	•
M	-	dGHB	-	Minimum valve OFF time – Digital Scroll™ line 2	2	0	65535	s	•	-
M	-	dGI	-	Minimum valve ON time – Digital Scroll™ line 1	0	0	65535	s	•	•
M	-	dGIB	-	Minimum valve ON time – Digital Scroll™ line 2	0	0	65535	s	•	-
M	-	dGL	-	Starting capacity – stage 1 – Digital Scroll™ line 1	0	0	100	%	•	•
M	-	dGLB	-	Starting capacity – stage 1 – Digital Scroll™ line 2	0	0	100	%	•	-
M	-	dGM	-	Starting capacity – stage 2 – Digital Scroll™ line 1	50	0	100	%	•	•
M	-	dGMB	-	Starting capacity – stage 2 – Digital Scroll™ line 2	50	0	100	%	•	-
M	-	dGn	-	Starting capacity – stage 3 – Digital Scroll™ line 1	100	0	100	%	•	•
M	-	dGnB	-	Starting capacity – stage 3 – Digital Scroll™ line 2	100	0	100	%	•	-
M	-	dGo	-	Starting time – stage 1 – Digital Scroll™ line 1	4	0	65535	s	•	•
M	-	dGoB	-	Starting time – stage 1 – Digital Scroll™ line 2	4	0	65535	s	•	-
M	-	dGP	-	Starting time – stage 2 – Digital Scroll™ line 1	180	0	65535	s	•	•
M	-	dGPB	-	Starting time – stage 2 – Digital Scroll™ line 2	180	0	65535	s	•	-
M	-	dGQ	-	Starting time – stage 3 – Digital Scroll™ line 1	60	0	65535	s	•	•
M	-	dGQB	-	Starting time – stage 3 – Digital Scroll™ line 2	60	0	65535	s	•	-
Operating hours										
S	CL1 -> rEG	HMP	nC > 0	Maintenance alarm threshold for line 1 compressors, expressed in hundreds of hours (0 = alarm disabled)	0	0	999	hx100	•	•
S	CL2 -> rEG	HMPB	nC2 > 0	Maintenance alarm threshold for line 2 compressors, expressed in hundreds of hours (0 = alarm disabled)	0	0	999	hx100	•	-
S	CL1 -> rEG	HMR1	nC > 0	Reset operating hours, compressor 1 line 1	0	0	1	-	•	•
S	CL1 -> rEG	HMR2	nC > 0	Reset operating hours, compressor 2 line 1	0	0	1	-	•	•
S	CL1 -> rEG	HMR3	nC > 0	Reset operating hours, compressor 3 line 1	0	0	1	-	•	•
S	CL1 -> rEG	HMR4	nC > 0	Reset operating hours, compressor 4 line 1	0	0	1	-	•	•
S	CL2 -> rEG	HMRA	nC2 > 0	Reset operating hours, compressor 1 line 2	0	0	1	-	•	-
S	CL2 -> rEG	HMRB	nC2 > 0	Reset operating hours, compressor 2 line 2	0	0	1	-	•	-

Tab. 7.b

7.3 Fans

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
Configuration										
S	FAn -> CFG	DFc	-	Capacity request during condenser emergency operation	70	0	100	%	•	•
S	FAn -> CFG	EF1	nF > 0	Enable fan 1 (0= disabled; 1= enabled)	1	0	1	-	•	•
S	FAn -> CFG	EF2	nF > 0	Enable fan 2 – see EF1	1	0	1	-	•	•
S	FAn -> CFG	EF3	nF > 0	Enable fan 3 – see EF1	1	0	1	-	•	•
S	FAn -> CFG	EF4	nF > 0	Enable fan 4 – see EF1	1	0	1	-	•	•
M	FAn -> CFG	FHC	-	Condenser fan inverter maximum speed	100	FLC	100	%	•	•
M	FAn -> CFG	FLC	-	Condenser fan inverter minimum speed	20	0	FHC	%	•	•
S	FAn -> CFG	FLo	-	Minimum condenser fan inverter output	40	0	100	%	•	•
S	FAn -> CFG	FSE	nF > 0	Minimum outside temperature threshold for disabling modulating fan speed up	0/ 32	-50/-58	50/ 122	°C/°F	•	•
S	FAn -> CFG	FSt	nF > 0	Speed up time when starting the fan	5	0	60	s	•	•
S	FAn -> CFG	FSU	nF > 0	Enable modulating fan speed up (0= disabled; 1= enabled)	0	0	1	-	•	•
M	FAn -> CFG	IFL1	-	Type of fan 1 (0 = On/Off; 1 = inverter)	0	0	1	-	•	•
M	FAn -> CFG	nF	-	Number of condenser fans	2	0	4	-	•	•
Control										
S	-	CtE	-	Fan control set point offset for compensation by time band	0	-9.9/-143	9.9/143	Δbarg/ Δpsig	•	•
S	-	CtE_T	vrt = 1	Fan control set point offset for compensation by time band, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/ Δ°F	•	•
S	FAn -> rEG	Cto	-	Fan control set point offset for compensation by digital input	0	-9.9/-143	9.9/143	Δbarg/ Δpsig	•	•
S	FAn -> rEG	Cto_T	vrt = 1	Fan control set point offset for compensation by digital input, expressed as a temperature	0	-99.9/-179	99.9/179	Δ°C/ Δ°F	•	•
S	FAn -> rEG	F31	nF > 0	Fans ON with compressors ON (0 = fans ON also with compressor OFF; 1= fans ON when at least one compressor is ON)	0	0	1	-	•	•
S	FAn -> rEG	FLD	nF > 0	Switch OFF delay between fans with rotation OFF request	2	0	999	s	•	•
S	FAn -> rEG	FLU	nF > 0	Switch ON delay between fans with rotation ON request	2	0	999	s	•	•
S	FAn -> rEG	FRC	-	Force off threshold for dead band fan control	0/0	-1/-14.5	150/2175 (*)	barg/ psig	•	•
S	-	FRC_T	-	Force off threshold for dead band fan control, expressed as a temperature	-45/-49	-99.9/-147	150/211	°C/°F	•	•
S	FAn -> rEG	FRM	nF > 0	Maximum time in which the requested capacity reaches 100% with dead band fan control	60	FRn	999	s	•	•
S	FAn -> rEG	FRn	nF > 0	Minimum time in which the requested capacity reaches 100% with dead band fan control	20	0	FRM	s	•	•
S	FAn -> rEG	FRo	nF > 0	Fan rotation type (0= FIFO; 1= LIFO)	0	0	1	-	•	•
S	FAn -> rEG	FRP	nF > 0	Minimum time in which the requested capacity reaches 0% with dead band fan control	10	0	FRQ	s	•	•
S	FAn -> rEG	FRQ	nF > 0	Maximum time in which the requested capacity reaches 0% with dead band fan control	60	FRP	999	s	•	•
S	FAn -> rEG	Frt	nF > 0	Fan control type (0= P+I; 1= dead band)	1	0	1	-	•	•
S	FAn -> CFG	FTI	nF > 0	Integral time for P+I condenser fan control	600	0	999	s	•	•
M	FAn -> CFG	IFd	-	Condenser fan inverter deceleration time from 100% to 0% speed	10	1	360	s	•	•
M	FAn -> CFG	iFU	-	Condenser fan inverter acceleration time from 0% to 100% speed	2	1	360	s	•	•
S	FAn -> rEG	RDF	-	Condenser fan control differential	3/43.5	0	20/290	Δbarg/ Δpsig	•	•
S	FAn -> rEG	RDF_T	vrt = 1	Condenser fan control differential, expressed as a temperature	15/27	0	99.9/179	Δ°C/ Δ°F	•	•
S	FAn -> rEG	RDFD	-	Decrease differential for condenser fan dead band control	0.5/7.2	0.5/7.2	20/290	Δbarg/ Δpsig	•	•
S	FAn -> rEG	RDFD_T	-	Decrease differential for condenser fan dead band control, expressed as a temperature	0.5/0.9	-99.9/-179	99.9/179	Δ°C/ Δ°F	•	•
S	FAn -> rEG	RDFi	-	Increase differential for condenser fan dead band control	0.5/7.2	0.5/7.2	20/290	Δbarg/ Δpsig	•	•
S	FAn -> rEG	RDFi_T	-	Increase differential for condenser fan dead band control, expressed as a temperature	0.5/0.9	-99.9/-179	99.9/179	Δ°C/ Δ°F	•	•
U	FAn -> rEG	STF	nF > 0	Condenser fan control set point	15.5/224 (40/580)	STFL	STFH	barg/ psig	•	•
U	FAn -> rEG	STFT	vrt = 1	Condenser fan control set point, expressed as a temperature	15.5/59.9	STFL_T	STFH_T	°C/°F	•	•
M	FAn -> rEG	STFH	nF > 0	Condenser fan control set point maximum limit	25/362 (150/2175 *)	STFL	/US	barg/ psig	•	•
M	FAn -> rEG	STFH_T	vrt = 1	Condenser fan control set point maximum limit, expressed as a temperature	55.5/77	STFL_T	150/211	°C/°F	•	•
M	FAn -> rEG	STFL	nF > 0	Condenser fan control set point minimum limit	1/14.5 (0/0)	/LS	STFH	barg/ psig	•	•
M	FAn -> rEG	STFL_T	vrt = 1	Condenser fan control set point minimum limit, expressed as a temperature	-45/-49	-99.9/-147	STFH_T	°C/°F	•	•
U	FAn -> rEG	STFT	-	Condenser fan control set point, expressed as a temperature	15.5/59.9	STFL_T	STFH_T	°C/°F	•	•

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
Manual operation										
S	FAn -> CFG	MEF	nF > 0	Manual mode, fan 1 On/Off fan: 0= automatic operation; 1= Off; 2= On. Inverter fan: 0= automatic operation; 1= Off; 2= 2%, ..., 100= 100%.	0	0	100	-	•	•
S	FAn -> CFG	MEF2	nF > 0	Manual mode, fan 2 (0 = automatic operation; 1= Off; 2= On.)	0	0	2	-	•	•
S	FAn -> CFG	MEF3	nF > 0	Manual mode, fan 3 (0 = automatic operation; 1= Off; 2= On)	0	0	2	-	•	•
S	FAn -> CFG	MEF4	nF > 0	Manual mode, fan 4 (0 = automatic operation; 1= Off; 2= On)	0	0	2	-	•	•
M		MT		Maximum manual mode/test time	60	0	999	min	•	•
Energy saving										
S	FAn -> ESv	FLcd	nF > 0	Temperature offset for floating condensing set point	10/18	-40/-72	150/270	Δ°C/Δ°F	•	•
S	FAn -> ESv	FLcE	nF > 0	Enable floating condensing set point (0= disabled; 1= enabled)	0	0	1	-	•	•
S		GBE		Enable gas cooler bypass for low temperature	0	0	1	-	-	•
S		GBM		Gas cooler bypass for low temperature 100% activation threshold	20/68	-99.9/-147	99.9/179	°C/°F	-	•
S		GBn		Gas cooler bypass for low temperature 0% activation threshold	25/77	-99.9/-147	99.9/179	°C/°F	-	•
Operating hours									•	•
S	FAn -> rEG	FMP	nF > 0	Maintenance alarm threshold for condenser fans, expressed in hundreds of hours (0 = alarm disabled)	0	0	320	hx100	•	•
S	FAn -> rEG	FMr1	nF > 0	Reset operating hours, fan 1	0	0	1	-	•	•
S	FAn -> rEG	FMr2	nF > 0	Reset operating hours, fan 2	0	0	1	-	•	•
S	FAn -> rEG	FMr3	nF > 0	Reset operating hours, fan 3	0	0	1	-	•	•
S	FAn -> rEG	FMr4	nF > 0	Reset operating hours, fan 4	0	0	1	-	•	•

Tab. 7.c

7.4 Inputs/Outputs

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
Analogue inputs										
M	-	/2	-	Analogue probe measurement stability (filter) 1= probe reading not delayed; ... 15= maximum probe reading delay	9	1	15	-	•	•
S	IO -> AIn	/C3	/F3 ≠ 0	Outside temperature probe calibration	0.0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	IO -> AIn	/CD	/FD ≠ 0	Suction temperature probe calibration, line 1	0.0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	IO -> AIn	/CDB	/FDB ≠ 0	Suction temperature probe calibration, line 2	0.0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	-
S	IO -> AIn	/CG	/FG ≠ 0	Generic probe calibration	0.0	-20/-99.9	20/99.9	Δ°C/Δ°F	•	•
S	IO -> AIn	/Ci	/Fi ≠ 0	Ambient temperature probe calibration	0.0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	IO -> AIn	/Co	/Fo ≠ 0	Discharge temperature probe calibration, line 1	0.0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	•
S	IO -> AIn	/Cob	/Fob ≠ 0	Discharge temperature probe calibration, line 2	0.0	-99.9/-179	99.9/179	Δ°C/Δ°F	•	-
S	IO -> AIn	/CS	/FS ≠ 0	Condensing pressure probe calibration (gas cooler)	0.0	-99.9/-1448 (*)	99.9/1448 (*)	Δbarg/Δpsig	•	•
S	IO -> AIn	/CT	/FT ≠ 0	Suction pressure probe calibration, line 1	0.0	-99.9/-1448 (*)	99.9/1448 (*)	Δbarg/Δpsig	•	•
S	IO -> AIn	/CTB	/FTB ≠ 0	Suction pressure probe calibration, line 2	0.0	-99.9/-1448 (*)	99.9/1448 (*)	Δbarg/Δpsig	•	-
S	IO -> AIn	/Cw	/Fw ≠ 0	Gas receiver pressure probe calibration	0.0	-99.9/-1448 (*)	99.9/1448 (*)	Δbarg/Δpsig	-	•
S	IO -> AIn	/Cy	/Fy ≠ 0	Gas cooler temperature probe calibration	0.0	-99.9/-179	99.9/179	Δ°C/Δ°F	-	•
S	IO -> AIn	/F3	-	Assign outside temperature probe channel (BASIC, MEDIUM and ADVANCED models: 0= function disabled; 1= S1; 2= S2; …; 6= S6; 7= S7 (ADVANCED only). CO2 model: 0= function disabled; 1= S1; 2 = S2; …; 6= S6; 12= S2 EVD; 14 S4 EVD.)	0	0	7 (14)	-	•	•
S	IO -> AIn	/FD	-	Assign line 1 suction temperature probe channel – see /F3	3	0	7 (14)	-	•	•
S	IO -> AIn	/FDB	-	Assign line 2 suction temperature probe channel – see /F3	0	0	7	-	•	-
S	IO -> AIn	/FG	-	Assign generic probe channel – see /F3	0	0	7 (14)	-	•	•
S	IO -> AIn	/Fi	-	Assign ambient temperature probe channel – see /F3	0	0	7 (14)	-	•	•
S	IO -> AIn	/Fo	-	Assign line 1 discharge temperature probe channel – see /F3	6	0	7 (14)	-	•	•
S	IO -> AIn	/Fob	-	Assign line 2 discharge temperature probe channel – see /F3	0	0	7	-	•	-
S	IO -> AIn	/FS	-	Assign condensing pressure probe channel (gas cooler) – see /F3	5	0	7 (14)	-	•	•
S	IO -> AIn	/FT	-	Assign line 1 suction pressure probe channel – see /F3	4	0	7 (14)	-	•	•

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
S	IO -> AIn	/FTB	-	Assign line 2 suction pressure probe channel – see /F3	0	0	7	-	•	-
S	IO -> AIn	/Fw	-	Assign tank pressure probe channel – See /F3	0	0	14	-	-	•
S	IO -> AIn	/Fy	-	Assign gas cooler temperature probe channel – See /F3	0	0	14	-	-	•
S	IO -> AIn	/LS	/FS≠ 0	Condensing pressure probe lower limit (gas cooler)	-1/-14.5 (0/0)	-1/-14.5	/US	barg/psig	•	•
S	IO -> AIn	/LT	/FT≠ 0	Suction pressure probe lower limit, line 1	-1/-14.5 (0/0)	-1/-14.5	/UT	barg/psig	•	•
S	IO -> AIn	/LTB	/FTB≠ 0	Suction pressure probe lower limit, line 2	-1/-14.5	-1/-14.5	/UTB	barg/psig	•	-
S	IO -> AIn	/Lw	/Fw≠ 0	Tank pressure probe lower limit	0/0	-1/-14.5	/Uw	barg/psig	-	•
M	IO -> AIn	/P1	-	Type of probe, group 1 (S1, S2, S3) 0= PT1000 | 1= NTC	1	0	1	-	•	•
M	IO -> AIn	/P2	-	Type of probe, group 2 (S4, S5) 1= NTC | 2= 0-5 V | 3= 4-20 mA 5= NTC HT | 6= 0.5...4.5 Vrat	3	0	6	-	•	•
M	IO -> AIn	/P3	-	Type of probe, group 3 (S6) 0= PT1000 | 1= NTC | 2= 0-5 V | 3= 4-20 mA 4= 0-10 V | 5= NTC HT | 6= 0.5...4.5 Vrat	5	0	6	-	•	•
M	IO -> AIn	/P4	-	Type of probe, group 4 (S7) 1= NTC	1	1	1	-	•	-
M	-	/P8	-	Type of EVD probe (S1, S3) 3= 4-20 mA | 6= 0.5...4.5 Vrat	6	0	6	-	-	•
M	-	/P9	-	Type of EVD probe (S2, S4) 1= NTC | 5= NTC HT	1	0	6	-	-	•
S	IO -> AIn	/US	-	Condensing pressure probe upper limit (gas cooler)	34.5/500 (60/870)	/LS	150/2175 (*)	barg/psig	•	•
S	IO -> AIn	/UT	-	Suction pressure probe upper limit, line 1	9.3/134 (150/2175 *)	/LT	60/870 (150/2175 *)	barg/psig	•	•
S	IO -> AIn	/UTB	-	Suction pressure probe upper limit, line 2	9.3/134	/LTB	60/870	barg/psig	•	-
S	IO -> AIn	/Uw	-	Tank pressure probe upper limit	60/870	/Lw	150/2175 (*)	barg/psig	-	•
Digital input										
S	IO -> dIn	DiA	-	Assign immediate external alarm digital input (0 = function disabled; 1= ID1, 2= ID2; …; 5= ID5; 6 = ID6, MEDIUM and ADVANCED versions only)	0	0	6 (5)	-	•	•
S	IO -> dIn	DiA1	-	Assign compressor 1 alarm digital input, line 1 - see DiA	1	0	6 (5)	-	•	•
S	IO -> dIn	DiA2	-	Assign compressor 2 alarm digital input, line 1 - see DiA	2	0	6 (5)	-	•	•
S	IO -> dIn	DiA3	-	Assign compressor 3 alarm digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	IO -> dIn	DiA4	-	Assign compressor 4 alarm digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	IO -> dIn	DiAA	-	Assign compressor 1 alarm digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	IO -> dIn	DiAB	-	Assign compressor 2 alarm digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	IO -> dIn	DIb	-	Assign delayed external alarm digital input - see DiA	0	0	6 (5)	-	•	•
S	IO -> dIn	DiF	-	Assign remote On/Off digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	IO -> dIn	DiFB	-	Assign remote On/Off digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	IO -> dIn	DiLv	-	Assign liquid level digital input - see DiA	0	0	6 (5)	-	•	•
S	IO -> dIn	DIS	-	Assign generic alarm digital input - see DiA	0	0	6 (5)	-	•	•
S	IO -> dIn	DiSC	-	Assign set point compensation digital input - see DiA	0	0	6 (5)	-	•	•
S	IO -> dIn	DiT	-	Assign low pressure digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	IO -> dIn	DiTB	-	Assign low pressure digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	IO -> dIn	DivA	-	Assign fan 1 digital input – See DIA	3	0	6 (5)	-	•	•
S	IO -> dIn	DivB	-	Assign fan 2 digital input – See DIA	4	0	6 (5)	-	•	•
S	IO -> dIn	DivC	-	Assign fan 3 digital input – See DIA	0	0	6 (5)	-	•	•
S	IO -> dIn	DivD	-	Assign fan 4 digital input – See DIA	0	0	6 (5)	-	•	•
S	IO -> dIn	DiY	-	Assign high pressure digital input – See DIA	5	0	6 (5)	-	•	•
S	IO -> dIn	RiA	diA ≠ 0	External alarm digital input logic (0 = NO; 1 = NC)	1	0	1	-	•	•
S	IO -> dIn	RiA1	diA1 ≠ 0	Compressor 1 alarm digital input logic, line 1 - see RiA	1	0	1	-	•	•
S	IO -> dIn	RiA2	diA2 ≠ 0	Compressor 2 alarm digital input logic, line 1 - see RiA	1	0	1	-	•	•
S	IO -> dIn	RiA3	diA3 ≠ 0	Compressor 3 alarm digital input logic, line 1 - see RiA	1	0	1	-	•	•
S	IO -> dIn	RiA4	diA4 ≠ 0	Compressor 4 alarm digital input logic, line 1 - see RiA	1	0	1	-	•	•
S	IO -> dIn	RiAA	diAA ≠ 0	Compressor 1 alarm digital input logic, line 2 - see RiA	1	0	1	-	•	-
S	IO -> dIn	RiAB	diAB ≠ 0	Compressor 2 alarm digital input logic, line 2 - see RiA	1	0	1	-	•	-
S	IO -> dIn	rIb	diF ≠ 0	Delayed external alarm digital input logic – See RiA	1	0	1	-	•	•
S	IO -> dIn	RiF	diF ≠ 0	Remote On/Off digital input logic, line 1 – See RiA	1	0	1	-	•	•
S	IO -> dIn	RiFB	diFB ≠ 0	Remote On/Off digital input logic, line 2 – See RiA	1	0	1	-	•	-
S	IO -> dIn	RiLv	diLv ≠ 0	Liquid level digital input logic - see RiA	1	0	1	-	•	•
S	IO -> dIn	rIS	diF ≠ 0	Generic alarm digital input logic - see RiA	1	0	1	-	•	•
S	IO -> dIn	RiSC	diSC ≠ 0	Set point compensation digital input logic – See RiA	1	0	1	-	•	•
S	IO -> dIn	RiT	diT ≠ 0	Low pressure digital input logic, line 1 – See RiA	1	0	1	-	•	•
S	IO -> dIn	RiTB	diTB ≠ 0	Low pressure digital input logic, line 2 – See RiA	1	0	1	-	•	-
S	IO -> dIn	RivA	divA ≠ 0	Fan 1 digital input logic - see RiA	1	0	1	-	•	•
S	IO -> dIn	RivB	divB ≠ 0	Fan 2 digital input logic - see RiA	1	0	1	-	•	•

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
S	IO -> dIn	RivC	divC ≠ 0	Fan 3 digital input logic - see RiA	1	0	1	-	•	•
S	IO -> dIn	RivD	divD ≠ 0	Fan 4 digital input logic - see RiA	1	0	1	-	•	•
S	IO -> dIn	RiY	diY ≠ 0	High pressure digital input logic - see RiA	1	0	1	-	•	•
Analogue outputs										
S	IO -> AO	/AbP	-	Assign analogue output for gas cooler low temperature bypass: 0= function disabled; 1= analogue output 1 (Y1); 2= analogue output 2 (Y2). 3= analogue output 3 (Y3, CO_2 model only); 4= analogue output 4 (Y4, CO_2 model only).	0	0	4	-	-	•
S	IO -> AO	/AD	-	Assign analogue output for generic modulating function - see /AbP	0	0	2 (4)	-	•	•
S	IO -> AO	/AE	-	Assign analogue output for inverter fan - see /AbP	0	0	2 (4)	-	•	•
S	IO -> AO	/Ai	-	Assign inverter compressor 1 analogue output, line 1 – see /AbP	0	0	2 (4)	-	•	•
S	IO -> AO	/AiB	-	Assign inverter compressor 1 analogue output, line 2 – see /AbP	0	0	2	-	•	-
S	IO -> AO	/AL	-	Assign analogue output for HPV valve – see /AbP	0	0	4	-	-	•
S	IO -> AO	/AM	-	Assign analogue output for HPV valve – see /AbP	0	0	4	-	-	•
S	IO -> AO	Ao1M	-	Maximum output value for Y1	10	Ao1n	10	-	•	•
S	IO -> AO	Ao1n	-	Minimum output value for Y1	0	0	Ao1M	-	•	•
S	IO -> AO	Ao2M	-	Maximum output value for Y2	10	Ao2n	10	-	•	•
S	IO -> AO	Ao2n	-	Minimum output value for Y2	0	0	Ao2M	-	•	•
S	IO -> AO	Ao3M	-	Maximum output value for Y3	10	Ao3n	10	-	-	•
S	IO -> AO	Ao3n	-	Minimum output value for Y3	0	0	Ao3M	-	-	•
S	IO -> AO	Ao4M	-	Maximum output value for Y4	10	Ao4n	10	-	-	•
S	IO -> AO	Ao4n	-	Minimum output value for Y4	0	0	Ao4M	-	-	•
S		MA1		Value for manual activation of analogue output 1	0	0	100	-	•	•
S		MA2		Value for manual activation of analogue output 2	0	0	100	-	•	•
S		MA3		Value for manual activation of analogue output 3	0	0	100	-	-	•
S		MA4		Value for manual activation of analogue output 4	0	0	100	-	-	•
M		MT		Maximum manual mode/test time (0 = no timeout)	60	0	999	min	•	•
Digital outputs										
S	IO -> dO	DoA1	-	Assign compressor 1 line 1 digital output (0= function disabled; 1= NO1, 2= NO2; …; 5= NO6; 6= NO6, excluding CO_2 model)	1	0	6 (5)	-	•	•
S	IO -> dO	DoA2	-	Assign compressor 2 digital output, line 1 See DoA1	2	0	6 (5)	-	•	•
S	IO -> dO	DoA3	-	Assign compressor 3 digital output, line 1 See DoA1	0	0	6 (5)	-	•	•
S	IO -> dO	DoA4	-	Assign compressor 4 digital output, line 1 See DoA1	0	0	6 (5)	-	•	•
S	IO -> dO	DoAA	-	Assign compressor 1 digital output, line 2 See DoA1	0	0	6	-	•	-
S	IO -> dO	DoAB	-	Assign compressor 2 digital output, line 2 See DoA1	0	0	6	-	•	-
S	IO -> dO	DoB	-	Assign global alarm digital output - See DoA1	5	0	6 (5)	-	•	•
S	IO -> dO	DobP	-	Assign digital output for gas cooler low temperature bypass - see DoA1	0	0	5	-	-	•
S	IO -> dO	DoH	-	Assign serious alarm digital output - See DoA1	0	0	6 (5)	-	•	•
S	-	DoJ1	-	Assign liquid alarm digital output, line 1 - see DoA1	0	0	6 (5)	-	•	•
S	-	DoJ2	-	Assign liquid alarm digital output, line 2 - see DoA1	0	0	6	-	•	-
S	IO -> dO	DoL1	-	Assign compressor 1 capacity control digital output 1, line 1 - see DoA1	0	-2	6 (5)	-	•	•
S	IO -> dO	DoL2	-	Assign compressor 1 capacity control digital output 2, line 1 - see DoA1	0	0	6 (5)	-	•	•
S	IO -> dO	DoM1	-	Assign compressor 1 unloader digital output 1, line 2 - see DoA1	0	-2	6	-	•	-
S	IO -> dO	DoS	-	Assign generic step function digital output - see DoA1	0	0	6 (5)	-	•	•
S	IO -> dO	DoT	-	Assign fan 1 digital output - see DoA1	3	0	6	-	•	•
S	IO -> dO	DoT2	-	Assign fan 2 digital output - see DoA1	4	0	6	-	•	•
S	IO -> dO	DoT3	-	Assign fan 3 digital output - see DoA1	0	0	6	-	•	•
S	IO -> dO	DoT4	-	Assign fan 4 digital output - see DoA1	0	0	6	-	•	•
S	IO -> dO	RoA1	DoA1≠ 0	Compressor 1 digital output logic, line 1 (0 = NO; 1= NC)	0	0	1	-	•	•
S	IO -> dO	RoA2	DoA2≠ 0	Compressor 2 digital output logic, line 1 - see RoA1	0	0	1	-	•	•
S	IO -> dO	RoA3	DoA3≠ 0	Compressor 3 digital output logic, line 1 - see RoA1	0	0	1	-	•	•
S	IO -> dO	RoA4	DoA4≠ 0	Compressor 4 digital output logic, line 1 - see RoA1	0	0	1	-	•	•
S	IO -> dO	RoAA	DoAA≠ 0	Compressor 1 digital output logic, line 2 - see RoA1	0	0	1	-	•	-
S	IO -> dO	RoAB	DoAB≠ 0	Compressor 2 digital output logic, line 2 - see RoA1	0	0	1	-	•	-
S	IO -> dO	RoB	DoB≠ 0	Global alarm digital output logic - see RoA1	0	0	1	-	•	•
S	IO -> dO	RoH	DoH≠ 0	Serious alarm digital output logic - see RoA1	0	0	1	-	•	•
S	-	RoJ1	-	Liquid alarm digital output logic, line 1 - see RoA1	0	0	1	-	•	•
S	-	RoJ2	-	Liquid alarm digital output logic, line 2 - see RoA1	0	0	1	-	•	-
S	IO -> dO	RoL1	DoL1≠ 0	Compressor 1 unloader digital output 1 logic, line 1 - see RoA1	0	0	1	-	•	•
S	IO -> dO	RoL2	DoL2≠ 0	Compressor 1 unloader digital output 2 logic, line 1 - see RoA1	0	0	1	-	•	•
S	IO -> dO	RoM1	DoM1≠ 0	Compressor 1 unloader digital output 1 logic, line 2 - see RoA1	0	0	1	-	•	-
S	IO -> dO	RoS	DoS≠ 0	Generic step function digital output logic - See RoA1	0	0	1	-	•	•

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
S	IO -> dO	RoT	DoT≠ 0	Fan 1 digital output logic - see RoA1	0	0	1	-	•	•
S	IO -> dO	RoT2	DoT2≠ 0	Fan 2 digital output logic - see RoA1	0	0	1	-	•	•
S	IO -> dO	RoT3	DoT3≠ 0	Fan 3 digital output logic - see RoA1	0	0	1	-	•	•
S	IO -> dO	RoT4	DoT4≠ 0	Fan 4 digital output logic - see RoA1	0	0	1	-	•	•
S		MD1		Value for manual activation of digital output 1 (0 = not active; 1 = active)	0	0	1	-	•	•
S		MD2		Value for manual activation of digital output 2 - see MD1	0	0	1	-	•	•
S		MD3		Value for manual activation of digital output 3 - see MD1	0	0	1	-	•	•
S		MD4		Value for manual activation of digital output 4 - see MD1	0	0	1	-	•	•
S		MD5		Value for manual activation of digital output 5 - see MD1	0	0	1	-	•	•
S		MD6		Value for manual activation of digital output 6 (excluding CO_2 model) - see MD1	0	0	1	-	•	-
S		ML1		Logic for manual activation of digital output 1 (0 = NO; 1= NC)	0	0	1	-	•	•
S		ML2		Value for manual activation of digital output 2 - see ML1	0	0	1	-	•	•
S		ML3		Value for manual activation of digital output 3 - see ML1	0	0	1	-	•	•
S		ML4		Value for manual activation of digital output 4 - see ML1	0	0	1	-	•	•
S		ML5		Value for manual activation of digital output 5 - see ML1	0	0	1	-	•	•
S		ML6		Value for manual activation of digital output 6 (excluding CO_2 model) - see ML1	0	0	1	-	•	-
S		Mo		Enable manual output activation mode (0 = not enabled; 1 = enabled)	0	0	1	-	•	•
M		MT		Maximum manual mode/test time (0 = no timeout)	60	0	999	min	•	•

Tab. 7.d

7.5 Driver

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
Configuration										
M		H13		EVD driver serial address	198	1	247	-	-	•
M		HEn		Enable EVD driver (0 = disabled; 1 = enabled)	1	0	1	-	-	•
M		P1		Type of EVD driver, valve A:	1	0	35	-	-	•

0= custom		18= Danfoss ETS 400	
1= CAREL EXV		19= Two CAREL EXVs connected together	
2= Alco EX4		20= Sporlan SER(I)G,J,K	
3= Alco EX5		21= Danfoss CCM 10-20-30	
4= Alco EX6		22= Danfoss CCM 40	
5= Alco EX7		23= Danfoss CCM T 2-4-8	
6= Alco EX8 330Hz CAREL recommended		24= Disabled	
7= Alco EX8 500Hz Alco specifications		25= CAREL E2J17AS1N0 ejector	
8= Sporlan SEI 0.5-11		26= CAREL E2J23AT1N0 ejector	
9= Sporlan SER 1.5-20		27= CAREL E3J26AT2N0 ejector	
10= Sporlan SEI 30		28= CAREL E3J33AU2N0 ejector	
11= Sporlan SEI 50		29= CAREL E3J39AV3N0 ejector	
12= Sporlan SEH 100		30= CAREL E6J50AV3N0 ejector	
13= Sporlan SEH 175		31= Danfoss CCMT 16	
14= Danfoss ETS 12.5-25B		32= Danfoss CCMT 24	
15= Danfoss ETS 50B		33= Danfoss CCMT 30	
16= Danfoss ETS 100B		34= Danfoss CCMT 42	
17= Danfoss ETS 250		35= Danfoss Colibri	

M		P1B		Type of EVD driver, valve B	1	0	35	-	-	•
M		vLr		EVD driver valve association:	3	0	3	-	-	•

0	Single EVD, valve A -> HPV
1	Single EVD, valve A -> FGPV
2	Twin EVD, valve A -> FGV, valve B -> HPV
3	Twin EVD, valve A -> HPV, valve B -> FGV

Tab. 7.e

7.6 HPV valve

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO2
Configuration										
S	IO -> AO	/AL	-	Assign analogue output for HPV feedback	0	0	4	-	-	•
M	-	Ehp	-	Enable HPV (0 = disabled; 1 = enabled)	1	0	1	-	-	•
M		vCA0		Custom HPV closing steps	0	0	9999	steps	-	•
M		vCA1		Custom HPV closing position synchronisation	0	0	1	-	-	•
M		vCA2		Custom HPV duty cycle	0	1	100	%	-	•
M		vCA3		Custom HPV closing speed	0	1	2000	steps/s	-	•
M		vCA4		Custom HPV holding current	0	0	250	mA	-	•
M		vCA5		Custom HPV maximum steps	0	0	9999	steps	-	•
M		vCA6		Custom HPV minimum steps	0	0	9999	steps	-	•
M		vCA7		Custom HPV rated current	0	0	800	mA	-	•
M		vCA8		Custom HPV opening position synchronisation	0	0	1	-	-	•
M		vCA9		Custom HPV rated speed	0	1	2000	steps/s	-	•
Control										
M	-	cdg	-	Maximum pressure	115/1667	cdq	150	barg/psig	-	•
M	-	cdi	-	Limit temperature between zone 2 and 3	20.0/68	6.0/42.8	cdj	°C/°F	-	•
M	-	cdj	-	Limit temperature between zone 1 and 2	31.0/87.8	cdi	50/122	°C/°F	-	•
M	-	cdo	-	Subcooling delta in subcritical mode	3.0	0	10/18	K	-	•
S	-	cdn	-	HPV PID parameters, integral time Ti	60	0	999	s	-	•
S	-	cdP	-	HPV PID parameters, proportional gain Kp	5	0	500	%/°C	-	•
M	-	cdq	-	Critical pressure in manual HPV set point calculation mode	82/1189.3	60/870	115/1667.9	barg/psig	-	•
M	-	cdV	-	Enable manual HPV set point calculation (0 = automatic; 1= manual)	2.5	0	10	-	-	•
M	-	cdx	-	Angular coefficient of straight line for manual HPV set point calculation	0	0	10/145	bar/psig /kJ/kg	-	•
S	-	cdy	-	HPV PID parameters, derivative time Td	0	0	999	s	-	•
M	-	cdz	-	Minimum pressure	34.0/493	0	99.9/1449	barg/psig	-	•
S	-	rhv	-	Offset to be applied to the outside temperature in the event of a faulty gas cooler temperature probe	0	0	99.9/179	Δ°C/Δ°F	-	•
Manual operation										
M		MT		Maximum manual mode/test time (0 = no timeout)	60	0	999	min	•	•
S		PMU		HPV valve manual mode (0= automatic; 1= OFF; 2= 2%, ..., 100= 100%)	0	0	100	-	-	•
Accessory functions										
S	-	cdb	-	Maximum offset to subtract from the HPV set point	10.0/145	-99.9/ -1449	99.9/1449	Δ barg/ Δ psig	-	•
S	-	cdc	-	Maximum offset to add to the HPV set point	10.0/145	-99.9/ -1449	99.9/1449	Δ barg/ Δ psig	-	•
S	-	cP1	-	HPV cooling capacity ratio	100	0	100	%	-	•
S	-	cP2	-	HPV prepositioning duration	6	0	999	s	-	•
M	-	cvE	-	Enable HPV closing with compressors OFF	1	0	1	-	-	•
M	-	cvt	-	HPV closing delay with compressors OFF	10	0	999	s	-	•
S	-	Ew	-	Enable safety procedure with HPV (0=disabled, 1=enabled)	0	0	1	-	-	•
S	-	Ltw	-	Receiver low pressure threshold	32.0/464	-1.0/-14.5	150/2175	barg/psig	-	•
M	-	MPS	-	Maximum HPV opening value	100	0	100	%	-	•
M	-	PSb	-	HPV position in standby	0	0	100	%	-	•
M	-	PSo	-	Minimum HPV opening value in ON status	0	0	100	%	-	•
M	-	SnC	-	Number of samples for HPV set point filter (1=filter disabled)	1	1	99	-	-	•
M	-	StM	-	Maximum HPV % variation per second	10	0	100	%/s	-	•
M	-	Stn	-	Minimum HPV set point	34.0/493	cdz	cdq	barg/psig	-	•
S	-	Utw	-	Receiver high pressure threshold	40.0/580	-1.0/-14.5	150/2175	barg/psig	-	•

Tab. 7.f

7.7 FGV valve

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO2
Configuration										
S	IO -> AO	/AM	-	Assign analogue output for FGV feedback	0	0	4	-	-	•
M	-	Efg	-	Enable FGV	1	0	1	-	-	•
M		vCB0		Custom FGV closing steps	0	0	9999	steps	-	•
M		vCB1		Custom FGV closing position synchronisation	0	0	1	-	-	•
M		vCB2		Custom FGV duty cycle	0	1	100	%	-	•
M		vCB3		Custom FGV closing speed	0	1	2000	steps/s	-	•
M		vCB4		Custom FGV holding current	0	0	250	mA	-	•
M		vCB5		Custom FGV maximum steps	0	0	9999	steps	-	•
M		vCB6		Custom FGV minimum steps	0	0	9999	steps	-	•
M		vCB7		Custom FGV rated current	0	0	800	mA	-	•
M		vCB8		Custom FGV opening position synchronisation	0	0	1	-	-	•
M		vCB9		Custom FGV rated speed	0	1	2000	steps/s	-	•
Control										
M	-	cdz	-	Minimum pressure	34.0/493	0	99.9/1449	barg/ psig	-	•
S	-	fgd	-	FGV PID parameters, derivative time Td	0	0	999	s	-	•
S	-	fgi	-	FGV PID parameters, integral time Ti	60	0	999	s	-	•
S	-	fgP	-	FGV PID parameters, proportional gain Kp	20	0	100	%/°C	-	•
S	-	SPg	-	FGV set point	35.0/507.6	-1.0/ -14.5	150/2175	barg/ psig	-	•
Manual operation										
M		MT		Maximum manual mode/test time (0 = no timeout)	60	0	999	min	•	•
S		PMUB		FGV valve manual mode (0= automatic; 1= OFF; 2= 2%, ..., 100= 100%)	0	0	100	-	-	•
Accessory functions										
S	-	cooB	-	FGV opening during prepositioning	50	0	100	%	-	•
S	-	covB	-	FGV prepositioning duration	6	0	999	s	-	•
S	-	cP1B	-	FGV cooling capacity ratio	50	0	100	%	-	•
S	-	cP2B	-	FGV prepositioning duration	6	0	999	s	-	•
M	-	cvEB	-	Enable FGV closing with compressors OFF	1	0	1	-	-	•
M	-	cvtB	-	FGV closing delay with compressors OFF	10	0	999	s	-	•
M	-	MPSB	-	Maximum FGV opening value	100	0	100	%	-	•
M	-	PSbB	-	FGV position in standby	0	0	100	%	-	•
M	-	PSoB	-	Minimum FGV opening value in ON status	0	0	100	%	-	•
M	-	StMB	-	Maximum HPV % variation per second	10	0	100	%/s	-	•

Tab. 7.g

7.8 Alarms

User	Display	Code	Visibility		Def.	Min.	Max.	UOM	HFCs	CO2
Prevention										
M	SAF-> Prv	cLdP	-	High discharge pressure prevention, OFF delay between compressors	30	0	999	s	•	•
S	SAF-> Prv	LshP	-	Safety threshold for superheat protection	6	LshA	20	K	•	•
S	-	LSP	-	Safety delay for superheat protection, line 1	5	0	60	s	•	•
S	-	LSPb	-	Safety delay for superheat protection, line 2	5	0	60	s	•	-
M	SAF-> Prv	Pvd	-	High discharge pressure prevention, evaluation time	5	0	999	min	•	•
M	SAF-> Prv	Pvt	-	High discharge temperature prevention, threshold	18/261 (100/1450 *)	-1/-14.5	150/2175 (*)	barg/ psig	•	•
M	SAF-> Prv	Pvt_T	vrt = 1	High discharge temperature prevention, threshold expressed as a temperature	55/131 (41/105)	-99.9/ -147	150/302	°C/°F	•	•
Alarms										
S	-	A11	-	Delay time for delayed external alarm	0	0	240	min	•	•
S		APd		Time fan forced to 100% with high pressure alarms	30	0	999	s	•	•
M	CL1 -> ALM	Atc	nC > 0	Type of compressor alarm reset: 0 = automatic; 1= manual	0	0	1	-	•	•
M	FAN ->ALM	AtF	nF > 0	Type of fan alarm reset - see Atc	0	0	1	-	•	•
M	SAF -> ALM	AtH	-	Type of high pressure switch alarm reset: 0 = automatic; 1= manual; 2= semi-automatic.	0	0	2	-	•	•
M	SAF -> ALM	AtL	-	Type of low pressure switch alarm reset, line 1 – see AtH	0	0	2	-	•	•
M	SAF -> ALM	AtLb	-	Type of low pressure switch alarm reset, line 2 – see AtH	0	0	2	-	•	-
M	SAF -> ALM	AtLn	-	Evaluation time for switching from semi-automatic to manual reset for low pressure alarms	60	0	999	min	•	•
M	SAF -> ALM	AtS	-	Type of low superheat alarm reset, line 1 – see AtH	1	0	2	-	•	•
M	SAF -> ALM	AtSb	-	Type of low superheat alarm reset, line 2 – see AtH	1	0	2	-	•	-
M	SAF -> ALM	cAD	-	Compressor alarm delay time	0	0	999	s	•	•
S	SAF -> ALM	FObd	-	Global alarm delay time	0	0	999	s	•	•
S	SAF -> ALM	Fod	nF > 0	Fan alarm delay time	0	0	999	s	•	•
M	SAF -> ALM	HPE	-	High pressure alarm from probe delay time	60	0	999	s	•	•
S	-	HPGs	-	Receiver maximum pressure alarm threshold	45.0/652	-1.0/- 14.5	150/ 2175(*)	barg/ psig	-	-
S	-	HPGd	-	Receiver maximum pressure alarm differential	5./72.5	0.0	9.9/143	Δbarg/ Δpsig	-	-
S	-	HPGt	-	Receiver maximum pressure alarm delay	30	0	9999	s	-	-
S	-	HPGE	-	Unit shutdown with maximum receiver pressure alarm (0=disabled; 1=enabled, the unit shuts down)	1	0	1	-	-	-

User	Display	Code	Visibility		Def.	Min.	Max.	UOM	HFCs	CO2
M	SAF -> ALM	HPn	-	Number of activations for switching from automatic to manual reset for high pressure alarm from pressure switch	3	0	9	-	•	•
M	SAF -> ALM	HPt	-	High pressure alarm from probe threshold	25/362 (110/1595 *)	-1/-14.5	150/2175 (*)	barg/ psig	•	•
M	SAF -> ALM	HPt_T	vrt = 1	High pressure alarm from probe threshold, expressed as a temperature	55/131 (43/109)	-99.9/ -147	150/302	°C/°F	•	•
M	SAF -> ALM	HSe	-	High suction pressure from probe alarm delay, line 1	60	0	999	s	•	•
M	SAF -> ALM	HSeb		High suction pressure from probe alarm delay, line 2	60	0	999	s	•	-
M	SAF -> ALM	HSt	-	High suction pressure alarm from probe threshold, line 1	9.3/134 (35/507.6)	-1/-14.5	60/870 (150/2175 *)	barg/ psig	•	•
M	SAF -> ALM	HSt_T	vrt = 1	High suction pressure alarm from probe threshold, line 1, expressed as a temperature	20/68	-99.9/ -147	150/302	°C/°F	•	•
M	SAF -> ALM	HStb	-	High suction pressure alarm from probe threshold, line 2	9.3/134	-1/-14.5	60/870	barg/ psig	•	-
M	SAF -> ALM	HStb_T	vrt = 1	High suction pressure alarm from probe threshold, line 2, expressed as a temperature	20/68	-99.9/ -147	150/302	°C/°F	•	-
M	SAF -> ALM	HtA	-	High ambient temperature alarm threshold	50/122	LtA	99.9/211	°C/°F	•	•
M	SAF -> ALM	HtE	-	High outside temperature alarm threshold	50/122	LtE	99.9/211	°C/°F	•	•
S	SAF -> ALM	Htt	-	High discharge temperature alarm threshold, line 1	110/230	-99.9/-147	150/302	°C/°F	•	•
S	SAF -> ALM	Httb	-	High discharge temperature alarm threshold, line 2	110/230	-99.9/-147	150/302	°C/°F	•	-
M	SAF -> ALM	LDe	-	Low discharge pressure alarm from probe delay	60	0	999	s	•	•
M	SAF -> ALM	LDt	-	Low discharge pressure alarm from probe threshold	0	-1/-14.5	150/2175 (*)	barg/ psig	•	•
M	SAF -> ALM	LDt_T	vrt = 1	Low discharge pressure alarm from probe threshold, expressed as a temperature	-45/-49	-99.9/ -147	150/302	°C/°F	•	•
S	SAF -> ALM	Lhdb	-	Emergency delay for superheat protection, line 2	5	0	60	s	•	-
S	SAF -> ALM	LLd	-	Liquid level alarm delay	60	0	500	min	•	•
M	SAF -> ALM	LPE	-	Low suction pressure from probe alarm delay, line 1	60	0	999	s	•	•
M	SAF -> ALM	LPEb	-	Low suction pressure from probe alarm delay, line 2	60	0	999	s	•	-
M	SAF -> ALM	LPn	-	Number of activations for switching from automatic to manual reset for low pressure alarm from pressure switch	3	0	9	-	•	•
M	SAF -> ALM	LPt	-	Low suction pressure alarm from probe threshold, line 1 (-1= alarm disabled)	0 (20/290)	-1/-14.5	150/ 2175(*)	barg/ psig	•	•
M	SAF -> ALM	LPt_T	vrt = 1	Low suction pressure alarm from probe threshold, line 1, expressed as a temperature	-45/-49	-99.9/ -147	150/302	°C/°F	•	•
M	SAF -> ALM	LPtb	-	Low suction pressure alarm from probe threshold, line 2 (-1= alarm disabled)	0	-1/-14.5	150/ 2175(*)	barg/ psig	•	-
M	SAF -> ALM	LPtb_T	vrt = 1	Low suction pressure alarm from probe threshold, line 2, expressed as a temperature	-45/-49	-99.9/ -147	150/302	°C/°F	•	-
S	SAF -> ALM	LSd	-	Low suction temperature alarm delay, line 1	300	0	999	s	•	•
S	SAF -> ALM	LSdb	-	Low suction temperature alarm delay, line 2	300	0	999	s	•	-
S	SAF -> ALM	LshA	-	Emergency threshold for superheat protection	2	-20	LshP	K	•	•
S	SAF -> ALM	LshC	-	Emergency control (duty cycle) activation time in a fixed period of 10 minutes	4	0	10	min	•	•
S	SAF -> ALM	Lshd	-	Emergency delay for superheat protection, line 1	5	0	60	s	•	•
M	SAF -> ALM	LtA	-	Low ambient temperature alarm threshold	-20/-4	-99.9/ -147	HtA	°C/°F	•	•
M	SAF -> ALM	LtE	-	Low outside temperature alarm threshold	-20/-4	-99.9/ -147	HtE	°C/°F	•	•
U	SAF -> ALM	rES	-	Reset alarms	0	0	1	-	•	•
S	SAF -> ALM	SHLn	-	Evaluation time for switching from semi-automatic to manual reset for low superheat alarms	60	0	999	min	•	•
S	SAF -> ALM	SHn	-	Number of activations for switching from automatic to manual reset for low superheat alarm	3	0	9	-	•	•
M	SAF -> ALM	P11	-	Low suction temperature alarm threshold, line 1	-5/-23	-99.9/-147	150/302	°C/°F	•	•
M	SAF -> ALM	P11B	-	Low suction temperature alarm threshold, line 2	-5/-23	-99.9/-147	150/302	°C/°F	•	-
S	-	Pb1	-	Distance from HPV set point alarm threshold	1	0	9.9	Δ barg/ Δ psig	-	•
S	-	Pb1B	-	Distance from FGV set point alarm threshold	1	0	9.9	Δbar/ Δ psig	-	•
S	-	Pb2	-	Distance from HPV set point alarm delay	0	0	255	min	-	•
S	-	Pb2B	-	Distance from FGV set point alarm delay	0	0	255	min	-	•
M		S1Ad... S4Ad		EVD driver probe S1...S4 alarm delay	10	0	240	s	-	•
M		S1E... S4E		Enable EVD driver S1...S4 probe alarm (0 = disabled; 1 = enabled)	0	0	1	-	-	•
M		S1AM		EVD driver S1 probe alarm upper threshold value	0	S1An	200/ 2900.8 (*)	barg/ psig	-	•
M		S1An		EVD driver S1 probe alarm lower threshold value	0	-20/ -290	S1AM	barg/ psig	-	•
M		S2AM		EVD driver S2 probe alarm upper threshold value	0	S2An	200/392	°C/°F	-	•
M		S2An		EVD driver S2 probe alarm lower threshold value	0	-85/ -121	S2AM	°C/°F	-	•
M		S3AM		EVD driver S3 probe alarm upper threshold value	0	S3An	200/ 2900.8 (*)	barg/ psig	-	•
M		S3An		EVD driver S3 probe alarm lower threshold value	0	-20/ -290	S3AM	barg/ psig	-	•
M		S4AM		EVD driver S4 probe alarm upper threshold value	0	S4An	200/392	°C/°F	-	•
M		S4An		EVD driver S4 probe alarm lower threshold value	0	-85/ -121	S4AM	°C/°F	-	•

Tab. 7.h

7.9 Generic functions

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
S	-	GFA_1	-	Generic alarm function, control probe 1 0= not configured; 1= suction pressure, line 1 (SSP); 2= suction pressure, line 2 (SSPB); 3= condensing pressure (SCP); 4= ambient temperature (SA); 5= outside temperature (SE); 6= discharge temperature, line 1 (SDT) 7= discharge temperature, line 2 (SDTb); 8= suction temperature, line 1 (TGS); 9= suction temperature, line 2 (TGSB); 10= generic temperature (SG) 11=gas cooler temperature (CO_2 model only); 12=receiver pressure (CO_2 model only)	0	0	10 (12)	-	•	•
S	-	GFA_2	-	Generic alarm function, control probe 2 - see GFA_1	0	0	10 (12)	-	•	•
S	-	GFA_AA	-	Generic alarm function, action taken 0= none; 1= stop control; 2= reduce capacity; 3= fans at maximum speed	0	0	3	-	•	•
S	-	GFA_AI-Type	-	Generic alarm function, alarm type (0= signal only; 1= serious alarm)	0	0	1	-	•	•
S	-	GFA_D	-	Generic alarm function, differential	0	0	99.9	-	•	•
S	-	GFA_De	-	Generic alarm function, delay	0	0	30000	s	•	•
S	-	GFA_E	-	Generic alarm function, enable 0= always; 1= unit On; 2= unit Off; 3= control On; 4= compressor On; 5= external alarm from digital input; 6= unit Off due to alarm; 7= high pressure alarm; 8= low pressure alarm, line 1; 9= line 2 low pressure alarm (excluding CO_2 model); 10= high pressure prevention active; 11= general alarm active; 12= generic warning active; 13= all compressors OFF	0	0	13	-	•	•
S	-	GFA_Hth	-	General alarm function, high threshold	0	-50	200	-	•	•
S	-	GFA_Lth	-	General alarm function, low threshold	0	-50	200	-	•	•
S	-	GFA_n	-	Generic alarm function, number of attempts before switching from semi-automatic to manual	0	0	99	-	•	•
S	-	GFA_P	-	Generic alarm function, evaluation period for switching from semi-automatic to manual	0	0	999	min	•	•
S	-	GFA_r	-	Generic alarm function, reset type (0 = automatic; 1 = semi-automatic; 2 = manual)	0	0	2	-	•	•
S	-	GFA_WA	-	Generic alarm function, action taken on warning 0 = none; 1 = stop control; 2 = reduce capacity; 3 = fans at maximum speed	0	0	3	-	•	•
S	-	GFA_WD	-	Generic alarm function, warning differential	0	0	99.9	-	•	•
S	-	GFA_WDe	-	Generic alarm function, warning delay	0	0	30000	s	•	•
S	-	GFA_We	-	Generic alarm function, enable warning (0 = disabled; 1 = enabled)	0	0	1	-	•	•
S	-	GFA_WHth	-	General alarm function, high warning threshold	0	-50	200	-	•	•
S	-	GFA_WLth	-	General alarm function, low warning threshold	0	-50	200	-	•	•
S	-	GFM_1	-	Generic modulating function: control probe 1 - see GFA_1	0	0	10 (12)	-	•	•
S	-	GFM_2	-	Generic modulating function: control probe 2 - see GFA_1	0	0	10 (12)	-	•	•
S	-	GFM_CD	-	Generic modulating function: cut-off differential	0	0	20	-	•	•
S	-	GFM_D	-	Generic modulating function, differential	0	0	99.9	-	•	•
S	-	GFM_E	-	Generic modulating function, enable - see GFA_E	0	0	13	-	•	•
S	-	GFM_F	-	Generic modulating function, control variable 0 = GFM_1 – GFM_2; 1 = minimum between GFM_1 and GFM_2; 2 = maximum between GFM_1 and GFM_2; 3 = average between GFM_1 and GFM_2.	0	0	3	-	•	•
S	-	GFM_H	-	Generic modulating function, hysteresis	0	0	20	-	•	•
S	-	GFM_Kp	-	Generic modulating function, proportional gain	1	0	100	-	•	•
S	-	GFM_Max	-	Generic modulating function, maximum output value	0	0	100	-	•	•
S	-	GFM_Min	-	Generic modulating function, minimum output value	0	0	100	-	•	•
S	-	GFM_S	-	Generic modulating function, set point	0	-50	200	-	•	•
S	-	GFM_T	-	Generic modulating function, control type (0 = direct, 1 = reverse)	0	0	1-		•	•
S	-	GFM_Td	-	Generic modulating function, derivative time	0	0	100	s	•	•
S	-	GFM_Ti	-	Generic modulating function, integral time	0	0	900	s	•	•
S	-	GFS_1	-	Generic stepped function, control probe 1- see GFA_1	0	0	10 (12)	-	•	•
S	-	GFS_2	-	Generic alarm function, control probe 2 - see GFA_1	0	0	10 (12)	-	•	•
S	-	GFS_D	-	Generic stepped function, differential	0	0	99.9	-	•	•
S	-	GFS_E	-	Generic stepped function, enable - see GFA_E	0	0	13	-	•	•
S	-	GFS_F	-	Generic stepped function, control variable – see GFM_F	0	0	3	-	•	•
S	-	GFS_S	-	Generic stepped function, set point	0	-50	200	-	•	•
S	-	GFS_T	-	Generic stepped function, control type – see GFM_T	0	0	1	-	•	•

Tab. 7.i

7.10 Scheduler

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
U	-	EnS	-	Enabe scheduler (0= disabled; 1= enabled)	0	0	1	-	•	•
U	-	d__	-	Date/time setting from supervisor, day	1	1	31	-	•	•
U	-	h__	-	Date/time setting from supervisor, hours	0	0	23	h	•	•
U	-	M__	-	Date/time setting from supervisor, month	1	1	12	-	•	•
U	-	m__	-	Date/time setting from supervisor, minutes	0	0	59	min	•	•
U	-	y__	-	Date/time setting from supervisor, year	20	20	99	-	•	•
U	-	SEh	-	End time band, hours	7	0	23	h	•	•
U	-	SEM	-	End time band, minutes	30	0	59	min	•	•
U	-	SSh	-	Start time band, hours	17	0	23	h	•	•
U	-	SSM	-	Start time band, minutes	30	0	59	min	•	•

Tab. 7.j

7.11 Serial ports

User	Display	Code	Visibility	Description	Def.	Min.	Max.	UOM	HFCs	CO_2
S	StG -> BMS	H0	-	BMS serial address	181	1	247	-	•	•
S	StG -> BMS	H1	-	BMS serial port configuration (stop bits and parity) 0= 1 stop bit, no parity; 1= 2 stop bits, no parity; 2= 1 stop bit, even parity; 3= 2 stop bit, even parity; 4= 1 stop bit, odd parity; 5= 2 stop bit, odd parity;	1	0	5	-	•	•
S	StG -> BMS	H2	-	BMS baud rate 0= 1200 | 1= 2400 | 2= 4800 | 3= 9600 4= 19200 | 5= 38400 | 6= 57600 | 7= 115200	4	0	8	bit/s	•	•
S		H4	-	Fieldbus speed (baud rate) 0= 1200 | 1= 2400 | 2= 4800 | 3= 9600 4= 19200 | 5= 38400 | 6= 57600 | 7= 115200	4	0	8	bit/s	•	•

Tab. 7.k

8. ALARMS AND SIGNALS

8.1 Types of alarms

The controller manages three types of alarms, depending on the reset mode:
- **A - automatic:** the alarm is reset and the device restarts automatically when the alarm condition is no longer present;
- **R - semi-automatic:** if the alarm occurs several times, reset becomes manual and an operator needs to physically restart the device.
- **M - manual:** an operator needs to physically restart the device.

Alarms that require technical service are shown on the display with the flashing spanner icon. If the spanner icon is on, it means that a device has reached the programmed operating hour threshold, and maintenance is required (the alarm code indicates which device is affected).

For some alarms, the reset mode can be configured by parameter. The configurable alarms are:
- Compressor alarms (Atc);
- Fan alarms (AtF);
- High pressure switch (AtH)
- Low pressure switch - line 1 (AtL)
- Low pressure switch – line 2 (AtLb, HFC models only)
- Low superheat - line 1 (AtS)
- Low superheat – line 2 (AtSb, HFC models only)
- Generic alarm function (GFA_r)

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	Atc	Type of compressor alarm reset (0= automatic; 1= manual)	0	0	1	-	•	•
M	AtF	Type of fan alarm reset - see Atc	0	0	1	-	•	•
M	AtH	Type of high pressure switch alarm reset 0 = Automatic - 1 = Manual - 2 = Semi-Automatic	0	0	2	-	•	•
M	AtL	Type of low pressure switch alarm reset, line 1 – see AtH	0	0	2	-	•	•
M	AtLb	Type of low pressure switch alarm reset, line 2 – see AtH	0	0	2	-	•	-
M	AtS	Type of low superheat alarm reset, line 1 – see AtH	1	0	2	-	•	•
M	AtSb	Type of low superheat alarm reset, line 2 – see AtH	1	0	2	-	•	-
S	GFA_r	Type ofgeneric alarm function reset – see AtH	1	0	2	-	•	•

Tab. 8.a

For each alarm with semi-automatic reset, the number of activations and/or the evaluation time before switching from automatic to manual can be set, using the corresponding parameters. See the table below for details.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	AtLn	Evaluation time for switching from semi-automatic to manual reset for low pressure alarms	60	0	999	min	•	•
S	GFA_n	Generic alarm function, number of attempts before switching from semi-automatic to manual	0	0	99	-	•	•
S	GFA_P	Generic alarm function, evaluation period for switching from semi-automatic to manual	0	0	999	min	•	•
M	HPn	Number of activations for switching from automatic to manual reset for high pressure alarm from pressure switch	3	0	9	-	•	•
M	Pvd	High discharge pressure prevention, evaluation time	5	0	999	min	•	•
S	SHLn	Evaluation time for switching from semi-automatic to manual reset for low superheat alarms	60	0	999	min	•	•
S	SHn	Number of activations for switching from automatic to manual reset for low superheat alarm	3	0	9	-	•	•

Tab. 8.b

Alarms can also be distinguished according to priority:
- **Warning**: signal only, buzzer not activated;
- **Normal alarm**: signal only, buzzer activated;
- **Serious line alarm**: signal, buzzer activated and devices on the line in question switched off;
- **Serious unit alarm**: signal, buzzer activated and unit shut down.

8.2 Active alarms

Alarms are signalled by buzzer and the flashing of the Alarm button. Pressing Alarm mutes the buzzer and displays the alarm code (on the top row) and any additional information (on the bottom row). Alarm activation is recorded in the alarm log. If the alarm ceases automatically, the Alarm button switches off, the alarm code disappears from the list and the alarm reset event is recorded in the alarm log; the exceptions are the LSH and LS2 alarms (HFC models only), which remain visible for 120 s after the alarm condition has ceased.

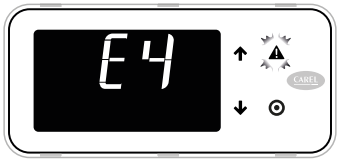
Alarms are also signalled by the activation of the global alarm and alarm notification digital outputs, if suitably configured using parameters DoB and DoH. Furthermore, the global alarm signal can be delayed by a time set using parameter FOdb.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	DoB	Assign global alarm digital output - see DoA1	5	0	6 (5)	-	•	•
S	DoH	Assign serious alarm digital output - see DoA1	0	0	6 (5)	-	•	•
S	FOdb	Global alarm delay time	0	0	999	s	•	•

Tab. 8.c

Alarm acknowledgement procedure

1. When an alarm is active, the buzzer sounds and the Alarm button lights up



2. Pressing Alarm mutes the buzzer and displays the alarm code; pressing UP/DOWN scrolls the list of any other alarms

3. When reaching the end of the alarm list, "ESC" is shown: press PRG to exit the alarm list.

4. Pressing the Alarm button for more than 3 s resets the alarms: "noAL" indicates that there are no more active alarms. Press PRG to exit the alarm list.

Pressing Alarm for more than 3 s while ESC is displayed resets all the alarms; a single alarm can be reset by pressing Alarm for more than 3 s while the corresponding code is displayed. If the condition that generated the alarm is still present, the alarm will be reactivated.
The alarms can also be reset from the 7-segment display, using parameter rES.
The same operations can be performed with APPLICA via smartphone, using the specific function on the alarm page (a BLE connection and "Service" level access are required).

Notice:
- deletion of the alarm log is irreversible;
- the buzzer is activated for all alarms.

8.3 Description of the main alarms

8.3.1 Digital input alarms

µRack manages two external alarms from digital input, IA and DA, which can be configured using parameters DiA and DIb. When these inputs are activated, a serious alarm is activated and the unit switches off, without waiting for the compressor times to elapse. Alarm DA can be delayed by a time set using parameter A11.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	A11	Delay time for delayed external alarm	0	0	240	min	•	•
S	DiA	Assign external alarm digital input (0 = function disabled; 1 = ID1, 2 = ID2; …; 5 = ID5; 6 = ID6, MEDIUM and ADVANCED versions only)	0	0	6 (5)	-	•	•
S	DIb	Assign delayed external alarm digital input - see DiA	0	0	6 (5)	-	•	•

Tab. 8.d

In addition to the generic digital input alarms, a specific alarm can be configured for each compressor and fan using parameters DiA1, …DiAB and DivA…DivD. The alarms for the individual devices can be delayed using parameters cAD and Fod for the compressors and fans respectively.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	cAD	Compressor alarm delay time	0	0	999	s	•	•
S	DiA1	Assign compressor 1 alarm digital input, line 1 - see DiA	1	0	6 (5)	-	•	•
S	DiA2	Assign compressor 2 alarm digital input, line 1 - see DiA	2	0	6 (5)	-	•	•
S	DiA3	Assign compressor 3 alarm digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	DiA4	Assign compressor 4 alarm digital input, line 1 - see DiA	0	0	6 (5)	-	•	•
S	DiAA	Assign compressor 1 alarm digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	DiAB	Assign compressor 2 alarm digital input, line 2 - see DiA	0	0	6 (5)	-	•	-
S	DivA	Assign fan 1 digital input - see DiA	3	0	6 (5)	-	•	•
S	DivB	Assign fan 2 digital input - see DiA	4	0	6 (5)	-	•	•
S	DivC	Assign fan 3 digital input - see DiA	0	0	6 (5)	-	•	•
S	DivD	Assign fan 4 digital input - see DiA	0	0	6 (5)	-	•	•
S	Fod	Fan alarm delay time	0	0	999	s	•	•

Tab. 8.e

µRack also manages a liquid level alarm LQL from digital input, which can be configured using parameter DiLv. The alarm can be delayed by a time set using parameter LLd.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	ALM	Liquid level alarm delay	60	0	500	min	•	•
S	DiLv	Assign liquid level digital input - see DiA	0	0	6 (5)	-	•	•

Tab. 8.f

8.3.2 Pressure alarms and prevention

µRack can manage pressure alarms from a pressure switch or probe, according to the following scheme.

Alarms from pressure switch:
- Low suction pressure line 1 (LP1)
- Low suction pressure line 2 (LP2, HFC models only)
- High condensing pressure (HP1)

Alarms from probe:
- Low suction temperature, line 1 (LP)
- Low suction pressure line 2 (LPb, HFC models only)
- High suction pressure line 1 (HS)
- High suction pressure line 2 (HSb HFC models only)
- Low condensing pressure (LPD)
- High condensing pressure (HP)

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

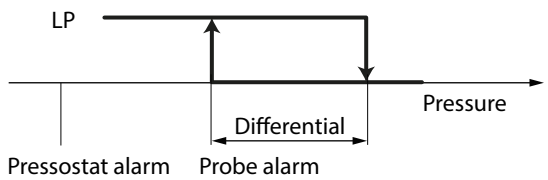


Fig. 8.a

Furthermore, the high pressure alarms can be prevented by forcing the devices on. See "High pressure prevention". In the event of a high condensing pressure alarm from a pressure switch or probe, the unit is switched off, with the fans forced to maximum speed for the time APd.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	APd	Time fans forced to maximum speed with high condensing pressure alarm	30	0	999	s	•	•

Alarms from pressure switch

The low suction pressure alarms from pressure switch LP1 and LP2 have the effect of stopping all the compressors on the line without observing the various times, therefore when the digital input configured as low pressure switch is activated, all the compressors on the line affected are stopped immediately. The type of reset can be selected using parameters AtL and AtLb. In the event of semi-automatic reset, both the evaluation time AtLn and the number of activations LPn in the specified period can be set. If the number of activations is higher than LPn, reset becomes manual.

The high condensing pressure alarm from pressure switch HP1 has the effect of shutting down the unit, without observing the compressor times. The type of reset can be selected using parameter AtH. In the event of semi-automatic reset, the number of activations HPn in the fixed 60 minute period can be set.. If the number of activations is higher than HPn, reset becomes manual.

User	Code	Description	Def	Min	Max	UOM	HFCs	CO_2
M	AtH	Type of high pressure switch alarm reset 0 = automatic; 1= manual; 2= semi-automatic	0	0	2	-	•	•
M	AtL	Type of low pressure switch alarm reset, line 1 – see AtH	0	0	2	-	•	•
M	AtLb	Type of low pressure switch alarm reset, line 2 – see AtH	0	0	2	-	•	-
M	AtLn	Evaluation time for switching from semi-automatic to manual reset for low pressure alarms	60	0	999	min	•	•
M	HPn	Number of activations for switching from automatic to manual reset for high pressure alarm from pressure switch	3	0	9	-	•	•
M	LPn	Number of activations for switching from automatic to manual reset for low pressure alarm from pressure switch	3	0	9	-	•	•

Tab. 8.g

Pressure alarms from probe

The probe pressure alarms all have automatic reset, and the activation threshold can be set for each alarm; the return differential is fixed at 1 bar/psi, as shown in the example in the figure. Moreover, for each alarm, a specific activation delay can be set. For control by temperature, the alarm thresholds taken into consideration are those set as temperature, converted to pressure. See the Alarm list for the effects of each probe pressure alarm.

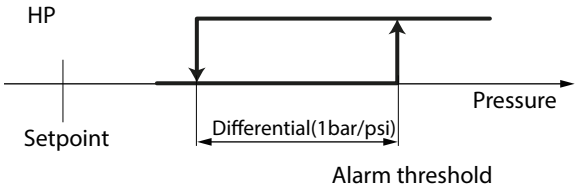


Fig. 8.b

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
M	HPE	High pressure alarm from probe delay time	60	0	999	s	•	•
M	HPt	High pressure alarm from probe threshold	25/362 (110/1595)	-1/-14.5	150/2175 (*)	barg/psig	•	•
M	HPt_T	High pressure alarm from probe threshold, expressed as a temperature	55/131 (43/109)	-99.9/-147	150/302	°C/°F	•	•
M	HSe	High suction pressure from probe alarm delay, line 1	60	0	999	s	•	•
M	HSeb	High suction pressure from probe alarm delay, line 2	60	0	999	s	•	-
M	HSt	High suction pressure alarm from probe threshold, line 1	9.3/134 (35/507)	-1/-14.5	60/870 (150/2175 *)	barg/psig	•	•
M	HSt_T	High suction pressure alarm from probe threshold, line 1, expressed as a temperature	20/68	-99.9/-147	150/302	°C/°F	•	•
M	HStb	High suction pressure alarm from probe threshold, line 2	9.3/134	-1/-14.5	60/870	barg/psig	•	-
M	HStb_T	High suction pressure alarm from probe threshold, line 2, expressed as a temperature	25/77	-99.9/-147	150/302	°C/°F	•	-
M	HtA	High ambient temperature alarm threshold	50/122	LtA	99.9/211	°C/°F	•	•
M	HtE	High outside temperature alarm threshold	50/122	LtE	99.9/211	°C/°F	•	•
M	LDe	Low discharge pressure alarm from probe delay	60	0	999	s	•	•
M	LDt	Low discharge pressure alarm from probe threshold	0	-1/-14.5	150/2175 (*)	barg/psig	•	•
M	LDt_T	Low discharge pressure alarm from probe threshold, expressed as a temperature	-45/-49	-99.9/-147	150/302	°C/°F	•	•
M	LPE	Low suction pressure from probe alarm delay, line 1	60	0	999	s	•	•
M	LPEb	Low suction pressure from probe alarm delay, line 2	60	0	999	s	•	-
M	LPt	Low suction pressure alarm from probe threshold, line 1 (-1= alarm disabled)	0 (20/290)	-1/-14.5	150/2175 (*)	barg/psig	•	•
M	LPt_T	Low suction pressure alarm from probe threshold, line 1, expressed as a temperature	-45/-49	-99.9/-147	150/302	°C/°F	•	•
M	LPtb	Low suction pressure alarm from probe threshold, line 2 (-1= alarm disabled)	0	-1 -14.5	150/2175 (*)	barg/psig	•	-
M	LPtb_T	Low suction pressure alarm from probe threshold, line 2, expressed as a temperature	-45/-49	-99.9/-147	150/302	°C/°F	•	-
M	LtA	Low ambient temperature alarm threshold	-20/-4	-99.9/-147	HtA	°C/°F	•	•
M	LtE	Low outside temperature alarm threshold	-20/-4	-99.9/-147	HtE	°C/°F	•	•
M	P11	Low suction temperature alarm threshold, line 1	-5/-23	-99.9/-147	150/302	°C/°F	•	•
M	P11B	Low suction temperature alarm threshold, line 2	-5/-23	-99.9/-147	150/302	°C/°F	•	-

Tab. 8.h

8.3.3 Temperature alarms

If the corresponding probes have been configured using the "/F" parameters µRack manages various probe temperature alarms:
- High discharge temperature, line 1 (HC)
- High discharge temperature, line 2 (HCb, HFC models only)
- Low suction temperature, line 1 (LSA)
- Low suction temperature, line 2 (LSB, HFC models only)
- High outside temperature (HiE)
- Low outside temperature (LiE)
- High ambient temperature (HiA)
- Low ambient temperature (LiA)

For the high discharge temperature alarms, the thresholds Htt and Httb can be set, while for the other alarms the thresholds are fixed, as shown in the table.

Alarm	Threshold
LSA	-5 °C/ 23 °F
LSB	-5 °C/ 23 °F
HiE	50 °C/ 122 °F
LiE	-20 °C/ -4 °F
HiA	50 °C/ 122 °F
LiA	-20 °C/ -4 °F

Finally, for the low suction temperature alarms, the activation delays LSd and LSdb can be set.

8.3.4 Device maintenance request

µRack manages the maintenance requests on exceeding the operating hour threshold for devices AM1…AMb and FM1…FM4. The operating hour threshold for the compressors is the same for line 1 and line 2 (parameters HMP and HMPb) and for the fans (parameter FMP), while the counter is reset individually for each device, using parameters HMR1…HMRB and FMr1…FMr4.

If the thresholds HMP, HMPb and FMP are set to zero, the corresponding maintenance requests are disabled.

User	Code	Description	Def. (Def. CO_2)	Min. (Min. CO_2)	Max. (Max. CO_2)	UOM	HFCs	CO_2
S	FMP	Maintenance alarm threshold for condenser fans, expressed in hundreds of hours (0 = alarm disabled)	0	0	320	hx100	•	•
S	FMr1	Reset operating hours, fan 1	0	0	1	-	•	•
S	FMr2	Reset operating hours, fan 2	0	0	1	-	•	•
S	FMr3	Reset operating hours, fan 3	0	0	1	-	•	•
S	FMr4	Reset operating hours, fan 4	0	0	1	-	•	•
S	HMP	Maintenance alarm threshold for line 1 compressors, expressed in hundreds of hours (0 = alarm disabled)	0	0	999	hx100	•	•
S	HMPB	Maintenance alarm threshold for line 2 compressors, expressed in hundreds of hours (0 = alarm disabled)	0	0	999	hx100	•	-
S	HMR1	Reset operating hours, compressor 1 line 1	0	0	1	-	•	•
S	HMR2	Reset operating hours, compressor 2 line 1	0	0	1	-	•	•
S	HMR3	Reset operating hours, compressor 3 line 1	0	0	1	-	•	•
S	HMR4	Reset operating hours, compressor 4 line 1	0	0	1	-	•	•
S	HMRA	Reset operating hours, compressor 1 line 2	0	0	1	-	•	-
S	HMRB	Reset operating hours, compressor 2 line 2	0	0	1	-	•	-

Tab. 8.i

8.4 Alarm list

Code	Description	Reset	Effect	Priority	Delay	No. of attempts	Period for eval. (s)	Troubleshooting	HFCs	CO_2
AC1	Compressor 1 fault from DIN, line 1	Par. Atc	Switch off comp. 1 line 1	Line 1 alarm	Par. cAD	-	-	Check the status of compressors 1 to 4	•	•
AC2	Compressor 2 fault from DIN, line 1	Par. Atc	Switch off comp. 2 line 1	Line 1 alarm	Par. cAD	-	-			
AC3	Compressor 3 fault from DIN, line 1	Par. Atc	Switch off comp. 3 line 1	Line 1 alarm	Par. cAD	-	-			
AC4	Compressor 4 fault from DIN, line 1	Par. Atc	Switch off comp. 4 line 1	Line 1 alarm	Par. cAD	-	-			
ACA	Compressor 1 fault from DIN, line 2	Par. Atc	Switch off comp. 1 line 2	Line 2 alarm	Par. cAD	-	-	Check status of compressor 1/2 on line 2	•	-
ACb	Compressor 2 fault from DIN, line 2	Par. Atc	Switch off comp. 2 line 2	Line 2 alarm	Par. cAD	-	-			
AEo	EVD driver offline	A	Switch off the unit	Serious unit alarm	5 s	-	-	• Check the connection to the EVD driver • Check that the EVD driver is powered	-	•
AF1	Fan 1 fault	Par. AtF	Switch off fan 1	Alarm	Par. Fod	-	-	Check the conditions of the condenser fans	•	•
AF2	Fan 2 fault	Par. AtF	Switch off fan 2	Alarm	Par. Fod	-	-			
AF3	Fan 3 fault	Par. AtF	Switch off fan 3	Alarm	Par. Fod	-	-			
AF4	Fan 4 fault	Par. AtF	Switch off fan 4	Alarm	Par. Fod	-	-			
AM1	Compressor 1 maintenance request, line 1	M	-	Warning	No	-	-	• Check the compressor operating hours • Check the compressor maintenance threshold	•	•
AM2	Compressor 2 maintenance request, line 1	M	-	Warning	No	-	-			
AM3	Compressor 3 maintenance request, line 1	M	-	Warning	No	-	-			
AM4	Compressor 4 maintenance request, line 1	M	-	Warning	No	-	-			
AMA	Compressor 1 maintenance request, line 2	M	-	Warning	No	-	-	• Check the operating hours of the compressors on line 2 • Check the maintenance threshold of the compressors on line 2	•	-
AMb	Compressor 2 maintenance request, line 2	M	-	Warning	No	-	-			
CfU	Analogue input configuration error (*)	A	-	Warning	0s	-	-	Check if there are multiple analogue inputs configured on the same channel	•	•
CfD	Digital input configuration error (*)	A	-	Warning	0s	-	-	Check if there are multiple digital inputs configured on the same channel	•	•
CfA	Analogue output configuration error (*)	A	-	Warning	0s	-	-	Check if there are multiple analogue outputs configured on the same channel	•	•
CfO	Digital output configuration error (*)	A	-	Warning	0s	-	-	Check if there are multiple digital outputs configured on the same channel	•	•
dA	External alarm from DIN with delay	A	Switch off the unit	Serious unit alarm	Par. A11	-	-	• Check the connected external devices • Check the settings of "Dib" and "rIb"	•	•
dE1	EVD driver battery alarm	A	-	Warning	-	-	-	If the error persists for more than 3 hours, replace the battery (alarm visible only if the driver is connected to the EVDBAT00400 module and with a suitably configured digital input, see manual +0300006EN)	-	•
dE2	Valve B driver disconnected alarm	A	Unit shutdown or FGV control disabled	Serious unit alarm (**)	-	-	-	Replace the EVD driver	-	•
dE3	Valve A motor alarm	A	Unit shutdown or FGV control disabled	Serious unit alarm (**)	-	-	-	• Check the connections and the status of the motor. • Power the driver off and on again	-	•
dE4	Valve B motor alarm	A	Unit shutdown or FGV control disabled	Serious unit alarm (**)	-	-	-			
dE5	Valve emergency closing alarm	A	The valves are closed	Alarm	-	-	-	Check the power supply to the EVD driver and µRack	-	•
dE6	Valve emergency closing not completed alarm	A	-	Warning	-	-	-			
dEE	EVD driver EEPROM damaged alarm	A	Switch off the unit	Serious unit alarm	-	-	-	Replace the EVD driver	-	•
E1	Probe 1 fault alarm	A	(***)	Alarm	10s	-	-	• Check the physical wiring of inputs S1 to S7 • Check the input group type settings (/P1, /P2, /P3, /P4) • Check the limits for active probes	•	•
E2	Probe 2 fault alarm	A	(***)	Alarm	10s	-	-			
E3	Probe 3 fault alarm	A	(***)	Alarm	10s	-	-			
E4	Probe 4 fault alarm	A	(***)	Alarm	10s	-	-			
E5	Probe 5 fault alarm	A	(***)	Alarm	10s	-	-			
E6	Probe 6 fault alarm	A	(***)	Alarm	10s	-	-			
E7	Probe 7 fault alarm	A	(***)	Alarm	10s	-	-			
ES1	EVD driver probe 1 malfunction alarm	A	(***)	Alarm	10s	-	-	• Check the physical wiring of inputs S1...S4 on the EVD driver • Check the input group type settings (/P7, /P8 • Check the limits for active probes	-	•
ES2	EVD driver probe 2 malfunction alarm	A	(***)	Alarm	10s	-	-			
ES3	EVD driver probe 3 malfunction alarm	A	(***)	Alarm	10s	-	-			
ES4	EVD driver probe 4 malfunction alarm	A	(***)	Alarm	10s	-	-			

Code	Description	Reset	Effect	Priority	Delay	No. of attempts	Period for eval. (s)	Troubleshooting	HFCs	CO_2
ETC	RTC fault	A	Disable the scheduler	Alarm	No	-	-	• The date and time have been lost. Set them again • If the error is repeated, the RTC battery may be discharged or the RTC chip damaged.	•	•
FM1	Fan 1 maintenance request	M	-	Warning	No	-	-	• Check the fan operating hours • Check the fan maintenance threshold	•	•
FM2	Fan 2 maintenance request	M	-	Warning	No	-	-			
FM3	Fan 3 maintenance request	M	-	Warning	No	-	-			
FM4	Fan 4 maintenance request	M	-	Warning	No	-	-			
GHI	Generic alarm 1 - High	Par. GFA_r	see par. GFA_AA	Par. GFA_ AIType	Par. GFA_De	Par. GFA_n	Par. GFA_P	• Check the probe associated with the generic alarm function (GFA_1 and GFA_2) • Check the threshold (GFA_ Hth)	•	•
GLO	Generic alarm 1 - Low	Par. GFA_r	see par. GFA_AA	Par. GFA_ AIType	Par. GFA_De	Par. GFA_n	Par. GFA_P	• Check the probe associated with the generic alarm function (GFA_1 and GFA_2) • Check the threshold (GFA_ Lth)	•	•
HCs	High discharge temperature alarm, line 1	A	Shut down line 1	Serious alarm line 1	No	-	-	• Check for oil in suction line 1 • Check the setting of Htt	•	•
HCb	High discharge temperature alarm, line 2	A	Shut down line 2	Serious alarm line 2	No	-	-	• Check for oil in suction line 2 • Check the setting of Httb	•	-
HiA	High ambient temperature alarm	A	-	Alarm	No	-	-	• Check the ambient temperature measurement • Check the connection of the ambient temperature probe • Check the high ambient temperature alarm settings	•	•
HiE	High outside temperature alarm	A	-	Alarm	No	-	-	• Check the outside temperature measurement • Check the connection of the outside temperature probe • Check the high outside temperature alarm settings	•	•
HP	High condensing pressure alarm from probe	A	Unit shutdown, fans stay on at maximum speed for the time APd	Serious unit alarm	Par. HPE	-	-	• Check the connection and reading of the discharge pressure probe • Check the condition of the condenser fan: there may be damage. • Check the condition of the condenser: it may be full of liquid after being inactive for a long time • Check the compressor discharge line: it may be blocked with dirt. • Check the oil separator: it may be mechanically blocked, preventing the refrigerant from flowing	•	•
HP1	High condensing pressure from pressure switch	Par. AtH	Unit shutdown, fans stay on at maximum speed for the time APd	Serious unit alarm	No	Par. HPn	60 min	• Check the connection and condition of the high pressure switch • Check the condition of the condenser fan: there may be damage. • Check the condition of the condenser: it may be full of liquid after being inactive for a long time • Check the compressor discharge line: it may be clogged with dirt. • Check the oil separator: it may be mechanically blocked, preventing the refrigerant from flowing	•	•
HPG	High pressure tank	A	see par. HPGE	Alarm	HPGt	-	-	• Check the tank pressure measurement • Check the connection of the tank pressure probe • Check the tank high pressure alarm settings	-	•
HPv	High condensing pressure prevention	A (R)	-	Warning	No	5	Par. Pvd	• Check that the fans are working correctly • Check the settings of Pvt, Pvd, cLdP, Pvt_T • Check that the condensing pressure probe is working	•	•

Code	Description	Reset	Effect	Priority	Delay	No. of attempts	Period for eval. (s)	Troubleshooting	HFCs	CO_2
HS	High suction pressure alarm from probe, line 1	A	-	Line 1 alarm	Par. HSe	-	-	• Check the position of the suction pressure probe • Check the condition of the expansion valves on the cabinet side • Check the compressor control and activation settings • Check the high suction pressure settings (threshold, delay)	•	•
HSb	High suction pressure alarm from probe, line 2	A	-	Line 2 alarm	Par. HSeb	-	-	• Check the position of the suction pressure probe on line 2 • Check the condition of the expansion valves on the cabinet side, line 2 • Check the control and activation settings for the compressors on line 2 • Check the high suction pressure settings (threshold, delay) on line 2	•	-
IA	Immediate external alarm from DIN	A	Switch off the unit	Serious unit alarm	No	-	-	• Check the connected external devices (e.g. HP or LP switches, common compressor alarms). • Check the settings of "DIA" and "RiA".	•	•
LDP	Low condensing pressure alarm from probe	A	-	Alarm	Par. LDe	-	-	• Check the position of the discharge pressure probe • Check for any leaks on the discharge piping • Check the fan activation settings • Check the low discharge pressure settings (threshold, delay)	•	•
LiA	Low ambient temperature alarm	A	-	Alarm	No	-	-	• Check the ambient temperature measurement • Check the connection of the ambient temperature probe • Check the high ambient temperature alarm settings	•	•
LiE	Low outside temperature alarm	A	-	Alarm	No	-	-	• Check the outside temperature measurement • Check the connection of the outside temperature probe • Check the high outside temperature alarm settings	•	•
LP	Low suction pressure alarm from probe, line 1	A	Shut down line 1	Serious alarm line 1	Par. LPE	-	-	• Check the connection and reading of the suction pressure probe on line 1 • Check the condition of the cabinets and cold rooms on line 1: the expansion valves may be closed. • Check the settings of the compressors on line 1, adjusting compressor control if the system is too slow in switching off the compressors.	•	•
LP1	Low suction pressure alarm from pressure switch, line 1	Par. AtL	Shut down line 1	Serious alarm line 1	No	Par. LPn	Par. AtLn	• Check the connection and condition of the low pressure switch on line 1 • Check the condition of the cabinets and cold rooms on line 1: the expansion valves may be closed. • Check the settings of the compressors on line 1, adjusting compressor control if the system is too slow in switching off the compressors.	•	•
LP2	Low suction pressure alarm from pressure switch, line 2	Par. AtLb	Shut down line 2	Serious alarm line 2	No	Par. LPn	Par. AtLn	• Check the connection and condition of the low pressure switch on line 2 • Check the condition of the cabinets and cold rooms on line 2: the expansion valves may be closed. • Check the settings of the compressors on line 2, adjusting compressor control if the system is too slow in switching off the compressors.	•	-

Code	Description	Reset	Effect	Priority	Delay	No. of attempts	Period for eval. (s)	Troubleshooting	HFCs	CO_2
LPb	Low suction pressure alarm from probe, line 2	A	Shut down line 2	Serious alarm line 2	Par. LPEb	-	-	• Check the connection and reading of the suction pressure probe on line 2 • Check the condition of the cabinets and cold rooms on line 2: the expansion valves may be closed. • Check the settings of the compressors on line 2, adjusting compressor control if the system is too slow in switching off the compressors.	•	-
LQL	Liquid level alarm	A	-	Alarm	Par. LLd	-	-	• Check the refrigerant charge • Check the position of the liquid level sensor	•	•
LS2	Low superheat alarm, line 2	Par. AtSb	Shut down line 2	Serious alarm line 2	Par. Lhdb	Par. SHn	Par. SHLn	• Check the suction pressure and suction temperature readings on line 2 • Check the installation of the suction pressure and temperature probes on line 2 (position, transducer housing, ...) • Check the LSH settings (parameters P72, P82) • Check the operation of the expansion valves on the cabinets and in the cold rooms on line 2.	•	-
LSA	Low suction temperature alarm, line 1	A	-	Alarm	Par. LSd	-	-	• Check the reading of the suction temperature probe on line 1 • Check the installation of the suction temperature probe on line 1 (position, transducer housing, ...) • Check the LSA settings (P11, P12) • Check the operation of the expansion valves on the cabinets and in the cold rooms on line 1 • Check control of the cabinets and cold rooms (temperature stability) on line 1	•	•
LSB	Low suction temperature alarm, line 2	A	-	Alarm	Par. Lsdb	-	-	• Check the reading of the suction temperature probe on line 1 • Check the installation of the suction temperature probe on line 1 (position, transducer housing, ...) • Check the LSB settings (P31, P32) • Check the operation of the expansion valves on the cabinets and in the cold rooms on line 1 • Check control of the cabinets and cold rooms (temperature stability) on line 1	•	-
LSH	Low superheat alarm, line 1	Par. AtS	Shut down line 1	Serious alarm line 1	Par. Lshd	Par. SHn	Par. SHLn	• Check the suction pressure and suction temperature readings on line 1 • Check the LSH settings (parameters P7, P8) • Check the operation of the expansion valves on the cabinets and in the cold rooms on line 1	•	•
MAn	Test mode or manual activation of loads in progress	A	-	Warning	-	-	-	• Check if there are devices in manual activation mode • Check if there are any outputs in test mode	•	•
SFS	FGV control temperature probe not working	A	Switch off the unit	Serious unit alarm	10 s	.	.	• Check the tank pressure probe reading • Check the installation of the tank pressure probe (location, transducer housing, ...)	-	•

Code	Description	Reset	Effect	Priority	Delay	No. of attempts	Period for eval. (s)	Troubleshooting	HFCs	CO_2
SHS	HPV control temperature probe not working	A	Switch off the unit	Serious unit alarm	10 s	.	.	• Check the gas cooler temperature probe reading • Check the installation of the gas cooler temperature probe (position, transducer housing, ...) • Check the outside temperature probe reading • Check the installation of the outside temperature probe (position, transducer housing, ...)	-	•
uGH	Generic alarm 1 - High	A	see par. GFA_WA	Warning	Par. GFA_WDe	-	-	• Check the probe associated with the generic alarm function (GFA_1 and GFA_2) • Check the threshold (GFA_WHth)	•	•
uGL	Generic alarm 1 - Low	A	see par. GFA_WA	Warning	Par. GFA_WDe	-	-	• Check the probe associated with the generic alarm function (GFA_1 and GFA_2) • Check the threshold (GFA_WLth)	•	•
vnCA	EVD driver incompatible with valve A alarm	A	Unit shutdown or FGV control disabled	Serious unit alarm (**)	-	-	-	• Check the type of valve A connected and configured	-	•
vnCB	EVD driver incompatible with valve B alarm	A	Unit shutdown or FGV control disabled	Serious unit alarm (**)	-	-	-	• Check the type of valve B connected and configured	-	•
vPHP	Distance from HPV set point alarm	A	-	Alarm	Pb2	-	-	• Check the gas cooler pressure probe reading • Check the installation of the gas cooler pressure probe (position, transducer housing, ...) • Check the settings (Pb1, Pb2) • Check operation of the HPV	-	•
vPFG	Distance from FGV set point alarm	A	-	Alarm	Pb2B	-	-	• Check the receiver pressure probe reading • Check the installation of the receiver pressure probe (location, transducer housing, ...) • Check the settings (Pb1B, Pb2B) • Check operation of the FGV	-	•

Tab. 8.j

(*) **Caution:** the alarm only signals the overlapping of multiple functions on the same physical channel. The user is responsible for verifying that the settings are correct.

(**): depending on the association of valves A and B with the HPV and FGV, the effect of the alarm can be to shut down the unit (HPV error) or to disable tank pressure control (FGV error).

(***): the alarm refers to the physical channel on the controller. The effect of the probe alarm will differ depending on the type of input selected.

9. TECHNICAL SPECIFICATIONS

	Panel version, BASIC models (P/N U20R00M-RK0*80)	DIN version, MEDIUM, ADVANCED & CO2 models (P/N U20R00MRK0*90, U20R00MRK0300 and U00000MRT0400)
Physical specifications		
Dimensions	See figures (par. 2.2.1)	See figures (par. 2.3.1)
Case	Polycarbonate	Polycarbonate
Mounting	panel	DIN rail
Ball pressure test temperature	125°C	125°C
Ingress protection	IP20 (rear) - IP65 (front)	IP00
Front cleaning	Use soft, non-abrasive cloth and neutral detergent or water	-
Environmental conditions		
Storage conditions	-40T80°C, <90 % RH non-condensing	-40T80°C, <90 % RH non-condensing
Operating conditions	-20T60°C, <90 % RH non-condensing	-20T60°C, <90 % RH non-condensing
Electrical specifications		
Rated power supply	24 Vac/dc (SELV or PELV power supply, Class 2)	MEDIUM, ADVANCED: 24 Vac/dc (SELV or PELV power supply, Class 2) CO_2: 115/230 Vac
Operating power supply voltage	24 Vac/dc, +10% -15%	MEDIUM, ADVANCED: 24 Vac/dc, +10% -15% CO_2: 115/230 Vac, +10% -15%
Input frequency (AC)	50/60 Hz	50/60 Hz
Maximum current draw	600 mA rms	Models without ExV valve driver: 600 mArms Models with ExV valve driver: 1.25 Arms
Power for transformer sizing	15 VA	Models without valve driver: 15 VA Models with valve driver: 30 VA
Clock	precision: ± 50 ppm; min time maintenance after power off: 6 months	precision: ± 50 ppm; min time maintenance after power off: 6 months
Software class and structure	A	A
Pollution degree	3	3
Class of protection against electric shock	To be incorporated in class I or II appliances	To be incorporated in class I or II appliances
Type of action and disconnection	1.C	1.C
Rated impulse voltage	relay outputs: 4 kV; 24 V input: 0.5 kV	MEDIUM, ADVANCED: relay outputs: 4 kV; 24 V input: 0.5 kV CO_2: relay outputs: 4 kV; 115-230 V input: 4 kV
Surge immunity category	relay outputs: III; 24 V input: II	MEDIUM, ADVANCED: relay outputs: III; 24 V input: II CO_2: relay outputs: III; 115-230V input III
Control device construction	Device to be incorporated	Device to be incorporated
Terminal block	Plug-in male-female. Wire sizes: see the connector table	Plug-in male-female. Wire sizes: see the connector table
Purpose of the controller	Electrical operating control	Electrical operating control
User interface		
Buzzer	built-in	not included on the controller, built into the remote HMI interface (ADVANCED and CO2 models)
Display	LED 2 rows, decimal point, and multi-function icons	LED 2 rows, decimal point, and multi-function icons
Connectivity		
NFC	Max distance 10 mm, variable according to the mobile device used	Max distance 10 mm, variable according to the mobile device used
Bluetooth Low Energy	Max distance 10m, variable according to the mobile device used	Max distance 10m, variable according to the mobile device used
BMS serial interface	Modbus® over RS485, not opto-isolated	Modbus® over RS485, not opto-isolated
FieldBUS serial interface.	Modbus® over RS485, not opto-isolated	Modbus® over RS485, not opto-isolated
HMI interface	Modbus® over RS485, not opto-isolated	Modbus® over RS485, not opto-isolated

Analogue inputs (Lmax=10m)

J2	**S1, S2, S3:** PT1000 / NTC **S5:** NTC / 0-5 V / 4-20 mA / NTC HT / 0.5-4.5 Vrat	**PT1000**: • resolution 0.1 °C; • 1 kΩ@0°C; • error ±1°C in the range -60+120°C; **NTC**: • resolution 0.1°C; • 10 kΩ@25°C; • beta 3435; • error ±1°C in the range -50T50°C, ±3°C in the range 50T90°C; **0-5 V, 0-10 V, 0.5-4.5 Vrat**: • error 2% fs, typical 1%; **4-20 mA**: error 5% fs, typical 1%; **NTC HT**: • resolution 0.1 °C; • 50 kΩ@25°C; • beta 3977; • error: ±1.5°C in the range -15T115°C, ±4°C in the range 40T-15°C and 115T150°C:	**PT1000**: • resolution 0.1 °C; • 1 kΩ@0°C; • error ±1°C in the range -60+120°C; **NTC**: • resolution 0.1°C; 10 kΩ @ 25°C, beta 3435, error:±1°C in the range -50T80°C, ±1.5°C in the range 80T105°C; **0-5 V, 0-10 V, 0.5-4.5 Vrat**: • error 2% fs, typical 1%; **4-20 mA**: • error 5% fs, typical 1%; **NTC HT**: • resolution 0.1 °C; • 50 kΩ@25°C; • beta 3977; • error ± 1°C in the range -30T50; ± 1.3°C in the range 50T85; ± 1.9°C in the range 85T120; ± 2.4°C in the range 120T150. Also see the manual +030220655.
J3	**S4:** NTC / 0-5 V / 4-20 mA / NTC HT / 0.5-4.5 Vrat **S6:** PT1000 / NTC / 0-5 V / 4-20 mA / 0-10 V / NTC HT / 0.5-4.5 Vrat		
J9	**S7**: NTC (MEDIUM and ADVANCED models only)	-	

Digital inputs (Lmax=10m)

		Panel version, BASIC models (P/N U20R00M-RK0*80)	DIN version, MEDIUM, ADVANCED & CO2 models (P/N U20R00MRK0*90, U20R00MRK0300 and U00000MRT0400)
J2	ID1(*)	Voltage-free contact, not optically-isolated, typical closing current 6 mA, voltage with contact open 13 V, max contact resistance 50 Ω.	Voltage-free contact, not optically-isolated, typical closing current 6 mA, voltage with contact open 13 V, max contact resistance 50 Ω.
J2	ID2		
J3	ID3(*), ID4, ID5		
J9	ID6 (MEDIUM and ADVANCED models only)	-	
(*) Fast digital input: 0-2 kHz; error 2% fs			

Valve output (Lmax= 2 m, 9 m with shielded cable)

J14 (ADVANCED model only)	-	CAREL E*V unipolar valve power supply: 13 Vdc, min winding resistance 40 Ω (not used)

Analogue outputs (Lmax=10m)

J2	Y1, Y2	-	0 to 10 Vdc: 10 mA max
J12	Y3, Y4 (CO_2 model only)		

Digital outputs (Lmax=10m)

Notice: the sum of current through NO1, NO2, NO3, NO4 must not exceed 10 A; in compliance with IEC/EN60079-15, on the DIN version it must not exceed 8 A.

J6	NO1, NO2, NO3, NO4	**5A:** EN60730: 5 A resistive, 250 Vac, 50k cycles; 4(1), 230 Vac, 100k cycles; 3 (1), 230 Vac, 100k cycles UL60730: 5A resistive, 250Vac, 30k cycles; 1FLA, 6LRA, 250Vac, 30k cycles; Pilot Duty C300, 30k cycles	**5A:** EN60730: 5 A resistive, 250 Vac, 50k cycles; 4(1), 230 Vac, 100k cycles; 3 (1), 230 Vac, 100k cycles UL60730: 5A resistive, 250Vac, 30k cycles; 1FLA, 6LRA, 250Vac, 30k cycles; Pilot Duty C300, 30k cycles
J7	NO5		
J11	NO6 (MEDIUM and ADVANCED models only)	-	**SSR:** solid state relay. 0.4 A 100-240 Vac 50/60 Hz

Emergency power supply

J10: Optional Ultracap module (ADVANCED and CO_2 models only)	-	13 Vdc ±10%

Probe (Lmax=10 m) and terminal (Lmax=2 m) power supplies

5V	5 Vdc ± 2% to power the 0 to 5 V ratiometric probes. Max current delivered: 35 mA protected against short-circuits	5 Vdc ± 2% to power the 0 to 5 V ratiometric probes. Max current delivered: 35 mA protected against short-circuits
+V	8-11 V to power the 4-20 mA current probes. Maximum current delivered: 80 mA protected against short-circuits	8-11 V to power the 4-20 mA current probes. Maximum current delivered: 80 mA protected against short-circuits
VL	Not used	Not used
J8	User terminal power supply; 13 Vdc ± 10%, 250 mA max	User terminal power supply; 13 Vdc ± 10%, 250 mA max

Serial ports

BMS	• Lmax=500 m, shielded cable (RS485 1½ twisted pair) (1) • Integrated • Protocol: Modbus® • HW driver: asynchronous half duplex RS 485 • Not optically-isolated • 3-pin plug-in connector, 3.81 mm pitch • Max data rate: 115200 bits/s • Maximum number of connectable devices: 16	• Lmax=500 m, shielded cable (RS485 1½ twisted pair) (1) • Integrated • Protocol: Modbus® • HW driver: asynchronous half duplex RS 485 • Not optically-isolated • 3-pin plug-in connector, 3.81 mm pitch • Max data rate: 115200 bits/s • Maximum number of connectable devices: 16
FieldBus	• Lmax=10 m, shielded cable (RS485 1½ twisted pair) (1) • Integrated • HW driver: asynchronous half duplex RS 485. Typical reception resistance 96 kohms, equal to 1/8 of unit load, i.e. 1/256 of maximum load applicable on the line • Not optically-isolated • Max data rate: 19200 bits/s • Maximum number of connectable devices: 16 • Protocol: Modbus® RTU	• Lmax=10 m, shielded cable (RS485 1½ twisted pair) (1) • Integrated • HW driver: asynchronous half duplex RS485. Typical reception resistance 96 kohms, equal to 1/8 of unit load, i.e. 1/256 of maximum load applicable on the line • Not optically-isolated • Max data rate: 19200 bits/s • Maximum number of connectable devices: 16 • Protocol: Modbus® RTU

Cable lengths

Analogue inputs/outputs, digital inputs/outputs, probe power	<10 m	<10 m
Valve	< 2 m, < 9m with shielded cable	< 2 m, < 9m with shielded cable
BMS and Fieldbus serial cables	<500 m with shielded cable (RS485 1½ twisted pair) (1)	<500 m with shielded cable (RS485 1½ twisted pair) (1)

Conformity

Electrical safety	UL/IEC	EN/UL 60730-1, EN/UL 60335-1
Electromagnetic compatibility	CE	EN 61000-6-1, EN 61000-6-2, EN 61000-6-3, EN 61000-6-4
Radio	Red	EN301489-1/EN301489-17, EN300328
	FCC	Contains FCC ID: WAP2001
	IC	Contains ICs: 7922A-2001
	ANATEL	ID: 03780-21-05684 Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados

	Panel version, BASIC models (P/N U20R00M-RK0*80)	DIN version, MEDIUM, ADVANCED & CO2 models (P/N U20R00MRK0*90, U20R00MRK0300 and U00000MRT0400)
Applications with flammable refrigerant gases (*) (*) Applicable to products with revision higher than 1.5xx.	The use of this product (except for SSR versions) with type A3, A2 or A2L flammable refrigerants, has been evaluated and found to comply with the following requirements: • Annex CC of IEC 60335-2-24:2010, referred to in clause 22.109, and annex BB of IEC 60335-2-89:2019 referred to in clause 22.113; components that produce arcs or sparks during normal operation have been tested and found to comply with the requirements of UL/IEC 60079-15; • IEC 60335-2-24:2010 (clause 22.110) • IEC 60335-2-40:2018 (clauses 22.116, 22.117) • IEC 60335-2-89:2019 (clause 22.114) The surface temperatures of all the components have been measured and verified during the tests required by IEC 60335 cl. 11 and 19 and found to be no higher than 268 °C. The versions with SSR comply with IEC 60335-2-40:2018 when using A2L refrigerants (e.g. R32); in particular, electronic components that may ignite a flame under normal operating conditions comply with clause JJ, and the maximum surface temperature of all components does not exceed 268°C, under normal operating conditions. The acceptability of these controllers in the final applications where flammable refrigerants are expected to be used must be reviewed and evaluated in the final application.	

Notice: (1) it is recommended to use a BELDEN 8761 cable (AWG 22).

9.5 Connector/cable table

Ref.	Description	Wiring terminals	Wire cross-section (mm^2)	Lmax (m)
J1	Controller power supply	Panel model: removable terminal, screw, 2-pin, pitch 5.08	0.5 to 1.5	10
		DIN rail model: removable terminal, screw, 2-pin, pitch 5.08	0.21 to 3.31	10
J2	Inputs S1, S2, S3, S5, ID1, ID2; outputs Y1, Y2	10-pin Microfit crimp connector	0.05 to 0.52	10
J3	Inputs S4, S6, ID3, ID4. ID5	8-pin Microfit crimp connector	0.05 to 0.52	10
J4	BMS port	Plug-in screw terminal, 3-pin, pitch 3.81	0,081 to 1.31	500
J5	Fieldbus port	Plug-in screw terminal, 3-pin, pitch 3.81	0,081 to 1.31	10
J6	Outputs NO1, NO2, NO3, NO4	6-pin Microfit crimp connector	0.5 to 1.31	10
J7	Output NO5	3-pin Microfit crimp connector	0.5 to 1.31	10
J8	Unit terminal	Connection cable part number: ACS00CB000010 (L=3m) /20 (L=1.5m)	0.13	2 (*)
J9	Inputs S7, ID6	4-pin Microfit crimp connector	0.05 to 0.52	10
J10	Ultracap	3-pin JST connector	0.13	2
J11	Output NO6	3-pin Microfit crimp connector	0.5 to 1.31	10
J12	Outputs Y3, Y4	4-pin Microfit crimp connector	0.05 to 0.52	10
J14	Unipolar ExV valve (not used)	CAREL unipolar ExV valve connector, pre-wired	-	2, 9 with shielded cable

Tab. 9.a

(*) device to be incorporated.

10. RELEASE NOTES

Software version - date	Manual version - date	Release
1.0.0; 30/09/2021	1.0; 31/08/2021	First
2.10; 25/01/2023	2.0; 30/01/2023	Second (complete revision)
2.3.4 (HFC); 1.0.0 (CO2)	3.0; 10-06-2024	Third (CO_2 model added; general revision)

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µRack +0300026EN rel. 3.0 - 10.06.2024