ENG

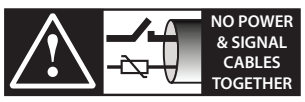
µChiller Process

Controller for process chillers

USER MANUAL

LEGGI E CONSERVA QUESTE ISTRUZIONI

READ AND SAVE THESE INSTRUCTIONS



READ CAREFULLY IN THE TEXT!

µChiller Process

+0300074EN - ENG

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GENERAL WARNINGS

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

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

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

DISPOSAL

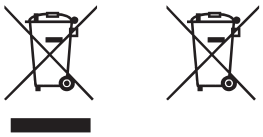


Fig. 1 Fig. 2

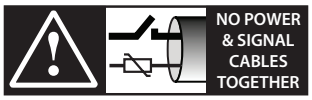
INFORMATION FOR USERS ON THE CORRECT HANDLING OF WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE)

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

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

Warranty on materials: 2 years (from production date, excluding consumables).
Approval: the quality and safety of CAREL S.p.A. products are guaranteed by the ISO 9001 certified design and production system.

IMPORTANT



READ CAREFULLY IN THE TEXT!

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

Key to the symbols:

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

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

Important: 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

µChiller Process is the Carel solution for complete management of air/water and water/water process chillers. The maximum configuration manages 2 compressors (*) in a single circuit. The distinctive element of µChiller Process is complete control of high-efficiency units through integrated management of two electronic valves (ExV) - expansion and hot gas bypass - and brushless BLDC compressors. This guarantees a prompt response of the compressor as well as higher protection and reliability, without however neglecting high unit efficiency. The user terminal allows wireless connectivity with mobile devices and is built-in on the panel mounted models, or sold separately on DIN rail mounted models. CAREL's "APPLICA" app, available on Google Play for the Android operating system and App Store for Apple devices, makes it easier to configure parameters and commission the unit in the field.

(*): 2 On/Off compressors or 1 BLDC compressor + 1 On/Off compressor.

1.1 Main functions

Ref.	Description
Main features	1 circuit and max 2 compressors
	Compressors in tandem configuration with possible BLDC compressor (*)
	Air/water chillers (A/W)
	Water/water chillers (W/W)
	Air-cooled condenser for A/W units
	Water-cooled condenser for W/W units
Hardware	Panel mounted model: management of ON-OFF compressors
	DIN rail model: ON-OFF compressor management and solid state relay output (SSR - 100-240 Vac)
	Enhanced DIN rail model: ON-OFF compressor management and solid state relay output (SSR - 100-240 Vac)
	High-efficiency DIN rail model: BLDC compressor management and solid state relay output (SSR - 100-240 Vac)
User interface	7-segment, 2-row LED display, communication via APPLICA app (compatible with NFC and BTLE) for mobile devices
Temperature control	PID with double parameters above/below the set point
	Control with tracking set point (also called "differential")
	Optional: dead band control on water delivery temp.
	Control with on-off or modulating hot gas bypass
	Set point compensation on outdoor temperature
Heating devices	Optional preheating function
	Heating device management as compressor capacity control
	On-off hot gas bypass management
	Modulating hot gas management (solenoid valve via SSR; 0-10 V modulating valve; ExV via valve driver)
Compressor rotation	FIFO or timed
Compressor management	Specific BLDC compressors (see list on KSA/SW&Support/Configuration & Updating software/ST Configuration/ BLDC compressors) Generic scroll compressors
	Generic scroll compressors
Oil management with BLDC	Oil recovery function (extended operation at part load)
	Oil equalisation (tandem with BLDC compressor)
Circuit destabilisation	Forced compressor rotation (extended operation at part load)
ExV driver	Built-in valve driver on enhanced and high efficiency models; can be configured as expansion or hot gas bypass
	External driver management via FieldBus port (all versions); • External EVD mini driver; can be configured as expansion or hot gas bypass • External EVD Evo driver; can be configured as expansion or hot gas bypass
Programming with time bands	Unit ON-OFF or 2nd set point (1 time band per day)
	"Noise reduction" function for condenser fans (1 time band per day)
User pumps	1/2 pumps
	Rotation by time or with pump overload alarm
	Cyclical activation during standby
Air/water-cooled condenser	On-off fan/pump control with compressor activation; stop 5 sec after the compressor
	On/off fan/pump control based on condensing temperature
	Modulating fan/pump control based on condensing temperature
	Optimised start-up to quickly bring the compressor(s) to steady operation
	Fan anti-block protection (harsh climate)
Prevent	Prevention of scroll compressor operating limits in relation to condensing and evaporation temperature
	Evaporator frost prevention
	Total management of the BLDC compressor envelope limits
Alarms	Management of automatic and manual reset according to alarm severity (see the chapter on Alarms)
	Alarm log (up to 40 events): alarm and reset date and time recorded
Connectivity/supervision	RS485 serial port
	Modbus RTU
	Baud rate up to 115200 bit/s
	Frame configurable by Parity (None, Even, Odd) and StopBits (1 or 2); Databits fixed at 8 bits.

Tab. 1.a

(*) the configuration envisaged requires the capacity of the ON/OFF compressor to be equal to 60% of the capacity of the BLDC

1.2 Models

P/N	Assembly	Connectivity	Compressor management:	Notes	Electronic expansion valve management
UCHBP000P0190	panel	NFC	On/Off	standard version	bipolar: with EVD Evolution driver; unipolar with EVD mini driver
UCHBP000P0200	panel	NFC, Bluetooth (BLE)	On/Off	standard version	bipolar: with EVD Evolution driver; unipolar with EVD mini driver
UCHBPL00P0200	panel	NFC, Bluetooth (BLE)	On/Off	Standard version + Logs**	bipolar: with EVD Evolution driver; unipolar with EVD mini driver
UCHBD000P1210	DIN rail	-	On/Off	standard version	bipolar: with EVD Evolution driver; unipolar with EVD mini driver
UCHBDL00P1210	DIN rail	-	On/Off	Standard version + Logs **	bipolar: with EVD Evolution driver; unipolar with EVD mini driver
UCHBDE00P1220	DIN rail	-	On/Off	enhanced version	unipolar: built-in with EVD mini driver; bipolar: with external EVD Evolution driver
UCHBDY00P1220	DIN rail	-	On/Off	enhanced version + Logs **	unipolar: with built-in EVD mini driver bipolar: with external EVD Evolution driver
UCHBDH00P1220	DIN rail	-	On-Off and BLDC	version version	unipolar: built-in with EVD mini driver; bipolar: with external EVD Evolution driver
UCHBDZ00P1220	DIN rail	-	On-Off and BLDC	High efficiency version + Logs**	unipolar: with built-in EVD mini driver bipolar: with external EVD Evolution driver

Tab. 1.a

Note: ** Vedi capitolo 8.3

1.3 Accessories

1.3.1 µChiller Process user terminal

For DIN rail mounted models (built-in on the panel model). The user terminal 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 for the Android operating system, see chapters "Commissioning" and "User interface"). For assembly, see the technical leaflet +0500146IE.

Fig. 1.a

P/N	Description
AX5000PD20A20	User terminal (NFC)
AX5000PD20A30	User terminal (NFC, Bluetooth BLE)
ACS00CB000020	Connection cable L=1.5 m
ACS00CB000010	Connection cable L=3 m

Tab. 1.b

1.3.2 EVD Evolution/EVD Evolution twin valve driver

The Enhanced and High Efficiency models have the driver built-into the controller, able to drive unipolar valves (up to Carel model E3V, with a cooling capacity less than 90-100kW); all versions can be connected to the external EVD Evolution driver to drive bipolar valves (with a higher cooling capacity).

µChiller Process can also feature a built-in EVD mini unipolar driver on all versions. Both the built-in and external drivers can be configured as desired for superheat control with a specific ExV installed upstream of the evaporator, or hot gas bypass control with an ExV typically installed between the compressor gas discharge pipe and the evaporator inlet pipe (immediately downstream of the thermostat).
All µChiller Process models can therefore simultaneously manage two ExVs with independent functions on the same circuit (hot gas and superheat).

Fig. 1.b

Fig. 1.c

P/N	Description
AX5000PD20A20	User terminal (NFC)
AX5000PD20A30	User terminal (NFC, Bluetooth BLE)
ACS00CB000020	Connection cable L=1.5 m
ACS00CB000010	Connection cable L=3 m

Tab. 1.b

1.3.3 Temperature probes

NTC probes for measuring the temperatures in the user circuit, the outdoor air or source, and the refrigeration circuit. NTC**HT probes are recommended for discharge temperature measurement (with BLDC compressors in heat pump mode).

µChiller Process can be configured to read PT1000 probes: grouped for the first set of analogue inputs (S1, S2, S3) and independently on universal analogue input S6. Analogue input S7 cannot be configured, as this is used exclusively for managing superheat with an NTC sensor.

Fig. 1.d

P/N	Type	Range
NTC060HF01	10 kΩ ±1% @25°C, IP67	-50 to 90°C strap-on
NTC060HP00	10 kΩ ±1% @25°C, IP67	-50 to 50 °C (105°C in air)
NTC060HT00	50 kΩ ±1% @25°C, IP67	30 to 100 °C 95% RH (air) (150 °C in a dry environment)
PT1*HP*	Pt1000 - Class B, IP67, polyolefin	-50T105 °C in air
PT1*WF*	Pt1000 - Class B, IP67, AISI 316 steel, diameter 4 mm - L= 30 mm	-50T105 °C
PT1*WP*	Pt1000 - Class B, IP67, PPcop. with AISI 316 cap, diameter 6 mm - L=50 mm	-50T105 °C
PT1*HT*	Pt1000 - Class B, IP67, silicone resin with AISI 304 cap, diameter 5 mm - L=40 mm	-50T250 °C
PT1*HF*	Pt1000 - Class B, IP67, thermoplastic with fixing tie	-50T105 °C

Tab. 1.c

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

1.3.4 Pressure probes

These measure:

1. evaporation pressure in the circuit, used to control superheat, manage the evaporator frost protection function 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.e

P/N	Type	Application	Range
SPKT0*13P*	0-5V	LP R407C, R290	-1 to 9.3 bars
SPKT0*43P*	0-5V	LP R410A, R32	0 to 17.3 bars
SPKT0*33P*	0-5V	HP R407C, R290	0 to 34.5 bars
SPKT0*B6P*	0-5V	HP R410A, R32	0 to 45 bars
SPKT0011C*	4-20mA	LP R407C, R290	0 to 10 bars
SPKT0041C*	4-20mA	LP R410A, R32	0 to 18.2 bars
SPKT0031C*	4-20mA	HP R407C, R290	0 to 30 bars
SPKT00B1C*	4-20mA	HP R410A, R32	0 to 44.8 bars
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.d

1.3.5 Level sensor (conductivity)

Carel offers the LSE** series level sensors for managing the open tanks on process chillers.
For correct operation of the level sensor, the following two essential parts are required:

- Level sensor (or conductivity sensor), to be installed directly on the metal or plastic tank to manage the minimum level (and to be connected to the following);
- Third-party control device, featuring:
  - an input for conductivity measurement
  - a digital output for signalling low level.

When the liquid inside the tank reaches the conductivity sensor, this sends the conductivity signal to the control device, which activates the digital output for signalling the minimum level alarm to a digital input on µChiller Process.
Conductivity sensors can be installed in a vertical, inclined or horizontal position. The system works with water whose conductivity meets the specifications of the control module (not suitable for demineralised water).

Notice: Pay attention when connecting the sensor to the control module:

- If the tank is metal, connect the single-wire cable to the control module, and the other terminal to the metal structure of the tank.
- If the tank is plastic, connect the single-wire cable to the control module, and the other terminal to the sensor body, taking the utmost care that no water comes into contact with the sensor body.

The technical characteristics of the level sensor (conductivity) are:

Fig. 1.f

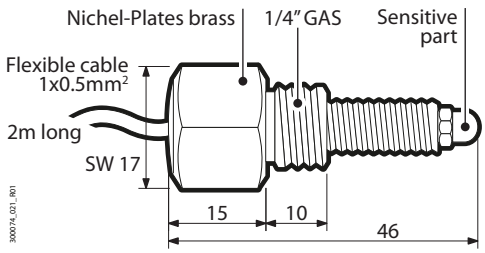


Fig. 1.g

Specifications:

Dimensions	mm
Cable length	2 m
Sensor body	nickel-coated
Sensitive element	steel
Tank connection	¼" gas
Part number	LSE0030611
Description	Conductivity level sensor 1/4 gas connection pck 25 pcs

Tab. 1.e

1.3.6 Unipolar valve (P/N E2V**FSAC*)

Fig. 1.h

Used with a compatible stator from the E2VSTA03**series. Unipolar electronic expansion valve, managed directly by the controller, which guarantees precise refrigerant flow even at low flow-rates. See technical leaflet +050001680.

1.3.7 Ultracap module (EVD0000UC0)

Fig. 1.i

The Ultracap module EVD0000UC0 is an optional external backup module for the EVD Evolution driver that ensures the valves are closed in the event of a power failure. The module guarantees temporary power supply to one EVD Evolution driver (single or twin) only in the event of a power failure, for enough time to immediately close the connected electronic valves (one or two). It therefore also avoids the need to install a solenoid valve in the refrigeration circuit, or a backup coil kit.

1.3.8 USB/RS485 converter (CVSTDUMOR0)

Fig. 1.j

Electronic device used to interface an RS485 network to a personal computer via the USB port. See technical leaflet +050000590.

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);
- exposure to direct sunlight and the elements in general;
- 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)

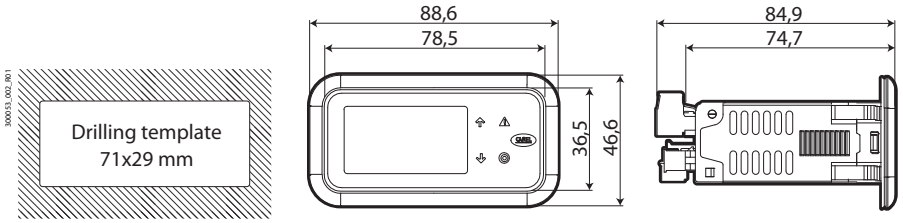


Fig. 2.a

2.2.2 Assembly

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

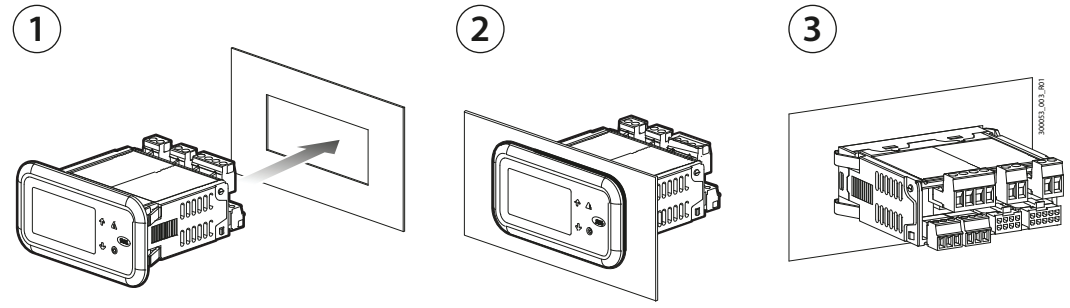


Fig. 2.b

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 panel 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

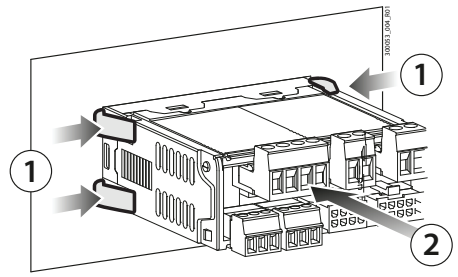


Fig. 2.c

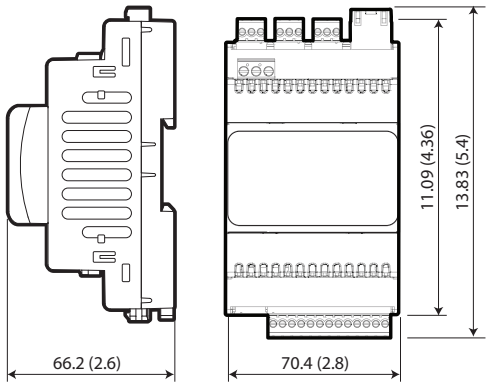
Open the electrical panel from the rear and press the anchoring tabs and then the controller to remove it.

1. Gently press the side anchoring tabs on the controller;
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)



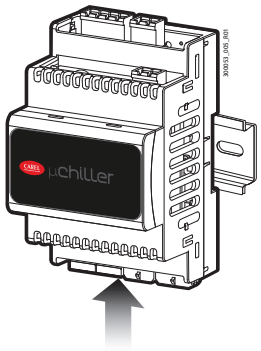


Fig. 2.d

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

2.3.2 Removal

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.

2.4 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

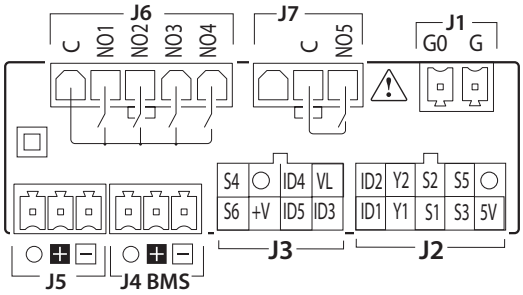
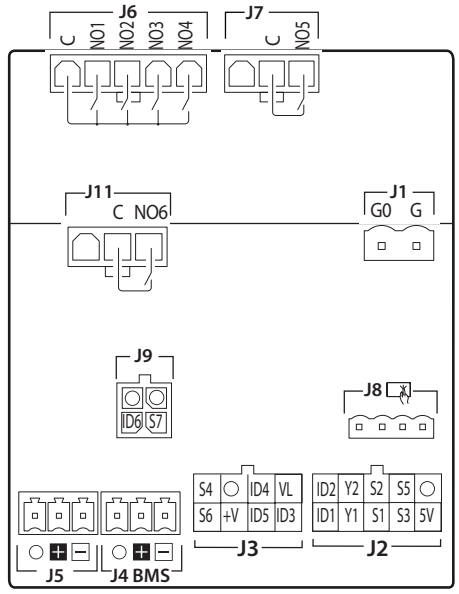


Fig. 2.e

DIN rail model

Basic



Enhanced / High Efficiency

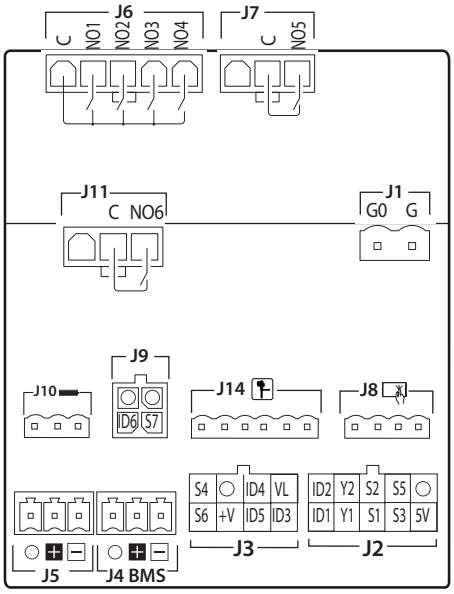


Fig. 2.f

Ref.		Description
J1	G	Power supply
	G0	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

Ref.		Description
J5	-	Fieldbus serial port (RS485): Rx-/Tx-
	+	Fieldbus serial port (RS485): Rx+/Tx+
	O	Fieldbus serial port (RS485): GND
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 (AX5* or PGR04*)
J9	S7	Analogue input 7
	ID6	Digital input 6
	O	Input reference
	O	Input reference
J10*	G	Ultracap module power supply (future use)
	G0	
	Vbat	Emergency power from Ultracap module (future use)
J11	-	(not used)
	C	Common for relay 6
	NO6	Digital output (relay) 6
J14*		Carel ExV unipolar valve connector

Tab. 2.a

(*) for DIN Enhanced / High Efficiency models only

2.5 Probe/digital input connection

NTC probes

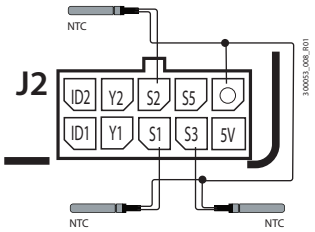


Fig. 2.g

4-20 mA probes/digital inputs

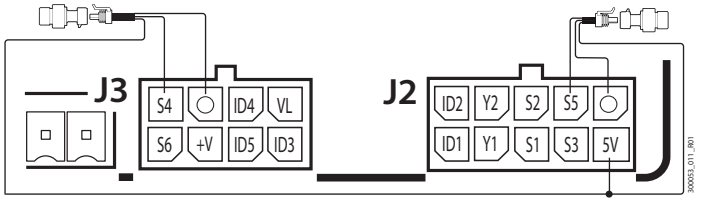


Fig. 2.h

0-10 Vdc probes

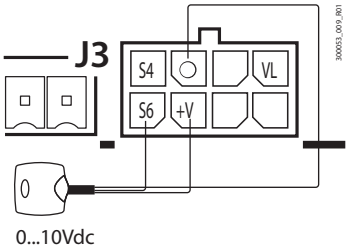


Fig. 2.i

0-5 V ratiometric pressure probes

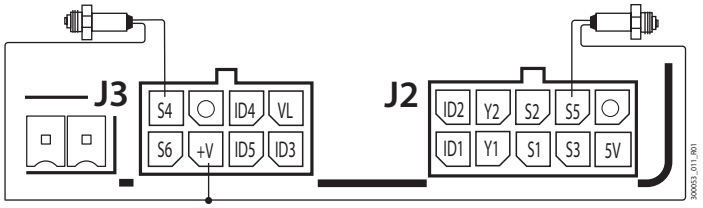


Fig. 2.j

Notice: O = GND
Notice: if an ExV valve is connected, an NTC temperature probe must also be connected to read the gas suction temperature: this probe must be connected to one of the available inputs provided.

For the position of the sensor on the suction pipe, see the installation guide +040010025 ""Sonde e sensori - Guida alla scelta e all'installazione ottimale / Probes and sensors - Selection and optimal installation guide", available at carel.com under product => sensor => quick guide.

2.6 Connection to user terminals

2.6.1 DIN rail model

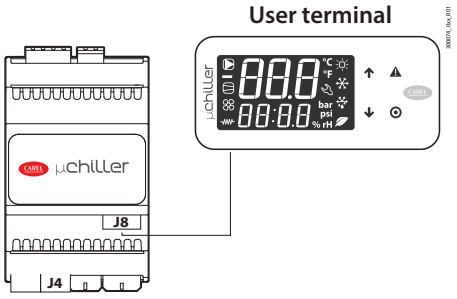


Fig. 2.k

2.7 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.

2.8 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 control cables have to cross over the power cables, the intersections must be as near as possible to 90 degrees, always avoiding running the control 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.

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). The earth connection of the shield must be made using the shortest connection possible on the metal plate at the bottom of the electrical panel.

Main device	Serial port	Lmax (m)	Wire/wire capacitance (pF/m)	resistance on first and last device	Max no. devices on bus	Data rate (bit/s)
µChiller Process	FBus	10	<90	120 Ω	16	19200
PC (supervision)	BMS	500	<90	120 Ω	16	115200

Notice: 120 Ω 1/4W terminating resistors on the first and last devices in the network must be used when the length exceeds 100 m.

2.9 Connection to Power+ (for BLDC)

For the serial connection between the controller and the Power+ speed drive, see the specific manual. Also see the following diagrams.

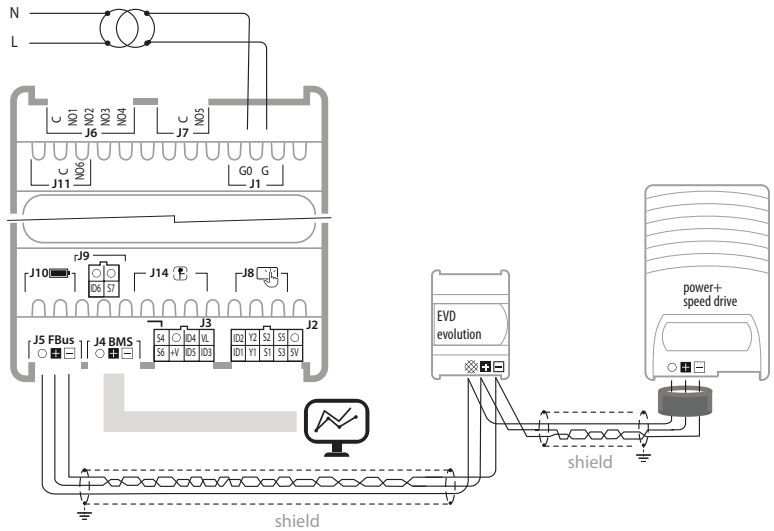


Fig. 2.l

2.10 Positioning of probes/components

Water-cooled condensing unit

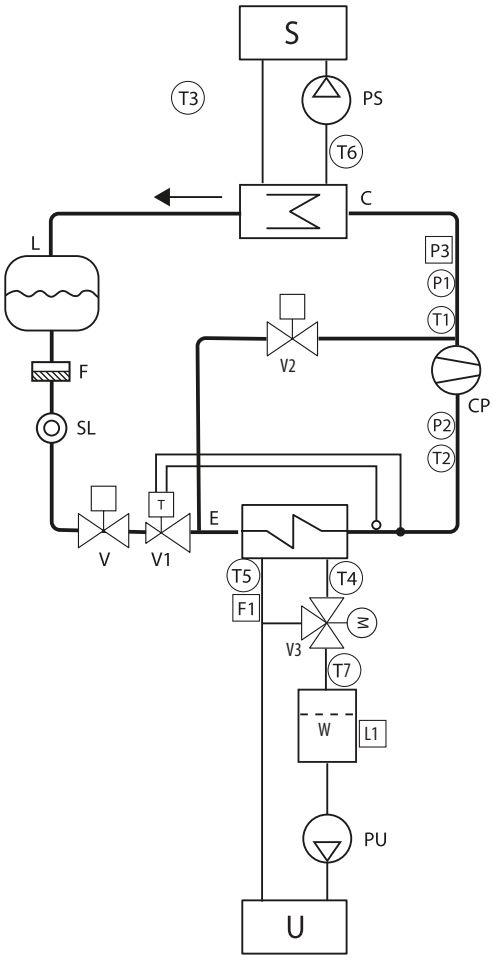


Fig. 2.m

Ref.	Description
S	Source
U	User
E	Evaporator
F	Filter-drier
L	Liquid receiver
CP	Compressor
C	Condenser
SL	Liquid sightglass
P1	Condensing pressure probe
V	Solenoid valve
V1	Thermostatic expansion valve
V2	Hot gas bypass valve
V3	3-way valve for water delivery control to the tank
W	User water tank

Air-cooled condensing unit

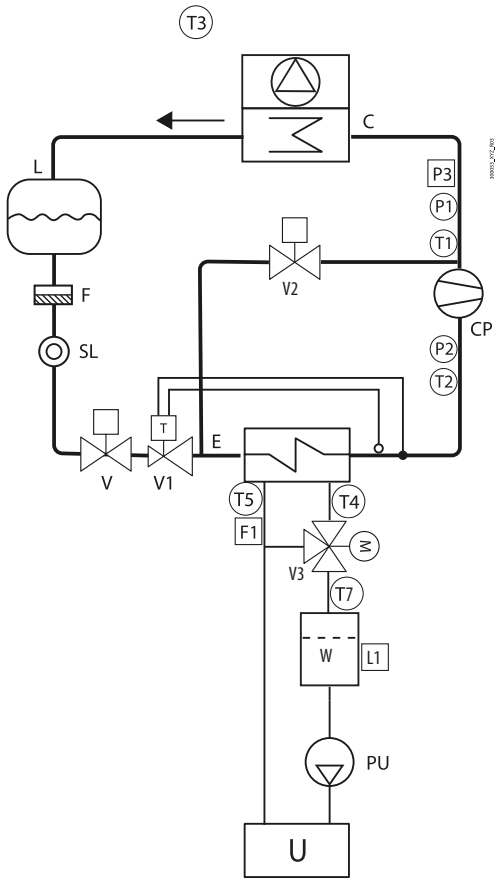


Fig. 2.n

Ref.	Description
L1	Water tank minimum level sensor alarm
PU	User pump
PS	Source pump
P2	Evaporation pressure probe
T1	Drain temperature
T2	Suction temperature
P3	High pressure switch
T3	Outside air temperature
F1	User pump flow switch
T4	Water delivery temperature (to) user/evaporator outlet
T5	Water return temperature (from) user
T6	Water delivery temperature (to) source
T7	Maximum tank temperature

Tab. 2.b

2.11 Functional diagrams

This section of the manual shows the most commonly-used process chiller diagrams. The aim is to guide users in setting the µChiller Process parameter so as to manage the chiller in accordance with the diagram shown. In fact, multiple selections are available for each I/O on µChiller Process. Follow the list shown in the table underneath the diagram to manage the unit in accordance with the diagram. Some example unit diagrams are shown below, starting from the simplest and proceeding in order of increasing complexity.

2.11.1 Chillers, On/Off compressors and thermostatic expansion valve

⚠ **Caution:** The black lines refer to the electrical connections, the grey lines the serial connections between controller and options (I/O expansion for the second circuit, EVD EVO and Power+).

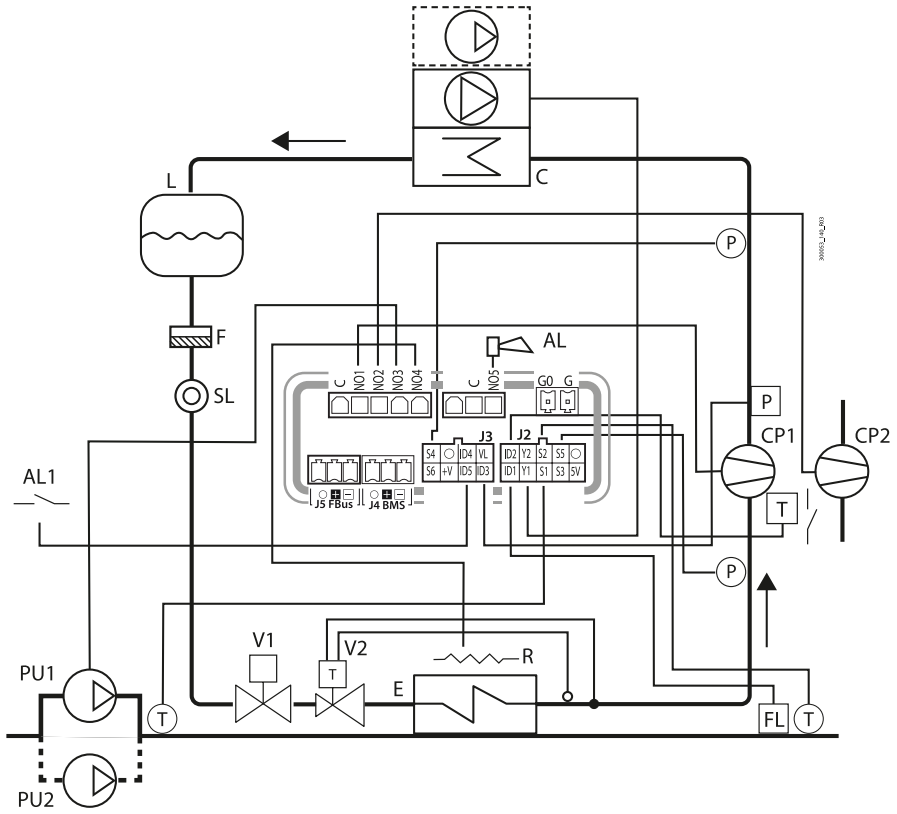


Fig. 2.o

Ref.	Description
C	Condenser
E	Evaporator
V1	Liquid solenoid valve
V2	Thermostatic expansion valve
SL	Liquid sightglass

Ref.	Description
F	Filter-drier
FL	Flow switch
CP1/2	Compressor 1/2
PU1/2	User pump 1/2
L	Liquid receiver

Ref.	Description
R	Heating device
P	Pressure probe/pressure switch
T	Temperature probe/thermostat
AL	Alarm
AL1	Remote alarm

Tab. 2.c

Analogue inputs

Ref.	Description	Type	Configuration parameters
S1	Return temperature from user	NTC	Hc18; Hc20
S2	Delivery temperature to user	NTC	Hc17; Hc20
S3	Not present	-	Hc00; Hc20
S4	Condensing pressure	0-5V	Hc01; Hc02; C040; C041; C042
S5	Evaporation pressure	0-5V	Hc01; Hc21; C037; C038; C039
S6	Not present	-	Hc03; U025; U026; U027

Tab. 2.d

Notice:
- see parameter table for details of the probe configuration;
- in the absence of pressure probe S5, probe S2 must be installed (minimum configuration), paying special attention to its thermal conductivity so as to guarantee evaporator frost protection;
- the discharge temperature probe is automatically assigned as NTC-HT.

Digital inputs

Ref.	Description	Config. parameters
ID1	User pump flow switch	Hc15; U060; U113; U059; U057
ID2	Compressor 1 overload	Hc16; C035; U113; U059; U057
ID3	High pressure switch	C034
ID4	User pump 1 overload	Hc06; U061; U113; U059; U057; C035; U062; C053
ID5	Remote alarm	Hc07; U057; U113; U059; C035; U062; U061

Tab. 2.e

Digital outputs

Ref.	Description	Configuration parameters
C-NO1	Compressor 1	C036
C-NO2	Compressor 2 / heater / condensing stage fan-pump (1)	C036; U119; S061
C-NO3	User pump 1 / condensing stage fan-pump (2)	U063; S061
C-NO4	Heater / user pump 2 (3)	U065; U119; U063
C5-NO5	Alarm	Hc14; U064

Tab. 2.f

Notice: the configuration of the outputs depends on the configuration of the unit:

- If 2 compressors => Compressor 2; if 1 compressor + heater => heater; if 1 compressor without heater => condensing stage fan-pump.
- If no. pumps = 0 => Condensing stage fan-pump; otherwise User pump 1.
- If Free cooling => FC valve; if 2 compressors with heater => heater; if 2 user pumps and Hc14 not 4 => User pump 2; otherwise => condensing stage fan-pump.

Analogue outputs

Ref.	Description	Type	Notes
Y1	Modulating/On-Off fan-pump	0-10V	FCS1*0 /CONVONOFF
Y2	Not used	0-10V	

Tab. 2.g

2.11.2 Chillers, On/Off compressors with free cooling and thermostatic expansion valve

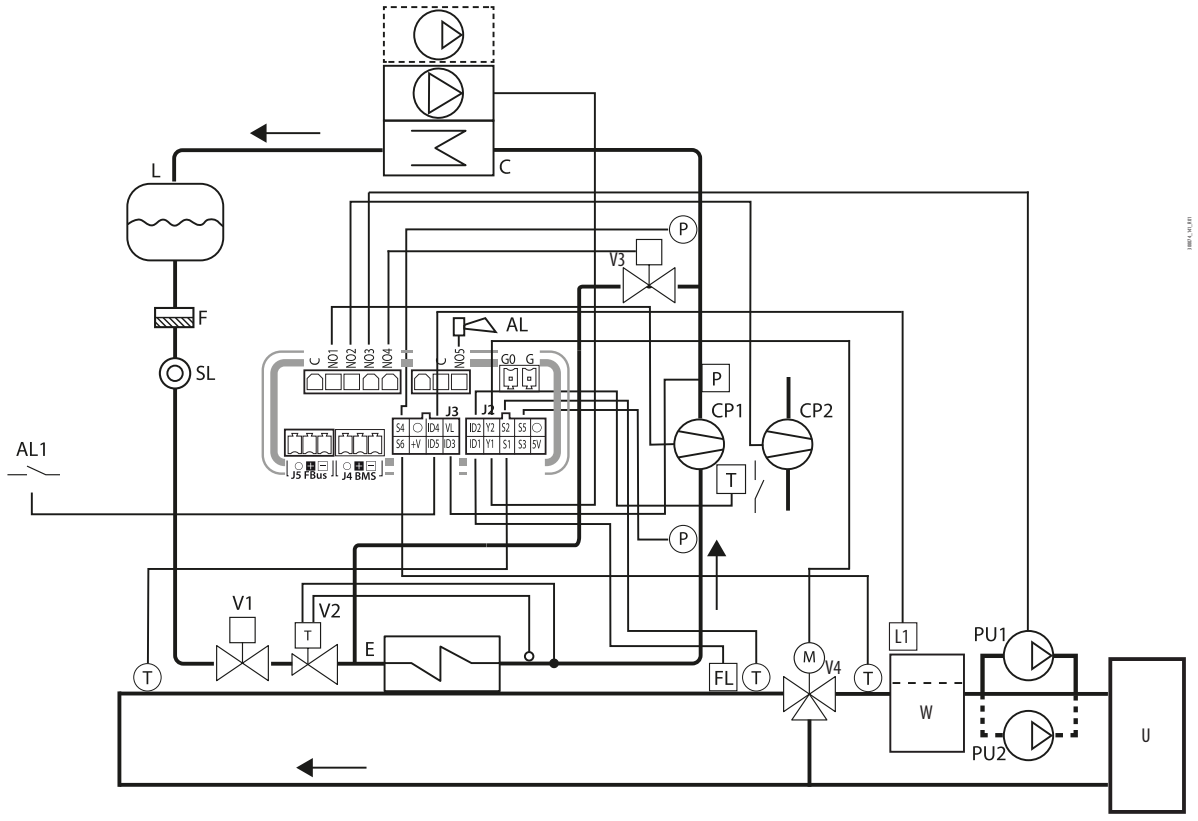


Fig. 2.p

Ref.	Description
C	Condenser
E	Evaporator
V1	Liquid solenoid valve
V2	Thermostatic expansion valve
V3	Hot gas bypass valve
SL	Liquid sightglass

Ref.	Description
F	Filter-drier
FL	Flow switch
CP1/2	Compressor 1/2
PU1/2	User pump 1/2
L	Liquid receiver
W	Water tank

Ref.	Description
L1	Level sensor
P	Pressure probe/pressure switch
T	Temperature probe/thermostat
AL	Alarm
AL1	Remote alarm

Tab. 2.h

Analogue inputs

Ref.	Description	Type	Configuration parameters
S1	Return temperature from user	NTC	Hc18; Hc20
S2	Delivery temperature to user	NTC	Hc17; Hc20
S3	Not present	-	Hc00; Hc20
S4	Condensing pressure	0-5V	Hc01; Hc02; C040; C041; C04
S5	Evaporation pressure	0-5V	Hc01; Hc21; C037; C038; C039
S6	Mixed water delivery / tank / generic probe temperature (AUX PID input)	NTC	Hc03; U025; U026; U027

Tab. 2.i

Notice:
- see parameter table for details of the probe configuration;
- in the absence of pressure probe S5, probe S2 must be installed (minimum configuration), paying special attention to its thermal conductivity so as to guarantee evaporator frost protection;
- the discharge temperature probe is automatically assigned as NTC-HT.

Digital inputs

Ref.	Description	Configuration parameters
ID1	User pump flow switch	Hc15; U060; U113; U059; U057
ID2	Compressor 1 overload	Hc16; C035; U113; U059; U057
ID3	High pressure switch	C034
ID4	Level sensor	Hc06; U113; U059; U057; C035; U062; U061; C053
ID5	Remote alarm	Hc07; U057; U113; U059; C035; U062; U061

Tab. 2.j

Digital outputs

Ref.	Description	Config. parameters
C-NO1	Compressor 1	C036
C-NO2	Compressor 2 / heater / condensing stage fan-pump (1)	C036; U119; S061
C-NO3	User pump 1 / condensing stage fan-pump (2)	U063; S061
C-NO4	Hot gas / heater / user pump 2 (3)	U114; U119; U063
C5-NO5	Alarm	Hc14; U064

Tab. 2.k

Notice: the configuration of the outputs depends on the configuration of the unit:
- If 2 compressors => Compressor 2; if 1 compressor + heater => heater; if 1 compressor without heater => condensing stage fan-pump.
- If no. pumps = 0 => Condensing stage fan-pump; otherwise User pump 1.
- If Free cooling => FC valve; if 2 compressors with heater or hot gas (and output 5 not configured as heater or hot gas) => heater / hot gas; if 2 user pumps and Hc14 not 4 => User pump 2; otherwise => condensing stage fan-pump.

Analogue outputs

Ref.	Description	Type	Notes
Y1	Modulating/On-Off fan	0-10V	FCS1*0/CONVONOFF
Y2	Mixing valve modulation (from AUX PID)	0-10V	

Tab. 2.l

2.11.3 DIN version On/Off compressors, thermostatic expansion valve, hot gas bypass solenoid valve with SSR modulation

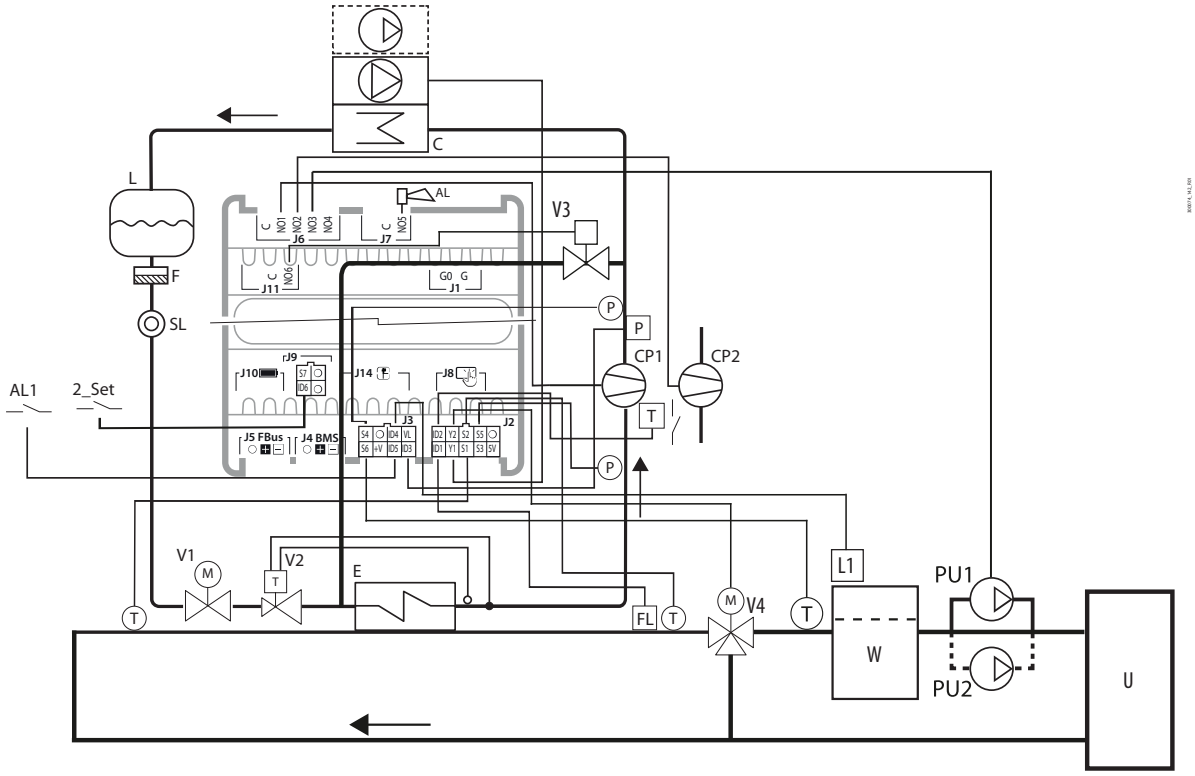


Fig. 2.q

Ref.	Description
C	Condenser
E	Evaporator
V1	Liquid solenoid valve
V2	Thermostatic expansion valve
V3	Hot gas bypass valve
V4	Mixing valve
W	Water tank

Ref.	Description
SL	Liquid sightglass
F	Filter-drier
FL	Flow switch
CP1/2	Compressor 1/2
PU1/2	User pump 1/2
L	Liquid receiver

Ref.	Description
L1	Level sensor
P	Pressure probe/pressure switch
T	Temperature probe/thermostat
AL	Alarm
AL1	Remote alarm
2_Set	2nd set point

Tab. 2.m

Analogue inputs

Ref.	Description	Type	Configuration parameters
S1	Return temperature from user	NTC	Hc18; Hc20
S2	Delivery temperature to user	NTC	Hc17; Hc20
S3	Not present	-	Hc00; Hc20
S4	Condensing pressure	0-5V	Hc01; Hc02; C040; C041; C04
S5	Evaporation pressure	0-5V	Hc01; Hc21; C037; C038; C039
S6	Mixed water delivery / tank / generic probe temperature (AUX PID input)	NTC	Hc03; Hc20; U025; U026; U027; Y018; Y019; Y020
S7	Not present	-	Hc04

Tab. 2.n

Notice:

- see parameter table for details of the probe configuration;
- in the absence of pressure probe S5, probe S2 must be installed (minimum configuration), paying special attention to its thermal conductivity so as to guarantee evaporator frost protection;
- the discharge temperature probe is automatically assigned as NTC-HT.

Digital inputs

Ref.	Description	Configuration parameters
ID1	User pump flow switch	Hc15; U060; U113; U059; U057
ID2	Compressor 1 overload	Hc16; C035; U113; U059; U057
ID3	High pressure switch	C034
ID4	Level sensor	Hc06; U057; U113; U059; C035; U062; U061; C053
ID5	Remote alarm	Hc07; U057; U113; U059; C035; U062; U061
ID6	2nd set point	HC08; U057; U113; U059; C035; U062; U061

Tab. 2.o

Digital outputs

Ref.	Description	Config. parameters
C-NO1	Compressor 1	C036
C-NO2	Compressor 2 / heater / condensing stage fan-pump (1)	C036; U119; S061
C-NO3	User pump 1 / condensing stage fan-pump (2)	U063; S061
C-NO4	Heater / user pump 2 (3)	U119; U063
C5-NO5	Alarm	Hc14; U064
C6-NO6	Hot gas valve (also modulating - U116 = 1 or 2)	Hc12; U116; U114

Tab. 2.p

Notice: the configuration of the outputs depends on the configuration of the unit:

- If 2 compressors => Compressor 2; if 1 compressor + heater => heater; if 1 compressor without heater => condensing stage fan-pump.
- If no. pumps = 0 => Condensing stage fan-pump; otherwise => User pump 1.
- If Free-cooling => FC valve; if 2 compressors with heater (and output 5 not configured as heater) => heater; if 2 user pumps and Hc14 other than user pump 2 => user pump 2; otherwise => condensing stage fan-pump.

Analogue outputs

Ref.	Description	Type	Notes
Y1	Modulating/On-Off fan - pump	0-10V	FCS1*0/CONVONOFF
Y2	Mixing valve modulation (from AUX PID)	0-10V	

Tab. 2.q

2.11.4 DIN version On/Off compressors, thermostatic expansion valve, ExV valve for hot gas bypass modulation

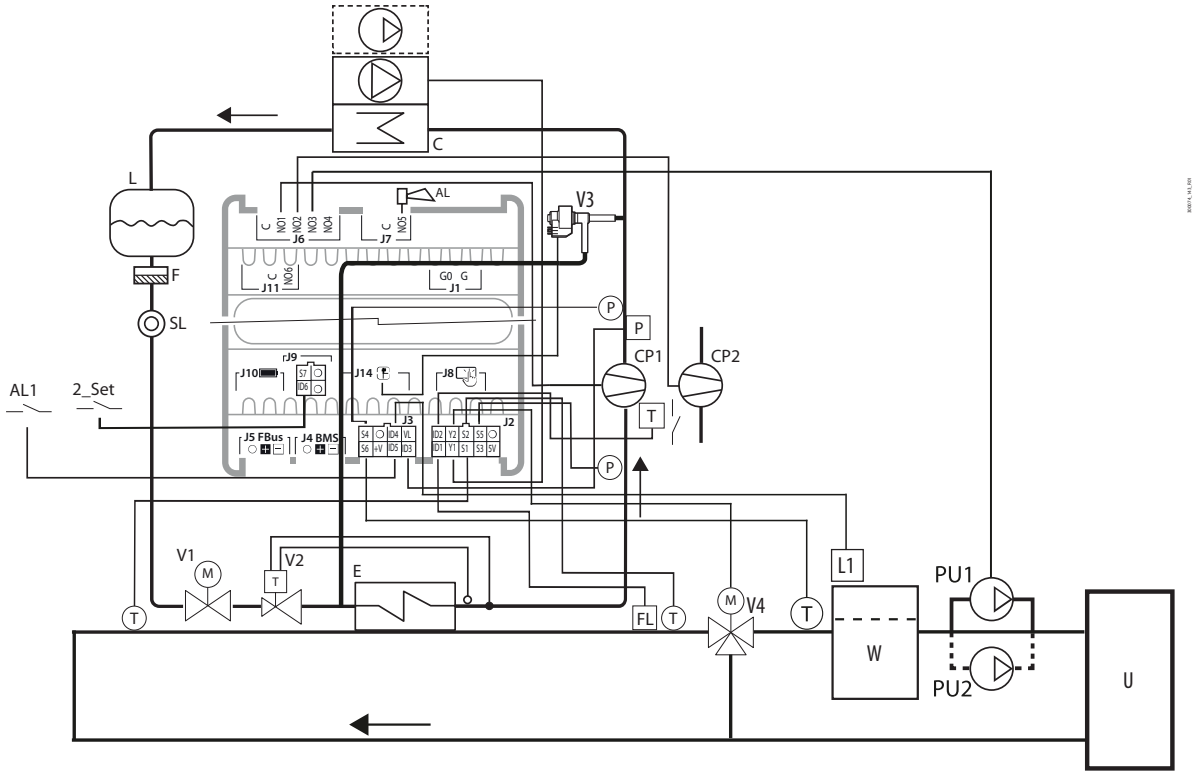


Fig. 2.r

Ref.	Description
C	Condenser
E	Evaporator
V1	Liquid solenoid valve
V2	Thermostatic expansion valve
V3	Hot gas bypass valve
V4	Mixing valve
SL	Liquid sightglass

Ref.	Description
F	Filter-drier
FL	Flow switch
CP1/2	Compressor 1/2
PU1/2	User pump 1/2
L	Liquid receiver
W	Water tank

Ref.	Description
L1	Level sensor
P	Pressure probe/pressure switch
T	Temperature probe/thermostat
AL	Alarm
AL1	Remote alarm
2_Set	2nd set point

Tab. 2.r

Analogue inputs

Ref.	Description	Type	Configuration parameters
S1	Return temperature from user	NTC	Hc18; Hc20
S2	Delivery temperature to user	NTC	Hc17; Hc20
S3	Not present	-	Hc00; Hc20
S4	Condensing pressure	0-5V	Hc01; Hc02; C040; C041; C04
S5	Evaporation pressure	0-5V	Hc01; Hc21; C037; C038; C039
S6	Mixed water delivery / tank / generic probe temperature (AUX PID input)	NTC	Hc03; Hc20; U025; U026; U027; Y018; Y019; Y020
S7	Not present	-	Hc04

Tab. 2.s

Notice:
- see parameter table for details of the probe configuration;
- in the absence of pressure probe S5, probe S2 must be installed (minimum configuration), paying special attention to its thermal conductivity so as to guarantee evaporator frost protection;
- the discharge temperature probe is automatically assigned as NTC-HT.

Digital inputs

Ref.	Description	Configuration parameters
ID1	User pump flow switch	Hc15; U060; U113; U059; U057
ID2	Compressor 1 overload	Hc16; C035; U113; U059; U057
ID3	High pressure switch	C034
ID4	Level sensor	Hc06; U057; U113; U059; C035; U062; U061; C053
ID5	Remote alarm	Hc07; U057; U113; U059; C035; U062; U061
ID6	2nd set point	HC08; U057; U113; U059; C035; U062; U061

Tab. 2.t

Digital outputs

Ref.	Description	Config. parameters
C-NO1	Compressor 1	C036
C-NO2	Compressor 2 / heater / condensing stage fan-pump (1)	C036; U119; S061
C-NO3	User pump 1 / condensing stage fan-pump (2)	U063; S061
C-NO4	Heater / user pump 2 (3)	U119; U063
C5-NO5	Alarm	Hc14; U064
C6-NO6	Not used	Hc12; U116; U114

Tab. 2.u

Notice: the configuration of the outputs depends on the configuration of the unit:
- If 2 compressors => Compressor 2; if 1 compressor + heater => heater; if 1 compressor without heater => condensing stage fan-pump.
- If no. pumps = 0 => Condensing stage fan-pump; otherwise => User pump 1.
- If Free-cooling => FC valve; if 2 compressors with heater (and output 5 not configured as heater) => heater; if 2 user pumps and Hc14 other than user pump 2 => user pump 2; otherwise => condensing stage fan-pump.

Analogue outputs

Ref.	Description	Type	Notes
Y1	Modulating (/On-Off) fan - pump	0-10V	CONVONOFF
Y2	Mixing valve modulation (AUX PID output)	0-10V	

Tab. 2.v

2.11.5 DINversionOn/Offcompressors,bipolarExVexpansionvalve,bipolarExVhotgasbypass modulation valve

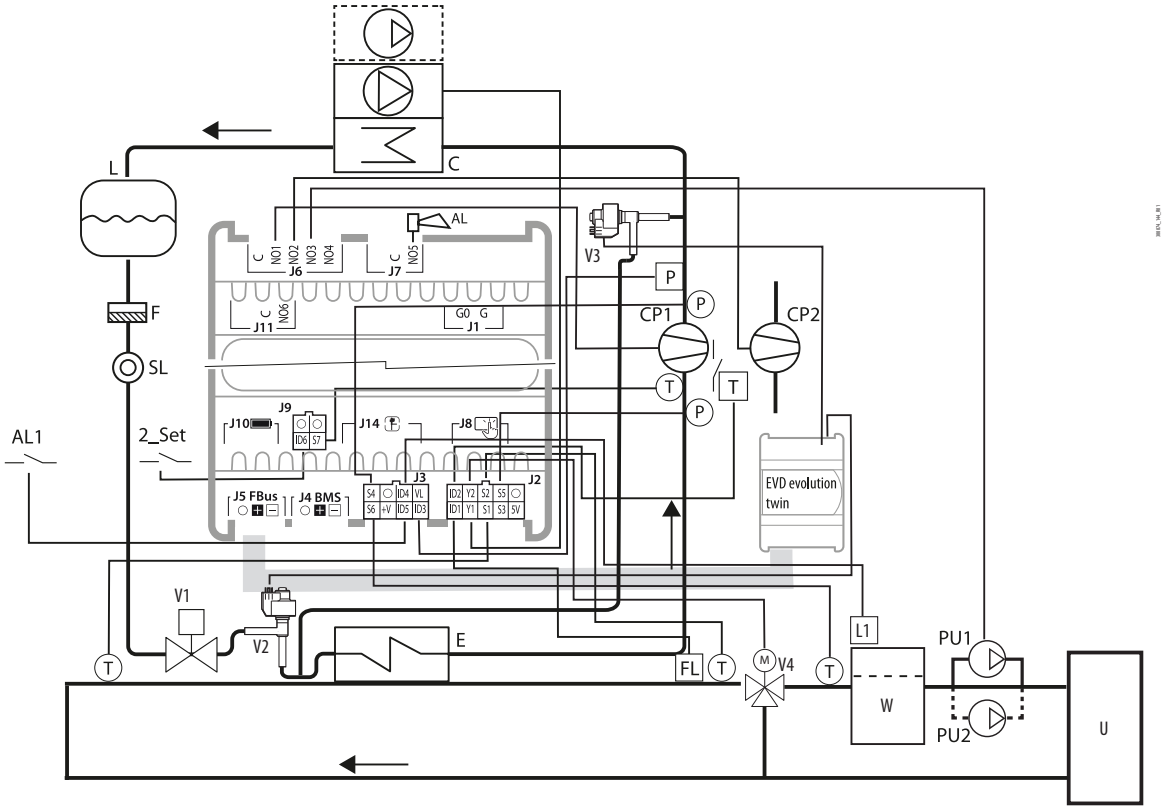


Fig. 2.s

Ref.	Description
C	Condenser
E	Evaporator
V1	Liquid solenoid valve
V2	Electronic expansion valve
V3	Hot gas bypass valve
V4	Mixing valve
W	Water tank

Ref.	Description
SL	Liquid sightglass
F	Filter-drier
FL	Flow switch
CP1/2	Compressor 1/2
PU1/2	User pump 1/2
L	Liquid receiver

Ref.	Description
L1	Level sensor
P	Pressure probe/pressure switch
T	Temperature probe/thermostat
AL	Alarm
AL1	Remote alarm
2_Set	2nd set point

Tab. 2.w

Analogue inputs

Ref.	Description	Type	Configuration parameters
S1	Return temperature from user	NTC	Hc18; Hc20
S2	Delivery temperature to user	NTC	Hc17; Hc20
S3	Not present	-	Hc00; Hc20
S4	Condensing pressure	0-5V	Hc01; Hc02; C040; C041; C04
S5	Evaporation pressure	0-5V	Hc01; Hc21; C037; C038; C039
S6	Mixed water delivery / tank / generic probe temperature (AUX PID input)	NTC	Hc03; Hc20; U025; U026; U027; Y018; Y019; Y020
S7	Suction temperature	NTC	Hc04

Tab. 2.x

Notice: see parameter table for details of probe configuration.

Digital inputs

Ref.	Description	Configuration parameters
ID1	User pump flow switch	Hc15; U060; U113; U059; U057
ID2	Compressor 1 overload	Hc16; C035; U113; U059; U057
ID3	High pressure switch	C034
ID4	Level sensor	Hc06; U057; U113; U059; C035; U062; U061; C053
ID5	Remote alarm	Hc07; U057; U113; U059; C035; U062; U061
ID6	2nd set point	HC08; U057; U113; U059; C035; U062; U061

Tab. 2.y

Digital outputs

Ref.	Description	Config. parameters
C-NO1	Compressor 1	C036
C-NO2	Compressor 2 / heater / condensing stage fan-pump (1)	C036; U119; S061
C-NO3	User pump 1 / condensing stage fan-pump (2)	U063; S061
C-NO4	Heater / user pump 2 (3)	U119; U063
C5-NO5	Alarm	Hc14; U064
C6-NO6	Not used	Hc12; U116; U114

Tab. 2.z

Notice: the configuration of the outputs depends on the configuration of the unit:

- If 2 compressors => Compressor 2; if 1 compressor + heater => heater; if 1 compressor without heater => condensing stage fan-pump.
- If no. pumps = 0 => Condensing stage fan-pump; otherwise => User pump 1.
- If Free-cooling => FC valve; if 2 compressors with heater (and output 5 not configured as heater) => heater; if 2 user pumps and Hc14 other than user pump 2 => user pump 2; otherwise => condensing stage fan-pump.

Analogue outputs

Ref.	Description	Type	Notes
Y1	Modulating (/On-Off) fan - pump	0-10V	FCS1*0 /CONVONOFF
Y2	Mixing valve modulation (AUX PID output)	0-10V	

Tab. 2.aa

2.11.6 DIN version BLDC+On/Off compressor, bipolar ExV expansion valve, hot gas bypass solenoid valve

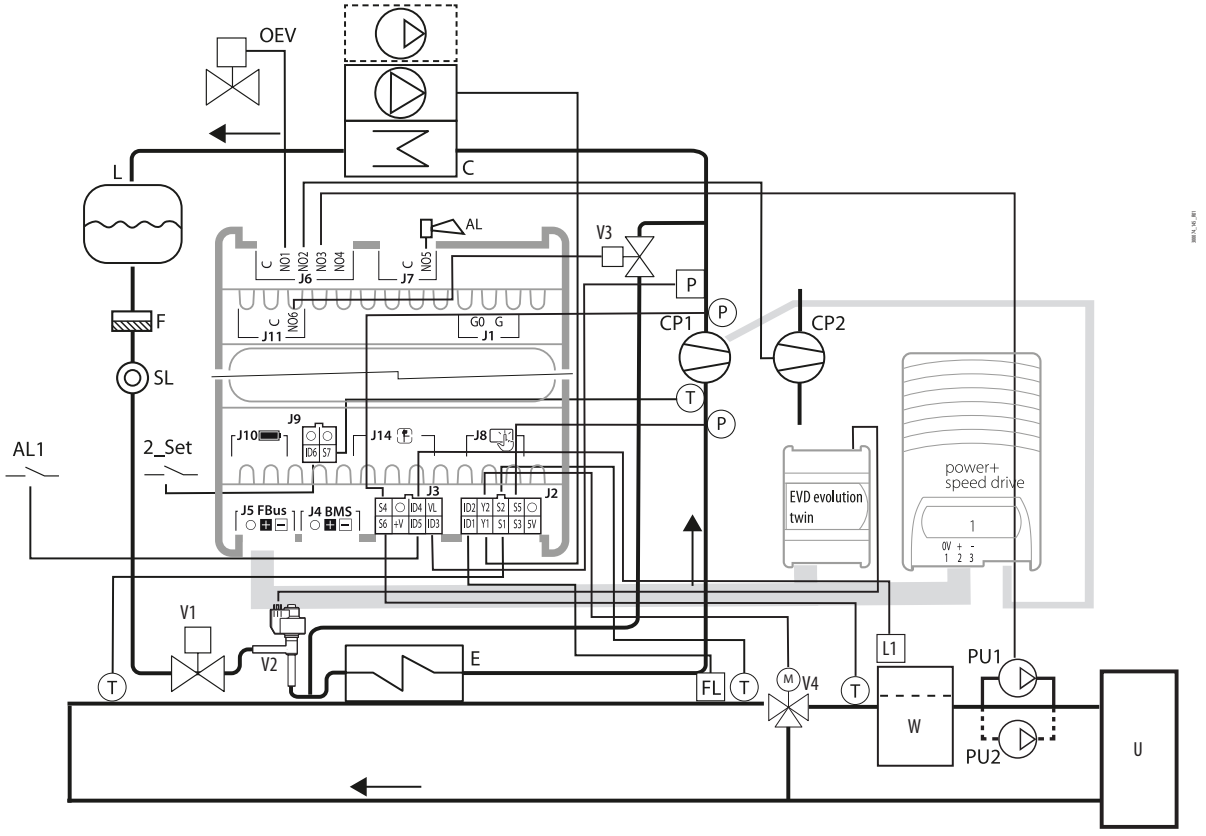


Fig. 2.t

Ref.	Description
C	Condenser
E	Evaporator
V1	Liquid solenoid valve
V2	Electronic expansion valve
V3	Hot gas bypass valve
V4	Mixing valve
SL	Liquid sightglass

Ref.	Description
F	Filter-drier
FL	Flow switch
CP1/2	Compressor 1/2
PU1/2	User pump 1/2
L	Liquid receiver
OEV	Oil eq. valve
W	Water tank

Ref.	Description
W	Water tank
L1	Level sensor
P	Pressure probe/pressure switch
T	Temperature probe/thermostat
AL	Alarm
AL1	Remote alarm
2_Set	2nd set point

Tab. 2.ab

Analogue inputs

Ref.	Description	Type	Configuration parameters
S1	Return temperature from user	NTC	Hc18; Hc20
S2	Delivery temperature to user	NTC	Hc17; Hc20
S3	Drain temperature	NTC-HT	Hc00; Hc20
S4	Condensing pressure	0-5V	Hc01; Hc02; C040; C041; C04
S5	Evaporation pressure	0-5V	Hc01; Hc21; C037; C038; C039
S6	Mixed water delivery / tank / generic probe temperature (AUX PID input)	NTC	Hc03; Hc20; U025; U026; U027; Y018; Y019; Y020
S7	Suction temperature	NTC	Hc04

Tab. 2.ac

Notice:
- see parameter table for details of the probe configuration;
- the discharge temperature probe is automatically assigned as NTC-HT.

Digital inputs

Ref.	Description	Configuration parameters
ID1	User pump flow switch	Hc15; U060; U113; U059; U057
ID2	Not present	Hc16; C035; U113; U059; U057
ID3	High pressure switch	C034
ID4	Level sensor	Hc06; U057; U113; U059; C035; U062; U061; C053
ID5	Remote alarm	Hc07; U057; U113; U059; C035; U062; U061
ID6	2nd set point	HC08; U057; U113; U059; C035; U062; U061

Tab. 2.ad

Digital outputs

Ref.	Description	Configuration parameters
C-NO1	Oil equalisation valve (tandem compressors only)	P016
C-NO2	Compressor 2 / heater / condensing stage fan-pump (1)	C036; U119; S061
C-NO3	User pump 1 / condensing stage fan-pump (2)	U063; S061
C-NO4	Heater / user pump 2 (3)	U119; U063
C-NO5	Alarm	Hc14; U064
C-NO6	Not used	Hc12; U116; U114

Tab. 2.ae

Notice: the configuration of the outputs depends on the configuration of the unit:
- If 2 compressors => Compressor 2; if 1 compressor + heater => heater; if 1 compressor without heater => condensing stage fan-pump.
- If no. pumps = 0 => Condensing stage fan-pump; otherwise => User pump 1.
- If Free-cooling => FC valve; if 2 compressors with heater (and output 5 not configured as heater) => heater; if 2 user pumps and Hc14 other than user pump 2 => user pump 2; otherwise => condensing stage fan-pump.

Analogue outputs

Ref.	Description	Type	Notes
Y1	Modulating (/On-Off) fan - pump	0-10V	FCS1*0 /CONVONOFF
Y2	Mixing valve modulation (AUX PID output)	0-10V	

Tab. 2.af

3. INITIAL CONFIGURATION

3.1 APPLICA app

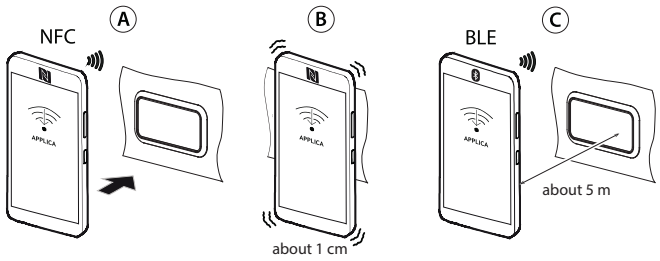


Fig. 3.a

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).

Once the Carel "Applica" app has been installed and opened (see the paragraph "Mobile device", proceed as follows:
1. For NFC devices (A), move the mobile device near to the µChiller Process 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 (B).
2. For Bluetooth devices (C), select the "SCAN BLUETOOTH" option, then choose the device from the list.

3.2 Configuration procedure

3.2.1 Standard and Enhanced models

Notice: refer to the table of models in the "Introduction".
1. With Bluetooth devices, access the Service menu by clicking the icon at the bottom right (figure). With NFC devices, the Service menu is already displayed by default (figure below);

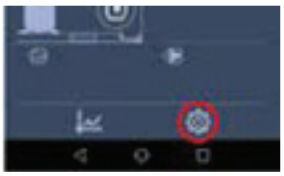
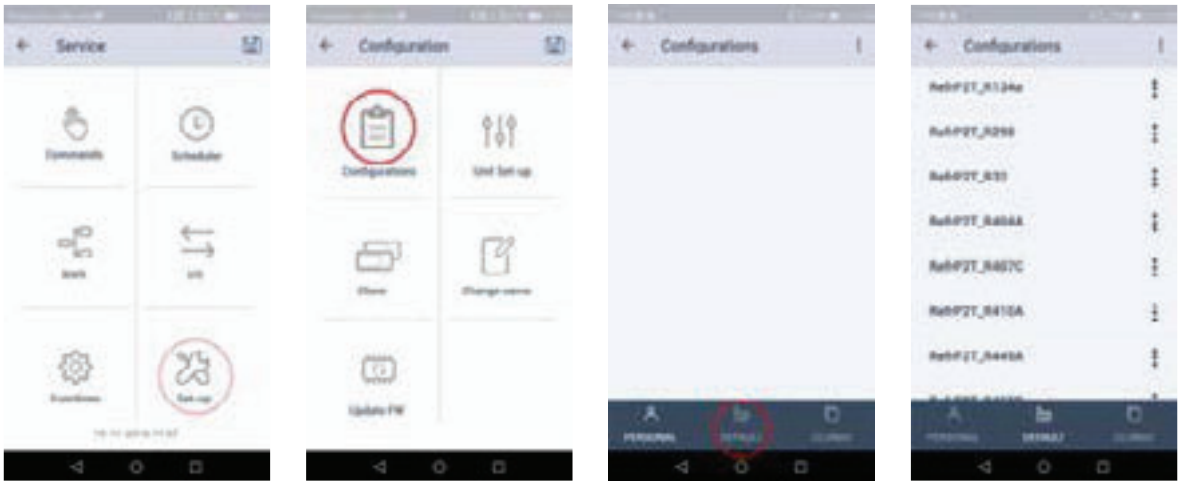


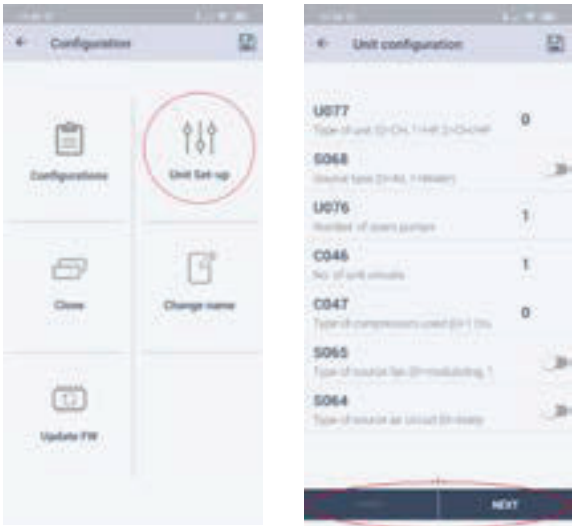
Fig. 3.b

2. click "Set-up"--> "Configurations" -->"Defaults" (figure);
3. select the refrigerant used in the unit;



4. apply the selected configuration via NFC or Bluetooth. **The refrigerant has now been correctly configured.**

5. continue configuring the unit by selecting the "Unit set-up" menu, pressing the PREV / NEXT buttons to scroll through all of the configuration parameter pages;



6. apply the parameters configured via NFC / Bluetooth to the controller.

3.4.1 High Efficiency model

Notice: refer to the table of models in the "Introduction".

1. With Bluetooth devices, access the Service menu by clicking the icon at the bottom right (figure). With NFC devices, the Service menu is already displayed by default (figure below);

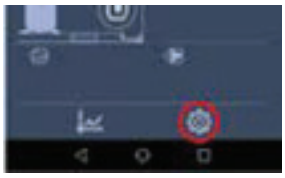
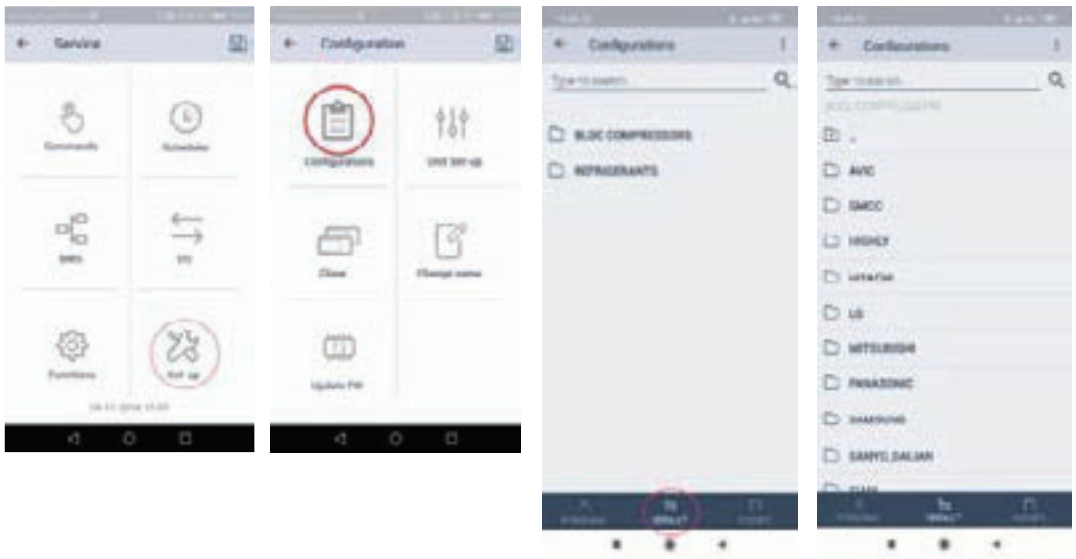


Fig. 3.c

2. click "Set-up"--> "Configurations" -->"Defaults" (figure);



3. apply the selected configuration to the controller via NFC or Bluetooth. The BLDC compressor model and the refrigerant have now been correctly configured.
4. continue configuring the unit by selecting the "Unit set-up" menu, pressing the PREV / NEXT buttons to scroll through all of the configuration parameter pages;

5. apply the parameters configured via NFC / Bluetooth to the controller.

3.3 Unit set-up parameter list

3.3.1 Unit parameters

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

Par.	Description	Def.	Min.	Max.	UOM
S068	Source type (0=Air, 1=Water)	0	0	1	-
U076	Number of user pumps	1	1	2	-
U115	Number of heaters	0	0	1	-
U116	Hot gas bypass type (0=No; 1=On-Off; 2=Modulating - internal SSR; 3=Modulating - external SSR; 4=Modulating - 0-10V; 5=Modulating - ExV)	0	0	5	-
C047	Type of compressors used (0=1 On/Off; 1=2 On/Off; 2=1 BLDC; 3=1 BLDC+On/Off)	0	0	1/3	-
C049	Process priority: used to immediately restart the compressor (limited to C050/h)	0	0	1	-
S065	Type of source fan (0/1=Modulating/ON-OFF)	0	0	1	-
E047	ExV driver (0=no Exv; 1=EVD EVO valve A SSH; 2=EVD EVO valve A HGBP; 3=EVD EVO valve A SSH; EVD EVO valve B HGBP; 4=EVD Mini SSH valve A; 5=EVD Mini HGBP valve A; 6=EVD Emb SSH valve A; 7=EVD Emb HGBP valve A; 8=EVD Mini SSH valve A, EVD Emb HGBP valve B; 9=EVD EVO SSH valve A, EVD Emb HGBP valve B; 10=EVD Emb SSH valve A, EV EVO HGBP valve B)	0	0	10	-
E046	EVD Evolution: valve (1=CAREL ExV, ...) (*) (*) see EVD Evolution manual for the complete list of selectable valves	1	1	24	-
E020	MOP in cooling: threshold	30.0	-60.0	200.0	°C
C017	Max high pressure threshold (HP)	65.0	0.0	999.9	°C
C018	Min low pressure threshold (LP)	0.2	-99.9	99.9	bar
Hc00	S3 configuration: 0=Not used 1=Outside air temp. 2=Discharge temp. 3=Suction temp. 4=Source water delivery temp. 5=Tank temp.	0	0	4	-
Hc03	S6 configuration 0=Not used; 1=Remote set point; 2=Outside air temp.	0	0	2	-
Hc04	S7 configuration (0=Not used; 1=Suction temp.	0	0	1	-
Hc01	S4 and S5 configuration (0=Pressure, 1=Temperature)	1	0	1	-
Hc02	Enable S4 (0/1=no/yes)	1	0	1	-
Hc06	ID4 configuration 0=Not used; 1=Tank level; 2=Remote On/Off; 3=Remote alarm; 4=Comp. 2 overload; 5=2nd set point; 6=User pump overload; 7=LP pressure switch; 8=Source fan/pump overload	0	0	7	-
Hc07	ID5 configuration 0=Not used; 1=Tank level; 2=Remote On/Off; 3=Remote alarm; 4=Comp. 2 overload; 5=2nd set point; 6=User pump 1 overload; 7=User pump 2 overload; 8=Source fan/pump overload	3	0	7	-
Hc08	ID6 configuration 0=Not used; 1=Tank level; 2=Remote On/Off; 3=Remote alarm; 4=Comp. 2 overload; 5=2nd set point; 6=User pump 1 overload; 7=User pump 2 overload; 8=Source fan/pump overload	5	0	7	-
Hc12	DO6 configuration 0=Not used; 1=Heater; 2=Source fan/pump; 3=Hot gas	1	0	3	-
Hc14	DO5 configuration 0=Not used; 1=Generic alarm; 2=Heater; 3=Hot gas; 4=User pump 2	1	0	4	-
Hc15	ID1 configuration 0=Not used; 1=Tank level; 2=Remote On/Off; 3=Remote alarm; 4=User flow switch; 5=Source fan/pump overload	4	0	4	-
Hc16	ID2 configuration 0=Not used; 1=Tank level; 2=Remote On/Off; 3=Remote alarm; 4=Comp. 2 overload; 5=Comp. 1 overload; 6=Circuit overload; 7=Source fan/pump overload	5	0	6	-
Hc17	S1 configuration (0=Not used; 1=Return water temperature from user)	1	0	1	-

Par.	Description	Def.	Min.	Max.	UOM
Hc18	S1 configuration (0=Not used; 1=Water delivery temperature to user)	1	0	1	-
Hc19	Configuration of probes S1, S2, S3 (0=NTC; 1=PT1000)	0	0	1	-
U068	Free cooling: enable (0/1=no/yes)	0	0	1	-
U074	Free cooling type (0=Air; 1=Remote coil; 2=Water)	0	0	2	-
U071	Design free cooling delta T	8.0	0.0	99.9	K
U061	User pump overload: input logic (0/1=NC/NO)	0	0	1	-
U065	Free cooling valve: output logic (0/1=NO/NC)	0	0	1	-
C037	Evaporation pressure: probe type (0=0-5V; 1=4-20mA)	0	0	1	-
C038	Evaporation pressure probe: min value	0.0	-1.0	99.9	bar
C039	Evaporation pressure probe: max value	17.3	0.0	99.9	bar
C040	Condensing pressure: probe type (0=0-5V; 1=4-20mA)	0	0	1	-
C041	Condensing pressure probe: min value	0.0	-1.0	99.9	bar
C042	Condensing pressure probe: max value	45.0	0.0	99.9	bar
U006	Cooling set point: minimum limit	5.0	-99.9	999.9	°C
U007	Cooling set point: maximum limit	20.0	-99.9	999.9	°C
Hc13	Buzzer (0/1=No/Yes)	1	0	1	-

Tab. 3.a

3.3.2 Analogue output configuration

uChiller process does not have any parameters for configuring analogue outputs Y1 and Y2.
These are configured automatically according to whether certain optional devices are present
The assignment priority is as follows.

Y1 configuration

Analogue output Y1 is assigned according to the following priority:

1. Modulating source pump or fan
   If air or remote air coil free cooling is enabled, Y1 will be assigned the modulating source fan request.
2. Auxiliary PID 1 output
   This is assigned if there is no modulating pump/fan in the unit.
3. Auxiliary PID 2 output
4. External SSR or 0-10V modulating hot gas bypass valve

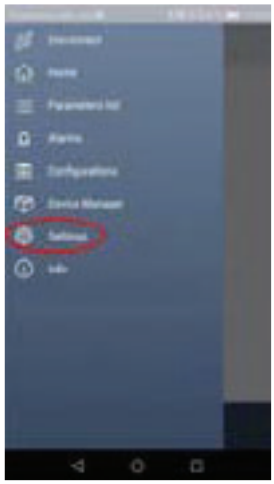
Y2 configuration

Analogue output Y2 is assigned according to the following priority:

1. Capacity request from free cooling
2. External SSR or 0-10V modulating hot gas bypass valve (only configured if this has not already been assigned to output Y1)
3. Auxiliary PID 1 output (if not already configured on Y1)
4. Auxiliary PID 2 output (if not already configured on Y1)

3.3.3 Applica: date and time setting

Applica includes a feature for setting the date and time on µChiller Process 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.

3.3.4 Applica: copy configuration

Applica includes a "Clone" feature to acquire the configuration from one unit and replicate it "one-for-one" to other units.

Procedure:
1. open Applica on the mobile device;
2. access the controller via NFC or Bluetooth, using the "Service" or "Manufacturer" profile credentials;
3. follow the path "Configurations/Clone";
4. enter a name to describe the configuration being saved;
5. with an NFC connection: move the device near to the display terminal on the µChiller Process that the configuration is being copied from; once the message shows the configuration has been acquired, this is saved to the smartphone's memory, available via icon 2 (see the following figure);
6. select the saved configuration; (with an NFC connection) move the device near to the display terminal on the µChiller Process that the same configuration is being applied to;
7. confirm and wait for the confirmation message.

Notice: with a Bluetooth connection the configuration is saved/applied on confirmation.

With reference to the figure on the side, tapping icon:
1. accesses the configurations saved by the user;
2. accesses the configurations prepared by Carel;
3. accesses the saved clones.

3.4 Applica Desktop

3.4.1 Commissioning software

Applica Desktop is a program intended for manufacturers and installers of units fitted with the µChiller Process 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 the commissioning procedure;
- troubleshoot any problems on the unit.

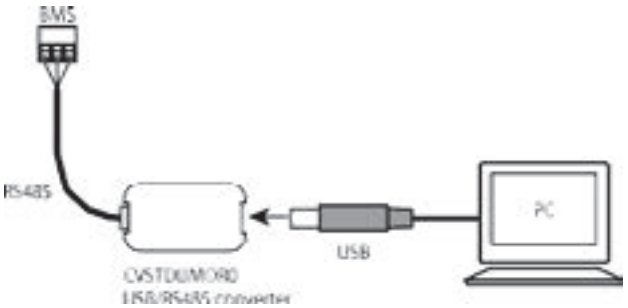


Fig. 3.a

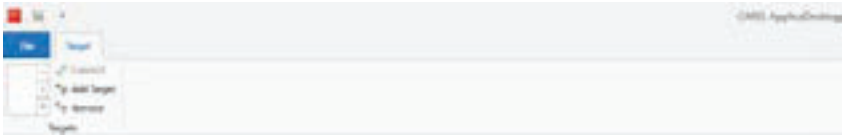
Notice:
- Applica Desktop can be used as an alternative to the Applica app, and requires an internet connection;
- For the physical connection to the BMS port on µChiller Process, use the USB/RS485 converter P/N CVSTDUMOR0

3.4.2 Preparing for operation

1. Access KSA, "Software & Support",
2. Select Configuration & Updating software / ST Configuration / Refrigerant Gases.
3. For µChiller Standard and Enhanced models (with On/Off compressor), select the refrigerant charged on the unit.
4. **Notice**: the BLDC compressor configuration must be performed with the unit OFF and the "Crankcase heater" function disabled (par. P034 = 0). For High Efficiency models (HE, with BLDC compressor), first import the BLDC compressor configuration, selecting the "BLDC Compressors" section, and then set the brand and model of compressor installed on the unit.

Configuration procedure

1. Connect to the BMS port on the µChiller Process controller, as shown in the figure;
2. Open Applica Desktop; a window will be opened with the right part of the top bar as shown below:



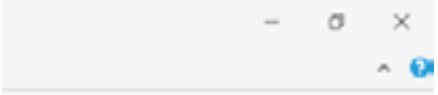
3. Select "Add target" and assign it a meaningful name (e.g. "µChiller Process");
4. In the "COM Port" field, enter the COM port used for the USB connection to the USB/RS485 converter;
5. Configure the connection parameters (Baudrate=115200, Bits=8, Parity=None, Stop Bits=Two, Serial Node=1) as shown in the figure (the data are saved automatically);

6. Use "Connect" to connect to the µChiller Process (which must be powered on);
7. Once connected, select the "Configurations" label: the command bar will be displayed, as shown:

8. Select "File -> Import" to load the refrigerant configurations downloaded from KSA;
9. Select the configuration to be applied to the µChiller Process, and then "Apply Configuration";

10. Applica Desktop will display a message when the parameters have been set, and if necessary indicating any values that have been applied that do not belong to the current user profile (some parameters may not be visible to the user).
11. Repeat the sequence of steps 8 and 9 for each configuration to be applied.

Notice: Applica Desktop features complete online help, available via the "?" icon at the top right of the window (figure):



4. USER INTERFACE

4.1 Introduction

µChiller Process 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 (depending on the model) connectivity for interaction with mobile devices (on which the Carel "Applica" app has been installed, available on Google Play for the Android operating system).

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 UoM, accessed at a Service level, including in the direct access functions menu.

Part number	Description	Def.	UoM	Min	Max	Lev.
UoM	Unit of measure - 0=°C/barg 1=°F/psig	0	-	0	1	S

Tab. 4.a

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

4.2 User terminal

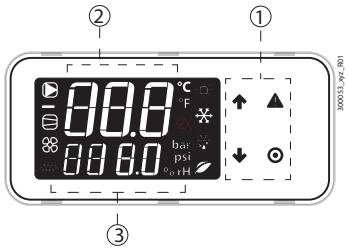


Fig. 4.a

Key:

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

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 commissioning tool.

4.2.1 Keypad

Button	Description	Function
	UP	• When scrolling: go to the previous parameter • In programming mode: increase the value Main menu: • Press and hold (3s): Switch unit on/off
	DOWN	• When scrolling: go to the next parameter • In programming mode: decrease in value Main menu: • pressed briefly: unit dashboard display • pressed and held (3 s): access User parameters (set point, unit on-off, ...)
	Alarm	• Pressed briefly: display active alarms and mute buzzer • Pressed and held (3 s): reset alarms.
	PRG	• When scrolling: access parameter programming mode In programming mode: • pressed briefly: confirm value • pressed and held (3 s): return to the main menu

Tab. 4.b

4.2.2 Icons

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

Icon	Function	On	Flashing
	User pump	Active	In manual operation
	Source device status (pump/fan)	Active	In manual operation
	Compressor status	Active	In manual operation (with ExV)
	Frost protection heater	Active	-
	Operating mode	Cooling	High/low water temperature
		Free cooling	-
	Service	Service request on exceeding operating hour threshold	Serious alarm, action required by qualified personnel

Tab. 4.c

4.3 Standard display

At start-up, the user terminal briefly shows "NFC", indicating that the NFC interface is available on the user terminal for communication with mobile devices, and then the standard display is shown. The standard display shows:

- on the top row: the delivery water temperature;
- on the bottom row, when the unit is on, the return water temperature; when the unit is off, it shows "OFF".

Use parameters U111 (display row 1) and U112 (display row2) to modify the variables displayed, choosing from the following:
0 = water return temperature;
1 = water delivery temperature;
2 = outside air temperature;
3 = tank water temperature;
4 = condensing temperature;
5 = evaporation temperature
6 = generic probe (S6);
7 = suction temperature
8 = PID control AUX output 1 (%);
9 = actual main control set point;
10 = capacity request;
11 = discharge temperature;
12 = PID control AUX output 2 (%).

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

4.3.1 Dashboard

From the main menu, press DOWN to access information on the status of the devices and the temperatures, superheat values, etc.

- unit "OFF" and the reason for shutdown:
  - "diSP" from keypad;
  - "dI" from remote contact (via digital input);
  - "Schd" from time band (scheduler);
  - "bMS" from BMS;
  - "DndC" operating in "cooling on demand" mode, below the set point;
  - "AlrM" from alarm.
- "CMP" compressors;
- "AFC1" condenser delivery water temperature;
- "EuP1" evaporation temperature;
- "SSH1" superheat;
- "Cnd1" condensing temperature;
- "dSt1" BLDC compressor discharge temperature;
- "SPrb" outside air temperature;
- "AUSn" generic probe (S6);
- "GPrb" generic probe (S6);
- "TAnt" tank water temperature;
- "dSP1" condensing pressure;
- "ScP1" evaporation pressure;
- "Sct1" suction temperature
- "Opn1" ExV: position (%);

and if the access level is "Service":
- "Hd00" supervisor address (BMS);
- "Hd01" BMS baud rate;
- "Hd02" BMS communication parameters;
- "ESC" to exit the dashboard.

Example

Go to the standard display.

Press DOWN: CMP indicates that compressor 1 is on (o) and compressor 2 is off (_).

Press DOWN: EuP1 indicates: circuit evaporation temperature (3.8°C).

Press DOWN: Cnd1 indicates the circuit condensing temperature (40.8°C).

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

4.3.2 Direct access functions

The user terminal only provides access to the basic configuration parameters, such as direct functions and active alarms without password protection, or, with password protection, to the parameters used to configure and optimise the unit.
Press DOWN for 3 s to access the direct access functions:
- set point;
- switching unit on and off;
- change operating mode (cooling/heating, only on reverse-cycle units);
- select unit of measure.

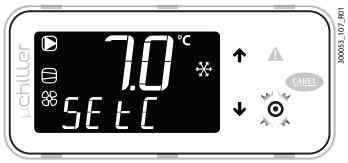
In programming mode, the bottom row shows the parameter code, and the top row shows the value.

Procedure

Press:
- DOWN for 3 s to access the parameters (User level, no password required);
- 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 DOWN for 3 s: the current set point (SEtA) is shown - read-only



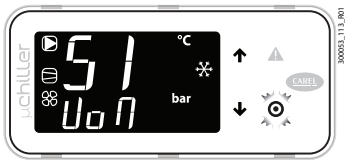
3. Press DOWN: the cooling set point (SEtC) is shown

4. If the tracking set point is active, the differential setting is shown (SEtd)

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

6. Press DOWN: the unit ON/OFF function (UnSt) is shown.

7. Press DOWN: the function to delete the alarm log (ClrH) is shown - Service level only.



8. Press DOWN: the unit of measure selection (UoM) is shown

9. Press DOWN: the AUX PID set point is shown.

10. Once the changes have been made, to exit either:
   - in the category level press ESC and then PRG;
   - press PRG for 3 s

4.3.3 Programming mode

Go to the standard display and press PRG to enter programming mode.

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: the password prompt (PSd) is shown

3. Press PRG: 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.

4. Press PRG: if the password is correct, the first parameter category is shown: PLt (=system)

5. Press PRG: the first parameter is displayed: U002 (Manual control pump 1)

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

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

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

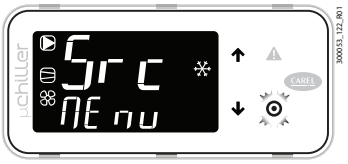
Notice: User password: 1000; Service password: 2000; Manufacturer password: 1234.
See the parameter table.

4.3.4 Programming menu

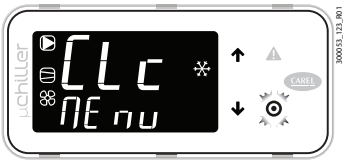
Category PLt (system): identified by code Uxxx, these parameters all relate to control and management of the system units.

Category EEV (ExV valve): identified by code Exxx, these parameters all relate to control and management of the electronic expansion valve(s).

Category CMP (compressors): identified by code Cxxx, these parameters all relate to control and management of the compressors and refrigerant circuit.



Category Src (source): identified by code Sxx, these parameters all relate to control and management of the condenser / source.



Category Clc (Clock): identified by code Haxx, these are the parameters for setting the date/time.

Category Hst (Alarm log): access the alarm log. Each event is described with the date (in the format DD MM) and time (in the format hh:mm) alternating.

Use Log-Out to exit the category.

Use ESC to return to the standard display.

Category tun (autotuning) Identified by code Yxxx, these are the parameters for automatic tuning of the auxiliary PID 1

Notice:

- the Service password also accesses the User parameters;
- if no button is pressed, after around 3 minutes the terminal will automatically return to the standard display.

5. FUNCTIONS

5.1 Temperature control

µChiller Process provides a main PID control function on the unit's water return (S1) or water delivery temperature (S2) or on the tank water temperature (configurable on S3 or S6); alternatively, dead band control can be selected on the unit water delivery temperature (S2). The set point can be switched between two values (including with a timed ramp) via digital input or scheduler; a set point can be defined for tracking the temperature of a second probe (also called "differential control"), or positive or negative compensation can be activated based on the outside temperature (as explained in the next chapter).
The cooling on demand function can also be enabled, so as to activate temperature control based on the value read by the tank temperature probe (configurable on S3 or S6). See the Installation chapter.
µChiller Process also provides an auxiliary PID control function, freely programmable for independent auxiliary control functions, with autotuning (see Auxiliary PID).

5.1.1 Main PID control

The PID control is freely configurable, with specific individual parameters for the action above the set point and the action below the set point (also see "Control diagrams").

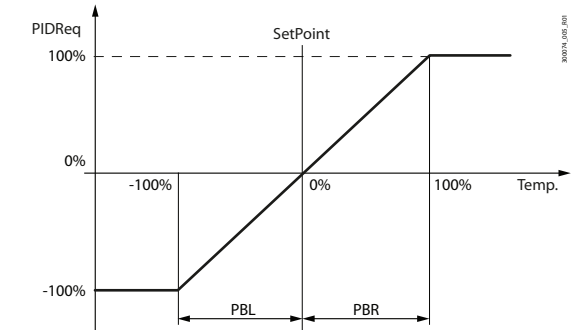


Fig. 5.a

Key

Set point	Current set point
PBL	Proportional band below the set point
PBR	Proportional band above the set point
PID Req.	PID request as a %
Temp.	Controlled temperature

Parameter U092 is used to select the controlled value, from:
- 0 = Water return temperature from user;
- 1 = Water delivery temperature to user;
- 2 = Tank water temperature.

The following parameters can be set:

User	Code	Description	Def	Min	Max	UOM
S	U081	Proportional band above the set point	5.0	0.0	999.9	K
S	U082	Integral time above the set point (Ti, action disabled when time set to 0)	0.0	0.0	999.9	s
S	U083	Derivative time above the set point (Td, action disabled when time set to 0)	0.0	0.0	999.9	s
S	U084	Proportional band below the set point	5.0	0.0	999.9	K
S	U085	Integral time below the set point (Ti, action disabled when time set to 0)	0.0	0.0	999.9	s
S	U086	Derivative time below the set point (Td, action disabled when time set to 0)	0.0	0.0	999.9	s
S	U092	Controlled water temperature (0=return temp; 1=delivery temp; 2=tank temp.)	0	0	2	-
U	SetC	Main control set point	7.0	U006	U007	°C

Tab. 5.a

The control sequence is as follows:
1. with the unit Off, control (PID or dead band) is disabled;
2. when the unit starts, following the set user pump – compressor delay (U047), the PID (or dead band) control is enabled and generates a capacity request (percentage) that is then processed so as to activate the compressors;
3. if this request is sufficient, one compressor will be started;
4. when the compressors are no longer needed to meet the control request, after the minimum running time has elapsed they can switch off;
5. if hot gas or a heating device are present, the compressor can remain on if activation of the hot gas function or heating device is sufficient to compensate for the excess cooling (see: "Control diagrams").

User	Code	Description	Def	Min	Max	UOM
S	U047	Compressor activation delay after user pump	30	0	999	s

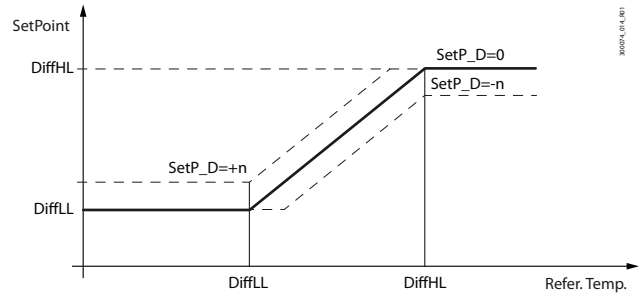
5.1.2 Set point tracking (differential control)

µChiller Process can enable a reference temperature probe for tracking set point control.
Tracking set point control (also improperly called differential control) manages the controlled temperature with reference to another temperature range (outside temp. or source), using a differential set point (SetP_D).
Parameter U103 is used to select the reference temperature, from:

- 0 = none;
- 1 = Tank water temperature;
- 2 = Outside air temperature;
- 3 = Water delivery temperature to user.

Notice: if no reference temperature is selected, the controller uses the standard set point (set or compensated).

User	Code	Description	Def	Min	Max	UOM
S	U103	Reference temperature selection for tracking set point: 0=no; 1=Tank temperature; 2=Outside air temperature; 3=Water delivery temperature	0	0	3	-
U	SEtd	Tracking set point offset	0	-99.9	99.9	°C
S	U104	Minimum tracking set point limit	10.0	-99.9	99.9	°C
S	U105	Maximum tracking set point limit	30.0	-99.9	99.9	°C



Key

Refer. temp.	Reference temperature
SetPoint	Resulting control set point
DiffLL	Minimum tracking set point limit
DifffHL	Maximum tracking set point limit
SetP_D	Tracking set point offset

Fig. 5.b

5.1.3 Set point switching - 2nd set point

If switching between the two set points (main and 2nd set point) is enabled by contact or scheduler, µChiller Process manages the changeover, in both directions, via a timed ramp.

User	Code	Description	Def	Min	Max	UOM
S	U017	Enable scheduler 0/1=No/Yes	0	0	1	-
S	U022	Scheduler changeover type 0/1=Off/2nd set point	0	0	1	-
U	SEtC	Main control set point	7.0	U006	U007	°C
U	U023	Main control 2nd set point	10.0	U006	U007	°C
S	U089	Set point switching: ramp time	0	0	999	s

5.1.4 Set point compensation

µChiller Process can adjust the set point based on the outside temperature.

Notice: this function can only be enabled if the outside temperature probe is fitted.

User	Code	Description	Def	Min	Max	UOM
M	Hc00	S3 configuration 0=Not used 1=Outside air temp. 2=Discharge temp. 3=Suction temp. 4=Source water delivery temp. 5=Tank temp.	0	0	4	-
M	Hc03	S6 configuration 0=Not used; 1=Remote set point; 2=Outside air temp.	0	0	2	-

The compensation (positive or negative) is determined by:

1. start compensation threshold;
2. end compensation threshold;
3. maximum compensation value

User	Code	Description	Def	Min	Max	UOM
S	U010	Enable set point compensation 0/1=no/yes	0	0	1	-
U	SEtC	Cooling set point	7.0	U006	U007	°C/°F
S	U011	Compensation: start	25.0	-99.9	999.9	°C
S	U012	Compensation: end	35.0	-99.9	999.9	°C
S	U013	Compensation: maximum value	5.0	-99.9	999.9	K

Positive compensation (positive DT):

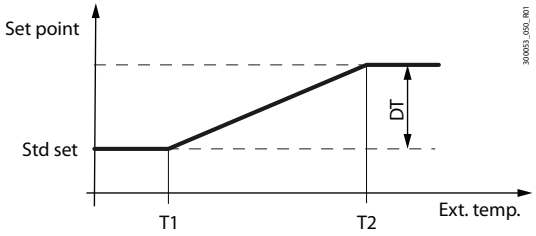


Fig. 5.a

Key

Ext. Temp.	Outside temperature
Std set	Control set point
T1	Outside temperature to start compensation
T2	Outside temperature to end compensation
DT	Maximum compensation value.

Negative compensation (negative DT):

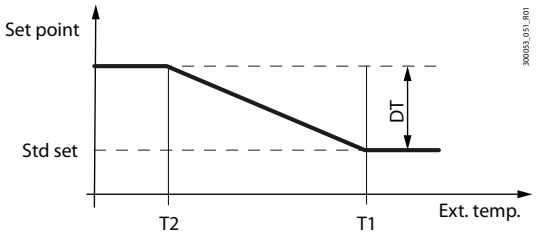


Fig. 5.b

Key

Ext. Temp.	Outside temperature
Std set	Control set point
T1	Outside temperature to start compensation
T2	Outside temperature to end compensation
DT	Maximum compensation value.

5.1.5 Set point from BMS

µChiller Process manages a variable set point from the BMS, bypassing the main control set point selected on the controller and accepting the value of the specific Modbus serial variable (BMS_RemSetP, HR 106 in REAL format, 2 registers). This operation is enabled via another serial variable (En_ BMS_ RemSetP, CS 111).

Notice: if the supervisor is offline, the unit continues to use the main control set point (SEtC), regardless of the value sent by the BMS.

User	Code	Description	Def	Min	Max	UOM
S	Hd08	Enable remote set point from BMS 0/1=no/yes	0	0	1	-
-	-	Remote set point from BMS	0	U006	U007	°C

5.1.6 Request from BMS

The request can be managed directly from the BMS, bypassing internal temperature control and using the percentage value (0 - 100.0%) sent via the specific Modbus serial variable (BMS_PwrReq, HR 253 in REAL format, 2 registers). This operation is enabled via another serial variable (En_BMS_PwrReq, CS 22).

Notice: if the supervisor is offline, the unit continues to operate independently, regardless of the request from the BMS.

User	Code	Description	Def	Min	Max	UOM
S	Hd08	Enable capacity request from BMS 0/1=no/yes	0	0	1	-
-	-	Remote capacity request from BMS	0	0.0	100.0	%

5.1.7 High/low controlled water temperature alarms

µChiller Process activates an alarm when the controlled water temperature exceeds the threshold set by the user (via the offset relative to the control set point). When the controlled temperature exceeds the threshold, a counter starts and after a delay (set-table), the alarm is activated. An initial delay disables the alarm in the transient period when the unit is starting.

Notice:

- temperature alarms are signal-only and do not shut the unit down;
- the signal can be used to activate a backup unit in critical applications.

User	Code	Description	Def	Min	Max	UOM
U	SetA	Current set point	-	-999.9	999.9	°C
S	U031	High water temperature alarm: offset	10.0	0.0	99.9	K
S	U090	Low water temperature alarm: offset	10.0	0.0	99.9	K
S	U032	High/low water temperature alarm: delay at start-up	15	0	99	min
S	U033	High/low water temperature alarm: delay in operation	180	0	999	s

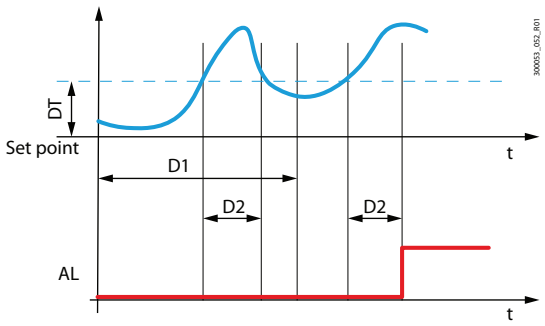


Fig. 5.c

Key

Set point	Current set point
DT	Offset
D1	Delay at start-up
D2	Delay in steady operation
AL	Alarm

5.2 Control diagrams

µChiller Process manages control in cooling mode only (chiller operation); the refrigeration cycle in fact cannot be reversed. The cooling effect of the compressor on the system can be limited using additional heating devices, which promptly bring the temperature back to the set point if the cooling delivered by the compressor is excessive. The control diagrams for the heating devices (On/Off or modulating) refer to generic devices. Of these, hot gas bypass valves are particularly interesting, as a result of their use and effectiveness in the field.
Based on the configuration of the controller, a number of specific control diagrams are illustrated in the following paragraphs.

5.2.1 control diagrams with ON/OFF compressors and heating step

Control diagram with one compressor and one heating step

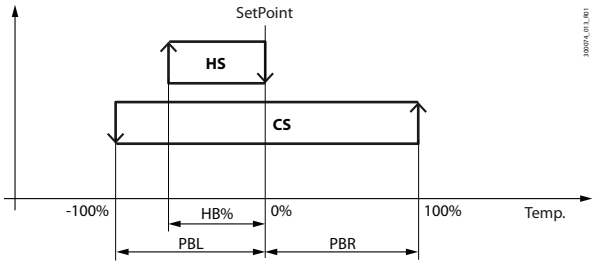


Fig. 5.d

Control diagram with two compressors and one heating step

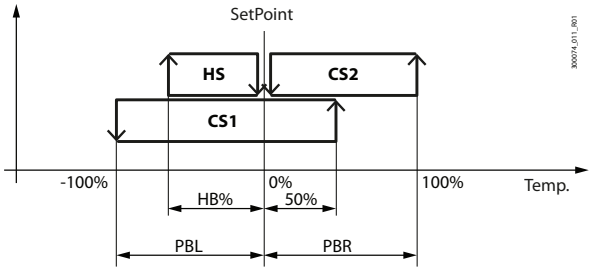


Fig. 5.e

Key

Set point	Current set point
HS	Heating step
CS	Compressor step
PBL	Proportional band below the set point
HB%	Heating step differential (% of PBL)
PBR	Proportional band above the set point
Temp.	Controlled temperature

The heating step may be an electric heater, a hot gas bypass solenoid valve or another heating, preheating or reheating device (e.g. a hot water plate heat exchanger upstream or downstream of the evaporator). The heating device activation point can be set (par. U087, as a % value of the proportional band below the set point).
The non-symmetrical diagram for the two-compressor version allows to the heater electrical power to be sized for a minimum of 25% of total cooling capacity.

Notice: µChiller Process manages the heating step to compensate for excess cooling capacity of the compressor, so as to delay or prevent the compressor from switching off: the step is not activated unless at least one compressor is on. The heating step can work alone only during the preheating phase (if activated), and only when the unit is on (see "Preheating").

User	Code	Description	Def	Min	Max	UOM
S	U081	Proportional band above the set point	5.0	0	999.9	K
S	U084	Proportional band below the set point	5.0	0	999.9	K
S	U087	Heating step differential (hysteresis)	75.0	5.0	100.0	%
M	C047	Type of compressors used (0=1 On/Off; 1=2 On/Off; 2=1 BLDC; 3=1 BLDC+On/Off)	0	0	3	-
M	U115	No. of heaters	0	0	1	-
U	SetC	Cooling set point	7.0	U006	U007	°C

5.2.2 Control diagrams with on-off compressors and modulating hot gas bypass

Control diagram with one compressor: step settings

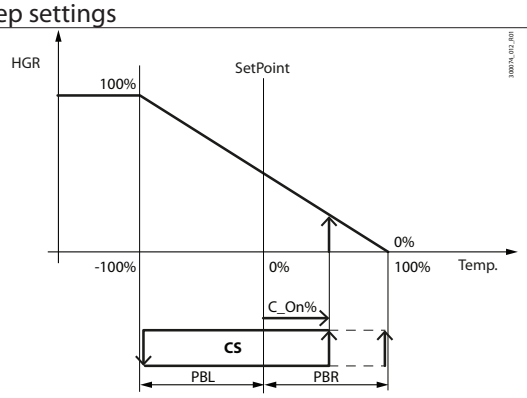


Fig. 5.f

Control diagram with one compressor: hot gas ramp settings

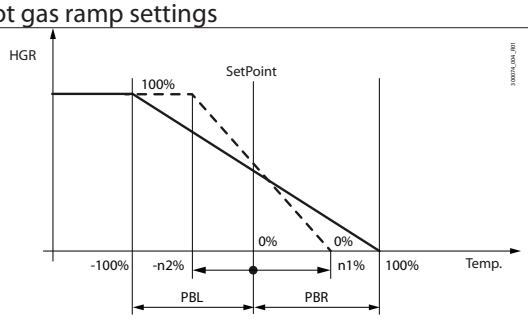


Fig. 5.g

Key

Set point	Current set point
CS	Compressor step
PBL	Proportional band below the set point (U084)
PBR	Proportional band above the set point (U081)
C_On%	Activation offset for the first compressor step (% of PBR) (U088)
n1%	Hot gas ramp start offset (0%) (% of PBR) (U102)
-n2%	Hot gas ramp end offset (100%) (% of PBL) (U101)
HGR	Hot gas modulation request
Temp.	Controlled temperature

Using a modulating hot gas bypass valve (U116=2, 3, 4, 5) makes it possible, by setting a parameter (U088), to specify the compressor step activation offset inside the proportional band on the right (C_On% in the diagrams). If the activation point for the first compressor step is 0%, when the unit is switched on (after the compressor start delay from pump on), the compressor is immediately activated (with PID output at zero).
With one compressor, precise capacity modulation is obtained by using hot gas bypass sized for the total rated capacity: the ramp end (n2; from 0% to -100%, default -100%) and ramp start points can be set (n1; from 0% to 100%, default 100%); the ramp is activated and deactivated based on compressor status (on or off).

User	Code	Description	Def	Min	Max	UOM
S	U081	Proportional band above the set point	5.0	0	999.9	K
S	U084	Proportional band below the set point	5.0	0	999.9	K
S	U088	Activation offset for the first compressor step	50.0	0	100.0	%
S	U101	Hot gas ramp end offset (100%) (% of U084)	-100.0	0	-100.0	%
S	U102	Hot gas ramp start offset (0%) (% of U081)	100.0	0	100.0	%
M	C047	Type of compressors used (0=1 On/Off; 1=2 On/Off; 2=1 BLDC; 3=1 BLDC+On/Off)	0	0	3	-
U	SetC	Cooling set point	7.0	U006	U007	°C

Control diagram with two compressors: step settings

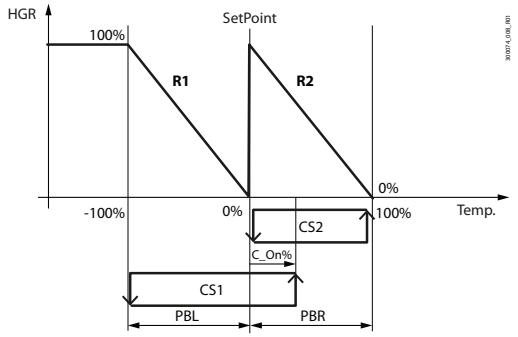


Fig. 5.h

Control diagram with two compressors: hot gas ramp settings

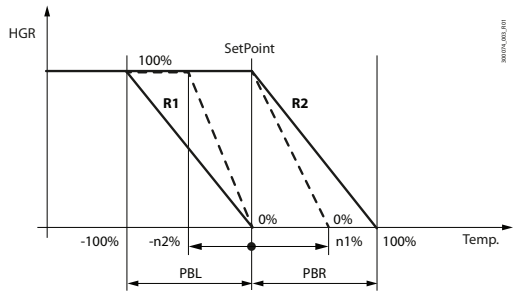


Fig. 5.i

Key

Set point	Current set point
CS1	First compressor step
CS2	Second compressor step
R1	Hot gas ramp first step
R2	Hot gas ramp second step
PBL	Proportional band below the set point (U084)

C_On%	Activation offset for the first compressor step (% of PBR) (U088)
n1%	Start offset (0%) hot gas ramp R2 (% of PBR) (U102)
-n2%	End offset (100%) hot gas ramp R1 (% of PBL) (U101)
HGR	Hot gas modulation request
Temp.	Controlled temperature
PBR	Proportional band above the set point (U081)

Using a modulating hot gas bypass valve (U116=2, 3, 4, 5) makes it possible, by setting a parameter (U088), to specify the first compressor step activation offset inside the proportional band on the right (C_On% in the diagrams). If the activation point for the first compressor step is 0%, when the unit is switched on (after the compressor start delay from pump on), the first compressor is immediately activated (with PID output at zero).
With two compressors, precise capacity modulation is obtained by using hot gas bypass sized for half of rated capacity; the two hot gas ramps (R1 and R2) act on the same device. The end ramp R1 (n2; from 0% to -100%, default -100%) and start ramp R2 points (n1; from 0% to 100%, default 100%) can be modified; each ramp, once having reached 100%, is reset when the corresponding compressor switches off.

User	Code	Description	Def	Min	Max	UOM
S	U081	Proportional band above the set point	5.0	0	999.9	K
S	U084	Proportional band below the set point	5.0	0	999.9	K
S	U088	Activation offset for the first compressor step	50.0	0	100.0	%
S	U101	End offset (100%) hot gas ramp R1 (% of U084)	-100.0	0	-100.0	%
S	U102	Start offset (0%) hot gas ramp R2 (% of U081)	100.0	0	100.0	%
M	C047	Type of compressors used (0=1 On/Off; 1=2 On/Off; 2=1 BLDC; 3=1 BLDC+On/Off)	0	0	3	-
M	U116	Hot gas bypass control type (0=No; 1=On/Off; 2=Modulating - internal SSR; 3=Modulating - external SSR; 4=Modulating - 0-10V; 5=Modulating with EXV)	0	0	5	-
U	SetC	Cooling set point	7.0	U006	U007	°C

5.2.3 Control diagrams with on-off compressors and on-off hot gas valve

Notice: the control diagrams shown in this paragraph are enabled when selecting on-off hot gas bypass (U116=1); for best control, the hot gas bypass should be sized for approximately half of the cooling step capacity (with two compressors, about 25% of rated unit capacity).

Control diagram with one compressor and one hot gas step

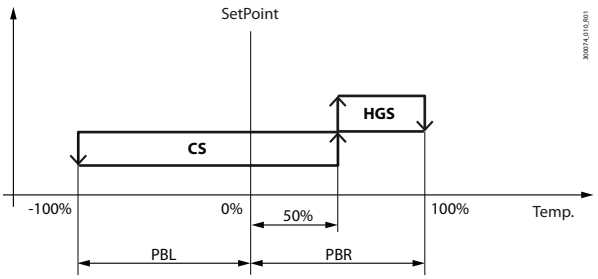


Fig. 5.j

Control diagram with two compressors and two hot gas steps

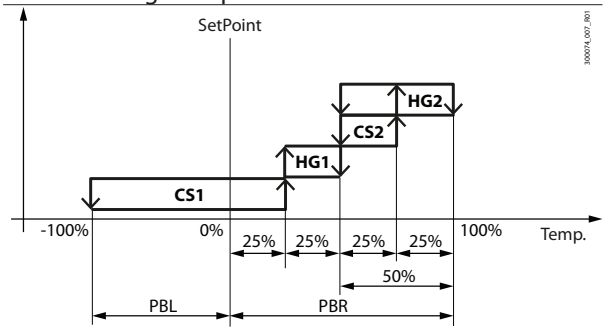


Fig. 5.k

Key

Set point	Current set point
CS	Compressor step
CS1	First compressor step
CS2	Second compressor step
HGS	Hot gas step
HG1	Hot gas step linked to the first compressor
HG2	Hot gas step linked to the second compressor
PBL	Proportional band below the set point (U084)
PBR	Proportional band above the set point (U081)
Temp.	Controlled temperature

The hot gas step is disabled when the corresponding compressor switches off; in the two-compressor configuration, the two hot gas steps act on the same device. As the required capacity increases, the activation sequence is as follows:
1. 25% request - first step on: one compressor is switched on and the hot gas bypass is activated;
2. 50% request - second step on: the hot gas bypass is deactivated (the compressor stays on);
3. 75% request - third step on: the second compressor is also switched on and the hot gas bypass is reactivated;
4. 100% request - fourth step on: the hot gas bypass is deactivated (both compressors on).

As the required capacity decreases, the deactivation sequence is as follows:
1. 75% request - fourth step off: hot gas bypass is activated;
2. 50% request - third step off: one compressor switches off and the hot gas bypass is deactivated (one compressor stays on);
3. 25% request - second step off: the hot gas bypass is reactivated;
4. 0% request - first step off: the second compressor also switches off and the hot gas bypass is deactivated.

User	Code	Description	Def	Min	Max	UOM
S	U081	Proportional band above the set point	5.0	0	999.9	K
S	U084	Proportional band below the set point	5.0	0	999.9	K
M	C047	Type of compressors used (0=1 On/Off; 1=2 On/Off; 2=1 BLDC; 3=1 BLDC+On/Off)	0	0	3	-
M	U116	Hot gas bypass control type (0=No; 1=On/Off; 2=Modulating - internal SSR; 3=Modulating - external SSR; 4=Modulating - 0-10V; 5=Modulating with EXV)	0	0	5	-
U	SetC	Cooling set point	7.0	U006	U007	°C

5.2.4 Control diagram with dead band on delivery temperature

In this configuration, the controller uses a proportional band and a set point (in the centre of the proportional band), as follows:

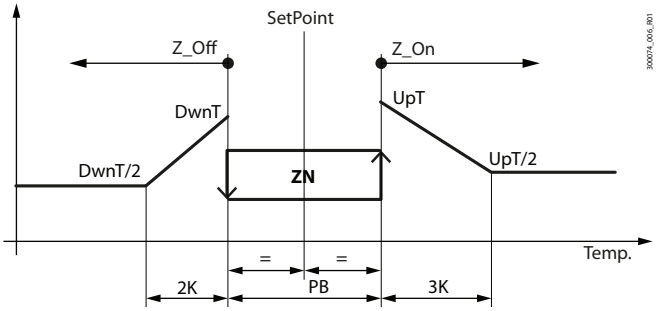


Fig. 5.l

Key

Set point	Current set point
ZN	Dead band
Z_On	Timed step activation zone
Z_Off	Timed step deactivation zone
UpT	Step on delay (C015) at the upper limit of the dead band
UpT/2	Step on delay (C015/2) at the upper limit of the dead band + 3K
DwnT	Step off delay (C016) at the lower limit of the dead band
DwnT/2	Step off delay (C016/2) at the lower limit of the dead band - 2K
3K	Delay time halving differential for activation of the steps
2K	Delay time halving differential for deactivation of the steps
PB	Dead band differential (U093)
Temp.	Water delivery temperature.

When control is enabled, if the delivery temperature is in the zone:
- dead band (ZN in Fig 5.l), no action is performed;
- timed on (Z_On in Fig 5.l), one step and the call counter are started to activated the subsequent steps;
- timed off (Z_Off in Fig 5.l) the shutdown counter is started for deactivation of the steps.

If there is a heating device, this is switched on and off without delay between activation and deactivation and vice-versa.

When the temperature remains in the step activation zone (Z_On), the timed activation sequence is as follows (example with two compressors and heating device):
1. first step ON: one compressor is switched on and the heating device is activated;
2. second step ON: the heating device is deactivated (the compressor stays on);
3. third step ON: the second compressor is also switched on and the heating device is reactivated;
4. fourth step ON: the heating device is deactivated (both compressors on).

When the temperature remains in the step deactivation zone (Z_ Off), the timed deactivation sequence is as follows (example with two compressors and heating device - starting from maximum capacity):
1. fourth step OFF: the heating device is activated;
2. third step OFF: one compressor switches off and the heating device is deactivated (one compressor stays on);
3. second step OFF: the heating device is reactivated;
4. first step OFF: the second compressor also switches off and the heating device is deactivated.

User	Code	Description	Def	Min	Max	UOM
S	U093	Dead band differential	5.0	0	999.9	K
S	C015	Step activation delay time	5.0	0	999.9	K
S	C016	Step deactivation delay time	5.0	0	999.9	K
M	C047	Type of compressors used (0=1 On/Off; 1=2 On/Off; 2=1 BLDC; 3=1 BLDC+On/Off)	0	0	3	-
M	U115	Heating device present (0=No; 1=Yes)	0	0	1	-
S	U096	Enable dead band control (0=No; 1=Yes)	0	0	1	-
U	SetC	Cooling set point	7.0	U006	U007	°C

Notice: the heating device may be an electric heater, a hot gas bypass solenoid valve or another heating, preheating or re-heating device (e.g. a hot water plate heat exchanger upstream or downstream of the evaporator).

5.2.5 Control diagrams with FC and/or BLDC option

If the free cooling or BLDC compressor option are selected, the standard control diagram is applied, with unform distribution of the compressor steps. Preheating can also be managed with the free cooling or BLDC option. If using the BLDC option without FC, the modulating hot gas bypass can be managed (stepped hot gas management is not available, the heater step can be used to control the hot gas solenoid valve).

Control diagram with FC, BLDC and (pre-)heating step

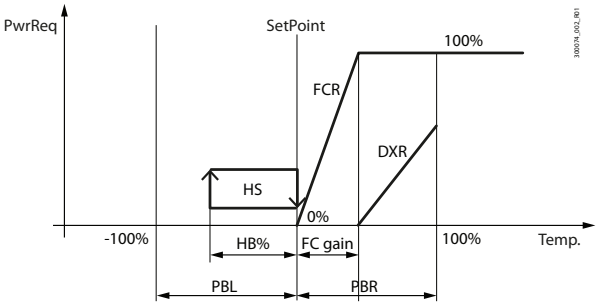


Fig. 5.m

Control diagram with BLDC and heating step

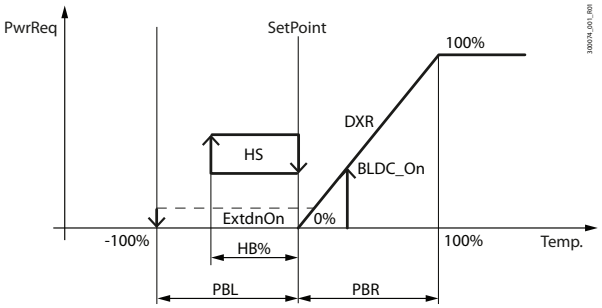


Fig. 5.n

Key

Set point	Current set point
HS	Heating (and/or preheating) step
FCR	Free cooling control ramp
DXR	Compressor request ramp
HB%	Heating step differential (% of PBL) (U084)
FC gain	FC control gain (%)
PBL	Proportional band below the set point (U084)
PBR	Proportional band above the set point (U081)
ExtdnOn	Operation with BLDC On below the set point (P035)
PwrReq	Capacity request %
Temp.	Controlled temperature

For details of free cooling operation, see the corresponding paragraph.
If a heating device is available, parameter P035 can be set to keep the BLDC on until the left end of the control band (-100%), ready to deliver cooling capacity if a rapid response is required.

User	Code	Description	Def	Min	Max	UOM
S	U081	Proportional band above the set point	5.0	0	999.9	K
S	U084	Proportional band below the set point	5.0	0	999.9	K
S	U087	Heating step differential (hysteresis)	75.0	5.0	100.0	%
M	C047	Type of compressors used (0=1 On/Off; 1=2 On/Off; 2=1 BLDC; 3=1 BLDC+On/Off)	0	0	3	-
M	U115	Heating device available (0/1=no/yes)	0	0	1	-
S	U068	Free cooling: enable (0/1=no/yes)	0	0	1	-
S	P035	BLDC on below the set point (with heating device available): enable (0/1=no/yes)	0	0	1	-
U	SetC	Cooling set point	7.0	U006	U007	°C

5.3 User pumps

µChiller Process can manage up to two user-side pumps (depending on the hardware used and the required configuration).
A delay can be set between pump and compressor activation (= temperature control enabled). A delay can also be set between the deactivation of the last compressor and the pump. If when the unit shuts down the compressors have been off for at least the "user pump shutdown delay after compressor", then the pump is stopped immediately.

User	Code	Description	Def	Min	Max	UOM
S	U045	Flow alarm delay from user pump on	10	0	999	s
S	U047	Compressor activation delay after user pump	30	0	999	s
S	U048	User pump shutdown delay after compressor	180	0	999	s

Tab. 5.b

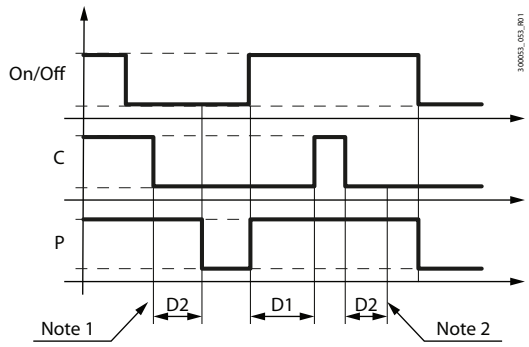


Fig. 5.o

Key

Unit	Unit On-Off (local or remote control)
C	Compressor
P	User pump
D1	Compressor activation delay after user pump (U045.U047)
D2	User pump shutdown delay after compressor
Notice 1	Control is not active: the compressors are stopped based on their own safety times
Notice 2	In this case, the pump can stop immediately

Below is a diagram that represents operation for the configuration with one pump only:

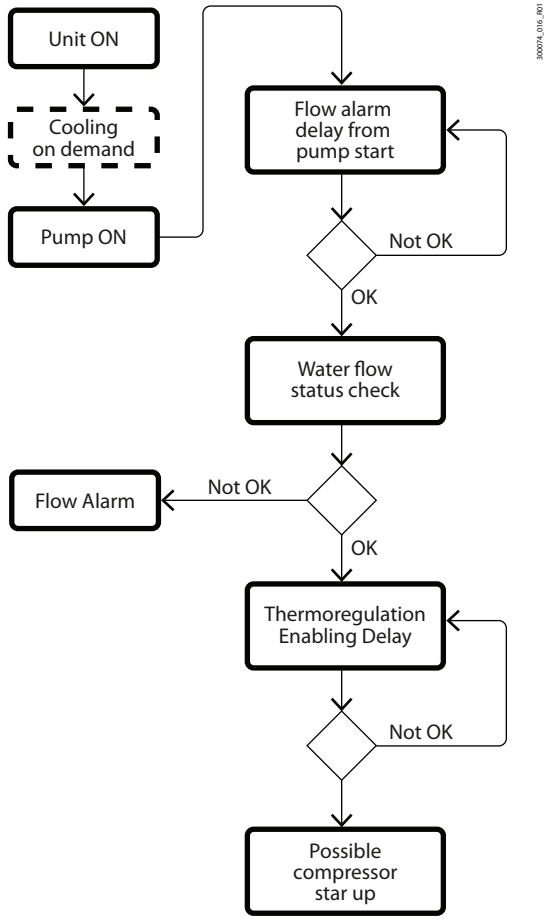


Fig. 5.p

The temperature control delay starts counting only after the flow alarm delay from pump on, so as to prevent the compressors from starting if there is no fluid flow.

Notice: if the "Cooling on demand" function is enabled, the pump and control are activated based on the call by the corresponding function (see the next paragraph).

Depending on the configuration, up to two user pumps can be enabled. µChiller Process includes the following functions:

- with two pumps, automatic rotation to ensure fluid circulation and equalisation of operating hours. Rotation is performed:
  - at the end of a period that can be set, in hours;
  - when there is an overload alarm on the active pump
- management of the pump overload alarm (if available, depending on the controller and the configuration) fault signal and immediate pump deactivation
- management of a flow switch that monitors fluid circulation in the system
- frost protection with unit off: the pump is started so as to activate fluid circulation (when the unit is on, the function is disabled)
- pump anti-seize: if the pump is off for more than a week, it is activated for 3 seconds.

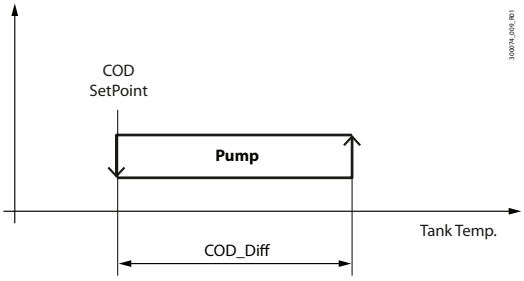
User	Code	Description	Def	Min	Max	UOM
S	U049	User pump rotation time	12	0	999	h

5.3.1 Modulating user pump

µChiller Process can manage a modulating user pump via the auxiliary PID.
To control the pump at constant delivery pressure, a suitable water delivery pressure sensor must be installed, connected to input S6, and acquired as a "generic sensor". The pump set point is controlled by the auxiliary PID. For the parameters to be set, see §5.4 Auxiliary PID.

5.3.2 Cooling on demand

If a tank is present, control can be set as "on demand", so as to activate the pump and the main control until a specific tank set point is reached (typical in winemaking applications). In this case, control follows the main set point, while a hysteresis cycle with specific set point and differential activates the pump and the main control (via the specific "tank temperature" probe installed on the tank).



Key

COD Set point	Cooling on demand set point (SetA + U097)
COD_Diff	Cooling on demand step hysteresis
Pump	Pump activation
Tank temp.	Tank temperature

Fig. 5.q

The "Cooling on demand" function is enabled by parameter and only when the tank probe is fitted; it is activated with the unit ON; below the set point, the unit is in standby with the pump off: the display shows "Off", however pressing the DOWN button, "dndC" is displayed to indicate that the "Cooling on demand" function is active. When the tank has been filled (= when the "Cooling on demand" set point has been reached), the main control is disabled and the pump is switched off with the standard delay after the compressors have switched off.

User	Code	Description	Def	Min	Max	UOM
S	U097	Cooling on demand: set point offset from active set point (SetA)	0	-99.9	99.9	K
S	U098	Cooling on demand: step differential	5.0	0.1	9.9	K
S	U099	Cooling on demand: enable (0/1=no/yes)	0	0	1	-
U	SetC	Cooling set point	7.0	U006	U007	°C

5.3.3 Cyclical pump activation during standby

When the chiller serves a chilled water tank (for example, in winemaking applications), the pump does not need to keep running, consequently energy can be saved by stopping the pump when the cooling demand is met.
A function can be activated to:

- switch the pump off after the compressors are stopped by the temperature controller;
- activate the pump periodically, in order to reactivate the compressors and satisfy demand from the user.

User	Code	Description	Def	Min	Max	UOM
S	U078	User pump in standby: enable On-Off cycles	0	0	1	-
S	U079	User pump in standby: On time	3	1	15	min
S	U080	User pump in standby: Off time	15	3	99	min

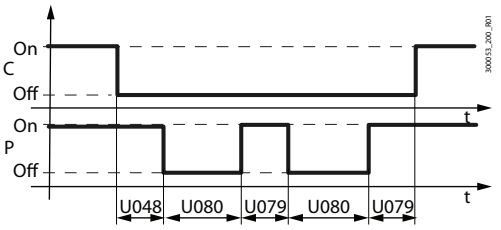


Fig. 5.r

5.4 Auxiliary PID

To allow the manufacturer flexibility in managing certain unit devices and cover cases that are not specifically foreseen by the configurations described in this manual, µChiller Process features an independent control loop. Each loop has its own independent PID control. Each PID can be assigned its own input process variable and can independently control an analogue output value.

The two auxiliary PIDs are programmable as regards the following elements:

- Direct/reverse function (acts in the portion from 0% to 100.0% or from 0% to -100.0%);
- Set point;
- Gain kP;
- Integral time Ti;
- Derivative time Td.
- Activation can be selected between:
  - Enabled when the unit is switched on;
  - Enabled with activation of the user pump;
  - Enabled with activation of main control;
  - Enabled when the first compressor starts;
  - Always enabled.
- Minimum control value % limitation (valid from activation);
- Maximum control value % limitation.

5.4.1 Auxiliary PID control diagram

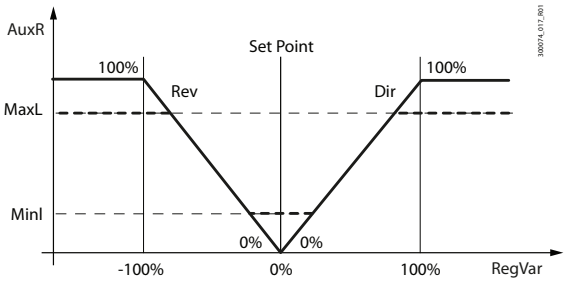


Fig. 5.s

Key

Set point	Auxiliary PID set point (Set2 and/or SEt3)
DIr	Direct action (as the controlled variable increases in value)
Rev	Reverse action (as the controlled variable decreases in value)
AuxR	Auxiliary PID output request (OUPI and/or OUP2)
MaxL	Maximum control limit (Y009 and/or Y029)
MinL	Minimum control limit (only if the PID loop is active) (Y008 and/or Y028)
BP	Bandwidth = 100 / Kp Error = Error on the set point

The input value can be selected between (parameter Y007):

- Value read by analogue input S1;
- Value read by analogue input S2;
- Value read by analogue input S3;
- Condensing temperature (read by analogue input S4, converted to temperature if S4 is configured as pressure);
- Evaporation temperature (read by analogue input S5, converted to temperature if S5 is configured as pressure);
- Value read by analogue input S6 or generic sensor;
- Value read by analogue input S7;
- Difference in reading of analogue inputs S2-S3;
- Difference in reading of analogue inputs S2-S6 or S2-generic sensor;

The PID control output request is automatically assigned to analogue output Y1 or Y2, based on the configuration of the controller and a list of priorities: For further details on configuring the analogue outputs, see section §3.3.2 Analogue output configuration.

User	Code	Description	Def	Min	Max	UOM
M,S,U	SEt2	Auxiliary PID 1 set point	18.0	-99.9	999.9	-
M,S,U	Set3	Auxiliary PID 2 set point	18.0	-99.9	999.9	-
M,S	Y001	Aux PID 1 direct/reverse action (0/1=direct/reverse)	0	0	1	-
M,S	Y002	Aux PID 1 user gain constant Kp	10.0	0.1	999.9	-
M,S	Y003	Aux PID 1 user integral time Ti	100.0	0	999.9	s
M,S	Y004	Aux PID 1 user derivative time Td	5.0	0	999.9	s
M,S	Y005	Aux PID 1 activation by: 0=None; 1=Unit On; 2=User pump; 3= Main control On; 4=Compressors ON; 5=Always ON	0	0	5	-
M,S	Y006	Aux PID 1 activation delay	0	0	999	s
M,S	Y007	Controlled variable (at Aux PID 1 input): 0=S1; 1=S2; 2=S3; 3=S4; 4=Tcond(S5); 5=Tevap(S6); 6=S7; 7=S2-S3; 8=S2-S6	0	0	8	-
M,S	Y008	Aux PID 1 minimum control limit	0	0	100.0	%
M,S	Y009	Aux PID 1 maximum control limit	100.0	0	100.0	%
M,S	Y010	Enable auxiliary PID 1: (0/1= no/yes)	0	0	1	-
M,S,U	InPI	Controlled variable value (at Aux PID 1 input)	0	-999.9	999.9	-
M,S,U	InP2	Controlled variable value (at Aux PID 2 input)	0	-999.9	999.9	-
M,S	OUPI	Aux PID 1 output request	0	0	100.0	%
M,S	OUP2	Aux PID 2 output request	0	0	100.0	%
M,S,U	Ausn	Generic sensor value (S6)	0	-99.9	999.9	-
M,S	Y018	Generic sensor (S6): offset	0	-99.9	999.9	-

User	Code	Description	Def	Min	Max	UOM
M,S	Y019	Generic sensor (S6): minimum value	0	-99.9	999.9	-
M,S	Y020	Generic sensor (S6): maximum value	100.0	-99.9	999.9	-
M,S	Y021	Aux PID 2 direct/reverse action (0/1=direct/reverse)	0	0	1	-
M,S	Y022	Aux PID 2 user gain constant Kp	10.0	0.1	999.9	-
M,S	Y023	Aux PID 2 user integral time Ti	100.0	0	999.9	s
M,S	Y024	Aux PID 2 user derivative time Td	5.0	0	999.9	s
M,S	Y025	Aux PID 2 activation by: 0=None; 1=Unit On; 2=User pump; 3= Main control On; 4=Compressors ON; 5=Always ON	0	0	5	-
M,S	Y026	Aux PID 2 activation delay	0	0	999	s
M,S	Y027	Controlled variable (at Aux PID 2 input): 0=S1; 1=S2; 2=S3; 3=S4; 4=Tcond(S5); 5=Tevap(S6); 6=S7; 7=S2-S3; 8=S2-S6	0	0	8	-
M,S	Y028	Aux PID 2 minimum control limit	0	0	100.0	%
M,S	Y029	Aux PID 2 maximum control limit	100.0	0	100.0	%
M,S	Y030	Enable auxiliary PID 2: (0/1= no/yes)	0	0	1	-
M,S	Y031	Aux PID 1: Select set point 0=SEt2; 1=SEtA	0	0	1	-
M,S	Y032	Aux PID 2: Select set point 0=SEt3; 1=SEtA	0	0	1	-

5.4.2 Auxiliary PID parameter autotuning

µChiller Process allows the auxiliary PID parameters to be tuned, even by users who are not experts in automation and control. If the user does not know which parameters to set, automatic tuning offers three starting values for PID system control. Furthermore, by enabling the Fine Tuning, errors in determining the values of Kp, Ti and Td can be minimised, however extending the overall time needed to automatically define the parameters.
Automatic tuning (without activating the Fine Tuning) takes a time that varies from ten minutes up to a limit of two and a half hours to complete: the closer the value of initial gain kP (parameter Y011) is to that characteristic value of the controlled system, fewer scans will be needed to complete the process correctly (with the default settings for the number of samples and sampling time, each scan lasts 10 minutes). If Fine Tuning is also activated, the process will also complete an extra scan, optimised according to the results obtained from the first.

Notice:
- automatic tuning only applies to auxiliary PID 1.
- automatic tuning on µChiller Process applies to all systems that, operating in pure proportional mode and gradually increasing the continuous gain, reach a situation that has stable swings in frequency, is stationary or damped in amplitude. There are systems that, on the contrary, always remain stable and therefore do not allow autotuning to be used.
- During the learning stage, the autotuning function takes control of the PID and triggers automatic swings in the system. Depending on the system in question, if the amplitude of these swings is too high, the process itself could be damaged. It is recommended to always proceed with caution and, if possible, monitor the system during the learning phase. The autotuning function can be interrupted at any time (via the same start parameter, Y017), even if tuning is in progress: in this case, the PID goes back to using the parameters that were initially set before the start of the autotuning function.
- For correct tuning, the PID must be actively controlling throughout the entire learning stage. Therefore, make sure that the set point is such that the PID is actively controlling. Example. The PID works between 0% and 100%. Set point = 45 (arbitrary value) but the controlled variable cannot exceed 30. The PID reaches saturation at 100% and cannot control beyond that value. This type of situation prevents the algorithm from learning correctly, leads to failure of the tuning procedure or (in the worst case scenario) the three values calculated are meaningless.
- Parameter Y011 defines the gain value kP that the autotuning process starts from: if the value is close to the correct one, the autotuning process will be completed more quickly; vice-versa, if it is far away, the procedure will be longer. For example, if the initial value is 10.0, while the controlled system needs a value around 200, the autotuning process may take up to two hours to complete.

User	Code	Description	Def	Min	Max	UOM
S	Y011	Autotuning: initial gain constant kP	10.0	0.1	999.9	-
S	Y012	Autotuning: number of samples	600	1	2048	-
S	Y013	Autotuning: sampling time	1.0	0.34	999	s
S	Y014	Autotuning: auxiliary PID 1 parameter selection (0=user parameters; 1=tuned parameters)	0	0	1	-
S	Y015	Autotuning: manual mode (0/1=no/yes)	0	0	1	-
S	Y016	Autotuning: enabling Fine Tuning (0/1=no/yes)	0	0	1	-
S	Y017	Autotuning: start/stop automatic procedure (1=start; 0=stop/off)	0	0	1	-
S	PIdP	Autotuning: gain constant kP sent to auxiliary PID 1	-	0.1	999.9	-
S	PIdI	Autotuning: integral time Ti sent to auxiliary PID 1	-	0	999.9	s
S	PIdd	Autotuning: derivative time Td sent to auxiliary PID 1	-	0	999.9	s
S	StUn	Autotuning: current status of the process 0=Completed; 1=Signal acquisition; 2=DFT calculation; 3=Auto swing peak calculation; 4=Optimised parameter calculation; 5=Fine Tuning procedure; 6=Auto swing recovery cycle; 7=Application of parameters for new attempt; 8=Analysis of results; 9=Initialisation; 10=Not yet completed	10	0	10	-
S	EtUn	Autotuning: process error 0=Tuning performed correctly; 1=Signal frequency lower than minimum; 2=Amplitude of peak lower than minimum threshold; 3=Fine Tuning; 4=Nothing to signal.	4	0	4	-
S	FtUn	Autotuning: Fine Tuning in progress (0/1=no/yes)	0	0	1	-

User	Code	Description	Def	Min	Max	UOM
S	PrtU	Autotuning: percentage of progress	0	0	100.0	%
S	PtUn	Autotuning: procedure in progress	0	0	1	-

5.4.3 What to do if the autotuning process fails

If the procedure ends (StUn=0 -> Completed) with an error signal (EtUn > 0), it means that the initial settings do not allow the procedure to correctly determine the values of the PID parameters (kP, Ti, Td) for the controlled system. The procedure can be repeated, changing the settings based on the error report:

Error	Technical details - suggested actions	Parameters involved and suggested values
1	The measured frequency is too close to zero frequency. This means that no peaks were found in the spectrum and/or the frequency value found is not significant. Try increasing the number of samples. This increases the frequency sensitivity and therefore improves detection of the main frequency of the auto-swings.	Y012 = previous value x 2; Alternatively or if the maximum number of samples has been reached: Y013 = previous value x 2
2	The amplitude of the main peak of the spectrum (relating to system swings) is less than the defined minimum noise threshold. The value found is not significant. Increase the value of Y011 and retry the tuning procedure	Y011 = previous value x 40

Tab. 5.c

5.5 Frost protection control

Frost protection control is preferably managed using the evaporation pressure probe, which directly monitors the conditions of the evaporator. If the evaporation pressure probe is fitted, the water delivery temperature probe is ignored, as this does not provide a significant indication of the possibility of ice forming inside the evaporator.
However, the absence of the evaporation pressure probe means frost protection is managed based on the water temperature leaving the evaporator: in this case, special attention must be paid to the position of the temperature probe, which should preferably be installed via a socket directly on the heat exchanger outlet connection. Care must also be paid to heat exchange between the socket and the temperature probe, using a special thermal paste.

5.5.1 Frost protection alarm from evaporation pressure/temperature probe

When there is a frost alarm on the evaporator, the circuit is shut down. Each circuit manages its own evaporation pressure probe, and consequently also the frost protection alarm. The evaporation temperature value is filtered based on an exponential distribution formula that takes into consideration the thermal mass of the evaporator so as to avoid false alarms at start-up. A specific algorithm uses this filtered value and activates the alarm if the frost protection threshold is exceeded.

User	Code	Description	Def	Min	Max	UOM
S	U050	User side frost protection: alarm threshold	-0.8	-99.9	999.9	°C
S	U051	User side frost protection: differential	30.0	0.0	999.9	K
S	U052	User-side frost protection: delay time at 1K	30	0	999	s

The figure shows the action of the filter on the evaporation temperature, according to the exponential distribution formula.

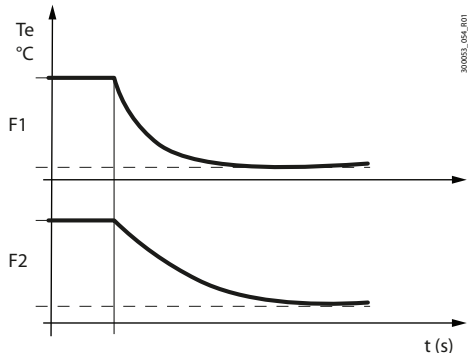


Fig. 5.t

Key

Te	Filtered evaporation temperature
F1	Filter with low delay
F2	Filter with high delay

When the filtered evaporation temperature falls below the alarm threshold, a counter is activated, and the counter time-out is either increased or decreased based on the deviation of the evaporation temperature from the frost protection threshold, until reaching zero when the deviation from the threshold it is greater than the differential, following a hyperbolic trend. This trend imitates the actual behaviour of ice formation and ensures better protection. The following diagram shows the trend in the alarm delay time according to the deviation from the alarm threshold, using the following values: delay time at 1K=60s; differential=30K. At the threshold the delay is equal to 10 times the set value (600s in the example).

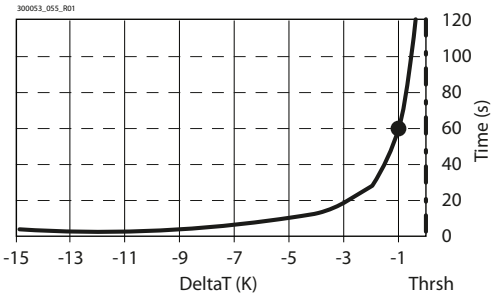


Fig. 5.u

Key

Time [s]	Frost protection alarm delay
Thrsh	Frost protection alarm threshold
DeltaT [K]	Deviation from the frost protection alarm threshold

Frost protection alarm operation:

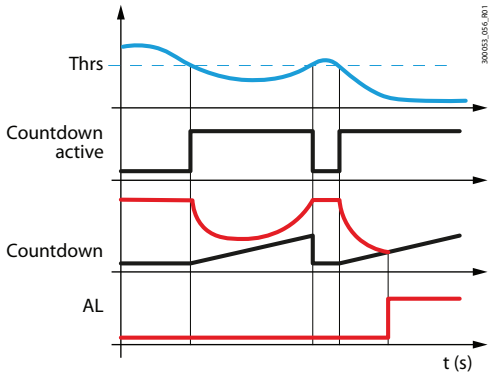


Fig. 5.v

Key

t [s]	Time [s]
Thrsh	Frost protection alarm threshold
AL	Frost protection alarm

The value of the delay (at 1K) in the previous example refers to a plate evaporator; if a tube bundle evaporator is used, which has greater thermal inertia, the delay time (at 1K) can be increased to a suitable value. The following table shows the recommended values for the alarm threshold (with pure water), differential and delay, according to the type of evaporator used.

Code	Description	Recommended values based on the heat exchanger	
		Tube bundle	Plate
U050	User side frost protection: alarm threshold	-0.3 °C	-1.2 °C
U051	User side frost protection: differential	30 °C	30 °C
U052	User-side frost protection: delay time at 1K	90 s	60 s

Tab. 5.d

With pure water, the frost protection threshold must be set just below zero (from -0.8°C to -1.5°C) to account for the heat transfer temperature gradient across the metal between the refrigerant and the water. For tube bundle heat exchangers, values close to zero (above -0.5°C) should be considered, to guarantee better protection due to their specific mechanical construction.

5.5.2 Frost protection threshold with glide (R407C)

A correct frost protection threshold also needs to consider the minimum temperature reached inside the evaporator. When using refrigerants without glide or with minimum glide (e.g. R410A, R134a) the value coincides with the pressure-temperature conversion (dew point) of the transducer fitted on the suction pipe, while for refrigerants with glide (e.g. R407C) the value to be used is lower than the pressure-temperature conversion (in the case of R407C it is 5- 6°C). The following diagram clearly shows the difference between the two temperature values(Tin and Tout) at the evaporation pressure (Pevap) due to the "glide" effect of the refrigerant.

P-H Diagram - Zeotropic Blend

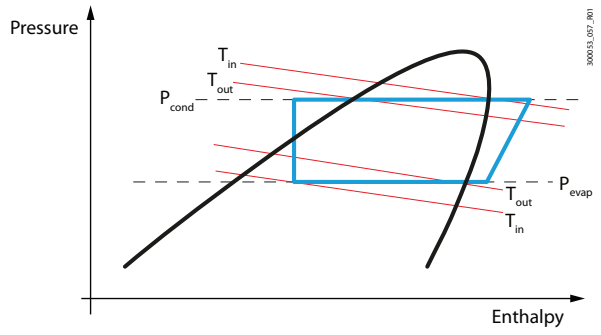


Fig. 5.w

Key

Tin (Pevap)	Evaporator refrigerant inlet temperature
Tout (Pevap)	Saturated evaporation temperature "dew"
Pcond	Condensing pressure
Pevap	Evaporation pressure

Notice: as a consequence of the above, the suggested frost protection set point with pure water and R407C refrigerant is 4-4.5°C.

5.5.3 Frost protection alarm from evaporation pressure/temperature probe

The frost protection threshold on the evaporation temperature is used as the minimum evaporation temperature threshold for frost prevention. Prevention is applied by limiting circuit capacity when the threshold is exceeded.

5.5.4 Frost protection alarm from evaporator water outlet temperature probe

When the water temperature leaving the evaporator falls below the frost protection alarm threshold (U050), the alarm delay countdown (U118) is activated; if the temperature does not rise back above SP+DT, the frost protection alarm is activated at the end of the countdown and the circuit is stopped.

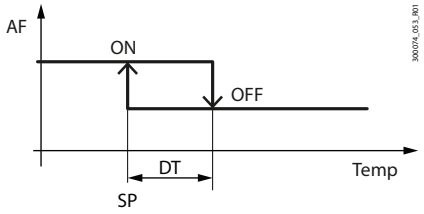


Fig. 5.x

Key

AF	Frost protection
DT	Hysteresis (U051)
SP	Frost alarm set point (U050)
Temp	Evaporator water outlet temperature (S2)

User	Code	Description	Def	Min	Max	UOM
S	U050	User side frost protection: alarm threshold	-0.8	-99.9	999.9	°C
S	U051	User side frost protection: differential	30.0	0.0	999.9	K
S	U118	Evaporator frost protection: delay time	10	0	999	s

Notice: the default values refer to using the pressure probe: see the table below for the correct settings of the values. The alarm threshold must be assessed based on evaporator efficiency: it must prevent the circuit from operating with the evaporation point constantly below the freezing point of the liquid in the circuit.

Code	Description	Recommended values based on the liquid used in the circuit	
		Pure water	Water-glycol
U050	Evaporator frost protection: alarm threshold	3.5 °C	3-4 °C above the point of freezing
U051	Evaporator frost protection: differential	1.0 K	1.0 K
U118	Evaporator frost protection: delay time	10 s	20 s

5.5.5 Frost protection with the unit OFF

µChiller Process provides frost protection management both when the unit is off and when the unit is on but with the compressors off: the water is prevented from freezing by activating the pump and/or antifreeze heater. When the water temperature in the heat exchangers reaches the frost protection set point, the selected device is activated. The probe used is the one located on the user heat exchanger outlet and source heat exchanger inlet. The following devices can be activated:

- heater;
- pump;
- heater and pump.

Important note:

There is only one digital output for the heating/frost protection device. This simultaneously manages frost protection on the evaporator and on the condenser for water-cooled. It is activated both by a request from the condenser and from the evaporator On the contrary, as regards the pump, there are two independent outputs for the condenser and the evaporator: if frost protection is activated, the output corresponding to the pump of the heat exchanger affected is activated.

User	Code	Description	Def	Min	Max	UOM
S	U053	Unit OFF: frost protection set point	4.0	-99.9	999.9	°C
S	U054	Unit OFF: frost protection differential	2.0	0.0	99.9	K
S	U075	Frost protection type - 0=Heater 1=Pump 2=Heater/pump	2	0	2	-

5.6 Preheating

The preheating function is required when there is a tank in the circuit and its temperature needs to be brought back to an initial level that is higher than ambient temperature when the unit is started.
The preheating stage (option activated by parameter, when a heating device is available) is activated when the unit is switched, with the set point selected; when the stage is active, after activation of the pump and the standard delay, if the controlled water temperature is below the heating device activation set point, this is activated. During the preheating stage, the compressor cannot be activated and the set temperature is shown on the display, with the status message HEAt flashing on the bottom row. The stage ends when the controlled temperature reaches the set point (with the heating device switched off); the compressor can now start. Preheating will now not be activated again (until the next time the unit is switched on). Outside of the preheating stage, the heater can only be activated to limit the cooling action of the compressor (i.e. it cannot work on its own).

Notice: hot gas bypass cannot be used for preheating.

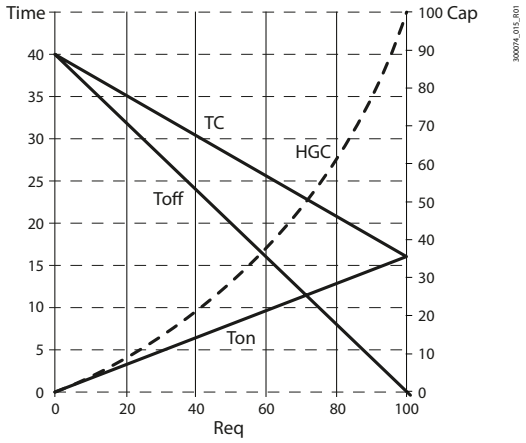
User	Code	Description	Def	Min	Max	UOM
S	U091	Preheating: enable (0/1=no/yes)	0	0	1	-
M	U115	Heating device available (0/1=no/yes)	0	0	1	-

5.7 Hot gas

µChiller Process can manage hot gas bypass as follows:
- stepped On-Off via controlling a solenoid valve connected to a relay output;
- modulating by managing a solenoid valve in On-Off cycles controlled via internal SSR relay (DIN models only);
- modulating by managing a solenoid valve in On-Off cycles controlled via external SSR relay, using a 0-10 V analogue output;
- modulating by operating a valve controlled by a 0-10 V signal connected to an analogue output;
- modulating by activating an ExV valve connected to the built-in or external valve driver.

5.7.1 Hot gas control diagram with On-Off cycle modulation

This function involves activating a solenoid valve via SSR output, controlled cyclically, with activation and deactivation times calculated according to parameter U100 (maximum valve off time). The combination of hot gas bypass valve on-off times based on the request gives a control diagram (represented by the HGC curve shown in the figure) that favours precise definition at low capacities, while at higher capacities preference is given to the response speed, to prevent the compressor from switching off.



Key

Req	Capacity request (temperature control) as a %
Cap	Hot gas capacity as a %
Time	Time in seconds
TC	Cycle duration
Ton	Hot gas solenoid valve on time
Toff	Hot gas solenoid valve off time
HGC	Hot gas capacity curve

Fig. 5.y

User	Code	Description	Def	Min	Max	UOM
S	U100	Maximum hot gas modulation On-Off cycle Off time (with SSR)	40	0.1	999.9	s
M	U116	Hot gas bypass control: 0=No; 1=ON/OFF; 2=Modul. internal SSR; 3=Modul. external SSR; 4=Modul. 0-10 V; 5=Modul. ExV	0	0	5	-

5.8 Compressor rotation

If there is just one compressor, the temperature control request will be exactly the same as the request that the compressor needs to satisfy. On units with two compressors, µChiller Process manages rotation in order to balance compressor operating hours and starts, so as to best deliver the required capacity.

5.8.1 Type of rotation

µChiller Process starts and stops the compressors based on:
- FIFO rotation (First In First Out), meaning the first compressor to start will also be the first to stop;
- activation time: the first compressor to start will be the one with the lowest number of operating hours

If the circuit is equipped with a variable-speed (BLDC) compressor, this will always be the first to start and the last to stop.

User	Code	Description	Def	Min	Max	UOM
M	C048	Compressor rotation type 1=FIFO, 2=Time	1	1	2	-

5.8.2 Capacity distribution

Compressor capacity distribution in steps

Below is an example of capacity distribution with two circuits in the tandem configuration with two fixed-speed compressors (scroll), each with the same capacity, and FIFO rotation.

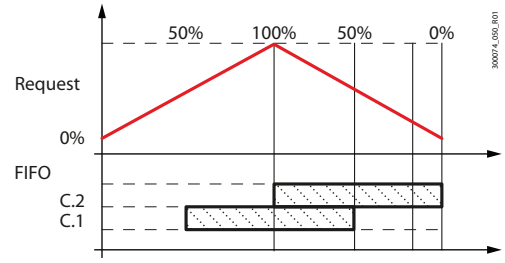


Fig. 5.z

Key

Request	Capacity request (temperature control)
C.1	Compressor 1
C.2	Compressor 2

Capacity distribution with BLDC compressors

If the circuit is equipped with a BLDC compressor, this will always be the first to start and the last to stop. Circuit operation is modulated so as to meet the capacity request, adjusting BLDC compressor speed and controlling the activation of ON-OFF compressors.

Notice: the configuration envisaged requires the capacity of the ON/OFF compressor to be equal to 60% of the capacity of the BLDC compressor (at maximum speed).

5.8.3 Rotation due to alarm

In the event of a compressor alarm, the next compressor available will be switched on as a replacement if the temperature control request is sufficiently high as to warrant starting another compressor.

5.8.4 Force rotation (destabilisation)

Some compressor manufacturers specify that on units with multiple compressors, the compressors need to be rotated after a certain period of inactivity, even if control is stable.
The destabilisation function, which meets this requirement:
- can be enabled by parameter;
- avoids refrigerant migration during long periods of inactivity;
- can also be used to keep all the compressors at operating temperature.

User	Code	Description	Def	Min	Max	UOM
M	C020	Maximum circuit destabilisation time	240	5	999	min
M	C044	Enable destabilisation 0/1=No/Yes	1	0	1	-

5.9 Compressor management

µChiller Process manages scroll compressors with direct starting or modulating BLDC compressors (scroll and rotary).
A maximum of 4 scroll compressors are available in tandem configuration on two circuits; in the High Efficiency models, with BLDC compressors, the maximum is 1BLDC+1On-Off per circuit.

The flow chart below shows the process for calculating the request to the compressors:

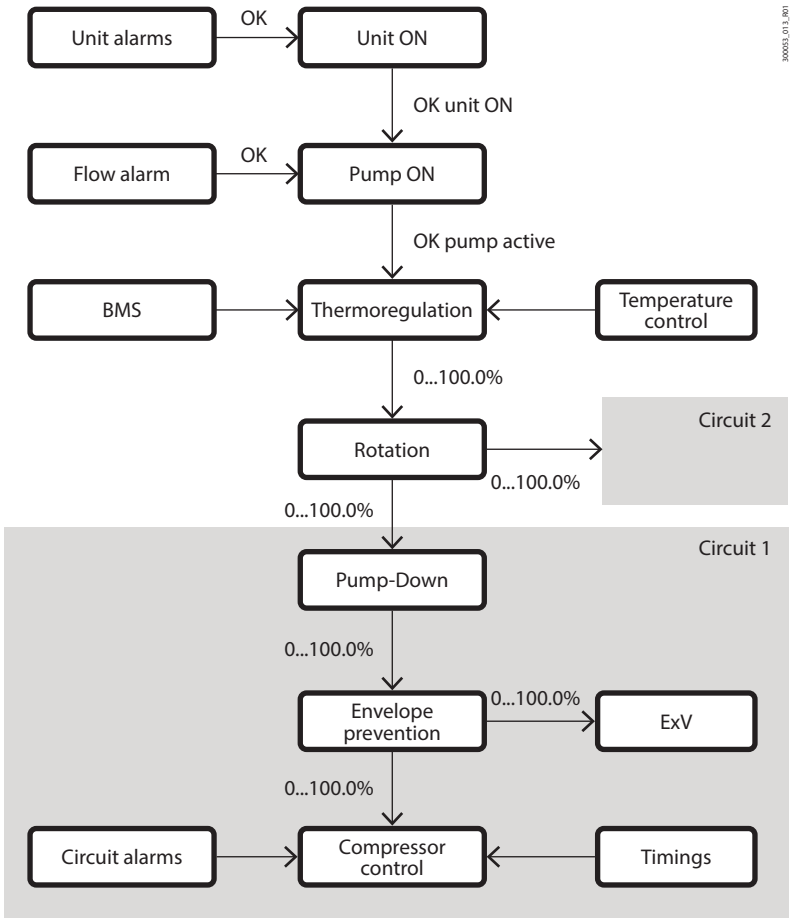


Fig. 5.aa

5.9.1 Predefined BLDC compressors

The type of BLDC compressor can be chosen from the list of compressors available on KSA (ksa.carel.com), under: KSA / SW&Support /Configuration & Updating software / ST Configuration / BLDC compressors.

When selecting a specific type of compressor, the following parameters are set based on the compressor manufacturer's technical specifications:

1. compressor motor:
   - all the characteristic electrical parameters of the compressor motor;
   - minimum and maximum frequency settings, acceleration and deceleration ramps.
2. compressor envelope:
   - all the characteristic points that define the shape of the compressor envelope;
   - maximum discharge temperature (compressor outlet).
3. compressor envelope management:
   - MOP and pressure difference (DeltaP), minimum ExV opening parameters;
   - working point control parameters;
   - prevention parameters.

5.9.2 Safety times

µChiller Process guarantees compliance with compressor safety times, such as:

- minimum on time;
- minimum off time after deactivation request from controller;
- minimum time between consecutive starts.

User	Code	Description	Def	Min	Max	UOM
M	C012	Min compressor on time	180	0	999	s
M	C013	Min compressor off time	60	0	999	s
M	C014	Min time between consecutive compressor starts	360	0	999	s

5.9.3 BLDC compressor start-up

µChiller Process manages the start-up of BLDC compressors in accordance with the manufacturer's specifications: on starting, the compressor is brought to start-up speed and kept at that speed, irrespective of the control request, for the entire minimum on time. At the end of this period, the speed is modulated by the controller, based on:

- request;
- position of the working point in relation to the compressor envelope (see par. "Prevention actions").

Notice: if at start-up the differential pressure is greater than the maximum allowed start-up threshold, the compressor remains on call awaiting the pressure to drop below the threshold. If after 5 minutes the compressor has not yet started, a specific alarm will be activated (A43/A76). However, this alarm still allows the other compressors to start.

User	Code	Description	Def	Min	Max	UOM
M	P021	Max. deltaP at start-up	900.0	0.0	2000.0	kPa

5.9.4 BLDC oil recovery

When the refrigerant gas speed in the circuit is below the value required to entrain the oil, operation periodically needs to be set to a sufficient value to guarantee oil return to the compressor crankcase. The function forces an increase in BLDC compressor capacity for a specific time, when the circuit has remained at low load (par. P007) for a minimum time (par. P008).

User	Code	Description	Def	Min	Max	UOM
M	P018	Enable oil recovery 0/1=No/Yes	0	0	1	-
M	P007	Oil recovery: min speed for activation	35.0	0.0	999.9	rps
M	P008	Oil recovery: comp. operating time at low speed	15	0	999	min
M	P009	Oil recovery: force comp. speed time	3	0	999	min
M	P010	Oil recovery: force comp. speed value	50.0	0.0	999.9	rps

5.9.5 Tandem BLDC oil equalisation

A solenoid valve is activated to take the oil from the crankcase overflow on each compressor and put it back in circulation (for example, at the inlet to the common manifold). If the function is enabled, when the fixed speed compressor starts, the solenoid valve is activated for an initial time (par. P011), and then cyclically for a time (par. P012), with a pause that increases over time from the minimum value (par. P013) to the maximum value (par. P014) in the specified time (par. P015).

User	Code	Description	Def	Min	Max	UOM
M	P017	Enable oil equalisation 0/1=No/Yes	0	0	1	-
M	P011	Oil equalisation: solenoid valve opening time at start-up	30	0	999	s
M	P012	Oil equalisation: solenoid valve opening time	3	0	999	s
M	P013	Oil equalisation: min solenoid valve closed time	1	0	999	min
M	P014	Oil equalisation: max solenoid valve closed time	15	0	999	min
M	P015	Oil equalisation: solenoid valve closed time increment	20	0	999	min

5.10 BLDC compressor protectors

To prevent the compressor from working outside the safety limits specified by the manufacturer, µChiller Process controls the operating limits (defined as the envelope) of BLDC compressors. In addition to the operating limits specified by the manufacturer, the maximum condensing temperature (par. P001) and minimum evaporation thresholds (par. P000) can be customised; these custom thresholds are considered only if they are more restrictive than the manufacturer's limits. On-Off compressors have no envelope data: the operating limits can be set using the parameters for the maximum high pressure threshold - equivalent temperature (par. C017), frost protection alarm threshold (on the evaporation temperature - par. U050) and MOP threshold (to control the maximum evaporation temperature, par. E020).

User	Code	Description	Def	Min	Max	UOM
S	P000	Min evaporation temp.: custom limit	-25.0	-99.9	999.9	°C/°F
S	P001	Max condensing temp.: custom limit	70.0	-99.9	999.9	°C/°F
M	C017	Max high pressure threshold (HP)	65.0	0.0	999.9	°C
M	C018	Min low pressure threshold (LP)	0.2	-99.9	99.9	bar
S	U050	User side frost protection: alarm threshold	-0.8	-99.9	999.9	°C
M	E020	MOP in cooling: threshold	30.0	-60.0	200.0	°C

Below is the description of the working zones in a generic envelope for a BLDC compressor:

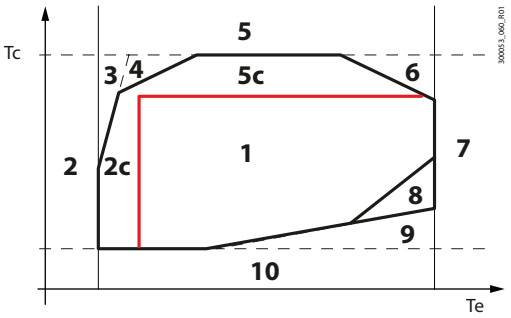


Fig. 5.ab

Zone	Par.	Description
1		Zone inside the operating limits (the prevention function is still active to prevent operation outside of the limits)
2a		Maximum compression ratio 1
2b		Maximum compression ratio 2
3		Maximum condensing pressure
3c	P001	Custom maximum condensing pressure threshold
4		Maximum motor current
5		Maximum evaporation pressure
6		Minimum compression ratio
7		Minimum differential pressure
8		Minimum condensing pressure
9		Minimum evaporation pressure
9c	P000	Custom minimum evaporation pressure threshold
10		High discharge temperature (but working pressure inside the envelope)

Tab. 5.e

When the compressor working point is outside of the envelope, an alarm delay starts counting: if the working point remains outside of the envelope, when the delay expires, a specific alarm is activated that stops the compressor; if, on the other hand, the working point returns back inside the envelope limits, the alarm delay is reset.

The high condensing pressure limit is determined by the minimum between:
- the nominal compressor threshold;
- the threshold modifiable by Service (par. P001).

The high evaporation pressure limit is determined by the minimum between:
- the nominal compressor threshold;
- the set MOP threshold (par. E020);

The low evaporation pressure limit for the prevention action is determined by maximum between:
- the nominal compressor threshold;
- the threshold modifiable by Service (par. P000);
- the frost protection limit (par. U050).

In addition to the operating limits defined by the shape of the envelope, there is also (heat pump versions only) a "Maximum discharge temperature" limit (specified by the compressor manufacturer), at which the compressor is shut down.

5.11 BLDC compressor alarm prevention

The evaporation and condensing pressure determine a working point in a zone of the envelope, and depending on the zone, the controller applies corrective actions to maintain or return BLDC compressor operation within the limits.

5.11.1 Prevention actions for BLDC compressors

Below is the description of the working zones in a generic envelope for BLDC compressors:

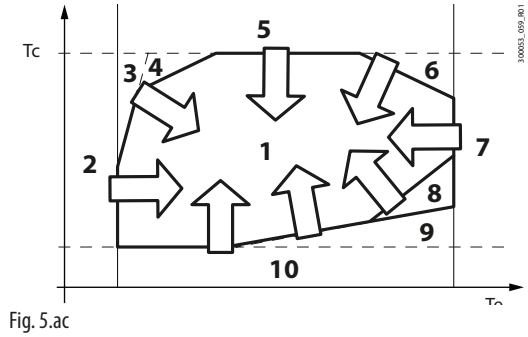


Fig. 5.ac

Zone	Description
1	Zone inside the operating limits
2	Prevention due to high compression ratio
3	Prevention due to high condensing pressure
4	Prevention due to high motor current
5	Prevention due to high evaporation pressure
6	Prevention due to low compression ratio
7	Prevention due to low differential pressure
8	Prevention due to low condensing pressure
9	Prevention due to low evaporation pressure

Tab. 5.f

To allow the compressor to work inside the envelope, specific prevention actions are adopted that adjust circuit capacity, the source fan set point and the opening of the ExV valve.
In particular, the actions involving circuit capacity are:

- decrease the rate at which the capacity request from the temperature controller increases/decreases when approaching the limit of the envelope;
- limit/increase circuit capacity.

The action on the ExV valve is applied by varying the MOP threshold (maximum evaporation temperature): the algorithm follows the set point, decreasing valve opening, and therefore reducing the mass flow of refrigerant, which in turn lowers the evaporation temperature. This action is applied with both BLDC compressors and fixed-speed compressors.
The actions involving the rate of capacity variation start when the working point is a set distance from the compressor operating limits. These actions are only possible with BLDC compressors.
In the event of fixed-speed compressors, the only actions possible on the circuit are to limit capacity via the number of the compressors on: this is implemented as soon as the working point exceeds the maximum condensing temperature (par. C017), frost protection alarm threshold (on the evaporation temperature - par. U050) or minimum evaporation temp. threshold (par. C018) - or the minimum of the two.
Below are details of the various actions to prevent the operating limits from being exceeded; action 1 refers to the control action (before exiting the envelope); action 2 to the limiting action (working point already outside of the envelope).

Low evaporation pressure prevention (zone 9)

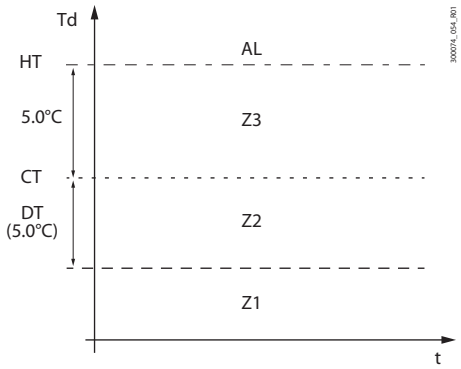
The low evaporation pressure limit for the prevention action is determined by maximum between:

- the nominal compressor threshold (BLDC only);
- the threshold set by the "Manufacturer": par. C018/P000 for On-Off/BLDC compressor;
- the evaporator frost protection limit: par. U050.

Device	Description
BLDC compressor	1. Decrease the rate of capacity increase. 2. Limit capacity
Tandem ON/OFF compressors	1. - 2. Shutdown a compressor
ExV	-
Fan	-

High compression ratio prevention (zone 2)

A high compression ratio is a thermal limit of compressor operation: normally control is activated at the limit of the envelope, reducing capacity when the limit is exceeded; if a probe is fitted to measure discharge temperature (HP version only) and if the temperature approaches the limits, compressor capacity will be modulated so as to managed the critical condition. A specific algorithm initially slows down the increase in capacity, until stopping it completely when at the set point (5°C below the maximum limit); if the temperature increases further, the algorithm gradually and slowly reduces capacity, taking into account compressor thermal inertia.



Key

Td	Drain temperature
HT	Low discharge temperature alarm threshold
CT	High discharge temperature control threshold
DT	Control action deviation
AL	High discharge temperature alarm zone
Z3	Capacity reduction zone
Z2	Acceleration control zone
Z1	Normal operating zone

Fig. 5.ad

Device	Description
BLDC compressor	1. Decrease the rate of capacity increase. 2. Limit capacity
Tandem on-off compressors	-
ExV valve	-
Fan	-

High condensing pressure prevention (zone 3)

Device	Description
BLDC compressor	1. Decrease the rate of capacity increase. 2. Limit capacity
Tandem on-off compressors	1. - 2. Shutdown a compressor
ExV valve	-
Fan	-

High motor current prevention (zone 4)

Device	Description
BLDC compressor	1. Decrease the rate of capacity increase. 2. Limit capacity
Tandem on-off compressors	1. - 2. Shutdown a compressor
ExV valve	MOP with specific algorithm
Fan	-

High evaporation pressure prevention (zone 5)

Device	Description
BLDC compressor	1. Decrease the rate of capacity reduction. 2. -
Tandem on-off compressors	-
ExV valve	MOP
Fan	-

Low compression ratio prevention (zone 6)

Device	Description
BLDC compressor	1. Decrease the rate of capacity reduction. 2. Increase capacity
Tandem on-off compressors	-
ExV valve	Variable MOP
Fan	Increase condensing pressure set point/decrease evaporation pressure set point

Low differential pressure prevention (zone 7)

Device	Description
BLDC compressor	1. Decrease the rate of capacity reduction. 2. Increase capacity
Tandem on-off compressors	-
ExV valve	Variable MOP
Fan	Increase condensing pressure set point/decrease evaporation pressure set point

Low condensing pressure prevention (zone 8)

Device	Description
BLDC compressor	1. Decrease the rate of capacity reduction. 2. Increase capacity
Tandem on-off compressors	-
ExV valve	-
Fan	-

5.12 Compressor alarms

If abnormal conditions occur and the prevention actions are not effective, the compressor will be shut down so as to avoid damage to the compressor itself or other unit components, i.e. the control algorithm stops the compressors and closes the expansion valve.

Compressor shutdown

The compressors will be available again after the:
- minimum compressor off time (par. C013);
- minimum time between consecutive compressor starts (par. C014).

User	Code	Description	Def	Min	Max	UOM
M	C013	Min compressor off time	60	30	999	s
M	C014	Min time between consecutive compressor starts	360	300	999	s

Compressor delay at start-up/in operation

Compressor start-up is a critical phase. µChiller Process thus manages certain alarms differently, in order to switch smoothly from start-up to normal, steady operation. These alarms are:
- low differential pressure;
- out of envelope alarm.

There are thus two delays for these alarms:
- delay at start-up;
- delay in operation.

The alarm condition is ignored when the compressor is off and during the start-up phase. When the unit reaches steady operation, the condition causes the corresponding alarm once the delay has elapsed.

Behaviour will thus be as follows:

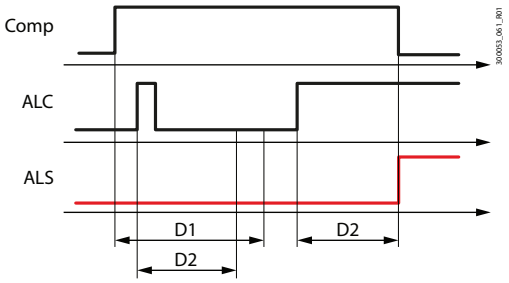


Fig. 5.ae

Key

Comp	Compressor status
ALC	Status of the alarm condition
ALS	Alarm signal
D1	Alarm disabling from compressor start-up
D2	Alarm delay in operation
t	Time

5.13 Power+ Speed drive

When the unit is fitted with a BLDC compressor, this is controlled by the Power+ speed drive, connected to the FBus serial port on µChiller Process via the Modbus main protocol with a baud rate of 19200 bps. Use a specific cable for RS485 (AWG20-22 with 1½ twisted pair plus shield). See the Power+ instruction manual +0300048EN.

5.14 Expansion valve driver

The driver to manage the electronic expansion valve is a fundamental device for the µChiller Process controller. This is used to safely manage the compressor and thus the circuit, constantly controlling the superheat and the position of the working point inside the compressor envelope. The solution provided manages unipolar valves up to a certain cooling capacity (Carel E3V - cooling capacity up to 90-100 kW) with the built-in EVD mini driver (DIN model only) or external driver, and bipolar valves with higher capacities, using the external EVD Evolution driver (single o twin). This must be connected to the FBus serial port on µChiller Process via the Modbus main protocol with a baud rate of 19200 bps. Use a specific cable for RS485 (AWG20-22 with 1½ twisted pair plus shield). See "Installation".

Notice:
- EVD Evolution is only used as a positioner for the expansion valve or hot gas valve.
- if the ExV electronic expansion valve is used, the suction temperature probe is connected to input S3 (panel model) or S7 (DIN rail model) on the µChiller Process controller. See the functional diagrams. For the installation guidelines, see document +040010025, available at www.carel.com.

5.14.1 ExV driver selection options

µChiller Process can control an ExV electronic expansion valve for both superheat control and hot gas bypass. Considering the valve driver resources available on the various models of µChiller Process (built-in unipolar driver on the Enhanced and High Efficiency models, EVD mini and EVD EVO - single or twin), the possible combinations are shown below:

Value of E047	ExV options	Notes
0	no valve	
1	EVD Evo - Superheat control valve	
2	EVD Evo - Hot gas bypass valve	Sets U116=5
3	EVD Evo twin - Superheat control valve A; hot gas bypass valve B	Sets U116=5
4	EVD mini - Superheat control valve	
5	EVD mini - Hot gas bypass valve	Sets U116=5
6	Built-in EVD - Superheat control valve	
7	Built-in EVD - Hot gas bypass valve	Sets U116=5
8	EVD mini - Superheat control valve; Built-in EVD - Hot gas bypass valve	Sets U116=5
9	EVD Evo - Superheat control valve; Built-in EVD - Hot gas bypass valve	Sets U116=5
10	Built-in EVD - Superheat control valve; EVD Evo - Hot gas bypass valve	Sets U116=5

Tab. 5.g

5.15 Expansion valve control

The control logic manages various functions:
- communication with the EVD Evolution driver, if used (read/write parameters via FBus serial port);
- control of suction superheat (SSH);
- low superheat control and alarm (Low SH);
- minimum evaporation temperature control and alarm (LOP);
- maximum evaporation temperature control and alarm (MOP);
- control of cooling capacity, so as to position the valve correctly in the transient stages according to circuit control status;
- control algorithm that calculates the valve opening steps;
- valve opening value sent to the valve driver.

If the EVD Evolution driver is offline, all the compressors are stopped immediately.

Notice: if the EVD Evolution or EVD mini driver is offline, µChiller Process signals the corresponding alarm, the valve remains in the same position and the circuit continues to operate: for expansion valves, the superheat value continues to be monitored and if the value is too low, µChiller Process generates the specific alarm; on the other hand, for a hot gas valve, uChiller Process operates at part cooling capacity.

Dedicated electronic expansion valve parameters

Certain parameters relating to the electronic expansion valve vary according to the operating mode:
- chiller;
- heat pump. These are:
- superheat parameters (set point and PID);
- alarm thresholds and integral actions for protection functions: LOP, MOP and Low SH.

5.15.1 Smart opening

When µChiller Process starts the compressor, the superheat control valve is pre-opened to reduce the low pressure condition. During valve pre-opening, before the compressor is effectively started, the algorithm checks for any liquid in the suction line, so as to force the compressor to start without waiting for the valve to open completely.

5.15.2 Ultracap module and blackout management (DIN only)

In the event of a power failure, the Ultracap module is activated and supplies sufficient energy to shut the unit down safely. On entering blackout status, the display LEDs are switched off, except for the flashing red LED to signal the alarm in progress. If a valve is present, this is quickly closed. The digital outputs are opened. Alarm A63 - Power failure - is triggered and saved in the alarm log.
The controller remains off in serious unit alarm mode until the energy stored on the Ultracap module runs out, after which the device switches off completely.
If mains power supply is restored before the Ultracap has used up all its energy, the blackout alarm is cleared and the controller automatically resumes operation.
Blackout management is not available for PANEL models. These models do not have the connection with the Ultracap module and do not manage the built-in expansion valve.

5.16 Condenser cooling

µChiller Process manages the following condensing fan or pump functions:
- On-Off - on with compressor on, off after the compressor switches off;
- On-Off - on and off with set + diff control on the condensing temperature;
- modulating with set + band proportional control on the condensing temperature;

In any case, the fan or condenser pump are switched off with a delay after the compressor stops, which can be set for parameter S027.

No delay is applied in cases where the request to switch off the fan/pump comes from:
- the source with the compressor on;
- fan/pump overload alarm (A64).

The standard management also includes the following additional functions:
- two set points (start-up/steady) to reach operating temperatures for correct lubrication more quickly;
- prevent function, which starts the fan/pump at 100% when approaching the maximum condensing temperature, even with the unit off;

In addition to the following functions, for the fan only:
- scheduler function with transition to a specific set point to lower the speed (low noise);
- gain control based on the outside temperature;
- anti-seize function for cold climates;

The following functions, on the other hand, are only active for the pump:
- anti-seize: if the pump is off for more than a week, it is activated for 3 seconds.
- frost protection with the unit off or unit on with the compressors off, activating the pump to restore fluid circulation;

µChiller Process manages the condensing stage devices via the pressure or temperature probe installed on the condenser. For modulating fans, the 0-10 V control signal (available on analogue output Y1) can be connected to several EC fans.

User	Code	Description	Def	Min	Max	UOM
M,S	S027	Fan/pump shutdown delay after compressor off	5	0	999	s

5.16.1 Modulating/On-Off fan control

Depending on the configuration used and the model (panel or DIN mounting), a relay output for On-Off control may not be available: in this case, analogue output Y1 connected to a Carel CONVONOFF module can be used to convert the 0-10 V analogue output into a relay command. For the possible configurations of the relay output used to control the On-Off device, see the following table:

Parameter (if used)	Relay output	Configuration
-	NO2	1 compressor (C047=0); no heater (U115=0)
-	NO3	no user pump (U076=0)
-	NO4	No FC (U068=0); No 2 compressors with heater (C047=0/2; U115=0) No if panel version, 2 compressors with On-Off hot gas (C047=0/2; U116=1) and HC14 <> 3
Hc12	NO6	Hc12=1 (DIN model only)

Tab. 5.h

User	Code	Description	Def	Min	Max	UOM
M	Hc12	NO6 configuration 0=not used - 1=Heater/heating device - 2=Condenser fan/pump 3=Hot gas bypass valve	0	0	1	-
S	S065	Type of source fan 0/1=Modulating/ON-OFF	0	0	1	-
S	S068	Condenser cooling 0/1=air/water	0	0	1	-
S	S028	Source fan in cooling: set point	30.0	-999.9	999.9	°C
S	S031	Source fan in cooling mode: set point at start-up	45.0	0.0	999.9	°C
S	S032	Source fan: delay at start-up in cooling	240	0	999	s
S	S034	Source fan: differential in cooling	15.0	0.0	99.9	K
S	S036	Modulating source fan: min speed value	20.0	0.0	100.0	%
S	S037	Modulating source fan: max speed value	80.0	0.0	100.0	%

Tab. 5.i

The following diagram shows the two control modes (modulating or on-off):

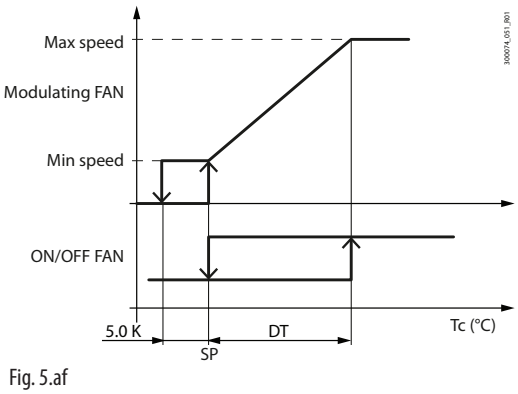


Fig. 5.af

Key

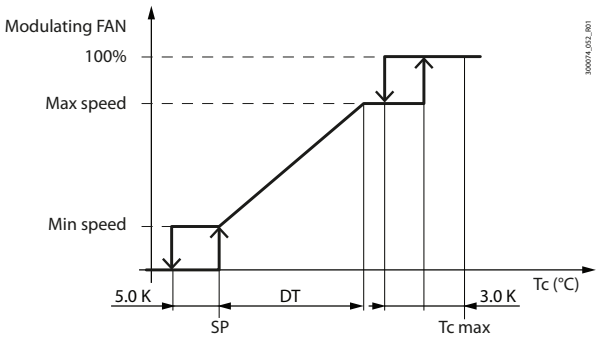
Max speed	Modulating condenser fan: max speed value
Min speed	Modulating condenser fan: min speed value
SP	Control set point
DT	Control differential
Tc	Condensing temperature

5.16.2 Modulating control

Fan/pump control may be modulating or ON-OFF and is based on the saturated temperature value, equivalent to the condensing pressure, limited by Tc max.

User	Code	Description	Def	Min	Max	UOM
S	C017	Max high pressure threshold (HP)	65.0	0.0	999.9	°C
S	S028	Source fan in cooling: set point	30.0	-999.9	999.9	°C
S	S034	Source fan: differential in cooling	15.0	0.0	99.9	K
S	S036	Modulating source fan: min speed value	20.0	0.0	100.0	%
S	S037	Modulating source fan: max speed value	80.0	0.0	100.0	%

The control diagram is shown below:



Key

Max speed	Modulating condenser fan: max speed value
Min speed	Modulating condenser fan: min speed value
SP	Control set point
DT	Control differential
Tc max	Maximum condensing temperature
Tc	Condensing temperature

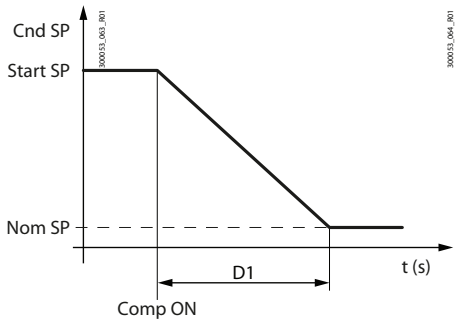
Fig. 5.ag

In the graph, some offsets are expressed with a numerical value, indicating that they are not modifiable but rather are fixed parameters. The current calculated set point value is displayed on the dashboard.

Set point control

On µChiller Process, a specific condensing temperature set point for starting the compressor can be set to a value that is higher than the nominal set point, so that the compressor can reach steady operation more quickly. The transition to the nominal set point is made gradually over a time equal to the delay at start-up.

User	Code	Description	Def	Min	Max	UOM
S	S031	Source fan in cooling mode: set point at start-up	45.0	0.0	999.9	°C
S	S032	Source fan: delay at start-up in cooling	240	0	999	s



Key

Cnd SP	Condensing temperature set point
Start SP	Set point at start-up
Nom SP	Nominal set point
Cmp ON	Compressor activation
D1	Delay at start-up

Fig. 5.ah

5.16.3 "Low noise" function

This function reduces the noise emitted by modulating fans by increasing the set point at night.

User	Code	Description	Def	Min	Max	UOM
S	S020	Enable noise reduction 0/1=No/Yes	0	0	1	-
S	S021	Noise reduction time band: start hours	22	0	23	h
S	S022	Noise reduction time band: start minutes	30	0	59	min
S	S023	Noise reduction time band: end hours	8	0	23	h
S	S024	Noise reduction time band: end minutes	30	0	59	min
S	S025	Source fan: noise reduction set point	45.0	0.0	999.9	°C

5.16.4 Fan anti-blocking function

For systems intended to operate in cold climates, µChiller Process modulates fan speed so as to prevent the unit from shutting down due to frost formation. The function is activated when the outdoor temperature falls below a threshold, and, instead of turning off the fans, keeps then on at a minimum speed. If the outside temperature is reached when the fans are off, these are activated at start-up speed for a certain time, and then switch to the minimum speed.

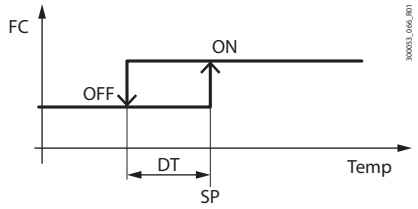
User	Code	Description	Def	Min	Max	UOM
S	S016	Source fan: cold climate temperature threshold	-0.5	-999.9	999.9	°C
S	S017	Source fan: min cold climate speed	10.0	0.0	100.0	%
S	S018	Source fan: cold climate speed at start-up	50.0	0.0	100.0	%
S	S019	Source fan: cold climate speed at start-up time	5	0	300	s

5.17 Free cooling

µChiller Process can enable the free cooling (FC) function. The type of free cooling is configured by parameter, and may be:
- air free cooling, on air/water units equipped with air-water heat exchanger coils upstream of the condenser coils and with modulating fan control;
- remote air free cooling (see the specific paragraph);
- water free cooling, on water/water units with mixing of the source water or via water-water heat exchanger upstream of the evaporator and a 3-way modulating valve on the free cooling circuit.

User	Code	Description	Def	Min	Max	UOM
S	U068	Free cooling: enable 0/1=no/yes	0	0	1	-
S	U069	Free cooling: activation differential	3.0	0.0	99.9	K
S	U070	Free cooling: hysteresis	1.5	0.0	99.9	K
S	U071	Design free cooling delta T	8.0	0.0	99.9	K
S	U072	Water free cooling: valve closing threshold	5.0	-999.9	999.9°C	°C
S	U073	Water free cooling: valve closing differential	3.0	0.0	99.9	K
M	U074	Free cooling type 0=Air; 1=Remote coil; 2=Water	0	0	2	-

Free cooling is enabled when the outside source temperature is sufficiently lower than the temperature of the water entering the unit, as shown in the following figure:



Key

FC	Free cooling
DT	Hysteresis
SP	Activation differential
Temp	User return temperature - outside/source temp.

Fig. 5.ai

Notice: the limit threshold U072 and corresponding hysteresis U073 has the purpose of preventing excessive lowering of the water temperature by closing the free cooling valve when the controller has already switched off the fan but the heat exchange in the free cooling coil (due to wind or very low temperatures) is still excessive.

On air/water units, the fans are controlled based on the condensing temperature as long as the circuit's compressor is on; as soon as the compressor stops, the free cooling fan is controlled so as to maintain the desired water temperature set point.

5.18 Types of free cooling

5.18.1 Condensing unit with common air circuit

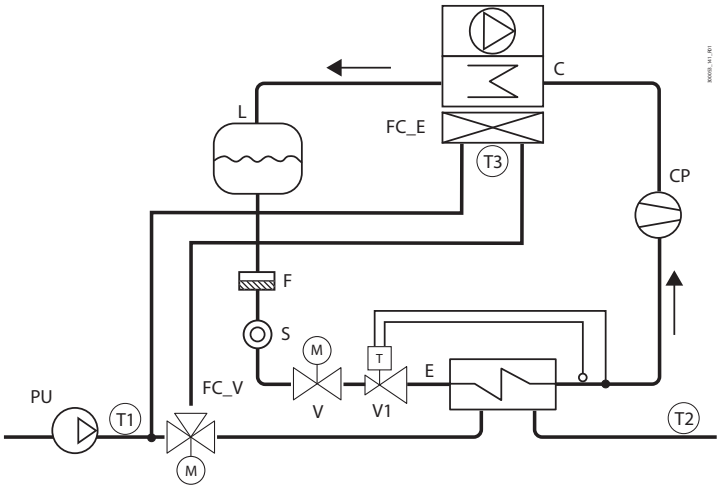
Free cooling is enabled based on the comparison between the user return water temperature and the outside air temperature; this directly controls switching of the three-way valve, which allows the water returning from the user terminals to flow through the free cooling coil before entering the evaporator. Free cooling capacity is controlled by modulating the fan speed (with the compressors off); in combined operation (free cooling + mechanical cooling), fan speed is controlled so as to correctly manage the condensing stage.

Inputs used:

To enable free cooling:
- User return temperature;
- Outside air temperature;

To manage capacity in free cooling mode:
- (according to the control probe used) Water return/delivery temp.

Outputs used:
- 0-10 V to manage the common fan between free cooling and condenser;
- Free cooling valve On-Off control.



Ref.	Description
FC_E	Free cooling heat exchanger
C	Condenser
E	Evaporator
F	Filter-drier
L	Liquid receiver
CP	Compressor
S	Liquid sightglass
FC_V	Free cooling valve
PU	User pump
T1	User return probe
T2	User delivery probe
T3	Outside temperature probe
V1	Thermostatic expansion valve
V	Solenoid valve

Fig. 5.aj

5.18.2 Air-cooled condensing unit with separate air circuit

Free cooling is enabled based on the comparison between the user return water temperature and the outside air temperature; this directly controls switching of the three-way valve, which allows the water returning from the user terminals to flow through the free cooling coil before entering the evaporator. Free cooling capacity is controlled by modulating the specific fan speed; in combined operation (free cooling + mechanical cooling), free cooling fan speed is always 100%.

Inputs used:

To enable free cooling:
- User return temperature;
- Outside air temperature;

To manage capacity in free cooling mode:
- (according to the control probe used) Return/delivery water temp.

Outputs used:
- 0-10 V to manage the condenser fan (Y1);
- 0-10 V to manage the free cooling fan (Y2);
- Free cooling valve On-Off control.

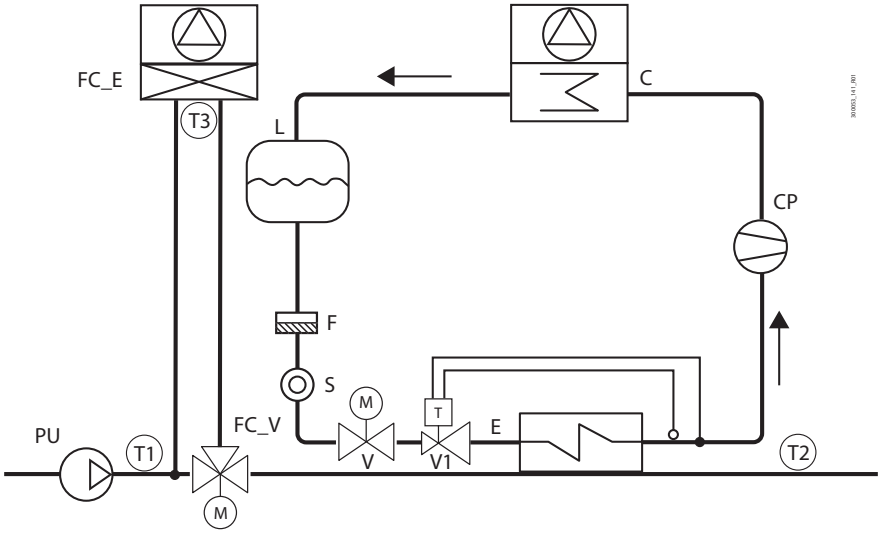


Fig. 5.ak

Ref.	Description
FC_E	Free cooling heat exchanger
C	Condenser
E	Evaporator
F	Filter-drier
L	Liquid receiver
CP	Compressor
S	Liquid sightglass

Ref.	Description
FC_V	Free cooling valve
PU	User pump
T1	User return probe
T2	User delivery probe
T3	Outside temperature probe
V1	Thermostatic expansion valve
V	Solenoid valve

5.18.3 Water-cooled condensing unit

Free cooling is enabled based on the comparison between the user return water temperature and the source water temperature (Temp. IN source); this controls modulation of the three-way valve that mixes the source water with the water returning from the user terminals through the free cooling coil before entering the evaporator.
Free cooling capacity is controlled by modulating the three-way free cooling valve; in combined operation (free cooling + mechanical cooling), the three-way free cooling valve is always open at 100%.

Inputs used:

To enable free cooling:
- User return temperature;
- Source inlet temperature;

To manage capacity in free cooling mode:
- (according to the control probe used) Water return/delivery temp.

Outputs used:
- 0-10 V to manage the condenser fan
- 0-10 V to manage the free cooling valve.

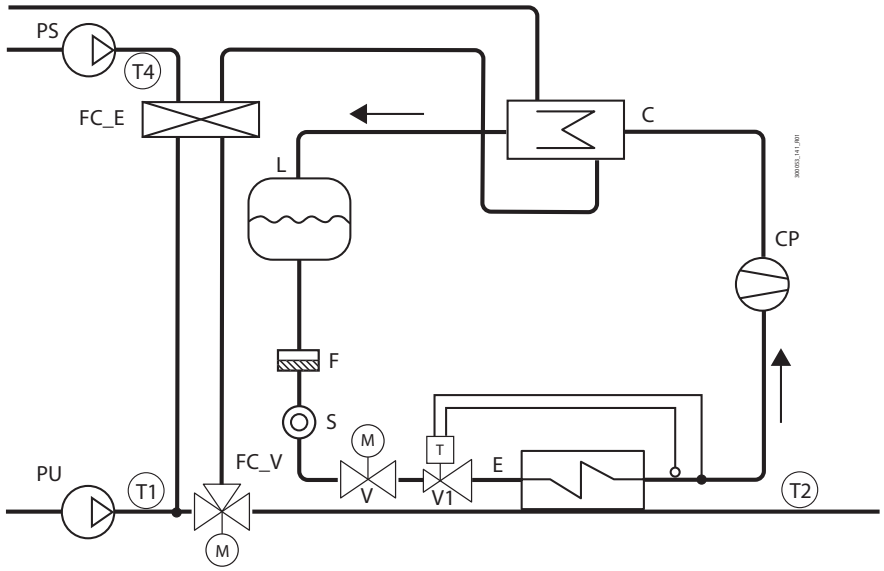


Fig. 5.al

Ref.	Description
FC_E	Free cooling heat exchanger
C	Condenser
E	Evaporator
F	Filter-drier
L	Liquid receiver
CP	Compressor
FC_E	Free cooling heat exchanger
S	Liquid sightglass

Ref.	Description
V	Solenoid valve
FC_V	Free cooling valve
PU	User pump
PS	Condenser pump
T1	User return probe
T2	User delivery probe
T4	Condenser cooling liquid return probe
V1	Thermostatic expansion valve

5.19 Free cooling functions

5.19.1 Dynamic control gain

This special function manages the balancing of capacity between the free cooling coil and the evaporator: this optimises control stability and fluidity.

User	Code	Description	Def	Min	Max	UOM
S	U070	Free cooling: hysteresis	1.5	0.0	99.9	K
S	U069	Free cooling: activation differential	3.0	0.0	99.9	K
S	U071	Design free cooling delta T	8.0	0.0	99.9	K

Tab. 5.j

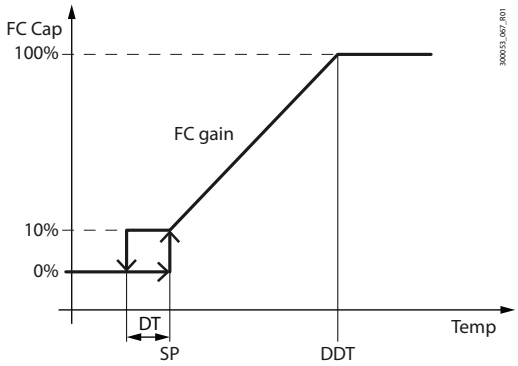


Fig. 5.am

Key

FC Cap	Free cooling capacity
DT	Hysteresis
SP	Activation differential
DDT	Design free cooling delta T
Temp	User return temp. - source temp.

The diagram shows the ideal behaviour of free cooling control (FC) in relation proportionally to its capacity; "Design free cooling delta T" is the temperature difference (water return - source) needed to cover the rated unit capacity using the free cooling coil only.
The value obtained - "FC gain" - is used to adapt the control ramp to the various cooling sources, as shown in the figure.

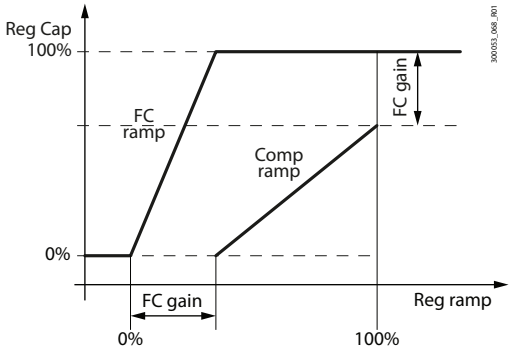


Fig. 5.an

Key

Reg Cap	Control capacity
FC ramp	Free cooling control ramp
FC gain	Dynamic gain of free cooling control
Comp ramp	Compressor control ramp
Reg ramp	Control ramp

The result is a perfect balance between the cooling capacities of the free cooling coil and the evaporator, in order to maintain the same proportionality in all load conditions. In other words, the same percentage of capacity is obtained for the same temperature variation in any load condition.

5.19.2 Effectiveness control

µChiller Process uses this function to start the compressors when the free cooling coil alone cannot bring the water to the set point, despite the fact that the source conditions theoretically allow for free cooling operation only. When this occurs, there may be a malfunction on the devices activated during free cooling; the compressors thus need to be started and free cooling disabled in order to ensure unit operation.
This situation is signalled by the "Free cooling warning".

5.19.3 Valve anti-block management

To avoid mechanical blocking of the valve, when a position (closed or open) is kept for more than a week, the valve is moved for 30 seconds to the opposite position.

5.20 Verify probe operation at start-up

µChiller Process features a specific function that can be enabled to verify the probe readings at start-up and detect possible malfunctions, considering that the thermal masses of the unit have evened out to ambient temperature while the unit was off. The function is optional and can be activated by parameter (U108): the minimum condition requires comparison of at least three probes.

If enabled, every time µChiller Process is switched on (the unit is powered on), during the pump start-up stage but before activating control, the probe readings are compared:
- water return temperature (S1) - possible alarm A52;
- water delivery temperature (S2) - possible alarm A53;
- saturated evaporation temperature - possible alarm A54;
- suction temperature - possible alarm A55.

User	Code	Description	Def	Min	Max	UOM
S	U108	Verify probes at start-up: 0/1=no/yes	0	0	1	-
S	U107	Verify probes at start-up: maximum deviation	1.0	0.0	9.9	K

The maximum deviation, set for parameter U107, represents how much the value measured by one probe differs from all of the others. If the value read of a probe deviates by +/- the value specified for parameter U107, a specific alarm is generated for the probe, with the deviation displayed on the alarm screen; the unit remains in standby, and control is not activated. Once the situation has been assessed, the user can start control by resetting the alarm.

Notice: if the probe check generates an alarm, A52, A53, A54 or A55, control is not activated until the alarm is reset: when the alarm is reset, the unit will start.

5.21 Manual device management

In the menu relating to the individual devices, 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.

User	Code	Description	Def	Min	Max	UOM
S	E000	Superheat ExV: manual mode 0/1=No/Yes	0	0	1	-
S	E001	Superheat ExV: steps in manual mode	0	0	65535	steps
S	E050	Hot gas bypass ExV: manual mode 0/1=No/Yes	0	0	1	-
S	E051	Hot gas bypass ExV: steps in manual mode	0	0	65535	steps
S	U002	User pump 1: operating mode 0=AUTO; 1=OFF; 2=ON	0	0	2	-
S	U005	User pump 2: operating mode 0=AUTO; 1=OFF; 2=ON	0	0	2	-
S	C002	Comp. 1: operating mode 0=AUTO; 1=OFF; 2=ON	0	0	2	-
S	C005	Comp. 2: operating mode 0=AUTO; 1=OFF; 2=ON	0	0	2	-
S	P019	BLDC compressor: operating mode 0=AUTO; 1=0%; 2=1%, . ; 101=100%	0	0	101	-
S	S008	Condenser fan/pump: operating mode 0=AUTO; 1=OFF; 2=ON	0	0	2	-
S	S011	Modulating condenser fan/pump: operating mode 0=AUTO; 1=0%; 2=1%, . ; 101=100%	0	0	101	-

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.

Manual operation of the devices is described below:

Device	Notes
Compressors	Safety times taken into account All compressor alarms are enabled
User pumps	Pump overload and flow alarm active
Source pump	-
Defrost	-
Source fans	Speed-up disabled
ExV	All alarms disabled

6. PARAMETER TABLE

Notice:
- Levels: U=User; S=Service; M=Manufacturer; Display: the x indicates that the parameter can be accessed from the display terminal;
- R/W=read/write parameters; R=read-only parameters.

6.1 System

User	Display	Code	Description	Def.	Min.	Max.	UOM	R/W	Modbus
Plt = System									
S		U000	User pump 1: maintenance hour threshold (x100)	99	0	999	h	R/W	HR002
S		U001	User pump 1: reset hour counter	0	0	1	-	R/W	CS000
S	x	U002	User pump 1: operating mode 0=AUTO 1=OFF 2=ON	0	0	2	-	R/W	HR003
S		U003	User pump 2: maintenance hour threshold (x100)	99	0	999	h	R/W	HR004
S		U004	User pump 2: reset hour counter	0	0	1	-	R/W	CS001
S	x	U005	User pump 2: operating mode 0=AUTO 1=OFF 2=ON	0	0	2	-	R/W	HR005
S		U006	Main control set point: minimum limit	5.0	-99.9	999.9	°C/°F	R/W	HR006 (2R)
S		U007	Main control set point: maximum limit	20.0	-99.9	999.9	°C/°F	R/W	HR008 (2R)
S		U010	Enable set point compensation 0/1=no/yes	0	0	1	-	R/W	CS002
S		U011	Set point compensation: start	25.0	-99.9	999.9	°C/°F	R/W	HR010 (2R)
S		U012	Set point compensation: end	35.0	-99.9	999.9	°C/°F	R/W	HR012 (2R)
S		U013	Set point compensation: maximum value	5.0	-99.9	999.9	K/R	R/W	HR014 (2R)
S		U017	Enable scheduler 0/1=No/Yes	0	0	1	-	R/W	CS003
S		U018	Time band: start hour	17	0	23	h	R/W	HR016
S		U019	Time band: start minute	30	0	59	min	R/W	HR017
S		U020	Time band: end hour	7	0	23	h	R/W	HR018
S		U021	Time band: end minute	0	0	59	min	R/W	HR019
S		U022	Scheduler changeover type 0=Off 1=2nd set point	0	0	1	-	R/W	CS004
U	x	U023	Main control 2nd set point	10.0	U006	U007	°C/°F	R/W	HR020 (2R)
S		U025	Remote set point: analogue input 0 = 0-5V 1=0-10V 2=4-20 mA	0	0	2	-	R/W	HR022
S		U026	Remote set point: min value	5.0	-99.9	999.9	°C/°F	R/W	HR024 (2R)
S		U027	Remote set point: max value	35.0	-99.9	99.9	°C/°F	R/W	HR026 (2R)
S		U028	Remote set point: offset	0.0	-99.9	99.9	K/R	R/W	HR028 (2R)
S		U030	Tank temperature: offset	0.0	-99.9	99.9	K/R	R/W	HR030 (2R)
S	x	U031	High water temp. alarm: offset	10.0	0.0	99.9	K/R	R/W	HR032 (2R)
S	x	U032	High/low water temp. alarm: delay at start-up	15	0	99	min	R/W	HR034
S	x	U033	High/low water temp. alarm: delay in operation	180	0	999	s	R/W	HR035
S		U045	User pump flow alarm: delay at start-up	10	0	999	s	R/W	HR036
S		U046	User pump flow alarm: delay in operation	3	0	99	s	R/W	HR037
S		U047	Compressor activation delay after user pump	30	0	999	s	R/W	HR038
S		U048	User pump shutdown delay after compressor	180	0	999	s	R/W	HR039
S		U049	User pump rotation time	12	0	999	h	R/W	HR040
S		U050	Evaporator frost protection: alarm threshold	-0.8	-99.9	999.9	°C/°F	R/W	HR041 (2R)
S		U051	Evaporator frost protection: differential	30.0	0.0	999.9	K/R	R/W	HR043 (2R)
S		U052	Evaporator frost protection: delay time at 1K	30	0	999	s	R/W	HR045
S		U053	Unit OFF: frost protection set point	4.0	-99.9	999.9	°C/°F	R/W	HR046 (2R)
S		U054	Unit OFF: frost protection differential	2.0	0.0	99.9	K/R	R/W	HR048 (2R)
S		U055	User return temp. probe: offset	0.0	-99.9	99.9	K/R	R/W	HR050 (2R)
S		U056	User delivery temp. probe: offset	0.0	-99.9	99.9	K/R	R/W	HR052 (2R)
S		U057	Remote alarm: input logic 0/1=NC/NO	0	0	1	-	R/W	CS005
S		U058	Source pump/fan overload: input logic 0/1=NC/NO	0	0	1	-	R/W	CS070
S	x	U059	Remote ON/OFF: input logic 0/1=NC/NO	1	0	1	-	R/W	CS006
S		U060	User pump flow switch: input logic 0/1=NC/NO	0	0	1	-	R/W	CS007
S		U061	User pump overload: input logic 0/1=NC/NO	0	0	1	-	R/W	CS008
S		U062	2nd set point: input logic 0/1=NC/NO	1	0	1	-	R/W	CS009
M		U063	User pump: input logic 0/1=NC/NO	0	0	1	-	R/W	CS010
S		U064	Global alarm relay: output logic 0/1=NC/NO	1	0	1	-	R/W	CS011
S		U065	Free cooling valve: output logic 0/1=NC/NO	0	0	1	-	R/W	CS012
S		U067	Alarm relay configuration 0/1=Control alarms/All	0	0	1	-	R/W	CS013
S		U068	Free cooling: enable 0/1=no/yes	0	0	1	-	R/W	CS014
S		U069	Free cooling: activation differential	3.0	0.0	99.9	K/R	R/W	HR056 (2R)
S		U070	Free cooling: hysteresis	1.5	0.0	99.9	K/R	R/W	HR058 (2R)
S		U071	Design free cooling delta T	8.0	0.0	99.9	K/R	R/W	HR060 (2R)
S		U072	Free cooling limit: valve water temp. closing threshold	5.0	-999.9	999.9	°C/°F	R/W	HR062 (2R)
S		U073	Free cooling limit: valve closing differential	3.0	0.0	99.9	K/R	R/W	HR064 (2R)
M		U074	Free cooling type 0=Air 1=Remote coil 2=Water	0	0	2	-	R/W	HR066

User	Display	Code	Description	Def.	Min.	Max.	UOM	R/W	Modbus
S		U075	Frost protection type 0=Heater 1=Pump 2=Heater/pump	2	0	2	-	R/W	HR067
M		U076	Number of user pumps	1	0	2	-	R/W	HR068
M		Cod	Board part number	-	-	-	-	R	---------
S		U078	Unit pump in standby: enable On-Off cycles 0/1=No/Yes	0	0	1	-	R/W	CS050
S		U079	User pump in standby: On time	3	1	15	min	R/W	HR054
S		U080	User pump in standby: Off time	15	3	99	min	R/W	HR055
S		U081	Main PID: prop. band above set point	5.0	0.0	999.9	K/R	R/W	HR115 (2R)
S		U082	Main PID: Ti above set point 0: integral action disabled	0	0	999.9	s	R/W	HR117 (2R)
S		U083	Main PID: Td above set point 0: derivative action disabled	0	0	999.9	s	R/W	HR119 (2R)
S		U084	Main PID: prop. band below set point	5.0	0.0	999.9	K/R	R/W	HR121 (2R)
S		U085	Main PID: Ti below set point 0: integral action disabled	0	0	999.9	s	R/W	HR123 (2R)
S		U086	Main PID: Td below set point 0: derivative action disabled	0	0	999.9	s	R/W	HR125 (2R)
S		U087	Heating step hysteresis (% prop. band below set)	75.0	5.0	100.0	%	R/W	HR140 (2R)
S		U088	Compressor step activation offset (% prop. band above set)	50.0	0	100.0	%	R/W	HR218 (2R)
S		U089	Set point switching: ramp time	0	0	999	s	R/W	HR127
S		U090	Low water temp. alarm: offset	10.0	0.0	99.9	K/R	R/W	HR137 (2R)
S		U091	Preheating: enable (0/1=no/yes)	0	0	1	-	R/W	CS066
S		U092	Controlled water temperature (0=return temp; 1=delivery temp; 2=tank temp.)	0	0	2	-	R/W	HR374
S		U093	Dead band differential	5.0	0	999.9	K/R	R/W	HR130 (2R)
S		U096	Enable dead band control (0=No; 1=Yes)	0	0	1	-	R/W	CS065
S		U097	Cooling on demand: set point offset from active set point (SetA)	0	-99.9	99.9	K/R	R/W	HR224 (2R)
S		U098	Cooling on demand: step differential	5.0	0.1	9.9	K/R	R/W	HR226 (2R)
S		U099	Cooling on demand: enable (0/1=no/yes)	0	0	1	-	R/W	CS064
S		U100	Maximum hot gas modulation On-Off cycle Off time (with SSR)	40	0.1	999.9	s	R/W	HR108 (2R)
S		U101	End offset (100%) hot gas ramp R1 (% of U084)	-100.0	0	-100.0	%	R/W	HR135 (2R)
S		U102	Start offset (0%) hot gas ramp R2 (% of U081)	100.0	0	100.0	%	R/W	HR133 (2R)
S		U103	Reference temperature selection for tracking set point: 0=no; 1=Tank temperature; 2=Outside air temperature; 3=Water delivery temperature	0	0	3	-	R/W	HR128
S		U104	Minimum tracking set point limit	10.0	-99.9	99.9	°C	R/W	HR220 (2R)
S		U105	Maximum tracking set point limit	30.0	-99.9	99.9	°C	R/W	HR222 (2R)
S		U107	Verify probes at start-up: maximum deviation	1.0	0.0	9.9	K/R	R/W	HR216 (2R)
S		U108	Verify probes at start-up: 0/1=no/yes	0	0	1	-	R/W	CS063
M		U109	Pump alarm: max number of attempts/hour	1	1	20	-	R/W	HR129
M		U110	Remote alarm: max number of attempts/hour	1	1	20	-	R/W	HR114
S		U111	Value on first row of the display: 0 = water return temperature; 1 = water delivery temperature; 2 = outside air temperature; 3 = tank water temperature; 4 = condensing temperature; 5 = evaporation temperature; 6 = generic probe (S6); 7 = suction temperature; 8 = AUX 1 PID control output (%); 9 = Current control setpoint; 10 = Capacity request (%); 11 = Discharge temperature; 12 = AUX 2 PID control output (%).	0	0	12	-	R/W	HR112
S		U112	Value on second row of the display: 0 = water return temperature; 1 = water delivery temperature; 2 = outside air temperature; 3 = tank water temperature; 4 = condensing temperature; 5 = evaporation temperature; 6 = generic probe (S6); 7 = suction temperature; 8 = AUX 1 PID control output (%); 9 = Current control setpoint; 10 = Capacity request (%); 11 = Discharge temperature; 12 = AUX 2 PID control output (%).	0	0	12	-	R/W	HR113
S		U113	Tank level: input logic 0/1=NC/NO	0	0	1	-	R/W	CS053
M		U114	Hot gas bypass ExV: output logic 0/1=NO/NC	0	0	1	-	R/W	CS056
M		U115	Heating device available (0/1=no/yes)	0	0	1	-	R/W	HR139
M		U116	Hot gas bypass control: 0=No; 1=ON/OFF; 2=Modul. internal SSR; 3=Modul. external SSR; 4=Modul. 0-10 V; 5=Modul. ExV	0	0	5	-	R/W	HR132
M		U117	Evaporator nominal DT on water side	5.0	1.0	99.9	K/R	R/W	HR228 (2R)
S		U118	Evaporator frost protection from temperature probe: delay time	10	0	999	s	R/W	HR023
M		U119	Heater/heating device: output logic 0/1=NO/NC	0	0	1	-	R/W	CS054
S	x	U120	Heater/heating device: operating mode 0=AUTO 1=OFF 2=ON	0	0	2	-	R/W	HR215

Tab. 6.a

6.2 Compressor

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
CMP = Compressor									
S		C000	Compressor 1: maintenance hour threshold (x100)	99	0	999	h	R/W	HR150
S		C001	Compressor 1: reset hour counter	0	0	1	-	R/W	CS017
S	x	C002	Compressor 1: operating mode 0=AUTO 1=OFF 2=ON	0	0	2	-	R/W	HR151
S		C003	Compressor 2: maintenance hour threshold (x100)	99	0	999	h	R/W	HR152
S		C004	Compressor 2: reset hour counter	0	0	1	-	R/W	CS018
S	x	C005	Compressor 2: operating mode 0=AUTO 1=OFF 2=ON	0	0	2	-	R/W	HR153
M		C012	Min compressor on time	180	30	999	s	R/W	HR154
M		C013	Min compressor off time	60	30	999	s	R/W	HR155
M		C014	Min time between consecutive compressor starts	360	300	999	s	R/W	HR156
M		C017	Max high pressure threshold (HP)	65.0	0.0	999.9	°C/°F	R/W	HR249 (2R)
M		C018	Min low pressure threshold (LP)	0.2	-99.9	99.9	bar/psi	R/W	HR251 (2R)
M		C020	Maximum circuit destabilisation time	240	5	999	min	R/W	HR159
S		C022	Discharge temperature: offset	0.0	-99.9	99.9	K/R	R/W	HR161 (2R)
S		C023	Suction temperature: offset	0.0	-99.9	99.9	K/R	R/W	HR163 (2R)
S		C026	Condensing pressure: offset	0.0	-99.9	99.9	bar/psi	R/W	HR165 (2R)
S		C027	Evaporation pressure: offset	0.0	-99.9	99.9	bar/psi	R/W	HR167 (2R)
S		C028	Condensing temperature: offset	0.0	-99.9	99.9	K/R	R/W	HR169 (2R)
S		C029	Evaporation temperature: offset	0.0	-99.9	99.9	K/R	R/W	HR171 (2R)
M		C034	HP pressure switch: input logic 0/1=NC/NO	0	0	1	-	R/W	CS019
M		C035	Compressor overload protector: input logic 0/1=NC/NO	0	0	1	-	R/W	CS020
M		C036	Compressor: input logic 0/1=NC/NO	0	0	1	-	R/W	CS021
			Evaporation pressure: probe type 0=0-5V; 1=4-20mA						
M		C038	Evaporation pressure probe: min value	0.0	-1.0	99.9	bar/psi	R/W	HR174 (2R)
M		C039	Evaporation pressure probe: max value	17.3	0.0	99.9	bar/psi	R/W	HR176 (2R)
			Condensing pressure: probe type 0=0-5V; 1=4-20mA						
M		C041	Condensing pressure probe: min value	0.0	-1.0	99.9	bar/psi	R/W	HR179 (2R)
M		C042	Condensing pressure probe: max value	45.0	0.0	99.9	bar/psi	R/W	HR181 (2R)
M		C044	Enable destabilisation 0/1=No/Yes	1	0	1	-	R/W	CS022
S		C045	Refrigerant 0=R22 0/1=No/Yes 2=R404A 3=R407C 4=R410A 6=R290 10=R744 22=R32 33=R449A 37=R452B 39=R454B	4	0	99	-	R	
M		C047	Type of compressors used 0=1 On/Off 1=2 On/Off 2=1 BLDC 3= 1 BLDC+On/Off	0	0	3	-	R/W	HR184
M		C048	Compressor rotation type 1=FIFO, 2=Time	1	1	2	-	R/W	HR185
M		C049	Enable rapid restart in event of serious alarm circuit/unit (ProcessPriority): 0/1=No/Yes	0	0	1	-	R/W	CS055
M		C050	Max no. of compressor alarms/hour in Process Priority	20	1	20	-	R/W	HR160
S		C051	LP pressure switch alarm: delay at start-up	90	0	999	s	R/W	HR213
S		C052	LP pressure switch alarm: delay in operation	15	0	999	s	R/W	HR214
M		C053	LP pressure switch: input logic 0/1=NC/NO	0	0	1	-	R/W	CS049

Tab. 6.b

6.3 BLDC and Inverter

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
S		P000	Min evaporation temp.: custom limit	-25.0	-99.9	999.9	°C/°F	R/W	HR255 (2R)
S		P001	Max condensing temp.: custom limit	70.0	-99.9	999.9	°C/°F	R/W	HR257 (2R)
M		P003	Out of envelope alarm delay	120	0	999	s	R/W	HR260
M		P004	Low pressure differential alarm delay	60	0	999	s	R/W	HR261
M		P005	Destabilisation: min. speed threshold	35.0	0.0	999.9	rps	R/W	HR262 (2R)
M		P006	Oil recovery: min request for activation	35.0	0.0	100.0	%	R/W	HR264 (2R)
M		P007	Oil recovery: min speed for activation	35.0	0.0	999.9	rps	R/W	HR266 (2R)
M		P008	Oil recovery: comp. operating time at low speed	15	0	999	min	R/W	HR268
M		P009	Oil recovery: force comp. speed time	3	0	999	min	R/W	HR269
M		P010	Oil recovery: force comp. speed value	50.0	0.0	999.9	rps	R/W	HR270 (2R)
M		P011	Oil equalisation: solenoid valve opening time at start-up	30	0	999	s	R/W	HR272
M		P012	Oil equalisation: solenoid valve opening time	3	0	999	s	R/W	HR273
M		P013	Oil equalisation: min solenoid valve time	1	0	999	min	R/W	HR274
M		P014	Oil equalisation: max solenoid valve closed time	15	0	999	min	R/W	HR275
M		P015	Oil equalisation: solenoid valve closed time increment	20	0	999	min	R/W	HR276
S		P016	Oil equalisation valve: output logic 0/1= NO/NC	0	0	1	-	R/W	CS042
M		P017	Enable oil equalisation 0/1=No/Yes	0	0	1	-	R/W	CS043
M		P018	Enable oil recovery 0/1=No/Yes	0	0	1	-	R/W	CS044
S	x	P019	BLDC compressor: operating mode 0=AUTO; 1=0%, ... 101=100%	0	0	101	-	R/W	HR277

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
M,U,S		PWRP_Err-Code_Circ1	Power+ error code - Circuit 1	-	-	-	-	R	IR138
M		P021	Max. deltaP at start-up	900.0	0.0	2000.0	kPa	R/W	HR278 (2R)
M		P022	EVD: max pre-opening time for pressure equalisation	10	0	999	s	R/W	HR280
M		P023	EVD: pre-opening value for pressure equalisation	50.0	0.0	100.0	%	R/W	HR281
M		P024	Start-up speed	50.0	20.0	120.0	rps	R/W	HR282 (2R)
M		P025	Custom speed: max value	120.0	0.0	999.9	rps	R/W	HR284 (2R)
M		P026	Custom speed: min value	20.0	0.0	999.9	rps	R/W	HR286 (2R)
S		P030	Skip frequency: centre point [010]	0.0	0.0	999.9	Hz	R/W	HR294 (2R)
S		P031	Skip frequency: band [011]	0.0	0.0	999.9	Hz	R/W	HR296 (2R)
M		P032	Enable motor over-temperature alarm (PTC) [027] 0/1=No/Yes	0	0	1		R/W	HR298
M		P033	Motor over-temperature alarm delay (PTC) [028]	0	0	999	s	R/W	HR299
S		P034	Enable crankcase heater function 0/1=No/Yes	0	0	1		R/W	CS045
S		P035	Enable BLDC on below set point (with heating) 0/1=No/Yes	0	0	1		R/W	CS068

Tab. 6.c

6.4 Valve

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
EEU = Valve									
S		E000	SH ExV: manual mode 0/1=No/Yes	0	0	1	-	R/W	CS015
S		E001	SH ExV: steps in manual mode	0	0	65535	steps	R/W	HR069
S	x	E004	Superheat (SH): set point	6.0	-40.0	180.0	K/R	R/W	HR070 (2R)
S		E005	Superheat (SH): Kp	15.0	0.0	800.0	-	R/W	HR072 (2R)
S		E006	Superheat (SH): Ti	150.0	0.0	1000.0	s	R/W	HR074 (2R)
S		E007	Superheat (SH): Td	1.0	0.0	800.0	s	R/W	HR076 (2R)
S		E012	LowSH: threshold	1.0	-40.0	180.0	K/R	R/W	HR078 (2R)
S		E013	LowSH: Ti	10.0	0.0	800.0	s	R/W	HR080(2R)
S		E016	LOP: threshold	-5.0	-60.0	200.0	°C/°F	R/W	HR082 (2R)
S		E017	LOP: Ti	5.0	0.0	800.0	s	R/W	HR084 (2R)
M		E020	MOP: threshold	30.0	-60.0	200.0	°C/°F	R/W	HR086 (2R)
M		E021	MOP: Ti	15.0	0.0	800.0	s	R/W	HR088 (2R)
M		E024	LowSH: alarm delay time	300	0	18000	s	R/W	HR090
M		E025	LOP: alarm delay time	300	0	18000	s	R/W	HR091
M		E026	MOP: alarm delay time	300	0	18000	s	R/W	HR092
M		E032	Valve opening % at start-up (ratio of EVAP/EEV capacity)	100	0	100	%	R/W	HR093
M		E034	Control delay after pre-positioning	6	3	18000	s	R/W	HR094
M		E046	EVD Evolution: valve (1=CAREL ExV, ...) (*)	1	1	24	-	R/W	HR095
S		E047	ExV driver (0=NO_ExV, 1=EVO SSH, 2=EVO HGBP, 3=EVO SSH (valve A) - HGBP (valve B), 4=Mini SSH, 5=Mini HGBP, 6=EMB SSH, 7=EMB HGBP, 8=EMB HGBP - Mini SSH, 9=EMB HGBP - EVO SSH, 10=EMB SSH - EVO HGBP)	0	0	10	-	R/W	HR096
S		E050	Hot gas ExV: manual mode 0/1=No/Yes	0	0	1	-	R/W	CS023
S		E051	Hot gas ExV: steps in manual mode	0	0	65535	steps	R/W	HR097
S		E052	DC power supply 0/1=No/Yes	0	0	1	-	R/W	CS069

Tab. 6.d

Notice: (*) see the EVD Evolution manual for the complete list of selectable valves.

6.5 Source

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
Src = Source									
S		S008	Condenser fan/pump: hour threshold for maintenance (x100)	99	0	999	h	R/W	HR186
S		S009	Condenser fan/pump: reset hour counter	0	0	1	-	R/W	CS024
S	x	S010	ON/OFF condenser fan/pump: operating mode 0=AUTO 1=OFF 2=ON	0	0	2	-	R/W	HR187
S	x	S011	Modulating condenser fan/pump: operating mode 0=AUTO 1=0% 2=1%, . 101=100%	0	0	101	-	R/W	HR188
S		S016	Condenser fan: temperature threshold for cold climate	-0.5	-999.9	999.9	°C/°F	R/W	HR189 (2R)
S		S017	Condenser fan: min speed for cold climate	10.0	0.0	100.0	%	R/W	HR191 (2R)
S		S018	Condenser fan: cold climate speed at start-up	50.0	0.0	100.0	%	R/W	HR193 (2R)
S		S019	Condenser fan: cold climate speed at start-up time	5	0	300	s	R/W	HR195
S	x	S020	Enable noise reduction 0/1=No/Yes	0	0	1	-	R/W	CS025
S		S021	Noise reduction time band: start hours	22	0	23	h	R/W	HR196

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
S		S022	Noise reduction time band: start minutes	30	0	59	min	R/W	HR197
S		S023	Noise reduction time band: end hours	8	0	23	h	R/W	HR198
S		S024	Noise reduction time band: end minutes	30	0	59	min	R/W	HR199
S		S025	Condenser fan: noise reduction set point	45.0	0.0	999.9	°C/°F	R/W	HR200 (2R)
S		S027	Fan/pump shutdown delay after compressor off	5	0	999	s	R/W	HR335 (2R)
S		S028	Condenser fan/pump: set point	30.0	-999.9	999.9	°C/°F	R/W	HR202 (2R)
S		S031	Condenser fan/pump: set point at start-up	45.0	0.0	999.9	°C/°F	R/W	HR204 (2R)
S		S032	Condenser fan/pump: delay ramp at start-up	240	0	999	s	R/W	HR206
S		S034	Condenser fan/pump: differential	15.0	0.0	99.9	K	R/W	HR207 (2R)
S		S036	Modulating condenser fan/pump: min speed value	20.0	0.0	100.0	%	R/W	HR209 (2R)
S		S037	Modulating condenser fan/pump: max speed value	80.0	0.0	100.0	%	R/W	HR211 (2R)
S		S060	Outside air temperature: probe offset	0.0	-99.9	99.9	K/R	R/W	HR230 (2R)
M		S061	Condenser fan/pump: output logic 0/1=NO/NC	0	0	1	-	R/W	CS027
S		S065	Type of condenser 0/1=Modulating/ON-OFF	0	0	1	-	R/W	CS029
S		S068	Unit type 0=Air 1=Water	0	0	1	-	R/W	CS031
S		S070	Condenser water temperature: probe offset	0.0	-99.9	99.9	K/R	R/W	HR304 (2R)

Tab. 6.e

6.6 I/O settings

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
M		Hc00	S3 configuration 0=Not used 1=Outside air temp. 2=Discharge temp. 3=Suction temp. 4=Condenser water temp. 5=Tank temp.	0	0	5	-	R/W	HR232
M		Hc01	S4 and S5 configuration 0=Pressure, 1=Temperature	0	0	1	-	R/W	HR233
M		Hc02	Enable S4 0/1=No/Yes	1	0	1	-	R/W	CS033
S		Hc03	S6 configuration 0=Not used; 1=Remote set point; 2=Outside air temp. 3=Tank temp. 4=Generic probe	0	0	4	-	R/W	HR234
M		Hc04	S7 configuration (DIN) 0=Not used 1=Suction temperature 2=Tank temp.	0	0	2	-	R/W	HR235
S		Hc06	ID4 configuration 0=Not used 1=Tank level 2=Remote On/Off 3=Remote alarm 4=Comp. 2 overload; 5=2nd set point; 6=User pump 1 overload; 7=LP pressure switch 8=Source fan/pump overload	0	0	8	-	R/W	HR236
S		Hc07	ID5 configuration 0=Not used 1=Tank level 2=Remote On/Off 3=Remote alarm 4=Comp. 2 overload; 5=2nd set point; 6=User pump 1 overload; 7=User pump 2 overload 8=Source fan/pump overload	3	0	8	-	R/W	HR237
S		Hc08	ID6 configuration 0=Not used 1=Tank level 2=Remote On/Off 3=Remote alarm 4=Comp. 2 overload; 5=2nd set point; 6=User pump 1 overload; 7=User pump 2 overload 8=Source fan/pump overload	5	0	8	-	R/W	HR238
M		Hc12	NO6 configuration 0=Not used 1=Heater/heating device 2=Condenser fan/pump 3=Hot gas ExV	0	0	3	-	R/W	HR333
S		Hc13	Buzzer 0/1=No/Yes	0	0	1	-	R/W	CS034
M		Hc14	NO5 configuration 0=Not used 1=General alarm 2=Heater/heating device 3=Hot gas ExV 4=User pump 2	0	0	4	-	R/W	HR239
S		Hc15	ID1 configuration 0=Not used 1=Tank level 2=Remote On/Off 3=Remote alarm 4=User flow switch 5=Source fan/pump overload	4	0	5	-	R/W	HR240
S		Hc16	ID2 configuration 0=Not used 1=Tank level 2=Remote On/Off 3=Remote alarm 4=Comp. 2 overload 5=Comp. 1 overload 6=Circuit overload; 7=Source fan/pump overload	5	0	7	-	R/W	HR241
M		Hc17	S2 configuration 0=Not used 1=User delivery temp.	1	0	1	-	R/W	HR307
M		Hc18	S1 configuration 0=Not used; 1=User return temperature	1	0	1	-	R/W	HR306
M		Hc19	Type of probe S1, S2, S3 0=NTC 1=PT1000	0	0	1	-	R/W	CS052

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
S		Hc20	Type of generic probe 0=0.5-4.5V 1=0-10V 2=4-20mA 3=NTC 4=PT1000	0	0	4	-	R/W	HR332
M		Hc21	Enable probe S5 evaporation P/T 0/1=no/yes	1	0	1	-	R/W	CS048

Tab. 6.f

6.7 BMS port

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
S	x	Hd00	BMS: serial address	1	1	247	-	R/W	HR142
S	x	Hd01	BMS: baud rate 3=9600; 4=19200; 5=38400; 6=57600; 7=115200	7	3	7	-	R/W	HR143
S	x	Hd02	BMS: settings 0=8-NONE-1 1=8-NONE-2 2=8-EVEN-1 3=8-EVEN-2 4=8-ODD-1 5=8-ODD-2	1	0	5	-	R/W	HR144
S	x	Hd05	Remote On-Off from BMS: enable 0/1=no/yes	1	0	1	-	R/W	CS040
S	x	Hd06	Capacity request from BMS: enable 0/1=no/yes	1	0	1	-	R/W	CS016
S	x	Hd07	Apply BMS serial line settings (with each variation)	-	0	1	-	R/W	CS051
S		Hd08	Enable remote set point from BMS 0/1=no/yes	0	0	1	-	R/W	CS067

Tab. 6.g

6.8 Password

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
U		He00	User password	1000	0000	9999	-	-	-
S		He01	Service password	2000	0000	9999	-	-	-
M		He02	Manufacturer password	1234	0000	9999	-	-	-
M		He03	Password for profile 1	0001	0000	9999	-	-	-
M		He04	Password for profile 2	0002	0000	9999	-	-	-
M		He05	Password for profile 3	0003	0000	9999	-	-	-
M		He06	Password for profile 4	0004	0000	9999	-	-	-
M		He07	Password for profile 5	0005	0000	9999	-	-	-
M		He08	Password for profile 6	0006	0000	9999	-	-	-
M		He09	Password for profile 7	0007	0000	9999	-	-	-

Tab. 6.h

6.9 Dashboard values

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
U	x	AFC1	Condenser water temperature	-	-999.9	999.9	°C/°F	R	IR030 (2R)
U	x	EuP1	Evaporation temperature (or converted value)	-	-999.9	999.9	°C/°F	R	IR026 (2R)
U	x	SSH1	Suction superheat	-	-999.9	999.9	°C/°F	R	IR036 (2R)
U	x	Cnd1	Condensing temperature (or converted value)	-	-999.9	999.9	°C/°F	R	IR024 (2R)
U	x	dSt1	BLDC discharge temperature	-	-999.9	999.9	°C/°F	R	IR014 (2R)
U	x	Sprb	Outside air temperature		-999.9	999.9	°C/°F	R	IR028 (2R)
U	x	AUSn	Generic probe	-	-999.9	999.9	-	R	IR038 (2R)
U	x	tAnt	Tank temperature	-	-999.9	999.9	°C/°F	R	IR018 (2R)
U		dSP1	Condensing pressure	-	-999.9	999.9	bar/psi	R	IR034 (2R)
U	x	rUSr	Water return temperature	-	-999.9	999.9	°C/°F	R	IR020 (2R)
U	x	dUSr	Water delivery temperature	-	-999.9	999.9	°C/°F	R	IR022 (2R)
U		ScP1	Evaporation pressure	-	-999.9	999.9	bar/psi	R	IR022 (2R)
U		Sct1	Suction temperature	-	-999.9	999.9	°C/°F	R	IR016 (2R)
U	x	SetA	Current set point	-	-999.9	999.9	°C/°F	R	IR041 (2R)
U		rSPt	Remote set point		-999.9	999.9	°C/°F		IR048 (2R)
U		OpnH	Hot gas bypass ExV: position	-	0	9999	%	R	IR010
U		OpnS	Superheat ExV: position	-	0	9999	%	R	IR011
S	x	Hd00	BMS: serial address	1	1	245	-	R	HR142
S	x	Hd01	BMS: baud rate 3=9600 4=19200 5=38400 6=57600 7=115200	7	3	7	-	R	HR143
S	x	Hd02	BMS: settings 0=8-NONE-1 1=8-NONE-2 2=8-EVEN-1 3=8-EVEN-2 4=8-ODD-1 5=8-ODD-2	0	0	5	-	R	HR144
S		H1C1	Compressor 1: hour counter	-	0	99999	h	R	IR004 (2R)
S		H1C2	Compressor 2: hour counter	-	0	99999	h	R	IR006 (2R)
S		HuP1	User pump 1: hour counter	-	0	99999	h	R	IR000 (2R)
S		HuP2	User pump 2: hour counter	-	0	99999	h	R	IR002 (2R)
S		HFn1	Condenser fan/pump: hour counter	-	0	99999	h	R	IR008 (2R)
S	x	rps1	BLDC speed	-	0	999.9	rps	R	IR076 (2R)
S	x	Mc1	BLDC current	-	0	99.9	A	R	IR078 (2R)

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
S		MP1	BLDC power	-	0	99.9	kW	R	IR080 (2R)
S		Drt1	Current speed drive temperature	-	0	999.9	°C/°F	R	IR082 (2R)
S		AlHs1_1	Speed drive 1 alarm log: last	-	0	99		R	IR084
S		AlHs2_1	Speed drive 1 alarm log: second-to-last	-	0	99		R	IR085
S		AlHs3_1	Speed drive 1 alarm log: third-to-last	-	0	99		R	IR086
S		AlHs4_1	Speed drive 1 alarm log: fourth-to-last	-	0	99		R	IR087
S		PtUn	Auxiliary PID 1: tuning in progress	-	0	1		R	IS112
S		FtUn	Auxiliary PID 1: fine tuning in progress	-	0	1		R	IS111
S		EtUn	Autotuning: process error 0=Tuning performed correctly; 1=Signal frequency lower than minimum; 2=Amplitude of peak lower than minimum threshold; 3=Fine Tuning; 4=Nothing to signal	4	0	4		R	IR075
S		StUn	Autotuning: current status of the process 0=Completed; 1=Signal acquisition; 2=DFT calculation; 3=Auto swing peak calculation; 4=Optimised parameter calculation; 5=Fine Tuning procedure; 6=Auto swing recovery cycle; 7=Application of parameters for new attempt; 8=Analysis of results; 9=Initialisation; 10=Not yet completed	10	0	10		R	IR074
S		InPI	Auxiliary PID 1: input variable	0	-999.9	999.9	-	R	IR068 (2R)
S		OUPI	Auxiliary PID 1: output	0	0.0	100.0	%	R	IR070 (2R)
S		PIdP	Autotuning: gain constant kP sent to auxiliary PID 1	-	0.1	999.9	-	R	IR062 (2R)
S		PIdI	Autotuning: integral time Ti sent to auxiliary PID 1	-	0	999.9	s	R	IR064 (2R)
S		PIdd	Autotuning: derivative time Td sent to auxiliary PID 1	-	0	999.9	s	R	IR066 (2R)
S		PrtU	Autotuning: percentage of progress	0	0	100.0	%	R	IR072 (2R)
U	x	SEtC	Main control set point	7.0	U006	U007	°C/°F	R/W	HR247 (2R)
U	x	SEtD	Tracking set point: offset	0.0	-99.9	99.9	°C/°F	R/W	HR110 (2R)
U	x	SEt2	Auxiliary PID 1: set point	0.0	-99.9	99.9	°C/°F	R/W	HR308 (2R)
U	x	set-02	Auxiliary PID: set point	0.0	-99.9	99.9	°C/°F	R/W	HR308 (2R)
U	x	UnSt	Unit On-Off from keypad 0=OFF 1=ON	0	0	1	-	R/W	CS037
-		RES	Reset alarms from BMS 0/1=No/Yes	0	0	1	-	R/W	CS038
S	x	ClrH	Reset alarm log 0/1=No/Yes	0	0	1	-	R/W	CS039
S	x	UoM	Unit of measure 0=°C/barg, 1=°F/psig	0	0	1	-	R/W	CS032

Tab. 6.i

6.10 Settings

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
U	x	SEtC	Main control set point	7.0	U006	U007	°C/°F	R/W	HR247 (2R)
U	x	SEtD	Tracking set point: offset	0.0	-99.9	99.9	°C/°F	R/W	HR110 (2R)
U	x	SEt2	Auxiliary PID 1: set point	0.0	-99.9	99.9	°C/°F	R/W	HR308 (2R)
U	x	SEt3	Auxiliary PID 2: set point	0.0	-99.9	99.9	°C/°F	R/W	HR386 (2R)
U	x	UnSt	Unit On-Off from keypad 0=OFF 1=ON	0	0	1	-	R/W	CS037
-		RES	Reset alarms from BMS 0/1=No/Yes	0	0	1	-	R/W	CS038
S	x	ClrH	Reset alarm log 0/1=No/Yes	0	0	1	-	R/W	CS039
S	x	UoM	Unit of measure 0=°C/barg, 1=°F/psig	0	0	1	-	R/W	CS032

Tab. 6.j

6.11 Auxiliary PID

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
M,S		Y001	Aux PID 1: control mode 0: direct, 1: reverse	0	0	1	-	R/W	CS57
M,S		Y002	Aux PID 1: Kp	10	0.1	999.9	-	R/W	HR310
M,S		Y003	Aux PID 1: Ti	100	0	999	s	R/W	HR312
M,S		Y004	Aux PID 1: Td	5	0	99	s	R/W	HR314
			Aux PID 1: activation 0: OFF 1: UNIT ON 2: WATER PUMP 3: MAIN CONTROL ON 4: COMPRESSORS ON 5: ALWAYS ON	0	0	5	-	R/W	HR316
M,S		Y006	Aux PID 1: activation delay	0	0	999	s	R/W	HR322

User	Display	Code	Description	Def.	Min	Max	UOM	R/W	Modbus
M,S		Y007	Aux PID 1: process variable (input) 0: Value from S1 1: Value from S2 2: Value from S3 3: Value from S4 4: Value from S5 5: Value from S6 or generic sensor 6: Value from S7 7: Differential value S2-S3 8: Differential value S2-S6 or S2 - generic sensor	0	0	8	-	R/W	HR317
M,S		Y008	Aux PID 1: minimum output value	0	0	100	-	R/W	HR318
M,S		Y009	Aux PID 1: maximum output value	100	0	100	-	R/W	HR320
M,S		Y010	Aux PID 1: enable	0	0	1	-	R/W	CS62
M,S		Y011	Autotuning: Initial Kp	5	0.1	999.9	-	R/W	HR324
M,S		Y012	Autotuning: number of samples	600	1	2048	-	R/W	HR326
M,S		Y013	Autotuning: sampling time	1	0.34	999	s	R/W	HR328
M,S		Y014	Autotuning: apply calculated coefficients	0	0	1	-	R/W	CS58
M,S		Y015	Autotuning: manual mode	0	0	1	-	R/W	CS59
M,S		Y016	Autotuning: fine tuning	0	0	1	-	R/W	CS60
M,S		Y017	Autotuning: start	0	0	1	-	R/W	CS61
M,S		Y018	Generic sensor: offset	0	-99.9	999.9	-	R/W	HR330
M,S		Y019	Generic sensor: min value	0	-99.9	999.9	-	R/W	HR102
M,S		Y020	Generic sensor: max value	100	-99.9	999.9	-	R/W	HR104
M,S		Y021	Aux PID 2: control mode 0: direct, 1: reverse	0	0	1	-	R/W	CS71
M,S		Y022	Aux PID 2: Kp	10	0.1	999.9	-	R/W	HR377
M,S		Y023	Aux PID 2: Ti	100	0	999	s	R/W	HR390
M,S		Y025	Aux PID 2: Td	5	0	99	s	R/W	HR388
M,S		Y026	Aux PID 2: activation delay	0	0	999	s	R/W	HR383
M,S		Y027	Aux PID 2: process variable (input) 0: Value from S1 1: Value from S2 2: Value from S3 3: Value from S4 4: Value from S5 5: Value from S6 or generic sensor 6: Value from S7 7: Differential value S2-S3 8: Differential value S2-S6 or S2 - generic sensor	0	0	8	-	R/W	HR385
M,S		Y028	Aux PID 2: minimum output value	0	0	100	-	R/W	HR381
M,S		Y029	Aux PID 2: maximum output value	100	0	100	-	R/W	HR379
M,S		Y030	Aux PID 2: enable	0	0	1	-	R/W	CS72
M,S		Y031	Aux PID 1: select set point 0: Auxiliary PID specific setpoint 1: Actual setpoint use by temperature control (SetA)	0	0	1	-	R/W	HR392
M,S		Y032	Aux PID 2: select set point 0: Auxiliary PID specific setpoint 1: Actual setpoint use by temperature control (SetA)	0	0	1	-	R/W	HR393

Tab. 6.k

7. SUPERVISOR TABLE

µChiller Process provides a database of supervisor variables via Modbus RTU protocol over RS485 (BMS port on the µChiller Process controller). The BMS port has the following default settings:

- baud rate 115,200;
- data bits 8;
- no parity;
- stop bits 2.

See the "Parameter table: BMS port" to set different values. "Index" is the address specified in the Modbus® frame.

7.1 Coil Status

Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
0	1	U001	BOOL		R/W		U001 - User pump 1 reset hour counters (0=No, 1=Yes)
1	1	U004	BOOL		R/W		U004 - User pump 2 reset hour counters (0=No, 1=Yes)
2	1	U010	BOOL		R/W		U010 - Enable setpoint compensation (0=No, 1=Yes)
3	1	U017	BOOL		R/W		U017 - Enable scheduler (0=No, 1=Yes)
4	1	U022	BOOL		R/W		U022 - Type of scheduling (0=Switch OFF, 1=Change setpoint)
5	1	U057	BOOL		R/W		U057 - Remote alarm input logic (0=N.C., 1=N.O.)
6	1	U059	BOOL		R/W		U059 - Remote unit ON/OFF input logic (0=N.O., 1=N.C.)
7	1	U060	BOOL		R/W		U060 - User pump flow input logic (0=N.C., 1=N.O.)
8	1	U061	BOOL		R/W		U061 - User pump overload input logic (0=N.C., 1=N.O.)
9	1	U062	BOOL		R/W		U062 - 2nd setpoint input logic (0=N.O., 1=N.C.)
10	1	U063	BOOL		R/W		U063 - User pump output logic (0=N.O., 1=N.C.)
11	1	U064	BOOL		R/W		U064 - Global alarm relay output logic (0=N.C., 1=N.O.)
12	1	U065	BOOL		R/W		U065 - Free-Cooling valve output logic (0=N.O., 1=N.C.)
13	1	U067	BOOL		R/W		U067 - Alarm relay configuration (0=Regulation alarms, 1=All alarms)
14	1	U068	BOOL		R/W		U068 - Enable Free-Cooling (0=No, 1=Yes)
15	1	E000	BOOL		R/W		E000 - ExV circ.1 enable manual mode (0=No, 1=Yes)
16	1	Hd06	BOOL		R/W		Hd06 - Enable power request from BMS (0=No, 1=Yes)
17	1	C001	BOOL		R/W		C001 - Compr.1 circ.1 reset hour counters (0=No, 1=Yes)
18	1	C004	BOOL		R/W		C004 - Compr.2 circ.1 reset hour counters (0=No, 1=Yes)
19	1	C034	BOOL		R/W		C034 - High press. pressostat input logic (0=N.C., 1=N.O.)
20	1	C035	BOOL		R/W		C035 - Compr. overload input logic (0=N.C., 1=N.O.)
21	1	C036	BOOL		R/W		C036 - Compr. output logic (0=N.O., 1=N.C.)
22	1	C044	BOOL		R/W		C044 - Enable circuit destabilization (0=No, 1=Yes)
23	1	E050	BOOL		R/W		E050 - Enable manual Positioning of HGBP ExV (0=No, 1=Yes)
24	1	S009	BOOL		R/W		S009 - Condenser fan/pump hour counter reset (0=No, 1=Yes)
25	1	S020	BOOL		R/W		S020 - Enable low noise (0=No, 1=Yes)
26	1	-	BOOL		R/W		Reserved
27	1	S061	BOOL		R/W		S061 - Condenser fan/pump output logic (0=N.O., 1=N.C.)
28	1	-	BOOL		R/W		Buzzer silenced
29	1	S065	BOOL		R/W		S065 - Condenser fan/pump type (0=Inverter, 1=ON/OFF)
30	1	-	BOOL		R/W		Reserved
31	1	S068	BOOL		R/W		S068 - Condenser cooling type (0=Air, 1=Water)
32	1	UoM	BOOL		R/W		UoM - Unit of measure used for Display 2-Row and BMS, not for Applica (0=°C/bar, 1=°F/PSI)
33	1	Hc02	BOOL		R/W		Hc02 - Analog input S4 enabling (0=No, 1=Yes)
34	1	Hc13	BOOL		R/W		Hc13 - Enable buzzer (0=No, 1=Yes)
35	1	Ha02	BOOL		R/W		Ha02 - Sets controller internal clock (0=No set, 1=Set)
36	1	Hd03	BOOL		R/W		Hd03 - Enable NFC (0=No, 1=Yes)
37	1	UnSt	BOOL		R/W		UnSt - Unit ON/OFF command by keyboard (0=OFF 1=ON)
38	1	RES	BOOL		R/W		RES - Reset active alarms by BMS (0=NO, 1=Reset)
39	1	ClrH	BOOL		R/W		ClrH - Delete alarms log (0=No, 1=Yes)
40	1	Hd05	BOOL		R/W		Hd05 - Enable unit ON/OFF command by BMS (0=No, 1=Yes)
41	1	-	BOOL		R/W		Unit ON/OFF command by BMS (0=Off, 1=ON)
42	1	P016	BOOL		R/W		P016 - Oil equalization solenoid valve circ.1 output logic (0=NC, 1=NO)
44	1	P017	BOOL		R/W		P017 - Enable oil equalization function (0=OFF, 1=ON)
45	1	P018	BOOL		R/W		P018 - Enable oil recovery function (0=OFF, 1=ON)
46	1	P034	BOOL		R/W		P034 - Enable cranckcase heater (0=OFF, 1=ON)
47	1	-	BOOL		R/W		Reserved
48	1	Hc21	BOOL		R/W		Hc21 - S5 probe P/T evap. enabling (0=No, 1=Yes)
49	1	C053	BOOL		R/W		C053 - Low press. pressostat input logic (0=N.C., 1=N.O.)
50	1	U078	BOOL		R/W		U078 - Burst function enabling (0=No, 1=Yes)
51	1	Hd07	BOOL		R/W		Hd07 - Applies the settings of serial line BMS (at each variation)
52	1	Hc19	BOOL		R/W		Hc19 - Probe type for S1, S2, S3 (0=NTC, 1=PT1000)
53	1	U113	BOOL		R/W		U113 - Tank level input logic (0=N.C., 1=N.O.)
54	1	U119	BOOL		R/W		U119 - Heaters output logic (0=N.O., 1=N.C.)
55	1	C049	BOOL		R/W		C049 - Enable the compressors safety timers reset to allow immediate machine restart (0=No, 1=Yes)
56	1	U114	BOOL		R/W		U114 - Hot Gas Bypass output logic (0=N.O., 1=N.C.)
57	1	Y001	BOOL		R/W		Y001 - Aux PID 1: Direct/reverse (0: Direct, 1: Reverse)
58	1	Y014	BOOL		R/W		Y014 - Aux PID 1: apply the tuned parameters (0=No, 1=Yes)

Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
59	1	Y015	BOOL		R/W		Y015 - Aux PID 1: manual tuning mode (0=No, 1=Yes)
60	1	Y016	BOOL		R/W		Y016 - Request for fine tuning reprocessing (0=No, 1=Yes)
61	1	Y017	BOOL		R/W		Y017 - Start/Abort the automatic tuning process
62	1	Y010	BOOL		R/W		Y010 - Auxiliary PID 1 enable (0=No, 1=Yes)
63	1	U108	BOOL		R/W		U108 - Check probe functionality at startup (0=No, 1=Yes)
64	1	U099	BOOL		R/W		U099 - Enable cooling on demand (0=No, 1=Yes)
65	1	U096	BOOL		R/W		U096 - Enable "Neutral Zone" regulation (0=No, 1=Yes)
66	1	U091	BOOL		R/W		U091 - Enable Pre-Heating (0=No, 1=Yes)
67	1	Hd08	BOOL		R/W		U106 - Enable remote set point from BMS (0=No, 1=Yes)
68	1	P035	BOOL		R/W		P035 - Enable BLDC On Below set point (with heat. resources) (0=No, 1=Yes)
69	1	E052	BOOL		R/W		E052 - Power supply in DC (0=No, 1=Yes)
70	1	U058	BOOL		R/W		U058 - Source fan/pump overload input logic (FALSE=N.C., TRUE=N.O.)
71	1	Y021	BOOL		R/W		Y021 - Direct/reverse for Aux PID 2 (FALSE: Direct, TRUE: Reverse)
72	1	Y030	BOOL		R/W		Y030 - Auxiliary PID 2 enable (FALSE=Disabled, TRUE=Enabled)

Tab. 7.a

7.2 Input Status

Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
0	1	A01	BOOL		R		Unit - Error in the number of retain memory writings
1	1	A02	BOOL		R		Unit - Error in retain memory writings
2	1	A03	BOOL		R		Unit - Remote alarm by digital input
3	1	A04	BOOL		R		Unit - Alarm remote set point out of range
4	1	A05	BOOL		R		Unit - Alarm user return water temperature probe broken or disconnected
5	1	A06	BOOL		R		Unit - Alarm user delivery water temperature probe broken or disconnected
6	1	A07	BOOL		R		Unit - Alarm tank temperature probe broken or disconnected
7	1	A08	BOOL		R		Unit - User pump 1 overload
8	1	A09	BOOL		R		Unit - User pump 2 overload
9	1	A10	BOOL		R		Unit - Flow switch alarm, no flow present with user pump 1 active
10	1	A11	BOOL		R		Unit - Flow switch alarm, no flow present with user pump 2 active
11	1	A12	BOOL		R		Unit - User pumps group alarm
12	1	A13	BOOL		R		User 1 pump maintenance
13	1	A14	BOOL		R		User 2 pump maintenance
14	1	A15	BOOL		R		Unit - High chilled water temperature
15	1	A16	BOOL		R		Unit - Alarm condens. water/air temperature probe broken or disconnected
16	1	A17	BOOL		R		Condenser fan/pump maintenance
17	1	A18	BOOL		R		Free-cooling anomaly
18	1	A19	BOOL		R		Circuit - Alarm discharge pressure probe broken or disconnected
19	1	A20	BOOL		R		Circuit - Alarm condensing temperature probe broken or disconnected
20	1	A21	BOOL		R		Circuit - Alarm suction pressure probe broken or disconnected
21	1	A22	BOOL		R		Circuit - Alarm evaporating temperature probe broken or disconnected
22	1	A23	BOOL		R		Circuit - Alarm discharge temperature probe broken or disconnected
23	1	A24	BOOL		R		Circuit - Alarm suction temperature probe broken or disconnected
24	1	A25	BOOL		R		Circuit - High pressure alarm by pressure switch
25	1	A26	BOOL		R		Circuit - High pressure alarm by transducer
26	1	A27	BOOL		R		Circuit - Low pressure alarm by transducer
27	1	A28	BOOL		R		Circuit - Alarm freeze evaporator
29	1	A30	BOOL		R		Circuit - Overload compressor 1
30	1	A31	BOOL		R		Circuit - Overload compressor 2
31	1	A32	BOOL		R		Compressor 1 maintenance
32	1	A33	BOOL		R		Compressor 2 maintenance
33	1	A35	BOOL		R		EVD - Low superheating (SH)
34	1	A36	BOOL		R		EVD - Low evaporation pressure (LOP)
35	1	A37	BOOL		R		EVD - Maximum evaporating pressure (MOP)
36	1	A38	BOOL		R		EVD - Valve motor error
37	1	A39	BOOL		R		EVD - Emergency closing
38	1	A40	BOOL		R		EVD - Incomplete valve closing
39	1	A41	BOOL		R		EVD - Offline
40	1	A42	BOOL		R		BLDC Envelope - General alarm + Alarm zone
41	1	A43	BOOL		R		BLDC - Delta pressure greater than the allowable at startup
42	1	A44	BOOL		R		BLDC - Starting failure
43	1	A45	BOOL		R		BLDC - Low differential pressure
44	1	A46	BOOL		R		BLDC - High discharge gas temperature
45	1	A47	BOOL		R		BLDC Inverter - Offline
46	1	A48	BOOL		R		BLDC Inverter - General alarm + Error code
47	1	A49	BOOL		R		Alarm generic sensor broken or disconnected
48	1	A50	BOOL		R		Unit - Low chilled water temperature
49	1	A51	BOOL		R		Unit - Tank low level
50	1	A52	BOOL		R		Unit - Sensor check fail: user return water temp. sensor
51	1	A53	BOOL		R		Unit - Sensor check fail: user delivery water temp. sensor
52	1	A54	BOOL		R		Unit - Sensor check fail: evaporator temp./pressure sensor
53	1	A55	BOOL		R		Unit - Sensor check fail: suction temp. sensor

Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
54	1	A56	BOOL		R		Circuit - Compressor alarm max retries reached
55	1	A57	BOOL		R		Circuit - Condenser water temp. probe (S3) broken or disconnected
56	1	A58	BOOL		R		EVD - EVD Evo not compatible
57	1	A59	BOOL		R		Aux PID 1 - Autotuning failure
58	1	A60	BOOL		R		Aux PID 1 - Autotuning abort by user
59	1	A61	BOOL		R		Supervisor (main Modbus) is offline
60	1		BOOL		R		Compressor 1 status (0=Off, 1=On)
61	1		BOOL		R		Compressor 2 status (0=Off, 1=On)
62	1		BOOL		R		Global alarm relay
63	1		BOOL		R		Free cooling valve status
64	1		BOOL		R		Antifreeze heater status
65	1		BOOL		R		Unit ON/OFF command by Scheduler
66	1		BOOL		R		Prevent request for antifreeze condition
67	1		BOOL		R		Force OFF compr.1
68	1		BOOL		R		Force OFF compr.2
69	1		BOOL		R		Prevent request for high pressure condition active
70	1		BOOL		R		Condenser fan/pump status
71	1		BOOL		R		User pump 1 status
72	1		BOOL		R		User pump 2 status
73	1		BOOL		R		Oil equalization solenoid valve circ.1 status
74	1		BOOL		R		Unit ON/OFF status
75	1		BOOL		R		At least one compressor is on
76	1		BOOL		R		Request of user pump activation by Manual-compressors control
77	1		BOOL		R		Manual status of compressors
78	1		BOOL		R		Compr. 1 forced On to avoid the oil migration
79	1		BOOL		R		Compr. 2 forced On to avoid the oil migration
80	1		BOOL		R		User pump flow absent
81	1		BOOL		R		Discharge press. probe enabled
82	1		BOOL		R		Discharge temp. probe enabled
83	1		BOOL		R		Overload compr.1 enabled
84	1		BOOL		R		Evap. temp. probe enabled
85	1		BOOL		R		Remote set point probe enabled
86	1		BOOL		R		Condenser fan/pump status
87	1		BOOL		R		Condenser water temp. probe enabled
88	1		BOOL		R		Tank temperature probe enabled
89	1		BOOL		R		Suction press. probe enabled
90	1		BOOL		R		User delivery water temperature probe enabled
91	1		BOOL		R		User return water temperature probe enabled
92	1		BOOL		R		External air temperature probe enabled
93	1		BOOL		R		Compr.2 enabled
94	1		BOOL		R		Compr. on/off type enabled
95	1		BOOL		R		Cond. temp. probe enabled
96	1		BOOL		R		Suction temp. probe enabled
97	1		BOOL		R		OR of all regulation alarms
98	1		BOOL		R		OR of all miscellaneous alarms
99	1		BOOL		R		Serious circ. alarm
101	1		BOOL		R		Compr.1 in alarm condition
104	1		BOOL		R		Compr.1 forced ON by timings (min compr. ON)
105	1		BOOL		R		Compr.1 forced OFF by timings (min compr. OFF)
106	1		BOOL		R		Compr.2 in alarm condition
109	1		BOOL		R		Compr.2 forced ON by timings (min compr. ON)
110	1		BOOL		R		Compr.2 forced OFF by timings (min compr. OFF)
111	1	FtUn	BOOL		R		FtUn - Fine tuning in progress
112	1	PtUn	BOOL		R		PtUn - Tuning in progress
113	1		BOOL		R		Generic sensor enabled
114	1		BOOL		R		User pump is running (No water flow alarm)
115	1		BOOL		R		User heater 1 status
116	1		BOOL		R		Free-Cooling condition
118	1		BOOL		R		Low noise function status
119	1		BOOL		R		UChiller Process PANEL model
120	1		BOOL		R		EVD mini offline alarm
121	1		BOOL		R		Power failure alarm (blackout)
122	1		BOOL		R		Source fan/pump overload

Tab. 7.b

7.3 Holding Register

Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
2	1	U000	INT	0..999	R/W	h	U000 - User pump 1 maintenance hour threshold (x100)
3	1	U002	INT	0..2	R/W		U002 - User pump manual mode (0=AUTO, 1=OFF, 2=ON)
4	1	U003	INT	0..999	R/W	h	U003 - User pump 2 maintenance hour threshold (x100)

Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
5	1	U005	INT	0..2	R/W		U005 - User pump 2 manual mode (0=AUTO, 1=OFF, 2=ON)
6	2	U006	REAL	-99.9..999.9	R/W	°C/°F	U006 - Cool setpoint low limit
8	2	U007	REAL	-99.9..999.9	R/W	°C/°F	U007 - Cool setpoint high limit
10	2	U011	REAL	-999.9..999.9	R/W	°C/°F	U011 - Starting temp. point for cool setpoint compensation
12	2	U012	REAL	-99.9..99.9	R/W	°C/°F	U012 - Ending temp. point for cool setpoint compensation
14	2	U013	REAL	-99.9..99.9	R/W	K/R	U013 - Max compensation for cool setpoint
16	1	U018	INT	0..23	R/W	h	Unit On-Off/2nd set point: time band hour start
17	1	U019	INT	0..59	R/W	min	Unit On-Off/2nd set point: Time band minute start
18	1	U020	INT	0..23	R/W	h	Unit On-Off/2nd set point: Time band hour end
19	1	U021	INT	0..59	R/W	min	Unit On-Off/2nd set point: Time band minute end
20	2	U023	REAL	U006..U007	R/W	°C/°F	U023 - 2nd cool setpoint
22	1	U025	INT	0..2	R/W		U025 - Analog setpoint input type (0=0-5V, 1=0-10V, 2=4-20mA)
23	2	U118	INT	0..999	R/W	s	U118 - Anti-frezee alarm delay
24	2	U026	REAL	-99.9..99.9	R/W	°C/°F	U026 - Remote setpoint min value
26	2	U027	REAL	-99.9..99.9	R/W	°C/°F	U027 - Remote setpoint max value
28	2	U028	REAL	-99.9..99.9	R/W	°C/°F	U028 - Remote setpoint offset
30	2	U030	REAL	-99.9..99.9	R/W	°C/°F	U030 - Tank temp. probe offset
32	2	U031	REAL	0..99.9	R/W	K/R	U031 - High water temp. setpoint offset
34	1	U032	INT	0..99	R/W	min	U032 - High/low water temp. startup delay
35	1	U033	INT	0..999	R/W	s	U033 - High/low water temp. run delay
36	1	U045	INT	0..999	R/W	s	U045 - User pump flow alarm startup delay
37	1	U046	INT	0..99	R/W	s	U046 - User pump flow alarm run delay
38	1	U047	INT	0..999	R/W	s	U047 - Compr. delay ON since the user pump ON
39	1	U048	INT	0..999	R/W	s	U048 - User pump delay OFF since the compr. OFF
40	1	U049	INT	0..999	R/W	h	U049 - User pump rotation time
41	2	U050	REAL	-999.9..999.9	R/W	°C/°F	U050 - Antifreeze user alarm threshold
43	2	U051	REAL	0..999.9	R/W	K/R	U051 - Antifreeze user alarm differential
45	1	U052	INT	0..999	R/W	s	U052 - Antifreeze user alarm delay time at 1K below threshold
46	2	U053	REAL	-999.9..999.9	R/W	°C/°F	U053 - Antifreeze (with unit OFF) setpoint
48	2	U054	REAL	0..99.9	R/W	K/R	U054 - Antifreeze (with unit OFF) differential
50	2	U055	REAL	-99.9..99.9	R/W	K/R	U055 - Probe offset of return water temp. from user
52	2	U056	REAL	-99.9..99.9	R/W	K/R	U056 - Probe offset of delivery water temp. to user
54	1	U079	INT	0..999	R/W	min	U079 - Burst funct. user pump on time
55	1	U080	INT	0..999	R/W	min	U080 - Burst funct. user pump off time
56	2	U069	REAL	0..99.9	R/W	K/R	U069 - Delta temp. to activate Free-Cooling
58	2	U070	REAL	0..99.9	R/W	K/R	U070 - Free-Cooling ON/OFF hysteresis
60	2	U071	REAL	0..99.9	R/W	K/R	U071 - Delta temp. Free-Cooling design (to reach unit nominal capacity)
62	2	U072	REAL	-99.9..999.9	R/W	°C/°F	U072 - Free-Cooling limit threshold (used to close FC valve: because FC gives water with temp. very low)
64	2	U073	REAL	0..99.9	R/W	K/R	U073 - Free-Cooling limit differential
66	1	U074	INT	0..2	R/W		U074 - Free-Cooling type (0=Air, 1=Remote air coil, 2=Water)
67	1	U075	INT	0..2	R/W		U075 - Antifreeze type (0=Heater, 1=Pump, 2=Heater-Pump)
68	1	U076	INT	1..2	R/W		U076 - User pump number
69	1	E001	INT	0..65535	R/W	Steps	E001 - Manual opening steps of SSH ExV
70	2	E004	REAL	-40..180	R/W	K/R	E004 - ExV SH setpoint in cool
72	2	E005	REAL	0..800	R/W		E005 - ExV SH regulation Kp in cool
74	2	E006	REAL	0..1000	R/W	s	E006 - ExV SH regulation Ti in cool
76	2	E007	REAL	0..800	R/W	s	E007 - ExV SH regulation Td in cool
78	2	E012	REAL	-40..180	R/W	K/R	E012 - ExV low SH threshold in cool
80	2	E013	REAL	0..800	R/W	s	E013 - ExV low SH Ti in cool
82	2	E016	REAL	-60..200	R/W	°C/°F	E016 - ExV LOP regulation threshold in cool
84	2	E017	REAL	0..800	R/W	s	E017 - ExV LOP regulation Ti in cool
86	2	E020	REAL	-60..200	R/W	°C/°F	E020 - ExV MOP regulation threshold in cool
88	2	E021	REAL	0..800	R/W	s	E021 - ExV MOP regulation Ti in cool
90	1	E024	INT	0..18000	R/W	s	E024 - ExV low SH alarm delay time
91	1	E025	INT	0..18000	R/W	s	E025 - ExV LOP alarm delay time
92	1	E026	INT	0..18000	R/W	s	E026 - ExV MOP alarm delay time
93	1	E032	INT	0..100	R/W	%	E032 - ExV startup valve opening % (capacity ratio EVAP / EEV) in cool
94	1	E034	INT	0..18000	R/W	s	E034 - ExV regulation delay after pre-positioning
95	1	E046	INT	1..24	R/W		E046 - ExV valve type for EVD EVO (1=CAREL EXV, ...)
96	1	E047	INT	0..10	R/W		E047 - Type of ExV driver (0=NO_ExV, 1=EVO SSH, 2=EVO HGBP, 3=EVO SSH (valve A) - HGBP (valve B), 4=Mini SSH, 5=Mini HGBP, 6=EMB SSH, 7=EMB HGBP, 8=EMB HGBP - Mini SSH, 9=EMB HGBP - EVO SSH, 10=EMB SSH - EVO HGBP)
97	1	E051	INT	0..65535	R/W	Steps	E051 - Manual opening steps of HGBP ExV
102	2	Y019	REAL	-99.9..999.9	R/W		Y019 - Generic sensor min value
104	2	Y020	REAL	-99.9..999.9	R/W		Y020 - Generic sensor max value
106	2		REAL	U006..U007	R/W	°C/°F	Remote set point from BMS (main regulation)
108	2	U100	REAL	0.1..999.9	R/W	s	U100 - Max period for Hot gas SV modulation (SSR)
110	2	SEtD	REAL	-99.9..99.9	R/W	K/R	SetD - Tracking setpoint: differential
112	1	U111	INT	0..8	R/W		U111 - Select the input/output to be displayed on row 1 (0= user water return temperature 1= user water delivery temperature 2= source temperature 3= tank temperature 4= condensing temperature 5= evaporating temperature 6= generic sensor 7= suction temperature 8= aux PID 1 output 9=Current main regulation setpoint 10=Power request 11=Discharge temperature 12=Aux PID 2 output)

Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
113	1	U112	INT	0..8	R/W		U112 - Select the input/output to be displayed on row 2 (0= user water return temperature 1= user water delivery temperature 2= source temperature 3= tank temperature 4= condensing temperature 5= evaporating temperature 6= generic sensor 7= suction temperature 8= aux PID 1 output 9=Current main regulation setpoint 10=Power request 11=Discharge temperature 12=Aux PID 2 output)
114	1	U110	INT	1..20	R/W		U110 - Remote alarm retry number
115	2	U081	REAL	0..999.9	R/W	K/R	U081 - Proportional band on the right side (above the set point)
117	2	U082	REAL	0..999.9	R/W	s	U082 - Ti right side (above the set point)
119	2	U083	REAL	0..999.9	R/W	s	U083 - Td right side (above the set point)
121	2	U084	REAL	0..999.9	R/W	K/R	U084 - Proportional band on the left side (below the set point)
123	2	U085	REAL	0..999.9	R/W	s	U085 - Ti left side (below the set point)
125	2	U086	REAL	0..999.9	R/W	s	U086 - Td left side (below the set point)
127	1	U089	INT	0..999	R/W	s	U089 - Ramp time between main regulation set points
128	1	U103	INT	0..3	R/W		U103 - Traking set point probe selector (0=None, 1=Tank temp., 2=Return temp., 3=Delivery temp.)
129	1	U109	INT	1..20	R/W		U109 - Pump alarm retry number
130	2	U093	REAL	0.1..9.9	R/W	K/R	U093 - Neutral zone proportional band
132	1	U116	INT	0..5	R/W		U116 - Hot Gas Bypass regulation type selector (0=None, 1=ON_OFF, 2=Modulating_SSR_Builtin, 3=Modulating_SSR_External, 4=Modulating_10V, 5=Modulating_EXV)
133	2	U102	REAL	0..100.0	R/W	%	U102 - Upper limit of hot gas regulation
135	2	U101	REAL	-100.0..0	R/W	%	U101 - Lower limit of hot gas regulation
137	2	U090	REAL	0..99.9	R/W	K/R	U090 - Low water temp. setpoint offset
139	1	U115	INT	0..1	R/W		U115 - Heaters number (0=None, 1=One heater)
140	2	U087	REAL	5.0..100.0	R/W	%	U087 - Percentage of heat proportional band
142	1	Hd00	INT	1..247	R/W		Hd00 - BMS port serial address
143	1	Hd01	INT	3..7	R/W		Hd01 - BMS port baud rate (3=9600, 4=19200, 5=38400, 6=57600, 7=115200)
144	1	Hd02	INT	0..5	R/W		Hd02 - BMS port network settings (0=8-NONE-1, 1=8-NONE-2, 2=8-EVEN-1, 3=8-EVEN-2, 4=8-ODD-1, 5=8-ODD-2)
150	1	C000	INT	0..999	R/W	h	C000 - Compr.1 maintenance hour threshold (x100)
151	1	C002	INT	0..2	R/W		C002 - Compr.1 manual mode (0=AUTO, 1=OFF, 2=ON)
152	1	C003	INT	0..999	R/W	h	C003 - Compr.2 maintenance hour threshold (x100)
153	1	C005	INT	0..2	R/W		C005 - Compr.2 manual mode (0=AUTO, 1=OFF, 2=ON)
154	1	C012	INT	30..999	R/W	s	C012 - Compr. min On time
155	1	C013	INT	30..999	R/W	s	C013 - Compr. min Off time
156	1	C014	INT	300..999	R/W	s	C014 - Min time between On of same compr.
159	1	C020	INT	5..999	R/W	min	C020 - Circuit destabilization max time with one or more compr. OFF
160	1	C050	INT	1..20	R/W		C050 - Maximum compressor-related alarms acceptable to allow ProcessPriority
161	2	C022	REAL	-99.9..99.9	R/W	K/R	C022 - Discharge temp. probe offset
163	2	C023	REAL	-99.9..99.9	R/W	K/R	C023 - Suction temp. probe offset
165	2	C026	REAL	-99.9..99.9	R/W	bar/psi	C026 - Discharge press. probe offset for circ.1
167	2	C027	REAL	-99.9..99.9	R/W	bar/psi	C027 - Suction press. probe offset for circ.1
169	2	C028	REAL	-99.9..99.9	R/W	K/R	C028 - Cond. temp. probe offset for circ.1
171	2	C029	REAL	-99.9..99.9	R/W	K/R	C029 - Evap. temp. probe offset for circ.1
172	1	C037	INT	0..1	R/W		C037 - Suction press. probe type (0=0..5V, 1=4..20mA)
174	2	C038	REAL	-1.0..99.9	R/W	bar/psi	C038 - Suction press. probe min value
176	2	C039	REAL	0.0..99.9	R/W	bar/psi	C039 - Suction press. probe max value
178	1	C040	INT	0..1	R/W		C040 - Discharge press. probe type (0=0..5V, 1=4..20mA)
179	2	C041	REAL	-1.0..99.9	R/W	bar/psi	C041 - Discharge press. probe min value
181	2	C042	REAL	0.0..99.9	R/W	bar/psi	C042 - Discharge press. probe max value
183	1	C043	INT	0..1	R/W		C043 - Discharge temp. probe type (0=NTC, 1=NTC-HT)
184	1	C047	INT	0..1/3	R/W		C047 - Type of compressors used (0=1 ON/OFF, 1=2 ON/OFF, 2=BLDC, 3=BLDC + ON/OFF)
185	1	C048	INT	1..2	R/W		C048 - Compressor rotation type (1=FIFO, 2=TIME)
186	1	S008	INT	0..999	R/W	h	S008 - Condenser fan/pump maintenance hour threshold (x100)
187	1	S010	INT	0..2	R/W		S010 - Condenser fan/pump ON/OFFcirc.1 manual mode (0=AUTO, 1=OFF, 2=ON)
188	1	S011	INT	0..101	R/W	%	S011 - Condenser fan/pump inverter circ.1 manual mode(0=AUTO, 1=0%, 2=1%, .. 101=100%)
189	2	S016	REAL	-99.9..999.9	R/W	°C/°F	S016 - Condenser fan temp. threshold for cold climates
191	2	S017	REAL	0..100	R/W	%	S017 - Condenser fan min speed for cold climates
193	2	S018	REAL	0..100	R/W	%	S018 - Condenser fan speed up speed for cold climates
195	1	S019	INT	0..300	R/W	s	S019 - Condenser fan speed up time for cold climates
196	1	S021	INT	0..23	R/W	h	S021 - Noise reduction time band: start hours
197	1	S022	INT	0..59	R/W	min	S022 - Noise reduction time band: start minutes
198	1	S023	INT	0..23	R/W	h	S023 - Noise reduction time band: end hours
199	1	S024	INT	0..59	R/W	min	S024 - Noise reduction time band: end minutes
200	2	S025	REAL	0..999.9	R/W	°C/°F	S025 - Low noise condenser fan setpoint in cooling
202	2	S028	REAL	-99.9..999.9	R/W	°C/°F	S028 - Condenser fan/pump setpoint
204	2	S031	REAL	0..999.9	R/W	°C/°F	S031 - Condenser fan/pump setpoint at startup
206	1	S032	INT	0..999	R/W	s	S032 - Condenser fan/pump startup delay
207	2	S034	REAL	0..99.9	R/W	K/R	S034 - Condenser fan/pump differential
209	2	S036	REAL	0..100	R/W	%	S036 - Condenser fan/pump inverter min speed
211	2	S037	REAL	0..100	R/W	%	S037 - Condenser fan/pump inverter max speed
213	1	C051	INT	0..999	R/W	s	C051 - Low press. pressostat alarm delay at startup
214	1	C052	INT	0..999	R/W	s	C052 - Low press. pressostat alarm delay at runtime
215	1	U120	INT	0..2	R/W	K/R	U120 - Heater manual mode (0=AUTO, 1=OFF, 2=ON)
216	2	U107	REAL	0..9.9	R/W	K/R	U107 - Sensor tolerance (probe functionality checking at startup)

Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
218	2	U088	REAL	0.0	R/W	%	U088 - 1st cool step on point related to prop. band above set point
220	2	U104	REAL	-99.9..999.9	R/W	K/R	U104 - Tracking setpoint: differential minimum limit
222	2	U105	REAL	-99.9..999.9	R/W	K/R	U105 - Tracking setpoint: differential maximum limit
224	2	U097	REAL	-99.9..99.9	R/W	K/R	U097 - Cooling on demand: offset referred to actual setpoint (SetA)
226	2	U098	REAL	0.1..9.9	R/W	K/R	U098 - Coling on demand: step hysteresis
228	2	U117	REAL	1.0..99.9	R/W	K/R	U117 - Evaporator delta by design (water side)
230	2	S060	REAL	-99.9..99.9	R/W	K/R	S060 - Source external air temperature offset
232	1	Hc00	INT	0..5	R/W		Hc00 - Analog input S3 config. (0=Not used, 1=Ext. air temp., 2=Discharge temp., 3=Suction temp., 4=Condenser water temp., 5=Tank temp.)
233	1	Hc01	INT	0..1	R/W		Hc01 - Analog input S4 and S5 config. (0=Pressure, 1=Temp.)
234	1	Hc03	INT	0..4	R/W		Hc03 - Analog input S6 config. (0=Not used, 1=Remote setpoint, 2=Ext. air temp., 3=Tank temp., 4= Generic sensor)
235	1	Hc04	INT	0..2	R/W		Hc04 - Analog input S7 config.(0=Not used, 1=Suction temp., 2=Tank temp.)
236	1	Hc06	INT	0..7	R/W		Hc06 - Digital input 4 config. (0=Not used, 1=Tank level, 2=Remote ON/OFF, 3=Remote alarm, 4=Compressor 2 thermal overload, 5=2nd setpoint, 6=User pump 1 overload, 7=LP pressostat switch)
237	1	Hc07	INT	0..8	R/W		Hc07 - Digital input 5 config. (0=Not used, 1=Tank level, 2=Remote ON/OFF, 3=Remote alarm, 4=Compressor 2 thermal overload, 5=2nd setpoint, 6=User pump 1 overload, 7=User pump 2 overload, 8=Source fan/pump overload)
238	1	Hc08	INT	0..8	R/W		Hc08 - Digital input 6 config. (0=Not used, 1=Tank level, 2=Remote ON/OFF, 3=Remote alarm, 4=Compressor 2 thermal overload, 5=2nd setpoint, 6=User pump 1 overload, 7=User pump 2 overload, 8=Source fan/pump overload)
239	1	Hc14	INT	0..4	R/W		Hc14 - Digital output 5 configuration (0=Not used, 1=General alarm, 2=Heater 1 status, 3=Hot gas bypass valve status, 4=User pump 2 status)
240	1	Hc15	INT	0..5	R/W		Hc15 - Digital input 1 config. (0=Not used, 1=Tank level, 2=Remote ON/OFF, 3=Remote alarm, 4=Use flow switch, 5=Source fan/pump overload)
241	1	Hc16	INT	0..7	R/W		Hc16 - Digital input 2 config. (0=Not used, 1=Tank level, 2=Remote ON/OFF, 3=Remote alarm, 4=Compressor 2 thermal overload, 5=Compressor 1 thermal overload, 6=Circuit thermal overload, 7=Source fan/pump overload)
247	2	SEtC	REAL	U006..U007	R/W	°C/°F	SEtC - Cool setpoint
249	2	C017	REAL	0..999.9	R/W	°C/°F	C017 - Threshold of max high pressure (HP)
251	2	C018	REAL	-99.9..99.9	R/W	bar/psi	C018 - Threshold of min low pressure (LP)
253	2		REAL	0..100.0	R/W	%	Power request coming from BMS
255	2	P000	REAL	-99.9..999.9	R/W	°C/°F	P000 - Evaporating min temp. custom envelop limit
257	2	P001	REAL	-99.9..999.9	R/W	°C/°F	P001 - Condensing max temp. custom envelop limit
259	1	P002	INT	0..999	R/W	s	P002 - Prevent min duration
260	1	P003	INT	0..999	R/W	s	P003 - Out of envelop alarm delay time
261	1	P004	INT	0..999	R/W	s	P004 - Low pressure difference alarm delay
262	2	P005	REAL	0..999.9	R/W	rps	P005 - Circuit destabilization min BLDC speed threshold
264	2	P006	REAL	0..100	R/W	%	P006 - Oil recovery min request for activation
266	2	P007	REAL	0..999.9	R/W	rps	P007 - Oil recovery min compr. speed for activation
268	1	P008	INT	0..999	R/W	min	P008 - Oil recovery time before activation in which the compr. can run at min speed
269	1	P009	INT	0..999	R/W	min	P009 - Oil recovery duration in which the compr. speed is forced
270	2	P010	REAL	0..999.9	R/W	rps	P010 - Oil recovery compr. speed in which the compr. is forced
272	1	P011	INT	0..999	R/W	s	P011- Oil equalization startup time of solenoid valve on compr. starts
273	1	P012	INT	0..999	R/W	s	P012 - Oil equalization solenoid valve open time
274	1	P013	INT	0..999	R/W	min	P013 - Oil equalization solenoid valve min off time
275	1	P014	INT	0..999	R/W	min	P014 - Oil equalization solenoid valve max off time
276	1	P015	INT	0..999	R/W	min	P015 - Oil equalization max time for the management
277	1	P019	INT	0..101	R/W	%	P019 - Compressor 1 circuit 1 manual mode (0=AUTO, 1=0%, ... 101=100%)
278	2	P021	REAL	0..2000.0	R/W	kPa	P021 - Max permitted Delta P to start up
280	1	P022	INT	0..999	R/W	s	P022 - Max time of EVD propening to equalize pressure
281	1	P023	INT	0..100.0	R/W	%	P023 - Preopening of EVD in case of prestart to equalize pressure
282	2	P024	REAL	20.0..120.0	R/W	rps	P024 - Start up speed
284	2	P025	REAL	0..999.9	R/W	rps	P025 - Max speed custom (rps)
286	2	P026	REAL	0..999.9	R/W	rps	P026 - Min speed custom (rps)
294	2	P030	REAL	0..999.9	R/W	Hz	P030 - Skip frequency: set 1 [010]
296	2	P031	REAL	0..999.9	R/W	Hz	P031 - Skip frequency: band 1 [011]
298	1	P032	INT		R/W		P032 - Enable motor overtemperature alarm (PTC) (0=OFF, 1=ON) [027]
299	1	P033	INT	0..999	R/W	s	P033 - Motor overtemperature alarm delay [028]
304	2	S070	REAL	-99.9..99.9	R/W	K/R	S070 - Cond.1 antifreeze temp. probe offset (S3)
306	1	Hc18	INT	0..1	R/W		Hc18 - Analog input 1 config. (0=Not used, 1=User water return temp.)
307	1	Hc17	INT	0..1	R/W		Hc17 - Analog input 2 config. (0=Not used, 1=User water delivery temp.)
308	2	SEt2	REAL	-99.9..999.9	R/W		SEt2 - Aux PID 1 set point
310	2	Y002	REAL	0.1..999.9	R/W		Y002 - Aux PID 1 gain
312	2	Y003	REAL	0..999.9	R/W	s	Y003 - Aux PID 1 integral time
314	2	Y004	REAL	0..99.9	R/W	s	Y004 - Aux PID 1 derivative time
316	1	Y005	INT	0..5	R/W		Y005 - Select enabling for auxiliary PID 1 - 0: OFF 1: UNIT ON 2: WATER PUMP 3: MAIN CONTROL ON 4: COMPRESSORS ON 5: ALWAYS ON
317	1	Y007	INT	0..8	R/W		Y007 - Process variable (input) for auxiliary PID 1 - 0: Value from S1 1: Value from S2 2: Value from S3 3: Value from S4 4: Value from S5 5: Value from S6 6: Value from S7 7: Differential value S2- S3 8: Differential value S2-S6
318	2	Y008	REAL	0..100.0	R/W	%	Y008 - Control value minimum limitation for auxiliary PID 1
320	2	Y009	REAL	0..100.0	R/W	%	Y009 - Control value maximum limitation for auxiliary PID 1
322	2	Y006	UDINT	0,999	R/W	s	Y006 - Delay in enabling auxiliary PID 1
324	2	Y011	REAL	0.1..999.9	R/W		Y011 - Starting Kp for tuning process

Index	Size	Ref.	Type	Min/Max	R/W	UoM	Description
326	2	Y012	UDINT	1..2048	R/W		Y012 - Number of samples for signal acquisition in PID tuner
328	2	Y013	REAL	0.34..999.9	R/W	s	Y013 - Sampling time for signal acquisition in PID tuner
330	2	Y018	REAL	-99.9..999.9	R/W		Y018 - Generic probe offset value
332	1	Hc20	INT	0..4	R/W		Hc20 - Generic sensor type (0=0.5-4.5V, 1=0-10V, 2=4-20mA, 3=NTC, 4=PT1000)
333	1	Hc12	INT	0..3	R/W		Hc12 - Digital output 6 configuration (0=Not used, 1=Heater 1 status, 2=Source fan/pump status, 3=Hot gas bypass valve status)
334	1	U092	INT	0..2	R/W		U092 -Main regulation sensor: 0 = User return water temp.; 1 = User delivery water temp.; 2 = Water tank temp.
335	1	S027	INT	0 to 999	R/W	s	Fan/pump shutdown delay after compressor off
336	1	Y025	INT	0..5	R/W		Y025 - Select enabling for auxiliary PID 2 - 0: OFF 1: UNIT ON 2: WATER PUMP 3: MAIN CONTROL ON 4: COMPRESSORS ON 5: ALWAYS ON
337	40	Ha01	STR	---	R/W		New time zone to set the clock
377	2	Y022	REAL	0.1..999.9	R/W		Gain (Kp) for auxiliary PID 2
379	2	Y029	REAL	0..100	R/W		Maximum limit for the output of auxiliary PID 2
381	2	Y028	REAL	0..100	R/W		Minimum limit for the output of auxiliary PID 2
383	2	Y026	REAL	0,999	R/W	S	Activation delay for auxiliary PID 2
385	1	Y027	INT	0..8	R/W		Y027 - Process variable (input) for auxiliary PID 2 0: Value from S1 1: Value from S2 2: Value from S3 3: Value from S4 4: Value from S5 5: Value from S6 or generic sensor 6: Value from S7 7: Differential value S2-S3 8: Differential value S2-S6 or S2 - generic sensor
386	2	SEt3	REAL	-99.9..999.9	R/W		Set point for the auxiliary PID 2
388	2	Y024	REAL	0..99	R/W	S	Derivative time for auxiliary PID 2
390	2	Y023	REAL	0 to 999	R/W	S	Integral time for auxiliary PID 2
392	1	Y031	INT	0..1	R/W		Select set point for auxiliary PID 1 0: Auxiliary PID specific setpoint 1: Actual set point used by temperature control (SetA)
393	1	Y032	INT	0..1	R/W		Select set point for auxiliary PID 2 0: Auxiliary PID specific setpoint 1: Actual set point used by temperature control (SetA)

Tab. 7.c

7.4 Input Register

Index	Size	Ref.	Type	R/W	UoM	Description
0	2	HuP1	INT	R	h	HuP1 - User pump 1 working hours
2	2	HuP2	INT	R	h	HuP2 - User pump 2 working hours
4	2	H1C1	INT	R	h	H1C1 - Compr.1 working hour
6	2	H1C2	INT	R	h	H1C2 - Compr.2 working hour
8	2	HFn1	INT	R	h	HFn1 - Condenser fan/pump working hour
10	1	OpnH	INT	R	%	OpnH - HGBP ExV position
11	1	OpnS	INT	R	%	OpnS - SSH ExV position
12	1		INT	R	steps	Current opening steps of SSH valve
13	1		INT	R	steps	Current opening steps of HGBP valve
14	2	dSt1	REAL	R	°C/°F	dSt1 - Discharge temperature
16	2	Sct1	REAL	R	°C/°F	Sct1 - Suction temperature
18	2	TAnt	REAL	R	°C/°F	tAnt - Tank water temperature
20	2	rUSr	REAL	R	°C/°F	rUSr - Return water temp. from user (S1)
22	2	dUSr	REAL	R	°C/°F	dUSr - Delivery water temperature to user (S2)
24	2	Cnd1	REAL	R	°C/°F	Cnd1 - Cond. temp. probe (or press. probe converted value)
26	2	EuP1	REAL	R	°C/°F	EuP1 - Evap. temp. probe (or press. probe converted value)
28	2	SPrb	REAL	R	°C/°F	SPrb - External air temperature
30	2	AFC1	REAL	R	°C/°F	AFC1 - Condenser water temperature
32	2	ScP1	REAL	R	bar/psi	ScP1 - Suction pressure
34	2	dSP1	REAL	R	bar/psi	dSP1 - Discharge pressure
36	2	SSH1	REAL	R	K/R	SSH1 - Suction Superheat
38	2	AUSn	REAL	R		AUSn - Generic sensor value
40	1	C045	INT	R		C045 - Refrigerant type (0=R22; 1=R134a; 2=R404A; 3=R407C; 4=R410A; 6=R290; 10=R744; 22=R32; 33=R449A; 37=R452B; 39=R454B)
41	2	SEtA	REAL	R	°C/°F	SEtA - Actual setpoint used by thermoregulation
43	2		REAL	R	%	Condenser fan/pump power request
45	1	INT		R		Unit status (0=OFF by remote DI, 1=OFF by keyboard, 2=OFF by scheduler, 3=OFF by BMS, 4=OFF by changeover mode Ch/HP, 5=OFF by alarm, 6=Unit in defrosting, 7=Unit ON, 8=Manual mode, 9=Demand cooling)

Index	Size	Ref.	Type	R/W	UoM	Description
46	2		REAL	R	°C/°F	Current SSH Setpoint
48	2	rSPt	REAL	R	°C/°F	rSPt - Remote set point
50	2		REAL	R	%	PwrReq - Power request
52	2		REAL	R	°C/°F	Condenser fan/pump set point
54	1		INT	R		ExV protection status (1=NONE, 2=LOWSH, 3=LOP, 4=MOP, 5=HITCOND)
56	2		REAL	R	%	Circuit power % by compressors ON
58	2		REAL	R	%	Direct expansion power request
60	2		REAL	R	%	Free cooling regulation request
62	2	PIdP	REAL	R		PIdP - Kp to be assigned to Aux PID 1
64	2	PIdI	REAL	R	s	PIdI - Ti to be assigned to Aux PID 1
66	2	PIdd	REAL	R	s	PIdd - Td to be assigned to Aux PID 1
68	2	InPI	REAL	R		InPI - Auxiliary PID 1 input variable
70	2	OUPI	REAL	R	%	OUPI - Auxiliary PID 1 output
72	2	PrtU	REAL	R	%	PrtU - Overall progress status of PID tuning process
74	1	StUn	INT	R		StUn - Status of PID tuner (0=Tuning done, 1=Signal sampling, 2=DFT computing, 3=Peak detection, 4=Params computing, 5=Fine Tuning, 6=Restore oscillation, 7=New attempt, 8=Analysis, 9=Initialisation, 10=Not yet performed)
75	1	EtUn	INT	R		EtUn - Error in tuning process (0=Tuning correctly done, 1=Low frequency, 2=Low amplitude, 3=Fine tuning, 4=None)
76	2	rps1	REAL	R	rps	PSD:Actual rotor speed coming from inverter
78	2	Mc1	REAL	R	A	PSD: Current motor current [A]
80	2	MP1	REAL	R	kW	PSD: Current motor consumption [kW]
82	2	Drt1	REAL	R	°C/°F	PSD: Current drive temperature[°C]
84	1		INT	R		PSD: the last alarm log
85	1		INT	R		PSD: the last-but-1st alarm log
86	1		INT	R		PSD: the last-but-2nd alarm log
87	1		INT	R		PSD: the last-but-3rd alarm log
88	1		INT	R		MotTyp - BLDC circ.1 Carel Database ID
89	1		INT	R		Envelope zone circ.1
90	2		REAL	R	°C/°F	EnvPnt_X1 - Envelope point
92	2		REAL	R	°C/°F	EnvPnt_Y1 - Envelope point
94	2		REAL	R	°C/°F	EnvPnt_X2 - Envelope point
96	2		REAL	R	°C/°F	EnvPnt_Y2 - Envelope point
98	2		REAL	R	°C/°F	EnvPnt_X3 - Envelope point
100	2		REAL	R	°C/°F	EnvPnt_Y3 - Envelope point
102	2		REAL	R	°C/°F	EnvPnt_X4 - Envelope point
104	2		REAL	R	°C/°F	EnvPnt_Y4 - Envelope point
106	2		REAL	R	°C/°F	EnvPnt_X5 - Envelope point
108	2		REAL	R	°C/°F	EnvPnt_Y5 - Envelope point
110	2		REAL	R	°C/°F	EnvPnt_X6 - Envelope point
112	2		REAL	R	°C/°F	EnvPnt_Y6 - Envelope point
114	2		REAL	R	°C/°F	EnvPnt_X7 - Envelope point
116	2		REAL	R	°C/°F	EnvPnt_Y7 - Envelope point
118	2		REAL	R	°C/°F	EnvPnt_X8 - Envelope point
120	2		REAL	R	°C/°F	EnvPnt_Y8 - Envelope point
122	2		REAL	R	%	Hot gas capacity request
124	1	Year	INT	R		Local time - year
125	1	Month	INT	R		Local time - month
126	1	Day	INT	R		Local time - day
127	1	Hour	INT	R		Local time - hour
128	1	Minute	INT	R		Local time - minute
129	2	RegVar	REAL	R		Auxiliary PID 2– Control variable
131	2	Output	REAL	R		Auxiliary PID 2 - Output
133	2	SetA	REAL	R		Auxiliary PID 1 - Current set point value
135	2	SetA	REAL	R		Auxiliary PID 2 - Current set point value
137	1	SW_Ver	INT	R		Software version
138	1	ErrCode	INT	R		Power+ error code - Circuit 1

Tab. 7.d

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).

8.1.1 Active alarms

Notice: the user terminal can only access the active alarms without password protection, or, with password protection, to the alarms relating to unit initialisation and optimisation.

Active alarms are signalled by buzzer and the Alarm button lighting up. 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 is reset automatically, the Alarm button goes off, the alarm code is cleared from the list and the alarm reset event is recorded in the alarm log.

Procedure (alarm acknowledgement):
1. press Alarm: the buzzer is muted, the alarm code is shown on the display;
2. press UP/DOWN to scroll through the list of alarms;
3. when finished, press Esc and then PRG to exit.

Procedure

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

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

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

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.

A single alarm can be reset by pressing Alarm for more than 3 s. If the condition that generated the alarm is still present, the alarm will be reactivated. The alarm log can be deleted using parameter ClrH, accessible via the Service level on the terminal or APPLICA via smartphone, with BLE connection, using the specific function on the alarm page ("Service" level access). 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;
- See Functions for the alarm parameters: evaporator outlet temperature, frost protection, compressor;
- the buzzer is activated for all alarms.

8.2 Alarm management

On process chillers, it is necessary to guarantee cooling as much as possible, avoiding having to shut the unit down unless strictly essential.
µChiller Process is equipped with specific functions to manage alarms and guarantee service continuity: a parameter (C049) can also be used to enable a quick reset of the cooling function in the event of an alarm (ProcessPriority function).

The following alarms, however, cannot be ignored:
- high pressure switch activation (A26);
- thermal protector activation (A30, A31).

The temperature probe alarms (A04; A05; A06; A07; A16) are managed with special logic if they concern a control probe (so to try and keep the cooling function active); if it is not a control probe, µChiller Process does not perform any action and simply signals the alarm.

8.2.1 Actions following control probe alarms

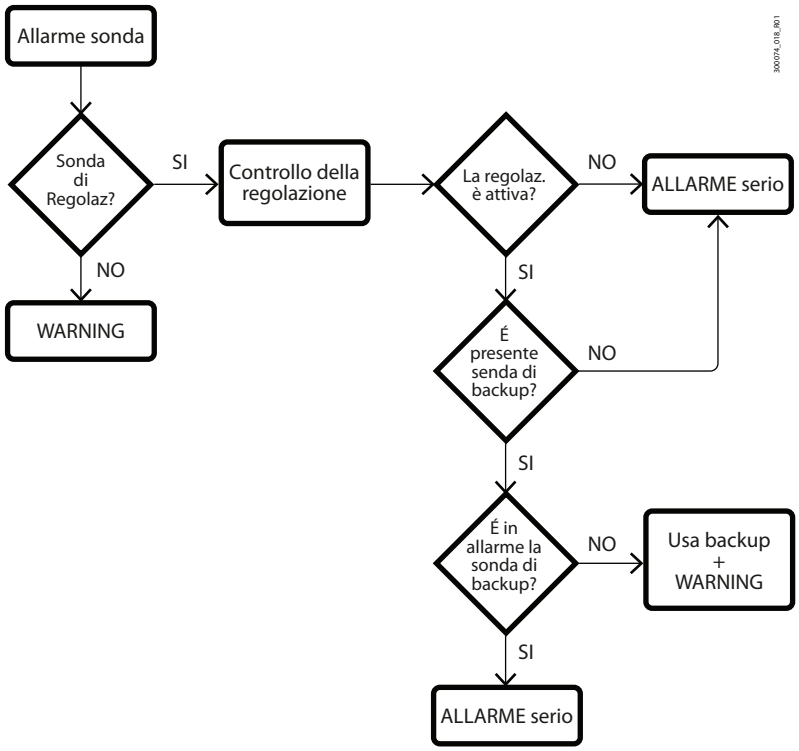


Fig. 8.a

Notice:
- a control action is only implemented is control is active; if a control probe alarm occurs at start-up, the unit remains in standby with the pump off and the alarm signal active (the user will need to select another control probe or fix the probe error).
- The control action for probe alarms used to manage the superheat ExV,

which requires the use of logged data, cannot be implemented if there is insufficient data: at least 10 minutes must elapse from activation of the compressor before having enough valid data regarding the valve position; during this time, any alarms are considered serious.

The actions performed by µChiller Process in response to specific alarms are shown below:
- **Remote set point input alarm (A04):** the standard set point is used.
- **User return temperature probe alarm (A05):**
  - if the user delivery temperature probe is available (and not affected by an alarm), this probe is used, with appropriate conversion considering the calculated water temperature difference;
  - if the user delivery temperature probe is unavailable, the unit shuts down.
- **User delivery temperature probe alarm (A06):**
  - if the user return temperature probe is available (and not affected by an alarm), this probe is used, with appropriate conversion considering the calculated water temperature difference;
  - if the user return temperature probe is unavailable, the unit shuts down.

- Tank temperature probe alarm (A07):
  - if used for the "cooling on demand" function, the function is disabled (µChiller Process works in normal control mode);
  - if used as the reference probe for the "tracking set point", the current control mode is activated, with a set point equal to the value of the active set point 60 s prior to the alarm, and this condition is maintained until the unit is switched off;
  - if used for direct control the user delivery temperature probe is available (and not affected by an alarm), this probe is used until the unit is switched off; if it is not available, the unit is switched off.
- Outside air temperature probe alarm (A16):
  - if used as the reference probe for the "tracking set point", the current control mode is activated, with a set point equal to the value of the active set point 60 s prior to the alarm, and this condition is maintained until the unit is switched off;
  - otherwise, signal-only.

8.2.2 Actions following non-control probe alarms

The actions performed by the µChiller Process when specific alarms occur on probes not used for the main unit control are shown below:

- Discharge pressure (A19) or condensing temperature probe alarm (A20):
  - the high pressure alarm from transducer (A26) is disabled;
  - if used to manage the condensing stage (i.e. control the condenser fan or pump), the fan/pump is activated (at 100% if modulating) in On-Off mode as defined with the compressors; with air cooling and a modulating fan, if the outside air temperature probe is available and not affected by an alarm, the control ramp is managed with a scaler on the source temperature (from 18 to -15°C, from 100% to the specified minimum value).
- Suction pressure probe alarm (A21):
  - the low pressure from transducer (A27), low superheat (A35), and low evaporation pressure (A36) alarms are disabled;
  - if an ExV used for SSH control, the ExV valve is managed according to current circuit capacity (cooling capacity), with reference to the average behaviour over the 10 minutes prior to the alarm; the valve closes if the compressor switches off.
  - if the user water delivery temperature probe is available, limit control with frost protection function will be activated on this probe, with the same set point as frost protection with the unit off (U053).
- Evaporation temperature probe alarm (A22):
  - the low superheat (A35) and low evaporation pressure (A36) alarms are disabled;
  - if an ExV used for SSH control, the ExV valve is managed according to current circuit capacity (cooling capacity), with reference to the average behaviour over the 10 minutes prior to the alarm; the valve closes if the compressor switches off.
  - if the user water delivery temperature probe is available, limit control with frost protection function will be activated on this probe, with the same set point as frost protection with the unit off (U053).
- Discharge temperature probe alarm (A23): signal-only.
- Suction temperature probe alarm (A24):
  - if an ExV used for SSH control, the ExV valve is managed according to current circuit capacity (cooling capacity), with reference to the average behaviour over the 10 minutes prior to the alarm; the valve closes if the compressor switches off;
  - otherwise, signal-only.

8.2.3 Control actions with other alarms

- Water flow alarms (A10 and A11):
  - if the unit configuration includes 2 pumps, the first flow alarm switches pumps;
  - or (second alarm) if the evaporation pressure probe is available and not affected by an alarm, signal-only (as evaporator frost protection stops the circuit if there is effectively no flow);
  - otherwise serious alarm that switches off the unit.
- EVD low superheat alarm (A35):
  - if the ProcessPriority function is active: signal-only;
  - otherwise serious alarm, shut down the circuit.
- Suction temperature probe alarm (A24):
  - if the ProcessPriority function is active: signal-only;
  - otherwise serious alarm, shut down the circuit.
- EVD MOP alarm (A37): signal-only.
- EVD EVO offline (A41) or EVD mini offline (A62) alarm:
  - if during unit start-up, serious alarm;
  - otherwise signal-only (the valve remains in position).
- Low tank water level alarm (A51):
  - if during unit start-up, serious alarm;
  - otherwise, signal-only.

8.2.4 Control actions with BLDC alarms

Considering the specific management of BLDC compressors and due to the type of compressor, there are no differences from the standard actions provided for BLDC alarms.

8.3 Logged data management on alarm event

µChiller Process manages a continuous circular log that stores the last 20 minutes of unit operation, sampling the following variables every 5 seconds:

1. User delivery temperature (°C x 10);
2. User return temperature (°C x 10);
3. Value read by input S3 (°C x 10);
4. Condensing temperature (°C x 10);
5. Evaporation temperature (°C)
6. Value read by input S7 (°C x 10);
7. Value read by input S6 (°C x 10 or generic auxiliary PID probe x 10);
8. Active set point (°C x 10);
9. BLDC compressor speed (rps);
10. BLDC current (A x10);
11. PWRP drive temperature (°C x 10);
12. BLDC: Current envelope zone;
13. Hot gas capacity request (% x10);
14. Superheat valve position (steps);
15. Hot gas valve position (steps);
16. Auxiliary PID 1 control ramp (% x 10);
17. Compressor 1 activation status;
18. Compressor 2 activation status;
19. Active user pump (0, 1, 2);
20. Equivalent compressor capacity (% x10);
21. Auxiliary PID 2 control ramp (% x 10).

For each sample, the date and time and also recorded, meaning the logged data can be associated with the time for further analysis.
Up to three logs are stored: in the event of a serious alarm, the log is "frozen" and µChiller Process starts recording a new log; on each serious alarm, the next log is started. After the third serious alarm, the first log is overwritten.
The logs can be downloaded using the Applica mobile app only via Bluetooth, or using Applica desktop: the data collection mode means the most recent period (up to 20 minutes) of current unit operation is available, thanks to the continuously-active circular log.

- When connected, Applica desktop automatically downloads all of the logs stored on µChiller Process;
- Applica mobile can also be configured to download the logs on µChiller Process automatically upon connection; in addition, it is also possible to set automatic export (in Excel format) and define the default recipient for forwarding via email.

Procedure

1. open Applica on the mobile device;
2. access the menu on the command bar at the top left;

3. select "Settings"

4. select "Data management"

This section includes all of the settings described in the text: the "Download period" can also be selected (for example, "1 day" to only download the log(s) for the day); a default name can also be assigned to the logs.

8.4 Alarm list

Code	Description	Reset	Effect	Priority	Delay	No. of attempts	Period for eval. (s)
A01	Unit: no. of permanent memory writes	M	-	Fault	No	-	-
A02	Unit: permanent memory writes	M	-	Fault	No	-	-
A03	Unit: remote alarm from digital input	R	Unit shutdown	Serious, unit	No	U110	3600
A04	Unit: remote set point input	A	Use standard set point	Fault	10s	-	-
A05	Unit: user water return temperature probe	A	See "Actions following probe alarm..."	Fault/serious, unit	10s	-	-
A06	Unit: user water delivery temperature probe	A	See "Actions following probe alarm..."	Fault/serious, unit	10s	-	-
A07	Unit: tank water temperature probe	A	See "Actions following probe alarm..."	Fault/serious, unit	10s		
A08	Unit: user pump 1 overload	R	-	Fault	No	U109	3600
A09	Unit: user pump 2 overload	R	-	Fault	No	U109	3600
A10	Unit: flow switch (with user pump 1 active)	R	See "Control actions with other alarms"	Fault/ Serious, unit	Par. U045/U046	U109	3600
A11	Unit: flow switch (with user pump 2 active)	R	See "Control actions with other alarms"	Serious, unit	Par. U045/U046	U109	3600
A12	Unit: user pump group	R	-	Serious, unit	No	U109	3600
A13	Unit: user pump 1 maintenance	A	-	Fault	Par. U000	-	-
A14	Unit: user pump 2 maintenance	A	-	Fault	Par. U003	-	-
A15	Unit: high chilled water temperature	A	-	Fault	Par. U032/U033	-	-
A16	Unit: outside air temperature probe	A	Disable FC and compensation (A/W units) Also see "Actions following probe alarm..."	Fault	10s	-	-
A17	Unit: condenser fan/pump maintenance	A	-	Fault	Par. S008	-	-
A18	Unit: Free cooling fault	M	Disable FC	Fault	Par. U032/180s	-	-
A19	Circuit: condensing pressure probe	A	See "Actions following probe alarm..."	Serious/circuit fault	10s	-	-
A20	Circuit: condensing temperature probe	A	See "Actions following probe alarm..."	Serious/circuit fault	10s	-	-
A21	Circuit: evaporation pressure probe	A	See "Actions following probe alarm..."	Serious/circuit fault	10s	-	-
A22	Circuit: evaporation temperature probe	A	See "Actions following probe alarm..."	Serious/circuit fault	10s	-	-
A23	Circuit: discharge temperature probe	A	See "Actions following probe alarm..."	Serious/circuit fault	10s	-	-
A24	Circuit: suction temperature probe	A	See "Control actions with other alarms"	Serious/circuit fault	10s	-	-
A25	Circuit: high pressure switch	R	Circuit shutdown	Serious, circuit	No	C050	3600
A26	Circuit: high condensing pressure/temperature from pressure/temperature probe	R	Circuit shutdown	Serious, circuit	No	C050	3600
A27	Circuit: low pressure from transducer	R	Circuit shutdown	Serious, circuit	No	C050	3600
A28	Circuit: frost protection evaporation temperature	R	Circuit shutdown	Serious, circuit	Param.U052	C050	3600
A29	Circuit: high pressure switch	R	Circuit shutdown	Serious, circuit	Par. C051/C052	C050	3600
A30	Circuit: compressor 1 overload	R	Stop compressor 1	Fault, circuit	No	C050	3600
	Circuit: compressor overload (Hc16=6)	R	Circuit shutdown	Serious, circuit	No	C050	3600
A31	Circuit: compressor 2 overload	R	Stop compressor 2	Fault, circuit	No	C050	3600
A32	Circuit: compressor 1 maintenance	A	-	Fault, circuit	Par. C000	-	-
A33	Circuit: compressor 2 maintenance	A	-	Fault, circuit	Par. C003	-	-
A35	EVD LowSH	M	See "Control actions with other alarms"	Serious/circuit fault	Par. E024	-	-
A36	EVD LOP	A	-	Fault, circuit	Par. E025	-	-
A37	EVD MOP	A	-	Fault, circuit	Par. E026	-	-
A38	EVD: motor error	M	Circuit shutdown	Serious, circuit	No	-	-
A39	EVD: emergency closing	A	-	Fault, circuit	No	-	-
A40	EVD: incomplete valve closing	A	-	Fault, circuit	No	-	-
A41	EVD EVD Evo offline	A	See "Control actions with other alarms"	Serious/circuit fault	30s	-	-
A42	BLDC: envelope alarm + zone alarm	R	Circuit shutdown	Serious, circuit	Par. P003	3	3600
A43	BLDC: high pressure differential at start-up	A	BLDC not enabled to start	Serious, circuit	5min	-	-
A44	BLDC: failed start-up	R	-	Serious, circuit	45s	5	3600
A45	BLDC: low pressure differential	A	Circuit shutdown	Serious, circuit	Par. P004	-	-
A46	BLDC: high gas discharge temp.	M	Circuit shutdown	Serious, circuit	No	-	-
A47	Speed drive: offline	A	Circuit/BLDC shutdown	Serious, circuit	30s	-	-
A48	Speed drive: alarm + error code	R	Circuit/BLDC shutdown	Serious, circuit	No	3	3600
A49	Unit: generic probe (S6)	A	-	Fault	10s	-	-
A50	Unit: low chilled water temperature	A	-	Fault	Par. U032/U033	-	-

Code	Description	Reset	Effect	Priority	Delay	No. of attempts	Period for eval. (s)
A51	Unit: low tank water level	A	-	Fault	3s	-	-
A52	Verify probe error: user return temperature probe (S1)	M	Circuit shutdown	Serious, circuit	Par. U045+U047	-	-
A53	Verify probe error: user delivery temperature probe (S2)	M	Circuit shutdown	Serious, circuit	Par. U045+U047	-	-
A54	Verify probe error: evaporation temperature probe (S5)	M	Circuit shutdown	Serious, circuit	Par. U045+U047	-	-
A55	Verify probe error: suction temperature probe (S3/S7)	M	Circuit shutdown	Serious, circuit	Par. U045+U047	-	-
A56	Circuit: max. compressor alarm attempts reached	M	Circuit shutdown	Serious, circuit	No	-	-
A57	Unit: condenser water temperature probe	A	-	Fault	10s	-	-
A58	Unit: EVD Evolution not compatible	A	Unit shutdown	Serious, unit	No	-	-
A59	Unit: autotuning anomaly	A	-	Fault	No	-	-
A60	Unit: autotuning stopped by user	A	-	Fault	No	-	-
A61	Unit: BMS offline	A	Ignore commands from BMS	Fault	No	-	-
A62	EVD EVD mini offline	A	See "Control actions with other alarms"	Serious/circuit fault	30s	-	-
A63	Power failure	A	See "Blackout management"	Serious/circuit fault	-	-	-
A64	Source fan/pump overload	A	Circuit shutdown	Serious/circuit fault	-	-	-

Tab. 8.a

9. TECHNICAL SPECIFICATIONS

Model	UCHBP* (panel models)	UCHBD* (DIN rail models)
Physical specifications		
Dimensions	See figures	See figures
Case	Polycarbonate	Polycarbonate
Assembly	panel	DIN rail
Ball pressure test temperature	125°C	125°C
Ingress protection	IP20 (rear) - IP65 (front)	IP00
Front cleaning	Use a soft non-abrasive cloth, neutral detergents or water	-
Environmental conditions		
Storage conditions	-40T85°C, <90 % RH non-condensing	-40T85°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 class 2 power supply)	24 Vac/dc (SELV or PELV class 2 power supply)
Operating power supply voltage	24 Vac/dc, +10% -15%	24 Vac/dc, +10% -15%
Input frequency (AC)	50/60 Hz	50/60 Hz
Maximum current draw	600 mA rms	DIN without ExV valve driver: 600 mArms DIN 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 maintenance time after shutdown: 72 h	precision: ± 50 ppm; min maintenance time after shutdown: 72 h
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	relay outputs: 4 kV; 24 V input: 0.5 kV
Surge immunity category	relay outputs: III; 24 V input: II	relay outputs: III; 24 V input: II
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, fitted on the remote HMI interface
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: NTC S5: 0-5 V ratiometric / 4-20 mA / NTC J3 S4: 0-5 V ratiometric / 4-20 mA / NTC S6: 0-5 V ratiometric / 0-10V / 4-20 mA / NTC	NTC: resolution 0.1 °C; 10Kohm@25°C, error: ± 1°C in the range - 50T50°C, ± 3°C in the range 50T90°C; 0-5 V ratiometric: error 2% fs, typical 1%; 4-20mA: error 5% fs, typical 1% 0-10 V: error 2% fs, typical 1%	NTC: resolution 0.1 °C; 10Kohm@25°C, error: ± 1°C in the range - 50T50°C, ± 3°C in the range 50T90°C; 0-5 V ratiometric: error 2% fs, typical 1%; 4-20mA: error 5% fs, typical 1% 0-10 V: error 2% fs, typical 1%
J9 S7: NTC (DIN version only)	-	NTC: resolution 0.1 °C; 10Kohm@25°C, error: ± 1°C in the range - 50T50°C ± 3°C in the range 50T90 ° C

Digital inputs (Lmax=10m)

Model		UCHBP* (panel models)	UCHBD* (DIN rail models)
J2	ID1(*)	Voltage-free contact, not opto-isolated, typical closing current 6 mA, open contact voltage 13V, max contact resistance 50Ω. (*) Fast digital input: 0-2 kHz; error 2% fs	
J2	ID2		
J3	ID3(*), ID4, ID5,		
J9	ID6 - available only on DIN vers.		

Model		UCHBP* (panel models)	UCHBD* (DIN rail models)
Valve output			
J14	Available only on DIN version	CAREL E*V unipolar valve power supply: 13 Vdc, min. winding resistance 40 Ω	CAREL E*V unipolar valve power supply: 13 Vdc, min. winding resistance 40 Ω
Analogue outputs (Lmax=10m)			
J14	Y1, Y2	0 to 10 Vdc: 10 mA max	0 to 10 Vdc: 10 mA max
Digital outputs (Lmax=10m)			
Notice: the sum of current draw on NO1, NO2, NO3 and NO4 must not exceed 8 A			
J6	NO1(5A), NO2(5A), NO3(5A), NO4(5A)	5A: EN60730: 5 A resistive, 250 Vac, 50k cycles; 4(1), 230 Vac, 100k cycles; 3 (1), 230 Vac, 100k cycles UL60730: 5 A resistive, 250 Vac, 30k cycles; 1 FLA, 6 LRA, 250 Vac, 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: 5 A resistive, 250 Vac, 30k cycles; 1 FLA, 6 LRA, 250 Vac, 30k cycles; Pilot Duty C300, 30k cycles
J7	NO5(5A)		
J11	NO6(0,5A) SSR - only for DIN	100-240 VAC 50/60Hz	-
Emergency power supply			
J10: Ultracap module (optional, available only on DIN version)		-	13 Vdc ±10%
Probe and terminal power supply (Lmax=10m)			
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	User terminal power supply
Serial ports			
BMS	• Lmax=500 m, shielded cable (RS485 1½ twisted pair) (1)	• Integrated • Protocol: Modbus • HW driver: asynchronous half duplex RS 485 secondary • Not optically-isolated • 3-pin plug-in connector, 3.81 mm pitch • Max data rate: 115200 bits/s • Maximum number of connectable devices: 16	• Integrated • Protocol: Modbus • HW driver: asynchronous half duplex RS 485 secondary • 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 main. 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	• Integrated • HW driver: asynchronous half duplex RS485 main. 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		< 10m (*) (*) in the panel version, if using the +13 V power supply in domestic environments, the maximum cable length is 2 m.	
Valve		< 2 m, < 9 m with shielded cable	< 2 m, < 9 m with shielded cable
BMS and Fieldbus serial cables		<500m with shielded cable	<500m with shielded cable
Conformity			
Electrical safety		EN/UL 60730-1, EN/UL 60335-1	EN/UL 60730-1, EN/UL 60335-1
Electromagnetic compatibility		EN 61000-6-1, EN 61000-6-2, EN 61000-6-3, EN 61000-6-4	EN 61000-6-1, EN 61000-6-2, EN 61000-6-3, EN 61000-6-4
Applications with flammable refrigerant gas (valid only for panel mount models)		EN/UL 60079-15, EN/UL 60335-2-34, EN/UL 60335-2-40, EN/UL 60335-2-89	EN/UL 60079-15, EN/UL 60335-2-34, EN/UL 60335-2-40, EN/UL 60335-2-89
Wireless compliance		RED, FCC, IC	RED, FCC, IC

Tab. 9.a

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

9.1 Connector/cable table

Ref.	Description	Wiring terminals	Wire cross-section (mm²)	Lmax (m)
J1	Controller power supply	Panel model: plug-in terminal, screw, 2-pin, pitch 5.08	0.5-1.5	10
		DIN rail model: plug-in terminal, screw, 2-pin, pitch 5.08	0.21-3.31	10
J2	Inputs S1, S2, S3, S5, ID1, ID2; outputs Y2, Y2	10-pin Microfit crimp connector	0.05-0.52	10
J3	Inputs S4, S6, ID3, ID4. ID5	8-pin Microfit crimp connector	0.05-0.52	10
J4	BMS	Plug-in screw terminal, 3-pin, pitch 3.81	0.081-1.31	500
J5	Fbus	Plug-in screw terminal, 3-pin, pitch 3.81	0.081-1.31	10
J6	Outputs NO1, NO2, NO3, NO4	6-pin Microfit crimp connector	0.5-1.31	10
J7	Output NO5	3-pin Microfit crimp connector	0.5-1.31	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	0.05-0.52	10
J10	Ultracap	3-pin JST connector	0.13	2
J11	Output NO6	3-pin Microfit crimp connector	0.5-1.31	10
J14	Unipolar ExV valve	CAREL ExV unipolar valve connector, pre-wired	-	2, 6 with shielded cable

Tab. 9.b

(*) device to be incorporated.

10. RELEASE NOTES

Software version - date	Manual version - date	Release
0.1.2; 08-07-2020	1.0; 02-07-2020	First
1.0.0	1.1; 24-08-2020	15-07-2020 Second

Tab. 10.a

CAREL

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

µChiller Process +0300074EN rel. 1.3 - 27.06.2022