



TECHNICAL MANUAL

INSTALLATION

USE

MAINTENANCE

KRYSTAL

MODELS:

021A - 031A - 041A - 051A - 061A (R410A)
051M/C (R407C)



m.a1ch.



REFRIGERANT
R410A

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REVERSIBLE HEAT PUMPS

KRYSTAL

1.0 GENERAL PRODUCT INFORMATION

6 different models of KRYSTAL units are available, 4 of which are single-phase and 2 three-phase.

All the assemblies are equipped with rotary or scroll compressors, depending on the models scaled for the use of R410A type refrigerant.

These units are designed to meet installation requirements in residential and commercial buildings, with a particular focus on footprint and noise levels. They include a series of accessories to facilitate installation and maintenance. All the assemblies are supplied fully wired and ready for connection to the user system. Before delivery, every machine is tested during operation, ensuring that all the safety features are in good working order.

Versions available:

KRYSTAL Heat pumps complete with pump and inertial buffer tank.

All the units comprise the following hydronic devices:

- water circulating pump
- water buffer tank
- water circulation safety flow switch
- expansion vessel
- 6 BAR safety valve
- evaporator antifreeze heater.

The units are supplied fully wired and packaged.

1.1 UNIT TECHNICAL FEATURES

Top brand rotary or Scroll **compressor** particularly suited for application in residential air conditioning, able to guarantee a high level of efficiency as well as very contained levels of noise and vibrations.

Finned coil type cooling **condenser** with copper pipes expanded into an aluminium finned coil and heat exchanger support frame in galvanised steel. On request, a version with copper or coated aluminium fins is available for installation in particularly aggressive atmospheres.

Braze welded plate **heat exchanger** in stainless steel Aisi 316.

Ventilating section comprised of axial fans with flattened blades and directly coupled rotating stator type motor. Each fan is equipped with a safety grille in coated galvanised steel.

Fully wired and sealed **refrigerant circuit** in copper pipe, comprising:

drier filter, capillary tubes for refrigerant expansion, solenoid valve for cooling cycle inversion, liquid receiver, safety pressure switches on the high and low pressure side, pressure ports for filling and draining refrigerant liquid and possible control pressure gauge connection. The whole circuit is insulated by a thick, closed cell foam anti-condensation pad.

Fully wired **electrical panel** in a steel box, manufactured in compliance with the strictest European regulations. The power circuit is designed for a supply at 230/1/50 or 400/3/50 V/ph/Hz depending on the model and comprises the contactor and magneto-thermal protection for the compressor. The regulation and controls are managed by a microprocessor unit coupled with the safety devices envisaged inside the machine or connected externally. The operating parameters can be programmed and set directly on the display module in the electrical panel, directly accessible from outside via the inspection door on the front panel of the unit.

Optional accessories available on request:

- SAB basic anti-vibration mounts;
- KRC basic simple remote control kit;
- KRC top complete remote control kit;
- KRS485 TTL/rs485 output for serial communication ModBus protocol.

** all these accessories are supplied separately for installation by the user.*

1.2 OPERATING LIMITS:
Cooling cycle:

External air temperature D.B. + 20°C ÷ + 40°C
 Chilled water temperature + 4°C ÷ + 15°C

Heating cycle:

External air temperature B.S. -10°C ÷ +20°C
 Hot water temperature + 35°C ÷ + 50°C

1.3 CONFIGURATION:
KRYSTAL 041 A

KRYSTAL	041	A
UNIT TYPE	SIZE	REFRIGERANT TYPE
REFRIGERANT TYPE		
A	R410A	

1.4 TECHNICAL DATA TABLE:

KRYSTAL MODELS		021A	031A	041A	051MC	051A	061A
Cooling capacity	kW	5,2	7,5	10,0	12,0	12,0	15,0
Heating capacity	kW	5,5	8,0	11,0	13,5	13,5	17,5
Scroll compressors	No.	1	1	1	1	1	1
Compressor type		rotary	rotary	scroll	scroll	scroll	scroll
Cooling circuits	No.	1	1	1	1	1	1
Capacity steps	No.	1	1	1	1	1	1
Nominal total absorbed power in cooling mode	kW	2,1	3,0	4,2	5,2	5,1	6,3
Power supply voltage	V/Hz/Ph	230/1/50	230/1/50	230/1/50	230/1/50	400/3/50	400/3/50
Sound power level LwA	dB(A)	71,0	73,0	76,0	76,0	76,0	76,0
Sound pressure level LpA	dB(A)	40,0	42,0	45,0	45,0	45,0	45,0
DIMENSION AND WEIGHTS							
Length	mm	1115	1115	1115	1115	1115	1115
Depth	mm	470	470	470	470	470	470
Height	mm	650	850	1245	1245	1245	1245
STD weight	Kg	90	110	145	150	150	160
Initial tank volume	l	15	23	32	32	32	32
Pump water flow	l/s	0,25	0,36	0,48	0,57	0,57	0,72
Pump useful static pressure	kpa	45	65	51	70	70	65
Refrigerant charge	Kg	1,7	2,6	2,9	3,0	3,0	3,2

Key

COOLING CAPACITY: System heat exchanger water (inlet/outlet) 12/7 °C
 External air 35 °C

HEATING CAPACITY: System heat exchanger water (inlet/outlet) 39/45 °C
 External air 7 °C / R.H. 85%

Sound pressure at 10 metres in open field

GENERAL INFORMATION

2.0 GENERAL INSTALLATION INFORMATION

All installation and maintenance operations must be carried out by qualified personnel, who must follow the instructions given in this manual and on the machine itself.

Failure to comply with these rules could cause damage or injury to persons, animals or property, for which the manufacturer may not be held responsible.

Before carrying out any maintenance work on the machine, make sure that the electrical panel is disconnected from the power supply by deactivating the main power isolator, which must be installed in the proximity of the machine.

All the units are built for installation outdoors and do not require any particular protection from atmospheric agents.

2.1 INSPECTION

Once it has arrived at its destination, the unit must undergo a thorough visual check, looking for any damage that may have occurred during transport to its destination.

Any imperfections or evident signs of damage should be reported promptly to the delivery firm and recorded on the delivery note, as well as reported in writing directly to TONONFORTY S.p.A., or to its local agent.

2.2 HANDLING

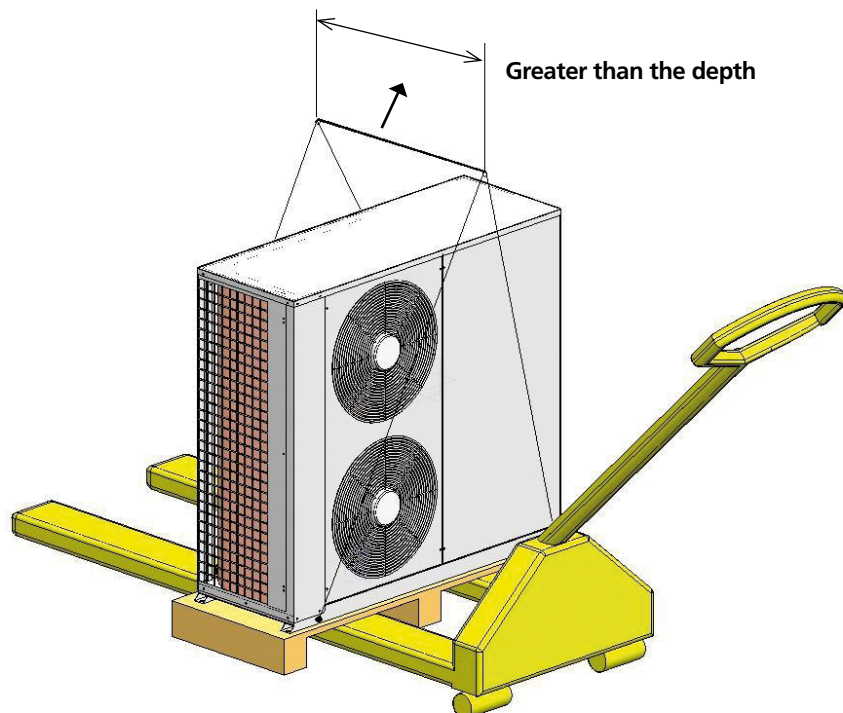
It is best to handle the unit with its original packaging intact. The packaging should only be removed once it has reached its final destination.

It can be handled using a standard manual transpallet, or lifted using ropes sufficiently spaced in order to prevent the possibility of the top being crushed by the cover shell.

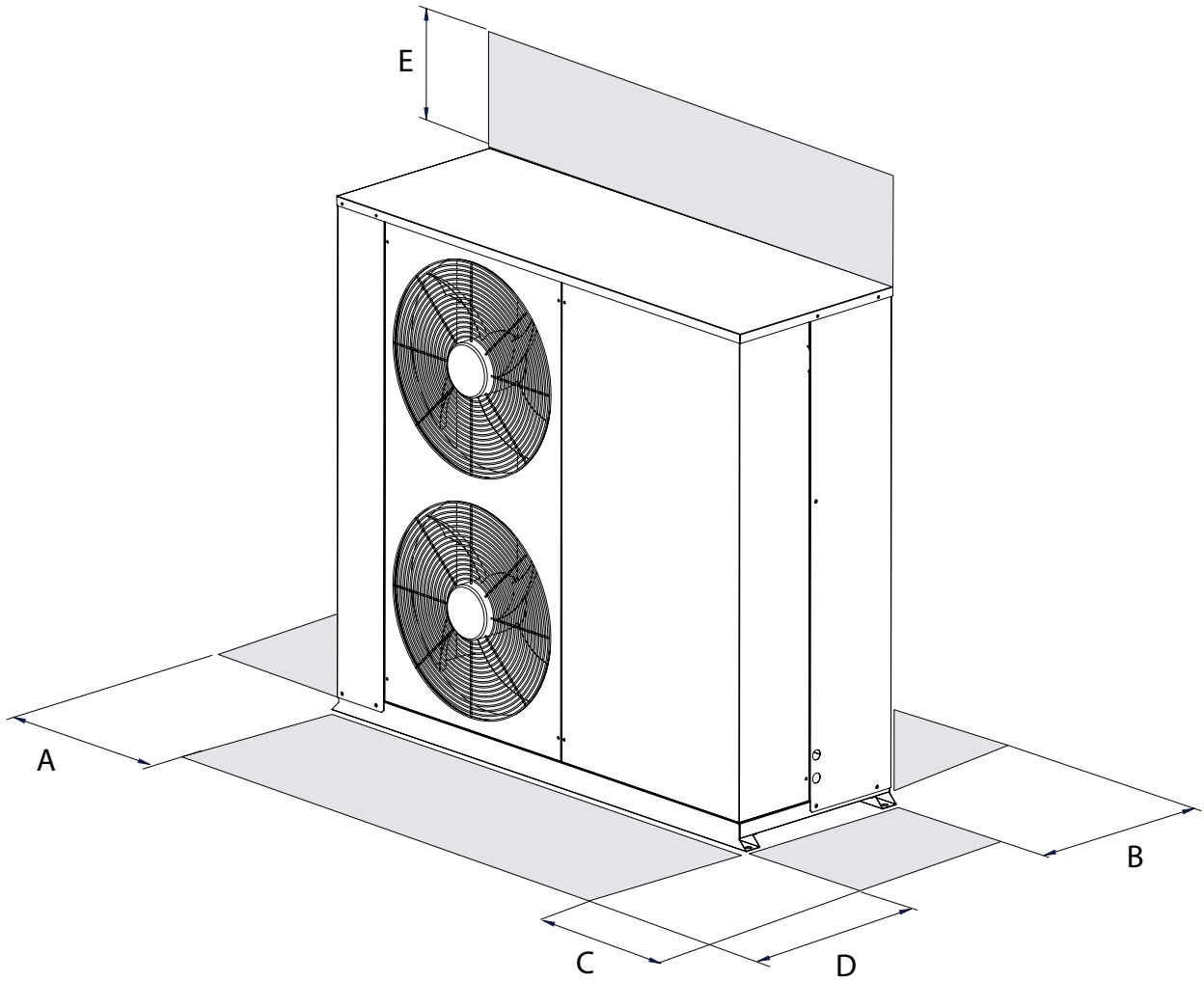
2.3 POSITIONING

The position of the unit must be defined carefully, bearing the following precautions in mind:

- The machine should only be installed outdoors, on any flat, horizontal surface able to support its weight (ground, terrace, roof, etc.).
- In the event of installation on the roof or terrace, it is advisable to place a rubber pad or the specific anti-vibration mounts (available as an accessory) between the support surface and the machine in order to prevent vibrations being transmitted from the unit to the building structure.
- Preferably choose areas far from windows or openings communicating with the interior of the rooms, if adjacent.
- Do not position the unit near chimneys, flues, ventilation or air extraction devices in order to prevent the unit from being subjected to flows of hot or polluted air.
- All the models in the Krystal range have a ventilating section with horizontal air expulsion.
- It is important to make sure that the air flow is not obstructed, as obstructions could cause the air to recirculate between the inlet and outlet side. Insufficient air circulation or recirculation through the finned coil heat exchanger could cause the machine to malfunction or shut down.



2.4 POSITIONING - CLEARANCE DISTANCES -



model	021 A	031 A	041 A	051M C	051 A	061 A
A	200	200	400	400	400	400
B	200	200	400	400	400	400
C	800	800	800	800	800	800
D	1000	1000	1500	1500	1500	1500
E	500	500	700	700	700	700

PLUMBING CONNECTIONS

3.0 PIPES

The system pipes may be made from steel, galvanised steel, polyethylene or PVC.

The pipes must be scaled on the basis of the nominal water flow, the system pressure drops and the characteristics of the circulating pump or other pump used in the system.

All the units come complete with a pump able to guarantee the useful static pressure indicated in the enclosed table. In this case, the pipes must necessarily be scaled on the basis of the pump performances, assessing the pressure drops present in the system carefully.

All the pipes should be suitably insulated to prevent heat build-ups (with a consequent decline in unit performance) and the formation of condensation on the outer surface. Use closed cell form insulation material of at least 10 mm thick for this purpose.

In order to prevent vibrations being transmitted from the unit to the user system and to compensate for thermal expansion, it is good practice to install elastic joints on the unit's plumbing connections.

The system should be developed in keeping with national regulations or those of the country of installation.

In any case, it is good practice to install the following devices in order to guarantee correct use and maintenance of the unit.

- anti-vibration elastic joints
- shut-off cocks.
- water temperature sensor housings.
- metal mesh filter
- air bleed devices
- automatic filling assembly
- drain cock

In order for correct working order and high performance to be guaranteed, every unit requires a constant nominal water flow as indicated in the table below.

The use of lower water flows could generate an operating anomaly, leading to serious consequences and damage to some important components such as the compressor.

Chapter 19 features the general plumbing diagrams, indicating parts present on the machine and parts to be installed in the field.

TECHNICAL DATA TABLE

FOR PLUMBING CIRCUIT SCALING:

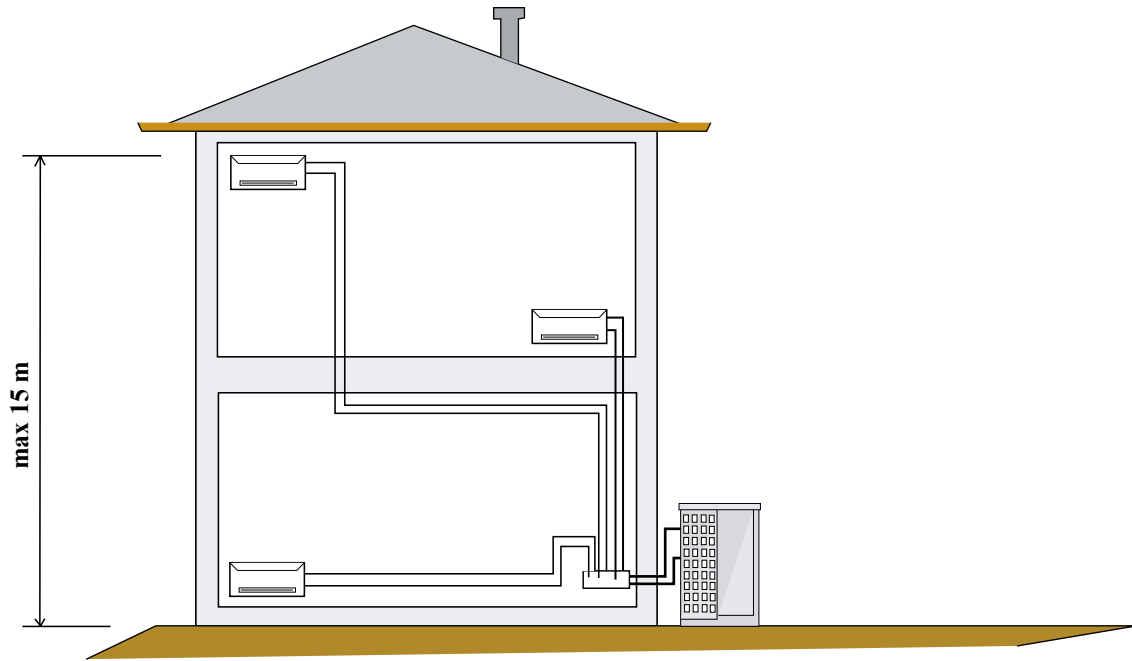
KRYSTAL MODELS		021A	031A	041A	051MC	051A	061A
Water flow	l/s	0.25	0.36	0.48	0.57	0.57	0.72
Pressure drops - HEAT EXCHANGER	kPa	17	17	27	33	33	37
External static pressure	kPa	45	65	51	70	70	65

DEPENDING ON THE MODELS AND TYPE OF USER SYSTEM CONFIGURATION, THE MACHINES SHOULD BE EQUIPPED WITH A SERIES OF COMPONENTS, LISTED ABOVE, IN ORDER TO ENSURE THE WORKING ORDER OF THE SYSTEM. HOWEVER, THESE DEVICES MUST BE CHECKED FROM TIME TO TIME TO MAKE SURE THAT THEY ARE WORKING PROPERLY.

- * CHECK THE INTERVENTION OF THE WATER FLOW METER PERIODICALLY.
- * CHECK THE READING ON THE ANTIFREEZE PROBE AND COMPARE IT WITH A CERTIFIED INSTRUMENT. IF THE VALUE IS WRONG, CALIBRATE THE PROBE.
- * PERIODICALLY CLEAN THE MESH FILTER INSTALLED ON THE MACHINE HEAT EXCHANGER INLET.
- * MAKE SURE THAT THE PLUMBING SYSTEM PRESSURE IS WITHIN THE SAFETY LIMITS (MAX 3 bar).

IN NORMAL CONDITIONS, THE PLUMBING PRESSURE MAY VARY FROM 0.8 ÷ 1.2 bar.

DIFFERENCE IN HEIGHT BETWEEN THE CHILLER ASSEMBLY AND THE HIGHEST PART OF THE SYSTEM



3.1 USE OF ANTIFREEZE LIQUIDS

If the plumbing is not drained during the winter break, the water needs to be mixed with antifreeze liquids in suitable percentage parts.

The use of antifreeze liquids causes a slight reduction in cooling capacity, but a considerable variation in the system's water flow values and pressure drops.

In these cases, it is important to check the performance of the pump carefully so as to prevent malfunctions and damage which would definitely be caused if the nominal water flow is not guaranteed.

The following table indicates the mix percentages suggested in event of use of ethylene glycol on the basis of the min. external ambient temperature in which the unit may find itself.

ATTENTION:
The pumps installed as standard can work with up to a maximum of 30% glycol. If you wish to use the machine with mixes of over 30%, please contact TONONFORTY S.p.a..

Winter external air temperature (machine off)	°C	5	2	-3	-10	-15
Recommended ethylene glycol percentage (in weight)	%	0	10	20	30	40
Cooling capacity correction coefficient *	-	1	0.97	0.95	0.93	0.9
Absorbed power correction coefficient *	-	1	0.99	0.98	0.97	0.96
Water flow correction coefficient	-	1	1.02	1.1	1.14	1.3
Evaporator pressure drops correction coefficient	-	1	1.08	1.3	1.39	1.6
Mixture freezing point	°C	0	-3	-8	-15	-23

* for operation in nominal conditions (external air temperature 35°C / chilled water temperature 7°C)

WIRING

4.0 GENERAL INDICATIONS

All the units are supplied with an electrical panel complete with all the elements needed for the machine to operate and to control the safety features present.

The wiring to the unit must be carried out in compliance with current national CEI regulations or regulations in the country of installation, in keeping with the indications given in the wiring diagram provided with the machine.

Before doing any work on the unit's internal or external electrical parts, make sure that it is disconnected from the power supply.

Scale the wire sections on the basis of the total maximum current absorbed. The wiring diagram shows the recommended sections for installations with an isolator with fuse protection installed near the unit.

Make sure the unit is adequately earthed, using the corresponding terminal found inside the electrical panel.

The power supply voltage must comply with the unit's characteristic data (voltage / frequency / No. phases / presence of neutral conductor). It must not undergo variations of over +- 5% with imbalance between the phases (in the case of the three-phase supply) under 2%.

The use of electricity sources that do not comply with the manufacturer's instructions may have a negative effect upon the working order and integrity of the machine and cause the guarantee to become null and void.

4.1 WIRING

The wiring to be carried out by the user is shown in the wiring diagram and can be summed up as follows:

• Power supply line connections:

Electrical panel terminal board numbering

Models 021 - 031 - 041

L-N-PE

Models 051 - 061

L1-L2-L3-N-PE

The units are scaled for a power supply of 320V/50Hz or 400V/50Hz + N* depending on the models.

*(neutral conductor for auxiliary power supply) + Pe.

• Remote consent on/off:

All models

terminals 4-5

USE A NON-POWERED CLEAN CONTACT

Parameter CF16=0

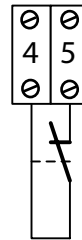
Logic: - closed contact: operation disabled
- open contact: operation enabled

The digital on/off input operating logic can be inverted by modifying the parameter CF16 in the user submenu (see point 12.1).

Example:

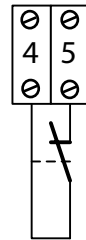
Electrical panel terminal board numbering

CF16=0



Contact closed
Remote unit OFF

CF16=1



Contact closed
Remote unit ON

N.B. The keypad can only be used to switch the unit on and off if the input is deactivated (remote priority).

• Remote summer/winter consent:

All models

terminals 4-6

- Function only active for heat pump models
KRYSTAL offers remote controlled chiller / heat pump selection.

USE A NON-POWERED CLEAN CONTACT

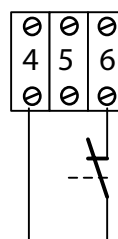
Operating logic:

With the parameter CF13=1 (standard configuration) and remote consent "open", the machine is forced to operate in "heat pump" mode, with the "chiller" switch closed.

With the parameter CF13=0 and remote consent "open", the machine is forced to operate in "chiller" mode, with the "heat pump" switch closed.

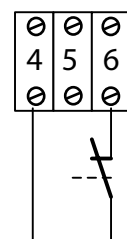
Electrical panel terminal board numbering

CF13=0



Contact closed
Unit in "heat pump" mode

CF13=1



Contact closed
Unit in "chiller" mode

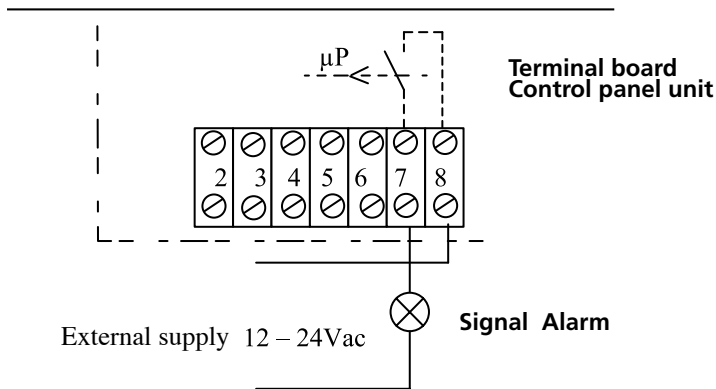
In order to use the remote summer/winter consent, parameter CF28 in the "User Menu" needs to be enabled (CF28=1). Once this parameter has been activated, remote consent selection takes priority (see paragraph 7).

•Alarm signal remote control:

All models terminals 7-8

- This allows an "activated alarm" signal to be given at a distance.
Terminals 7-8 are connected to a clean exchange contact, which changes its status as soon as one of the alarms controlled by the microprocessor is triggered.
Any alarm signal device to be connected to terminals 7-8 should preferably be powered with voltage 12 - 24 Vac.

μP direct consent from the relay on the regulator display



•power cable access:

The holes for the machine power and control cables are located on the plumbing connection side.
The entrance to the electrical panel is on the bottom of the same, through the relative cable glands.
The connection terminals can be accessed by removing the front panel from the electrical panel.

4.2 KRYSTAL ELECTRICAL ABSORPTION TABLE

KRYSTAL MODELS		021A	031A	041A	051MC	051A	061A
Rotary compressor	No.	1	1	-	-	-	-
Scroll compressor		-	-	1	1	1	1
Cooling circuits	No.	1	1	1	1	1	1
Capacity steps	No.	1	1	1	1	1	1
Machine power supply voltage	V/Hz/Ph	230/1/50	230/1/50	230/1/50	230/1/50	400/3/50	400/3/50
COMPRESSOR							
Power supply voltage	V/Hz/Ph	230/1/50	230/1/50	230/1/50	230/1/50	400/3/50	400/3/50
Nominal absorbed power	kW	1,85	2,44	3,75	4,2	4,2	5,5
Nominal absorbed current	A	8,04	10,6	18,1	18,26	7,49	9,8
Maximum absorbed current	A	12,5	15,8	27,1	30,1	11,3	13,7
Starting current	A	17	24	50	50	30	35
Compressor contactor (AC3)	No.	1	1	1	1	1	1
	kW	4,5	4,5	4,5	4,5	7,5	7,5
PUMP							
Power supply voltage	V/Hz/Ph	230/1/50	230/1/50	230/1/50	230/1/50	230/1/50	230/1/50
Nominal absorbed power	kW	0,1	0,2	0,6	0,6	0,6	0,6
Nominal absorbed current	A	0,43	0,86	2,6	2,6	2,6	2,6
Pump relay	No.	-	-	1	1	1	1
	mod.	-	-	4	4	4	4
FANS							
Power supply voltage	V/Hz/Ph	230/1/50	230/1/50	230/1/50	230/1/50	230/1/50	230/1/50
Total nominal absorbed power	kW	0,12	0,12	0,24	0,24	0,24	0,24
Total nominal absorbed current	A	0,52	0,52	1,04	1,04	1,04	1,04
No. fans	A	1	1	2	2	2	2
TOTAL ABSORPTION							
Nominal absorbed power	kW	2,1	2,8	4,6	4,6	5,0	6,3
Nominal absorbed current	A	9,0	12,0	21,7	22,3	11,1	13,4
Maximum absorbed current	A	13,5	17,2	30,7	33,7	14,9	17,3
Total starting current	A	18,0	25,4	53,6	53,0	33,6	38,6
Main switch	No.	1	1	1	1	1	1
	mod.	2p/16A	2p/20A	2p/32A	3p/20A	3p/20A	3p/20A
phase sequence relay	No.	-	-	-	1	1	1
Transformer aux. 6VA 230 / 12 V ac	No.	1	1	1	1	1	1
Prot. fuses Aux. (230 V side)	No.	1	1	1	1	1	1
	A						
Prot. fuses Aux. (12 V side)	No.	1	1	1	1	1	1
	A						
Minimum power cable section (*)	mm ²	6	10	10	10	6	6

(*) The section indicated refers to installations with distances of no more than 10 m between the machine and the power socket. In the case of greater distances, the power cable section should be assessed on the basis of the voltage drop generated by the length of the power cable.

REGULATION

5.0 USE OF REGULATION

MICROPROCESSOR REGULATION

DEVICE *m.a1Ch.*

All the units are fitted with a microprocessor regulator able to control all the characteristic parameters on which the operation of the machine depends.

5.1 USER INTERFACE



The instrument display is divided into three zones.

- **Top left zone:**
Displays the user system IN / OUT water temperature.
IN - inlet water temperature (return from the user system)
OUT - outlet water temperature (delivery to the user system)
- **Bottom left zone:**
Displays the temperature / condensation pressure or active time (function active on request as an accessory).
- **Right-hand zone:**
Signal icons.

5.2 SIGNAL ICONS

The signal icons provide a series of general information on the machine status.

°C **Degrees Celsius**
Indicates that the value shown on the display is equivalent to a temperature (also inside the user menu).

bar **Bar**
Indicates that the value shown on the display is equivalent to a pressure (also inside the user menu).

1 2 **Compressor 1 / 2**
Indicates the compressor status
Flashing: Compressor 1 / 2 required
Timer on
Fixed: Compressor 1 / 2 active

Zz **Unit in Stand_by**
The stand_by mode is active whenever the unit is switched off from "chiller" or "heat pump" mode.

It is signalled with the icon on.
Even in stand-by mode, the controller can be used to:

- 1) Display the temperatures recorded;
- 2) Manage the alarm situations, displaying them and signalling them;
- 3) Activate the electric heaters to protect against frost.



General alarm

indicates the presence of one or more alarms. In the case of an automatic reset alarm, the key functions menu M needs to be activated and the "AlrM" function selected.



High pressure alarm

signals the intervention of the high pressure switch safety alarm. The safety device is connected to the digital input ID3 (see *relative wiring diagram*).



Low pressure alarm

signals the intervention of the low pressure switch safety alarm. The safety device is connected to the digital input ID4 (see *relative wiring diagram*).



Antifreeze heaters

Indicates the status of the antifreeze electric heaters.



Flow meter alarm

signals the intervention of the water flow meter safety alarm. The safety device is connected to the digital input ID1 (see *relative wiring diagram*).



Time left / Clock



Maintenance request

Compressor or system pump maintenance request due to excess number of hours in operation.



Menu

Signals entry into the "functions menu"

5.3 KEY FUNCTION

	M allows the user to enter the functions menu and change the time.
	SET allows the user to display or modify the set point. In programming mode, it is used to select a parameter or confirm a value.
	If pressed for 5 seconds, it allows the user to switch the unit on or off in cooling (chiller) mode. It selects water IN/OUT temperatures in the top display. In programming mode, it allows the user to run through the parameter codes or increase their value.
	If pressed for 5 seconds, it allows the user to switch the unit on in heating (heat pump) mode. It selects external air temperature / defrost display. In programming mode, it allows the user to run through the parameter codes or decrease their value.

5.4 COMBINED KEY FUNCTION

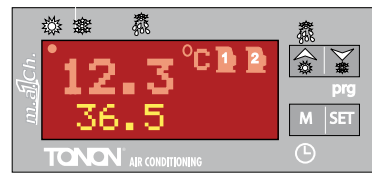
	To enter programming mode.
	To exit programming mode.
	When pressed for over 5 seconds, they start a manual defrost cycle.

5.5 SYMBOLS AND LEDS ON FRONT PANEL

Symbol	LED	Function
	On	Unit on in chiller mode
	On	Unit on in heat pump mode
	Flashing	In programming phase (flashes together with the LED)
	Flashing	Expected defrost start time
	On	Defrost active
	Off	Defrost disabled or completed
		Clock regulation

DISPLAY

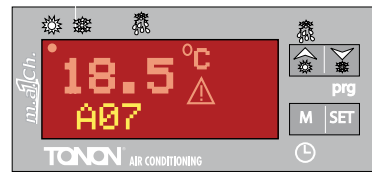
6.0 DISPLAY IN NORMAL CONDITIONS



Top display: Inlet water temperature (user system return), outlet water temperature (user system delivery). **Bottom display:** Condensation temperature or pressure, with relative units of measurement.

Active time (optional on request).

6.1 DISPLAY IN ALARM CONDITIONS

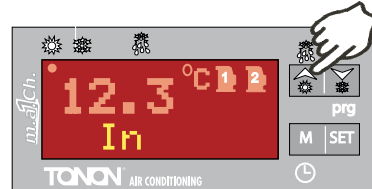


Starting with a normal situation (no active alarm), as soon as the instrument records an alarm situation, the **bottom display** shows the alarm code and the respective flashing icon alternating with the temperature / pressure (fig. presence of high pressure alarm).

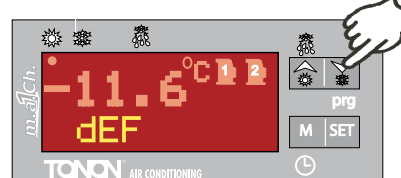
6.2 RAPID DISPLAY OF MAIN INFORMATION

In order to assist the user during the machine testing or checking phase, the operations for displaying the most important information have been simplified, without the need to access the selection menu.

- pressing the up key allows the user to see the system delivery and return temperature in rotation. This function facilitates the evaporator inlet/outlet temperature differential check, which should be around 5°C in normal operating conditions.




- pressing the down key allows the user to see the external air temperature (optional sensor) / and condensation or defrost temperature (heat pump unit) in rotation.



UNIT IN STAND-BY

7.0 UNIT IN STAND-BY

Stand-by mode is activated whenever the unit is switched off, whether in chiller or heat pump mode.

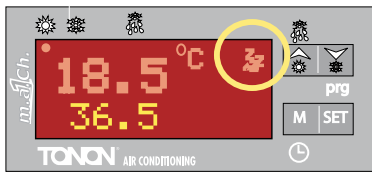
It is indicated by the on  icon.

Even in stand-by mode, the controller can be used to:


- 1) Show the measurements on the display
- 2) Manage the alarm situations, displaying them and signalling them.



Activate the electric heaters in the evaporator to protect against frost on the basis of the heat regulator.

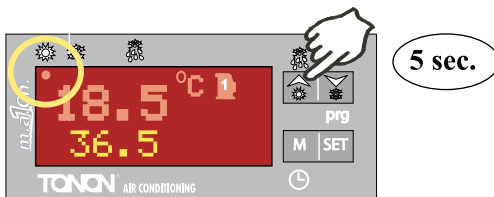
It is only possible to switch from chiller to heat pump mode by switching the unit off.




7.1 COOLING MODE (SUMMER MODE) ACTIVATION / DEACTIVATION



By pressing the key for 5 seconds , the unit switches from stand-by to chiller function and vice versa. Once the timer delay is over, the compressors are then activated if no alarms are active.

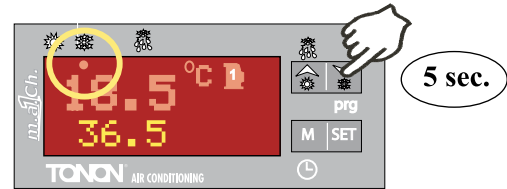
During the switch-on phase, the stand-by icon  is switched off, while the "sun" LED flashes , relative to the chiller operating mode. During operation in "chiller" mode, it is only possible to modify the relative set point ("StC" Set Chiller), or display the dynamic set point if active ("StD").



7.2 HEATING MODE (WINTER MODE) ACTIVATION / DEACTIVATION

By pressing the key for 5 seconds , the unit switches from stand-by to heat pump operation and vice versa. Once the timer delay is over, the compressors are then activated if no alarms are active. During the switch-on phase, the stand-by icon is

switched off , while the "snow" LED flashes , relative to "heat pump" operating mode. During operation in "heat pump" mode, it is only possible to modify the relative set point ("StH" Set heat pump), or display the dynamic set point if active ("StD").



7.3 ACTIVATION/DEACTIVATION VIA DIGITAL INPUT

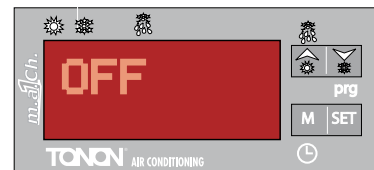
To be used if you wish to control the activation and deactivation of the machine at a distance, i.e. via the clock (see par. 4.1).

USE A NON-POWERED CLEAN CONTACT

1. Takes priority over the keypad
2. The user can only switch the unit on and off from the keypad if the input is deactivated
3. With the digital input deactivated, the instrument goes back to conditions prior to activation.

The top display shows the word "OFF", with the decimal LED flashing.

N.B. it is possible to invert the polarity of input id5, so that the unit operates ON with the signal active. The parameter that determines this function is CF16=1, which can be modified directly by the user (see par. "user menu" access).



7.4 CHILLER/HEAT PUMP MODE CONTROL VIA DIGITAL INPUT

In order to use the remote summer/winter consent, parameter CF28 in the "User Menu" needs to be enabled (CF28=1). Once this parameter has been activated, remote consent selection takes priority.

With CF28=1, if the unit is in "chiller" or "heat pump" mode and is asked to change operating mode, the controller switches all the outputs off (compressor, pump, etc.) and waits for a fixed period of time, as indicated by the flashing chiller or heat pump LED. The flashing indicates the operating mode into which the machine will be switched back on, respecting the compressor protection times.

SET POINT SETTING

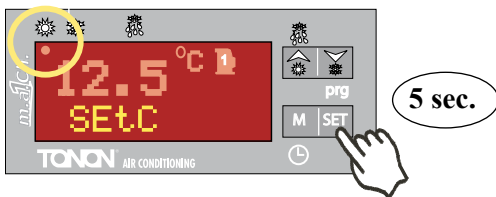
8.0 "SET POINT" SETTING



8.1 SET.C Chiller set point 12.5°C

When pressing the SET key with the unit in stand-by or chiller mode, the set value is displayed. To change this value, just keep the SET key pressed down for around 5 seconds, after which the value on the display will begin to flash. The cursor keys (UP and DOWN arrows) can be used to modify the value within the factory-set limits.

ST05 10°C minimum summer set point
ST06 18°C maximum summer set point



The value flashes and the value is modified using the cursor key.

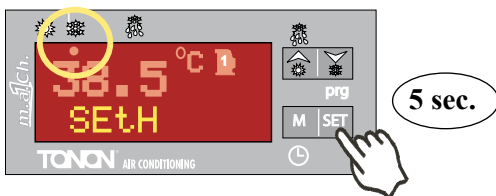


Pressing the SET key stores the change.

8.2 SET.H Heat pump set point 38.5°C

When pressing the SET key with the unit in stand-by or heat pump mode, the set value is displayed. To change this value, just keep the SET key pressed down for around 5 seconds, after which the value on the display will begin to flash. The cursor keys (UP and DOWN arrows) can be used to modify the value within the factory-set limits.

ST07 36°C minimum winter set point
ST08 43°C maximum winter set point



The value flashes and the value is modified using the cursor key.



Pressing the SET key stores the change.

PANEL

9.0 BASIC REMOTE CONTROL PANEL BASIC KRC (Optional on request)

This keypad can be used for ON/OFF control of all the HYDRA and HYDRA-HP units. In the case of HYDRA-HP reversible units with heat pump, it can be used to switch the operating mode from chiller to heat pump and vice versa. It can also signal an active machine alarm status via the red LED. Once the wiring has been completed, as described below, check that the jumper situated on the right-hand side of the electrical terminal board is closed (power supply 12Vac). Incorrect positioning of the jumper could damage the remote device.

N.B. Change the parameter CF16 = 1 in order to respect the activation logic with that of the remote panel. The parameter can be modified directly from the "user menu" see par.12.1.

CONTROLS

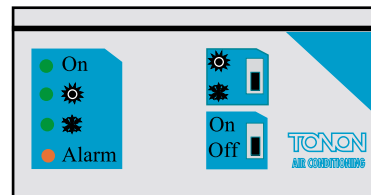
- 1 ON/OFF toggle switch
- 2 Summer / winter toggle switch

DISPLAY

- 3 Green LED on
- 4 Summer green LED
- 5 Winter green LED
- 6 Alarm red LED

DIMENSIONS

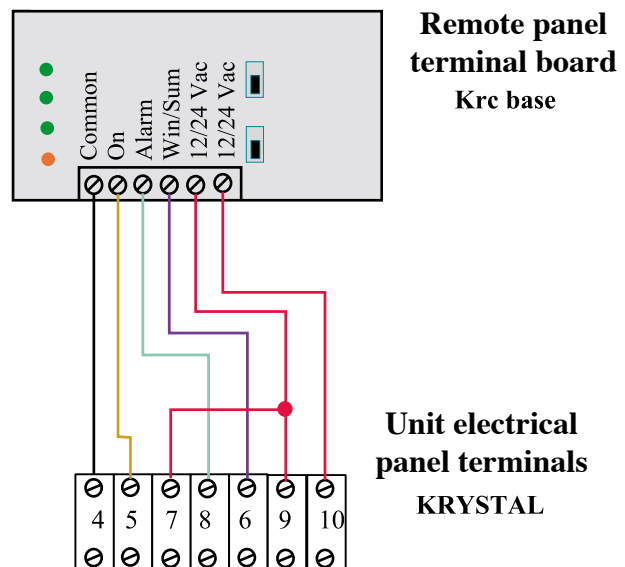
- 120 x 70 x 28.7 mm

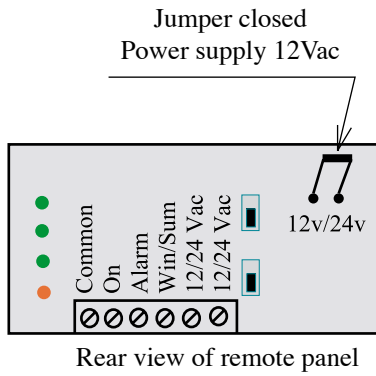


9.1 BASIC KRC REMOTE PANEL WIRING

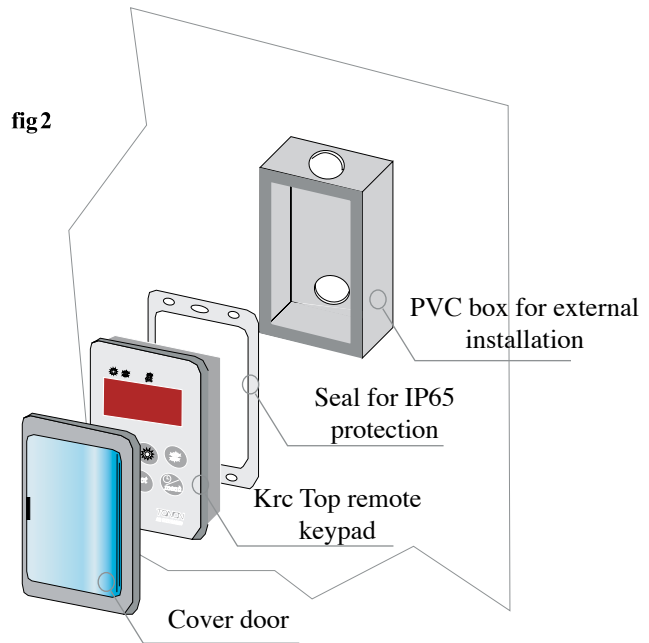
The electrical connection between the remote panel and the electrical panel of the unit to be controlled should be made by the user, using a 6-pole cable (6 wires) with a minimum section of 0.5 mm². The maximum recommended width should not exceed 150m.

The wiring to the remote panel can be summed up as follows:





In order to obtain IP65 frontal protection, use the frontal protection rubber. For external wall-mounting, an adaptor is available for vertical keypads **V-KIT-Top**, as illustrated in figure 2.

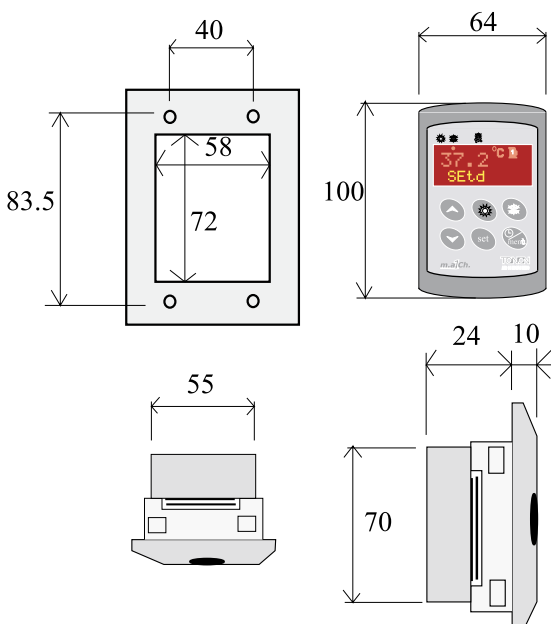


REMOTE CONTROL KIT

10.0 TOP REMOTE CONTROL KIT TOP KRC (Optional on request)



Supplied as an accessory on request, the kit makes it possible to display and manage all the control parameters in the same way as the machine control panel. The keypad format means that the device can even be installed in common wall boxes (3 modules) used in domestic electrical systems. The remote terminal should be mounted on a panel or a hole of 72x56 mm, and secured with screws.



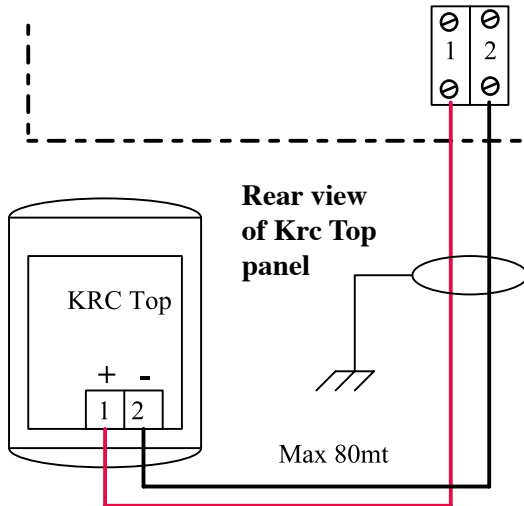
10.1 KRC Top KEY FUNCTION

	M allows the user to enter the functions menu and change the time.
	SET allows the user to display or modify the set point. In programming mode, it is used to select a parameter or confirm a value.
	Selects water IN/OUT temperatures, on the top display. In programming mode it runs through the parameter codes or increases their value.
	Selects external air / defrost temperature display. In programming mode it runs through the parameter codes or decreases their value.
	If pressed for 5 seconds, it switches the unit on or off in chiller or heat pump mode.
	If pressed for 5 seconds, it switches the unit on or off in chiller or heat pump mode.

10.2 KRC TOP WIRING

The connection between the electrical panel and the remote terminal must be made by the user, using a shielded 2-way wire with a minimum section of 0.5 mm². The maximum recommended width should not exceed 80 m. If it exceeds this length, the section should be increased up to 1.5 mm² for a maximum length of 150 m. **The connection cable is not included in the remote control kit.**

ELECTRICAL PANEL TERMINAL BOARD



FUNCTIONS MENU

11.0 "M KEY" FUNCTIONS MENU

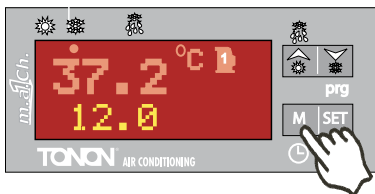
Entering the functions menu allows the user to:

- 1) Display and reset the alarms present;
- 2) Display and reset the controlled load operating times;
- 3) Display the time left until defrosting starts (only if the unit is configured as a heat pump);
- 4) Display the alarm history;
- 5) Cancel the alarm history.

(When viewing the functions menu, the "menu" icon lights up).

11.1 ACCESS TO THE "M" FUNCTIONS MENU

Press and release the M (menu) key. The "menu" icon appears.





11.2 EXITING THE FUNCTIONS MENU

Press and release the M key or wait for time out (15 seconds). The "menu" icon disappears.

11.3 HOW TO DISPLAY THE ALARMS

The system manages around 30 alarm codes. The most important are displayed through the icons on the sides of the 2 displays. All the alarms have an identification code and up to 50 are memorised at any one time, in order of when they occurred.

Enter the functions menu:

- 1) Use the UP or DOWN keys  to select the "ALrM" function.
- 2) Press and release the SET key.
- 3) Use the UP or DOWN keys  to run through all the alarms present; To exit press the M key or wait 15 seconds for time out.

11.4 HOW TO RESET AN ALARM

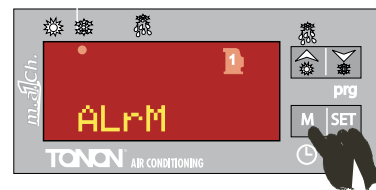
In the event of a serious alarm being triggered, such as high pressure, evaporator antifreeze etc., the system needs to be reset manually.


All manual reset and automatic reset alarms are recorded in the Eprom memory so that the unit operation can be checked at a later time.

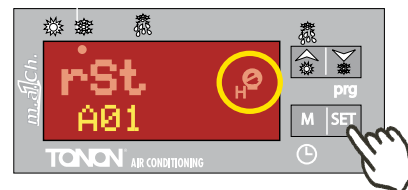
N.B. If the alarm persists, seek assistance from the TONON Authorised Service Centre.

Procedure for resetting manual reset alarms:

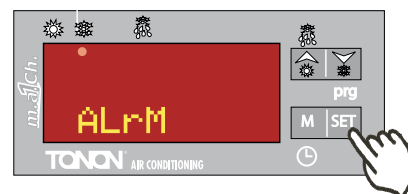
- 1) Enter the functions menu.
- 2) Select the "ALrM" function



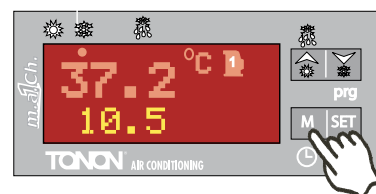
- 3) Press SET, the bottom display shows the alarm code
- 4) Top display: rSt label if the alarm can be reset, NO label if it cannot. Run through the alarms present with the keys 




- 5) Press SET in correspondence to the rSt label to reset the alarm and move on to the next

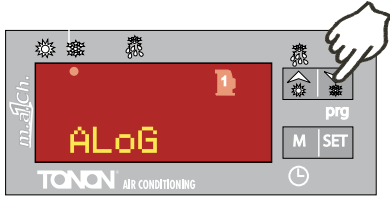


- 6) To exit press the menu key or wait 15 seconds for time out.

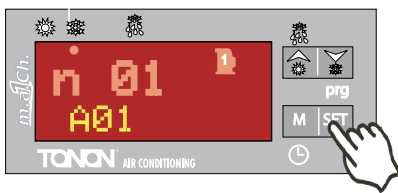



11.5 HOW TO DISPLAY THE ALARM HISTORY

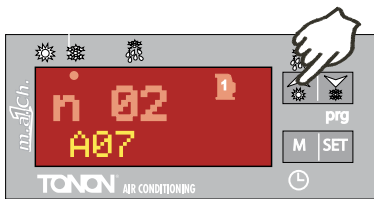
- 1) Enter the functions menu
- 2) Use the UP or DOWN keys  to select the function **ALOG**;



- 3) Press **SET**, bottom display shows label with alarm code, top display shows label "n" with progressive number;

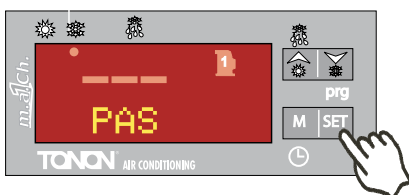
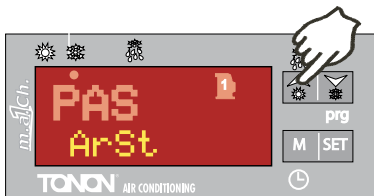


- 4) Use the UP or DOWN keys  to run through all the alarms present;



- 5) To exit the **ALOG** function and return to the normal display, press the **M** key or wait for time-out (15 seconds)

There are **50** alarms saved in the memory. Each alarm over this number will automatically cancel the oldest alarm from the memory (the display works upwards, from the oldest to the most recent).



N.B. The alarm history can only be cancelled by entering the maintenance password.

11.6 ALARM TABLE


Code	Meaning	Cause	Action	Reset
P1	PB1 probe alarm	Probe faulty or resistive value out of range	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Automatic If the value is within the envisaged range.
P2	PB2 probe alarm	Probe faulty or resistive value out of range	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Automatic If the value is within the envisaged range.
P3	PB3 probe alarm	Probe faulty or resistive/ current value out of range	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Automatic If the value is within the envisaged range.
P4	PB4 probe alarm	Probe faulty or resistive value out of range	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Automatic If the value is within the envisaged range.
A01	PB2 probe alarm	Intervention of one of the high pressure switches Hp1 – Hp2	Alarm relay output active Buzzer active High pressure alarm icon flashing Display code	Manual Return of the pressure within range, plus reset procedure point 11.4
A02	High pressure switch alarm	Intervention of low pressure switch-Lp1	Alarm relay output active Buzzer active Low pressure alarm icon flashing Display code	Automatic Becomes manual after 2 interventions in one hour Manual Return of the pressure within range, plus reset procedure point 11.4
A05	Low pressure switch alarm	Limit AL11 exceeded by probe pB3 (condensation control)	Alarm relay output active Buzzer active High pressure alarm icon flashing Display code	Manual Return of the temperature within range, plus reset procedure point 11.4
A06	Condenser high temperature alarm	Limit AL13 exceeded by probe pB3 (defrost control)	Alarm relay output active Buzzer active Low pressure alarm icon flashing Display code	Automatic Becomes manual after 2 interventions in one hour Manual Return of the pressure within range, plus reset procedure point 11.4
A07	Antifreeze alarm	Antifreeze alarm set limit AR03 exceeded by probe pB2 on the evaporator (delivery temperature)	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Manual Return of the temperature within range, plus reset procedure point 11.4
A08	Flow meter alarm	Intervention of the water flow safety evaporator (FL)	Alarm relay output active Buzzer active Flow meter alarm icon flashing Display code	Automatic Becomes manual after 2 interventions in one hour Manual Return of the pressure within range, plus reset procedure point 11.4
A09	Compressor 1 thermoswitch	Activation of digital input by compressor 1 magneto-thermal switch	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Manual Restoration of safe conditions, plus reset procedure point 11.4
A10	Compressor 2 thermal alarm	Activation of digital input by compressor 2 magneto-thermal switch	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Manual Restoration of safe conditions, plus reset procedure point 11.4

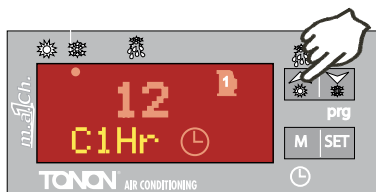
Code	Meaning	Cause	Action	Reset
A11	Condensation fan thermal alarm	Activation of digital input by fan thermoswitch (thermoswitch and klixon)	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Manual Restoration of safe conditions, plus reset procedure point 11.4
A12	Defrost error alarm	End of defrost for dF07 (maximum time)	Display code Signal only	Automatic With a subsequent correct defrost cycle
A13	Compressor 1 maintenance alarm	Compressor 1 operating hours exceeded	Alarm relay output active Buzzer active Maintenance icon flashing Display code	Manual Operating hours reset point 11.9.
A14	Compressor 2 maintenance alarm	Compressor 2 operating hours exceeded	Alarm relay output active Buzzer active Maintenance icon flashing Display code	Manual Operating hours reset point 11.9.
A15	Water pump maintenance alarm	System pump operating hours exceeded	Alarm relay output active Buzzer active Maintenance icon flashing Display code	Manual Operating hours reset point 11.9.
rtC	Clock alarm	Clock requires regulation	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Manual Clock regulation plus reset procedure point 11.4.
rtF	Clock alarm	Clock faulty Clock malfunction	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Manual Reset procedure point 11.4. If the alarm recurs after reset, replace the clock
EE	Eeprom error alarm	Memory data loss	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Manual Reset procedure point 11.4. If the alarm recurs after reset, the device remains blocked
ACF 1	Configuration alarm	Unit configured as heat pump with inversion not configured	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Automatic With correct reprogramming
ACF 2	Configuration alarm	Air/water unit without probe configured for condensation control	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Automatic With correct reprogramming
ACF 3	Configuration alarm	Two digital inputs with the same configuration	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Automatic With correct reprogramming
ACF 4	Configuration alarm	CF28= 1 and the unconfigured digital input or CF28= 2 PB4 probe other than 3	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Automatic With correct reprogramming
AFr	Network frequency alarm	Network frequency out of range	Alarm relay output active Buzzer active Generic alarm icon flashing Display code	Automatic Return of frequency within operating range

11.7 ALARM TABLE

Alarm Code	Alarm Description	Comp.1	Antifreeze heaters	Pump	Condenser fan	Boiler
P1	Probe PB1	OFF	Yes with Ar19 =0		OFF	OFF
P2	Probe PB2	OFF	Yes with Ar19 =0		OFF	OFF
P3	Probe PB3	OFF	Yes with Ar19 =0		OFF	OFF
P4	Probe PB4	OFF	Yes with Ar19 =0		OFF	OFF
A01	Maximum switch	OFF				
A02	Minimum pressure switch	OFF			OFF	
A05	High temperature High pressure	OFF				
A06	Low pressure low temperature	OFF			OFF	
A07	Antifreeze	OFF			OFF	
A08	Flow meter	OFF	Boiler heater OFF	OFF		OFF
A09	Compressor 1 thermoswitch	OFF				
A10	Compressor 2 thermoswitch					
A11	Condensation fan thermoswitch	OFF			OFF	
A12	Defrost error					
A13	Compressor 1 maintenance					
A14	Compressor 2 maintenance					
A15	Water pump maintenance					
rtC	Clock alarm					
RtF	Clock alarm					
EE	Eeprom alarm	OFF	OFF	OFF	OFF	OFF
ACF1	Configuration alarm	OFF	OFF	OFF	OFF	OFF
ACF2	Configuration alarm	OFF	OFF	OFF	OFF	OFF
ACF3	Configuration alarm	OFF	OFF	OFF	OFF	OFF
ACF4	Configuration alarm	OFF	OFF	OFF	OFF	OFF
AFr	Network frequency alarm	OFF	OFF	OFF	OFF	OFF

11.8 LOAD OPERATING TIME DISPLAY



- 1) Enter the key functions menu **M**;
- 2) Press the UP or DOWN keys  until the bottom display shows the individual load label; C1Hr (compressor No. 1 operating hours), CHr2 (compressor No. 2 operating hours), PFHr (system water pump operating hours).

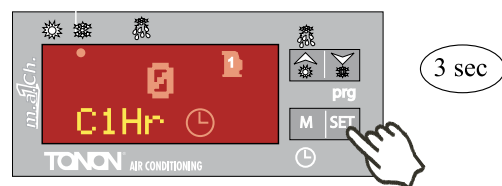


The top display will show the operating hours.

The icon  will be on.

11.9 LOAD OPERATING HOURS RESET

- 1) Enter the key functions menu **M**;
- 2) Press the UP or DOWN keys  until the bottom display shows the individual load label (C1Hr, C2Hr,PFHr) and the top display shows the operating hours.
- 3) Press the SET key  for 3 seconds: **the top display will show 0, indicating that it has been reset.**
- 4) Exit the functions menu by pressing the M key or waiting for time out (15 seconds)
- 5) Repeat operations 1-4 for the other loads.



We recommend that the maintenance worker carries out a preventive check before resetting this signal, in order to prevent subsequent problems.

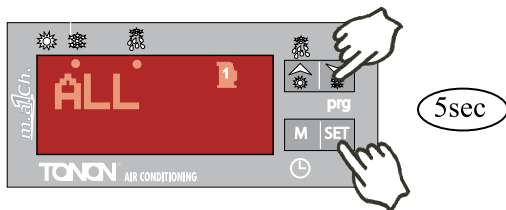
KEYPAD PROGRAMMING

12.0 KEYPAD PROGRAMMING

The controller parameters have been grouped into families, each identified by a label. This allows the user to have rapid access to the parameters concerned.

LABEL	MEANING
ALL	Displays all the parameters
ST	Displays only the heat regulation parameters
CF	Displays only the configuration parameters
SD	Displays only the dynamic set point parameters
ES	Displays only the energy saving parameters
CO	Displays only the compressor parameters
FA	Displays only the ventilation parameters
Ar	Displays only the antifreeze heater / boiler parameters
DF	Displays only the defrost parameters
AL	Displays only the alarm parameters

12.1 ACCESSING THE "PR1" PARAMETERS (USER LEVEL)



To enter the "pr1" menu of parameters accessible to the user:

- 1) Press the SET + DOWN arrow keys for a few seconds.

(1 and begin to flash)
the top display shows "ALL",
the first family of parameters.

- 2) Select the various families using the UP and DOWN arrows .

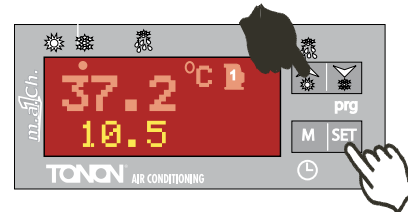
- 3) Press the SET key to display the label and code of the first parameter contained in the family present in "Pr1" on the bottom display, and its value on the top display. After selection, it is now possible to run through and modify the parameters contained in the family.

12.2 CHANGING THE VALUE OF A PARAMETER

1. Enter programming mode;
2. Select the desired parameter;
3. Press the SET key to enable modification of the value;
4. Modify the value using the UP and DOWN keys .
5. Press "SET" to memorise the new value and move on to the next parameter code;

6. EXITING PROGRAMMING MODE:

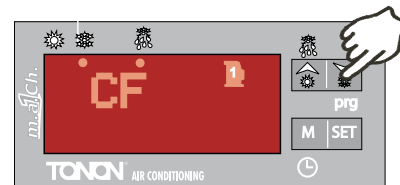
Press SET + UP arrow, when a parameter is displayed, or wait (15 seconds) without pressing any keys.



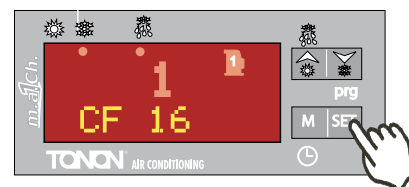
N.B. The new set value is memorised, even when you exit programming due to time out without having pressed the SET key.

12.3 KEY SEQUENCE FOR CHANGING PARAMETERS

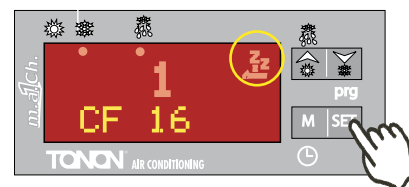
- 1) Press SET + UP arrow to access the user menu "PR1"
- 2) Use the keys to select the family of parameters to be displayed (i.e. CF configuration parameter)



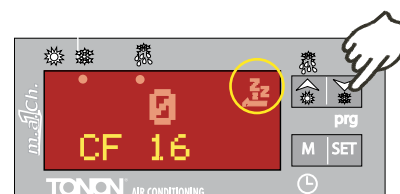
- 3) Press SET to access the parameters in the chosen family.



- 4) Press SET to select the set value to be changed. **N.B. Function only possible with unit in stand-by.**



- 5) Press to change the parameter. Press SET to save the change.



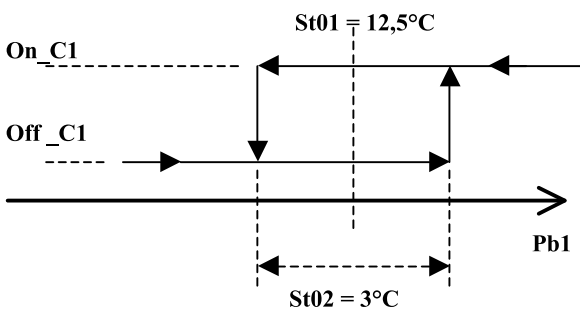
COMPRESSOR REGULATION

13.0 COMPRESSOR REGULATION IN "CHILLER" OR "HEAT PUMP" MODE

All the units are controlled on the basis of the temperature measured by the probe Pb1 located at the evaporator inlet (return temperature from the user system). The compressor function is described below:

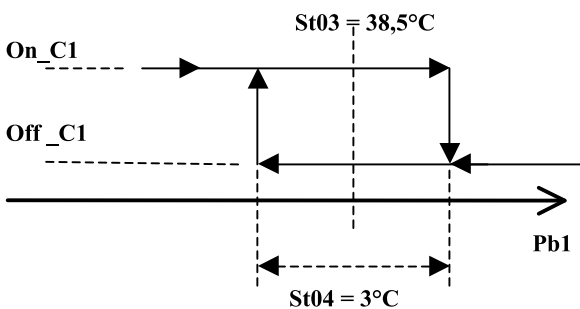
"Chiller" operation

St01 summer set point (Chiller)
St02 summer differential
C1 Compressor 1
Pb1 regulation probe



"Heat pump" operation

St03 winter set point (heat pump)
St04 winter differential
C1 Compressor 1
Pb1 regulation probe



13.1 CIRCULATING PUMP OPERATING MODE

The system pump operation is controlled by the machine regulator.

13.2 TIMERS

In order to ensure correct machine operation and prevent the untimely intervention of certain safety features during the unit start-up or shutdown phases, the following timers are active in the regulation system:

CO02 360 seconds

Minimum switch-off time.

Determines the time during which the compressor must remain inactive, even if it is switched back on. During this phase, the compressor LED flashes.

CO03 10 seconds

Switch-on delay between the two compressors.

Establishes the switch-on delay between the two, to reduce starting current absorption. During this phase the compressor LED flashes.

CO05 60 seconds

Switch-on delay understood as physical control power supply.

Delays the activation of all the outputs in order to distribute network absorption and protect the compressor(s) from repeated switch-ons in the case of frequent power shortages.

CO07 250 seconds

Water pump switch-off delay after compressor switch-off.

The water pump is only deactivated when the machine is switched off (unit in stand-by).

13.3 FAN OPERATION

All the units are provided with a fan speed control device. They can be regulated on the basis of temperature (pb3) Ideal temperature range for control type:

Operation in "Chiller" mode:

External air temperature: 20 ÷ 35°C

Control in standard temperature

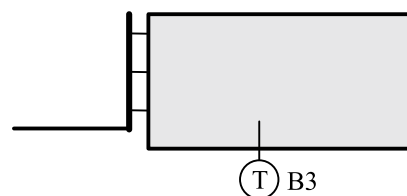
13.4 DEFROSTING

All the KRYSTAL heat pump units use a defrost control with pressure sensor.

Operation:

when the defrost start temperature TB3 (par. DF03) is reached, the delay countdown begins. Once the delay has passed, a defrost cycle gets underway. The cycle is exited on the basis of the set point (par. DF04), once the value of probe TB3 has been reached. The maximum cycle duration is set at 5 minutes. Once the maximum time has passed, the defrost error is shown on the display.

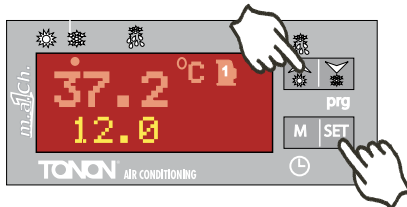
Temperature combined control



13.5 MANUAL DEFROST

The control can also be used to force a defrost cycle manually. Once the cycle is under way, the end is respected on the basis of the set temperature or pressure (par. DF04).

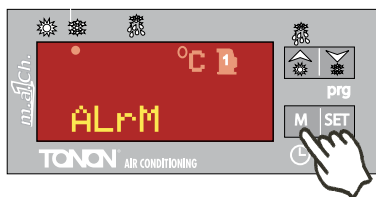
To activate the manual function, press the SET + UP arrow keys for 5 seconds.



13.6 REMAINING TIME UNTIL DEFROST DISPLAY

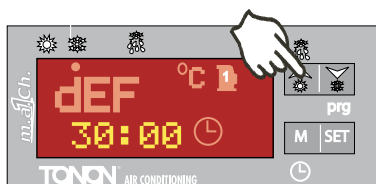
It is possible to view the remaining time until defrost starts on the display. To view this time, press the M key and use the UP and DOWN keys to run through until coming to the "dEF" label. The time is displayed on the bottom display in minutes and seconds.

- 1- Press the M key to access the FUNCTIONS MENU.



- 2- Run through with the keys until coming to the dEF label. The time remaining until defrost starts is shown on the bottom display.

N.B. In the case of combined defrost, once the delay period has passed, the defrost function is only activated if the combined set point condition is met (see par. 13.5).



START-UP

14.0 PRELIMINARY CHECKS

Before starting the unit, it is essential to carry out some general checks in order to ensure that it is in good working order.

- 1) make sure that the plumbing is correctly connected in keeping with the general diagrams enclosed with this manual. Make sure that the user system return water pipe is connected to the "WATER INLET" connection, while the water delivery pipe to the system should be connected to the "WATER OUTLET" connection.

- 2) Bleed the plumbing carefully with the pump off. The presence of air bubbles could have a negative effect on the operation of the unit and could also cause ice to form in the evaporator, perhaps causing it to break and polluting the refrigerant circuit.

- 3) Make sure that all the intercept valves in the system are open, that the system is pressurised and that water circulation is normal.

- 4) Check the wiring, making sure that the conductor sections and their housings correspond to the indications in the wiring diagram enclosed.

- 5) Check that the terminals are tightened.

- 6) Make sure that the power supply corresponds to that indicated on the wiring diagram. Also check that the voltage is constant and is not more than 5% over or under the required value.

- 7) Units 051-061 are equipped with a three-phase compressor and have a cyclical phase connection control relay. The machine will not start if the connections are wrong. **The LED on the relay lights up if the connections and phase sequence are correct. The LED switches off if the phases are wrongly connected.**

In this case it will be sufficient to invert the connection of two of the three phases to ensure that the compressor rotates in the right direction.

- 8) Units with compressor oil heater (crankcase heater) must be activated for at least 8 hours before the compressor starts.

To power the crankcase heater, you need to activate the main switch while seeking to avoid activating the compressor using the On/Off control on the display panel.

- 9) Make sure that the air flow is not obstructed through the finned coil condenser (presence of foreign bodies, packaging, leaves, etc.).

We recommend avoiding use of the general isolating switch for switching the unit on or off.

14.1 COMMISSIONING


Once you have carried out all the above checks, the unit is ready to be started up.

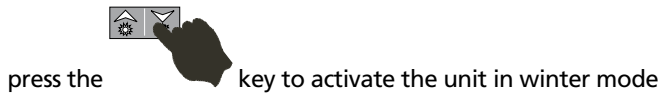
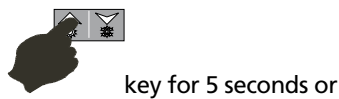
The controller can be accessed directly through the PVC door on the front panel of the machine.

All the thermal switches on the electrical panel QM1, etc. must be inserted in order to power all the various users.

If the regulator display is not on, make sure that the phase control relay KA3 is active. If it is not, invert the phases at the line terminal board entrance (see previous paragraph point 6).

The regulator display shows the system return temperature (system water inlet) and the bottom display shows the temperature or ventilation control pressure respectively.

The machine waits for a command, stand-by, icon  on. To activate the unit in summer mode (chiller) press the



(see paragraph 7.1 o 7.2.)

SUMMER COMMISSIONING

The regulation device is factory-calibrated with the summer operating (chiller) set point of 12.5°C and differential of 3°C. This indicates that the unit will be enabled to operate when the return water temperature is over 14°C and will automatically stop when it reaches a temperature of 11°C.

Before starting up the unit, it is good practice to check the set point value by proceeding as follows:

- press the SET button
- the code Set C (summer set point) will appear on the bottom display
- the set value 12.5 appears on the top display.

To modify the value see paragraph 8.0.

WINTER COMMISSIONING

The regulation device is factory-calibrated with the winter operating (heat pump) set point of 38.5°C and differential of 3°C. This indicates that the unit will be enabled to operate when the return water temperature is under 37°C and will automatically stop when it reaches a temperature of 40.0°C.

Before starting up the unit, it is good practice to check the set point value by proceeding as follows:

- press the SET button
- the code Set H (winter set point) will appear on the bottom display
- the set value 38.5 appears on the top display.

To modify the value see paragraph 8.0.

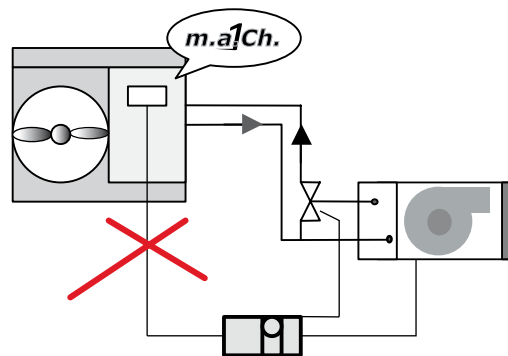
N.B. if the unit is not active via remote control, the top display shows the label OFF (see paragraph 7.3).

14.2 USER SYSTEM INTERFACE

The TONON® chiller and heat pump units can be interfaced with different types of systems. It is therefore important to respect certain technical plumbing and electrical aspects in order to avoid problems of varying degrees of severity during operation.

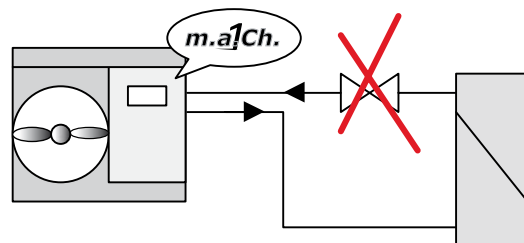
1. All the units are automatically heat-regulated. During the operating period, it is preferable for the unit to be constantly active, so as to keep the water in the user system at the right temperature.

DO NOT USE THE AMBIENT THERMOSTAT TO SWITCH THE MACHINE ON AND OFF.



2. All the units require a constant water flow to the heat exchanger. It is therefore important that there is no variation in the flow during unit operation.

NEVER INTERCEPT THE MACHINE DELIVERY AND RETURN PLUMBING IN ANY WAY.



3. All the units require a nominal flow, see par. 3.0, which guarantees a temperature differential of approx. 5 °C between the heat exchanger inlet and outlet. One of the most simple controls involves checking that there are no excessively high pressure drops in the system.

CHECKS DURING OPERATION

15.0 GENERAL INDICATIONS

- Units supplied complete with a temperature / condensation pressure control device permit operation even at low external air temperatures (min. +5°C).

This device intervenes by activating the fan rotation speed modulation on the basis of the condensed refrigerant temperature.

When the compressor is started up, the fan is immediately engaged at maximum rotation speed. After a short time, the regulation device automatically enables air flow modulation in order to keep the temperature constant and the condensation pressure within the values established on the basis of the external air temperature.

The regulation device is set to avoid damaging simultaneous compressor start-ups, meaning that timers are active during the normal operating cycle (see par.13.2).

15.1 CHECKS

- Water temperature

Once normal operating conditions have been reached, check the difference between the inlet and outlet water temperature.

The inlet temperature is normally shown on the display.

To display the outlet temperature, call up parameter "r6" by activating the "direct menu".

The temperature difference should be between 4.5 and 5.5 °C.

Greater differences indicate a lack of water circulation in the system (in this event, check the pump characteristics).

Lower differences indicate excessive water circulation in the system (in this case it is possible to reduce the water flow by working on the intercept valves in the system).

- Operating temperatures / pressures

After a few minutes of operation, use the pressure gauges (supplied as accessories or to be connected in the field) to check the condensation (high pressure side) and evaporation (low pressure side) temperatures.

High pressure side:

Pressure	Bar	29	-	33
	kPa	2900	-	3300

Low pressure side:

Pressure	Bar	7	-	8.2
	kPa	700	-	820

- Refrigerant charge

The temporary presence of bubbles visible through the liquid indicator (if present) should be considered normal. The persistence of the phenomenon indicates a lack of refrigerant inside the refrigerant circuit.

The refrigerant charge is indicated on the identification label stuck to the machine.

- Presence of damp

After a few hours of operation, check the colour of the crown inside the liquid indicator (if present):

- a fairly yellow colour indicates the presence of damp in the refrigerant circuit. In this case the circuit needs to be dried out by qualified personnel.

- Refrigerant gas overheating temperature

Corresponds to difference between the gas temperature in the suction pipe and the evaporation temperature read on the pressure gauge.

Good working order is envisaged for the unit at values between 4 and 10 °C.

- Refrigerant liquid undercooling temperature

Corresponds to the difference between the condensation temperature read on the pressure gauge and the temperature measured in the liquid pipe.

Good working order is envisaged for the unit at values over 2 - 3 °C.

- Electrical absorption

Check that the electrical absorption corresponds to the values in the electrical data table.

15.2 CONTROL AND SAFETY FEATURES

All the units have a regulation device and a series of safety features, as described in the regulator parameters table. These devices are factory-calibrated and checked during the testing phase before delivery. Once the unit has been installed and after a reasonable period of operation, it is good practice to check the effectiveness of the control / safety devices and their correspondence to the calibration values given in the following tables.

Safety features

Device differential	set point	safety
---------------------	-----------	--------

Antifreeze thermostat	4°C	3°C
------------------------------	------------	------------

- alarm activation temperature: set point
- re-enablement temperature: set point + diff.

Low pressure switch	44 Bar 4400 kPa	8 Bar 800 kPa
----------------------------	----------------------------------	--------------------------------

- alarm activation temperature: set point
- re-enablement temperature: set point - diff.

Low pressure switch	2 Bar 200 kPa	1 Bar 100 kPa
----------------------------	--------------------------------	--------------------------------

- alarm activation temperature: set point
- re-enablement temperature: set point + diff.

compressor thermal protection	1.33 x I nom. comp.
--------------------------------------	----------------------------

The antifreeze and high pressure alarms can be reset manually. Before restoring the shutdown unit (see par.11.4), check the cause of the fault. If the alarm persists, contact the **TONONFORTY® Authorised Service Centre** for assistance.

MAINTENANCE

16.0 GENERAL INFORMATION

Before leaving the factory, all the machines are carefully tested during operation for a sufficient period of time to ascertain that the components are in good working order and that all the control and safety features intervene effectively.

Once it has been correctly installed, no further fine tuning will be required unless repairs are made or anomalous operating conditions arise.

However, it is indispensable to carry out periodic checks in order to ensure that it is in good working order, especially after prolonged periods out of use.

This maintenance work should only be carried out by qualified **TONONFORTY®** personnel, following the instructions given in this manual.

The maintenance operations described below should be considered "routine" and play an extremely important role as regards the operation and working life of the machine.

There is a "troubleshooting" list at the end of the chapter, highlighting possible problems which may affect the machine and indicating the relative causes and possible solutions.

16.1 PERIODIC MAINTENANCE AND CHECKS

Monthly checks

- Check the operating pressures on the high and low pressure side using a common pressure gauge assembly or, if provided, the pressure gauges wired into the machine itself.

Nominal operating pressures:

External air temperature:		35°C
High pressure side	Bar	29
	kPa	2900
Water temperature:		12-7 °C
Low pressure side	Bar	8
	kPa	800

Check that the safety appliances are in good working order and make sure that the intervention values correspond to those listed in paragraph 15.1.

Check the refrigerant charge through the liquid indicator if present on the unit. In normal operating conditions, the sight of bubbles through the indicator could suggest a potential lack of refrigerant.

Also check the colour of the crown around the liquid indicator. A yellowish colour indicates the presence of damp, meaning that the filter needs to be replaced and, if this is not sufficient, the refrigerant circuit may need to be dried out.

Check that the electrical absorption corresponds to the values in the electrical data table.

Check the contents of the plumbing circuit, carefully eliminating any remaining air bubbles through the bleed devices.

Check the tightness of the electric terminals inside the electrical panel and on the user parts outside the electrical panel.

Six-monthly checks and maintenance

Carry out all the monthly maintenance operations.

Check the cleanliness of the condenser coil. If necessary, clean the fins using compressed air directed against the air flow or, in the event of significant blockages, use a moderate pressure jet of water.

Check the regularity of the noise and vibrations of the moving parts (compressor / fan / pump).

16.2 SEASONAL SHUTDOWN

The KRYSTAL series water chillers and heat pumps can be used in air conditioning systems in cooling mode only.

If the machine is installed in zones where there is a possibility of frost during the winter, it is indispensable to drain the water contained in this system or mix it with antifreeze solutions in suitable percentage parts. In the latter case, the performances of the machine and the water circulating pump will be penalised slightly (see table par. 3.0).

16.3 SAFETY INFORMATION

All the maintenance and repair operations, the replacement of any component, topping up with refrigerant gas and dismantling the unit should be carried out by personnel qualified to work on air conditioning units.

Wiring

Install an automatic differential switch near the unit. The switch must be of adequate capacity for the electrical absorption. Earth the unit and check the effectiveness of this connection.

Refrigerant liquids

The type of refrigerant used is identified on the technical data label on the plumbing connection side.

The lubricant oil used is identified on the compressor label.

Warnings

In the case of accidental leakage of the refrigerant gas, please observe the following precautions:

- If it comes into contact with skin or eyes, the refrigerant gas can cause cold burns. In this case it is advisable to use gloves and protective clothing and protection for the eyes and face.
- The inhalation of refrigerant gas over a long period of time can cause loss of consciousness and cardiac problems. Higher concentrations can cause asphyxia due to the lack of oxygen present in the surrounding atmosphere.
- Avoid the use of naked flames, which could cause the formation of toxic substances through combustion.

**16.4 DEMOLITION OF THE MACHINE
AND DISPOSAL OF HARMFUL SUBSTANCES**

The demolition and handling of the substances used in the machine must be carried out by authorised personnel, in keeping with current legislation. Harmful substances such as compressor oil and refrigerant liquid, must not be disposed of directly into the environment, but recovered and delivered to specific collection centres. All the identification labels and technical documentation accompanying the machine must be destroyed.

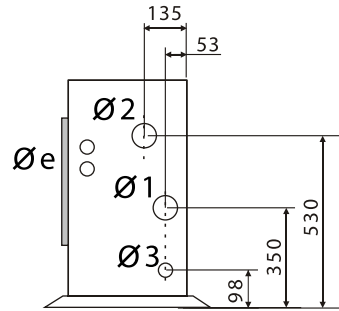
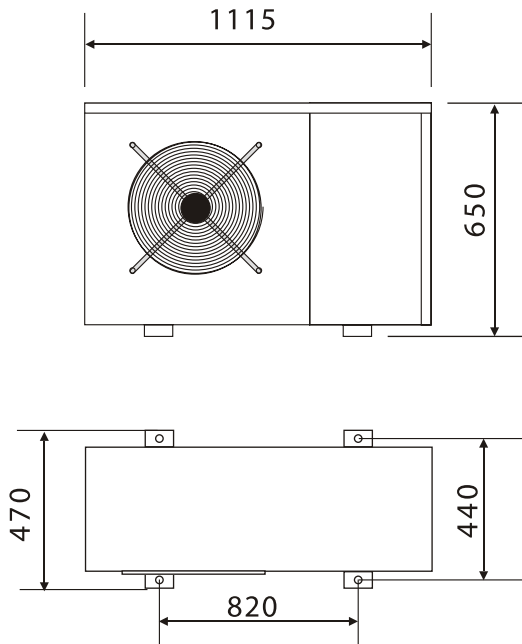
17.0 TROUBLESHOOTING

FAULT	SYMPTOM	PROBABLE CAUSE	RECOMMENDED OPERATION
The machine does not start	The display panel does not light up	No power	Check the wiring to the general power supply terminals and check the voltage values. Check the fuses on the secondary side of the auxiliary transformer.
		Phase direction inverted. The phase control relay KA3 does not give consent. Signal LED inactive.	Invert the electrical panel terminal board input phases.
	The display panel is on, but the machine does not start	Unit in STAND_BY	See paragraph 7.0 for machine activation.
	The display panel shows the label OFF	No external consent	Check the connections to external consent terminals 2-3.
	The machine does not start and the LED on the display panel starts to flash	Timer on	Wait for the timer to run its course (max. 360 seconds) after which the compressor should start
	The bottom display on the control panel flashes, indicating one or more alpha-numerical codes alternating with the temperature value	One or more safety features have triggered an alarm	Check the type of safety feature that has intervened, check the causes of the alarm and restore the safety feature (see list of alarm codes in par.11.6)
The compressor stops and starts continuously	Normal operation, excessively frequent stops and starts due to intervention of the low pressure switch	Lack of refrigerant	Identify and eliminate the refrigerant leak and top up
	Suction pressure too low and frost on the filter	Liquid line filter blocked	Replace the filter
The compressor operates without ever stopping	Excessively high temperature in the air conditioned room	Excessive thermal load	Check the infiltrations and insulation
	Excessively low temperature in the air conditioned room	The thermostat is triggered at a temperature that is too low	Recalibrate or repair the thermostat
	Bubbles on the refrigerant passage indicator	Lack of refrigerant	Identify and eliminate the refrigerant leak and top up
The compressor is noisy	The compressor is noisy, or the delivery pressure is too low and the suction pressure is too high	Wear or fault in the compressor compression spirals	Review the compressor
	The compressor "makes a hammering noise" The suction pipe is anomalously cold	Broken parts inside the compressor	Review the compressor
		Liquid return	Check for overheating and the position of the expansion valve bulb
		Expansion valve stuck in the open position	Repair or replace the expansion valve

FAULT	SYMPTOM	PROBABLE CAUSE	RECOMMENDED OPERATION
The system performance is below normal	The thermostatic valve whistles	Vaporisation of the refrigerant liquid	Add refrigerant
	Difference in temperature in the refrigerant pipe near the filter or the expansion valve	Filter or solenoid valve blocked	Clean or replace
	Intermittent or interrupted operation	Expansion valve blocked or obstructed	Repair or replace.
	Excessive overheating	Poorly regulated overheating	Regulate the expansion valve and check for overheating
		Excessive pressure drop in the evaporator	Check for overheating and recalibrate the expansion valve
Excessively high delivery pressure	Excessively hot air at the condenser outlet	Poor condensation air flow	Check the state of the fan and look for any obstacles to the air flow
		Dirty condenser	Remove the material blocking the condenser (leaves, paper, etc.)
	Cold air at the condenser outlet	Circuit with too much refrigerant, condenser partially flooded	Remove refrigerant from the condenser
Excessively high suction pressure	The compressor operates without ever stopping	Excessive evaporator load	Check for excessive external air infiltrating into the air conditioned room
	Abnormally cold suction pipe	Over-supply to the expansion valve	Regulate the degree of overheating and check the bulb position
		Expansion valve stuck in the open position	Repair or replace the valve
	Noisy compressor	Damaged compressor compression spirals	Review the compressor

18.0 FOOTPRINT DIMENSIONS

KRYSTAL MODELS 021 A

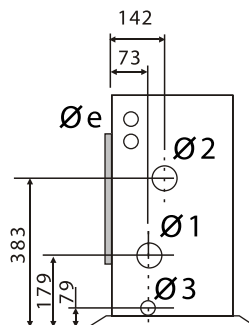
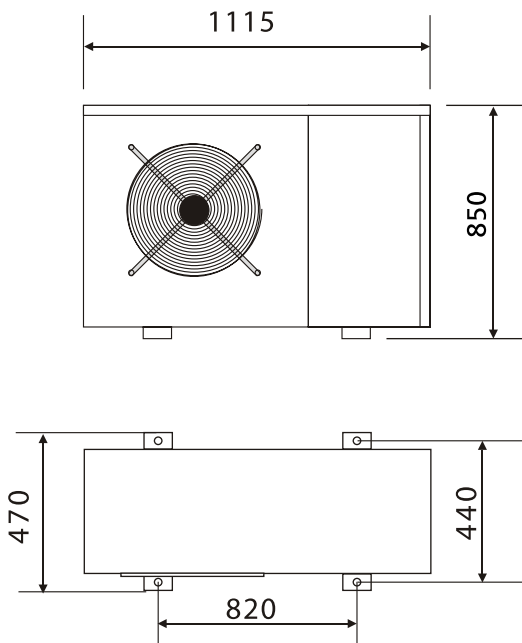


- Ø1 Water inlet $\frac{3}{4}$ "
- Ø2 Water outlet $\frac{3}{4}$ "
- Ø3 Water drain $\frac{3}{4}$ "
- Øe Holes for the passage of electrical power cables

IN System water inlet (return from the user system)
OUT System water outlet (delivery to the user system)

N.B. All the plumbing connections have female type threads

KRYSTAL MODELS 031 A

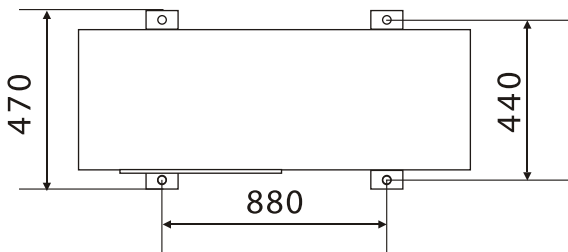
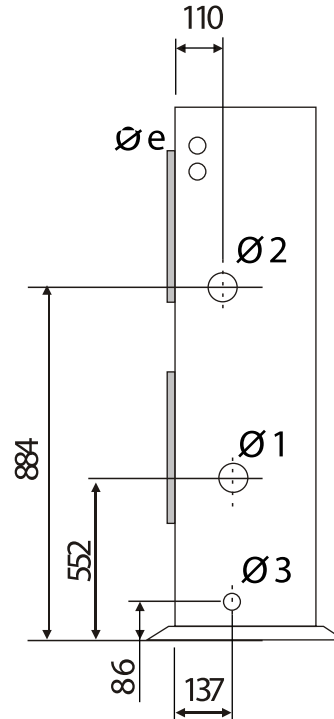
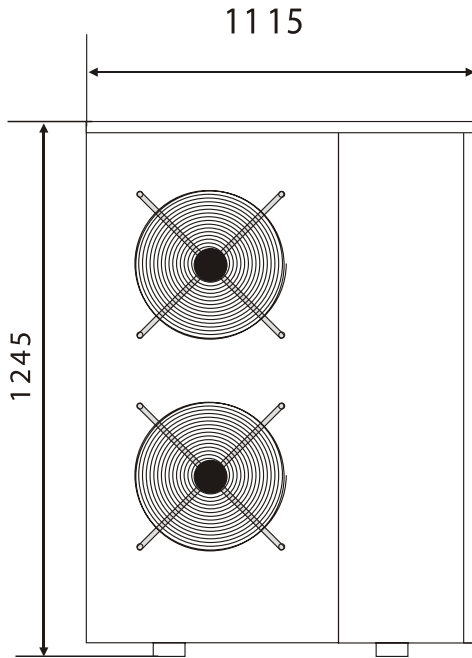


- Ø1 Water inlet 1 "
- Ø2 Water outlet 1 "
- Ø3 Water drain $\frac{3}{4}$ "
- Øe Holes for the passage of electrical power cables

IN System water inlet (return from the user system)
OUT System water outlet (delivery to the user system)

N.B. All the plumbing connections have female type threads

KRYSTAL MODELS 041 A - 051 A - 061 A



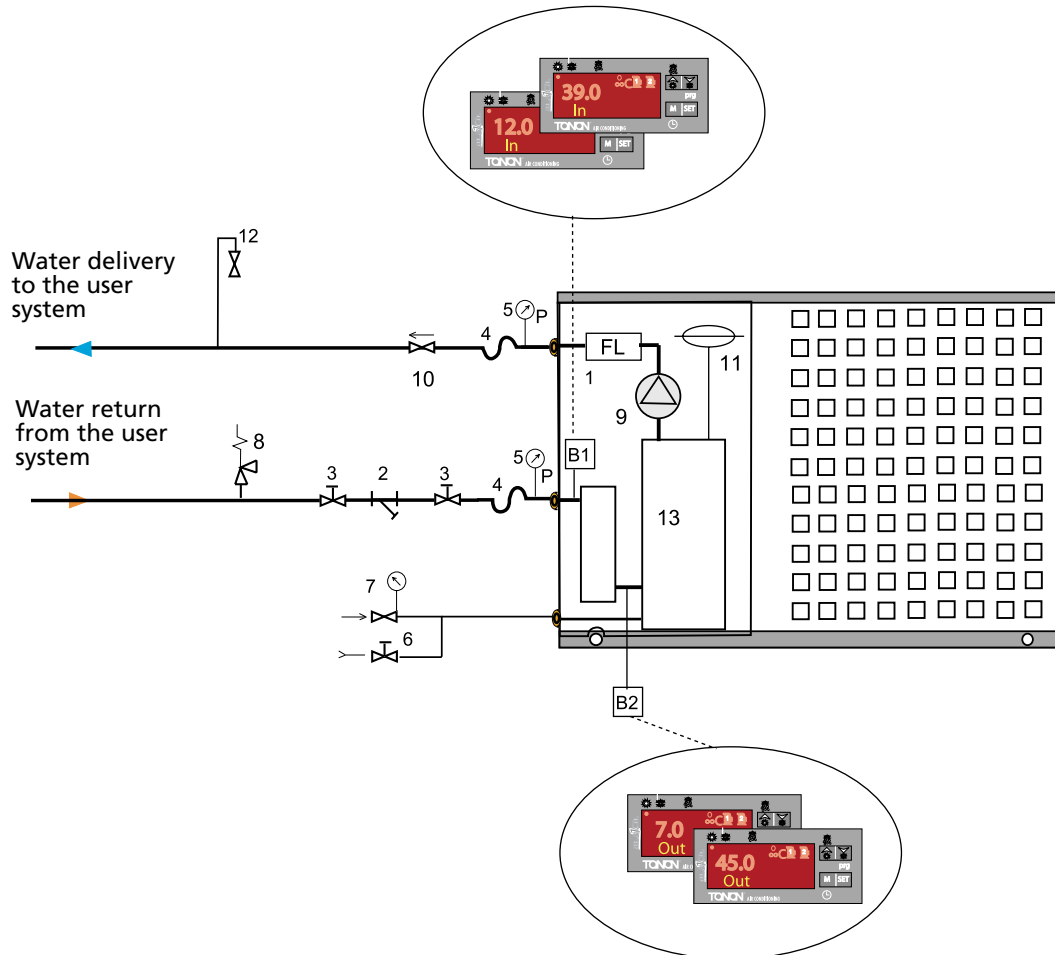
- Ø1 Water inlet _1" _
- Ø2 Water outlet _1" _
- Ø3 Water drain _3/4" _
- Ø e Holes for the passage of electrical power cables

IN System water inlet (return from the user system)
OUT System water outlet (delivery to the user system)

N.B. All the plumbing connections have female type threads

19.0 GENERAL PLUMBING DIAGRAMS

SYSTEM TYPE FOR COUPLING WITH KRYSTAL HEAT PUMP



KEY

- | | | | | | |
|-----|--------------------------------|-----|-------------------|-----|------------------|
| 1- | differential pressure switch | 2- | mesh filter | 3- | intercept valves |
| 4- | anti-vibration plumbing joints | 5- | pressure gauges | 6- | drain cock |
| 7- | charge assembly | 8- | safety valve 6bar | 9- | circulating pump |
| 10- | check valve | 11- | expansion vessel | 12- | air bleed valve |
| 13- | water buffer tank | | | | |

NB: BEFORE MAKING THE PLUMBING CONNECTIONS, COMPARE THE SYSTEM PRESSURE DROPS WITH THE USEFUL STATIC PRESSURE OF THE PUMP INSTALLED ON THE MACHINE:

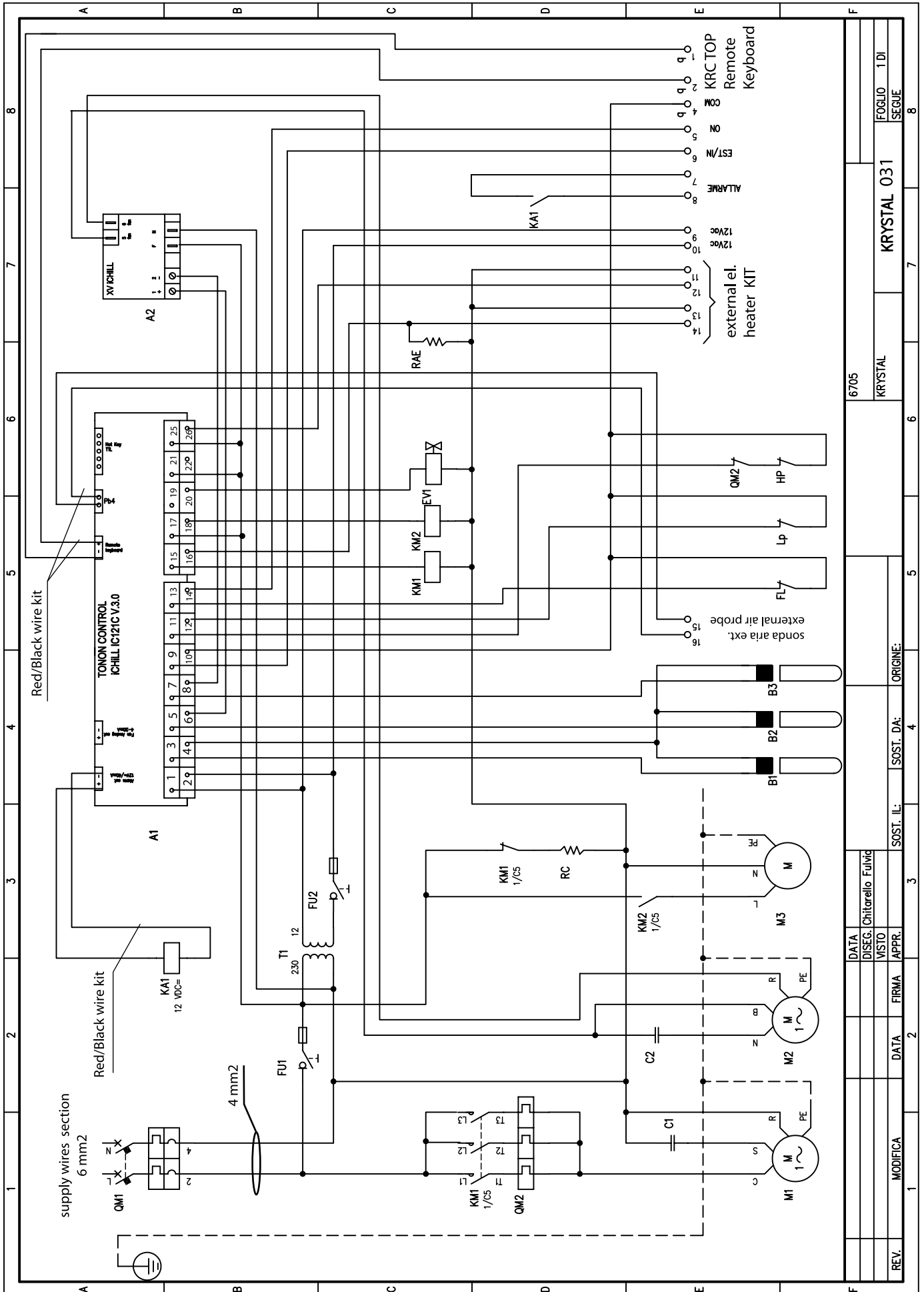
PUMP USEFUL STATIC PRESSURE => SYSTEM PRESSURE DROPS

20.0 WIRING DIAGRAMS

KEY TO ELECTRICAL COMPONENTS IN THE ELECTRICAL PANEL

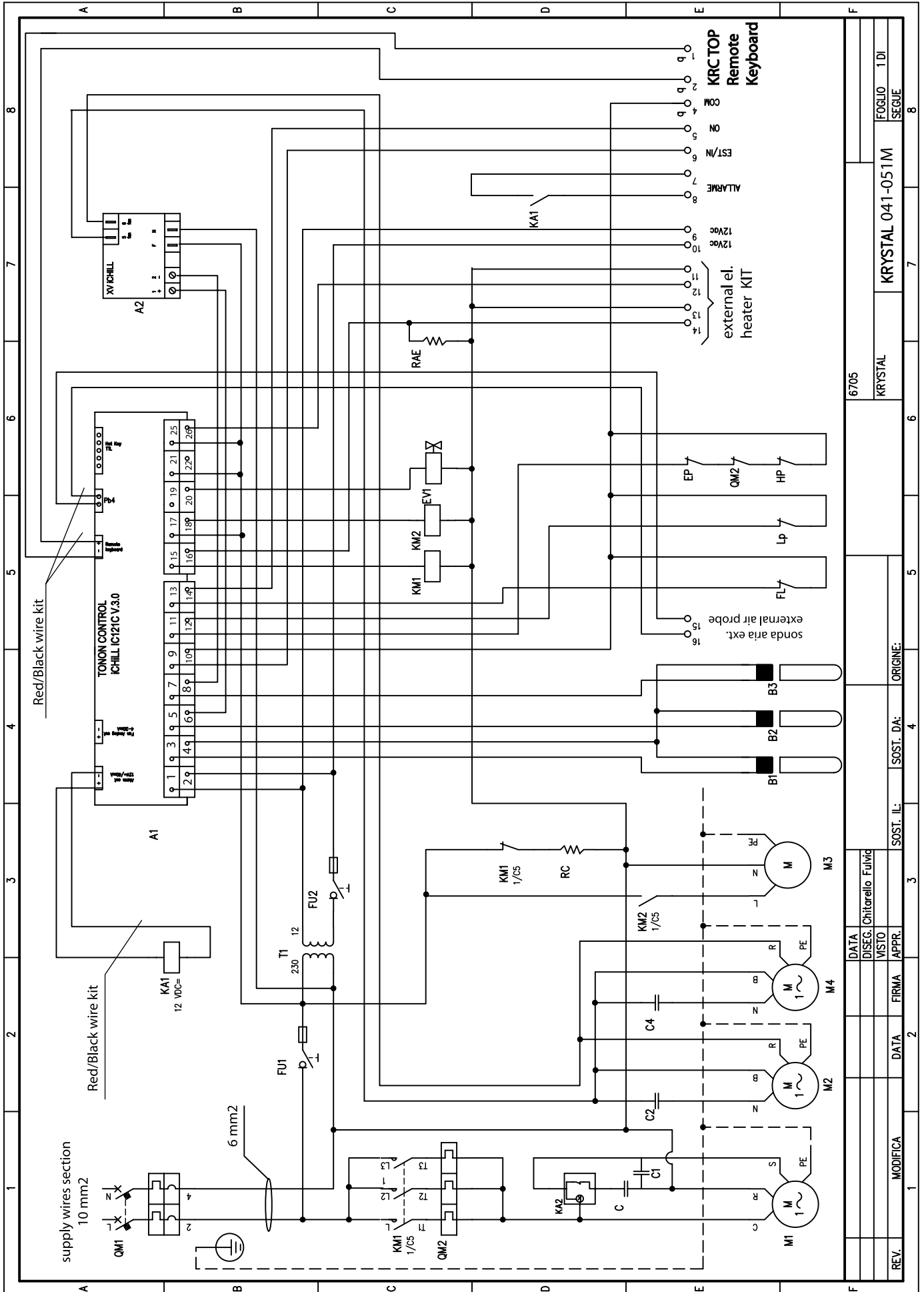
A1	MICROPROCESSOR ELECTRONIC REGULATOR
A2	FAN SPEED CONTROLLER
EV1	CYCLE INVERSION VALVE
FL	FLOW METER
FU1/2	AUXILIARY CIRCUIT PROTECTION FUSES
HP	HIGH PRESSURE SWITCH
KA3	CYCLICAL PHASE CONTROL RELAY
KM1	COMPRESSOR POWER CONTACTOR
KM2	PUMP POWER CONTACTOR
LP	LOW PRESSURE SWITCH
M1	COMPRESSOR MOTOR
M2	FAN MOTOR
M3	PUMP MOTOR
M4	FAN MOTOR model 051 - 061
B1	OPERATING PROBE
B2	ANTIFREEZE PROBE
B3	CONDENSER PROBE
QM1	GENERAL MAGNETO-THERMAL PROTECTION
QM2	COMPRESSOR GENERAL MAGNETO-THERMAL PROTECTION
RC	COMPRESSOR OIL CRANKCASE HEATER
T1	AUXILIARY CIRCUIT TRANSFORMER 230V/12V 5VA
TX1	FAN 1 KLIXON

diagrams KRYSTAL 031A



REV.	MODIFICA	DATA	FIRMA	APPR.	VISTO	DISSEG.	Chitarello Fulvio
SOST. IL:				SOST. DA:		ORIGINE:	
6705				KRYSTAL		KRYSTAL 031	
FOGLIO				1 DI		8	
SEGUE							

diagrams KRISTAL 041A 051C



REV.	MODIFICA	DATA	FIRMA	APPR.	VISTO	DATA	DISSEG. Chitarello Fulvio
SOST. IL:	SOST. DA:	ORIGINE:					
6705							KRYSTAL
KRYSTAL 041-051M							FOGLIO 1 DI
							8

**AZIENDA CON SISTEMA DI
GESTIONE PER LA QUALITÀ
CERTIFICATO DA DNV
=UNI EN ISO 9001:2000=**

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