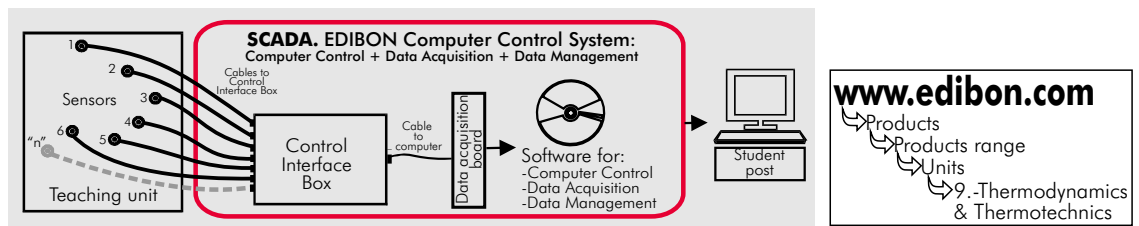
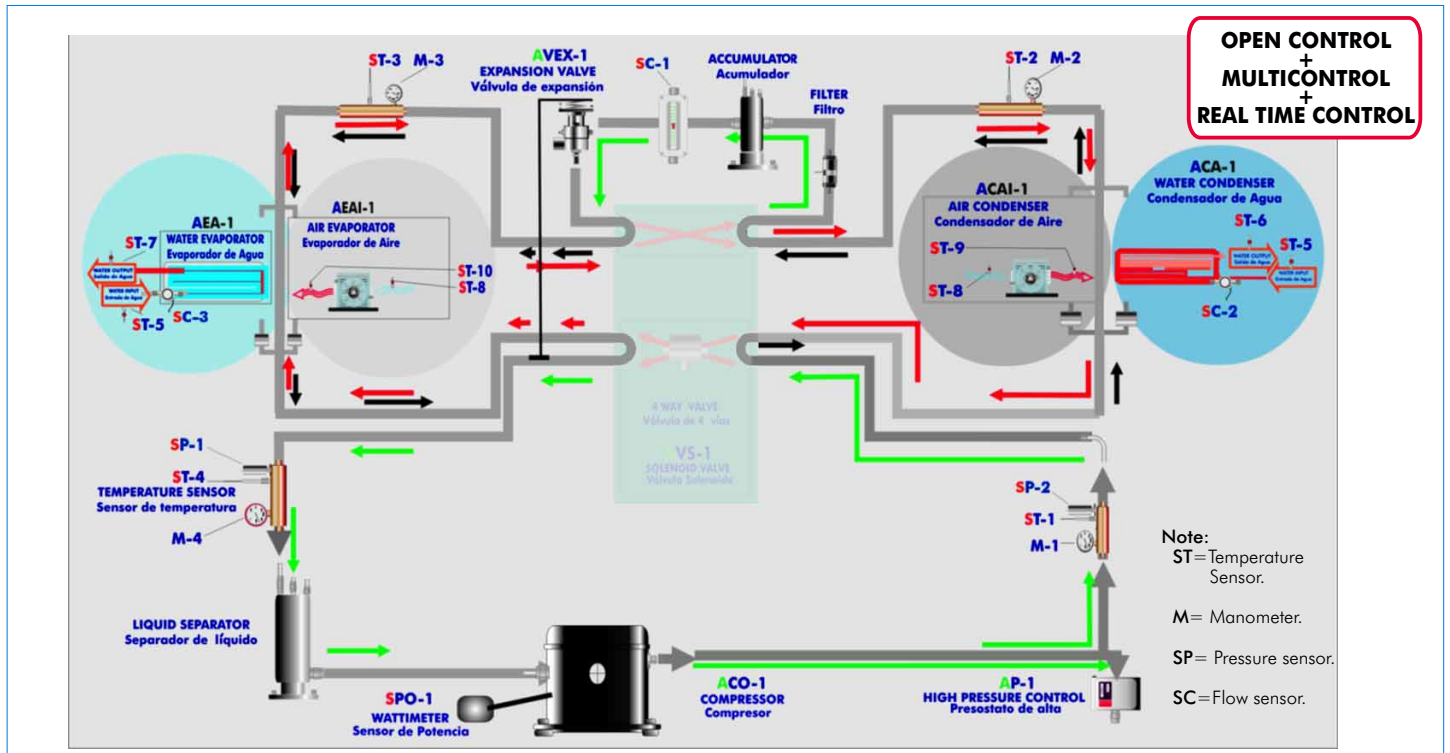


① Unit: THAR22C. Refrigeration and Air Conditioning Unit (two condensers (water and air) and two evaporators (water and air))



### PROCESS DIAGRAM AND ELEMENTS ALLOCATION



**Items supplied as standard**

**① THAR22C. Unit:**

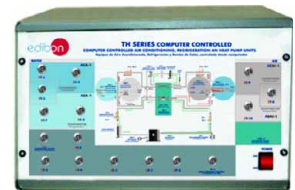
- Bench-top unit.
- Anodized aluminium structure and panels in painted steel (epoxy paint).
- Main metallic elements in stainless steel.
- Diagram in the front panel with similar distribution to the elements in the real unit.
- Cooling compressor, computer controlled.
- Air condenser, computer controlled.
- Water condenser.
- High pressure control.
- Coolant accumulation tank.
- Cooling filter.
- Expansion valve.
- Water evaporator.
- Air evaporator, computer controlled.
- Tank of division of the cooling liquid.
- 4 Manometers.
- 10 Temperature sensors (4 sensors measure the cooling temperature, 3 sensors measure the water temperature, 3 sensors measure the air temperature):
  - Temperature sensor, J type (compressor outlet).
  - Temperature sensor, J type (condenser outlet/evaporator inlet).
  - Temperature sensor, J type (evaporator inlet/condenser outlet).
  - Temperature sensor, J type (compressor inlet).
  - Temperature sensor, J type (water inlet).
  - Temperature sensor, J type (condenser outlet/evaporator).
  - Temperature sensor, J type (evaporator outlet/condenser).
  - Temperature sensor, J type (room air).
  - Temperature sensor, J type (condenser outlet/evaporator).
  - Temperature sensor, J type (evaporator outlet/condenser).
- 3 Flow sensors:
  - Cooling flow sensor. Water flow sensor (water condenser). Water flow sensor (water evaporator).
- 2 Pressure sensors:
  - Cooling pressure sensor (compressor outlet).
  - Cooling pressure sensor (compressor inlet).
- Wattmeter.



THAR22C. Unit

**② THAR22C/CIB. Control Interface Box:**

- Control interface box with process diagram in the front panel and with the same distribution that the different elements located in the unit, for an easy understanding by the student.
- All sensors, with their respective signals, are properly manipulated from -10V. to +10V computer output. Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors. Single cable between the control interface box and computer.
- The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure.
- Simultaneously visualization in the computer of all parameters involved in the process.
- Calibration of all sensors involved in the process.
- Real time curves representation about system responses.
- Storage of all the process data and results in a file. Graphic representation, in real time, of all the process/system responses.
- All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process. All the actuators and sensors values and their responses are placed in only one computer screen.
- Shield and filtered signals to avoid external interferences.
- Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.
- Real time computer control for pumps, compressors, resistances, control valves, etc.
- Open control allowing modifications, at any time and in a real time, of parameters involved in the process simultaneously.
- Three safety levels, one mechanical in the unit, other electronic in control interface and the third one in the control software.



THAR22C/CIB

**③ DAB. Data Acquisition Board:**

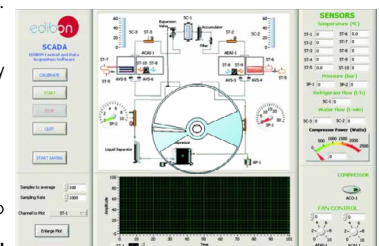
- PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.
- Analog input: Channels= 16 single-ended or 8 differential. Resolution= 16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (Kilo samples per second). Input range (V)=±10V. Data transfers=DMA, interrupts, programmed I/O. Number of DMA channels=6.
- Analog output: Channels=2. Resolution= 16 bits, 1 in 65536. Maximum output rate up to: 833 KS/s. Output range(V)=±10V. Data transfers=DMA, interrupts, programmed I/O.
- Digital Input/Output: Channels=24 inputs/outputs. DO or DI Sample Clock frequency: 0 to 1 MHz.
- Timing: Counter/timers=2. Resolution: Counter/timers: 32 bits.



DAB

**④ THAR22C/CCSOF. Computer Control + Data Acquisition + Data Management Software:**

- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen.
- Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneously way.
- Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters. Management, processing, comparison and storage of data.
- Sampling velocity up to 250,000 data per second guaranteed.
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access at different work levels.
- This unit allows that the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.



THAR22C/CCSOF

**⑤ Cables and Accessories**, for normal operation.

**⑥ Manuals:** This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

**\* References 1 to 6: THAR22C + THAR22C/CIB + DAB + THAR22C/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.**

Continue...

**Complementary items to the standard supply**

PLC. Industrial Control using PLC (7 and 8):

**⑦ PLC-PI. PLC Module:**

Circuit diagram in the front panel.

Front panel:

**Digital inputs(X) and Digital outputs (Y) block:**

**16 Digital inputs**, activated by switches and 16 LEDs for confirmation (red).

**14 Digital outputs** (through SCSI connector) with 14 LEDs for message (green).

**Analog inputs block:**

**16 Analog inputs** (-10V. to + 10V.)(through SCSI connector).

**Analog outputs block:**

**4 Analog outputs** (-10V. to + 10V.)(through SCSI connector).

**Touch screen:**

High visibility and multiple functions.

Display of a highly visible status.

Recipe function.

Bar graph function.

Flow display function.

Alarm list.

Multi language function.

True type fonts.

Back panel:

Power supply connector.

Fuse 2A.

RS-232 connector to PC.

USB 2.0 connector to PC.

Inside:

Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

**Panasonic PLC:**

**High-speed scan of 0.32 μsec.** for a basic instruction.

**Program capacity of 32 Ksteps**, with a sufficient comment area.

Free input AC voltage(100 to 240 V AC).

DC input: 16 (24 VDC).

Relay output: 14 (250 VA AC/2 A).

**High-speed counter.**

**Multi-point PID control.**

**Digital inputs/outputs and analog inputs/outputs Panasonic modules.**

Communication RS232 wire, to computer (PC).

**⑧ THAR22C/PLC-SOF. PLC Control Software:**

For this particular unit, always included with PLC supply.



PLC-PI

**Items available on request**

**⑨ THAR22C/CAL. Computer Aided Learning Software (Results Calculation and Analysis).**

**⑩ THAR22C/FSS. Faults Simulation System.**

Software Main Screens

Main screen

The main screen displays a refrigeration cycle diagram with components including SC-3, ST-3, Expansion Valve, SC-1, Accumulator, Filter, ST-2, SC-2, ACAl-1, AEAl-1, ST-7, ST-10, ST-8, ST-6, ST-5, AVS-5, AVS-6, AVS-3, AVS-4, Liquid Separator, Compressor, and AP-1. It features control buttons (CALIBRATE, START, STOP, QUIT, START SAVING), a plot of Amplitude vs Time for channel ST-1, and various sensor/actuator readouts.

**SENSORS**  
 Temperature (°C)  
 ST-1 0 ST-6 0.0  
 ST-2 0 ST-7 0  
 ST-3 0 ST-8 0  
 ST-4 0 ST-9 0  
 ST-5 0.0 ST-10 0

**Pressure (bar)**  
 SP-1 0 SP-2 0

**Refrigerant Flow (l/h)**  
 SC-1 0

**Water Flow (l/min)**  
 SC-3 0 SC-2 0

**Compressor Power (Watts)**  
 0 500 1000 1500 2000 2500

**COMPRESSOR**  
 ACO-1

**FAN CONTROL**  
 AEAl-1 ACAl-1

Plot: Amplitude vs Time (0-101). Channel: ST-1.

Note: ST= Temperature sensor. SP= Pressure sensor. SC= Flor sensor. ACO-1= Compressor. AEAl-1= Air evaporator. ACAl-1= Air condenser.

Examples of Sensors Calibration screens

**CALIBRATION** window for sensor SP-1:

Analog Input Channel: SP-1  
 Sensor Name: SP-1  
 Calibration units: bar  
 Full Scale: 1  
 Gain: 0,196684 Offset: -0,061385  
 Sensors: Volume-flow  
 Least Squares Fit  
 PTA: 10  
 Volts: 0,08424 Calibrated: -0,04482  
 Buttons: ENTER, EXIT, EXIT & SAVE

**MULTICALIBRATE** window:

Signed Technical Support  
 Reference Value: 23,2113  
 AT Full Scale Tolerance (%)  
 100 1

Reference Select	Sensors	volts	Calibrated	Err (%)
<input checked="" type="checkbox"/>	ST-1	0,2046	22,3821	0,82
<input checked="" type="checkbox"/>	ST-2	0,2292	23,483	0,28
<input checked="" type="checkbox"/>	ST-3	0,2353	23,1522	0,05
<input checked="" type="checkbox"/>	ST-4	0,2301	23,2113	0,01
<input type="checkbox"/>	SCC-1	0,1527	13,1629	10,04
<input type="checkbox"/>	SC-1	-5,2792	172,5164	149,31
<input type="checkbox"/>		-0,2362	-22,6609	45,87
<input type="checkbox"/>		-0,1774	0,0319629	23,17
<input type="checkbox"/>		-0,2681	-60,4623	85,67
<input type="checkbox"/>		-0,2251	0,4208	22,78
<input type="checkbox"/>		-0,2529	-0,2529	23,46
<input type="checkbox"/>		-0,2063	-0,1178	23,32
<input type="checkbox"/>		-0,2581	-226,9384	250,14
<input type="checkbox"/>		-0,3634	-0,3634	23,57
<input type="checkbox"/>		-0,275	-0,275	23,48
<input type="checkbox"/>		-0,2005	-0,2005	23,41

Buttons: ENTER, DONE

**GAIN OFFSET p**

Sensors	GAIN	OFFSET	p
ST-1	97,7605	2,3804	0
ST-2	97,7997	1,0627	0
ST-3	95,6345	0,6041	0
ST-4	96,6188	0,9823	0
SCC-1	93,9573	-1,1855	0
SC-1	162,04	1027,9537	0
	97,4967	0,3678	0
	0,679363	0,1525	0
	41,2123	-49,4113	0
	0,27089	0,4817	0
	1	0	0
	0,417958	-0,0315	0
	879,1	0	0
	1	0	0
	1	0	0
	1	0	0

## EXERCISES AND PRACTICAL POSSIBILITIES

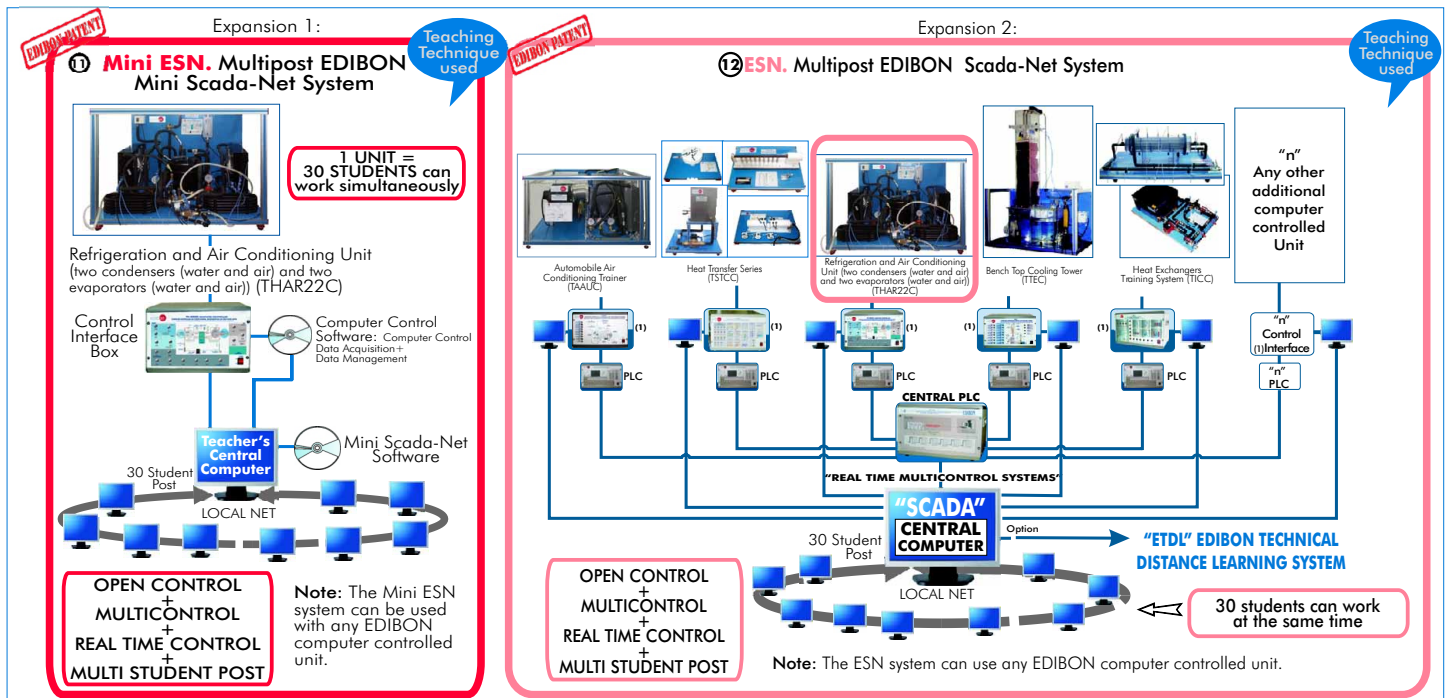
### Some Practical Possibilities of the Unit:

- 1.-Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Water-water).
- 2.-Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Water-air).
- 3.-Determination of the inlet power, produced heat and performance coefficient. Air as heat source. (Air-air).
- 4.-Determination of the inlet power, heat produced and performance coefficient. Water as heat source. (Air-water).
- 5.-Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source. (Water-water).
- 6.-Preparation of performance curves of the unit at different inlet and outlet temperatures. Air as heat source. (Water-air).
- 7.-Preparation of performance curves of the unit with different inlet and outlet temperatures. Water as heat source. (Air-water).
- 8.-Preparation of the performance curves of the unit with different inlet and outlet temperatures. Air as heat source. (Air-air).
- 9.-Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Water-water).
- 10.-Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Water-air).
- 11.-Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Water as heat source. (Air-water).
- 12.-Lay out of the steam compression cycle in a diagram P-H and comparison with the ideal cycle. Air as heat source. (Air-air).
- 13.-Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Water-water).
- 14.-Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Water-air).
- 15.-Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Water as heat source. (Air-water).
- 16.-Preparation of the performance curves of the unit based on the properties of the refrigerant and at different condensation and evaporation temperatures. Air as heat source. (Air-air).

Other possible practices:

- 17.-Temperature sensors calibration.
  - 18.-Water flow sensors calibration.
  - 19.-Refrigerant flow sensor calibration.
  - 20.-Pressure sensors calibration.
- Practices to be done by PLC Module (PLC-PI) + PLC Control Software:
- 21.-Control of the THAR22C unit process through the control interface box without computer.
  - 22.-Visualization of all the sensors values used in THAR22C unit process.
  - 23.-Calibration of all sensors included in THAR22C unit process.
  - 24.-Hand on of all the actuators involved in the THAR22C unit process.
  - 25.-Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
  - 26.-Simulation of outside actions, in the cases do not exist hardware elements (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
  - 27.-PLC hardware general use and manipulation.
  - 28.-PLC process application for the THAR22C unit.
  - 29.-PLC structure.
  - 30.-PLC inputs and outputs configuration.
  - 31.-PLC configuration possibilities.
  - 32.-PLC program languages.
  - 33.-PLC different programming standard languages (literal structured, graphic etc.)
  - 34.-New configuration and development of new process.
  - 35.-Hand on an established process.
  - 36.-To visualize and see the results and to make comparisons with the THAR22C unit process.
  - 37.-Possibility of creating new process in relation with the THAR22C unit.
  - 38.-PLC Programming Exercises.
  - 39.-Own PLC applications in accordance with teacher and student requirements.

## POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS



## ORDER INFORMATION

### Items supplied as standard:

Minimum configuration for normal operation includes:

- ① Unit: THAR22C. Refrigeration and Conditioning Unit (two condensers (water and air) and two evaporators (water and air)).
- ② THAR22C/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ THAR22C/CCSOF. Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

### Complementary items to the standard supply:

- PLC. Industrial Control using PLC. (7 and 8):
- ⑦ PCL-PI. PLC Module.
- ⑧ THAR22C/PLC-SOF. PLC Control Software.
- ⑨ THAR22C/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
- ⑩ THAR22C/FSS. Faults Simulation System. (Available on request).

### Expansions

- ① Mini ESN. Multipost EDIBON Mini Scada-Net System.
- ② ESN. Multipost EDIBON Scada-Net System.

**\* IMPORTANT: Under THAR22C we always supply all the elements for immediate running as 1, 2, 3, 4, 5 and 6.**

## REQUIRED SERVICES

Electrical supply: 220V, 1-phase + neutral + ground, 50 Hz.; or 110V, 1-phase + neutral + ground, 60Hz.; and 1 CV max.

Water supply and drainage.

Computer (PC).

## DIMENSIONS & WEIGHTS

THAR22C Unit: -Dimensions: 900 x 600 x 500 mm. approx.

-Weight: 100 Kg. approx.

Control Interface Box: -Dimensions: 490 x 330 x 310 mm. approx.

-Weight: 10 Kg. approx.

PLC Module (PLC-PI): -Dimensions: 490 x 330 x 310 mm. approx.

-Weight: 30 Kg. approx.

## RECOMMENDED ACCESSORIES

For refilling R134a refrigerant and maintenance, we recommend:

- T/KIT1. Maintenance Kit, containing: vacuum pump, hoses and manometers.

- T/KIT2. Maintenance Kit, containing: leakage detector.

- R134a refrigerant (to be acquired by the customer locally).

## AVAILABLE VERSIONS

Offered in this catalogue:

- **THAR22C.** Computer Controlled **Refrigeration and Air Conditioning Unit (two condensers (water and air) and two evaporators (water and air)).**

Offered in other catalogue:

- **THAR22B.** **Refrigeration and Air Conditioning Unit (two condensers (water and air) and two evaporators (water and air)).**

## OTHER AVAILABLE REFRIGERATION AND AIR CONDITIONING UNITS

- **THAR2LC.** Computer Controlled **Refrigeration and Air Conditioning Unit (two condensers (water and air) and one evaporator (water)).**

- **THAR2LB.** **Refrigeration and Air Conditioning Unit (two condensers (water and air) and one evaporator (water)).**

- **THARL2C.** Computer Controlled **Refrigeration and Air Conditioning Unit (one condenser (water) and two evaporators (water and air)).**

- **THARL2B.** **Refrigeration and Air Conditioning Unit (one condenser (water) and two evaporators (water and air)).**

- **THARALC.** Computer Controlled **Refrigeration and Air Conditioning Unit (one condenser (air) and one evaporator (water)).**

- **THARALB.** **Refrigeration and Air Conditioning Unit (one condenser (air) and one evaporator (water)).**

- **THARA2C.** Computer Controlled **Refrigeration and Air Conditioning Unit (one condenser (air) and two evaporators (water and air)).**

- **THARA2B.** **Refrigeration and Air Conditioning Unit (one condenser (air) and two evaporators (water and air)).**

- **THARLLC.** Computer Controlled **Refrigeration and Air Conditioning Unit (one condenser (water) and one evaporator (water)).**

- **THARLLB.** **Refrigeration and Air Conditioning Unit (one condenser (water) and one evaporator (water)).**

\* Specifications subject to change without previous notice, due to the convenience of improvements of the product.



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