

## Computer controlled vapour-compression refrigeration unit – RA1-MKII

The RA1-MKII is a self contained computer controlled vapour-compression refrigeration system with automatic recording of all important process variables using an integral USB interface device.

Compressor speed and power supplied are displayed on the PC. The hermetically sealed refrigerant exiting the compressor passes through a condenser, receiver, filter, variable area flowmeter, expansion valve and evaporator before returning to the inlet side of the compressor.

**AUTOMATIC DATA LOGGING WITH REALTIME DISPLAY  
SELF CONTAINED UNIT**

RA1: Unit with water reservoir



### Features

- ▶ Complete system enabling demonstration of the most common refrigeration system used today
- ▶ Computer controlled with automatic recording of measured and calculated variables using a PC
- ▶ Overall performance of the system is calculated and displayed continuously enabling the effect of changes in the system to be evaluated
- ▶ Submersible variable speed pumps supply water at a stable temperature and pressure from the reservoir to the condenser and evaporator eliminating fluctuations
- ▶ Condenser and evaporator both use plate heat exchangers enabling a full energy balance to be carried out while varying the operating conditions on both sides of the compressor
- ▶ Separation of the refrigerant and water circuits aids understanding of the refrigeration system and the function of the various components
- ▶ Real-time superheat conditions in the condenser and evaporator are calculated and displayed
- ▶ Real-time display of Coefficient of Performance (COP)
- ▶ Expansion valve setting can be varied by the operator to change the operating point (evaporator superheat setting)
- ▶ Use of the refrigerant flowmeter as a sight glass enables observation of any vapour bubbles downstream of the compressor when conditions are not optimal
- ▶ Alarms protect the equipment from misuse by switching the compressor off if pressures, temperatures, flowrates or pumps drift outside acceptable limits. Advanced warnings enable the operator to take remedial action before the compressor is switched off
- ▶ Bourdon type gauges indicate the pressure and corresponding refrigerant saturation temperature on both sides of the compressor independent from the electronic systems

## Experimental content

- Gain an in-depth understanding of the vapour-compression process by changing the operation of different parts of the process and recording the response of the complete system
- To operate vapour-compression refrigeration system and understand the relation between the hardware components and the refrigeration cycle
- First Law of Thermodynamics - The law of conservation of energy
- To investigate the effect on the refrigeration system of the flow of water through the condenser and to determine the optimum flow rate for a given load
- To investigate the effect on the refrigeration system of the flow of water through the evaporator and to determine the optimum flow rate for a given system load
- To investigate the effect of the flow of refrigerant through the refrigeration system, and whether there is an optimum flow rate
- To investigate the effect of closing/opening the expansion valve on a refrigeration system, and to determine the optimum setting for a particular application
- Coefficient of Performance (COP)
- Thermodynamic system modelling
- To perform appropriate energy balances and a detailed analysis of the performance of the refrigeration system

## Technical specifications

Refrigeration system	Vapour-compression type
Refrigerant	R134a
Hermetically sealed compressor speed range	2000 to 4400 RPM
Hermetically sealed compressor supply	24V DC to speed controller of brushless 3 phase DC motor
Hermetically sealed compressor rating	7.11 cm <sup>3</sup> (0.434 cu in) for high evaporator temperature with 7.2°C rating point
Condenser	Brazed plate heat exchanger using water as heat transfer medium
Evaporator	Brazed plate heat exchanger using water as heat transfer medium
Water reservoir	Working capacity 400 litres
Temperature sensors	NTC Thermistor
Refrigerant flowmeter	Variable area flowmeter

## Overall dimensions

Bench mounted refrigeration unit with separate floor standing water reservoir

Length of refrigeration unit	0.95m
Width	0.52m
Height	0.50m
Length of water reserve	1.09m
Width	0.71m
Height	0.79m

## Packed and crated shipping specifications

Volume	1.26m <sup>3</sup>
Gross weight	160Kg

**Note:** Refrigeration unit is located on top of the water reservoir when installed

## Complementary products

RA2 Air conditioning unit  
RA3 Recirculating air conditioning unit  
RA4 Air conditioning training Unit  
HT Series  
TH Series

## Requirements

## Scale



- Electricity supply: Single phase (see ordering codes)
- Software requires the user to have a PC running Windows 7 or above with a USB port.

## Software

Computer controlled system with automatic data acquisition of sensor values with tabulated and graphic options.

Diagrammatic representation of the equipment, complete with real-time demonstration of the various sensor outputs and instantaneous coefficient of performance (COP)

Operator control of compressor speed (motor speed), condenser cooling water flowrate (pump speed) and evaporator heating water flowrate (pump speed)

Misuse protection alarms

## Ordering specification

- Complete refrigeration system enabling demonstration of the vapour-compression refrigeration cycle
- Computer controlled system with automatic recording of process variables using an integral USB interface
- Measurement sensors include:
  - 9x Thermistor sensors measuring temperatures throughout the system
  - 2x Turbine type flow meters measuring flow of water through the condenser and evaporator
  - 2x Electronic sensors measuring pressures before and after the compressor
  - 2x Bourdon type refrigeration pressure gauges (with scale indicating equivalent refrigerant saturation temperature)
  - 1x Variable area flowmeter measuring refrigerant flowrate
  - 1x DC current shunt measuring current to the compressor motor
- Bench mounted refrigeration unit supplied complete with large water reservoir to isolate the process from fluctuations in temperature or pressure in the mains water supply
- Comprehensive instruction manual supplied

## Ordering codes

- RA1-MKII-A: 230V/1ph/50Hz 5 Amps
- RA1-MKII-B: 110V/1ph/60Hz 10 Amps
- RA1-MKII-G: 220V/1ph/60Hz 5 Amps



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