

# RHT Doc.™ - Relative Humidity and Temperature Calibrator

Designed, built, and supported by InstruQuest Inc.

## Model 1. Relative Humidity (RH) and Temperature Calibrator with Operational Software

The RHT Doc. is a relative humidity and temperature calibration system designed for laboratory and field applications. Performance, accuracy, convenience of use, and very low cost make it ideally suited for calibrating or developing RH sensing devices.

Primarily, saturated or unsaturated salt solutions are used to generate discrete values of RH but a flow-through stream of known RH can also be used. Several innovations were implemented to alleviate problems that were previously encountered while working with salt solutions.

The RHT Doc. has built-in microcontroller based electronics that allows processing digital and analog signals, displays them on a LCD screen, and transmits them to a PC via USB/Serial link for further processing. For example, single-wire digital transfer protocol for Rotronic digital probes has been implemented. For analog probes, two analog channels with 16-bit resolution and  $\pm 10\text{VDC}$  range are available at the back of the unit.

For temperature determination a calibrated RTD sensor is used and it is placed in the vicinity of the RH probe. Since it is easily removable, it can also serve as an external digital thermometer. The accuracy of the temperature readings is  $\pm 0.1^\circ\text{C}$  and the on screen readability is  $0.01^\circ\text{C}$ .

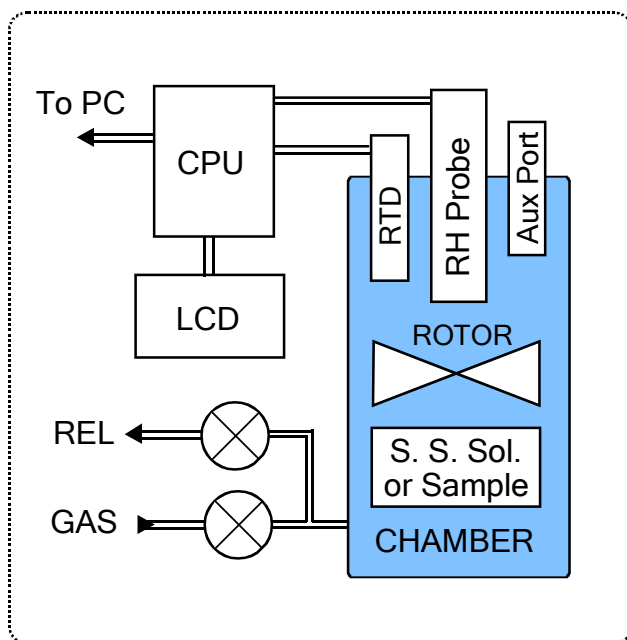
If connected to a PC, the provided Windows® based software allows the user for recording data according to the user defined templates, graphing, printing reports, etc.



### Features:

- Standards “certified” by Nature
- Fast equilibration
- Temperature uniformity and control
- Constant pressure
- Removable cartridges
- Tests digital and analog probes
- Accommodates different sizes
- Flow-through or closed operation
- Precision temperature probe
- Windows™ based software
- Low cost
- Lab or field operation
- Variety of applications

## RHT Doc. Operation



RHT Doc. Simplified Operational Diagram

A special air stirring mechanism that uses magnetically coupled drive was designed to achieve fast equilibration time and minimize heat generation. The user has the option of turning it on or off.

The chamber is machined from aluminum to assure excellent temperature uniformity and it is hard anodized for corrosion protection. Insulation jacket with flexible heater can be installed over the chamber. The temperature controller maintains the chamber temperature within 0.1°C. The temperature can be regulated from just above the ambient to at least 40°C. Placing the instrument in an environmental chamber with good temperature regulation will add additional capabilities of measurements at a larger range of temperatures.

A removable Teflon cartridge that can contain the saturated or unsaturated salt solution or a sample can be easily placed in the chamber. The user can have several cartridges at disposal for preparation and storage of the saturated salt solutions. Convenient and clean operation is assured. The cartridges can be hermetically closed when not in use.

RH probes of different diameters can be easily installed by using different adapters and O-ring sizes in the main port. The main port largest diameter is 15.5mm (0.61"). The auxiliary port can accept devices thinner than 3.5mm (0.14") O.D.

The two-valve manifold adds additional functionality to the chamber. Since the chamber is vacuum-proof, external temperature fluctuations would cause pressure changes in the chamber, and therefore affecting the RH probe readings. By turning the Relieve valve (REL) on, the "breathing" mechanism is activated and the pressure remains constant despite the temperature variations. It can be turned off when the temperature stabilizes.

An external source of gas can be connected to the 1/8" bulkhead located at the back of the instrument and supplied to the chamber by activating the GAS valve. The gas can be exhausted via AUX port. By supplying a dry gas, the 0% RH reference point can be materialized. Also, purging the system with different gases and equilibrating the chamber at the saturated salt atmosphere, responses of RH sensors can be studied.

Optionally, attaching a barometric pressure sensor (extra analog channel is available) and a device allowing to change pressure in the chamber, e.g. precision gas syringe, the pressure in the chamber can be varied and known. Therefore, responses of different RH sensors vs. pressure can be obtained. Also, using a small air pump a gaseous atmosphere can be drawn into the chamber from remote places via flexible tubing for moisture analysis.

The instrument requires external 12VDC supply for its operation. Either an AC-to-DC Wall Adapter with 12DC output or 12V battery can be used.

## RHT Doc. Operational Software.

The menu driven Windows™ based software allows recording experimental data, graphing, reporting, changing hardware configurations, and carrying out simple RH calculations. Before running an experiment, the user needs to either load a previously saved template (experiment protocol) or to create one. The template allows to enter some information about the run and to select data saving criteria (time, changes in RH, temperatures, pressure). During the run, any value can be modified at any time. A snapshot of the **New Template** form is presented below.

**Create New Template Form**

Experiment Information

Exp. Data File: MyFirst      Notes: NaCl

Operator ID: John Doe      Note 2:

Note 3:

Averaging

Number of readings (every 0.66s) to average for a data point: 4

Record RH and Temperature Data Point if any checked condition(s) is(are) true

Save Data Point Every: 2 [min]

| RH(Last Point)-RH(Current Point) | >= 0.1 [%]

| pr T(Last Point) - pr T(Current Point) | >= 0.1 [C]

| rtd T(Last Point) - rtd T(Current Point) | >= 0.1 [C]

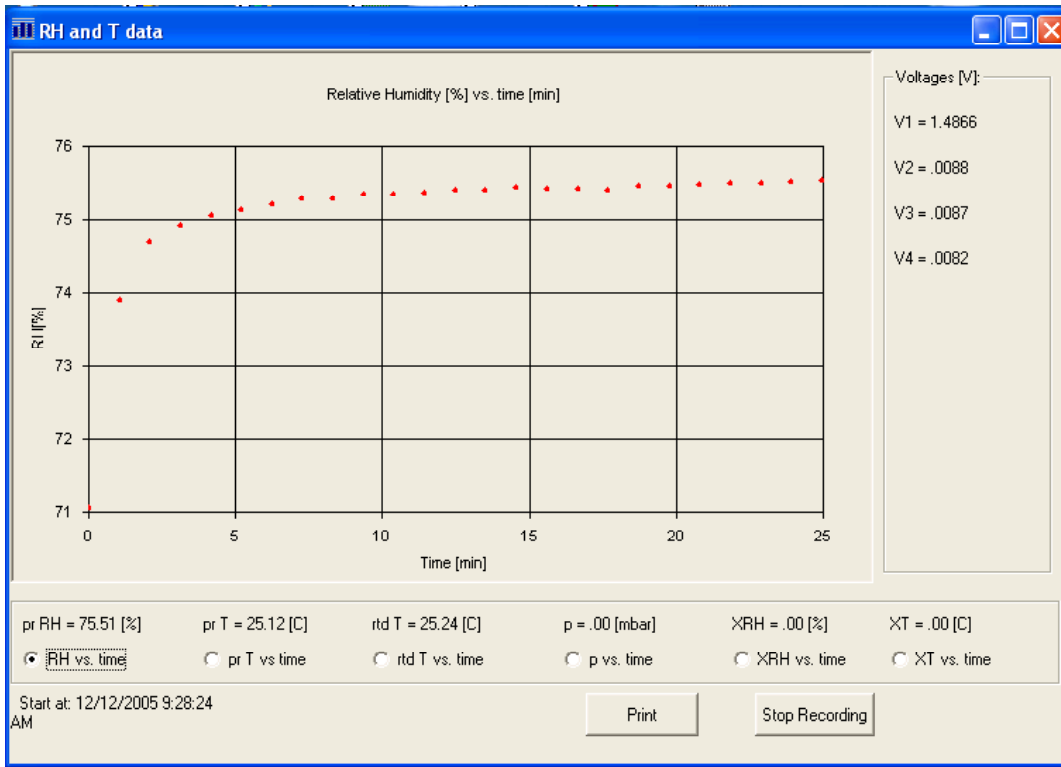
| p(Last Point) - p(Current Point) | >= 1 [mbar]

Save Template      Run Experiment      Continue after changes      Cancel

When the experiment protocol has been defined and saved, clicking the **Run Experiment** button activates the Chart form (see the next page). The form serves as graphical presentation of the experimental data and as a real time update of the transmitted data. If a digital RH probe (from ROTRONIC) is used, selecting the **pr RH vs. time** or **pr T vs. time** shows the probe relative humidity or temperature data versus time, respectively. By clicking the **rtd T vs. time** option button, the data from the provided RTD temperature probe are displayed. The **p vs. time** button is reserved for presenting pressure data from an (optional) or user provided pressure transducer (Analog channel 2).

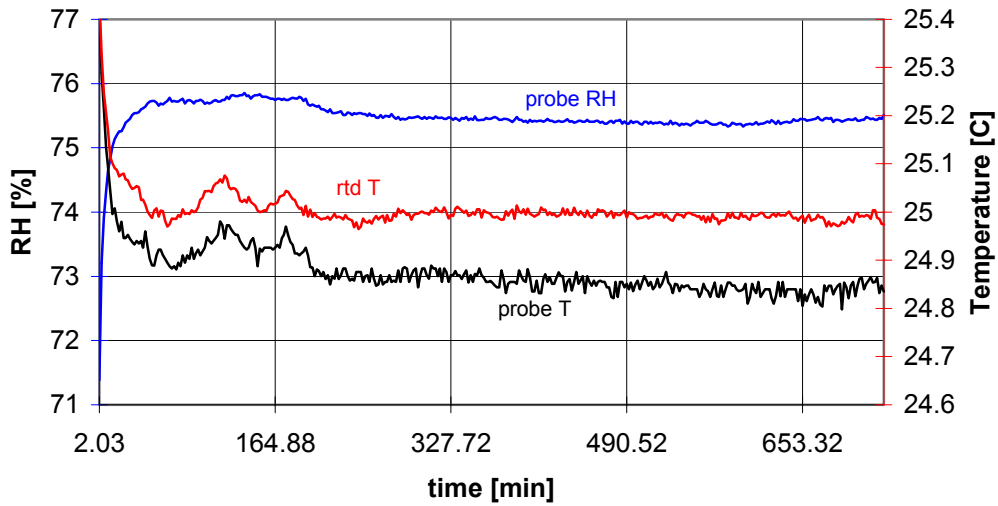
While working with analog RH probes that provide humidity and temperature data in form of analog voltages, the software also allows for recording those voltage values. In the Hardware Configuration form, the user can enter the “transfer functions “ that define the correspondence between the voltages and the RH and temperatures values. Thus, the **XRH vs. time** and **XT vs. time** buttons allow displaying the relative humidity and temperature, respectively.

Clicking the **Print** command button at any time causes printing the report with the currently displayed data.



The experimental results can be easily transferred to Excel (macro) for further processing. The figure below shows several series of data presented on the chart.

### RH probe calibration using NaCl Sat. Salt



## Applications:

1. Calibration / verification of RH probes (sensors)
2. Study of RH sensors characteristics at different temperatures, pressures, and gaseous atmospheres
3. Moisture analyzer / transmitter
  - 3.1. Study of headspace humidity over sample using a previously calibrated RH probe
  - 3.2. Sampling and determination of humidity in gases (from remote locations) using an air pump
  - 3.3. Precise measurement of humidity and temperature (RH and temperature probe with integral calibrator)

## Specifications:

Temperature probe (RTD):	Accuracy: $\pm 0.1^{\circ}\text{C}$	Readability = $0.01^{\circ}\text{C}$
Temperature control:	Stability $0.1^{\circ}\text{C}$	Range: above ambient to $40^{\circ}\text{C}$
Standard RH Probe sizes:	15 to 5 mm, special sizes upon request	
Main RH probe port:	I.D 15.5mm (0.61")	
Gas Inlet Port:	1/8" Swagelok™ type (compression) bulkhead	
Auxiliary port:	1/16 or 1/8" NPT, Typically 1/8" tube Male adapter installed.	
Power requirements:	12VDC adapter (center positive),	
Box dimensions: (W x H x D)	7.25" x 3.45" x 8.0" ( 18.4 cm x 8.8cm x 20.3 cm) (not including protrusions and the chamber)	
Instrument mass:	3 lb (1.4 kg)	
Standard equipment:	RHT Doc. w/ software, manual, cables, USB and power adapter 3 Teflon sample holders w/ hermetic closure assembly Set of adapters for 8, 10, 12 mm RH probes	

**Note:** For downloading the calibration results to Rotronic digital RH probes, additional equipment from **ROTRONIC INSTRUMENT CORP.** needs to be purchased:

**R87/MOKX-03-WIN** – Calibration Cbl 3m/DAT05 w. 9VDC Adap.  
**HW3** Software

**Note:** Reagents for preparation of salt solutions are readily available from many sources, e.g. Sigma-Aldrich, Mallinckrodt-Baker, Cole-Parmer, and normally are not supplied with the instrument.

**Note:** Among many sources of information about practice, theory, selection and preparation of the humidity fixed point solutions using salts, the publication R121 edition 1996(E) by OIML is highly recommended. Please follow the link:

<http://www.oiml.org/publications/R/R121-e96.pdf>