The HumiSys™ RH Generator

Designed, built, and supported by InstruQuest Inc.

Versatile Relative Humidity Generation and Multi-Sensor System

The new HumiSys with single or dual RH probes capabilities is a versatile, precise, and cost effective water vapor generation and calibration system for low flow rates (up to 500 cc/min) applications. Fast response, wide flow range, ability to collect data from variety of sensors, fully automatic and manual operation make it ideally suited for a wide variety of applications requiring an accurate and stable source of water vapor. Its modular design, ability to work in different hardware configurations, ability of user-implemented control using a simple command language, and versatility of the supplied operational software allow easy integration into a larger analytical setup or interfacing with other devices.

The HumiSys uses two mass flow controllers to generate fast, stable, and repeatable RH values from 0 to 100% at temperatures up to 90 ˚C . Typically the system is supplied with one RH probe and external temperature probe. Second RH probe can be used for monitoring purposes.

A precision pressure regulator isolates the selectable flow rate from fluctuations in the supply line. An automatic water supply system eliminates frequent user intervention inherent to other generators. The generated water vapor stream is delivered to the location of choice via flexible heated transfer line (standard equipment).

Applications

Programmable RH source for:

- Providing RH option to other analytical instruments: Gravimetric sorption analyzers, DMA, TGA, X-Ray Diffractometers, WVTR measurement instrumentation, etc.

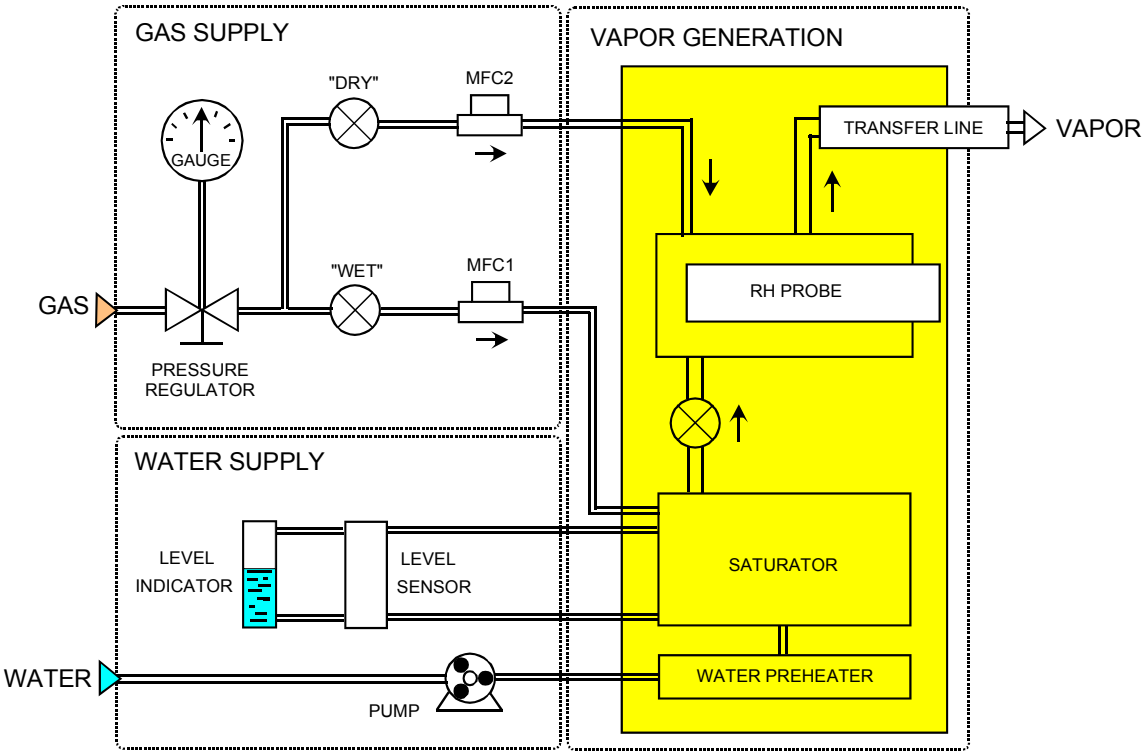
- High stability RH source - Relative humidity sensors calibration, troubleshooting system for sample chamber designs

- Sample conditioning in specialized instrumentation, maintenance of precise RH in variety of industrial chambers

Operation

A dry or semi-dry gas source is connected at the instrument back using 1/8” OD tubing. Typically, the gas source can be air generated from oil-less compressor or inert gas from a gas cylinder. The dryness of the gas will affect the lowest achievable RH values.

The gas pressure regulator allows selection of the desired pressure and observing it on the gauge (front panel). The gas flow can be divided into two branches. The gas portion flowing through the “WET” valve and mass flow controller (MFC1) enters the saturator where it becomes saturated with water vapors. After passing through the saturator, the humidified gas mixes with the gas flowing through the “DRY” valve and MFC2 in the mixing manifold. The humidified stream passes through the RH probe port and is redirected to the outlet port to which a heated transfer hose is normally connected. Internal connection of the hose ensures no condensation for high temperature operations. Automatic temperature control and available different sizes and lengths of the hose make interfacing very easy.



A high quality miniature, high temperature RH probe is employed to sense the amount of moisture in the mixed gas. The gas flow ratio is adjusted as needed to achieve the desired RH value. From the manifold the output stream is delivered via the heated transfer line to the location of choice. The temperature of the transfer line is automatically maintained at saturator temperature by a special controller board. No additional external controller is needed.

The water used for gas saturation should be de-ionized and of high purity to avoid contamination of the high surface media in the saturator and to minimize maintenance. The autonomous water delivery system consists of peristaltic pump and its controller, water level sensor, visual level indicator, pump enable switch (ON/OFF), and pump direction switch (Forward/Reverse) located at the back. When water level drops below certain level, the pump is activated and it supplies enough water to restore the required level. This amount of water is preheated to the saturator temperature to avoid any temperature drops in the saturator chamber. If automatic refill action is temporarily not desired, the pump enable switch can be turned off. In a case the water has to be removed from the system, e.g. for shipping purposes, the pump direction switch has to be switched to the REV position until the water is emptied.

RH Control Modes

Two basic modes can be used to provide RH control to the user defined location:

Mode 1. The RH probe used for RH control can be placed inside the user chamber (in a representative place near sample)

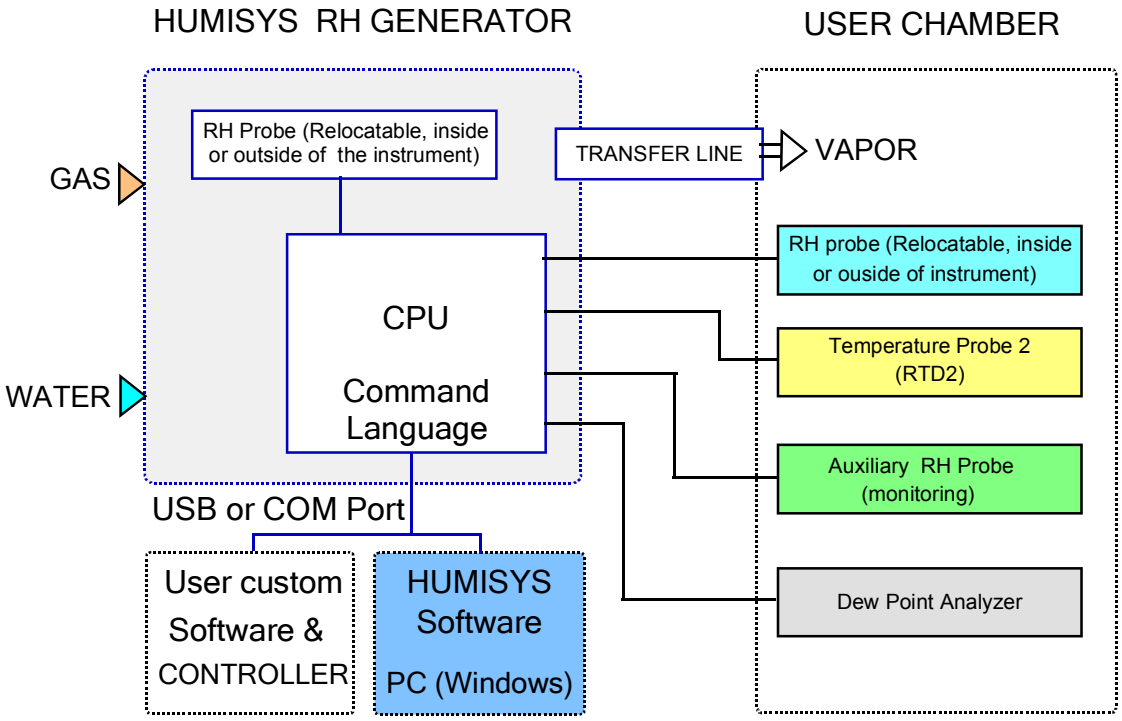
Mode 2. The RH probe used for control can be placed inside the RH generator and external temperature probe can be used for temperature monitoring of the user chamber.

The (optional) additional RH probe can be used for RH and temperature monitoring at any place. Additional modes and application specific sensors can be provided for customized units.

Auto and Manual Control

The HumiSys features Automatic and Manual mode of operation. The Manual mode was added to provide fast setup for "turn-key" operation. Saturator temperature, states of solenoids, voltages for MFC control are settable from the front panel controls. The resulting RH and temperature can be viewed on the LCD display. Windows based operational software is provided for automatic RH control (standard equipment). To facilitate interfacing with other instruments, an external voltage signal to start the software can be used.

Microcontroller board and ancillary electronics opens many possibilities for implementation of automatic operation of the instrument and interfacing to external hardware. From an OEM user point of view, the analog and digital resources of the microcontroller board add the convenience of relinquishing any master controller from providing them. To ensure modular and "open-architecture" approach to design of control

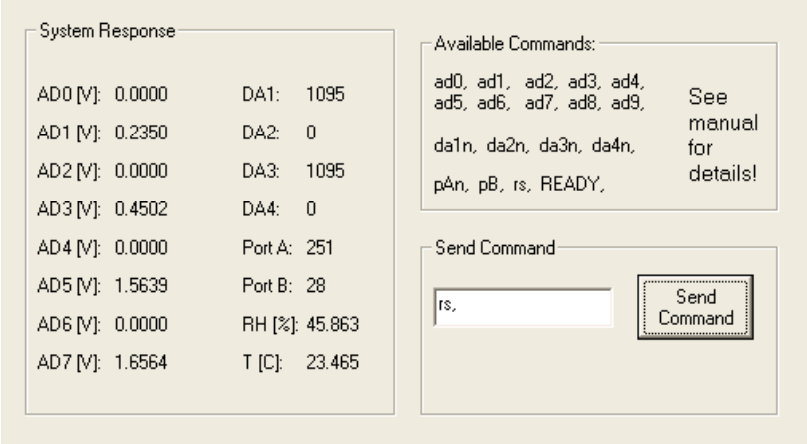


system, a command language was developed to control the instrument via serial port. A USB to serial port converter can be easily added to utilize a computer USB port if a serial port is not available. Different optional sensors can be attached to the instrument and their data can be transferred to a master controller. Using these commands, versatile PC software for experiment design, control, and interfacing to external sensor(s) has been developed.

Direct control via serial port using command language

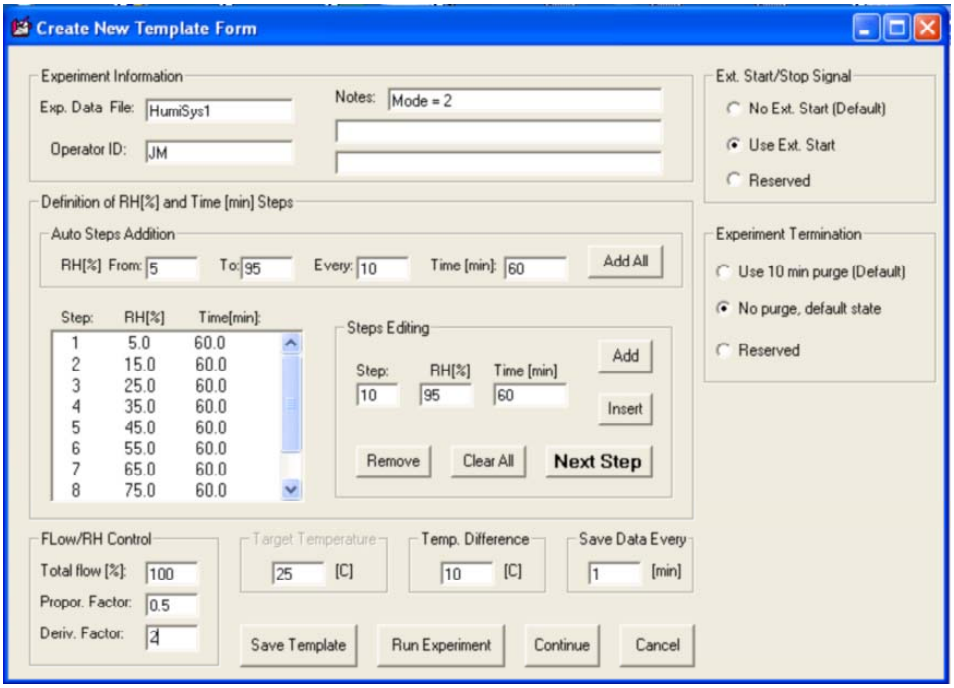
To allow OEM users direct control over the instrument hardware but without the need of knowing details of complex electronics, the following strategy is employed. Monitoring or changing each resource, like A/D and D/A channels or digital ports, is carried out by issuing a simple command via serial port. Command handlers written in the firmware software carry out requested tasks. Single-wire data transfer protocol for some digital RH probes (16-bit resolution) from Rotronic Instrument Corp. is also implemented. Basically, the instrument with any external hardware (sensors) connected to it can be perceived as a black box that can be easily operated using a simple set of commands. For example, the Diagnostics screen in the

provided PC software will report the entire state of the system with one simple command: “rs,”. Please see a portion of the screen below.



Experiment design and control using Windows® based PC software

User friendly software for execution of different RH steps, diagnostics, calibration, graphing, reporting, and RH calculations has been designed. Automation of templates design, flexibility in experiment modification during run, and ability to switch between Auto and Manual operation are very useful in any research work. A snapshot of the template design screen is presented below.



The instrument can be equipped with different hardware configurations and it can be used as a calibrator or generator. Depending on which sensor is currently used for determining the final RH, one of several modes of operation can be selected. The system can be easily accommodated to different RH needs by user.

Specifications

RH range: 0 to 100 %

RH resolution: 1/264 % (RH probe)

Temperature resolution: 1/264 ˚C (RH probe)

RH accuracy: RH probe sensor dependent (±1%, ±1.5%)

Maximum temperature of saturator: 90 ˚C

Dew Point: Using RH probe for dew points above 80 ˚C is not recommended.

Thermal protection: Thermal cut-off for the saturator heater. Temperature limit is also set in the temperature controller.

Flow Rate: Determined by the MFC range, Available ranges for standard unit: 50, 100, 200, 500 cc/min.

For higher flow rates please review the high flow version of the instrument (HumiSys HF)

Gas Type: Inert gas, typically air or N_2

Gas Inlet Port: 1/8" (Swagelok® type bulkhead)

Gas Inlet Pressure:
Maximum: 20 bar (300 psi)
Minimum: 0.7 bar (10 psi)

Internal Output port: 0.25" (6.35 mm) OD tubing – (the compression fitting can be easily replaced to accommodate other sizes).

Transfer line dimensions:
Heated length about – typically 1 m (40")
Inner tube: 0.25" OD; 3/16" or 1/8" ID
(6mm OD, 4 mm ID, optional)
Thickness w/ insulation: about 19-20 mm (0.8")
Other lengths and sizes available as options

Transfer Line Temperature:
Maximum (Continuous) 100 ˚C
Minimum: Ambient

Dimensions: (W x H x D)
(22.3 cm x 29.2 cm x 40.6 cm)
(8.75" x 11.5" x 16")
(Not including protrusions in front and back)

Instrument Weight:
13 kg (28 lb)

Power Requirements:
100-120 VAC, 300VA, 60 Hz nominal
or: 220-240 VAC, 300VA, 50 Hz nominal

These specifications are subject to change at any time

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