HumiSys™ HF
High Flow RH Generator

Designed, built, and supported by InstruQuest Inc.

Versatile Relative Humidity Generation and Multi-Sensor System

The HumiSys HF is a high flow version of the previously introduced water vapor generation system. 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 of control using a simple command language, and versatility of PC software allow easy integration into a larger analytical setup or interfacing with other devices.

The HumiSys HF uses two mass flow controllers to generate fast, stable, and repeatable RH values from 0 to 100% at temperatures up to 95 ˚C (extended temperature models) and flow rates up to 50 L/min. Typically, temperature probe (RTD1) and digital RH probe (RH and temperature data, 16-bit resolution) are used for control of RH. Additional temperature probe (RTD2) and RH probe, as well as other sensors can be used for monitoring temperatures and RH at other locations in the process chamber.

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

Applications

Programmable RH source suitable for:

- Evaluation of variety of processes towards water vapor presence
- Evaluation of distribution of RH and temperature gradients in chambers
- Gravimetric sorption systems
- Permeation measurement instruments
- Relative humidity sensors calibration
- Sample conditioning in specialized instrumentation
- Study of materials hydration
- Maintenance of precise RH in variety of industrial chambers

Operation

A dry or semi-dry gas source is connected at the instrument back via 1/4" compression fitting. Typically, the gas source can be air generated from an oil-less compressor or inert gas can be supplied from a gas cylinder. The dryness of the gas will affect the lowest achievable RH values.

Precision pressure regulator allows selection of the desired pressure and observing it on the gauge. The gas flow is 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. After passing through the saturator the saturated gas mixes with the gas flowing through the "DRY" valve and MFC2 in the mixing manifold.

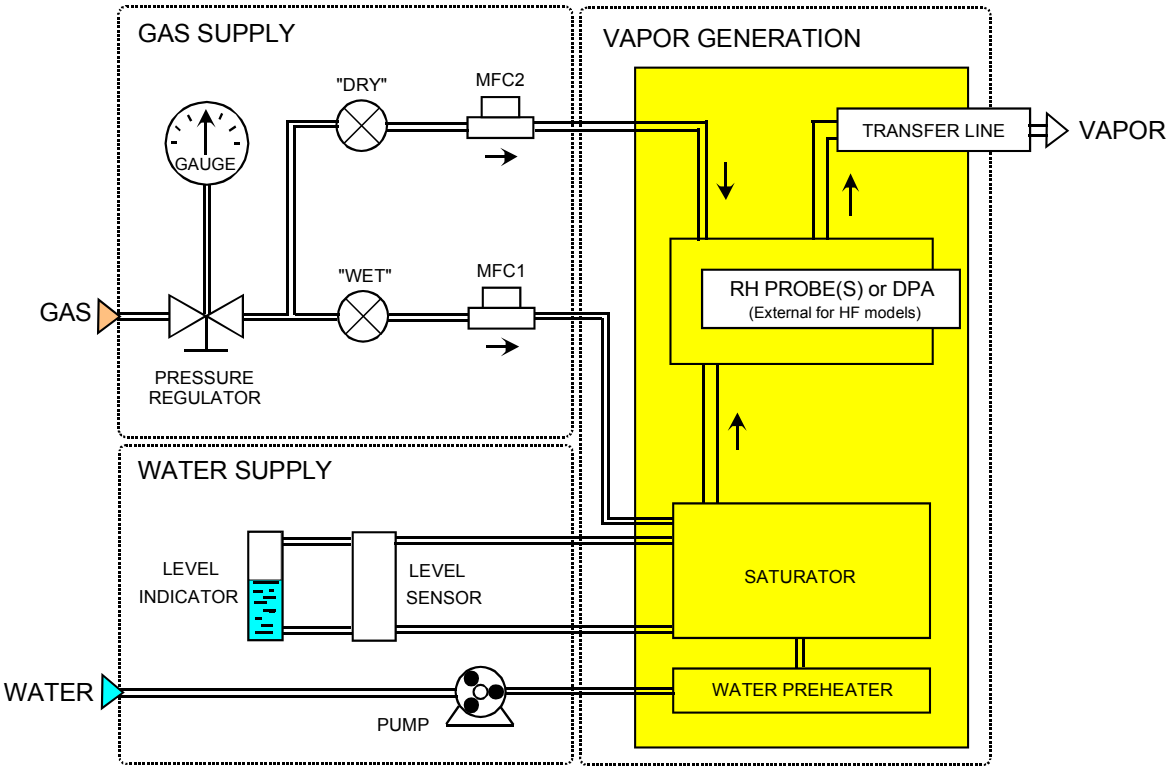


Fig.1. Simplified operation diagram

A high quality RH probe or a dew point analyzer 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.

The water used for gas saturation should be de-ionized and of high purity 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.

Control

The HumiSys HF 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, temperature, and the MFC voltages can be viewed on the LCD display.

Microcontroller boards and ancillary electronics opens many possibilities in implementation of automatic operation of the instrument and interfacing with 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

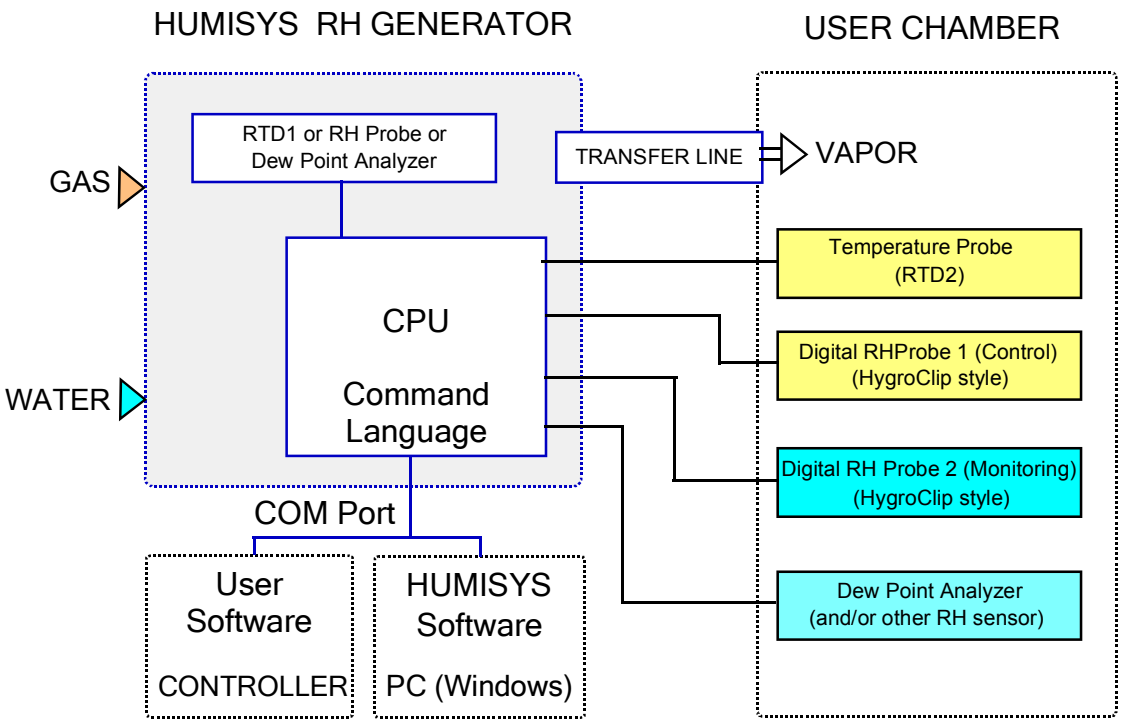


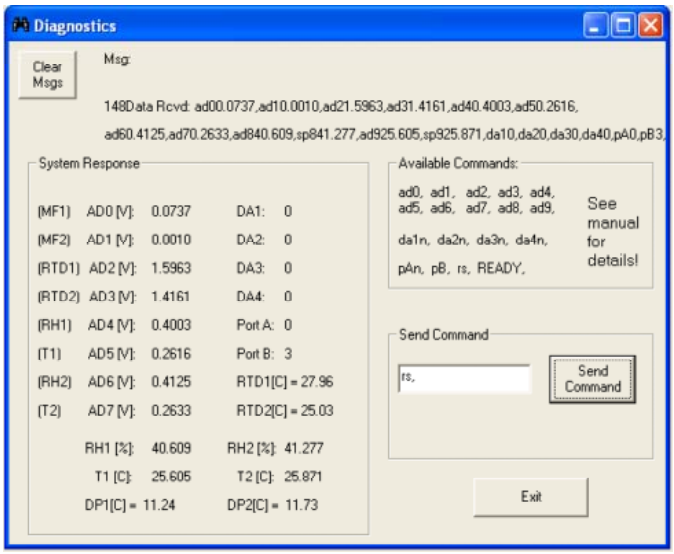
Fig. 2. HumiSys HF Control and Optional Sensors

system, a command language was developed to control the instrument via serial port. 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.

Up to two external temperature probes (RTD) for monitoring temperatures at user defined locations can be connected at the instrument back. For monitoring/verifying RH in large chambers, the second digital RH probe can be provided. A signal from a Dew Point Analyzer or other sensor (analog, serial) can also be processed. Spare I/O digital lines and D/A channel(s) can be used for custom interfacing.

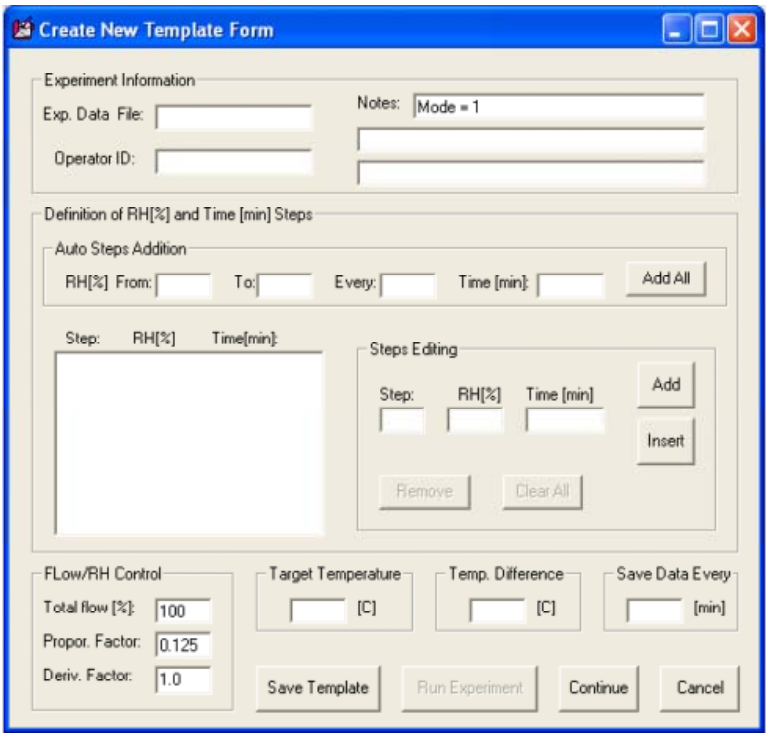
Direct control via serial port using command language

To allow 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 snapshot of the screen below.



Experiment design and control using Windows® based PC software

User friendly software for execution of up to 1000 of different RH steps of practically infinite duration, 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. Amount of total flow rate is selectable.
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 could be implemented. The system can be easily accommodated to address different RH needs.

Specifications

RH range: 0 to 100 %

RH resolution: 1/264 % (RH probe)

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

RH accuracy: sensor dependent (±1% Rh probe, ± 0.2 ˚C DPA)

Maximum temperature of saturator: 95 ˚C (for extended temperature units)

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, typically: 2 ,5, 10, 20,, 30, or 50 L/min.

Gas Type: Inert gas, typically air or N_2

Gas Inlet Port: 1/4" (Swagelok® type bulkhead)

Gas Inlet Pressure:
Maximum: 150 psi (10.3 bar)
Minimum: 20 psi (1.4 bar) above the desired regulated pressure

Outlet port: 0.375" (9.5 mm) OD tubing or 1/2" (12.6mm) hose for 50 L/min – (the fitting can be easily replaced to accommodate other sizes).

Transfer line dimensions:
Heated length at least - 40" (1 m)
0.375" OD, 0.25" ID
Thickness w/ insulation: about 0.8" (20-21 mm)
Other lengths and sizes available as options

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

Dimensions: (W x H x D)
11.25" x 14.3" x 19"
(28.5 x 36.3 x 48.2 cm)
(Not including protrusions in front and back)

Instrument Weight:
25 lb (55 kg)

Power Requirements:
110 VAC, 600VA, 60 Hz nominal
(Optional): 220 VAC, 600VA, 50 Hz nominal

These specifications are subject to change at any time