

Greenhouse



Facts & figures:

Tomato is the second most important commercial vegetable crop after potato. Current world production is about 100 million tonnes produced on 3.7 million hectares.

In the year 2000, per capita consumption of fresh tomatoes in the U.S. was 17.8 lb./ 8.73 kg.

About 85 percent of the world's soybeans are processed, or "crushed," annually into soybean meal and oil. Around 98 percent of the soybean meal that is crushed is further processed into animal feed.

The Food and Agriculture Organization of the United Nations (FAO) reports that world production of carrots and turnips (these plants are combined by the FAO for reporting purposes) for calendar year 2011 was almost 35,658 million tonnes.

Greenhouse in general

The idea of growing plants in environmentally controlled areas has existed since Roman times. The emperor Tiberius ate a cucumber-like vegetable daily. The Roman gardeners used artificial methods (similar to the greenhouse system) of growing to have the vegetable available on his table every day of the year.

The next step from the conventional greenhouse as we know it today will be the introduction of "vertical farms". Currently, sophisticated so called "plantscrapers" are be-

ing planned or are already under construction in Sweden, Japan, China, Singapore and the United States.



Skyscraper farming might yet be a possible answer to the question of how to feed the nine billion people that are expected by the middle of the

century. These types of greenhouses have a tightly controlled level of temperature, humidity & CO₂, sophisticated watering systems and in addition to sunlight, advanced artificial LED lighting that is specifically designed and installed for each plant family. This way, the crops grow much faster and very efficiently all year round. It is estimated, that the Swedish plantscrapper that is planned to be 54m high, will produce thousands of tonnes of food a year, enough to feed up to 30,000 people.

Why the need to measure humidity?

Greenhouse humidity levels are important both in preventing plant diseases and promoting healthy and strong plant growth. High humidity can promote Botrytis and other fungal diseases. High humidity also restricts plant transpiration, which in turn limits evaporative leaf cooling and can lead to overheating of plant foliage. If high humidity persists for a long time, the restriction of transpiration can limit the "transpiration stream" of nutrients and can lead to nutrient deficiencies.

Low humidity levels are best

avoided because these may increase foliar transpiration to the extent that the root system cannot keep up.

Humidity is perhaps the most difficult of the greenhouse conditions to control. Most growers simply aim to avoid the extremes of humidity. Over most temperature ranges, a greenhouse humidity of 50 - 85 %rh is generally safe.

Low humidity can be managed with the use of misters and foggers. It is also useful to shade plants under conditions of low humidity to reduce the

rate of transpiration.

Transpiring plants add water vapour to the greenhouse air, increasing the humidity inside the greenhouse. Therefore, managing high humidity starts with ventilation control. Replacing warmer, humid greenhouse air with cooler, drier external air. Ventilation also involves significant energy losses, and therefore ventilation must often be accompanied by heating. Therefore, lowering greenhouse humidity with a combination of ventilation and heating increases energy costs significantly.

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What solution can Rotronic offer?

The heart of the latest humidity measurement products is the Rotronic capacitive sensor: HygroMer IN-1. This thick-film sensor, with the best long term stability on the market is ideal for

applications where probes don't usually get calibrated frequently.

All products with this logo contain an AirChip3000.



AirChip3000 advantages:

- Relative humidity, temperature and dew point outputs
- Can store 2,000 points
- Sensor self-test function



HF1 space mount transmitter

Rotronic products:

Humidity and temperature probes:

- **HC2-S**
Standard humidity sensor
-50...100 °C,
0...100 %rh,
±0.8 %rh and ±0.1 K
- **HC2-IC402**
-100...200 °C,
0...100 %rh,
Ø15 mm
±0.8 %rh and ±0.1 K
- **HC2-IC402-A**
-100...200 °C,
0...100 %rh,
Ø15/25 mm,
±0.8 %rh and ±0.1 K

Transmitters:

- **HF5 series**
For interchangeable probes,
Various analogue and digital
outputs, Display,
All psychrometric calculations
available...
- **HF3 series**
-40...60 °C, 0...100 %rh
±2 %rh and ±0.3 K
Various analogue outputs,
Display...
- **HF1 series**
0...50 °C, 5...95 %rh
±3 %rh and ±0.3 K
Various analogue outputs,
Display...

Handheld instruments:

- **HP22**
For interchangeable
probes,
High accuracy relative
humidity and tempera-
ture measurement,
Dew point and other
psychrometric calcula-
tions, Display
- **HP23**
Same functionality as
HP22 plus: two interchangeable
probe inputs, 20,000 data point
memory with real-time clock,
Data capture of 250 data points
each for up to 8 defined loca-
tions



HF1 duct mount transmitter



HP23 handheld device

Customer benefits:

Accuracy:

Choosing Rotronic products gives you the best accuracy on the market.

Precise humidity measurement enables the control units to work at their maximum performance

Communication:

Networking with Rotronic is an easy affair! With the wide range of communication interfaces available, from conventional analogue out-

put signals to USB, RS-485, Wireless and Ethernet RJ-45, Rotronic can provide the required interface to your DDC control system, or any third party monitoring system.

Long term stability:

With long term sensor stability of under 1 %rh per year (depending on the environment), Rotronic offers the possibility to "plug & play": install the device and leave it. We would recommend

regular spot checks between multipoint calibrations.

Calibration:

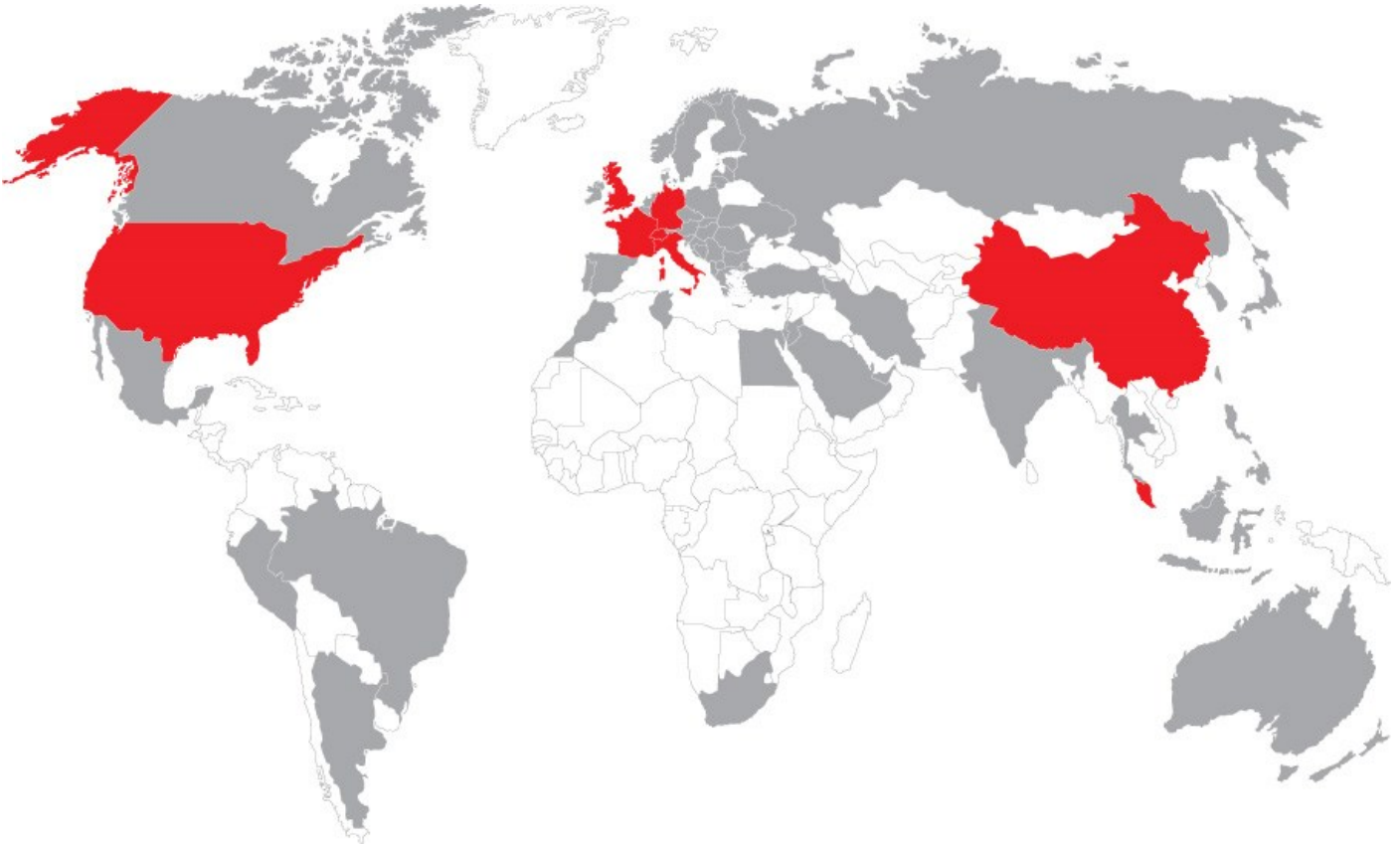
Rotronic offers a factory calibration certificate, and SCS certificate if required. The portable HygroGen temperature & humidity calibrator as well as traceable unsaturated humidity salts are available for on-site calibration. All HygroClip2 probes can be set with two fixed %rh / °C values to validate the loop to the controller.



HF5 wall transmitter in combination with probe / extension cable

Contact us:

Rotronic is represented in more than 40 countries around the world. An up-to-date list of all our partners is available at www.rotronic.com



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