S8000 -100

High-Precision Chilled Mirror Hygrometer

High-precision low dew-point reference hygrometer for humidity calibration and standards laboratories.

Highlights

- Accuracy of ±0.1 °C
- Precision measurement to -100 °C frost point (13.8 ppb_V) with no need for additional cooling
- ±0.15 °Cfp reproducibility at -100 °Cfp
- Simple configuration and operation via touch screen interface
- Sensor optimized for fast response to low moisture levels
- External 4-wire Pt100 connections
- Microscope for visual inspection of condensate on mirror
- Compact 19" x 4U package for flexibility of installation
- Ethernet or USB connections
- SD card datalogging

Applications

- Reference humidity measurements in standards laboratories
- Reference instrument in humidity calibration facilities
- Precision moisture measurements in research and development

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The New Laboratory Humidity Reference Standard

The S8000 -100 hygrometer directly measures the formation of condensation on a mirrored surface, offering the widest possible measurement range of -100...+20 °C frost/dew point. Fully automated control of the system means that no operator intervention is required. The instrument provides a range of Modbus digital communications, and analog outputs allowing it to be monitored remotely or via specific S8000 -100 logging software.

4-wire Pt100 connections are provided on the rear panel for remote mirror temperature monitoring.

A high-contrast touch-screen LCD display gives or presents entirely customizable local indication of the measured values, along with a trend graph and fault warnings.

Optical System for High Sensitivity and Fast Response to Humidity Changes

The S8000 -100 utilizes a unique advanced dual optics system to detect very small changes in moisture condensed on the mirror surface, resulting in very high sensitivity and fast response to changes in frost point, even at low levels of moisture, where measurements are the most challenging.

Use Your Preferred Communication

The S8000 -100 can be ordered with a wide range of communication protocols:

- Modbus RTU over:
  - USB
  - RS232
  - RS485
- Modbus TCP over Ethernet
- 2 user configurable 0/4...20 mA
- Status and Process Alarm contacts
- Datalogging to SD Card

Uncompromising Accuracy

The new sensor design incorporates a high precision Pt100 to measure the mirror temperature. Combined with high integrity internal sampling, featuring welded stainless steel tubing and VCR fittings, this provides ±0.1 °C accuracy of dew-point measurement and the fastest possible response time to very low frost points.

To further improve the accuracy of pressure-derived calculated values, a barometric pressure transducer is installed, which provides a real-time pressure input for these parameters.

Confidence Through Seeing What You Measure

It is possible for moisture to exist as a liquid at temperatures down to -40 °C. The difference in condensation temperature between water and ice can be 10% of the reading.

The S8000 -100 takes two approaches to ensure confidence in the phase of water condensate being measured (dew or frost):

Frost Assurance (FAST)
Frost Assurance determines whether the dew point of the sample is in the temperature region where super-cooled water can exist, and if so, will drive the mirror down to below -40 °C to ensure that ice is present on the mirror surface.

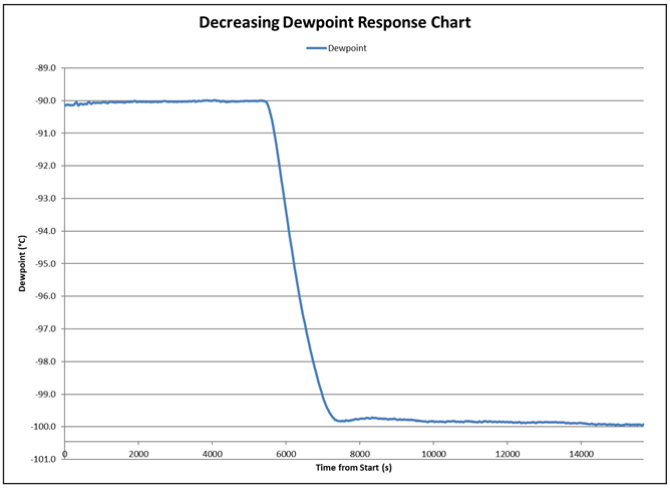
Microscope
A viewing microscope is supplied as standard. This enables the user to inspect the mirror directly during the measurement process, and determine the state of condensation.

DCC for Increased Reliability

The S8000 -100 utilizes a system called DCC (Dynamic Contamination Correction). The DCC system is automated and adapts the instrument control to achieve optimum measurement performance at all times by guaranteeing a uniform condensate layer. This ensures highly repeatable measurement performance.

Although the DCC system is fully automatic, it can be configured by the user for individual applications.

Typical Response Time



Technology: Chilled Mirror

Michell's chilled mirror dew-point hygrometers are precision instruments for critical measurement and control applications.

Chilled mirror sensors measure a primary characteristic of moisture – the temperature at which condensation forms on a surface.

This means that chilled mirror instruments are inherently repeatable, giving reliable results every time.

The chilled mirror sensor consists of a temperature controlled mirror and an advanced optical detection system.

A gas sample is passed into the sensor housing and flows over the surface of the chilled mirror contained within. At a temperature dependent upon the moisture content in the gas, and the operating pressure, the moisture in the gas condenses out on the surface of the mirror.

An optical system is used to detect the point at which this occurs, and this information is used to control the mirror temperature and maintain a constant thickness of the condensation layer on the mirror surface.

A light-emitting diode (1) provides a light beam of constant intensity which is focused by a lens system (2) to become the incident beam on the mirror surface (3), flooding it with a pool of light.

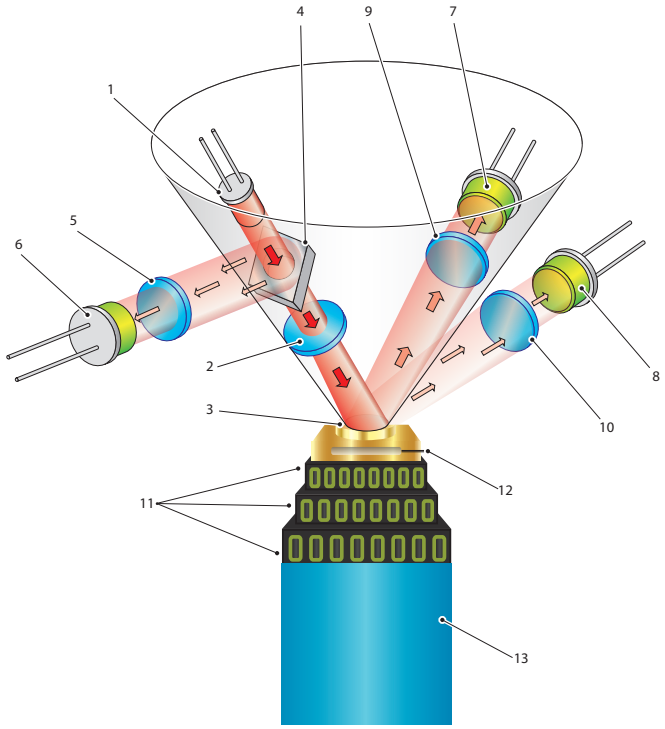
Before the light beam reaches the mirror (3), a beam splitter (4) directs part of the beam via a lens system (5) onto a sensor (6), which monitors the intensity of the LED light and provides a feedback loop to keep this at a constant level.

Two sensors (7 and 8) monitor the light level reflected by the mirror. One of these sensors (7) measures the light level due to the reflected incident beam, and the other (8) measures the degree of light scatter due to the formation of water/ice on the mirror surface. Each sensor has its own optical lens system (9 and 10) to concentrate the reflected light onto the sensor.

The output from each of these sensors is compared and then used to control the drive to a Thermo-electric cooler (11). Dependant on the result of this comparison, the control system will cause the heat pump (11) to either heat or cool the mirror (3) in order to maintain the desired condensation film thickness on the mirror surface.

At an equilibrium point, where the evaporation rate and condensation rate on the surface of the mirror are equal, the mirror temperature, read by a Pt100 platinum resistance thermometer (12) embedded in the mirror, represents the dew point.

The 'hot' side of the Thermo-electric cooler is coupled to an auxiliary cooling system through a thermal mass (13), which smooths its response. The cooling system removes heat from the hot side of the Thermo-electric cooler, by cooling it to an appropriate temperature. This supplements the depression capabilities and enables measurement of very low dew points.



Experts in Chilled Mirror Technology

The S8000 -100 is the result of 40 years' experience of developing chilled mirror technology.

As one of the world's largest producers of high-quality dew-point sensors, we use the S8000 -100, along with other instruments in the chilled mirror range, as the work-horses of our manufacturing and calibration operations.

Technical Specifications

Dew-Point Sensor

Measurement Range	-100...+20 °C frost/dew point
Measurement Accuracy*	±0.1 °C
Reproducibility at -100 °Cfp	±0.15 °C
Stability at -100 °Cfp	±0.05 °C
Speed of Response	<2hrs to ±0.25 °C stability @-90 °Cfp <6hrs to ±0.25 °C stability @-100 °Cfp
Temperature dependence at -100 °C	±0.15 °Cfp per 1 °C environmental temperature change
Mirror	Gold-plated copper
Temperature Measurement	4-wire Pt100, 1/10 DIN class B
Sample Flow Rate	500...1000 ml/min (recommended 750 ml/min)
Sample Gas Pressure	1.6 bara max.

Pressure Sensor

Measurement range	0...1.6 bara
Measurement Accuracy	Accuracy 0.25% FS Typical Thermal error 1.5% FS Typical Drift 0.2% FS/p.a non-cumulative Temp Comp -20 °C...+80 °C

Flow Sensor

Measurement Range	0 to 1000 ml/min
Measurement Accuracy	±1.5% FS (10...100% of rated flow)

* Measurement accuracy means maximum deviation between instrument under test and corrected reference. To this must be added the uncertainties associated with the calibration system and the environmental conditions during testing or subsequent use.

Monitor

Resolution	User selectable to 0.001 °C, depending on parameter
Measurement units	°C dew/frost point, °C temperature, ml/min flow, bara pressure
Calculated units	Relative humidity – %, Absolute humidity – g/m^3, ppm_v, Mixing Ratio – g/kg, Wet Bulb Temperature (Twb) – °C, °F, Water Vapor Pressure (wvp) – Pa, °F, Pressure converted DP – °C, °F, Pressure – kPa, Barg, Psia, Psig
Outputs	**Analog:** 2x active mA outputs, configurable 0...20 mA or 4...20 mA **Digital:** Modbus RTU over USB Optional: Modbus RTU over RS485/RS232, Modbus TCP **Alarm:** 1x Process Relay 1x Alarm Relay Both Form C, 1 A, 30 V DC
User Interface	5.7" LCD with touchscreen
Data Logging	SD Card (8GB supplied) and USB interface. Supports SD Card (FAT-32) – 32 GB max. that allows 24 million logs or 560 days, logging at 2-second intervals
Environmental Conditions	+5 °C...+30 °C
Power Supply	85...264 V AC
Power Consumption	185 VA

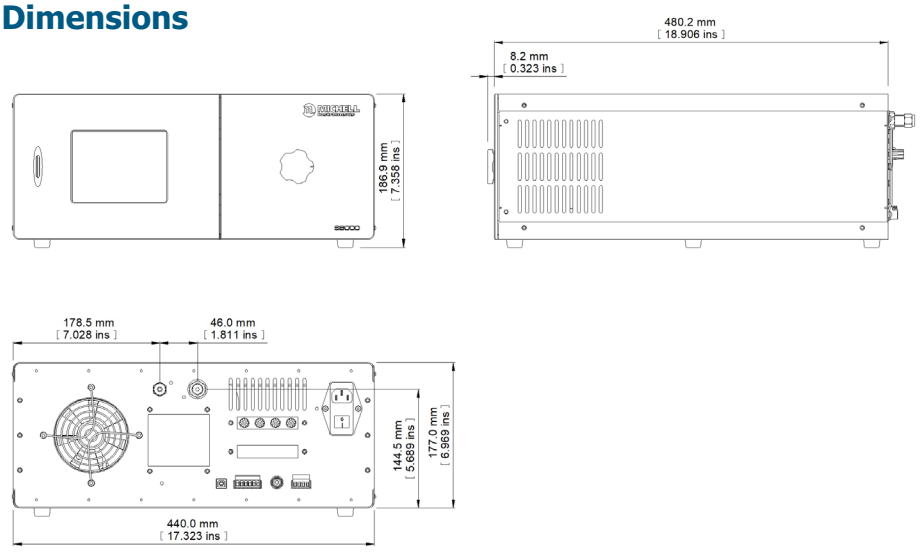
Mechanical Specification

Dimensions (W x H x D)	440 mm x 185 mm x 515 mm
Weight	22 kg
Sample gas connections	Inlet: ¼" VCR Outlet: ¼" Swagelok tube

General

Optional Remote Temperature Probe	4-wire Pt100, 1/10 DIN class B, 2m cable
Calibration	5-point UKAS calibration to -90 °Cfp + -100 °Cfp

Dimensions



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Michell Instruments adopts a continuous development programme which sometimes necessitates specification changes without notice.
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