

Humidity and Dew-Point Calibration

Instruments, Systems
& Services



Michell Instruments

has 40 years' experience providing moisture measurement & calibration solutions to our customers

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Michell Instruments

Global leader for trace moisture, humidity and oxygen analysis

Michell Instruments is an international leader in high-precision sensing, with 40 years experience in the field, specializing in instrumentation for dew point, relative humidity and oxygen analysis.

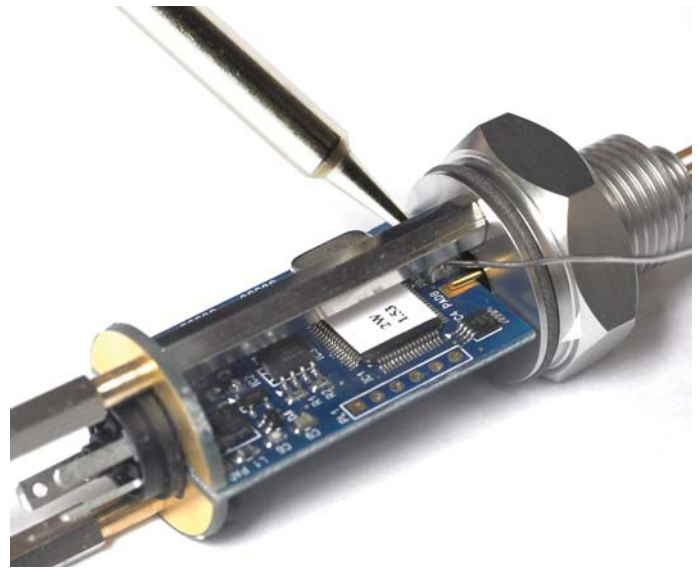
Michell Instruments has a long history in the field of humidity calibration, originating in the design and provision of the Transfer Standard Dew-point Hygrometer (TSDH) to provide traceability to NIST (National Institute of Standards and Technology) for European calibration laboratories. As the largest manufacturer of dew-point sensors in Europe, Michell Instruments has over 2000 sensors under calibration at any moment in time, in our own production facility in Ely, UK, in addition to local calibration centres in situated in the Netherlands, France, Italy, Germany, China, Japan and USA. The development and optimization of our own calibration systems has helped us to build a comprehensive portfolio of calibration products and solutions that enable our customers to perform their own on-site humidity calibrations.

Manufacturing, Research and Development

Michell Instruments has three manufacturing and R&D locations: Oosterhout, The Netherlands; Lyon, France and Ely UK. The UK location is the main BS EN ISO 9001:2008 certified manufacturing facility.

Service and Support

Michell Instruments offers practical and flexible after-sales service: Whether you prefer on-site maintenance, return to base or service exchange; we provide the simplest way to maintain your measurement. Michell Instruments operates extensive network of subsidiaries and distributors stretching across 56 countries, offering the services of trained application engineers. Service centres and calibration laboratories are located on three continents: North America, Europe and Asia.



Accreditations

Michell Instruments understands and endorses the need to conform to recognized standards for quality and calibration. Our calibration laboratory maintains full traceability to British (NPL) and American (NIST) Humidity Standards.

UKAS

Michell Instruments Limited has been accredited to ISO 17025 by UKAS (United Kingdom Accreditation Service) for the calibration of dew-point hygrometers since 1986 (laboratory number 0179) and our current dew-point calibration range is -90 to +90°C (-130 to +194°F). For full details of our measurement capability please see our Schedule of Accreditation. Our traceability to NIST (National Institute of Standards & Technology) is over the range -75 to +20°C (-103 to +68°F).

NVLAP

Our UKAS accreditation is commonly recognised elsewhere in the world as EAL, or NVLAP (National Voluntary Laboratory Accreditation Program) in the USA.

ISO 9001

Michell Instruments Ltd UK manufacturing facility has been continuously registered to BS EN ISO9001 since 1989.

Hazardous Area Products

Michell Instruments also produces instruments specifically designed for use within hazardous areas. All such products are independently assessed and certified to many international standards, including, but not limited to, ATEX (European), IECEx, CSA, FM, UL, GOST-R and GOST-K. Accreditations and certificates for these products can be downloaded from the www.michell.com under the Product Documents/Accreditations section.





A Background to Calibration

The following guide will provide you with some essential knowledge about humidity calibration, helping you to better understand your own requirements when selecting an appropriate solution from our comprehensive range of humidity calibration equipment.

Why is Calibration Important?

Reputable manufacturers will provide calibration certificates with instruments or sensors at the time of purchase. However, this is not a guarantee of the measurement performance throughout the entire lifetime of the equipment. Over time, the ageing of mechanical and electronic components can cause changes in the characteristics of sensors or instruments. More critically, once the device has been used in the field, and possibly introduced to contaminants which can have an impact on accuracy, it is difficult to say with any degree of certainty whether or not the original calibration is still valid.

When the readings provided by a sensor or instrument are critical to a process or testing procedure, it is vital to know that the device is still performing within its original specifications, or if new correction factors need to be applied.

When an instrument is re-calibrated, a report is provided showing the calibration corrections before, and after, any adjustment was performed. For many hygrometer users, these 'readings before' are crucial, as they can be retrospectively applied to readings taken in the period before calibration.

In order to minimize uncertainty and have confidence in measurements made with the instrument, it is important to have the quality assurance of a regular, accredited calibration procedure.

What is Calibration?

Calibration is the process of comparing a measuring instrument against an authoritative reference to identify any bias or systematic error in the readings. The reference instrument in any calibration should ideally be at least 10 times as accurate as the instrument under test to avoid the tolerances of the reference influencing whether the test instrument is classed as a 'pass' or 'fail'. Generally, a calibration will be performed by repeating the process of comparison at a representative selection of points across the measurement range.

Calibration is often interpreted as 'adjustment of an instrument to read correctly', but this is a misconception. Adjustment of an instrument to match a calibrated reference is a separate concept. It is a process which is usually carried out by the equipment manufacturer, by internally applying the calibration corrections to bring the output readings into line with the indications of the calibration reference. At the end of the calibration, a certificate is issued.

Calibration Standards and Traceability

The best way to ensure accuracy of measurement is through traceability to attested standards. This leads to consistency of measurements across different instrumentation, locations and users. Traceability is an unbroken chain of calibrations which relate a working hygrometer back to a national standard.

Most countries hold their own authoritative national standard for dew point and humidity, which forms the primary measurement standard. Alternatively, reference standards are shared across a region. The reference instruments of calibration facilities in the country or region are calibrated against this primary standard, and are then used as references or 'transfer standards' to calibrate other instruments. This approach can be represented by the pyramid graphic (Fig. 1).

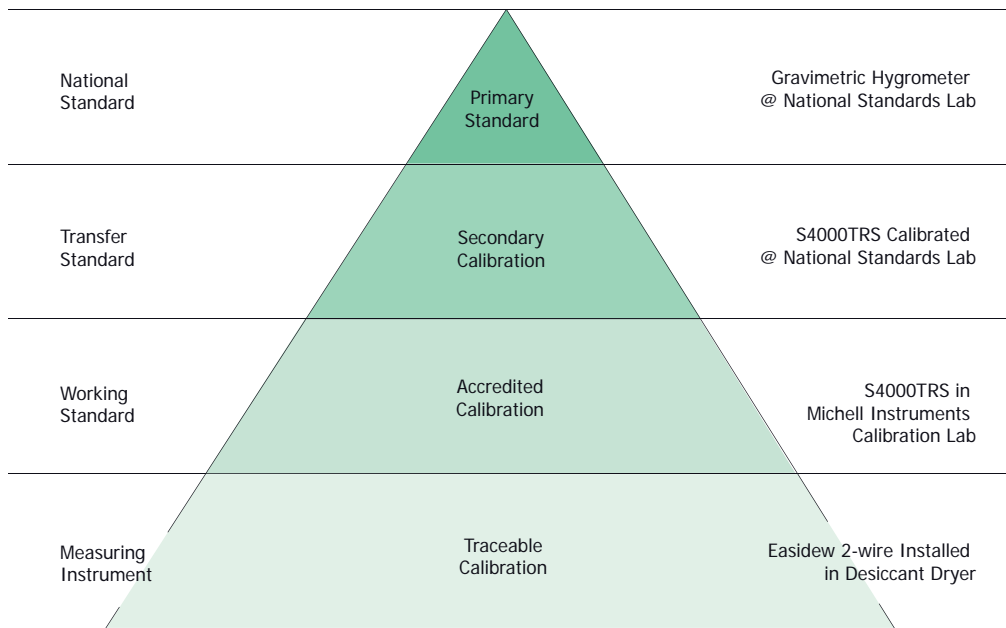


Fig. 1 - Calibration Standards and Traceability Pyramid

Humidity Calibration Theory

Humidity calibrations involve generating a stable level of humidity in a sample gas, measuring this with a suitable fundamental reference instrument and the instrument under calibration, and making a comparison of the readings.

A humidity calibration system comprises of:

- A dry air source
- A humidity generator to provide the desired moisture content
- A reference instrument which is more accurate than the instrument under test - to provide an authoritative measurement
- A manifold to supply calibration gas to the sensors/instruments under test

If the calibration is being performed in terms of relative humidity and temperature, then the manifold must be temperature controlled or placed in a temperature-controlled environment in order to determine the relative humidity by associating the generated dew-point value with the temperature.


Michell Instruments is the only supplier to offer complete dew-point calibration systems and individual calibration components, all of which are designed and built in-house.

Typical Calibration Certificate

Information that should be included on the calibration certificate:

CERTIFICATE OF CALIBRATION

Certificate Number **00000**
 Date of Issue **04th January 2012**



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0179

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Customer Sample Customer
Customer address Sample Address
Customer order number Sample Order Number
Received 07th December 2011
Instrument Michell Dewpoint meter
Model Optidew Vision
Serial number Instrument 123456
Sensor 123456. **Temperature probe** 123456
Michell reference number T12345
Measurements performed 19th to 22nd December 2011
Laboratory temperature 21 ±2 °C
Laboratory humidity 35 ±10 %rh

The hygrometer was calibrated by comparison using reference instruments with UKAS calibration certificates.

The Dewpoint sensor was placed in a sensor block through which the sample air passed. The sample air was divided to give one path through the reference hygrometer and the other through the test hygrometer.

At 21 °C, the sensor temperature was controlled, by placing the sensor in a liquid cooled sample block, and circulating fluid through it. The fluid temperature is controlled by a re-circulating bath to within ±1.0 °C of the nominal value and ±0.5 °C stability. At the higher temperatures the calibration was performed in a climatic chamber to within ±0.3 °C of the nominal value.

The temperature probe was placed approximately 10 mm from the two reference probes. The calibration was performed in a climatic chamber.

The optical surfaces of the hygrometers were cleaned using de-ionised water, prior to the calibration.

The output used from the hygrometer was the digital display with a resolution to 0.1 °C.

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

A unique reference number identifying the certificate or calibration run

Calibration location

Customer details, sometimes including the customers address, customer number or order number

Any serial numbers that identify the instrument, and associated measuring components

The date of the calibration, and sometimes the date when the subsequent calibration is due

A list of calibrated equipment used during the calibration, or a list of unique identifiers corresponding to that equipment (not shown on this example certificate)

A calibration certificate will contain a table with a list of calibration points:

The 1st column shows the measured value indicated by the reference instrument

The 2nd column shows the measured value indicated by the instrument under calibration

The 4th column shows the correction that should be applied to any measured values obtained from the instrument under calibration

The correction is derived from the difference between the measured value indicated by the reference instrument and that indicated by the instrument under calibration.

Generally, if the instrument under calibration has multiple ways to report the measured value, (i.e. built-in display, digital output, analog voltage or current outputs), then the values taken from these different outputs will also be shown on the certificate at each calibration point.

An estimation of uncertainty over the range of the calibration

CERTIFICATE OF CALIBRATION
 UKAS Accredited Calibration Laboratory 0179
 Certificate Number **00000** Page 2 of 2

At each Dewpoint, time was allowed to ensure that the calibration conditions had stabilised. This was confirmed while recording the 10 readings (at 2 minute intervals) that are averaged to give the figures recorded in this certificate.

No adjustment was made to the hygrometer before the calibration was performed.

The measured sample flow rate through the Dewpoint sensor was 1.0 l/m.

Generated Dewpoint °C	Test hygrometer			
	Dewpoint °C	Sensor Temperature °C	Dewpoint Correction °C	Expanded Uncertainty °C
-20.37	-20.2	21	-0.2	±0.21
-5.03	-4.9	21	-0.1	±0.19
10.26	10.2	21	+0.1	±0.18
25.06	25.1	45	0.0	±0.25
39.98	39.9	45	+0.1	±0.25
70.10	70.1	75	0.0	±0.25

Applied Temperature °C	Test hygrometer		
	Temperature °C	Temperature Correction °C	Expanded Uncertainty °C
10.03	10.0	0.0	±0.19
25.05	25.0	+0.1	±0.19
40.07	40.0	+0.1	±0.19
70.01	70.0	0.0	±0.18

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties quoted in the Certificate of Calibration only apply to the measured value obtained during the period of calibration and are not indicative of the long-term stability of the instrument under test.



In-House Calibration vs. External Calibration

Meteorological organizations, standards laboratories, pharmaceutical manufacturing plants, and other businesses or institutions that operate many calibrated instruments or sensors must have an effective calibration system in place. It is usually more sensible to perform calibrations in-house, rather than managing the cost and downtime (or availability of replacement calibrated sensors) associated with sending equipment away to an external commercial calibration laboratory.

However, purchasing and operating a dedicated humidity calibration system can be a significant commitment in terms of initial cost, personnel training, record keeping, and in some cases physical space. For companies that use a small number of humidity instruments, sending these to a commercial calibration laboratory for regular calibration is the most cost-effective solution.

Michell Instruments Calibration Services

Michell Instruments offers a calibration service for most moisture sensors and instrumentation, carried out against test equipment traceable to national standards at NPL (National Physical Laboratory, London, UK) and NIST (National Institute of Standards & Technology, Maryland, USA) through Michell's ISO/IEC 17025 UKAS (United Kingdom Accreditation Service) accreditation.

We provide traceable calibration from -100 to +90°C (-148 to +194°F) dew point, or full ISO 17025 accredited calibrations from -90 to +90°C (-130 to +194°F) dew point.

Michell Instruments Service Exchange Scheme

In some cases it is not practical for a user to remove a working sensor in order to return it to our lab for recalibration. For this reason Michell Instruments offers an exchange program for sensors, to help customers keep their processes running cost effectively with virtually no down-time.

Before re-calibration is due, the customer orders an exchange sensor from Michell Instruments or one of our global representatives. Once received at the customer's premises, the original sensor is removed and replaced with the exchange sensor, and the original is returned to Michell Instruments. All calibration data is stored within the sensor, so no additional work is required. Each sensor comes with a traceable calibration certificate as standard.

The returned sensor is refurbished and fitted with a replacement sensor tile, and is then used for future service exchange replacements. This means that the service can be offered for the same price as a return-to-base re-calibration.

Michell Instruments also offer a range of extended maintenance policies, which cover annual servicing, recalibration & software upgrades for a wide range of instruments. **Please contact your Michell Instruments representative for pricing details on policies providing cover for up to 4 years.**

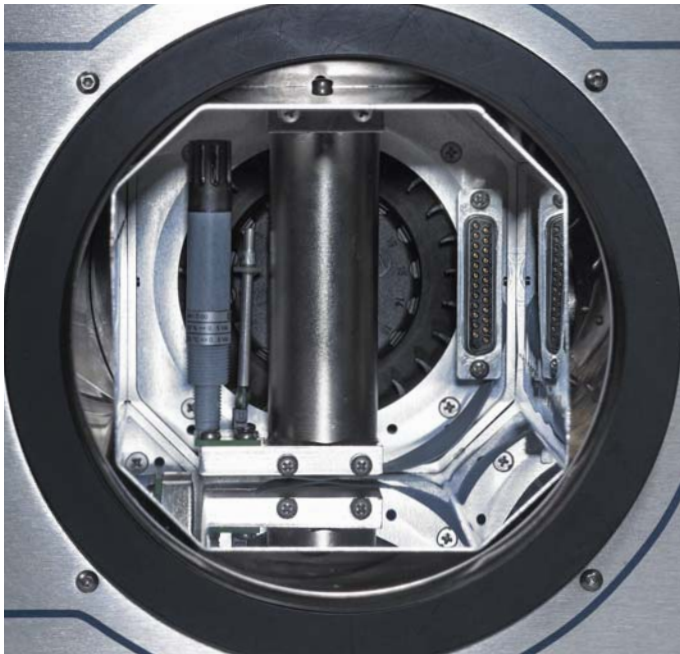
Choosing the Correct Moisture Calibration System

Measurement Parameter

The process of deciding which calibration system is best suited to your needs is dependent on the devices to be calibrated and their measurement parameters.

Dew Point

If the devices are measuring dew point, then the calibration manifold is usually situated in an ambient temperature environment. As dew-point calibration systems are frequently intended to produce very low moisture contents, the manifold needs to be of a high integrity design; working with the sealing mechanism of the sensor to ensure that moisture ingress from the ambient environment is prevented. For extremely low dew points ($<-80^{\circ}\text{C}$ ($<-112^{\circ}\text{F}$)) it is sometimes necessary, (depending on the ambient conditions) to enclose the manifold in a chamber which can be purged with dry air, thus limiting the effects of ingress.



S904/OptiCal Calibration Chamber

Relative Humidity and Temperature

There are two different approaches to calibrating relative humidity sensors.

One approach is to place the sensors directly into a calibration 'chamber', which is a temperature and humidity controlled self-contained environment. This functions in a similar way to a climatic chamber, only on a much smaller scale and with much greater uniformity. Calibration chambers without temperature control also exist, meaning that the selected relative humidity will be generated at the prevailing ambient temperature—however, it is important to ensure that when these types of generator are used, they are placed into an environment with a stable temperature.

The second approach is to use an external dew-point generator to pass a flow through a manifold into which the sensors are mounted. The manifold is placed inside a larger, temperature controlled chamber.

The advantages of this second approach are:

- The volume of the manifold is quite small, and there are few ingress points, so step changes tend to happen more quickly.
- Using a volumetric mixing dew-point generator allows much lower humidities to be achieved compared with a calibration chamber.

The disadvantages are:

- The components involved are physically much larger.
- They can be significantly more expensive than a self-contained chamber.

Measurement Range

The next deciding factor is measurement range. The questions to ask here are:

- What is the complete operating range of your devices? (Also consider temperature range if the probes in question are measuring relative humidity).
- Do you need to calibrate across the complete range, or do you have a specific area or areas of interest?

Relative Humidity

The range of an RH calibration system depends on the ability to control two separate parameters: the temperature range of the chamber and the relative humidity range (the lowest RH point being the limiting factor in most cases).

All Michell relative humidity chambers (S904, OptiCal) are capable of drying their internal volumes to just 10% RH at any temperature within their operating range. It is challenging to dry a comparatively large volume below this point, as the system is simply extracting the air, drying it with a desiccant cartridge and re-injecting it with a slightly lower moisture content. It is possible to humidify the chamber up to 90% RH which, generally speaking, is a sensible limit set for the purpose of preventing condensation. If condensation should occur, it would take a long period of time (and a significant strain on the desiccant cartridge) to dry the chamber out again.

The Michell Instruments' HG10 uses an external humidity generator to feed a stream of air, with a precisely controlled humidity, directly into a manifold within a temperature controlled chamber. The humidity generator is fed with fresh dry air from a pressure swing dryer, and can achieve very low humidities at a specific temperature, with a total range of 1 to 95% RH.

Dew Point

Dew-point calibration systems generally produce much lower absolute humidities than RH calibration systems. The generation range of dew-point systems depends on two factors:

- The output dew point of the pressure swing dryer used to provide the dry air source to the humidity generator (sometimes referred to as 'full dry').
- The resolution of the dew-point generator—which is its ability to mix specific quantities of full dry and saturated air together, in stages, to achieve accurate outputs of very low moisture content. Where volumetric flow mixing generators are concerned; the more stages of mixing, the lower the dew point the generator can control to. For example, a single stage DG3 can only control to a minimum dew point of approximately -40°C (-40°F), no matter how dry the input air is; whereas a two stage DG2 can generate dew points to -75°C (-103°F). Three stages of mixing give the capability to generate dew points to -100°C (-148°F).

Calibration Technology

Air Sources

Michell Instruments' dew-point calibration systems require clean and dry compressed air to operate correctly. The required specification of this air varies depending on the model of pressure swing dryer selected, but typically it should be at a pressure of approximately 7 barg (100 psig). For calibration systems designed to generate $<-80^{\circ}\text{C}$ ($<-112^{\circ}\text{F}$) dew point (generally those utilizing the PSD4), the supply air will need to be pre-dried to $<-40^{\circ}\text{C}$ ($<-40^{\circ}\text{F}$) dew point, in order to maximize the effectiveness of the pressure swing dryer.

For users who do not have a supply of compressed, or instrument air readily available on site, Michell Instruments can provide compressors suited to each type of system, and a pre-dryer for use with systems designed for $<-80^{\circ}\text{Cdp}$ (-112°Fdp) capability. See the PSD2 & PSD4 datasheet and the related order codes section for details.

Pressure Swing Dryers

Michell Instruments' air dryers operate on the 'pressure swing' principle. Two desiccant columns are connected to each other in parallel. Compressed air from the dryer inlet is passed through the first desiccant column to remove virtually all of the moisture present. The majority of the dry air from this column is partially expanded to further reduce the dew point and then directed to the dryer outlet. The remaining dry air is used to purge the second, off-line desiccant column to sweep away the moisture it collected during its on-line cycle to the atmosphere.

After a pre-determined period of time, the function of the two columns is switched - the first column is re-generated while the second column is on-line, producing a flow of dry air. As part of the changeover, the off-line column is rapidly de-pressurized which causes the moisture adsorbed by the desiccant to be released and purged away. One cycle of this operation is represented diagrammatically in Fig. 2.

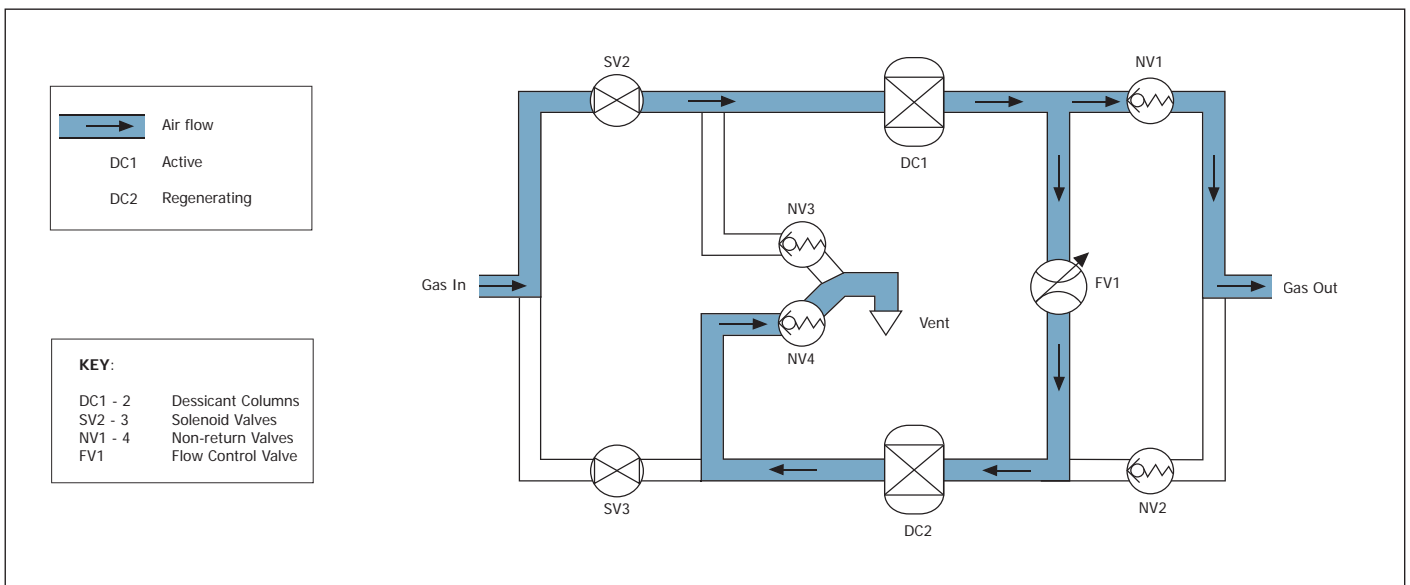


Fig. 2. One dryer cycle of the PSD2

The dryers require minimal maintenance and, under normal operating conditions, only require a desiccant change approximately once every 5 years. The highly efficient purge/regenerate system enables the dryer to operate at the same high performance levels throughout the lifetime of the desiccant.

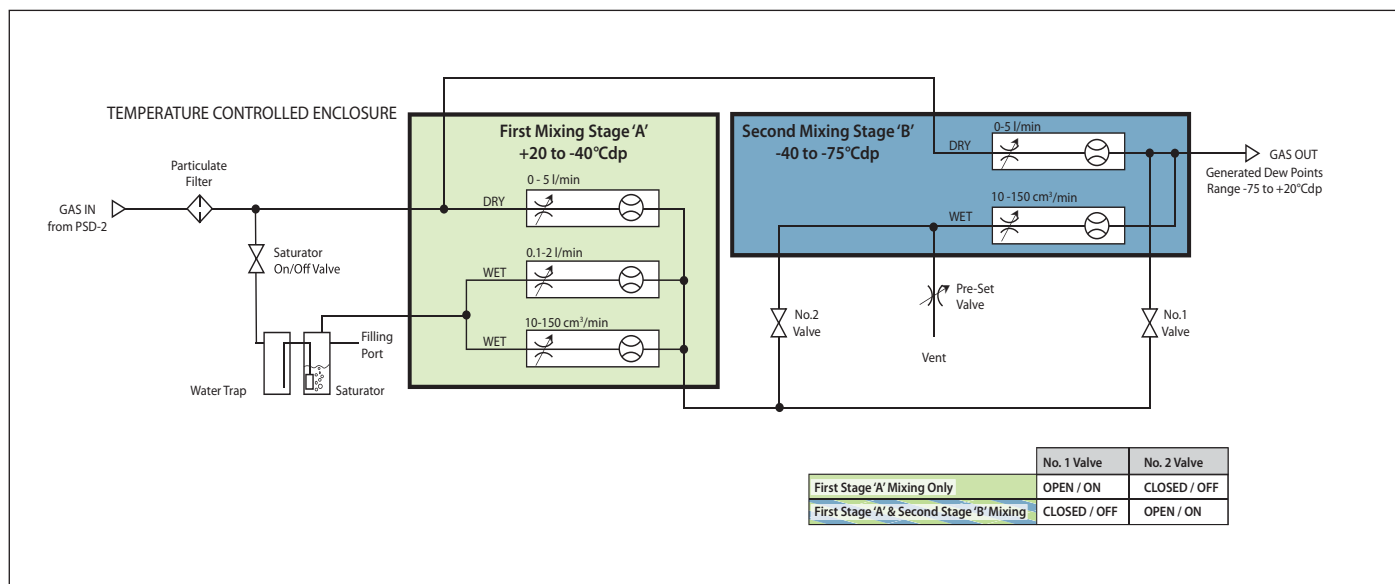
There are two models of dryer in Michell's PSD range:

- The PSD-2 gives an output of -80°C (-112°F) dew point air or better.
- The PSD-4 gives an output of -100°Cdp (-148°Fdp) or better (the PSD-4 requires an input source of dry instrument or calibration air of -40°Cdp (-40°Fdp)).

Dew-Point Generators

The DG Series dew-point generators are based on the volumetric mixing of dry and wet gases. This gives the fastest response when changing between set points when compared to other dew-point generation technologies, (such as two-temperature, two-pressure or the combination of both). The mixing is either controlled by flow metering valves for a manual control of the target dew point, or automated using a bank of preset metering valves, selected by actuating combinations of solenoids to switch between the different wet-dry mixing ratios.

A dry gas source is fed to the generator from a pressure swing dryer, and split into two streams. One stream is bubbled through liquid water via a sintered glass nozzle, ensuring it is completely saturated with water vapor, while the other stream remains dry. The two gas streams are then mixed at atmospheric pressure, in a single or multi-stage process to generate the target humidity level. The entire enclosure is insulated and temperature controlled ensuring the saturation, and therefore the output, is always consistent.



Flow diagram for DG2 showing mixing stages

A single stage of mixing provides a coarse adjustment, limited to around -40°Cdp (-40°Fdp). In order to generate drier dew points the output of this first stage, is mixed with the dry gas source a second time, providing finer adjustments for low moisture concentrations down to -75°Cdp (-103°Fdp). For trace moisture levels, a third stage can be added, where the output of the second stage is again mixed with the dry gas source, giving the possibility to generate dew points as low as -90°Cdp (-130°Fdp). The -100°C (-148°F) dew point is taken directly from the output of the dryer.

Manual Mixing – DG2 & DG3

The DG3 with manual single-stage mixing has the ability to generate dew points ranging from -40 to +20°Cdp (-40 to +68°Fdp). Drier dew points, down to -75°Cdp (-103°Fdp), can be reached by the DG2 which has a second stage of gas-flow mixing. The great strengths of the DG2 and DG3 are their ease of use and flexibility in manually generating an accurate target dew point by fine tuning the gas mix via the flow metering valves. A table of nominal flows is supplied with the generator to guide the user in setting the metering valves appropriately for each desired set point.

Automatic Mixing – DG4

The DG4 uses a two-stage flow mixing system with calibrated needle valves controlled by solenoid drivers to mix dry air and saturated air in precisely pre-metered proportions. This allows the operator to generate a range of dew-point levels from -75 to +20°C (-103 to +68°F). The exact number of presets can be specified at the time of order (normally, 11 are chosen), giving +10°Cdp (+18°Fdp) intervals across the range. The generator can be driven by computer software, the RS232 interface, or via the front panel manual override switches.

Automatic Mixing – VDS

In order to generate dew points down to -100°C (-148°F), a more sophisticated system is required. The software controlled Vapor Delivery System (VDS) generator gives precise, repeatable and flexible control of the generated dew point. Individual, three-stage, mass flow controllers select precise proportions of wet and premixed air. Humidity injection is achieved by a liquid mass flow controller and controlled evaporation system. The entire system is controlled by dedicated PC software, allowing automatic calibration programs to be created, or set points to be triggered manually.

Control

There are **three options of set point control**, which vary between models. This is an important factor to consider, as some systems may have a greater requirement for automation.

This is especially applicatory if the system is being designed to calibrate a large volume of sensors:

- Manual flow mixing (DG3, DG2) – The wet and dry flows are manually altered by metering valves on the front panel of the generator. On the DG2 these are monitored by means of a flow meter for each valve. A table of nominal flow values for each set point is provided, and full analog adjustability is possible across the complete range of the device.
- Locally controlled automatic flow mixing (DG4) – The generator is supplied with a number of user-defined (at the time of order) humidity set points (minimum of 4, including full dry, maximum of 11), which are selected by means of buttons on the front panel.
- Remote controlled automatic flow mixing (DG4, VDS3) – Control is implemented by sending serial commands to the generator via RS232, or USB, either through dedicated control software (which can run user-defined sequences), or via the customer's own system.

Reference Instrument

Michell Instruments' chilled mirror 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:

- Have no drift: the temperature at which condensation forms is measured directly so there are no calculated variables that could shift over time.
- Are inherently repeatable, giving reliable results every time.

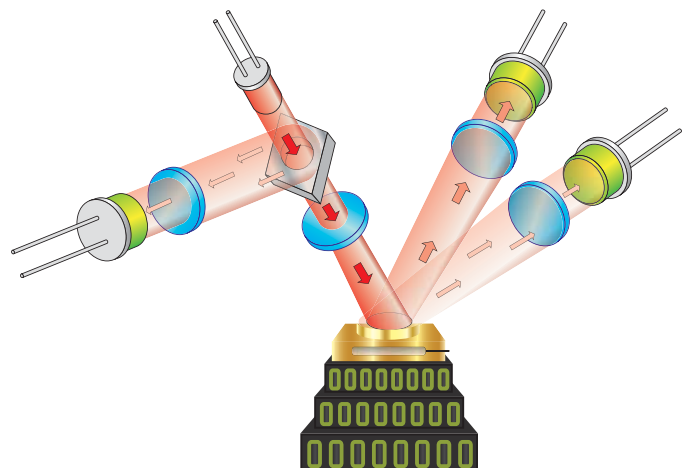
Chilled Mirror Operation

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

A beam of light from an LED is focused on the mirror surface with a fixed intensity. As the mirror is cooled, less light is reflected due to the scattering effect of the condensate formed on the mirror surface. The levels of reflected and scattered light are measured by two photo-detectors and compared against a third reference detector measuring the intensity of light from the LED.

The signals from this optical system are used to precisely control the drive to a solid state thermoelectric cooler (TEC), which heats or cools the mirror surface. The mirror surface is then controlled in an equilibrium state whereby evaporation and condensation are occurring at the same rate. In this condition the temperature of the mirror, measured by a platinum resistance thermometer, is equal to the dew-point temperature of the gas.

In the S8000 RS and S4000 TRS, an auxiliary cooling system is used to remove heat from the 'hot' side of the TEC. This supplements the depression capabilities of the heat pump, and enables measurement of very low dew points.



Choosing a Reference Instrument

The two most important considerations when choosing an appropriate reference instrument for performing traceable, credible calibrations are accuracy, and measurement range. As explained earlier in this guide, the accuracy of the reference should ideally be better than the accuracy of the units under calibration. Measurement range should be chosen to match the generation range of the operators humidity generation equipment.

Michell Instruments' range of chilled mirror reference hygrometers have measurement capabilities matched to the performance of each of the different RH and dew-point generator options.

When using a chilled mirror reference to perform relative humidity calibrations, it is necessary to calculate relative humidity from dew-point, and therefore a measurement of ambient temperature is also required.

The actual formula used is:
$$RH\% = \frac{e}{e_s} \times 100$$

Vapor pressure (e) is determined by solving the Sonntag (1990) formula for the current dew-point temperature, and saturation vapor pressure (e_s) is found by repeating the process for the ambient temperature.

This calculation is recognized and published in the National Physical Laboratory's 1996 publication 'A Guide to the Measurement of Humidity'. Its use will, in most cases, still yield lower uncertainties of measurement than can be achieved with hygrometers which directly measure relative humidity.

Calibration

Although Michell Instruments' chilled mirror hygrometers are fundamental and do not drift, in order to maintain the traceability of your reference it is advisable to return it to Michell Instruments to be calibrated against one of our transfer standards on an annual basis.

Manifold

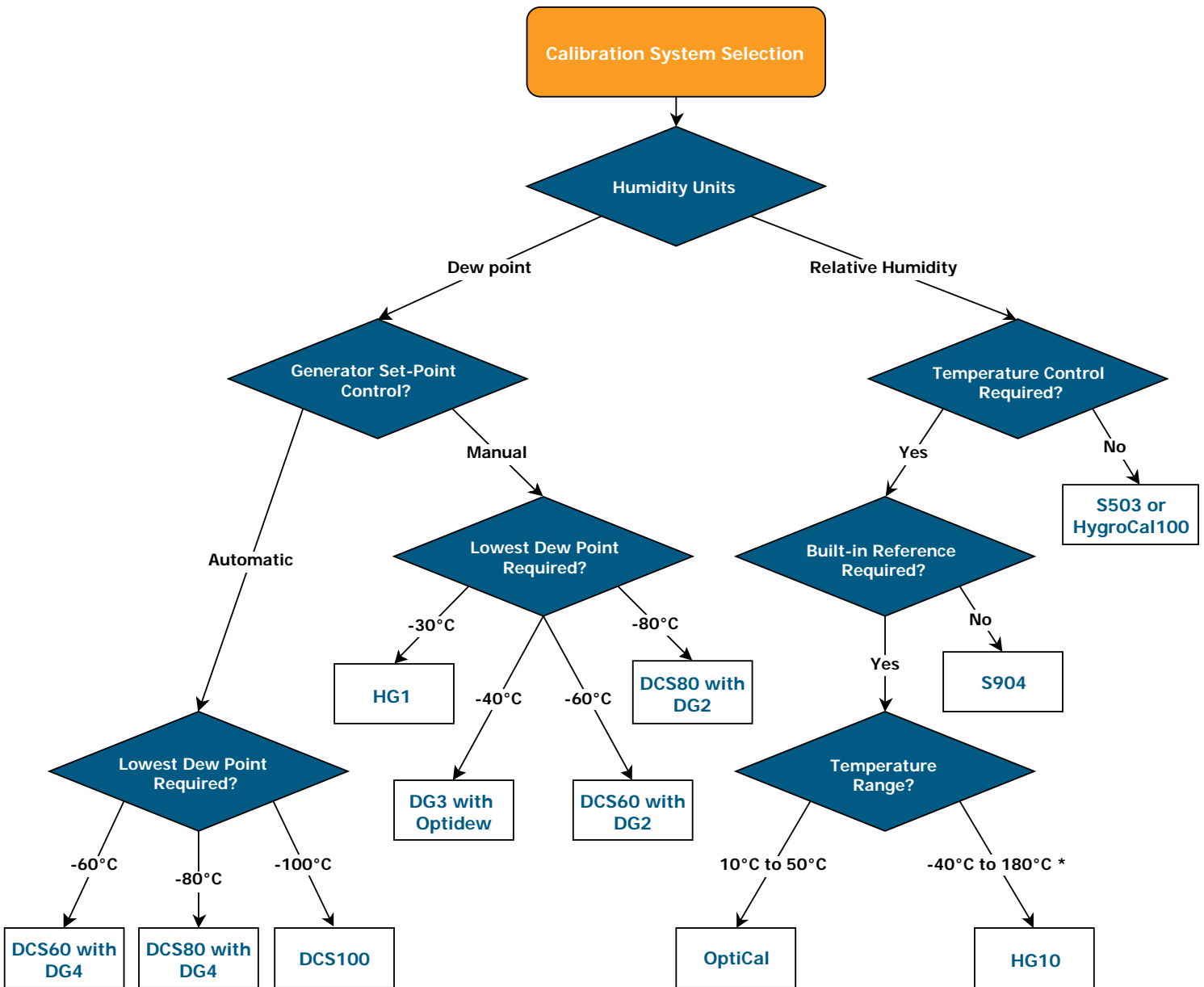
Standardized or customized designs of manifold are available for Michell Instruments' sensors depending on how many sensors are intended to be calibrated on the system at any one time. Manifolds to accept non-Michell sensors or instruments can also be custom designed; the optimal configuration can be designed from the dimensions of the device and its mounting arrangement.

Integration

Integration of the system components, such as logging of sensors under test, the reference instrument and other further enhancements, can be realized. Please contact a Michell Instruments' representative for further details.

Calibration System Selection Guide

The following flow chart is designed to aid the process of selecting an appropriate calibration system:



* Typical range, dependent on customers specification at time of order



Our sophisticated range of calibration instruments and integrated systems can provide traceable calibration of humidity sensors in your own laboratory

Calibration Instruments

Technical Specifications & Detailed Information

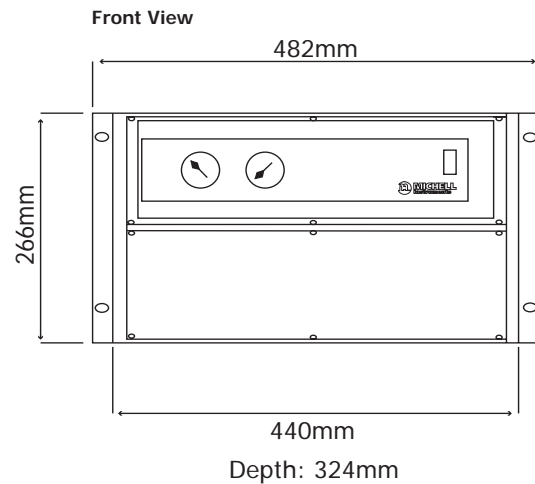
Pressure Swing Dryers

Pressure Swing dryers provide a source of very dry compressed air for use as a zero gas in humidity calibration systems, or for general laboratory applications.

PSD2 & PSD4 Pressure Swing Dryers



Dimensions - PSD2



The Michell PSD Series Pressure Swing Dryers use two columns filled with 4Å molecular sieve desiccant, which are used alternately on a two-minute switching cycle. The PSD dryers are designed to operate continuously, using a small proportion of the dried air, to regenerate the offline column — generally giving desiccant life in excess of five years. This type of heatless regeneration also uses significantly less energy than a 'heated' type of dryer.

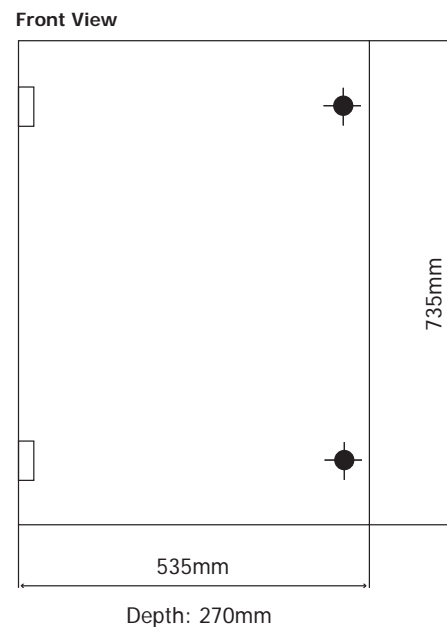
The PSD2 is fitted with inlet and outlet pressure regulation, and delivers up to 7 NI/min (14.8 scfh) of dry air at 1ppmv or better.

The PSD4 is supplied with stainless steel internals and larger volume desiccant columns. These factors, combined with high integrity VCR couplings, deliver an output of up to 90 NI/min (optional) at better than 13ppb_v.

Highlights

- Excellent long term stability
- Maintenance-free except for a desiccant change once every 5 years
- Completely self-contained
- Low power consumption

Dimensions - PSD4



Pressure Swing Dryers

Technical Specifications

Model	PSD2	PSD4-STD (Standard)	PSD4-HFV (High flow volume)	PSD4-HPO (High pressure output)
Performance				
Gas output				
Flow	7 NI/min (14.8 scfh)	30 NI/min (63.6 scfh)	90 NI/min (109.7 scfh)	30 NI/min (63.6 scfh)
Pressure		0.5 barg (7 psig)		User-settable up 8 barg (116 psig)
Moisture content	<1ppm _v		<13ppb _v	
Input Requirements				
Gas supply				
Flow	10 NI/min (21.2 scfh)	30 NI/min (63.6 scfh)	90 NI/min (109.7 scfh)	30 NI/min (63.6 scfh)
Pressure	5 to 7 barg (70 to 100 psig)		6 to 10 barg (87 to 145 psig)	
Moisture content	Oil and liquid water-free		<16ppm _v	
Electrical Input				
Power		100 to 115 OR 220 to 240 VAC, 50/60Hz		
Power connection		IEC (3 pin female c13) input socket		
Environmental Conditions				
Operating temperature	+5 to +35°C (+41 to +95°F)		+10 to +40°C (+50 to +104°F)	
Storage temperature	-40 to +35°C (-40 to +95°F)		-40 to +50°C (-40 to +122°F)	
Mechanical Specifications				
Type	Twin column desiccant, pressure swing			
Desiccant	4 Ångström Molecular sieve bead (4-8 mesh)			
Timer	Motorized cam			
Gas connections				
Inlet	Swagelok® ¼"		¼" VCR Swagelok®	
Outlet	Swagelok® ¼"	¼" VCR Swagelok®	½" VCR Swagelok®	¼" VCR Swagelok®
Filters				
Outlet	None	Millipore Wafergard IIF Micro Inline (sealed type) with PTFE membrane element rated at >99.999% retention of 0.003µm particles		
Vent	None	Bonded glass microfiber rated at >99.999% retention of 0.1µm particles		
Construction	Rack mount: 19" x 6U x 324mm (12.8")	GRP wall mounting enclosure: 735 x 535 x 270mm (29 x 21 x 10.5")		
Weight	12.5kg (27.5lbs)	25kg (55lbs)	30kg (66lbs)	26kg (57lbs)

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: PSD2 and PSD4_97160_V3_UK_0815

Dew-Point Generators

The Michell range of dew-point generators provides flexibility and control at a competitive price. Based on the volumetric mixing of dry and wet gases, the instruments can be controlled either manually or automatically to suit a wide range of calibration applications.

Generator Overview

Feature	Product	DG3	DG2	DG4	VDS3
Generation range		-40 to +20°Cdp (-40 to +68°Fdp)	-75 to +20°Cdp (-103 to +68°Fdp)	-75 to +20°Cdp (-103 to +68°Fdp)	-95 to +20°Cdp (-139 to +68°Fdp)
Temperature controlled		Yes	Yes	Yes	Yes
Control method		Manual Mixing	Manual Mixing	Automatic – Local or Remote control	Automatic – Remote control

DG3

Dew-Point Generator



Technical Specifications

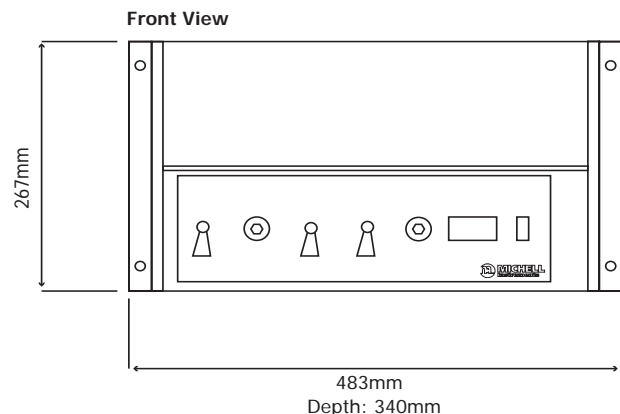
Mixing stages	1 stage
Humidity range	-40 to +20°Cdp (-40 to +68°Fdp)
Gas supply	6 NI/min (12.7 scfh) air @ 0.75 barg (11 psig) and -75°Cdp (-103°Fdp)
Gas output	1 to 5 NI/min (2.1 to 10.6 scfh) air @ 0.5 to 1 barg (7 to 15 psig)
Filter	Particulate filter
Saturator	Polycarbonate and porous polyethylene sinter
Heating	Finned heating elements, 500 watts, fan circulation
Power supply	220 to 240 V, 50Hz or 100 to 120 V; 60Hz
Storage temperature	+5 to +40°C (+41 to +104°F) (with saturators empty)
Operating temperature	+18 to +24°C (+64 to +75°F)
Enclosure size	19" sub-rack x 6U high x 340mm (13.4") deep
Weight	9kg (20lbs)

The DG3 is our entry-level, single-stage mixing humidity generator. It is operated by manually mixing the two gas streams using flow control valves. The DG3 provides flows up to 5 NI/min (10.6 scfh) and generates dew points ranging from -40 to +20°Cdp (-40 to +68°Fdp). Infinite mixing is achievable within its working range.

Highlights

- Consistently dry output over long time periods
- Full analog control of generated dew points across -40 to +20°Cdp (-40 to +68°Fdp) operating range
- Generated output responds quickly to a change of set-point
- Stable humidity generation
- Compact packaging

Dimensions



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: DG3_97334_V1_UK_0613

DG2

Dew-Point Generator



Technical Specifications

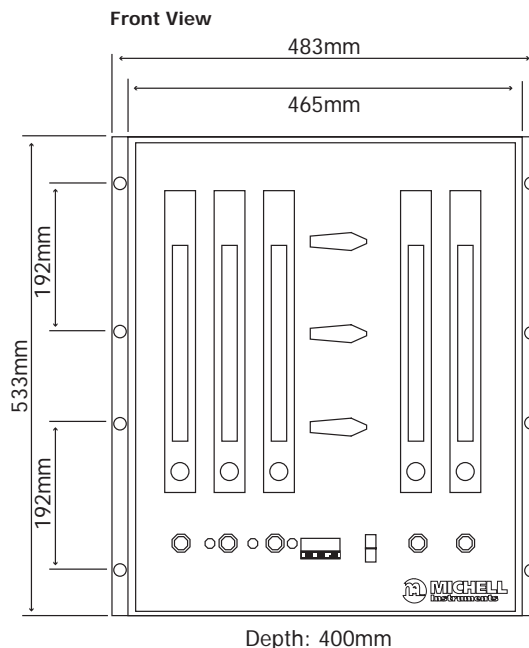
Mixing stages	2 stage
Humidity range	-75 to +20°Cdp (-103 to +68°Fdp)
Gas supply	8 NI/min (17 scfh) -1 air @ 1 barg (11 psig) and -75°Cdp (-103°Fdp)
Gas output	1 to 5 NI/min (2.1 to 10.6 scfh) (dependent on set point) @ ATM
Filter	Particulate filter
Saturator	Polycarbonate and porous polyethylene sinter
Heating	Finned heating elements, 500 watts, fan circulation
Power supply	220 to 240 V, 50Hz or 100 to 120 V; 60Hz
Storage temperature	+5 to +40°C (+41 to +104°F) (with saturators empty)
Operating temperature	+18 to +24°C (+64 to +75°F)
Enclosure size	19" sub-rack x 12U high x 400mm (15.8") deep
Weight	20kg (44lbs)

The DG2 has two stages of gas-flow mixing which allow it to generate dew points down to -75°Cdp (-103°Fdp). The great strengths of the DG2 are its ease of use and its flexibility in manually generating an accurate target dew point by fine tuning the gas mix via its flow metering valves. Infinite mixing is achievable within its working range.

Highlights

- Operation range of -75 to +20°Cdp (-103 to +68°Fdp) suiting the vast majority of calibration requirements
- Simple operation through manual flow mixing
- Flexibility in generating precise target dew-point temperature
- Generated output responds quickly to a change of set-point
- Stable humidity generation

Dimensions



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: DG2_97333_V1_UK_0613

DG4

Dew-Point Generator

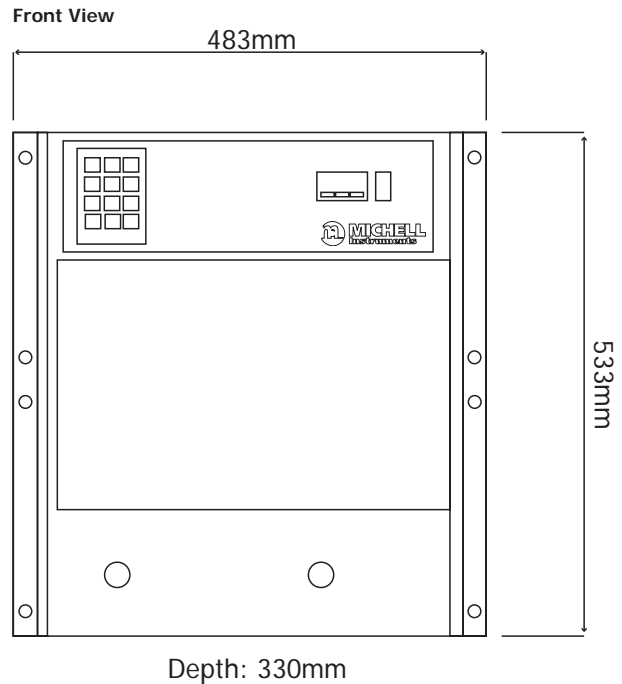


Technical Specifications



Mixing stages	2 stage
Humidity range	-75 to +20°Cdp (-103 to +68°Fdp)
Gas supply	8 NI/min (16 scfh) (max) @ 0.7 barg / 11 psig and -75°Cdp (-103°Fdp)
Gas output	1 to 5 NI/min (2.1 to 10.6 scfh) (dependent on set point) @ ATM
Filter	Particulate filter
Saturator	Polycarbonate and porous polyethylene sinter
Heating	Finned heating elements, 300 watts, fan circulation
Power supply	220/240V, 50Hz or 100/120V; 60Hz
Storage temperature	+5 to +40°C (+41 to +104°F) (with saturators empty)
Operating temperature	+18 to +24°C (+64 to +75°F)
Enclosure size	19" sub-rack x 6U high x 330mm (13") deep
Weight	25kg (55lbs)

Dimensions



The DG4 is a two-stage push-button dew-point generator which operates in the range of -75 to +20°Cdp (-103 to +68°Fdp). It can be delivered with between 3 and 10 factory-set dew point settings, selectable from the front panel keypad. Its RS232 communication port enables set points to be selected remotely by a PC or other device. The DG4 offers maximum flexibility via its pre-set values combined with optional manual mixing above -40°C (-40°F) dew point.

Highlights

- Operation range of -75 to 20°Cdp (-103 to +68°Fdp) suiting the vast majority of calibration requirements
- Simple operation through push-button switching of set points
- Remote control via RS232 comms
- Generated output responds quickly to a change of set point
- Stable humidity generation

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: DG4_97335_V2_UK_0315

VDS3

Dew-Point Generator



Technical Specifications



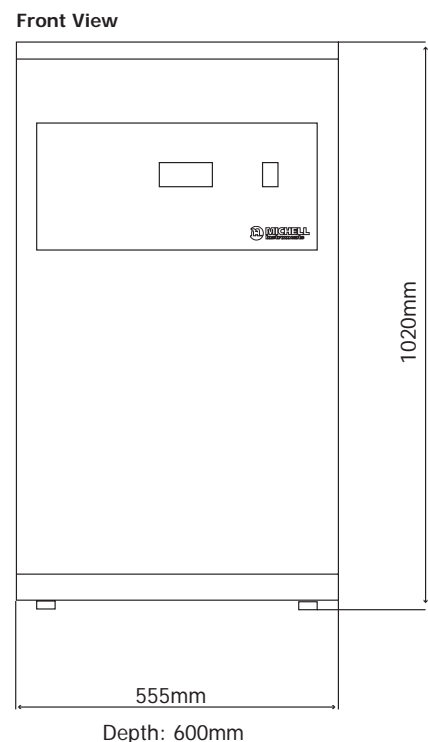
Dew-point range	-100 to +20°Cdp (-148 to +68°Fdp) (factory default preset values= -100, -90, -80, -70 -60, -50, -40, -30, -20, -10, 0, +10 and +20°C (+68°F))
Output stability	±0.5°C (±0.9°F)
Required gas supply	30 NI/min (63.6 scfh) @ 4.8 barg (70 psig) pressure and <13.8 ppb _v (-100°C / -148°F atmospheric dew-point) moisture content, or 90 NI/min (190.7 scfh) for high-flow output version
Gas output	10 NI/min (21.2 scfh) @ 0.5 barg (7.3 psig) or 30 NI/min (63.6 scfh) for high-flow output version
Cable connection	USB (type B) for PC Control RS485 (9 way D plug) for Setup
Water reservoir	Material= ABS Capacity= 1 liter
Power supply	220 to 240 V AC or 100 to 120 V AC 50/60 Hz
Power consumption	500 Watt maximum
Power connector	3 pin IEC
Power supply fuse	3A (F) quick blow
Operating temperature	+10 to +40°C (+50 to 104°F)
Construction	Painted diecast aluminum enclosure with smoked glass door
Dimensions	1020 x 555 x 600mm (40 x 22 x 24") h x w x d
Weight	65kg (143lbs) maximum

The VDS3 is a sophisticated computer-controlled dew-point generator that operates in the range of -100 to +20°Cdp (-148 to +68°Fdp). Individual three-stage mass flow controllers select precise proportions of wet and pre-mixed air. Humidity injection is achieved by a liquid mass flow controller and controlled evaporation system. The Vapor Delivery System (VDS) gives repeatable and flexible control of the generated dew point and can be programmed with up to 13 presets that can be activated manually or as part of an automatic calibration program.

Highlights

- Operation range of -100 to +20°Cdp (-148 to +68°Fdp) suiting the calibrated range of almost all dew-point sensors
- Fully automated remote control
- Mass flow controlled mixing of wet and dry flows ensures complete repeatability of set-points
- Generated output responds quickly to a change of set-point
- System optimized for excellent output stability (±0.5°C / ±0.9°F)

Dimensions



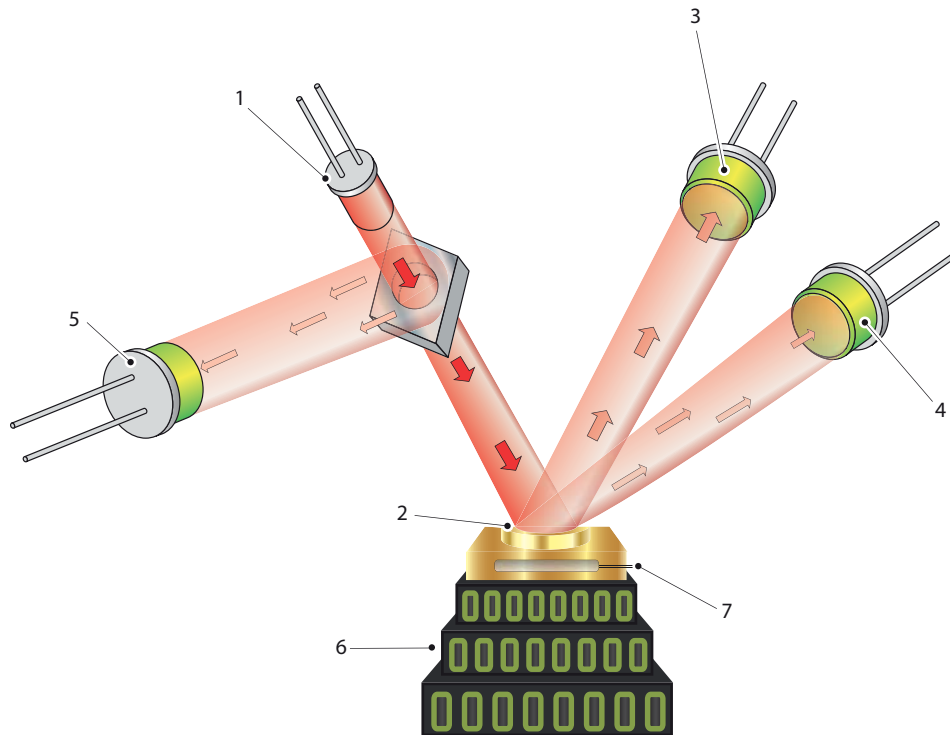
Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: VDS3_97336_V1.2_UK_0716

How Does Chilled Mirror Technology Work?

The Chilled Mirror sensor consists of a temperature-controlled mirror and an advanced optical detection system.



Michell Instruments S8000 sensors utilize our **RRS Optical System** to guarantee 0.01°C sensitivity and the fastest dynamic response to dew points as low as -90°C. The system employs active monitoring and adjustment to automatically rebalance the optics to accommodate any changes in the signal level not associated with condensed moisture.










A beam of light from an LED (1) is focused on the mirror surface (2) with a fixed intensity. As the mirror is cooled, less light is reflected due to the scattering effect of the condensate formed on the mirror surface. The levels of reflected and scattered light are measured by two photo-detectors (3 & 4) and compared against a third reference detector (5) measuring the intensity of light from the LED.

The signals from this optics system are used to precisely control the drive to a solid state thermoelectric cooler (TEC) (6), which heats or cools the mirror surface. The mirror surface is then controlled in an equilibrium state whereby evaporation and condensation are occurring at the same rate. In this condition, the temperature of the mirror, measured by a platinum resistance thermometer (7), is equal to the dew-point temperature of the gas.

In the **S8000 RS**, and **S4000 TRS**, an auxiliary cooling system is used to remove heat from the "hot" side of the TEC. This supplements the depression capabilities of the heat pump, and enables measurement of very low dew points.



Chilled Mirror Product Comparison Table

Product	Dew-Point Measurement Range from 20°C Ambient (°C)	Maximum Measureable Dew Point (°C)	Minimum Measureable Dew Point with Additional Cooling (°Cdp)	Accuracy (°C)	Integrated Auxiliary Cooling	Sensor Location
Optidew Vision 	-40/+20 (-40/68°F)	+130 (+266°F)	-40 (-40°Fdp)	±0.2 (0.36°F)	No	Remote
S4000 Climatic 	-55/+20 (-67/+68°F)	+85 (+185°F)	-80 (-112°Fdp)	±0.1 (±0.18°F)	No	Remote
S4000 TRS 	-100/+20 (-148/+68°F)	+20 (+68°F)	Not applicable	±0.1 (±0.18°F)	Yes	Integral
S8000 Remote 	-40/+20 (-40/+68°F)	+90 (+194°F)	-50 (-58°Fdp)	±0.1 (±0.18°F)	No	Remote
S8000 Integrale 	-60/+40 (-76/+104°F)	+40 (+104°F)	Not applicable	±0.1 (±0.18°F)	No	Integral
S8000 RS RS80 	-80/+20 (-112/+68°F)	+20 (+68°F)	Not applicable	±0.1 (±0.18°F)	Yes	Integral
RS90 	-90/+20 (-130/+68°F)	+20 (+68°F)	Not applicable	±0.1 (±0.18°F)	Yes	Integral

Optidew Vision

Optical Dew-Point Meter



The Optidew Vision precision dew-point meter is based on the proven, fundamental optical dew-point measurement principle, giving long-term drift-free performance. It offers a wide measurement range from the equivalent of <math><0.5</math> to 100% RH at ambient temperature (dew point range:

As a calibration reference

The Optidew is an excellent entry level calibration reference, supplied as standard with a fully traceable in-house calibration or optional UKAS-certified calibration. Its simple operation makes it possible for anyone to use with minimum training. Simply connect the instrument, power it up and measurement will begin automatically.

Data communication and application software

The instrument provides two linear 4-20 mA outputs and RS232 or RS485 serial communications, allowing configuration and monitoring by a suitable computer, data logger or other device. The comprehensive application software provides an interface to configure and control instrument functions, and enables all measured and calculated parameters to be graphed or logged over time.

Frost assurance technology (FAST)

Super-cooled water can exist at temperatures down to

FAST, the frost assurance technology that guarantees all dew-point measurements below

Compact and convenient package

The bench-top enclosure for the Optidew Vision has a handle that doubles as a stand. An optional panel-mounting kit is also available for 19" rack mounting. A bright and clear 2-line vacuum fluorescent display on the front panel enables the instrument parameters to be monitored even when not connected to the application software.

Highlights

- Fundamental drift-free dew-point measurement
- Convenient, transportable package
- $\pm 0.2^{\circ}\text{Cdp}$ ($\pm 0.36^{\circ}\text{Fdp}$) accuracy; optional higher accuracy available
- High temperature sensor option to $+130^{\circ}\text{C}$ ($+266^{\circ}\text{F}$)
- NEMA-12 bench-top housing
- Display and output of multiple engineering units
- High pressure sensor option to 25 MPa (250 barg / 3626 psig)

Optidew Vision

Technical Specifications

Performance				
Measurement accuracy	$\pm 0.2^{\circ}\text{Cdp}$ ($\pm 0.36^{\circ}\text{Fdp}$), $\pm 0.15^{\circ}\text{Cdp}$ ($\pm 0.27^{\circ}\text{Fdp}$) accuracy optional, $\pm 0.1^{\circ}\text{C}$ ($\pm 0.18^{\circ}\text{F}$) temperature			
Measurement units	$^{\circ}\text{C}$, $^{\circ}\text{F}$ dew point; %RH; $^{\circ}\text{C}$, $^{\circ}\text{F}$ temperature; g/m^3 ; g/kg ; a_w ; Δ ($t - t$ dew point)			
Response speed	1 $^{\circ}\text{C}/\text{sec}$ (1.8 $^{\circ}\text{F}/\text{sec}$) plus settling time (dew point dependant)			
Power supply	90 to 264 V AC or 127 to 370 V DC, 47 to 440 Hz, 20 W max, internally fused, 4A quick blow			
Dew-Point Sensor				
Sensor	1-Stage	2-Stage	High Temp PEEK	Climatic or Aluminum head
Dew-point range	-30 $^{\circ}\text{Cdp}$ @ sensor temp of +20 $^{\circ}\text{C}$ +90 $^{\circ}\text{Cdp}$ @ sensor temp of +90 $^{\circ}\text{C}$	-40 $^{\circ}\text{Cdp}$ @ sensor temp of +20 $^{\circ}\text{C}$ +90 $^{\circ}\text{Cdp}$ @ sensor temp of +90 $^{\circ}\text{C}$	-40 $^{\circ}\text{Cdp}$ @ sensor temp of +20 $^{\circ}\text{C}$ +130 $^{\circ}\text{Cdp}$ @ sensor temp of +130 $^{\circ}\text{C}$	-10 $^{\circ}\text{Cdp}$ @ sensor temp of +20 $^{\circ}\text{C}$ +130 $^{\circ}\text{Cdp}$ @ sensor temp of +130 $^{\circ}\text{C}$
Temperature range	-40 to +90 $^{\circ}\text{C}$ (-40 to +194 $^{\circ}\text{F}$)	-40 to +90 $^{\circ}\text{C}$ (-40 to +194 $^{\circ}\text{F}$)	-40 to +130 $^{\circ}\text{C}$ (-40 to +266 $^{\circ}\text{F}$)	-40 to +130 $^{\circ}\text{C}$ (-40 to +266 $^{\circ}\text{F}$)
%RH range	<2 to 100%	<0.5 to 100%	<0.5 to 100%	10 to 100%
Min measured dew point @ +20 $^{\circ}\text{C}$	-30 $^{\circ}\text{C}$ (-22 $^{\circ}\text{F}$)	-40 $^{\circ}\text{C}$ (-40 $^{\circ}\text{F}$)	-40 $^{\circ}\text{C}$ (-40 $^{\circ}\text{F}$)	-10 $^{\circ}\text{C}$ (+14 $^{\circ}\text{F}$)
Mirror material options	Gold plated copper (standard), gold stud, 316 stainless steel stud**, platinum stud**			
Sensor body material options	Acetal (standard), high temperature PEEK, 316 stainless steel**, anodized aluminum**			
Temperature measurement	4 wire Pt100, 1/3 DIN class B			
Sample flow	0.1 to 2 Nl/min (0.2 to 4 scfh) (in sampling block)			
Maximum velocity	10 m/sec direct insertion, 30 m/sec with sintered guard			
Pressure	Standard unit: 2 Mpa / 20 barg (300 psig) (max), ingress protection: IP66 High Pressure version: 25 Mpa / 250 barg (3626 psig) (max), ingress protection: IP65			
Sensor cable	Standard cable: PVC insulator material, +70 $^{\circ}\text{C}$ (+158 $^{\circ}\text{F}$) max temperature High temperature cable: Silicone insulator material, +180 $^{\circ}\text{C}$ (+356 $^{\circ}\text{F}$) max temperature			
Cable length	2m (6.56'); 50m (164'); up to 250m (820') on special request			

Remote PRT

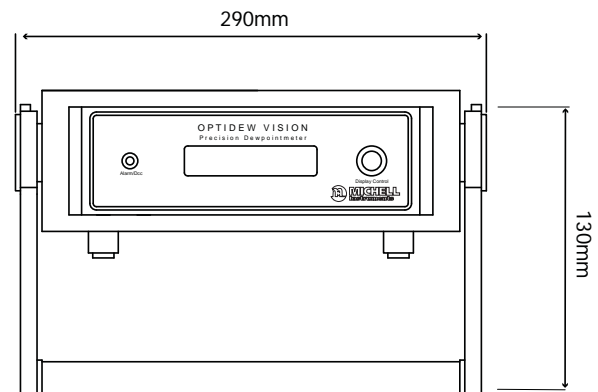
Temperature measurement	4 wire Pt100, 1/10 DIN class B
Remote PRT cable	Standard cable: PVC insulator material, +70 $^{\circ}\text{C}$ (+158 $^{\circ}\text{F}$) max temperature High temperature cable: PTFE insulator material, +250 $^{\circ}\text{C}$ (+482 $^{\circ}\text{F}$) max temperature
Cable length	2m (6.56'); 50m (164') max; up to 250m (820') on special request

Transmitter Electronics

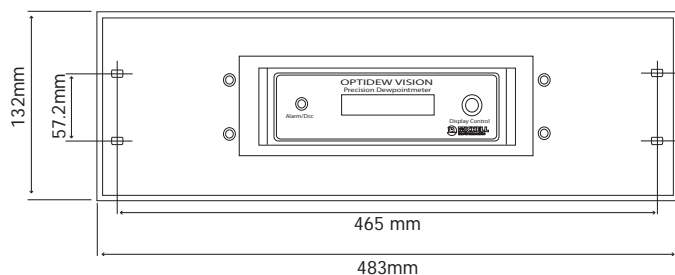
Resolution	0.1 for $^{\circ}\text{C}$, $^{\circ}\text{F}$ and %RH, 0.01 for g/m^3 and g/kg
Outputs	Analog: 4–20 mA or 0–20 mA over user-settable output, Accuracy: $\pm 0.2^{\circ}\text{C}$ ($\pm 3.6^{\circ}\text{F}$); 500 Ω maximum load resistance Digital: RS232 @ 9600 baud rate Alarm: Volt free contact, max 2 A @ 30 V DC, 0.5 A @ 120 V AC
Status LEDs	DCC/Alarm Status
Operating temperature	-20 to +50 $^{\circ}\text{C}$ (-4 to +122 $^{\circ}\text{F}$) ambient
Environmental conditions	Up to 98% RH non-condensing
Enclosure	Standing case with carry handle, panel mounting kit optional
Ingress protection	IP54 (NEMA 2)
Cable pack	Mains, RS232 cable and output connector
General	
Calibration	4-point traceable in-house calibration as standard, UKAS accredited calibrations optional — please consult Michell

Dimensions

Front View



Front View with Panel Mount Kit



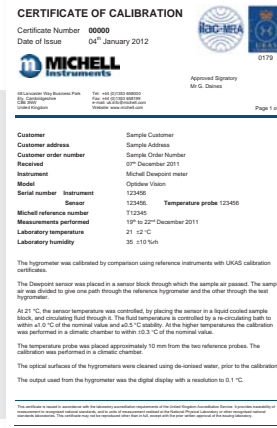
Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: Optidew Vision_97144_V6_UK_1115

S8000 Chilled Mirror Series Features

As the largest dew-point sensor manufacturer in Europe we know how important it is to have an accurate and reliable calibration reference. Our S8000 Series of chilled mirror reference hygrometers provide extremely accurate and precise measurement of dew point, relative humidity and temperature and are constantly in use in our own production environment, 24/7 calibration facility and service center. Michell's 40 years of expertise in the field of moisture measurement is built into each and every chilled mirror hygrometer design and our technical experts are always on hand to provide support and advice where needed.

Supplied with Traceable Calibration

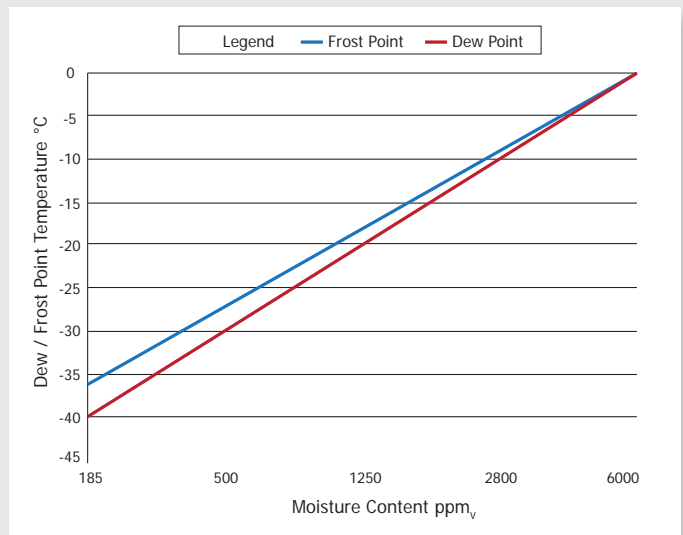
Chilled mirror is free from temperature dependence and remains accurate and drift-free across the entire measurement range. The S8000 Series of instruments are delivered fully calibrated and traceable to NPL and NIST national standards through Michell's world class UKAS accredited humidity calibration laboratory.



Frost Assurance

All S8000 Series instruments feature FAST, the frost assurance technology that forces ice formation on the mirror so all dew-point measurements made below 0°C (+32°F) are guaranteed to be 'over ice'. The FAST system works by rapidly cooling the mirror until a film of ice has formed on the mirror of pre-determined thickness – once ice has been formed, control returns to the instrument and measurement can begin.

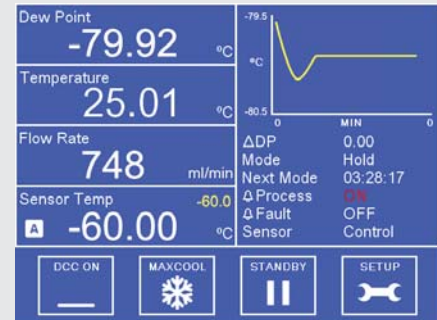
A viewing microscope is also available for the S8000 Integrale and S8000 RS. This enables the user to inspect the mirror surface during the measurement process, enhancing confidence in the formation of the correct phase of water condensate (dew or frost) on the mirror surface and therefore measurement accuracy.



Frost Point vs. Dew-Point temperatures below 0°C

Display & Outputs

A clear, bright and highly visible LCD display is capable of showing any three user-selectable parameters in large clear text. The display also features a stability graph and displays the operational status of the unit. An easy to use menu system enables the operating parameters of the instrument to be quickly customized to suit the target application. The S8000 Series also comes with customizable analog outputs and one or more alarms, enabling integration into an existing process or automated test and calibration system.



Built-in Data Logging

A sophisticated logging system provides the facility to log the values of all the instrument parameters at operator specified intervals. The log files are saved directly onto a removable SD memory card (supplied), allowing the logs to be easily transferred to a PC for analysis or correlation with test results.



Application Software

S8000 Series instruments feature a digital communications port (USB, RS232, RS485, Modbus or Ethernet options, depending on model) and multiple analog outputs, allowing configuration and monitoring by a suitable computer, data logger or other device. Adjustable isolated alarm contacts allow the S8000 Series to be used for direct process control.

Comprehensive application software is supplied with our chilled mirror hygrometers free of charge, to provide an interface to configure and control instrument functions, and enable all measured and calculated parameters to be graphed or logged over time.



S8000 Integrale

Precision Chilled Mirror Hygrometer



The S8000 Integrale is the base model of the S8000 Series and is suitable for a range of calibration applications. The integrated sensor head enables the S8000 to function as a stand-alone instrument, allowing measurement to -60°Cdp (-76°Fdp).

The hygrometer provides a direct measurement of dew point, temperature and pressure. Dew-point measurement is based on the proven, fundamental optical chilled mirror measurement principle, giving long-term drift-free humidity measurement over the entire operating range. The S8000 uses this measurement to offer a range of available measurement units including ppm_v , absolute humidity, relative humidity and ppm_w .

To further improve the accuracy of pressure-derived calculated values (ppm_v , ppm_w absolute humidity), an optional internal pressure transducer can be supplied, which provides real-time pressure. This allows for continued humidity measurement stability even during fluctuations in sample pressure.

A pair of adjustable isolated alarm contacts allow the S8000 Integrale Chilled Mirror Hygrometer to be used for direct process control. A high-contrast touch screen LCD display provides entirely customizable local indication of the measured values, along with a trend graph and fault warnings.

Highlights

- $\pm 0.1^{\circ}\text{Cdp}$ ($\pm 0.18^{\circ}\text{Fdp}$) accuracy
- Fundamental, accurate and drift-free measurement
- Simple configuration and operation via touch screen interface
- Precision measurements to -60°C (-76°F) dew point
- FAST – guaranteed frost formation below 0°C ($+32^{\circ}\text{C}$)
- Measure at pressures up to 2 MPa (20 barg)
- USB, Ethernet, RS485 or RS232 connectivity
- Datalogging to SD card or via digital comms

S8000 Integrale

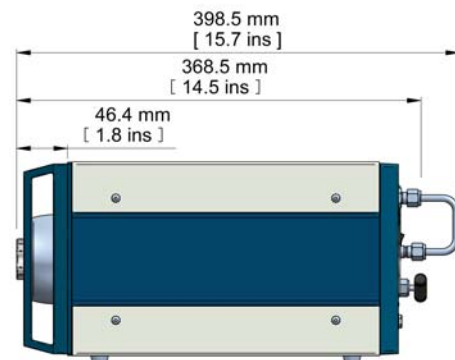
Technical Specifications

Dew-Point Sensor Performance	
Measurement technology	Chilled Mirror
Measurement range	-60 to +40°Cdp (-76 to +104°Fdp)
Accuracy	±0.1°C (±0.18°F)
Reproducibility	±0.05°C (±0.09°F)
Operating pressure	
Low pressure version	0 to 1 barg / 14.5 psig
High pressure version	0 to 20 barg / 290 psig
Sample flow rate	0.1 to 1 NI/min (0.2 to 2.1 scfh)
Detection system	RRS Triple Detection
Remote PRT Probe (Optional)	
Temperature measurement	4 wire Pt100, 1/10 DIN class B
Measurement accuracy	±0.1°C (±0.18°F)
Cable length	2m (6.6') (250m (820') max)
Flow Sensor	
Measurement accuracy	Typical ±5% uncalibrated
Measurement range	0 to 1000 ml/min
Integrated Pressure Sensor (Optional)	
Measurement range	0 to 25 bara (0 to 377 psia)
Measurement accuracy	0.25% Full Scale
Measurement units	psia, bara, KPa or MPag
Monitor	
Resolution	User-selectable to 0.001 dependant on parameter
Measurement units	°C and °F for dew point and temperature %RH, g/m ³ , g/kg, ppm _v , ppm _w (SF ₆), for calculated humidities
Outputs	
Analog	3 channels, user-selectable 4–20 mA, 0–20 mA or 0–1 V
Digital	Modbus RTU over USB, and optional Modbus RTU over RS232, RS485 or Modbus TCP over Ethernet
Alarm	Two volt-free changeover contacts, one process alarm, one fault alarm; 1 A @ 30 V DC
HMI	5.7" LCD with touchscreen, white on blue graphics
Data logging	SD Card (512Mb supplied) and USB interface SD Card (FAT-16) — 2Gb max. that allows 24 million logs or 560 days, logging at 2 second intervals
Environmental conditions	-20 to +40°C (-4 to +104°F)
Power supply	85 to 264 V AC, 47/63 Hz
Power consumption	100 V A
EMC - Class A Emissions Industrial Location Immunity	Complies with EN61236:1997 (+A1/A2/A3)

Mechanical Specifications

Dimensions	184 x 483 x 368mm (7.3 x 19 x 14.5") h x w x d
Weight	11kg (24.3lb)
General	
Process connections	6mm Swagelok® tube or 1/4" Swagelok® tube
Storage temperature	-20 to +50°C (-40 to +122°F)
Calibration	3-point traceable in-house calibration as standard UKAS accredited calibrations optional — please consult Michell

Dimensions



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: S8000 MKII_97509_V1_UK_Datasheet_1015

S8000 Remote

High Precision Dew-Point Hygrometer



The S8000 Remote has all the great features of the other S8000 Series chilled mirror hygrometers, but with a convenient and compact remote sensor design. The field-proven sensor boasts upgraded temperature control for extremely accurate dew-point measurement. Coupled with the standard $\pm 0.1^{\circ}\text{C}$ (0.18°F) accuracy ambient temperature sensor, it provides fundamentally derived, high precision relative humidity readings necessary for validating the results of environmental tests.

The perfect reference for environmental chambers

The relative humidity in climatic chambers will always deviate from the set point. Even in high precision chambers this deviation is typically between 1-3% RH, which can have a considerable effect on the results of many tests. The S8000 Remote can reduce this uncertainty to just 0.5% RH, depending on set point.

The compact remote sensor takes up minimal space in the chamber and features an open cell design, removing the need for any complex heated sampling arrangements or an external pump. Installing the sensor is simply a matter of placing it in an appropriate position within the chamber, and routing the cable externally to the instrument. An optional aluminum sensor head provides a swift response to changes in temperature, preventing any risks of condensation occurring during rapid transitions between temperature set points.

Highlights

- Fundamental, accurate and drift-free measurement
- Remote sensor
- Open design allows remote sensor to be mounted into a sample flow or simply placed in an environment to be monitored
- -40 to $+90^{\circ}\text{C}$ (-40 to $+194^{\circ}\text{F}$) dew-point range with 0.1°C (0.18°F) accuracy
- Data logging to USB or SD card
- 'FAST' guarantees frost formation below 0°C ($+32^{\circ}\text{F}$)
- Sensor operates in pressures up to 20 barg (290 psig)

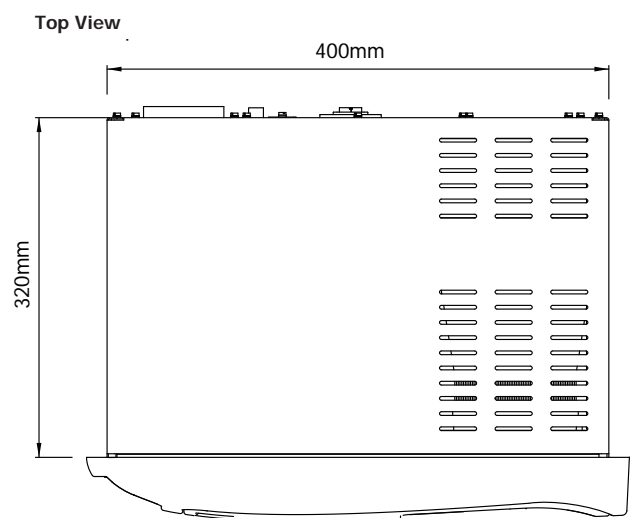
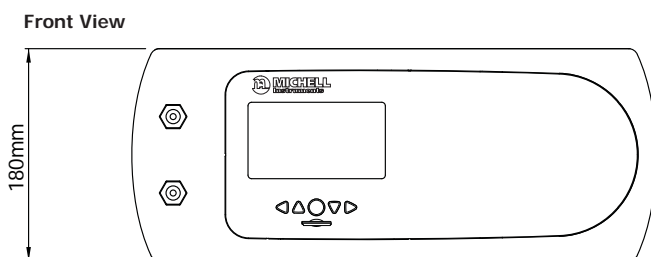
S8000 Remote

Technical Specifications

Performance		
Sensor type	Acetal	Aluminium
Dew-point range	-40°Cdp @ sensor temp of +20°C to +90°Cdp @ sensor temp of +90°C	-20°Cdp @ sensor temp of +20°C to +90°Cdp @ sensor temp of +90°C
Operating temperature	-40 to +90°C (-40 to +194°F)	
%RH range	< 0.5-100%	< 4.5-100%
Accuracy	±0.1°C (±0.18°F)	
Response speed	1°C/sec (1.8°F/sec) plus settling time	
Reproducibility	±0.05°C (±0.09°F)	
Operating pressure	0 to 20 barg (0 to 290 psig)	
Remote PRT		
Temperature measurement	4 wire Pt100, 1/10 DIN class B	
Accuracy	±0.1°C (±0.18°F)	
Cable length	2m (6.6ft) (250m (820ft) max)	
Optional Remote Pressure Sensor		
Measurement range	0 to 25 bara (0 to 377 psia)	
Accuracy	Accuracy 0.25% Full Scale	
Measurement units	psia, bara, KPa or MPa	
Pressure transducer thread	1/8" NPT	
Monitor		
Resolution	User-selectable to 0.001 dependant on parameter	
Measurement units	°C and °F for dew point and temperature %RH, g/m ³ , g/kg, ppm _v , ppm _w (SF ₆), for calculated humidities	

Outputs	Analog	3 channels, user selectable 4-20 mA, 0-20 mA or 0-1 V
	Digital	PC Communications using Modbus RTU over USB
	Alarm	Two volt free changeover contacts, one process alarm, one fault alarm; 1 A @ 30 V DC
HMI	High definition, blue LCD, user-adjustable contrast, menu navigation via five button keypad	
Data logging	SD Card (512Mb supplied) and USB interface SD Card (FAT-16) - 2Gb max. that allows 24 million logs or 560 days, logging at 2 second intervals	
Environmental conditions	-20 to +50°C (-4 to +122°F)	
Power supply	85 to 264 V AC, 47/63 Hz	
Power consumption	100 V A	
Mechanical Specifications		
Dimensions (instrument)	180 x 400 x 320mm (7.1 x 15.7 x 12.5") h x w x d	
Dimensions (sensor)	ø45 x 128mm with M36 x 1.5-6g mounting thread	
Cable length	2, 5 or 10m (6.5, 16.4 or 32.8ft)	
Weight	7.9kg (17.4lbs)	
General		
Storage temperature	-40 to +60°C (-40 to +140°F)	
Detection system	Single optics detection system with auto adjustment	
Calibration	4-point traceable in-house calibration as standard; UKAS accredited calibrations optional - please consult Michell Instruments	

Dimensions



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: S8000 Remote_97307_V3_UK_1115

S8000 RS

High Precision Dew-Point Hygrometer



The S8000 RS is at the cutting edge of chilled mirror reference technology. The advanced sensor design has been refined over several generations and is accurate, reliable and highly sensitive. A sophisticated auxiliary cooling system allows the instrument to precisely measure dry dew points to -90°C (-130°F) (100 ppb_v) with no need for additional, external cooling equipment. Combined with its $\pm 0.1^{\circ}\text{C}$ ($\pm 0.18^{\circ}\text{F}$) accuracy this makes it the most cost-effective and convenient hygrometer in its class.

The S8000 RS comes with all the features you would expect from a modern laboratory instrument including a large touch screen interface, built in data-logging, Ethernet / USB connectivity and dedicated application software. It is also the smallest and lightest of the instruments in its class, weighing just 17kg (37.5lbs), and is suitable for rack mounting.

Improved touch screen display

The S8000 RS features an upgraded display offering touch screen operation and a larger viewing area, while retaining all of the functionality of the original S8000 display. A powerful new menu system optimized for touch screen usage makes configuration of instrument parameters quick and easy.

New sensor head design for uncompromising accuracy

The S8000 RS sensor is optimised for measurement of low dew points, and incorporates a high precision Pt100 to measure the mirror temperature. Combined with a sensitive optical detection system and high integrity

internal sampling, featuring welded stainless steel tubing and VCR fittings, this provides $\pm 0.1^{\circ}\text{C}$ ($\pm 0.18^{\circ}\text{F}$) accuracy of dew-point measurement and the fastest possible response time to very low dew points.

To further improve the accuracy of pressure-derived calculated values an optional pressure transducer can be installed, which provides a real-time pressure input for these parameters. This allows for continued measurement accuracy, even during sample pressure fluctuations.

Highlights

- Accuracy of $\pm 0.1^{\circ}\text{C}$ ($\pm 0.18^{\circ}\text{F}$)
- Precision measurement to -90°Cdp (-130°Fdp) (100 ppb_v) with no need for additional cooling
- Simple configuration and operation via touch screen interface
- Sensor head optimized for fast response to low moisture levels
- High measurement sensitivity
- Microscope for visual inspection of condensate on mirror
- Compact 19" x 4U package for flexibility of installation
- Lightweight at 17kg (37.5lbs) – less than half the weight of closest competitor
- Ethernet or USB connections
- SD card datalogging

S8000 RS

Technical Specifications

Dew-Point Sensor Performance	
Measurement technology	Chilled Mirror
Measurement range	RS80: -80 to +20°Cdp (-112 to +68°Fdp) RS90: -90 to +20°C dp (-130 to +68°Fdp)
Measurement accuracy	±0.1°C (±0.18°F)
Reproducibility	±0.05°C (±0.09°F)
Mirror	Gold plated copper
Temperature measurement	4 wire Pt100, 1/10 DIN class B
Sample flow rate	0.5 to 1 NI/min (1 to 2.1 scfh)
Sample gas pressure	1 MPa (10 barg / 145 psig) maximum
Remote PRT	
Temperature measurement	4 wire PT100, 1/10 DIN class B
Measurement accuracy	±0.1°C (±0.18°F)
Cable length	2m (250m max) (6.6ft (820ft max))
Flow Sensor	
Measurement range	0 to 1 NI/min (0 to 2.1 scfh)

Optional Integrated Pressure Sensor

Measurement range	0 to 1.6 MPa (0 to 16 barg / 0 to 232 psig)
Measurement accuracy	0.25% full scale
Measurement units	barg, psig, kPa, MPa
Cable pack	Supply and USB cables Output connectors suitable for indoor use

Monitor

Resolution	User selectable to 0.001°C (0.0018°F), depending on parameter
Measurement units moisture	°Cdp or °Fdp, % RH, g/m ³ , g/kg, ppm _v , ppm _w (SF ₆)
Temperature	°C or °F
Pressure	barg, psig, kPa, MPa
Outputs	Analog: Three channels, user selectable 4-20 mA, 0-20 mA or 0-1 V Digital: USB and Modbus TCP (over Ethernet)
Alarm	Two volt-free changeover contacts, one process alarm, one fault alarm; 1 A @ 30 V DC
HMI	5.7" LCD with touchscreen, white on blue graphics
Data logging	SD Card (512 MB supplied) and USB interface. Supports SD Card (FAT-16) - 2Gb max. allows 24 million logs or 560 days logging at 2 second intervals

Environmental conditions	+5 to +30°C (+41 to +86°F) max 80% RH
Power supply	85 to 264 V AC, 47/63 Hz
Power consumption	250 V A

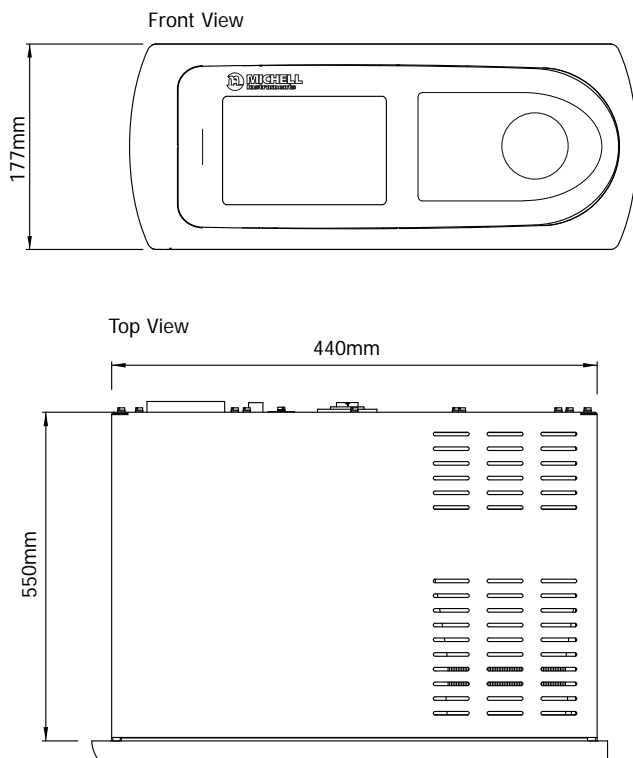
Mechanical Specifications

Dimensions	177 x 440 x 550mm (7 x 17.32 x 21.65") (h x w x d)
Weight	17kg (37.5lbs)
Sample gas circuit	316 stainless steel
Sample gas connections	Inlet: 1/4" VCR Outlet: 1/4" Swagelok®

General

Calibration	5-point in-house calibration, national standards traceable as standard UKAS accredited calibrations optional – please consult Michell Instruments
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Dimensions



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: S8000 RS_97316_V2_UK_0116

S4000 Series

Precision Dew-Point Hygrometers



S4000 TRS



S4000 Remote Climatic

The Michell Instruments S4000 Series of chilled mirror hygrometer is available in two distinct models: the S4000 TRS for very dry dew point measurements to -100°C (-148°F), and the S4000 RC for a dynamic range of wet and dry measurements.

The S4000 Series is supplied with all the standard features of our other chilled mirror hygrometers including dynamic contamination control, a microscope for visual identification of the condensate, RS232 digital communications, and both current and voltage analog outputs.

S4000 TRS

The S4000 TRS is Michell Instruments' industry proven chilled mirror reference hygrometer, offering $\pm 0.1^{\circ}\text{C}$ ($\pm 0.18^{\circ}\text{F}$) dew point and temperature accuracy, across a wide range of dew points from -100°C (-148°F) (14 ppb_v) to $+20^{\circ}\text{C}$ ($+68^{\circ}\text{F}$).

The S4000 TRS was selected to provide transfer of the trace humidity standard between the NPL (National Physical Laboratory, London UK) and NIST (National Institute of Standards & Technology, Washington DC, USA), on account of its excellent stability and reproducibility. It is now widely used in calibration and standards laboratories worldwide, in recognition of these characteristics.

S4000 RC

The S4000 Remote Climatic offers the widest range of any of Michell's chilled mirror hygrometers, and is capable of measuring dew points from -85°C to $+80^{\circ}\text{C}$ (-121 to $+176^{\circ}\text{F}$) It includes the same high quality sensing components as the S4000 TRS and a dew-point and temperature accuracy of $\pm 0.1^{\circ}\text{C}$ ($\pm 0.18^{\circ}\text{F}$) across the range.

The S4000 Remote Climatic features a monolithic sensor block designed for mounting in climatic chambers or other environmental monitoring applications.

Highlights

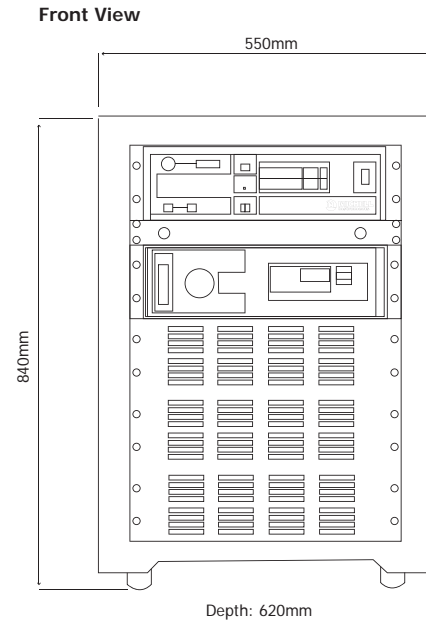
- 0.1°Cdp (0.18°Fdp) accuracy
- Measurement range: S4000 TRS: -100 to $+20^{\circ}\text{Cdp}$ (-148 to $+68^{\circ}\text{Fdp}$); S4000 RC: -80 to $+85^{\circ}\text{Cdp}$ (-112 to $+185^{\circ}\text{Fdp}$)
- Precision $100 \ \Omega$ 4 wire platinum resistance thermometer
- Dual optics detection system
- Available with VCR couplings for optimum trace moisture sampling (S4000 TRS)
- Dual multi-function LED display with unit indicator

S4000 Series

Technical Specifications

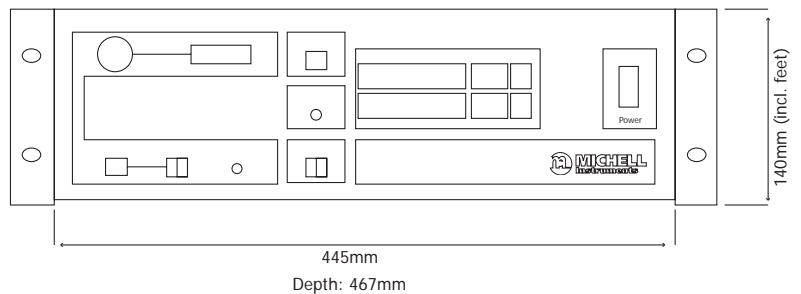
Model	S4000 TRS	S4000 RC
Performance		
Measurement technology	Chilled Mirror	
Measurement range	-100 to +20°Cdp (-148 to +68°Fdp)	-80 to +85°Cdp (-112 to +185°Fdp)
Measurement accuracy	±0.1°Cdp (±0.18°Fdp) ±0.1°C (±0.18°F) temperature	
Measurement units	°Cdp, °Fdp; °C, °F temperature; % RH, ppm _v , ppm _w , g/m ³ , g/kg, ppm _w for SF ₆	
Repeatability	Better than 0.1°C (0.18°F)	
Resolution	0.01 (0.1 for % RH)	
Dew-Point Sensor		
Mirror	Gold plated copper	
Dual optics detection	Wide band red LED with dual photo sensors, all system insulated	
Temperature measurement	4 wire Pt100, 1/10 DIN class B	
Sample flow rate	0.1 to 0.7 NI/min (0 to 1.5 scfh) (recommended)	
Integrated flowmeter	0 to 1 NI/min (0 to 2.1 scfh)	
Sensor pressure	Atmospheric	
Configuration	Integral	Remote
Auxiliary cooling	Internal refrigeration	Passive - air cooled
Remote PRT		
Temperature measurement	4 wire Pt100, 1/10 DIN class B	
Monitor		
Resolution	0.01°C (0.018°F)	
Outputs	Analog: 2 channels, 10 mV/°Cdp, 4-20 mA Digital: RS232 Logic: Data hold, ABC Logic status, optics alarm	
Auxiliary input pressure transducer	4-20 mA input for automatic compensation 0-0.34 MPa (0 to 3.4 barg / 0 to 50 psig) (optional)	
Operating temperature	0 to +40°C (+32 to +104°F)	
Dimensions	840 x 550 x 620mm (33 x 21.7 x 24.4") (h x w x d) - mini rack	Monitor: 140 x 445 x 467mm (5.5 x 17.5 x 18.4") (h x w x d) Sensor: 230 x 228 x 165mm (9 x 8.9 x 6.5") (h x w x d)
Weight	85kg (187lbs)	Monitor: 7.5kg (16.5lbs) Sensor: 5.5kg (12.1lbs)
Power supply	Monitor: 90 to 265 V AC; 50/60 Hz Sensor: 100 to 115 or 220 to 240 V AC; 50/60 Hz	

S4000 TRS Dimensions

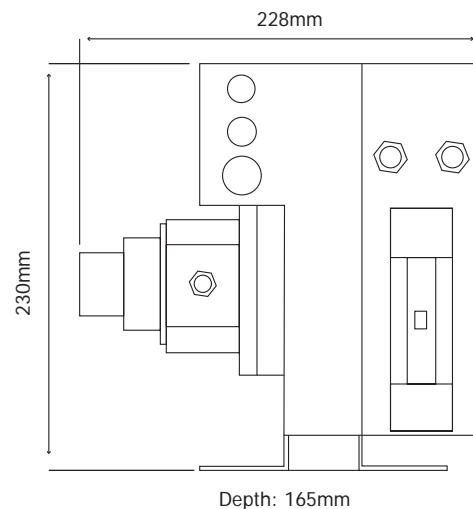


S4000 RC Dimensions

Monitor Front View



Sensor Side View



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: S8000 TRS_97146_V4_UK_0613

Integrated Calibration Systems

Dew-Point Calibration

HG1

Humidity Calibrator



A low-cost, easy to use, fully integrated system for the calibration of dew-point and relative humidity sensors from 2 to 90% relative humidity, -30 to +20°Cdp (-22 to +68°Fdp).

Operation of the HG1 Humidity Calibrator is based on a simple, yet reliable, principle: a source of dry air is split into two streams, one of which is humidified by bubbling it through a water saturator. The two air streams are then volumetrically mixed to produce an air flow of fixed humidity, dependent upon the mixing ratio selected on the HG1's front panel-mounted flow meters.

The HG1 includes an integrated air pump to draw in ambient air, which is passed through a single column of desiccant. Alternatively, a dry air source, such as instrument air or bottled nitrogen, can be connected to the gas inlet to boost the low-end capability down to -40°C (-40°F) dew point and increase the amount of time before the desiccant requires regeneration.

The HG1 can be supplied with a built-in chilled mirror reference instrument to provide a fundamental measurement of the generated dew point when absolute accuracy is required. The chilled mirror reference sensor is mounted directly into the sample chamber.

The reference instrument comes supplied with a software suite that provides real-time monitoring, charting and logging capabilities via a built-in RS232 communications port.

The HG1's integrated test chamber can accommodate a variety of humidity sensors (dimensions opposite) also, as an alternative to the integrated calibration chamber, the unit is supplied with a gas-outlet feed to supply calibration air to an external manifold or system.

The maintenance of the HG1 is simple. When saturated, the desiccant changes color, indicating that it needs to be regenerated which is done by heating in an oven. The saturator water level is monitored from the rear of the unit and an easy top-up arrangement is provided.

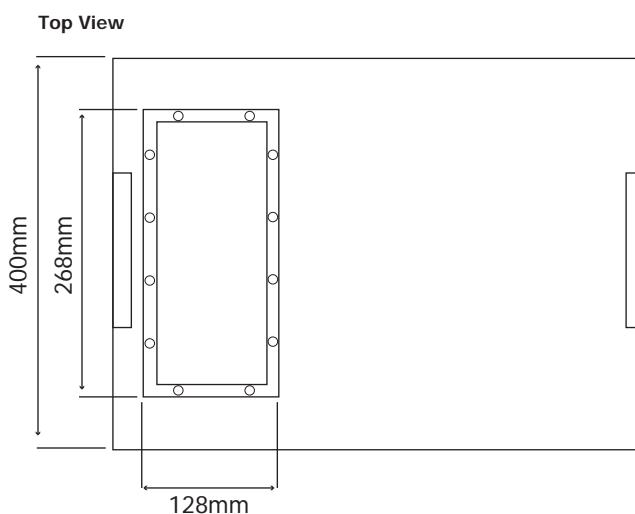
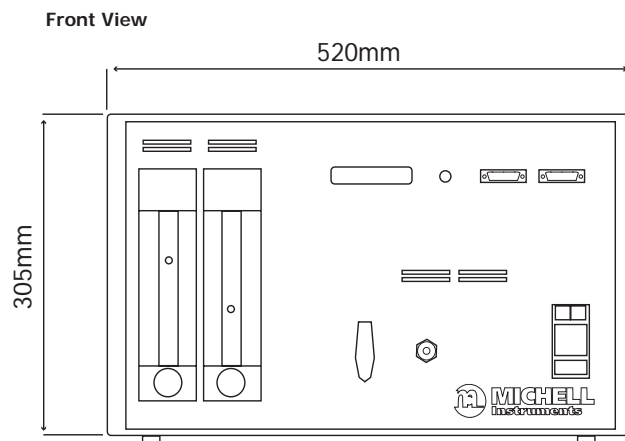
Highlights

- Integrated chilled mirror reference hygrometer
- Straightforward operation
- Allows quick verification tests of humidity sensors
- Transportable

Technical Specifications

Calibration range	2 to 90% RH (-30 to +20°Cdp (-22 to +68°Fdp)) @ 21°C (69.8°F) ambient
Reference accuracy	Typically ±2% of reading (% relative humidity), 0.2°Cdp (0.36°Fdp), 0.1°C (0.18°F) ambient temperature (with Optidew reference hygrometer)
Calibration	Through traceable calibration of integrated Optidew reference hygrometer, to NPL and NIST
Operating temperature	+10 to +35°C (+50 to +95°F) ambient
Power	90 to 120V AC @ 60Hz or 220 to 260V AC @ 50Hz
Calibration chamber	Steel with gasket seal 120 x 120 x 250mm (4.7 x 4.7 x 9.8") (h x w x d)
Overall dimensions	Painted aluminum case 305 x 520 x 400mm (12 x 20.5 x 15.7") (h x w x d)
Sample flow rate	4 NI/min (0.85 scfh) for the sensor cell
Weight	20kg (44lbs)

Dimensions



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: HG1_97158_V2_UK_0613

DCS - Dew-Point Calibration Systems

DCS60, DCS80, DCS100



DCS80 with S8000RS

The DCS system is a complete rack-mounted calibration station capable of producing a flow of air (or nitrogen) at a pre-specified range of dew-point temperatures from a minimum of -100°C (-148°F) to a maximum of $+20^{\circ}\text{C}$ ($+68^{\circ}\text{F}$).

When ordering this system, simply specify the required operating range, and Michell Instruments will determine the most economical way to construct your calibration system.

Each DCS comprises the following components:

Air Compressor

An oil-free laboratory mini compressor, used to generate clean compressed air to feed the air dryer system. The compressor can be housed within the calibration rack system (< 72 dbA noise level) or in a separate room, with an air feed to the DCS system.

Pressure Swing Dryer

The dryer provides a source of dry or super-dry air required by the generator. The PSD2 Dryer is used with the DCS80 calibration systems, and provides a supply of dry air with a dew point of -80°C (-112°F) or less in continuous operation. The PSD4 supplied with the DCS100 system provides dry air of -100°Cdp (-148°Fdp) dew point or less. An appropriate dryer will be selected for the calibration system, based on the dew-point range requirements specified.

Generator

The dew-point generator produces, and allows adjustment of, the flow of humidity controlled calibration gas. A DCS60/80 system can be supplied with either a DG2 or DG4 generator.

The DG2 dew-point generator allows full manual, analog control of the generated dew point by means of metering valves on the front panel.

The DG4 dew-point generator provides automated control of the generated dew point by allowing the selection of the desired dew point either via push buttons on the front panel, or by remote control via RS232 communications. The pre-set dew points are chosen at the time of order.

The DCS100 is supplied with a Vapor Delivery System (VDS) generator, which can be controlled directly or programmed to cycle through a range of outputs by means of dedicated control software.

Reference Hygrometer

The Reference Hygrometer serves to provide a dependable measurement of the calibration gas produced by the dew-point generator, to allow comparison against instruments under test.

A Chilled Mirror hygrometer directly measures the temperature at which condensation forms, and provides inherently repeatable, reliable results every time. Meaning is best suited for use as a reference instrument.

To ensure traceability to higher standards, the reference will be supplied with either a national standards traceable, or a UKAS accredited calibration.

Highlights

- Complete dew-point calibration solution with optional compressor, dryer, dew-point generator, reference instrument and optional manifold
- Generated output responds quickly to a change of set point
- Stable humidity generation
- Simple operation through manual flow mixing or push-button switching of set points
- Remote control via RS232 comms (dependant on model)

DCS - Dew-Point Calibration Systems

DCS60

The DCS60 is supplied with an S8000 Integrale, which is air cooled and has the capability to measure to dew points of -60°C (-76°F).

DCS80

The DCS80 is supplied with an S8000 RS, which features an automatically controlled auxiliary cooling system, and has the capability to measure to dew points of -90°C (-130°F).

DCS100

The DCS100 is supplied with an S4000 TRS, which utilizes a manually controlled auxiliary cooling system, and has the capability to measure to dew points of -100°C (-148°F).



DCS100

Calibration Manifold

Michell Instruments' dedicated systems engineering team can design and build for you a calibration manifold to suit any type of dew-point sensor, or a combination of sensors from different manufacturers. Just tell us the sensor type and we'll do the rest.

Housing

The whole system is conveniently mounted in a 19" rack unit for ease of use. If using a high purity air or nitrogen supply, this may be chosen as a feed to the system instead of the integral compressor/dryer system. A Michell Instruments' technical sales representative can give advice on how to accommodate this variation.

Technical Specifications

	DCS60	DCS80	DCS100
Range	-60 to $+20^{\circ}\text{Cdp}$ (-76 to $+68^{\circ}\text{Fdp}$)	-80 to $+20^{\circ}\text{Cdp}$ (-112 to $+68^{\circ}\text{Fdp}$)	-100 to $+20^{\circ}\text{Cdp}$ (-148 to $+68^{\circ}\text{Fdp}$)
Air dryer	PSD2 Dryer	PSD2 Dryer	PSD4 Super Dryer
Generator method	DG2 with manual flow metering DG4 with solenoid controlled needle valves	DG2 with manual flow metering DG4 with solenoid controlled needle valves	VDS system with mass flow controllers
Reference hygrometer	S8000 Integrale Chilled Mirror Hygrometer	S8000 RS Chilled Mirror Hygrometer	S4000 TRS Chilled Mirror Hygrometer
Calibration flow rate	2 to 5 NI/min (4.2 to 10.6 scfh)	2 to 5 NI/min (4.2 to 10.6 scfh)	10 NI/min (21.2 scfh)
Best system uncertainty	$\pm 0.2^{\circ}\text{C}$ ($\pm 0.36^{\circ}\text{F}$) dew point ($k = 2$) @ $+20^{\circ}\text{Cdp}$ ($+68^{\circ}\text{Fdp}$)		
Set point precision	$\pm 0.5^{\circ}\text{C}$ ($\pm 0.9^{\circ}\text{F}$) dew point		
Carrier gas	Oil-free compressed air (compressor supplied)		
Operating temperature	$+15$ to $+30^{\circ}\text{C}$ ($+59$ to $+86^{\circ}\text{F}$)		
Traceability	Directly to NPL and NIST through Reference Hygrometer		
Power	220 to 240 V AC or 100 to 130 V DC, 50/60 Hz		
Housing	Wheeled 19" rack system, 1.9 m (74.8") high		
Weight	98kg (216lbs) (approx)	125kg (231lbs) (approx)	Varies

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: DCS_97162_V3_UK_0315

Integrated Calibration Systems

RH Calibration

HygroCal100 Humidity Validator



The HygroCal100 provides a stable test chamber to quickly evaluate the performance of relative humidity sensors across a wide range of 5 to 95% relative humidity. The intuitive design allows the probes under test to be fully integrated with the chamber and user interface (UI), so up to 7 probes with a variety of diameters and output signals can be powered, monitored and logged simultaneously by one self-contained unit.

A 4.3" LCD touch-screen runs a powerful UI, which displays all measured values from the reference and probes under test, along with a graphical trend indication of chamber stability. It is also capable of automating complete validation procedures with ease, and providing a complete logged output in csv format straight to your USB memory device, to minimize the time you spend taking readings.

Chamber Integrity

The HygroCal100 has a test chamber milled from a solid piece of Acetal, with minimal sealing points, ensuring the integrity required to maintain <5% RH from laboratory ambient temperatures, and $\pm 0.5\%$ RH uniformity across the chamber.

Portability

The HygroCal100 is fitted with a high capacity battery pack, which can power the generator and 7 sensors under test for up to 8 hours. The unit can also run from mains power while charging the battery.

A hard carry case is supplied with the unit, which has space for the HygroCal100 itself, in addition to the battery charger, spare water and desiccant.

Integrate Your Own Reference

The HygroCal interface allows you to assign any hygrometer with an analog output as your reference device, giving you the flexibility to incorporate your traceable reference in your validation routine.

Automated Validation

The HygroCal100's advanced UI allows you to define your own calibration procedure, point-by-point, assigning times to each condition to allow your probes under test to stabilize. The system always waits until the conditions in the chamber are completely stable before beginning the check.

Correct Chamber Control To Your Own Reference

To ensure continual long term stability of the chamber, the in-built calibration correction system can compare the readings of your traceable reference to a range of pre-set generated conditions – making adjustments to the control sensor to ensure that your set point always matches your own reference.

Highlights

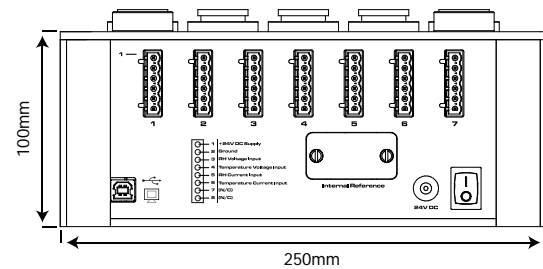
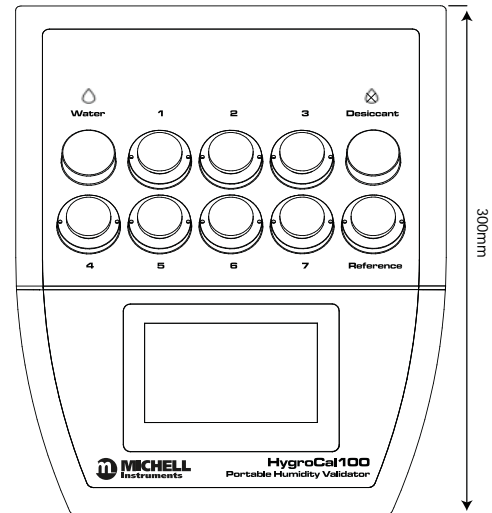
- Truly portable at 3.2kg, and completely self-contained
- Intuitive UI makes automating probe verification simple
- Integral battery pack means validation can be done without access to services
- Validate 7 probes simultaneously
- Automated validation procedures for complete hands-off probe verification
- Internal calibration correction cycle ensures continued confidence
- Optional chilled mirror reference hygrometer, allowing use as a calibrator
- Download logged verification data direct to USB memory

HygroCal100

Technical Specifications

Chamber	
Generation range	5 to 95% RH
RH stability	±0.5%
RH uniformity	±0.5%
Stabilization time	Typically <5 min for full stability from step changes of 10% RH
Control Probe	
RH accuracy	±0.8%
Temperature accuracy	±0.2°C (±0.36°C)
Long term stability	±1% per year
Electrical Specifications	
User interface	4.3" color LCD with touchscreen
Interface with probes	24 V excitation voltage, accepts signals: 0–20 mA, 4–20 mA, 0–1 V, 0–5 V, 0–10 V
Measurement units	%RH, temperature in °C, °F
Displayed resolution	0.1
Data logging	2Gb internal memory available for log files; or 10.6yrs storage at 5s intervals
Battery	1500 mAh
Power supply	24 V DC (100 to 240 V AC, 50/60 Hz adaptor included)
Mechanical Specifications	
Probe ports	8 - port adaptors to accommodate probes of diameters: 12mm, 13.5mm, 14mm, 15mm, 18.5mm, 19mm, 24mm, 25mm
Chamber volume	Approx 1050cm ³
Maximum probe insertion depth	60mm (2.4")
Desiccant reservoir capacity	25cm ³ (1.5 In ³)
Saturator reservoir capacity	25ml
Environmental conditions	+5 to +40°C (+41 to +104°F)
Dimensions	100 x 250 x 300mm (3.9 x 9.8 x 11.8") (h x w x d)
Weight	3.2kg (7lb)

Dimensions



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: HygroCal100_97502_V1_UK_Datasheet_1015

S904

Humidity Calibrator



The S904 is a completely stand-alone and transportable calibrator for humidity sensors, requiring no external services other than mains power. The calibration chamber features 5 interchangeable ports to accommodate virtually any brand, type or model of sensor. This calibrator is ideal for companies or organizations looking to calibrate large numbers of probes in a laboratory or field setting.

The environment within the insulated calibration chamber is temperature controlled using a 4-zone fan-assisted Peltier arrangement for maximum stability, and minimum temperature gradient. The humidity of the circulating air is precisely regulated using a closed-loop control system that functions by proportionally mixing flows of dry and saturated air.

Two highly visible LED panels on the front of the S904 display the current humidity and temperature within the calibration chamber. The response time to a humidity or temperature step change is typically less than 10 minutes, so a simple 3-point calibration can be carried out in under an hour.

An optional integrated digital interface is available for the S904. This allows the humidity and temperature set points of the chamber to be controlled with the supplied PC application software, enabling the operator to create completely automated calibration profiles for unattended laboratory operation. The software also gives the ability to monitor, chart and log data from the connected probes and calibration reference on a PC for later analysis. Alternatively, the set points can be controlled manually with the front panel controls - making the S904 ideal for field calibrations where a PC is not available.

The S904 is easy to maintain. The desiccant changes color to indicate when it needs to be recharged and this is visible through a clear window on the front of the unit. Recharging the desiccant is simply a matter of heating it in a conventional oven at +150°C (+302°F) for 3 hours. The water reservoir at the front of the unit shows the current saturator fill level, and makes it easy to top-up with distilled water when required.

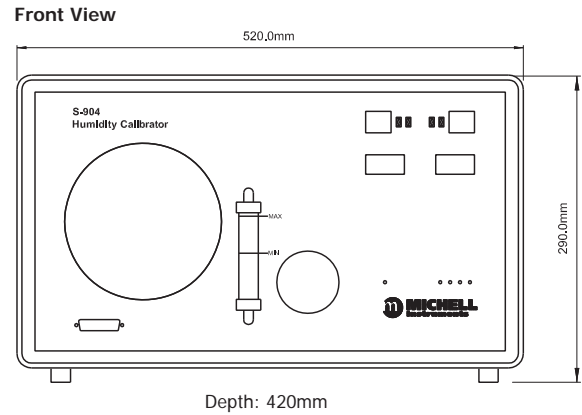
Highlights

- Simple operation and maintenance
- Excellent chamber stability and uniformity
- Manual control or optional straightforward automated set point programming
- Optional in-built data-logging for reference probe and probes under calibration

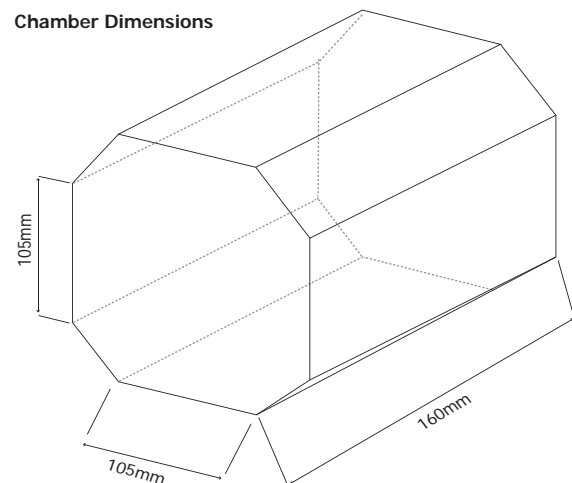
Technical Specifications

Humidity	
Generation range	10–90% RH
Accuracy control element	≤±1% RH (10–70% RH) ≤±1.5% RH (70–90% RH)
Stability	±0.2% RH (20–80% RH)
Temperature	
Generated range	+10 to +50°C (+50 to +122°F) (lowest T set point = 10°C (18°F) below ambient)
Accuracy	±0.1°C (±0.2°F)
Stability	±0.1°C (±0.2°F)
Chamber	
Ramp rate from +20 to +40°C (+68 to +104°F) +40 to +20°C (+104 to +68°F)	1.5°C / minute (2.7°F / minute) 0.7°C / minute (1.2°F / minute)
Control element	Removable relative humidity sensor
General	
Probe ports	up to 5 – sensor body diameters 5 to 25mm (0.2 to 0.98") accommodated by port adapters
Chamber volume	2000cm ³ (122.1in ³)
Chamber dimensions	105 x 105 x 160mm (4.13 x 4.13 x 6.3") (h x w x d)
Instrument dimensions	290 x 520 x 420mm (11.4 x 20.5 x 16.5") (h x w x d)
Set point resolution	0.1 for humidity and temperature
Displays	3 digit LED, 10mm (0.39") characters
Supply	85 to 264 V AC, 47/63 Hz, 150 VA
Weight	30kg (66lbs)

Dimensions



Chamber Dimensions



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: S904_97200_V3.1_UK_0713

OptiCal

Humidity Calibrator



The OptiCal is a premium calibration solution for humidity sensors. The stand-alone and transportable calibrator requires no external services other than mains power, and features an integrated chilled mirror reference instrument to enable the operator to perform calibrations that are traceable to national standards.

The calibration chamber features 5 interchangeable ports to accommodate virtually any brand, type or model of sensor. The environment within the insulated calibration chamber is temperature controlled using a 4-zone fan-assisted Peltier arrangement for maximum stability, and minimum temperature gradient. The humidity of the circulating air is precisely regulated using a closed-loop control system that functions by proportionally mixing flows of dry and saturated air.

A bright and clear VFD (vacuum fluorescent display) displays the parameters measured by the reference instrument in various relative and absolute humidity units, alongside the temperature within the chamber.

The humidity and temperature set-points can be controlled either manually or automatically as part of a calibration program. Manual control is achieved by the switches on the front panel and response time to a humidity or temperature step change is typically quicker than 10 minutes. The supplied application software allows calibration programs to be created, enabling automatic time-based control of temperature and humidity set points. The software also allows the user to monitor, chart and log calibration reference data on a PC for later analysis.

The OptiCal is supplied with an integrated Optidew chilled mirror reference instrument with traceable calibration to national standards, which provides measurement integrity and traceability for the sensors being calibrated.

The desiccant changes color to indicate when it needs to be recharged, and is visible through a clear window on the front of the unit. Recharging the desiccant is simply a matter of heating it in a conventional oven at +150°C (+302°F) for 3 hours. The water reservoir at the front of the unit shows the current saturator fill level, and makes it easy to top-up with distilled water when required. No other maintenance is necessary, apart from periodic calibration of the chilled mirror reference.

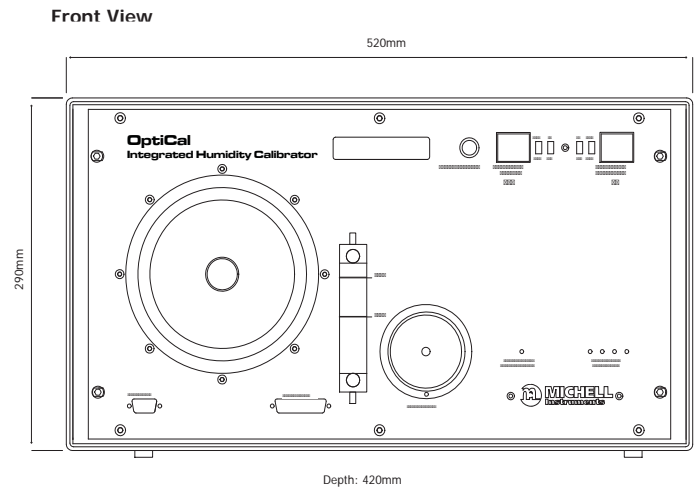
Highlights

- Simple operation and maintenance
- Excellent chamber stability and uniformity
- Manual control or optional straightforward automated set point programming
- Generate 10 to 90% RH over +10 to +50°C (+50 to +122°F) temperature
- Built in precision chilled mirror reference instrument
- Transportable to allow on-site calibrations

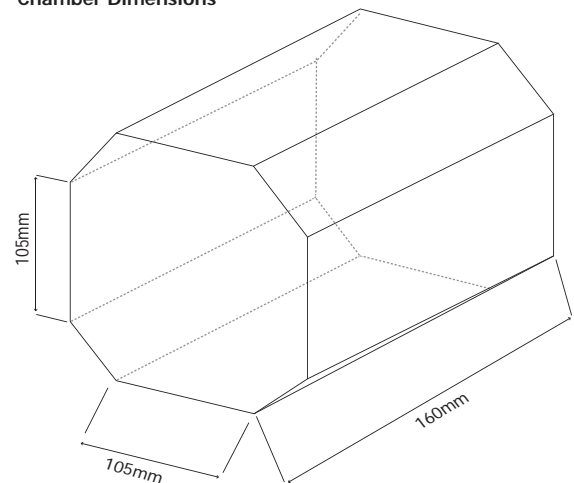
Technical Specifications

Humidity	
Generated range	10 - 90% RH
Control element accuracy	≤ ±1% RH (10-70% RH) ≤ ±1.5% RH (70-90% RH)
Stability	±0.2% RH (20-80% RH)
Temperature	
Generated range	+10 to +50°C (+50 to +122°F) (lowest T set point = 10°C (18°F) below ambient)
Accuracy	±0.1°C (±0.18°F)
Stability	±0.1°C (±0.18°F)
Chamber	
Ramp rate from	
+20 to +40°C (+68 to +104°F)	1.5°C / minute (2.7°F / minute)
+40 to +20°C (+104 to +68°F)	0.7°C / minute (1.2°F / minute)
Control element	Removable relative humidity sensor
Reference	
Accuracy	
Dew Point	±0.2°C (±0.36°F)
Temperature	±0.1°C (±0.18°F)
Measurement units	
Dew Point	(°C/°F), % RH
Temperature	(°C/°F), gm ⁻³ , gkg ⁻¹ , water activity (a _w)
Outputs	
Analog	4-20 mA or 0-20 mA over user-settable output
Accuracy	±0.2°C (±3.6°F)
Digital	500 Ω maximum load resistance
Alarm	RS232 @ 9600 baud rate Volt free contact, 30 V, 100 mA maximum
General	
Probe ports	Up to 5 - sensor body diameters 5 to 25mm (0.2 to 0.98") accommodated by port adapters
Chamber volume	2000cm ³ (112.1in ³)
Chamber dimensions	105 x 105 x 160mm (4.13 x 4.13 x 6.3") (w x h x d)
Instrument dimensions	290 x 520 x 420mm (11.4 x 20.5 x 16.5") (h x w x d)
Set-point resolution	0.1 for humidity and temperature
Displays	2 line Vacuum Fluorescent Display
Supply	85 to 264 V AC, 47/63 Hz, 150 VA
Weight	20kg (44lbs)

Dimensions



Chamber Dimensions



Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: OptiCal_97161_V3_UK_0613

HG10

Humidity Calibrator



The Michell HG10 Humidity Calibration System is a highly flexible computer-controlled automatic calibration system for humidity sensors. The HG10 is capable of repeatable generation of temperature and relative humidity set points over the range 1 to 95% RH (-50 to +50°Cdp (-58 to +122°Fdp)) at temperatures of +20 to +50°C (+68 to +122°F) with excellent stability. The supplied chilled mirror reference instrument provides traceability directly to national standards, and makes the system suitable for use in high-level calibration laboratories.

The HG10 comprises three main components, the humidity generator, test chamber and reference hygrometer.

Humidity Generator

The humidity generator used in the HG10 is based on the volumetric mixing of dry and wet gases, giving the fastest response when changing between set points in comparison to other dew-point generation technologies such as two-temperature, two-pressure or the combination of two-temperature and two-pressure. The mixing is automated using high-precision mass flow controllers to accurately control the ratio of wet to dry air, generating the required relative humidity.

A dry gas source is fed to the generator from a pressure swing dryer, and split into two streams. One stream is bubbled through liquid water via a sintered glass nozzle ensuring it is completely saturated with water vapor, while the other stream remains dry. The two gas streams are then mixed at atmospheric pressure to generate the target humidity level. The entire enclosure is insulated and temperature controlled ensuring the saturation, and therefore the output is always consistent.

The generated sample gas is passed directly to the hygrometers under test using a heated sample line. Three clear digital displays on the front panel of the generator indicate the generator temperature, heat traced sample line temperature and relative humidity set point.

Test Chamber

The standard HG10 chamber has internal dimensions of 550 x 550 x 320mm (21.6 x 21.6 x 12.6"), (h x w x d) and can be controlled and operated at temperatures from -10 to +50°C (+14 to +122°F). Alternative test-chambers are available in a range of different sizes and configurations. Please contact a Michell Instruments' representative for further details.

Reference Hygrometer

No calibration has validity unless it provides traceability to a recognized national standard. For this reason, the HG10 includes an S4000 Climatic Precision Chilled Mirror Hygrometer with a remote climatic sensor for precise monitoring of the generated humidity. The S4000 Climatic is calibrated in our UKAS laboratory, providing direct traceability to the UK national standard held by the National Physical Laboratory. Michell Instruments also maintains a traceable path directly to the NIST Humidity Standard in Washington, USA.

Automated Operation

The supplied PC software allows the creation of automatic calibration programs, for evaluating the performance of humidity sensors over a range of operating conditions. The measured values from the chilled mirror reference are used in a closed control loop to enable repeatable set point generation, time and time again.

Highlights

- No other single system generates as wide a range of wet to dry dew points
- High accuracy $\pm 0.1^\circ\text{C}$ ($\pm 0.18^\circ\text{F}$) fundamental reference
- User-configurable temperature and humidity profiling allows calibration cycles to be run without constant supervision
- Very fast changes between generated relative humidity points

Technical Specifications

HG10	
General	
Enclosure	19" Rack System, H=2.1m (6.8')
Power supply	100-115 V or 220 to 240 V 50/60Hz
Pressure Swing Dryer	
Gas output	
Flow	7 NI/min (14.8 scfh)
Pressure	0.68 barg (10 psig)
Moisture content	<1ppm _v (<-75°Cdp (<-103°Fdp))
Required gas supply	
Flow	10 NI/min (21.2 scfh)
Pressure	5 to 7 barg (70 to 100 psig)
Moisture content	Oil and liquid water-free
Type	Twin column desiccant, pressure swing
Desiccant	4 Ångström Molecular sieve bead (4-8 mesh)
Timer	Motorized cam
Operating temperature	+5 to +35°C (+41 to +95°F)
Generator	
Generation range	
Humidity	1 to 95% RH (-50 to +50°Cdp (-58 to +122°Fdp))
Temperature	Dependant on temperature chamber
Generated gas output	Air 2 NI/min (4.2 scfh) @ 0.5 barg (7 psig) via heat traced line
Dual stage MFC mixing	Dual mass flow controllers
Power consumption	550 V A maximum
Operating temperature	+5 to +40°C (+41 to -104°F;) 10 to 90% RH
Enclosure	19" Rack System, H= 2.1m (6.8")
Control system	Closed loop feedback
Reference Instrument	
Performance	
Measurement technology	Chilled Mirror
Measurement range	-80 to +85°Cdp (-112 to +185°Fdp)
Measurement accuracy	±0.1°Cdp (±0.18°Fdp) ±0.1°C (±0.18°F) temperature
Repeatability	Better than 0.1°C (±0.18°F)
Resolution	0.01 (0.1 for % RH)
Dew-Point Sensor	
Mirror	Gold plated copper
Temperature measurement	4 wire Pt100, 1/10 DIN class B
Sample flow rate	0.1 to 0.7 NI/min (0 to 1.5 scfh) (recommended)
Integrated flowmeter	0 to 1 NI/min (0 to 2.1 scfh)
Sensor pressure	Atmospheric
Configuration	Remote

Remote PRT	
Temperature measurement	4 wire Pt100, 1/10 DIN class B
Monitor	
Resolution	0.01°C (0.018°F)
Dual optics detection	Wide band red LED with dual photo sensors, all system insulated
Outputs	
Analog	2 channels, 10 mV/°Cdp, 4-20mA
Digital	RS232
Logic	Data hold, ABC Logic status, optics alarm
Operating temperature	0 to +40°C (+32 to +104°F)

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: HG10_97158_V2_UK_0613



Order Codes Content

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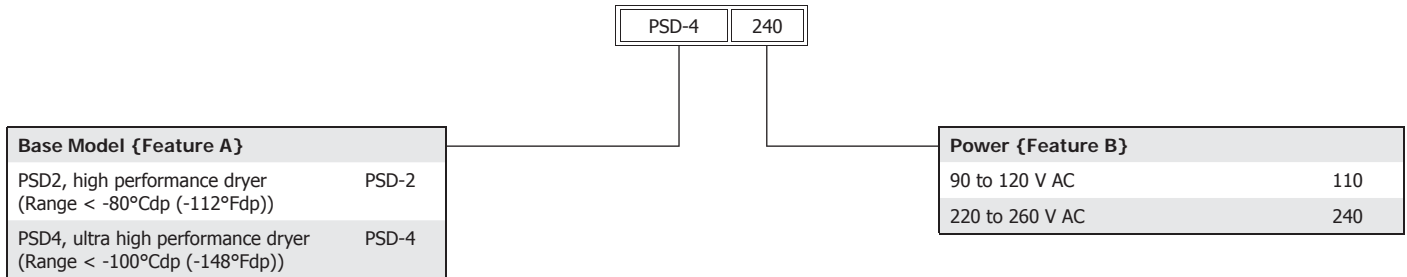
PSD2 & PSD4

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B}

Ordering Example: PSD-4 + 240

PSD4 ultra high performance dryer, 220 to 260 V AC



CMP - Compressor and Reservoir for PSD2/4

Item	Product / Description
CMP-10-240	Mini compressor to feed PSD2
CMP-25-240	Compressor and reservoir to feed PSD4

Accessories and Spare Parts

Item	Product / Description
PSD-4-FO	Outlet Millipore wafergard inline sealed particulate filter 0.003µm
PSD-4-FV	Vent particulate filter element 0.1µm

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: PSD2 and PSD4 Order Codes_97160_V2.1_UK_0415

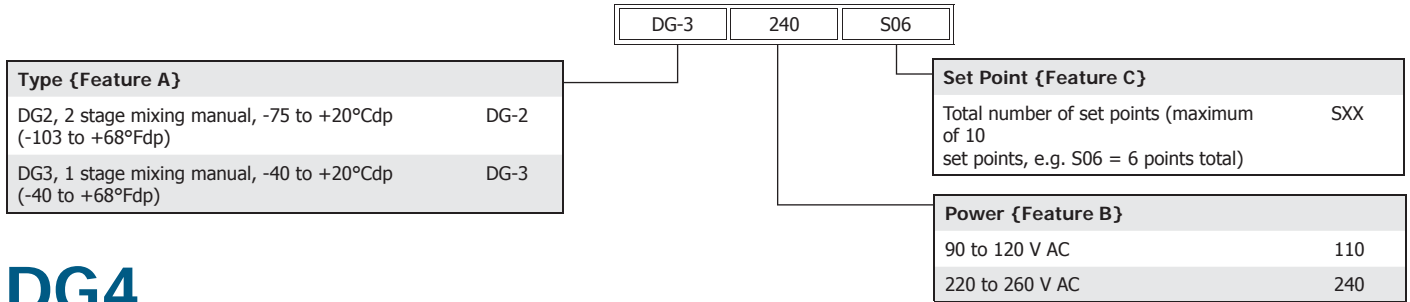
DG2 and DG3

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C}

Ordering Example: DG-3 + 240 + S06

DG3, 1 stage mixing manual -40 to +20°Cdp (-40 to +68°Fdp), 220 to 260 V AC, with 6 additional generation set points



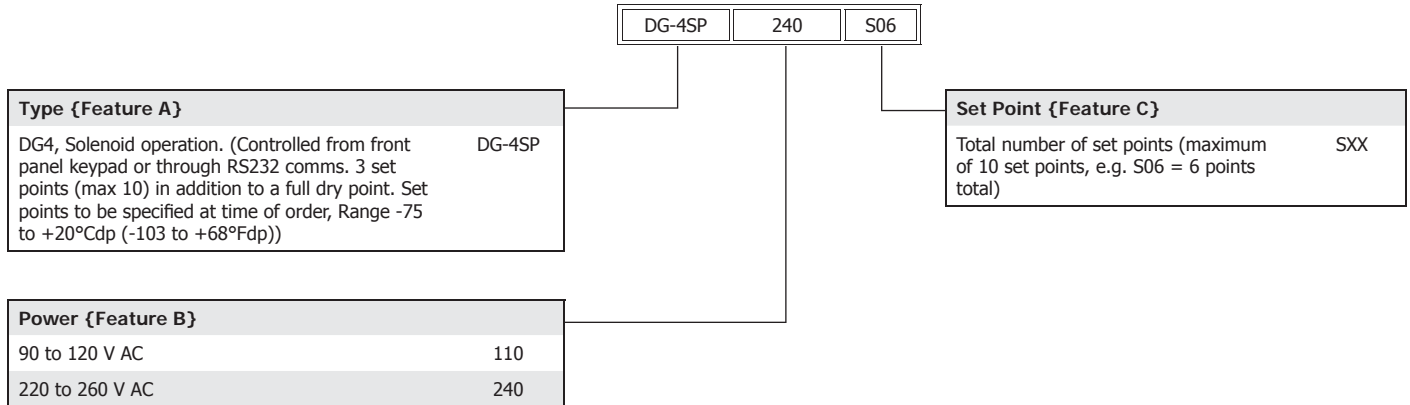
DG4

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C}

Ordering Example: DG-4SP + 240 + S06

DG4 Solenoid operation, 220 to 260 V AC, with 6 additional generation set points



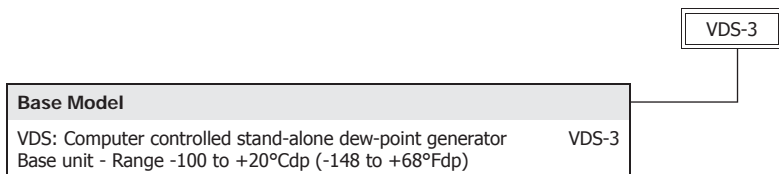
VDS3

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A}

Ordering Example: VDS-3

VDS: Computer controlled stand-alone dew-point generator with range -100 to +20°Cdp (-148 to +68°Fdp)



Custom-built calibration systems are available covering the range from -100°Cdp (-148°Fdp) (10 ppb_v) up to +85°Cdp (+185°Fdp). Please discuss your requirements with Michell Instruments' technical sales department.

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version. Issue No: Dew Point Generators Order Codes_97334_V3_UK_0616

Optidew Vision

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C} + {Feature D} + {Feature E} + {Feature F}

Ordering Example: OPV + HT-SC02 + 02-ACE-SS + H + 232 + CM-STD

Optidew Vision with 2m (6.6') high temperature cable assemblies for dew point & temperature, 2 stage sensor Acetal housing + stainless steel stud mirror, high pressure (up to 3625 psig / 250 barg), RS232 output & standard traceable in-house calibration



Base Model {Feature A}	
Base unit: Dew-Point Hygrometer	OPV

Cable {Feature B}	
No cable	SC0
2m (6.56') cable assemblies (for dp & t) – max temp: +70°C	SC02
5m (16.4') cable assemblies (for dp & t) – max temp: +70°C	SC05
10m (32.8') cable assemblies (for dp & t) – max temp: +70°C	SC10
2m (6.56') high temp cable assemblies (for dp & t) – max temp: +180°C	HT-SC02
5m (16.4') high temp cable assemblies (for dp & t) – max temp: +180°C	HT-SC05
10m (32.8') high temp cable assemblies (for dp & t) – max temp: +180°C	HT-SC10
Other cable lengths available on special request, price per meter above 2m	

Sensor {Feature C}	
1 stage sensor Acetal + Au coated Cu mirror	01-ACE-STD
2 stage sensor Acetal + Au coated Cu mirror	02-ACE-STD
2 stage sensor Acetal + Au stud mirror	02-ACE-AUS
2 stage sensor Acetal + SS stud mirror	02-ACE-SS
2 stage sensor Acetal + Pt stud mirror	02-ACE-PLT
2 stage sensor PEEK + Au coated Cu mirror	02-PEEK-STD
2 stage sensor PEEK + Au stud mirror	02-PEEK-AUS
2 stage sensor PEEK + SS stud mirror	02-PEEK-SS
2 stage sensor PEEK + Pt stud mirror	02-PEEK-PLT
2 stage sensor SS + Au coated Cu mirror	02-SS-STD
2 stage sensor SS + Au stud mirror	02-SS-AUS
2 stage sensor SS + SS stud mirror	02-SS-SS
2 stage sensor SS + Pt stud mirror	02-SS-PLT
2 stage sensor AL + Au coated Cu mirror	02-AL-STD
2 stage sensor AL + Au stud mirror	02-AL-AUS
2 stage sensor AL + SS stud mirror	02-AL-SS
2 stage sensor AL + Pt stud mirror	02-AL-PLT
2 stage aluminum climatic sensor	CLIMATIC

Calibration {Feature F}	
Standard traceable in-house calibration	CM-STD
High accuracy traceable calibration to ±0.15°C (±0.27°F)	CM-ACC
5-pt UKAS dew-point calibration (specify points required on order)	CM-DPUKAS
Additional UKAS dew-point calibration point	CM-DPAP01
5-pt UKAS RH calibration at one temp (specify points required on order)	CM-RHUKAS
Additional UKAS RH calibration point	CM-RHAP01
Additional five UKAS RH points at alt temp	CM-RHAT

Digital {Feature E}	
RS232	232
RS485	485

Pressure {Feature D}	
Low pressure (up to 290 psig / 20 barg)	L
High pressure (up to 3625 psig / 250 barg)	H

Optidew Vision

Order Codes

Accessories and Spare Parts

Item	Product / Description
Sensor Guards	
OPT-SSG	Sintered SS guard (for particulate contamination 10-12µm)
OPT-HSG	HDPE sintered guard (for particulate and liquid protection 10µm)
OPT-SSB	Sensor sampling block - SS with 1/8" NPT in/out threaded gas ports
External Connections	
OPV-DPSC-02	2m (6.56') sensor cable with connectors (dew point only) — Max temp: +70°C
OPV-DPSC-05	5m (16.4') sensor cable with connectors (dew point only) — Max temp: +70°C
OPV-DPSC-10	10m (32.8') sensor cable with connectors (dew point only) — Max temp: +70°C
OPV-DPHTSC-02	2m (6.56') high temperature sensor cable (with connectors, dew point only) — Max temp: +180°C
OPV-DPHTSC-05	5m (16.4') high temperature sensor cable (with connectors, dew point only) — Max temp: +180°C
OPV-DPHTSC-10	10m (32.8') high temperature sensor cable (with connectors, dew point only) — Max temp: +180°C
OPT-PRT-02	Remote PRT, 2m (6.56') cable with connector — Max temp: +70°C
OPT-PRT-05	Remote PRT, 5m (16.4') cable with connector — Max temp: +70°C
OPT-PRT-10	Remote PRT, 10m (32.8') cable with connector — Max temp: +70°C
OPT-PRHT-02	Remote PRT, 2m (6.56') with high temperature cable and connector — Max temp: +250°C
OPT-PRHT-05	Remote PRT, 5m (16.4') with high temperature cable and connector — Max temp: +250°C
OPT-PRHT-10	Remote PRT, 10m (32.8') with high temperature cable and connector — Max temp: +250°C
Other cable lengths available on special request, price per meter — above 2 meters	
Miscellaneous	
OPT-ACH-110	Air cooled heatsink, heat sink and cooling fan (specify 110 or 220V) (includes sensor sampling block)
OPT-ACH-220	
OPT-LCB	Liquid cooled block w/gas ports & coolant channel (requires ext coolant supply)
OPT-SLK	Sensor lock nut kit (to mount the dew-point sensor to a panel or bulkhead)
OPV-PMK	Panel mounting kit for 19" rack
OPV-TCS	Heavy duty transport case
CM-CLN-KIT	Cleaning materials (required for periodic maintenance of chilled mirror dew-point hygrometer sensors - fluids not included)

Services

Item	Product / Description
CM-TC	Traceable calibration (as supplied as standard with new instrument)
OPT-ACC	High accuracy calibration to $\pm 0.15^{\circ}\text{Cdp}$ ($\pm 0.27^{\circ}\text{F}$) (not available with SS sensor)
READINGS	Readings before calibration (calibration data recorded before adjustment)
CM-DPUKAS	5-pt UKAS dew-point calibration (specify points required on order)
CM-DPAP01	Additional calibration points for UKAS calibration
CM-RHUKAS	5-pt UKAS RH calibration at one temp (specify points required on order)
CM-RHAP01	Additional calibration points for % RH (at the same temperature)
CM-RHAT	UKAS % RH calibration of 5 points (at an additional temperature, please contact MIL before ordering)

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: Optidew Vision Order Codes_97144_V4_UK_0616

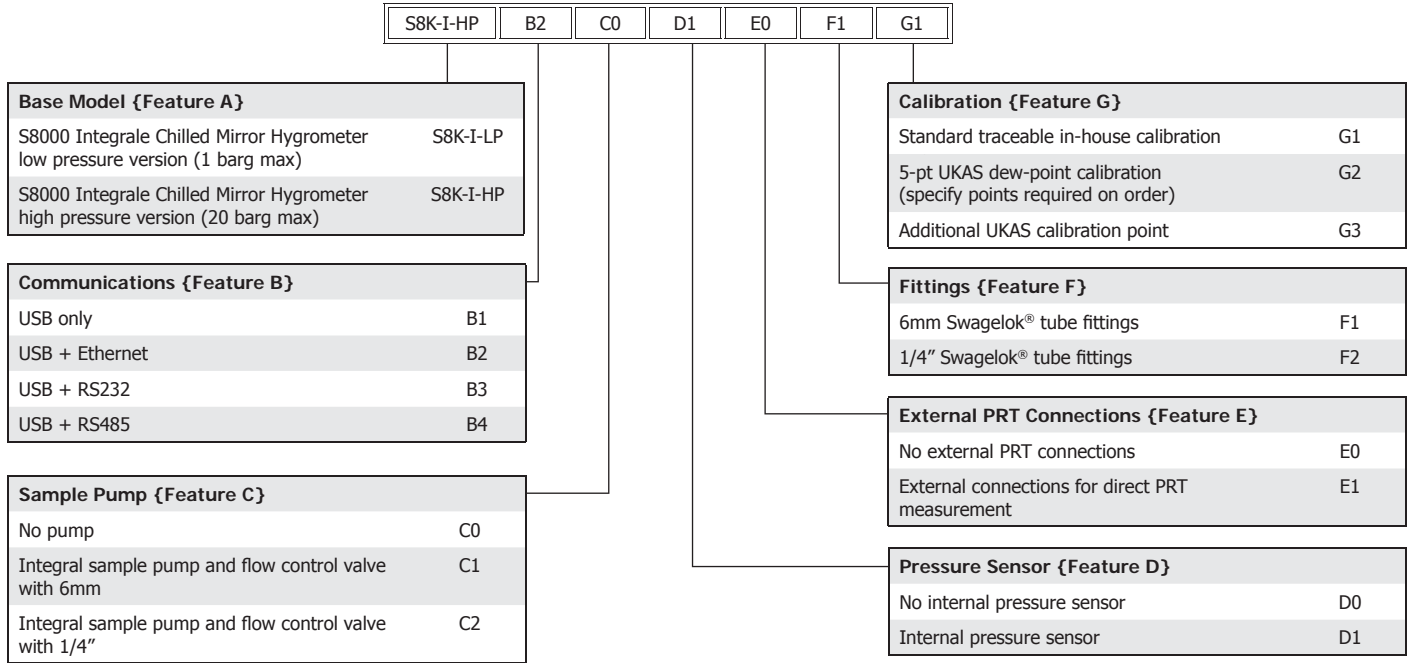
S8000 Integrale

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C} + {Feature D} + {Feature E} + {Feature F} + {Feature G}

Ordering Example: S8K-I-HP + B2 + C0 + D1 + E0 + F1 + G1

S8000 Integrale Chilled Mirror Hygrometer, high pressure version (20 barg max), USB and Ethernet communications, no pump, internal pressure sensor, no external PRT connections, 6mm Swagelok® tube fittings, standard traceable in-house calibration



Accessories and Spare Parts

Item	Product / Description
S8K-PRT	Remote PRT, 2m cable with connector
S8K-RS-MCI	Mirror viewing microscope
CM-CLN-KIT	Cleaning materials (required for periodic maintenance of Chilled Mirror Hygrometer sensors, fluids not included)
S8K-RS232	RS232 communications module (installation by Michell engineer only)
S8K-RS485	RS485 communications module (installation by Michell engineer only)
S8K-LAN	Ethernet communications module (installation by Michell engineer only)
S8K-PUMP	Integral sample pump module (installation by Michell engineer only)

Services

Order Codes	Product / Description
CM-TC	Traceable calibration (as supplied as standard with new instrument)
READINGS	Readings before calibration (calibration data recorded before adjustment)
CM-DPKAS	5-pt UKAS dew-point calibration (specify points required on order)
CM-DPAP01	Additional calibration points for UKAS calibration
CM-RHUKAS	5-pt UKAS RH calibration at one temp (specify points required on order)
CM-RHAP01	Additional calibration points for %RH (at the same temperature)
CM-RHAT	UKAS %RH calibration of 5 points at an additional temperature (please contact MIL before ordering)

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: S8000 Integrale MKII_97509_V1.1_UK_Order Codes_0316

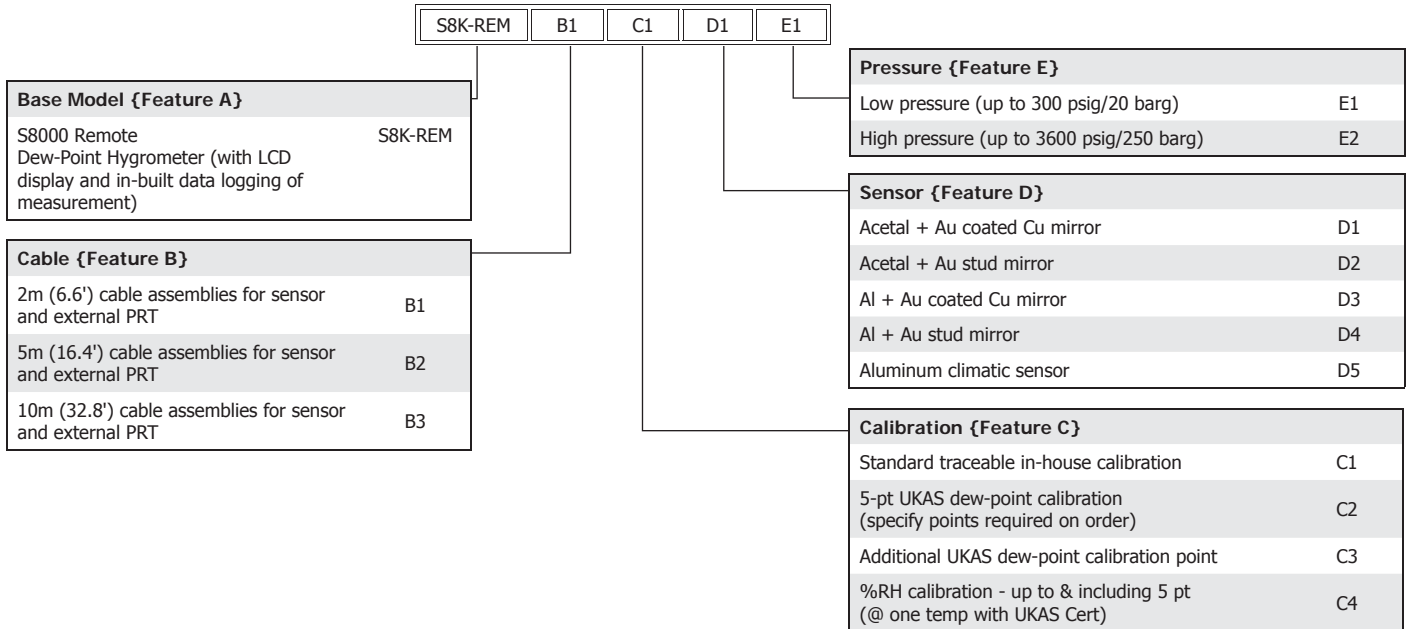
S8000 Remote

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C} + {Feature D} + {Feature E}

Ordering Example: S8K-REM + B1 + C1 + D1 + E1

S8000 Remote with 2m (6.6') cable assemblies for sensor and external PRT with standard traceable in-house calibration with acetal sensor + Au coated Cu mirror, low pressure (up to 300 psig/20 barg) version



Accessories and Spare Parts

Item	Product / Description
S8K-REM-PS02	External pressure sensor with 2m (6.6') cable
S8K-REM-PS05	External pressure sensor with 5m (16.4') cable
S8K-REM-PS10	External pressure sensor with 10m (32.8') cable
S8K-PRT	Remote PRT, 2m (6.6') cable with connector
S8K-PKI	Panel mounting kit for 19" rack
S8K-REM-TCI	Transport case
OPT-SSB	Sensor sampling block
OPT-SLK	Sensor lock nut (to mount sensor to panel or bulkhead)
OPT-HSG	HDPE sintered guard (for particulate and liquid protection 10µm)
S8K-REM-TSG	S8000 Remote guard for S904
OPT-SSG	Sintered SS guard (for particulate contamination 10-12µm)
CM-CLN-KIT	Cleaning materials (required for periodic maintenance of chilled mirror dew-point hygrometer sensors - fluids not included)

Services

Order Codes	Product / Description
CM-TC	Traceable calibration (as supplied as standard with new instrument)
READINGS	Readings before calibration (calibration data recorded before adjustment)
CM-DPUKAS	5-pt UKAS dew-point calibration (specify points required on order)
CM-DPAP01	Additional calibration points for UKAS calibration
CM-RHUKAS	5-pt UKAS RH calibration at one temp (specify points required on order)
CM-RHAP01	Additional calibration points for %RH (at the same temperature)
CM-RHAT	UKAS %RH calibration of 5 points (at an additional temperature, please contact MIL before ordering)

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: S8000 Remote Order Codes_97307_V2_UK_0316

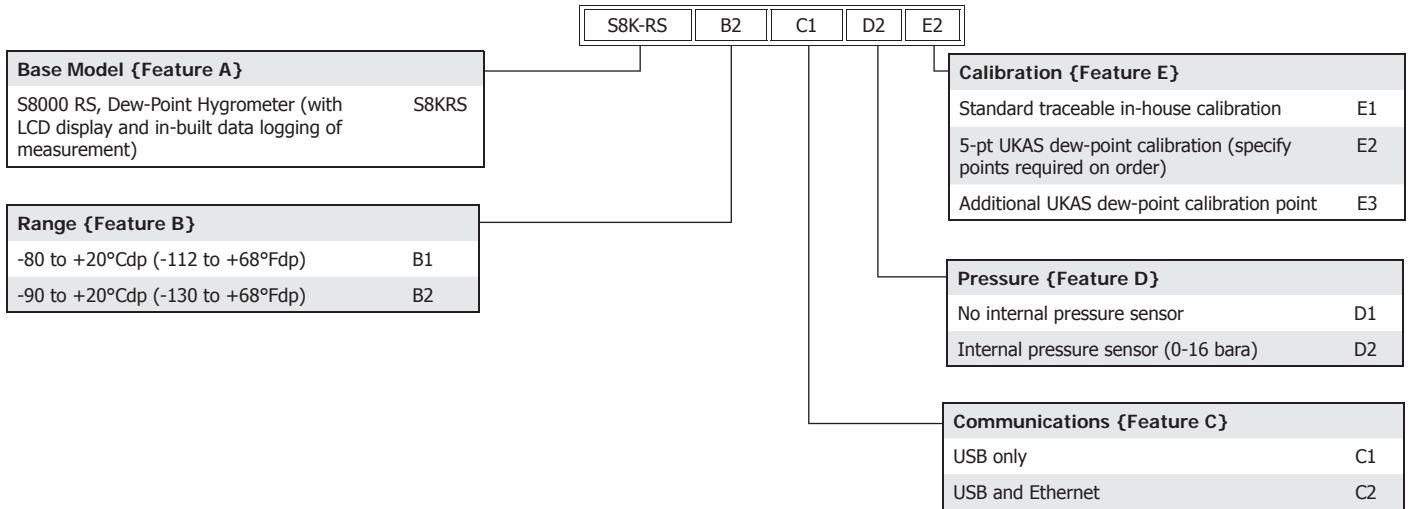
S8000 RS

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C} + {Feature D} + {Feature E}

Ordering Example: S8K-RS + B2 + C1 + D2 + E2

S8000 RS, -90 to +20°Cdp (-130 to +68°Fdp) range, USB, internal pressure transducer and 5-pt UKAS dew-point calibration



Accessories and Spare Parts

Item	Product / Description
S8K-RS-PKI	19" rack mounting kit
S8K-RS-PRT	Remote PRT, 2m (6.6') cable with connector
S8K-RS-MCI	Microscope
S8K-RS-TCI	Transport case
CM-CLN-KIT	Cleaning materials (required for periodic maintenance of chilled mirror dew-point hygrometer sensors - fluids not included)
GEN-VCRW14GR	¼" VCR Washer with Gasket Retainer
GEN-14VCR6	¼" VCR Female to 6mm Swagelok Tube
GEN-14VCR14	¼" VCR Female to ¼" Swagelok Tube

Services

Order Codes	Product / Description
CM-TC	Traceable calibration (as supplied as standard with new instrument)
READINGS	Readings before calibration (calibration data recorded before adjustment)
CM-DPUKAS	5-pt UKAS dew-point calibration (specify points required on order)
CM-DPAP01	Additional calibration points for UKAS calibration
CM-RHUKAS	5-pt UKAS RH calibration at one temp (specify points required on order)
CM-RHAP01	Additional calibration points for %RH (at the same temperature)
CM-RHAT	UKAS %RH calibration of 5 points (at an additional temperature, please contact MIL before ordering)

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: S8000 RS Order Codes_97316_V4.1_UK_0616

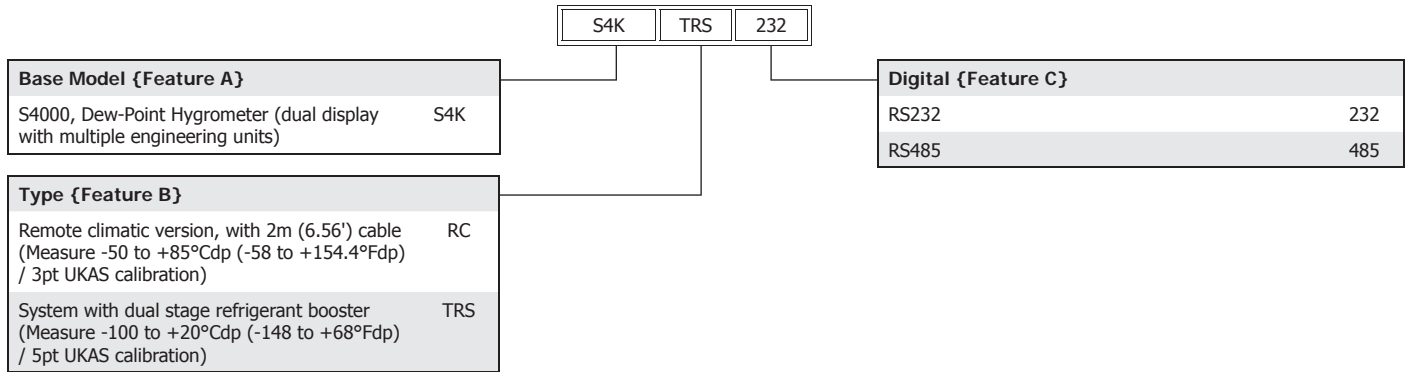
S4000

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C}

Ordering Example: S4K + TRS + 232

S4000 TRS with dual stage refrigerant booster, RS232 communications



Accessories and Spare Parts

Item	Product / Description
S4K-MC	Microscope
S4K-PRT	Remote PRT, 2m (6.6') cable with connector
CM-CLN-KIT	Cleaning materials (required for periodic maintenance of chilled mirror dew-point hygrometer sensors - fluids not included)
GEN-VCRW14GR	¼" VCR Washer with Gasket Retainer
GEN-14VCR6	¼" VCR Female to 6mm Swagelok Tube
GEN-14VCR14	¼" VCR Female to ¼" Swagelok Tube

Services

Order Codes	Product / Description
CM-DPUKAS	5-pt UKAS dew-point calibration (specify points required on order)
CM-DPAP01	Additional calibration points for UKAS calibration
CM-RHUKAS	5-pt UKAS RH calibration at one temp (specify points required on order)
CM-RHAP01	Additional calibration points for % RH (at the same temperature)
CM-RHAT	UKAS % RH calibration of 5 points (at an additional temperature, please contact MIL before ordering)
READINGS	Report on measurement accuracy before re-calibration

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: S4000 TRS Order Codes_97146_V3_UK_0316

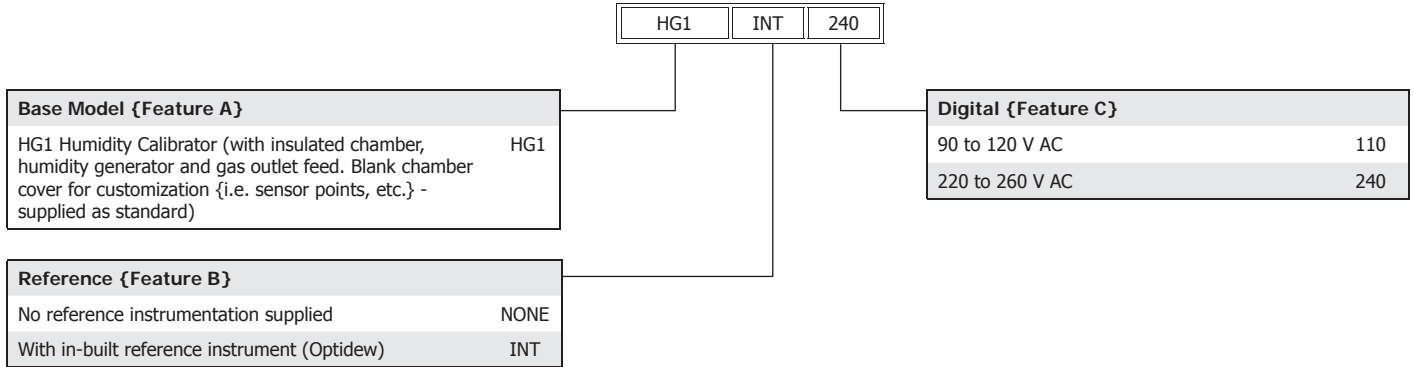
HG1

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C}

Ordering Example: HG1 + INT + 240

HG1 with in-built reference instrument (Optidew) for 220 to 260 V AC operation



Accessories and Spare Parts

Item	Product / Description
HG1-CC	Chamber cover for 8 probes (max) (dependant upon probe type)

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
 Issue No: HG1 Order Codes_97158_V1.1_UK_0415

DCS60 Dew-Point Calibration System

Order Codes

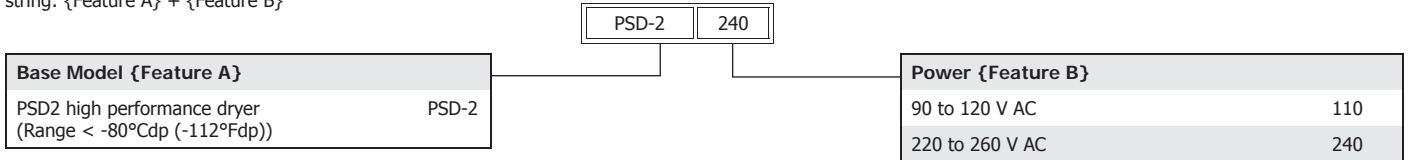
To construct the order code, select the relevant features from the tables below, to create a string: {Dry Air Generator} + {Dew-Point Generator} + {Dew-Point Hygrometer}

Ordering Example: PSD-2 + 240 + DG-4SP + 240 + S10 + S8K-I-LP + B2 + C0 + D0 + E0 + F1 + G2

PSD2 Pressure Swing Dryer, 220 to 260 V AC, DG4 Dew-Point Generator, 220 to 260 V AC, with 10 additional generation set points, S8000 Integrale Chilled Mirror Hygrometer low pressure version (1 barg max), USB + Ethernet communications, no pump, no internal pressure sensor, 6mm Swagelok Tube Fittings, 5-pt UKAS dewpoint calibration

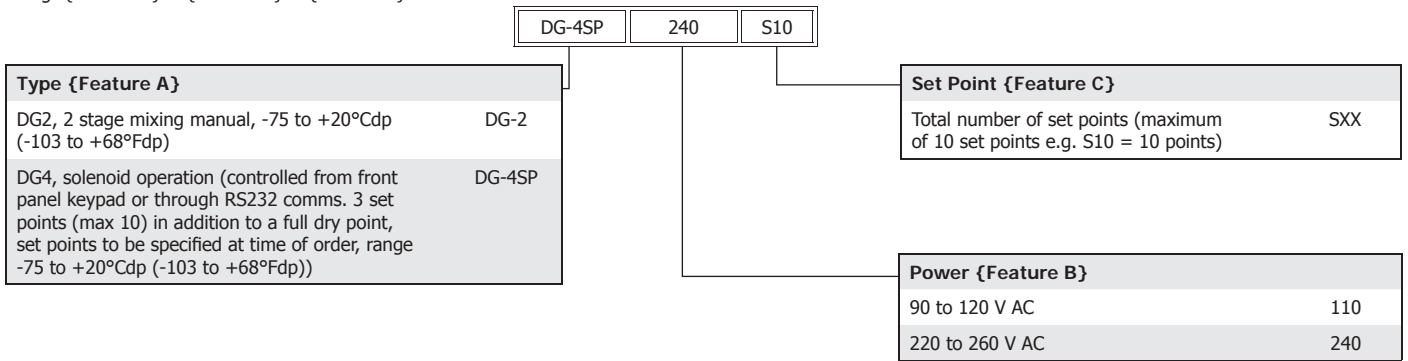
Dry Air Generation - Pressure Swing Dryer

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B}

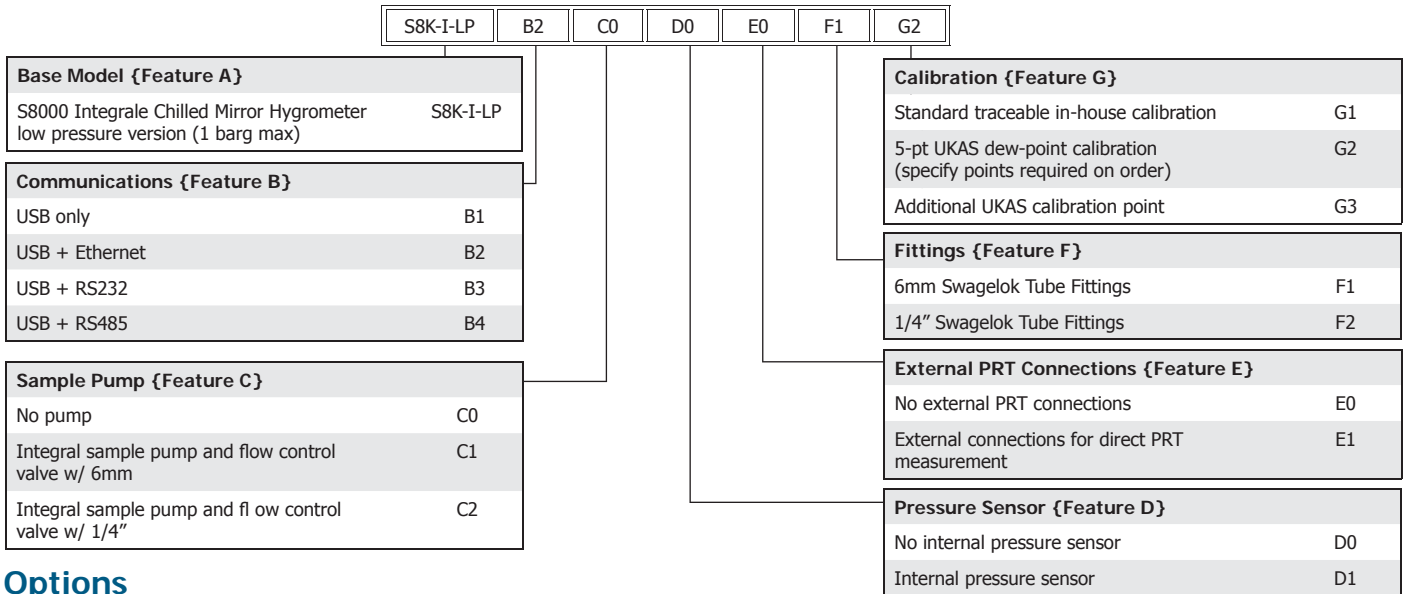


Dew-Point Generator

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C}



Dew-Point Hygrometer (with LCD display and in-built data logging of measurement)



Options

Item	Product / Description
Rack System	
DCS-RAK	Floor standing rack with instrument shelf (for positioning of instrument / sensor under test)
Compressor System	
CMP-10-240	Oil-free air mini compressor, 29 psig/2 barg, 10 NI/min (for PSD-2)
CMP-SPC	Soundproof cabinet for compressor
Sensor Manifold	
DCS-MAN	Sensor manifold (Manufactured to suit the customer's sensors typically in anodized aluminum for RH probes or 316 SS for dew-point sensors, price available on request when sensors to be calibrated are fully defined)

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.
Issue No: DCS60 Order Codes_97162_V3_UK_0316

DCS80 Dew-Point Calibration System

Order Codes

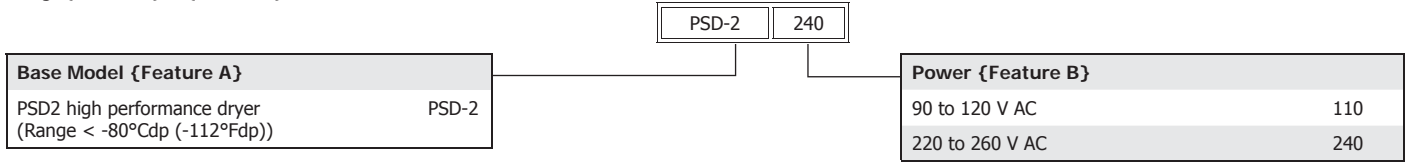
To construct the order code, select the relevant features from the tables below, to create a string: {Dry Air Generator} + {Dew-Point Generator} + {Dew-Point Hygrometer}

Ordering Example: PSD-2 + 240 + DG-4SP + 240 + S10 + S8K-RS + B1 + C2 + D1 + E2

PSD2 Pressure Swing Dryer, 220 to 260 V AC, DG4 Dew-Point Generator, 220 to 260 V AC, with 10 additional generation set points, S8KRS Dew-Point Hygrometer, -80 to +20°Cdp (-112 to +68°Fdp), USB & Ethernet, 5-pt UKAS dew-point calibration

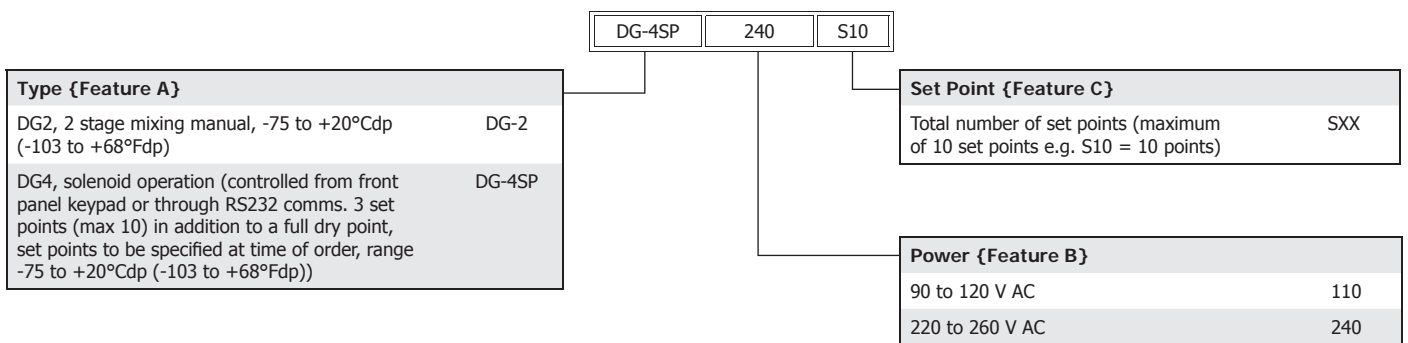
Dry Air Generation - Pressure Swing Dryer

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B}



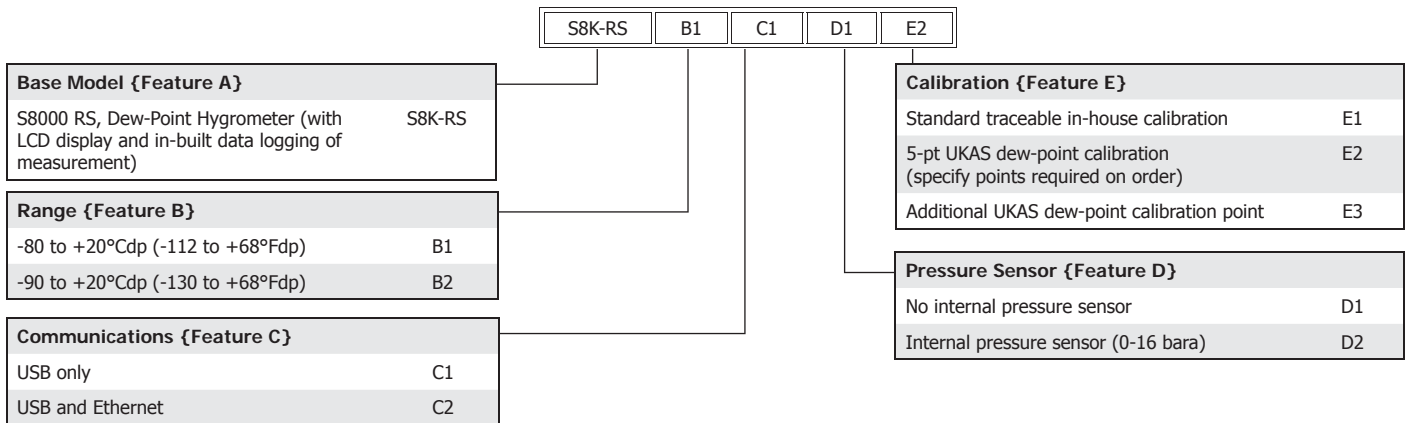
Dew-Point Generator

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C}



Dew-Point Hygrometer (with LCD display and in-built data logging of measurement)

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C} + {Feature D} + {Feature E}



Options

Item	Product / Description
Rack System	
DCS-RAK	Floor standing rack with instrument shelf (for positioning of instrument / sensor under test)
Compressor System	
CMP-10-240	Oil-free air mini compressor, 29 psig/2 barg, 10 NI/min (for PSD-2)
CMP-SPC	Soundproof cabinet for compressor
Sensor Manifold	
DCS-MAN	Sensor manifold (Manufactured to suit the customer's sensors typically in anodized aluminum for RH probes or 316 SS for dew-point sensors, price available on request when sensors to be calibrated are fully defined)

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: DCS80 Order Codes_97162_V3_UK_0316

DCS100 Dew-Point Calibration System

Order Codes

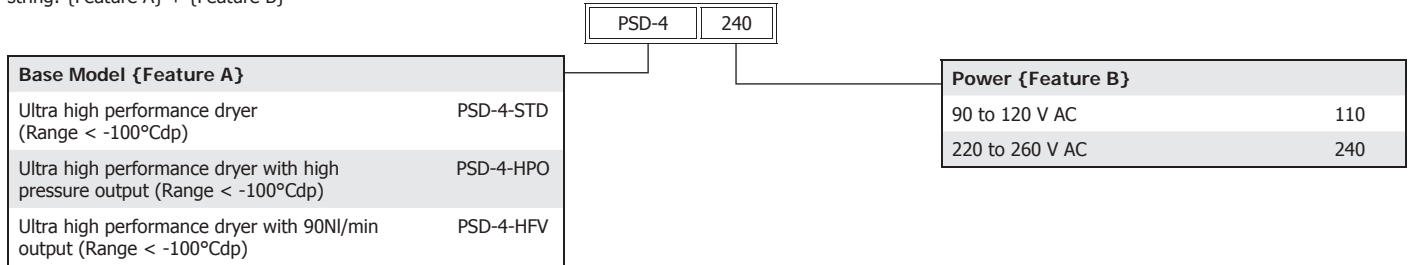
To construct the order code, select the relevant features from the tables below, to create a string: {Dry Air Generator} + {Dew-Point Generator} + {Dew-Point Hygrometer}

Ordering Example: PSD-4-STD + 240 + VDS-3 + S4K-TRS + 232 + 240

PSD4 Pressure Swing Dryer, 220 to 260 V AC, VDS3 Dew-Point Generator, S4KTRS Dew-Point Hygrometer, RS232, 220 to 260 V AC

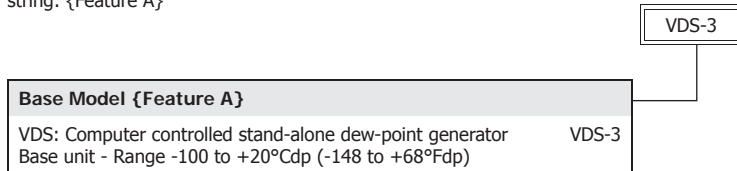
Dry Air Generation - Pressure Swing Dryer

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B}



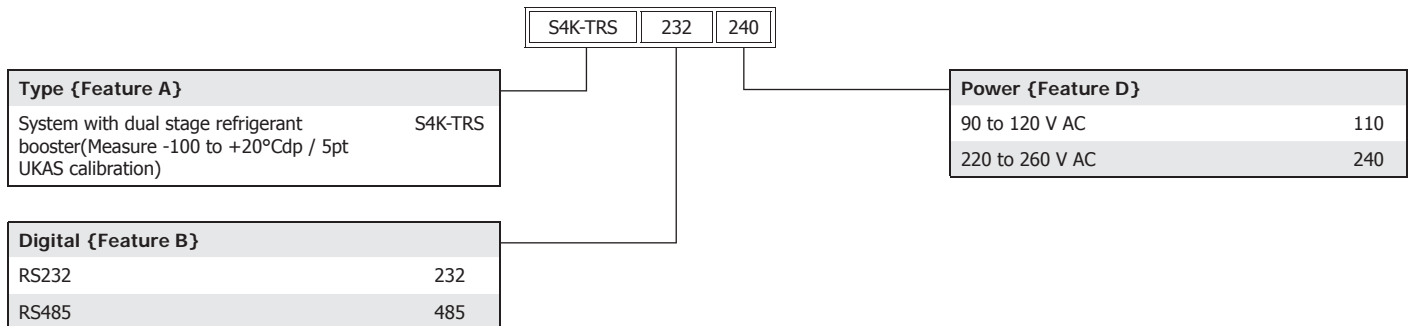
Dew-Point Generator

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A}



Dew-Point Hygrometer

To construct the order code, select the relevant feature from the tables below, starting with the type, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C}



Options

Item	Product / Description
Compressor System	
CMP-25-240	Compressor and reservoir to feed PSD-4 & DG
Pre-Dryer	
DCS-PRE	Domnick Hunter pre-dryer (to dry PSD4 air supply to -40°Cdp (-40°Fdp))
Sensor Manifold	
DCS-MAN	Sensor Manifold (Manufactured to suit the customer's sensors typically in anodized aluminum for RH probes or 316 SS for dew-point sensors, price available on request when sensors to be calibrated are fully defined)

Accessories and Spare Parts

Item	Product / Description
PSD-4-FO	Outlet Millipore wafergard inline sealed particulate filter 0.003µm
PSD-4-FV	Vent particulate filter element 0.1µm

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: DCS100 Order Codes_97162_V3_UK_0316

HygroCal100

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C} + {Feature D} + {Feature E} + {Feature F}

Ordering Example: HC100-B2+C1+D1+E1+F1+F1+F1+F1+F6+F6+F6

HygroCal100 with internal battery, MDM25 calibration kit, Transport case, euro power supply, 4x 12mm port adaptors and 3x 19mm port adaptors

HC100	B2	C1	D1	E1	F1, F1, F1, F1, F6, F6, F6
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Base Model {Feature A}	
Portable Humidity Validator + 7 probe input connectors, 8 user specified port adaptors, port adaptor tool, syringe and desiccant.	HC100

Calibration Kit {Feature B}	
No additional calibration equipment	B1
Calibration kit 1 (HC100 including MDM25 hand-held hygrometer and probe with calibration certificate and 7 user specified port adaptors)	B2*
Calibration kit 2 (Optidew Vision Chilled Mirror Hygrometer, Optidew port adaptor kit and 6 user specified port adaptors)	B3**

*If option B2 is selected, only 7 port adaptors should be chosen

**If option B3 is selected, only 6 port adaptors should be chosen

Internal Battery {Feature C}	
No internal battery	C0
Internal battery	C1

Port Adaptors {Feature F}	
Port adaptor 12mm (0.47")	F1
Port adaptor 13.5mm (0.53")	F2
Port adaptor 14mm (0.55")	F3
Port adaptor 15mm (0.59")	F4
Port adaptor 18.5mm (0.73")	F5
Port adaptor 19mm (0.75")	F6
Port adaptor 24mm (0.94")	F7
Port adaptor 25mm (0.98")	F8

Power Lead {Feature E}	
European power supply	E1
UK power supply	E2
North American power supply	E3
Australian power supply	E4

Transport Case {Feature D}	
No transport case supplied	D0
Transport case with foam insert for HygroCal100 and accessories, with bottles for desiccant and water	D1

Accessories and Spare Parts

Item	Product / Description
HC100-CHA	HC100 power supply adaptor
A000171	Spare 0.25kg desiccant
A000172	Spare 3kg desiccant
HC100-TC	Spare carry case
HC100-BOT	Bottles for spare desiccant and water storage
HC100-CMKIT	Optidew/S8000 Remote port adaptor kit
HC100-HS3CON	HygroSmart 3 cable connector
HC100-CON	Spare phoenix connector, screw terminal
HC100-HS3-S-R	Replacement HygroSmart Sensor, prepared for the HC100
Port Adaptors (8 port adaptors can be specified free-of-charge with a new HygroCal100)	
A000291	Port adaptor 12mm (0.47")
A000292	Port adaptor 13.5mm (0.53")
A000293	Port adaptor 14mm (0.55")
A000294	Port adaptor 15mm (0.59")
A000295	Port adaptor 18.5mm (0.73")
A000296	Port adaptor 19mm (0.75")
A000297	Port adaptor 24mm (0.94")
A000298	Port adaptor 25mm (0.98")

S904

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B} + {Feature C}

Ordering Example: S904 + 263 + 13.5

Base unit, S904, Relative Humidity and Temperature Generator for Humidity and Temperature Calibrations with Port adapter 13.5mm (0.53"), door with 5 ports

S904	263	13.5
------	-----	------

Type {Feature A}		Adaptor {Feature C}	
Base unit, S904, Relative Humidity and Temperature Generator for Humidity and Temperature Calibrations	S904	Port adapter 12mm (0.47")	12.0
Base unit - with RS232/USB interface (data-logging software for PC - 6 channel data-logger)	S904-D	Port adapter 13.5mm (0.53")	13.5
		Port adapter 14mm (0.55")	14.0
		Port adapter 15mm (0.59")	15.0
		Port adapter 18.5mm (0.73")	18.5
		Port adapter 19mm (0.75")	19.0
		Port adapter 24mm (0.94")	24.0
		Port adapter 25mm (0.98")	25.0

Door {Feature B}	
Door with 5 ports	263
Door with clear window - no ports	266
Door without ports	268
Door kit for use with Optidew	269
Door kit with 1x 30mm port	370

Accessories and Spare Parts

Item	Product / Description
Doors and Door Ports	
A000266	Door with clear window - no ports
A000268	Door without ports
A000263	Door kit with 5 ports - please order adaptors separately
A000264	Door kit with 5 ports and 25 adapters (5 x ø19mm (0.75"), 4 x ø12mm (0.47"), ø13.5mm (0.53"), ø15mm (0.59"), ø18.5mm (0.73"), ø24mm (0.94") - and blind stops. Adapter tool included
A000269	Door kit for use with MI Optidew. (Optidew dew-point sensor port adapter, PRT port adapter and 4 x ø19mm (0.75") adapters - adapter tool included)
A000273	Polymer port adpt ø18.5mm (0.73") to ø3mm (0.19") (for Optidew probe)
A000290	Molded polymer port adpt & blind stop (to be modified by customer) (M30x1)
A000290X	Polymer port adpt ø client specific & blind stop
A000291	Polymer port adpt for ø12mm (0.47") probe, blind stop (M30x1)
A000292	Polymer port adpt for ø13.5mm (0.53") probe, blind stop (M30x1)
A000293	Polymer port adpt for ø14mm (0.55") probe, blind stop (M30x1)
A000294	Polymer port adpt for ø15mm (0.59") probe, blind stop (M30x1)
A000295	Polymer port adpt for ø18.5mm (0.73") probe, blind stop (M30x1)
A000296	Polymer port adpt for ø19mm (0.75") probe, blind stop (M30x1)
A000297	Polymer port adpt for ø24mm (0.95") probe, blind stop (M30x1)
A000298	Polymer port adpt for ø25mm (0.98") probe, blind stop (M30x1)
A000277	Blind stop for Optidew adapter
A000278	Blind stop for PRT adapter
A000200	ø18.5mm (0.73") Blind stop
A000265	Tool for changing the port adapters
Miscellaneous	
OPT-V-01	Optidew Vision reference hygrometer with sensor
A000240	Drying module
A000242	Water bottle
A000171	0.25kg (0.55lbs) desiccant (orange)
A000172	3kg (6.6lbs) desiccant (orange)
HT961T00	Control sensor
OCAL-TC	Transport case for OptiCal and S904
S8K-REM-TSG	S8000 Remote guard for S904

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: S904 Order Codes_97200_V3_UK_0516

OptiCal

Order Codes

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A}

Ordering Example: OPTICAL

OptiCal - Precision humidity calibration system with temperature control includes 5 port door and integrated chilled mirror reference hygrometer with 3 point UKAS RH calibration

OPTICAL

Type {Feature A}	
Base unit - OptiCal, Precision humidity calibration system with temperature control. Includes 5 port door and integrated chilled mirror reference hygrometer with 3 point UKAS RH calibration	OPTICAL

Accessories and Spare Parts

Item	Product / Description
Doors and Door Ports	
A000266	Door with clear window - no ports
A000268	Door without ports
A000263	Door with 5 ports – please order adapters separately
A000264	Door kit with 5 ports and 25 adapters (5 x ø19mm (0.75"), 4 x ø12mm (0.47"), ø13.5mm (0.53"), ø15mm (0.59"), ø18.5mm (0.73"), ø24mm (0.94") - and blind stops. Adapter tool included
A000269	Door kit for use with MI Optidew. (Optidew dew-point sensor port adapter, PRT port adapter and 4 x ø19mm (0.75") adapters. Adapter tool included)
A000273	Polymer port adpt ø18.5mm (0.73") to ø3mm (0.19") (for Optidew probe)
A000290	M30x1 Molded polymer port adpt & blind stop (to be modified by customer)
A000290X	Polymer port adpt ø client specific & blind stop
A000291	Polymer port adpt for ø12mm (0.47") probe, blind stop (M30x1)
A000292	Polymer port adpt for ø13.5mm (0.53") probe, blind stop (M30x1)
A000293	Polymer port adpt for ø14mm (0.55") probe, blind stop (M30x1)
A000294	Polymer port adpt for ø15mm (0.59") probe, blind stop (M30x1)
A000295	Polymer port adpt for ø18.5mm (0.73") probe, blind stop (M30x1)
A000296	Polymer port adpt for ø19mm (0.75") probe, blind stop (M30x1)
A000297	Polymer port adpt for ø24mm (0.95") probe, blind stop (M30x1)
A000298	Polymer port adpt for ø25mm (0.98") probe, blind stop (M30x1)
A000200	ø18.5mm (0.73") Blind stop
A000265	Tool for changing the port adapters
Miscellaneous	
A000171	0.25kg (0.55lbs) desiccant (orange)
A000172	3kg (6.6lbs) desiccant (orange)
A000240	Drying module
A000242	Water bottle
A000243	PRT sensor
HT961T00	Control sensor
OCAL-TC	Transport Case for OptiCal and S904
S8K-REM-TSG	S8000 Remote guard for S904

Note: Custom-built calibration systems available covering the range from -100°C (-148°F) dew point (10 ppb_v) up to +85°C (+176°F) dew point. Please discuss your requirements with Michell Instruments' Technical Sales Department

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: OptiCal Order Codes_97161_V3_UK_0416

HG10

Order Codes

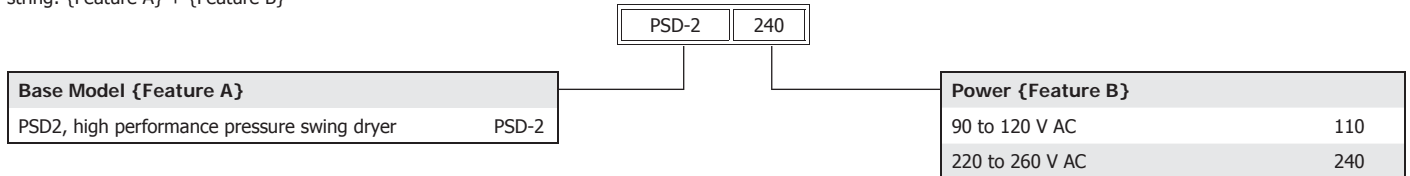
To construct the order code, select the relevant features from the tables below, to create a string: {Dry Air Generator} + {Dew-Point Generator} + {Dew-Point Hygrometer} + {Temperature Test Chamber}

Ordering Example: PSD-2 + 240 + HG-10 + S4K-RC-232 + UNI + 110

PSD2, high performance pressure swing dryer with 220 to 260 V AC power, HG10 PC control interface, S4000 Remote Climatic with 90 to 260 V AC power, 100 liter temperature test chamber

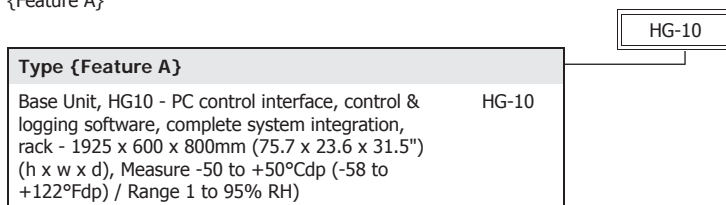
Dry Air Generation - Pressure Swing Dryer

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B}



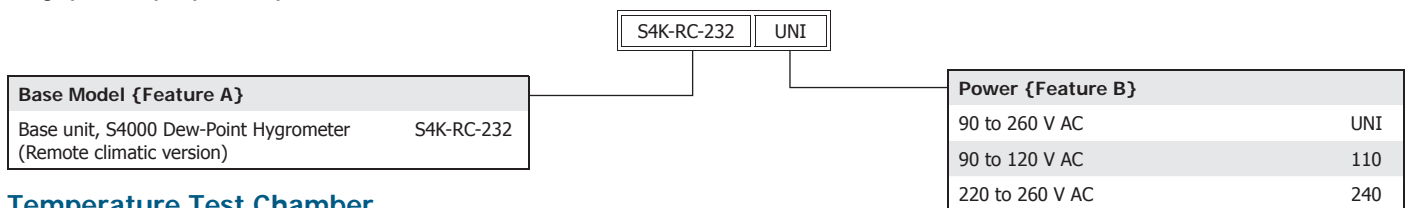
Dew-Point Generator

To construct the order code, select the relevant feature from the table below, starting with the type, which is {Feature A} and then add on options to create a string: {Feature A}



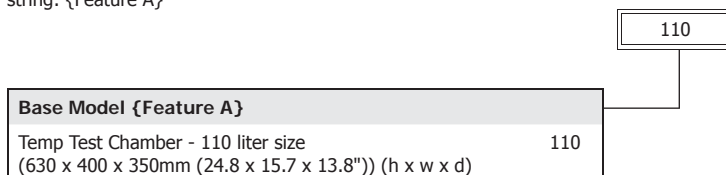
Dew-Point Hygrometer

To construct the order code, select the relevant feature from the tables below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A} + {Feature B}



Temperature Test Chamber

To construct the order code, select the relevant feature from the table below, starting with the base model, which is {Feature A} and then add on options to create a string: {Feature A}



Options

Item	Product / Description
Compressor System	
CMP-10-240	Oil free air mini compressor (29 psig / 2 barg, 10 l/min for PSD2)
Sensor Manifold	
DCS-MAN	Sensor Manifold (Manufactured to suit the customer's sensors typically in anodized aluminum for RH probes or 316 SS for dew-point sensors Price available on request when sensors to be calibrated are fully defined)

Michell Instruments can supply temperature controlled test chambers in a variety of configurations and capacities from 35 to 200L (+). Please contact Michell Instruments to discuss exact requirements and to receive a formal quotation before placing an order.

Please note: Michell Instruments adopts a continuous development program which sometimes necessitates specification changes without notice. Please contact us for latest version.

Issue No: HG10 Order Codes_97158_V3_UK_0316

Abbreviations

The following abbreviations are used in this catalog;

Abbreviation	Definition	Abbreviation	Definition
°C	Degrees Celsius	NVLAP	National Voluntary Laboratory Accreditation Program
°F	Degrees Fahrenheit	ppm _v	Parts per million (by volume)
AC	Alternating current	ppm _w	Parts per million (by weight)
ATEX	European hazardous area directive 94/9/EC	PRT	Platinum resistance thermometer (typically type Pt100)
atm	Pressure unit (atmosphere)	psig	Pound(s) per square inch (gauge)
bar	Pressure unit (=100 kP or 0.987 atm)	RH	Relative humidity
COM	Common	RS232	Serial communications standard
CSA	Canadian Standards Authority	RTU	Remote Terminal Unit
dBA	Decibel (a-weighting)	scfh	Standard cubic feet per hour
dp	Dew point	SD	Storage Device card (memory card for storing datalog files)
EU	European Union	sec	Second(s)
FM	Factory Mutual	TEC	Thermo-electric cooler
fs	Full scale	temp	Temperature
g/kg	Grams per kilogram	UKAS	United Kingdom Accreditation Service
g/m ³	Grams per cubic meter	UL	Underwriters Laboratories (US)
GOST-K	General Safety and Quality System Standards for Kazakhstan	USB	Universal Serial Bus
GOST-R	General Safety and Quality System Standards for Russia	V	Volts
HMI	Human Machine Interface	VA	Volt-ampere
Hz	Hertz	VCR	Vacuum Coupling Radiation fitting
IEC	International Electrotechnical Commission		
IECEX	International Electrotechnical Commission standard for equipment for use in explosive atmospheres		
lbs	Pound(s)		
LCD	Liquid crystal display		
LED	Light emitting diode		
mA	Milliampere		
max	Maximum		
min	Minute(s)		
mV	Millivolt(s)		
N/C	Normally closed		
N/O	Normally open		
NIST	National Institute of Standards and Technology (US)		
NI/min	Normal liters per minute		
No	Number		
NPL	National Physical Laboratory		

Glossary

Absorption (of water vapor)

Retention (of water vapor) by penetration into the bulk of a material

Adsorption (of water vapor)

Retention (of water vapor) as a surface layer on a material

Condensation

Condensation occurs when a vapor is compressed or cooled to its dew point, at which point its state changes from gas to liquid. This is often manifested as liquid droplets on a solid surface which is cooler than the dew-point temperature of the vapor.

Contaminant

An undesirable particulate, liquid or vapor component in a sample gas.

Desiccant

Any substance which exerts a drying action by chemically absorbing water vapor

Humidity

The presence of water vapor in air or other gas

Hygrometer

Any instrument for measuring humidity

Hygrometry

The measurement of humidity is called hygrometry, derived from the Greek term 'hygros' meaning moist. Hygrometry is the subject of humidity measurement

Inert gas

Chemically nonreactive gas, such as nitrogen, helium, argon etc

Manifold

A sample chamber designed to accommodate multiple probes or sensors, for the purpose of exposing them to humidity controlled calibration air or gas.

Moisture

Refers to liquid water or water vapor in any form

Platinum Resistance Thermometer

A highly accurate type of resistance temperature sensor commonly used in instrumentation. Also known as an RTD, PRT or PT100

Probe

Part of the instrument that houses the sensor remotely from the main body of the instrument

Sensor

The active or sensing part of a measuring instrument

Glossary

Transmitter

Instrument which normally gives an electrical output (analog or digital) rather than a displayed result

Partial pressure (of water vapor)

The part of the overall pressure exerted by the water vapor component in a gas. Expressed in units of pressure such as Pascal (100 kPa = 1 bar)

Saturated vapor pressure

Maximum pressure of water vapor that can exist at a given temperature. Expressed in units of pressure such as Pascal (100 kPa = 1 bar)

Dew Point (or dew point temperature) (°Cdp or °Fdp)

The dew point is the temperature at which condensation occurs if a gas is cooled (at constant pressure). This is in effect, the temperature at which a gas becomes saturated in equilibrium with water vapor.

Dew point relates directly and uniquely to the water vapor pressure

Frost point (or frost-point temperature)

The temperature at which ice forms on cooling a gas. This is, in effect the temperature at which air is saturated in equilibrium with ice. It is the exact counterpart to dew point (though values differ).

Confusion can arise from the fact that condensation formed below 0°C is not necessarily ice. At temperatures down to -30°C there is a high likelihood that condensation will occur in liquid phase, known as super-cooled water. The condensation temperatures for water and ice differ in this temperature range for a gas of the same moisture content. Care must be taken when interpreting the measurements of condensation dew-point meters, to correctly determine the state of the condensate.

The term "dew point" is often used generally to include "frost point".

Mixing Ratio

Mass of water vapor per unit mass of dry air with which it is associated. It is a dimensionless ratio, but is often expressed in grams of water per kilogram of dry gas (g.kg⁻¹) or in other units of mass.

For low levels of moisture content, this may be expressed in parts per million by weight, i.e. mass of water vapor per million parts of dry gas (ppm or ppm(w)).

Parts per million

The total quantity of water vapour present in a gas, expressed as a fraction of 1x10⁶. Abbreviated as "ppm", the unit can be in terms of total gas volume (ppm_v), or molecular weight (ppm_w). For actual vapour pressure; e (in Pascals), and total gas pressure; p (in Pascals):

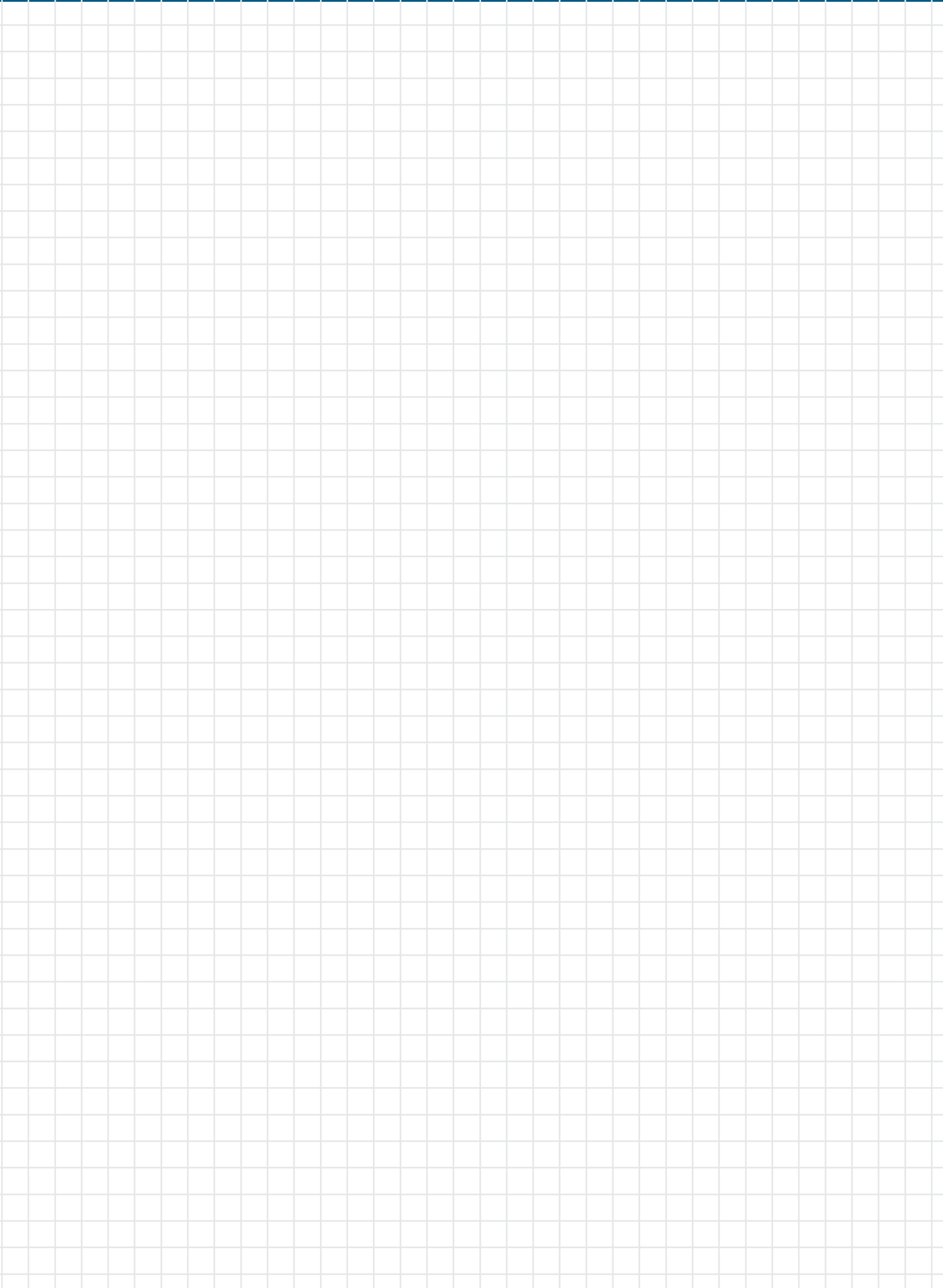
$$\text{ppm}_v = \frac{e}{p} \times 100000$$

Relative Humidity

The relative humidity of a gas expresses how much water vapour it contains in relation to the total amount of water vapour sustainable at that temperature. This is defined as: The ratio of the actual vapour pressure to the saturation vapour pressure over a plane liquid water surface at the same temperature, expressed as a percentage.

Although this is not a recognised abbreviation, the phrase "relative humidity" is commonly abbreviated RH, as in "X% RH". For actual vapor pressure; e (in Pascals) and saturation vapor pressure; e_s (in Pascals):

$$\text{RH (in \%)} = \frac{e}{e_s} \times 100$$



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Humidity and Dew-Point Calibration — Instruments, Systems & Services

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