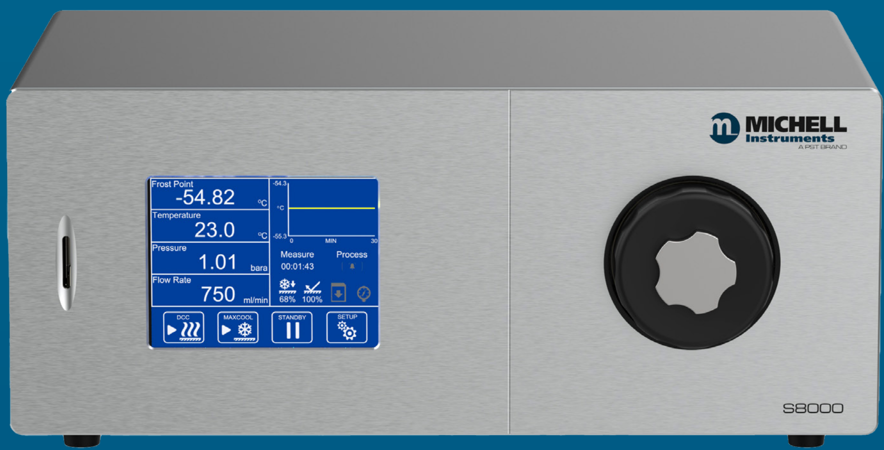
MICHELL Instruments
A PST BRAND

S8000
Chilled Mirror Hygrometer
User Manual



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Please fill out the form(s) below for each instrument that has been purchased.

Use this information when contacting Michell Instruments for service purposes.

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S8000

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Safety

The manufacturer has designed this equipment to be safe when operated using the procedures detailed in this manual. The user must not use this equipment for any other purpose than that stated. Do not apply values greater than the maximum value stated.

This manual contains operating and safety instructions, which must be followed to ensure the safe operation and to maintain the equipment in a safe condition. The safety instructions are either warnings or cautions issued to protect the user and the equipment from injury or damage. Use qualified personnel and good engineering practice for all procedures in this manual.

Electrical Safety

The instrument is designed to be completely safe when used with options and accessories supplied by the manufacturer for use with the instrument. The input power supply voltage limits are 85 to 264 V AC, 47/63 Hz. Refer to Appendix A: Technical Specifications.

Pressure Safety

Before pressurizing, the user must ensure through appropriate protective measures that the system or the device will not be over-pressurized. When working with the instrument and pressurized gases safety glasses should be worn.

DO NOT permit pressures greater than the safe working pressure to be applied to the instrument. The specified maximum safe working pressure is 1 barg (14.5 psig) for the low pressure version, or 20 barg (290 psig) for the high pressure version. This instrument is not designed to accept gas pressures higher than the specified maximum working pressure.

Application of gas pressures higher than the specified maximum will result in potential damage and may render the instrument unsafe and in a condition of incorrect functionality. Only personnel trained in the safe handling of high pressure gases should be allowed to operate this instrument. Refer to Appendix A - Technical Specifications in this manual.

Toxic Materials

The use of hazardous materials in the construction of this instrument has been minimized. During normal operation, it is not possible for the user to come into contact with any hazardous substance, which might be employed in the construction of the instrument. Care should, however, be exercised during maintenance and the disposal of certain parts.

Repair and Maintenance

The instrument must be maintained either by the manufacturer or an accredited service agent. For the contact details of Michell instruments' offices worldwide, refer to www.ProcessSensing.com.

Calibration

The recommended calibration interval for the S8000 is one year, unless otherwise specified by Michell Instruments Ltd. The instrument should be returned to the manufacturer, Michell Instruments, or one of their accredited service agents for re-calibration (go to www.ProcessSensing.com for contact information).

Safety Conformity

This product meets the essential protection requirements of the relevant UK, EU and US standards and directives. Further details may be found in the Technical Specifications in Appendix A.

Abbreviations

The following abbreviations are used in this manual:

DCC	Dynamic Contamination Correction
FAST	Frost Assurance System Technology
MAXCOOL	Maximum Sensor Cooling
AC	alternating current
barg	pressure unit (=100 kP or 0.987 atm) gauge
bara	pressure unit (absolute)
°C	degrees Celsius
°F	degrees Fahrenheit
COM	common
dp	dew point
EU	European Union
g/kg	grams per kilogram
g/m^3	grams per cubic meter
HMI	Human Machine Interface
Hz	Hertz
IEC	International Electrotechnical Commission
Nl/min	normal liters per minute
lb	pound
mA	milliampere
max	maximum
min	minute(s)
N/C	normally closed
N/O	normally open
ppm_V	parts per million (by volume)
ppm_W	parts per million (by weight)
PRT	Platinum resistance thermometer (typically type Pt 100)
psig	pound(s) per square inch (gauge)
psia	pound(s) per square inch (absolute)
RH	relative humidity
RTU	Remote Terminal Unit
scfh	standard cubic feet per hour
SD	storage device card (memory card for storing datalog files)
USB	Universal Serial Bus
V	Volts

Warnings

The general warnings listed below are applicable to this instrument. They are repeated in the text in the appropriate locations.

Where this hazard warning symbol appears in the following sections, it is used to indicate areas where potentially hazardous operations need to be carried out.

Where this symbol appears in the following sections it is used to indicate areas of potential risk of electric shock.

1 INTRODUCTION

The S8000 is a high precision instrument used for the measurement of dew point in air and other gases. Relative humidity, moisture content, and other calculated parameters based on dew point, pressure and temperature of the sample gas can also be displayed.

The S8000 is capable of measuring dew points as low as -60 °C (-76 °F); it can measure dew points up to (but not including) the point of condensation (maximum +40 °C (+104 °F)).

Two models of the S8000 instrument are available:

- Low Pressure (1 barg (14.5 psig) max)
- High Pressure (20 barg (290 psig) max)

Figure 1 *S8000*

1.1 Operating Principle

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

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

A 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.

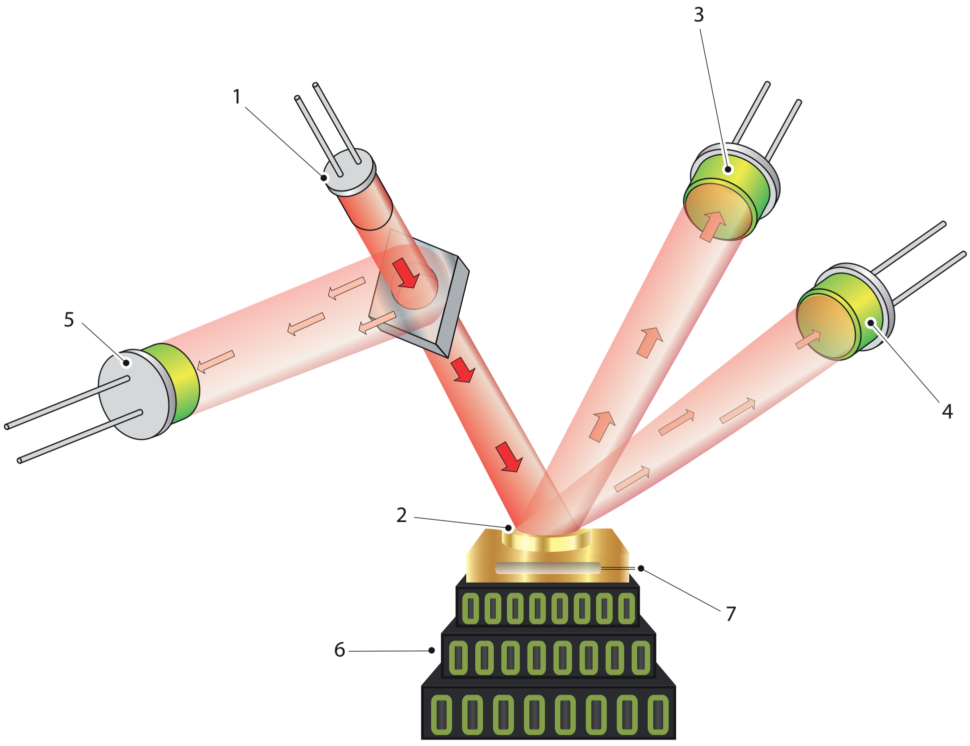


Figure 2 *Operating Principle*

2 INSTALLATION

2.1 Safety

It is essential that the installation of the electrical and gas supplies to this instrument is undertaken by competent personnel.

2.2 Unpacking the Instrument

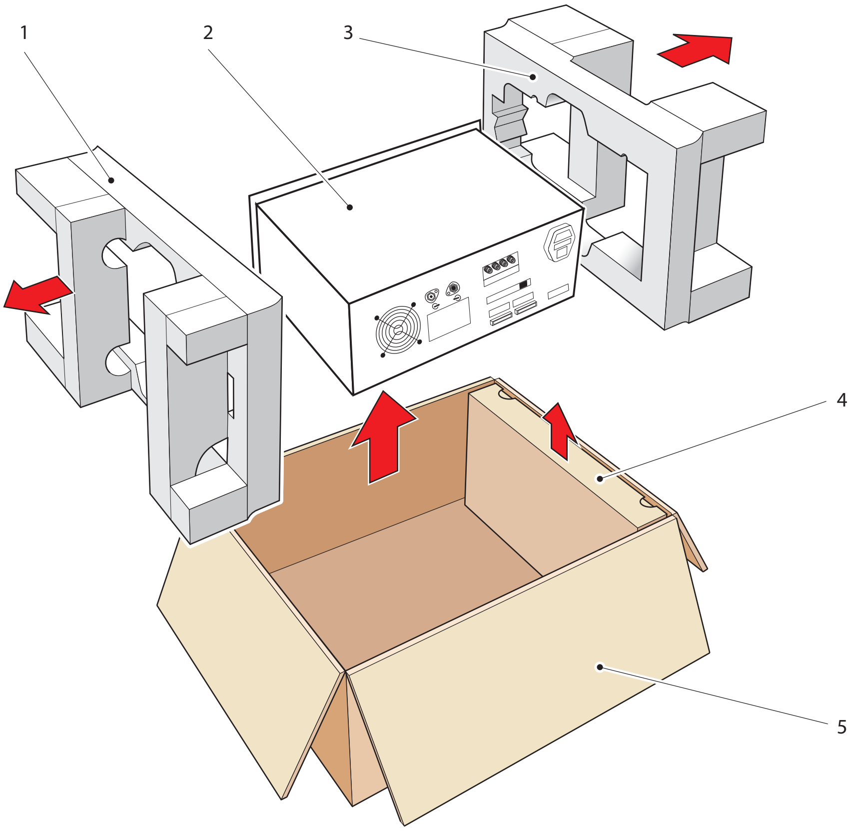


Figure 3 *S8000 Packing*

Open the box (5) and unpack carefully as follows (see *Figure 3*):

1. Remove the accessories box (4).
2. Lift out the instrument (2) together with its end packing pieces (1 & 3).
3. Remove the end packing pieces (1 & 3) and set the instrument down at the site of installation.
4. Save all the packing materials for the purpose of returning the instrument for re-calibration or any warranty claims.

The accessories box should contain the following items:

1. Traceable calibration certificate
2. IEC power cable
3. SD memory storage card
4. Optics cleaning kit
5. Allen Key SMM
6. USB communications cable
7. Pt100 temperature probe (optional)
8. CAT5 ethernet cable (optional)
9. Microscope (optional)

If there are any shortages, please notify Michell Instruments immediately (see www.ProcessSensing.com for contact information).

2.3 Operating Requirements

2.3.1 Environmental Requirements

The S8000 instrument should either be placed on a firm and level surface in a laboratory environment, or mounted into a standard 19" rack. Recommended ambient temperature +20 to +25 °C (+68 to +77 °F) although the instrument will operate, within specification, at elevated ambient temperatures of up to +40 °C (+104 °F), providing the cooling vents are kept clear and unrestricted. **It is essential however that this upper temperature limit (+40 °C (+104 °F)) is not exceeded.**

A free flow of air around the instrument is required at all times.

The instrument is suitable for mounting in a standard 19" rack.

For rack mounted instruments, forced air cooling of the rack should be considered if operating at high ambient temperatures.

2.3.2 Electrical Requirements

All versions of the instrument require the following electrical supply:

- 85 to 264 V AC, 47/63 Hz, 120 VA max
- Alarm outputs for all instrument types comprise two sets of changeover relay contacts, one set for a **PROCESS** alarm and one set for an **INSTRUMENT FAULT**. Both sets of contacts are rated at 24 V, 1 A. **NOTE: THIS RATING MUST NOT BE EXCEEDED.**

2.4 Exterior Layout

The controls and indicators relating to the operator interface are located on the front panel.

The external PRT connection, mains power IEC socket, analog output connector, remote temperature probe connector, alarm relay connector, the USB socket, and the Ethernet socket (optional) are located on the rear panel.

Figures 4 and 5 show the layout of these controls for both the rack mount/horizontal and vertical versions of the instrument. Tables 1 and 2 detail the controls and indicators and the function key operations.

Front Panel

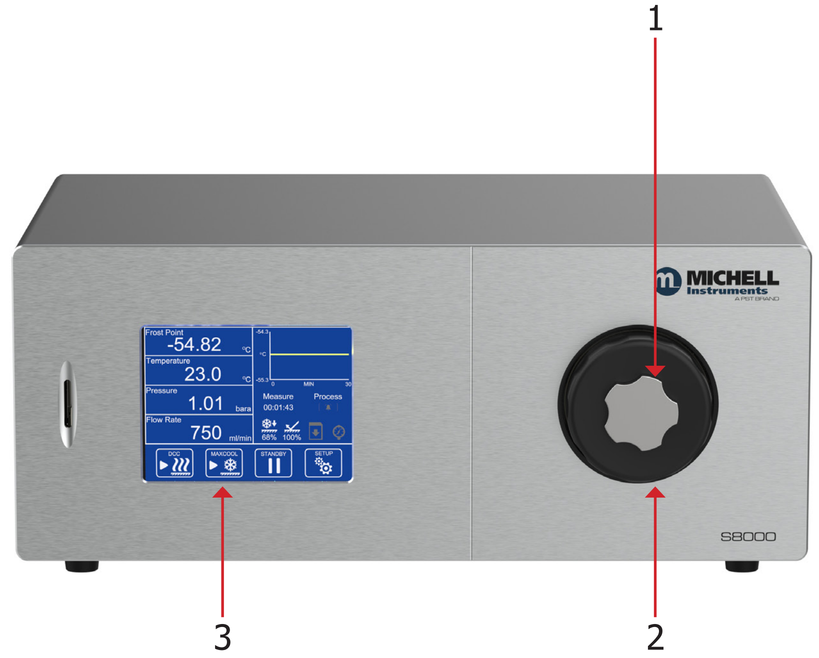


Figure 4 *Front Panel*

Item	Name	Description
1	**Microscope Blanking Plug**	Used to cover the microscope port when not in use. Also to be used as a key to remove optics window.
2	**Sensor Housing**	Exterior housing of the sensor. Please see Section 5.3 for information about mirror maintenance.
3	**Touch Screen Display**	Displays measured values and enables the user to control the operation of the instrument. See Section 3.2 for information about the touch screen and menu system.

Table 1 Front Panel Controls and Indicators

Rear Panel

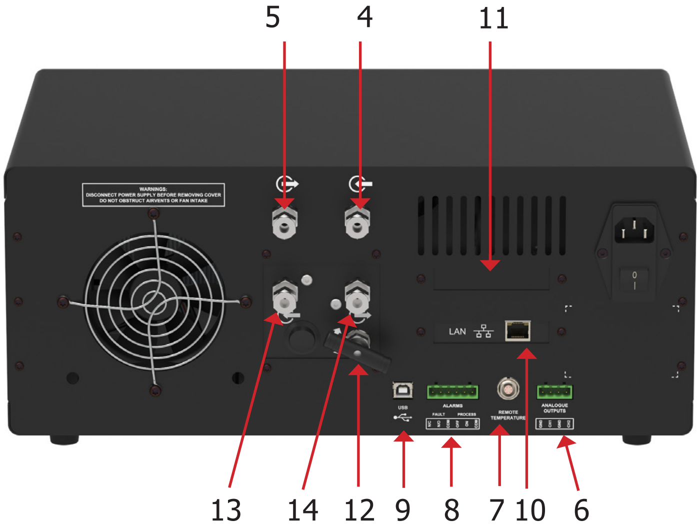


Figure 5 *Rear Panel*

Item	Name	Description
4	**Gas Input Port**	Usually slightly above atmospheric pressure in order to maintain flow rate over the mirror, but can be up to a maximum of 20 barg depending upon application.
5	**Gas Output Port**	Usually vented to atmosphere.
6	**Analog Output Connector**	Three, 2-wire output channels, CH1, CH2 and CH3, each of which may be configured to give either a 0-20 mA or a 4-20 mA current loop output or a 0 to 1 V voltage signal representing any one of the measured or calculated output parameters selected. Spans for each signal output are separately configurable. Refer to Section 2.5.2.
7	**Remote Temperature Probe (optional)**	6-Pin Lemo socket for connection of remote Pt100 temperature probe.
8	**Alarms**	Process and Fault alarm outputs. Each alarm has one set of potential free, changeover, relay contacts, common (COM), normally closed (N/C) and normally open (N/O). The Process alarm can be configured to operate at a specified level on any of the measured or calculated parameters. Refer to Section 2.5.3.
9	**USB Communications Port**	Used for connection to an external computer system for running application software (optional).

10	**RJ45 Ethernet Socket**	Used for communication with the instrument over a network connection. See Section 3.2.14 for details on how to configure the network settings. See Section 4 for information on using and installing the application software.
11	**Flow Control Valve (Optional)**	Used to regulate flow through the sensor when pump is in use.
12	**Pump Input Port (Optional)**	Can be linked to Gas Output port with supplied tubing for operation with sample pump - **NOT TO BE USED ABOVE ATMOSPHERIC PRESSURE.**
13	**Pump Output Port (Optional)**	Vented to atmosphere when pump is in use.

Table 2 Rear Panel Controls and Indicators

2.5 Rear Panel Connections (All Versions)

These tasks should be undertaken only by competent personnel.

DANGER
Electric
Shock Risk

All the connections to the rear panel are electrical connections.

Exercise due caution, particularly when connecting to external alarm circuits which could be at high potential.

Connections to the rear panel of the instrument are explained in the following sections.

2.5.1 Power Supply Input

The AC power supply is a push fit into the IEC C13 power input socket.

Ensure the power switch is OFF before connecting the cable.

The voltage range is 85...264 V AC, 47/63 Hz.

2.5.2 Analog Output Connections

The two analog outputs can be configured to represent any of the directly measured or calculated output parameters. They are provided as 2-wire signals from a 6-way connector located on the rear panel of the instrument.

Each of these outputs provide a current loop signal (4...20 mA or 0...20 mA). The 0/4...20 mA outputs are active (sourcing) and must be connected to a passive (sinking) input on the receiving equipment. The configuration of these outputs, i.e. parameter represented, output type (current loop or voltage) and upper/lower span levels are set up via the Setup Menu Screen (refer to Section 3.2.4).

These signals may be used to control external systems. During a **DCC** cycle, and for the hold period following a **DCC** cycle, they are held at the level that they were at immediately prior to the start of the cycle. When the dew-point measurement is stable, or if the maximum hold period has expired, they are released and will track the selected parameter throughout the measurement cycle.

The default settings of these analog outputs are:

Channel 1: Dew point, -60...+20 ºC
Channel 2: ppm_V, 0...3000

NOTE: The analog outputs are only active during the MEASURE phase. They will, therefore, be off after switch-on and remain off until the system enters the MEASURE phase.

The two analog output port connections are made via a single 4-way push fit connector block. All outputs are 2-wire, positive-going signals referenced to a common 0 V line. To differentiate between the outputs it is recommended that a black lead be used for each of the COM (common) lines and a separate color for each of the positive lines.

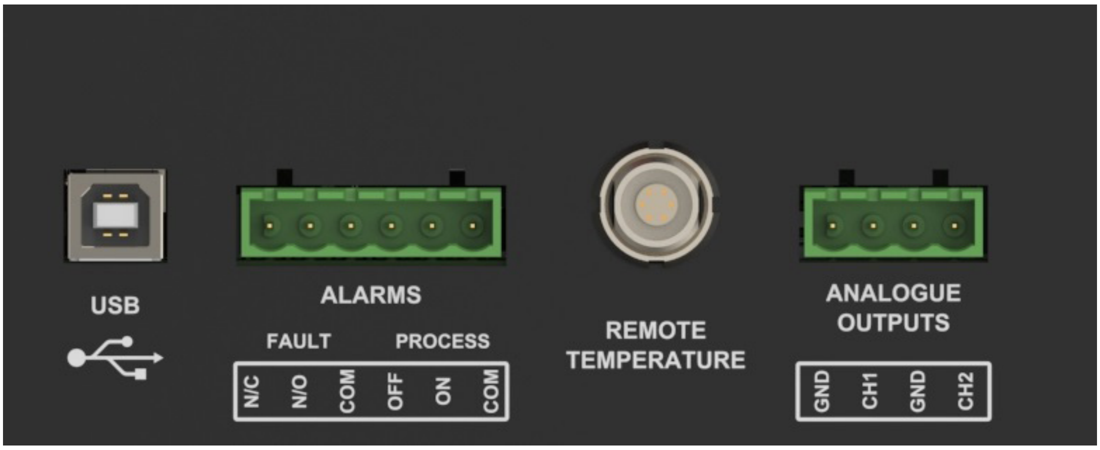


Figure 6 *Alarm and Analog Output Connection*

2.5.3 Alarm Output Connections

Two alarm outputs are provided from a terminal block, located on the rear panel of the instrument, as two pairs of potential free, change-over relay contacts. These are designated as a **PROCESS** alarm and a **FAULT** alarm.

Under the Setup Menu Screen, (refer to Section 3.2.4), the **PROCESS** alarm can be configured to represent any one of the measured or calculated parameters and set up to operate when a pre-set parameter threshold level is exceeded. By default, the **PROCESS** alarm is set to monitor the dew-point parameter.

The two alarm output ports are connected to the instrument via a single 6-way, push-fit connector block as shown in *Figure 6*. Each output comprises a 3-wire set of potential free, change-over relay contacts.

Each contact set is labelled **COM** (common 0 V), **N/O** (normally open with respect to **COM**) and **N/C** (normally closed with respect to **COM**).

To differentiate between the alarm output channels, it is recommended that a black lead is used for each of the **COM** (common) lines and a separate color for each of the **N/O** and **N/C** lines.

WARNING: Alarm leads MUST be potential free when wiring to the connector block. Both sets of contacts are rated at 30 V, 1A. THIS RATING MUST NOT BE EXCEEDED.

2.5.4 Remote Temperature Probe

1. Align the red dot on the body of the temperature probe connector with the red dot on the socket labelled **REMOTE TEMPERATURE** (see *Figure 6*).
2. Push the connector into the socket until it locks. **NOTE: Do not attempt to force it into the socket. If it does not fit in, rotate it until the key locks and it pushes in easily.**
3. To remove the connector, slide the connector's body collar (1) back along its axis, away from the instrument, to release the lock. Gently pull the connector body out of the socket. **NOTE: Do not attempt to pull the connector out with the cable – make sure that the collar is released first.**

2.5.5 USB Communications Port Connector

The instrument features a USB port for communication with the application software. The appropriate cable will be supplied with the instrument.

1. Check the orientation of the connector and gently push it into the communications socket (see *Figures 6 and 7)*.
2. To remove the connector, pull it out of the socket by holding the connector body. **Do not attempt to remove the connector from the socket by pulling on the cable.**

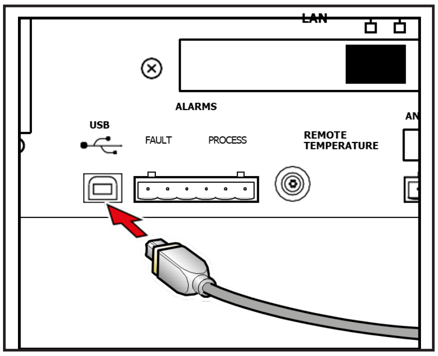


Figure 7 *USB Port Connection*

The application software includes a virtual serial port driver allowing the customers own software to be used with the device. The communications protocol used is Modbus RTU. Refer to Appendix B for the Modbus register map.

2.5.6 Ethernet

The instrument features an optional additional digital communication point. If Ethernet is selected, then an RJ45 socket is present. The protocol used is Modbus TCP.

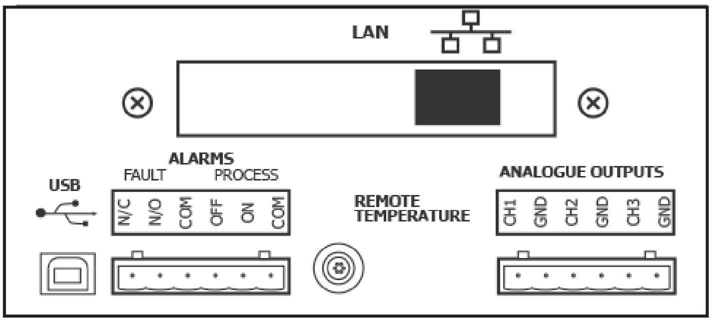


Figure 8 *Ethernet Port*

2.5.7 Connection of Gas Supplies

POSSIBLE INJURY! The tubing, valves and other apparatus attached to this instrument must be adequate for the maximum pressure which will be applied, otherwise physical injury to the operator or bystander is possible.

Before connection or disconnection of the instrument to and from the gas line it is essential to vent the system to atmospheric pressure, otherwise severe injury could result.

Sample gas connections are made via the **GAS OUT** port (7) and the **GAS IN** port (8) located on the rear panel.

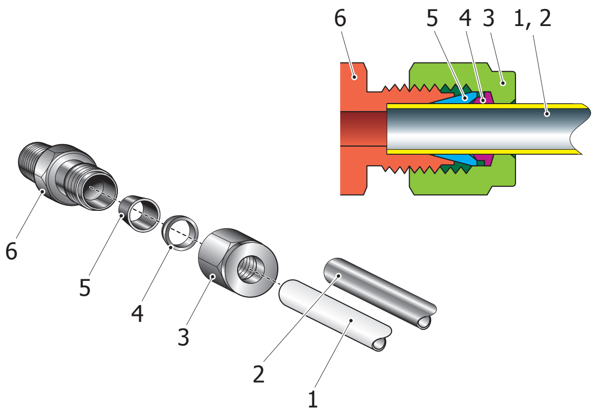


Figure 9 *Gas Connections*

The sample inlet and outlet connections are 6mm Swagelok® tube couplings. The gas input connection must be made with 6mm stainless-steel tubing. The gas output connection for most applications can just be exhausted to atmosphere via 300 mm (11.8") of PTFE tubing (1).

The method of connection to the **GAS IN** port (8) is as follows.

1. Cut appropriate diameter stainless steel tubing (2) to the correct length and, if necessary, bend to shape to suit the location of the instrument. **NOTE: To facilitate ease of connection to the port, at least 75mm (3") of the tubing coming out of the GAS IN port should be straight**.
2. Clean off any burrs or metal shavings adhering to the tubing.
3. Pass the tubing (2) through the Swagelok nut (3).
4. Fit the back ferrule (4) over the tubing (2) with the bevelled end facing the back of the front ferrule (5).
5. Place the front ferrule (5) over the tubing (2), bevelled end towards the adaptor (6).
6. Push the tubing as far as it will go into the fitting and tighten up the locking nut (3) finger tight.
7. Hold the adaptor (6) flats with a wrench and tighten up the locking nut (3) 1¼ turns. This action compresses the front ferrule (5) and back ferrule (4) onto the tubing to form a gas tight seal. **CAUTION: Do not overtighten as this could cause the ferrules to crack and destroy the integrity of the seal.**
8. Connect the **GAS OUT** port (7) in a similar manner to that described in operations 1–7 above, optionally using PTFE tubing (1) in place of stainless steel (2).

2.6 Internal Sample Pump (optional, for 1 barg only)

The internal sample pump can be used to allow measurement of static samples at atmospheric pressure. The pump can be routed in to the sample loop or bypassed, depending on whether it is connected via the external tube link.

2.7 External Sample Pump (for 20 barg – pump not supplied)

The instrument can be configured for operation with a pressurized sample by following the instructions below.

To configure the instrument for sample pump operation (atmospheric input pressure only):

1. Connect the external tube link from the **GAS OUT** port, to the **PUMP IN** port, and tighten to form a gas-tight seal.
2. Connect the sample line to the **GAS IN** port.
3. The user must ensure that the flow rate is controlled at 0.75 Nl/min.

NOTE: A third-party pump and flow-control valve should be obtained for pressures above 1 barg.

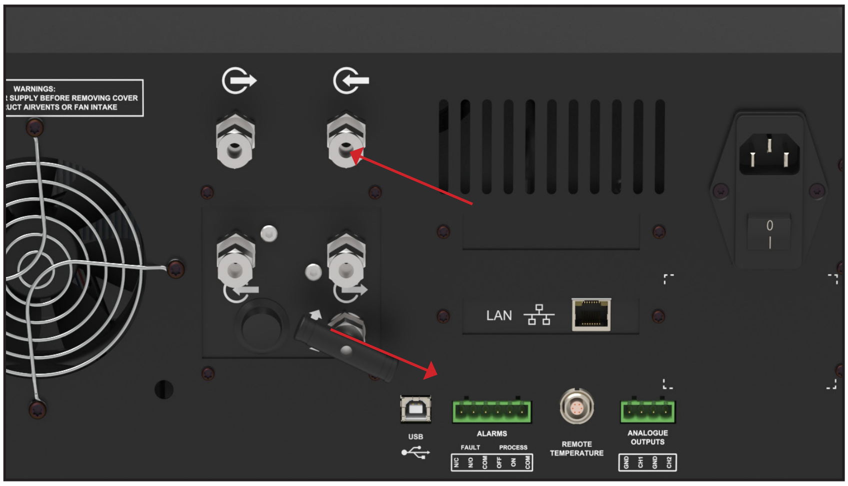


Figure 10 *Gas Connections when Pump is Fitted*

2.8 Conversion of S8000 to Rack Mount

Figure 11 illustrates the method for fitting a rack mount instrument into a standard 19" rack. To fit the unit proceed as follows:

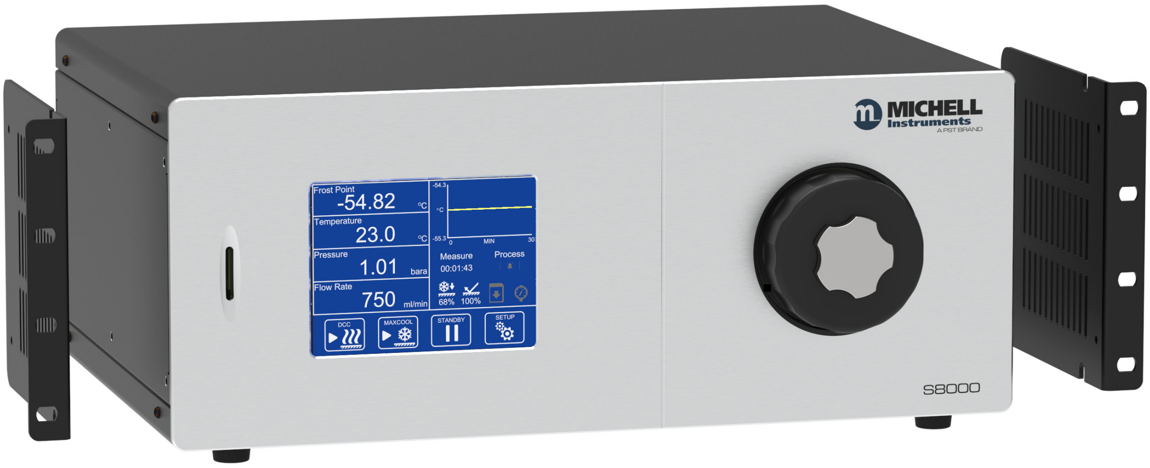


Figure 11 *Rack Fixing Method*

1. Turn the unit on its left end and remove the four screws and washers from the side panel.
2. Line up the fixing holes on the right hand side of the instrument with the corresponding holes in the right hand wing (flange facing outwards).
3. Insert the four screws and washers through the wing and tighten finger tight.
4. Ensure that the front flange is square to the front of the instrument and tighten the screws.
5. Turn the unit on its right end and repeat operations 1 to 4.

To remove from the rack wings, follow these directions above in reverse.

3 OPERATION

As supplied, the S8000 is ready for operation and a set of default parameters has been installed. This section describes both the general operation of the instrument and the method of setting it up and changing the default parameters (see Appendix C) – should this become necessary.

3.1 General Operational Information

While the instrument can physically operate in a flowing gas stream of between 0.5 and 1 Nl/min, (1.0 and 2.1 scfh), Michell Instruments recommends operating at 0.75 Nl/min (1.59 scfh) which is the flow-rate used during calibration. Operating at an alternative rate could impact the instrument's response time.

For all applications, the sample gas is taken into the instrument via the **GAS IN** port located on the rear panel, from where it passes into a sample chamber. The gas flow rate is then measured on the exhaust side of the sample chamber, prior to being exhausted from the instrument via the **GAS OUT** port.

Within the sample chamber, the gas is passed over a Peltier chilled, gold-plated mirror. The instrument's internal control system maintains the drive to the Peltier heat pump to ensure, by controlling the mirror temperature, that a level of condensate is maintained on the mirror surface. The temperature of the mirror is then measured as the dew point.

After passing over the mirror, the sample gas is then typically exhausted to atmosphere via the **GAS OUT** port.

The sampling chamber is available in two different configurations; low pressure and high pressure. The low pressure version is designed to operate up to 1 barg (14.5 psig) max and the high pressure version up to 20 barg (290 psig) max. When operating in high pressure applications, a relevant gas sample line, representative of the product, would be taken and fed into the instrument. In these applications, a metering valve can be installed after the output port to maintain flow rate to within the instruments operational limits.

When the sample to be measured is at atmospheric pressure, the [optional] sample pump can be used to draw it through the instrument. Using the tube link provided, the **GAS OUT** port can be connected to the **PUMP IN** port. The flow rate can then be adjusted using the integrated metering valve. The **PUMP OUT** port then becomes the outlet.

The S8000 is suitable for the measurement of moisture content in a wide variety of clean, non-corrosive gases. It will not contaminate high purity gases and is safe for use in critical semi-conductor and fiber optic manufacturing applications.

3.2 Instrument Display

The S8000 features a 5.7" color touch screen display.

When the instrument is switched on, an **Initialising** status bar will be shown while the menu system loads.

After the menu system has loaded, the Main Screen will show.

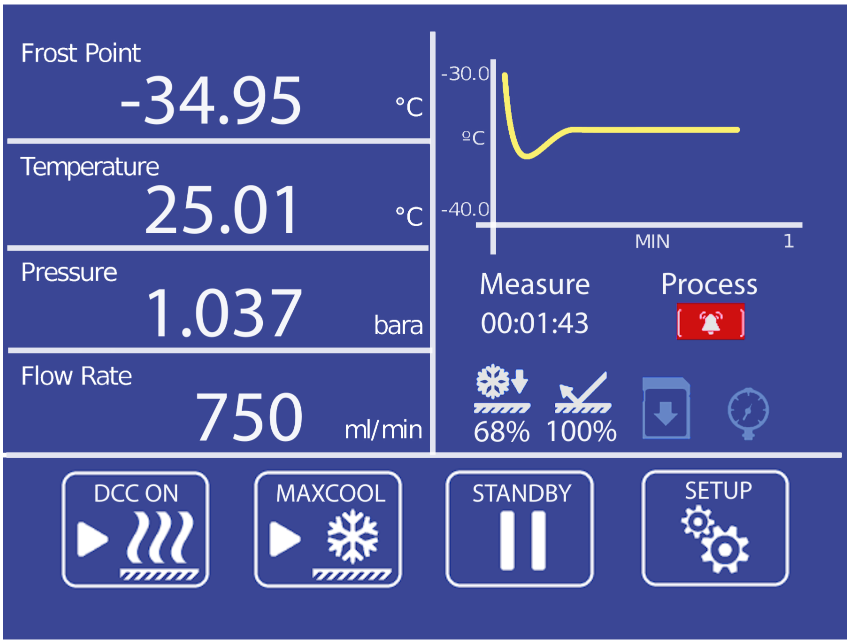


Figure 12 *Main Screen*

3.2.1 Main Screen

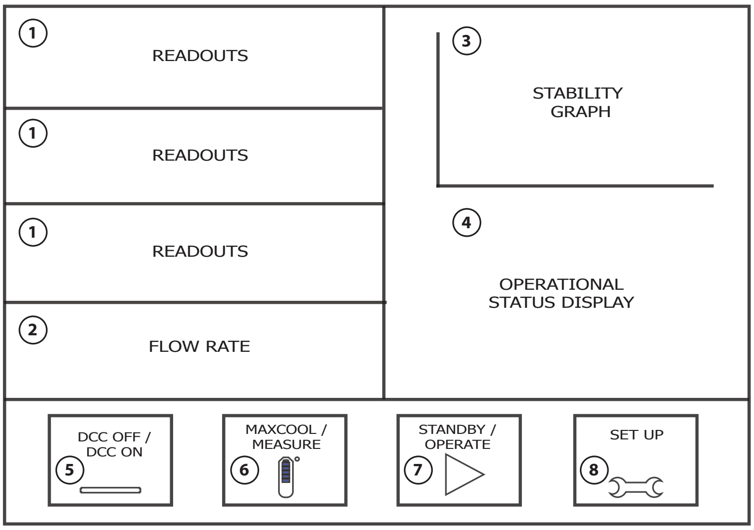


Figure 13 *Main Screen Layout*

No	Name	Description
1	**Readouts (Customizable)**	These readouts display measured instrument parameters. See Section 3.2.2 for additional information.
2	**Flow Readout**	Displays flow rate in chosen units.
3	**Stability Graph**	Displays a plot of the dew point over time. Touch the readout once to enter full screen mode.
4	**Operational Status Display**	A detailed description of each item displayed in this area is in Section 3.2.3.
5	**DCC Button**	Initiate a DCC cycle. See Section 3.5.1 for a detailed explanation of the DCC function. See Section 3.2.6 for DCC setup parameters.
6	**MAXCOOL Button**	Toggle **MAXCOOL** mode. See Section 3.5.2 for a detailed explanation of the **MAXCOOL** function.
7	**STANDBY Button**	Switch between **MEASURE** and **STANDBY** mode. When switching to **MEASURE** mode a DCC cycle will be initiated. See Section 3.5.6 for a detailed explanation of **STANDBY** mode.
8	**SETUP Button**	Access to the Setup Menu. See Section 3.2.4 for more information about the setup menu system.

Table 3 Main Screen Description

3.2.2 Customizable Readouts

The three readouts on the Main Screen can be configured by the user to show any of the following parameters:

- Dew Point
- Temperature
- Pressure
- % Relative Humidity
- g/m^3
- g/kg
- ppm_V
- %Vol
- Twb
- wvp (water vapor pressure)
- Dew Point (pressure corrected)

The parameters displayed by default are Dew Point, Pressure and Flow.

Follow these instructions to change the parameter:

1. Touch the readout once to enable parameter selection.
2. Touch the left or right arrows to select the parameter to be displayed.
3. Touch the center of the readout to confirm selection.

3.2.2.1 Full-Screen Mode

Any of the readouts can be shown in full-screen mode by touching and holding the readout.

3.2.3 Operational Status Display

The Operational Status display includes the following:

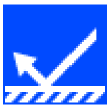
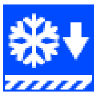
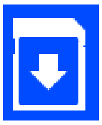
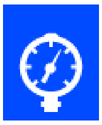
Mode	Reports current operational mode. This will either be **Measure, Standby, DCC, Hold**, **Maxcool** or **Flood**.
Next Mode	Shows the time (in Hours: Minutes: Seconds) remaining until the transition to the next mode of operation. If DCC is configured for manual activation only, then this countdown will display --:--:--.
Process	This notification indicates whether a parameter process alarm is either **ON** or **OFF**. The process alarm can be set on any parameter (see Section 3.2.9).
Film Thickness 	This figure indicates the quantity of condensate present on the mirror on a % scale. 0 % indicates condensate has not yet formed. 100 % is the target level, and ±1 % indicates the instrument is stable and controlling on the dew/frost point.
TEC Drive  	This symbol changes to indicate that the mirror is either being heated or cooled. The figure indicates the % of the total available cooling or heating power currently being used.
Logging 	Indicates data logging to SD is enabled (see Section 3.2.7).
Pressure compensation 	Indicates dew point is being calculated to atmospheric pressure (see Section 3.2.12).

Table 4 Operational Status Display

3.2.4 Setup Menu Screen

The Setup Menu is used to adjust the operational parameters of the instrument, change the display setup and start or stop the data-logging feature.

Initially, when the Setup Menu Screen is opened, a set of labelled icons is displayed. Touching one of these icons will take you to the appropriate submenu.

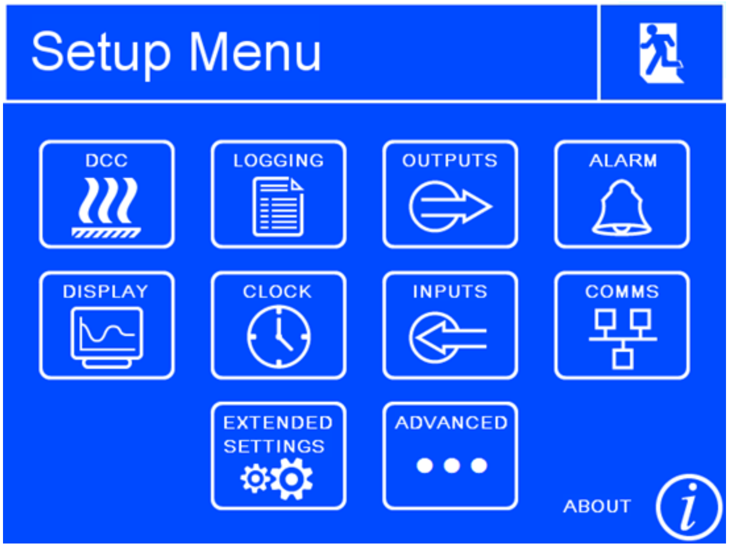


Figure 14 *Setup Menu Screen*

Once a submenu has been entered, parameters can be changed by touching the outlined values. There are three types of input for editable values:

- Toggle Button – Touching the outlined value will switch between predefined states, i.e. On/Off or Auto/manual.
- List Selection – A list of options will be displayed for the user to select.
- Numeric Input – Touching the outlined value will bring up the numeric keypad (see following page).

3.2.4.1 Numeric Input

When entering a numeric value, a virtual keypad will be displayed.

Figure 15 *Virtual Keyboard*

The allowable range will initially be shown at the top of the keypad, e.g. 0 → 50

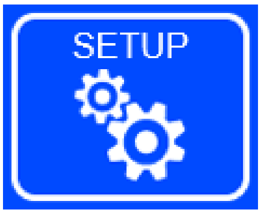
Some parameters can be disabled by entering a value of 0; this will be indicated by 0[off] → 50

- C Clear Input
- Backspace
- Cancel input
- OK Save input

3.2.4.2 Leaving Menus

To return from a menu or to cancel a numeric input, touch the exit icon.

3.2.5 Menu Structure



DCC	LOGGING	OUTPUTS	ALARM	DISPLAY	CLOCK	INPUTS	COMMS	EXTENDED SETTINGS
Type	Interval	Output Select	Type	Resolution	Date	Temperature input source	Modbus	PRT Mode
Setpoint		Output Type	Parameter	Stability	Time	Value	Address	Flood Recovery
Mode		Parameter	Setpoint	Temp Unit		Pressure Compensation	IP Address	
Interval		Alarm	Hysteresis	Display Hold			Subnet Mask	
Period		Minimum	Low Setpoint	Pressure Unit			Default Gateway	
Output Hold		Maximum	High Setpoint	Language				
FAST			Contamination Warning	Timebase				
FAST SP			Calibrate Optics	Brightness				

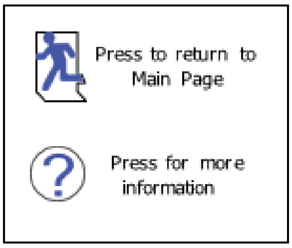


Figure 16 *Menu Structure*

3.2.6 DCC

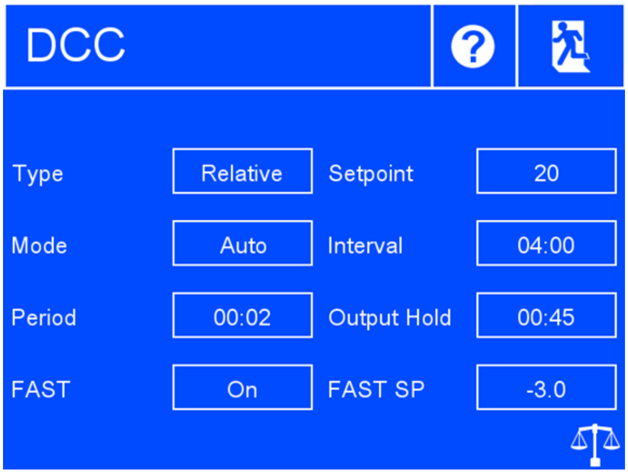


Figure 17 *DCC Screen*

Parameter	Description
Type	DCC heating temperature can either be relative to last measured dew point or an absolute temperature. Actual temperature or Δ is defined by 'Setpoint'. **Available Input:** Relative, Absolute
Setpoint	Mirror heating temperature during DCC, either absolute or relative to last measured dew point. See 'Type' option above. **Available Input:** 1...120 °C
Mode	DCCs can either be triggered automatically at every interval or they can be manually triggered only. **Available Input:** Manual, Auto
Interval	Time between automatic DCCs **Input format:** hh:mm **Limits:** 01:00...99:00
Period	Duration of the DCC **Input format:** hh:mm **Limits:** 00:01...00:59
Output Hold	Minimum time to hold analog outputs after finishing a DCC **Input format:** hh:mm **Limits:** 00:04...00:59
FAST	Turns frost assurance on or off. See Section 3.5.5 for further information **Available Input:** On, Off
FAST SP	Passing this mirror temperature will trigger the frost assurance function without a DCC **Available Input:** -28...-3 °C

Table 5 DCC Parameters

3.2.7 LOGGING

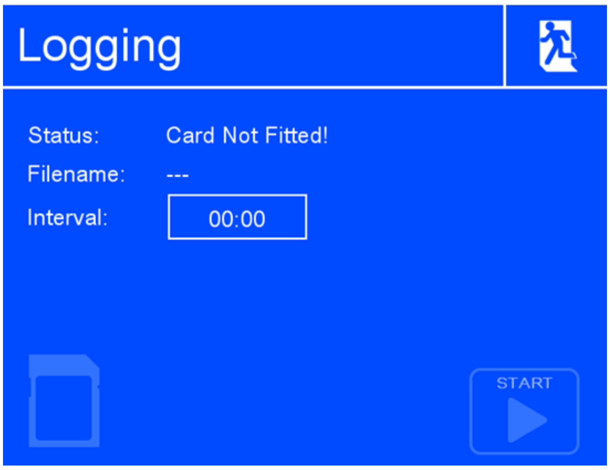


Figure 18 *Logging Screen*

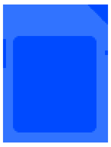
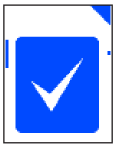
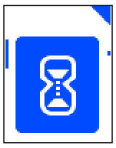
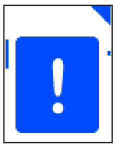
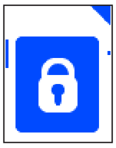
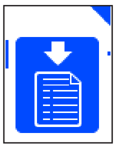
Parameter	Description	
Interval	Changes the interval at which data is recorded **Input format:** mm:ss – **Limits:** 00:05...10:00	
SD status indicator	Indicates status of inserted SD card:	
		No SD Card inserted
		Ready to log
		Initialising card
		Error occurred
		SD Card is write protected
		Logging
START/STOP	Begins a new log (file name is generated automatically) or ends a log in progress.	

Table 6 Logging Parameters

3.2.8 OUTPUTS

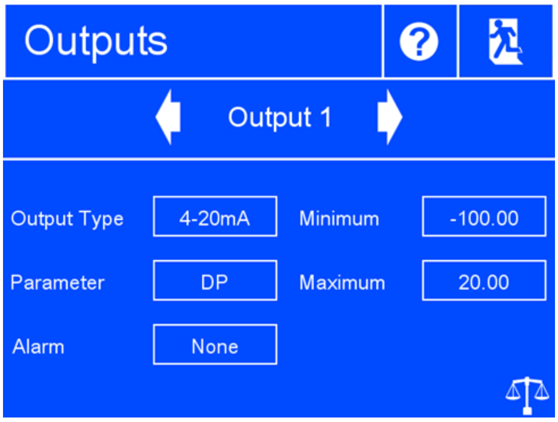


Figure 19 *Outputs Screen*

Parameter	Description
Output Selector Arrows	Selects the output to be adjusted
Output Type	Determines the mA output range **Available Input:** 4...20 mA/0...20 mA
Parameter	Assigns the chosen calculated or measured parameter to this output channel **Available Input:** Dew Point, Temperature, Pressure, % Relative Humidity, g/m^3, g/kg, ppm_V, %Vol, Twb, wvp (water vapor pressure), Dew Point (pressure corrected)
Minimum	The minimum output range for the selected parameter **Available Input:** Dependent on parameter
Maximum	The maximum output range for the selected parameter **Available Input:** Dependent on parameter

Table 7 Outputs Parameters

3.2.9 ALARM

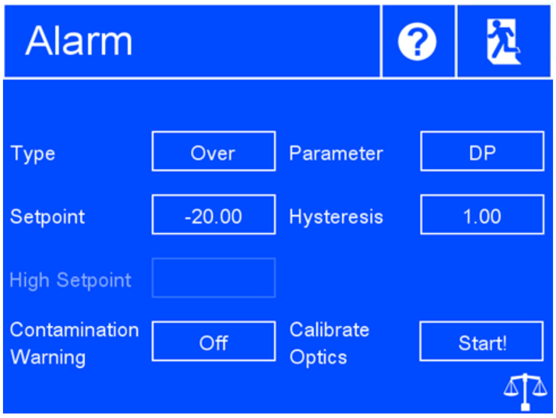


Figure 20 *Alarm Screen*

Parameter	Description
Type	Sets the trip criteria for the process alarm. **Available Input:** Over, Under, In. Band, Out. Band, Off
Parameter	Sets the parameter associated with the process alarm. **Available Input:** Dew Point, Temperature, Pressure, % Relative Humidity, g/m^3, g/kg, ppm$_V$, %Vol, Twb, wvp (water vapor pressure), Dew Point (pressure corrected)
Setpoint	Sets the trip point for Over or Under alarm types. **Available Input:** Dependent on parameter
Low Setpoint	Sets the low trip point for Band alarm types. **Available Input:** Dependent on parameter
High Setpoint	Sets the high trip point for Band alarm types. **Available Input:** Dependent on parameter
Hysteresis	Sets the deviation from trip point before the alarm deactivates. **Available Input:** Dependent on parameter
Contamination Warning	Sets whether an Optics Warning trips the process alarm. Refer to Section 3.3.2 for information about the optics warning. **Available Input:** On, Off
Calibrate Optics	It is necessary to run this function whenever the mirror is cleaned, or if a different dew-point sensor is installed. Following this, a DCC will begin.

Table 8 Alarm Parameters

3.2.10 DISPLAY

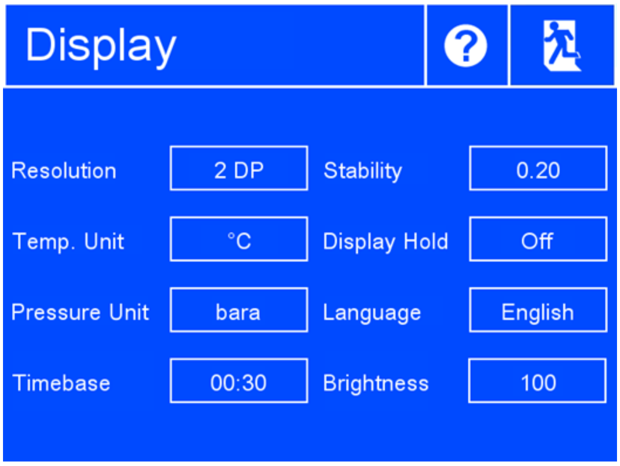


Figure 21 *Display Screen*

Parameter	Description
Resolution	Changes the number of decimal places for all displayed parameters. **Available Input:** 1 DP, 2 DP, 3 DP
Temperature Unit	Measurement unit for temperature values **Available Input:** °C, °F
Pressure Unit	Measurement unit for pressure values **Available Input:** kPa, psig, psia, barg, bara
Timebase	X axis span for trend graph on main screen **Input Format:** hh:mm **Limits:** 00:01...10:00
Stability	Determines a stable measurement following DCC, which is conditional to release Data Hold. Entered value is ΔDP over 30s. **Available Input:** 0.2...20
Display Hold	When enabled, values on display are also held during Data Hold. **Available Input:** Off, On
Language	Sets user interface language **Available Input:** English
Backlight	Display backlight control **Available Input:** 0...100 %

Table 9 Display Parameters

3.2.11 CLOCK

Figure 22 *Clock Screen*

Parameter	Description
Date	Current date.
Time	Current time.

Table 10 Clock Parameters

3.2.12 Inputs

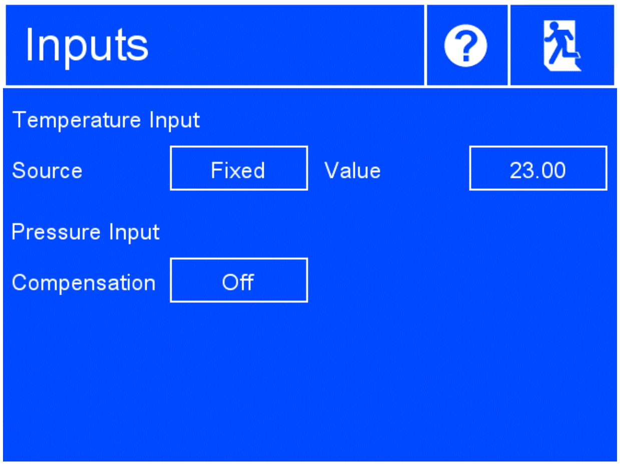


Figure 23 *Inputs Screen*

Parameter	Description
Source (Temperature Input)	Changes between temperature input from external Pt100 or a fixed value. **Available Input:** Fixed, External
Value (If 'Fixed' selected)	Sets temperature used for internal calculations.
Compensation	Recalculate dew point to atmospheric pressure based on measured pressure. **Available Input:** Off, On

Table 11 Inputs Parameters

3.2.13 Comms

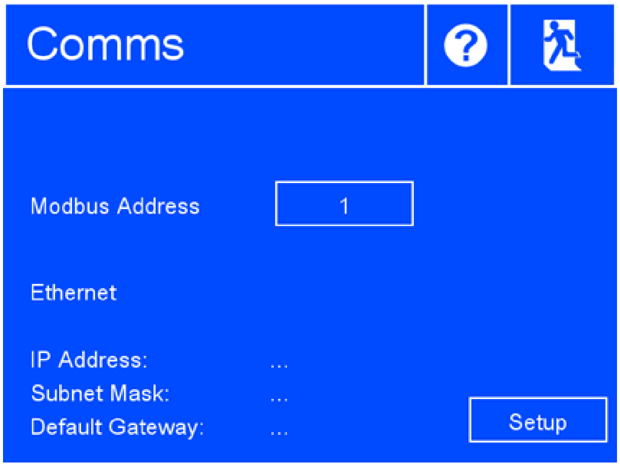


Figure 24 *Comms Screen*

Parameter	Description
Modbus Address	Sets the Modbus slave address
Setup	Access the TCP/IP Network Settings page

Table 12 Comms Parameters

3.2.14 Network Settings

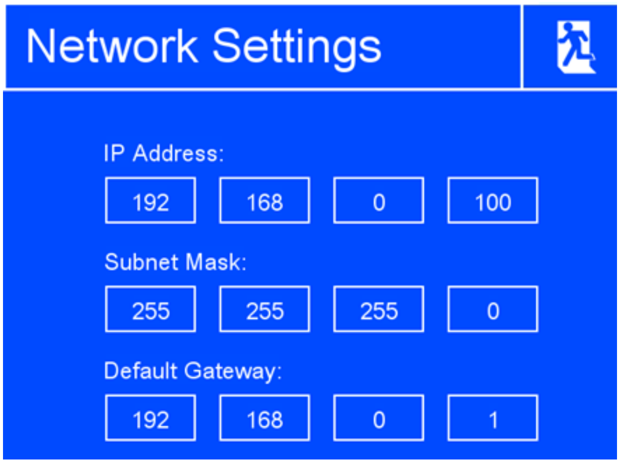


Figure 25 *Network Settings Screen*

Parameter	Description
IP Address	The IP address of the instrument
Subnet Mask	Determines network subnet address
Default Gateway	Default gateway address

Table 13 Network Parameters

3.2.15 ABOUT (Network Settings)

When using an S8000 that is fitted with an Ethernet module this page is accessible via the About Screen.

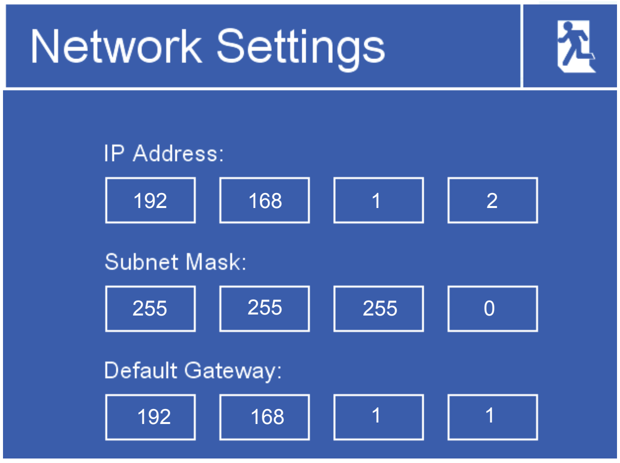


Figure 26 *Network Settings Screen*

Parameter	Description
IP Address	The IP address of the instrument.
Subnet Mask	The subnet mask that determines what subnet the IP address is on.
Default Gateway	The default gateway for network communication.

Table 14 Network Parameters

3.2.16 Extended Settings

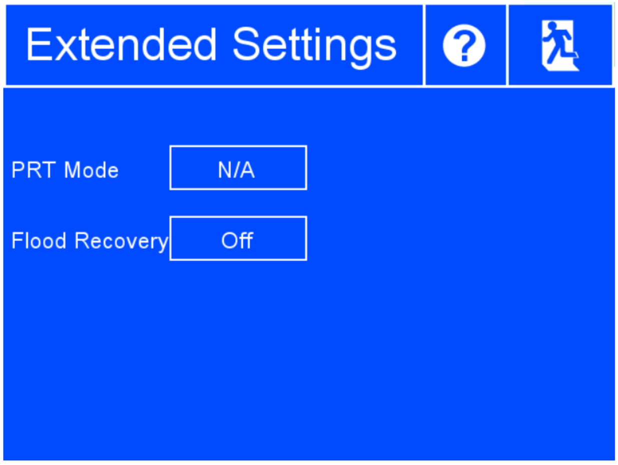


Figure 27 *Extended Settings Screen*

Parameter	Description
PRT Mode	Option not available on this model
Flood Recovery	Sets sensor temperature to +20 °C and initiates an extended DCC if mirror temperature exceeds sensor temperature. See Section 3.5.7 for further information. **Available Input:** Off, On

Table 15 Extended Settings Parameters

3.3 Warnings and Faults

The S8000 contains a comprehensive self-diagnosis system to alert the user whenever there is an issue which could affect the measurement. These alerts are divided into two categories:

Warnings: A problem which is not currently affecting the measurement but requires attention.

Faults: A problem which requires immediate attention. Whenever a fault is triggered, the S8000 will switch to 'Standby' and remain in this mode until the operator intervenes.

When a Fault is present, the System Alarm symbol will appear over the sensor status display on the main screen. Pressing the System Alarm symbol will display all current faults and warnings. At any other time, active warnings can be viewed by pressing the right-hand side of the sensor status display. A system fault will usually be accompanied by one or more warnings, which describe the problem in more detail.

Once a fault has been resolved, it is necessary to run a DCC cycle to return the instrument to normal operation.

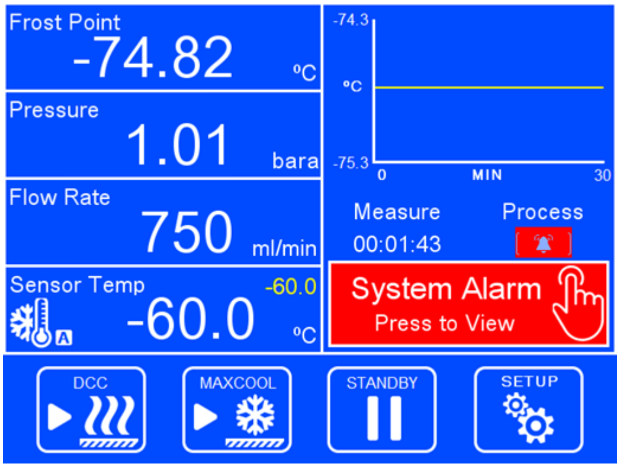


Figure 28 *System Alarm Screen*

3.3.1 Fault Codes

No.	Name	Description
1	Mirror PRT Failure	Chilled Mirror sensor Pt100 resistance out of range
2	Ambient PRT Failure	Remote Temperature probe Pt100 resistance out of range
3	Chiller PRT Failure	Cold finger Pt100 resistance out of range
4	RESERVED	
5	Mirror temperature too high	Mirror temperature exceeded 130 °C
6	RESERVED	
7	Optics setpoint search failed	Optics calibration failed during DCC
8	Optics outside max. operating limit	Optics reflected signal out of range (high)
9	Optics outside min. operating limit	Optics reflected signal out of range (low)
10	Cooling Saturated timeout	TEC drive in maximum cooling mode beyond allowable time limit
11	Heating Saturated timeout	TEC drive in maximum heating mode beyond allowable time limit
12	RESERVED	
13	Pressure input failure	Pressure transmitter signal <3.6mA or >21 mA
14	Optics contamination	Mirror requires cleaning followed by Optics Calibration
15	RESERVED	

3.3.2 Optics Warning

Throughout the life of the instrument, periodic cleaning of the mirror surface and optics window will be required. The frequency of this depends upon operating conditions and the potential in the application for contaminants to be deposited on the mirror.

The S8000 will notify the user on the state of mirror contamination. The instrument will initially give a warning in the sensor status display when contamination is detected but will continue to operate. Cleaning the mirror then pressing the **Calibrate Optics** button is necessary when this warning is displayed. If the contamination reaches levels which will drastically affect performance, a fault alarm will trip, causing the instrument to switch to standby mode until action is taken.

For remote indication of an optics warning, the process alarm contact can be set to trip whenever the optics warning is active. See Section 3.2.9 for further information.

See Section 5.3 for mirror cleaning instructions.

3.4 Operational Functions

3.4.1 Operating Cycle

The default parameters set up for the instrument define an operating cycle (see *Figure 29*).

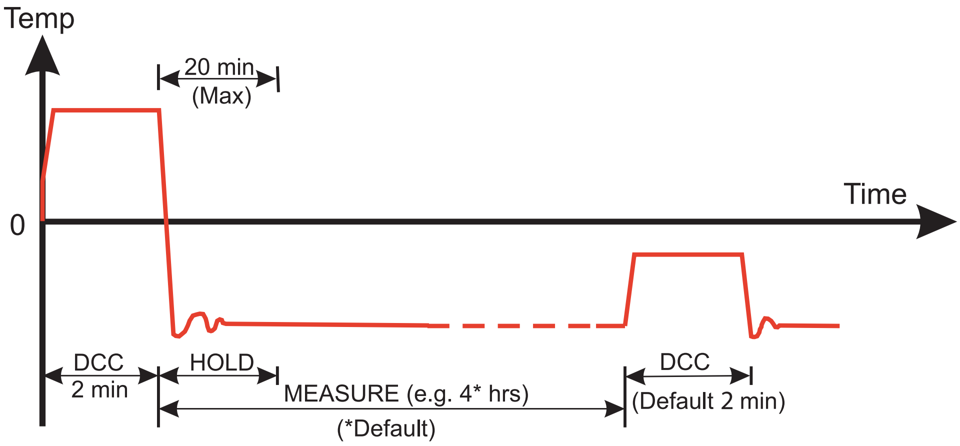


Figure 29 *Typical Operating Cycle*

At initial switch-on, the instrument enters a DCC cycle for 2 minutes. This heats the mirror to a default temperature of +20 °C (+36 °F) above the previously measured value - at the time of switch on this will be ambient temperature. This ensures that all moisture is driven off the surface of the mirror.

The mirror is maintained at this temperature for the DCC duration (default 2 minutes) or 2 minutes on switch-on. During the DCC process, Data Hold fixes the analog outputs at the value(s) read before DCC commenced. Data Hold typically lasts 4 minutes from the end of a DCC cycle, or until the instrument has reached the dew point. This procedure is in place to prevent any system which is connected to the outputs from receiving a 'false' reading.

After the DCC period has finished, the measurement (**MEASURE**) period commences, during which the control system decreases the mirror temperature until it reaches the dew point. The sensor will take a short amount of time to settle on the dew point. The length of this stabilization time depends upon the temperature of the dew point. When the measurement is stable the Status area of the display will indicate **CONTROL**.

The end of a DCC cycle re-sets the interval counter, meaning that another DCC will start (by default) in 4 hours time. Once the measurement is stable, **HOLD** will release, and the analog outputs will resume their normal operation. At this point the **STATUS** area of the display will change to **MEASURE**.

3.5 Operating Guide

3.5.1 DCC – Dynamic Contamination Control

Dynamic Contamination Control (**DCC**) is a system designed to compensate for the loss of measurement accuracy which results from mirror surface contamination.

During the **DCC** process the mirror is heated to a default temperature of 20 °C above the dew point to remove the condensation which has formed during measurement. The surface finish of this mirror, with the contamination which remains, is used by the optics as a reference point for further measurements. This ensures the accuracy of the instrument is unaffected by any loss of reflectivity due to wear or contamination of the mirror.

After switch-on, the mirror is assumed to be clean, therefore the instrument will only run a **DCC** for 2 minutes to quickly establish a clean mirror reference point. By default, every subsequent **DCC** is 4 minutes in duration and will automatically occur every 4 hours.

At certain times it may be desirable to disable the **DCC** function in order to prevent it from interrupting a measurement cycle, e.g. during a calibration run. However, the DCC functionality is important to the continued accuracy and stability of the instrument and should not be permanently disabled.

A manual **DCC** can be initiated or cancelled by touching the **DCC** button on the Main Screen. The DCC button is context sensitive, i.e. if **DCC** is on, the Main Screen shows **DCC OFF** as being selectable. Similarly if **DCC** is off, **DCC ON** is shown.

It is possible to change the parameters relating to the **DCC** cycle on the **DCC** Setup Screen (see Section 3.2.6).

3.5.2 MAXCOOL Function

The **MAXCOOL** function over-rides the dew-point control loop and applies maximum cooling drive to the Peltier heat pump. It can be used to determine:

- the lowest temperature the mirror can be driven down to with reference to the sensor body. This temperature is indicated on the display.
- whether or not the instrument is controlling at the dew point and whether it is able to reach it. This situation could, for instance, arise when attempting to measure very low dew points where, possibly due to a high ambient temperature, the Peltier heat pump is unable to depress the mirror temperature low enough to reach the dew point.
- whether the instrument is controlling by switching **MAXCOOL** on for a short period and then switching back to **MEASURE.** This will depress the mirror temperature briefly and when it is switched back to **MEASURE** the control loop should be able to stabilize the mirror temperature at the dew point again.

The **MAXCOOL** function can be turned on by touching the **MAXCOOL** button on the Main Screen.

3.5.3 Pressure Compensation

As an option, the S8000 instrument can be fitted with an internal pressure sensor that measures the sample gas pressure. The pressure measured by this sensor is then used internally as the basis for compensation for all of the pressure related parameters, ppm_V, ppm_W, g/m^3 and g/kg. If a pressure transducer is not fitted 101.3 kPa is used as the basis of all these calculations. The internal pressure transducer is ranged 0 to 25 bara (0 to 363 psia).

3.5.4 Data Logging

The data logging function allows all of the measured parameters to be logged at a user specified interval on the supplied SD card via the SD card slot on the front of the instrument. The filename for each log file is generated automatically from the instrument date and time.

Log files are saved in CSV (comma separated value) format. This allows them to be imported easily into Excel or other programs for charting and trend analysis. To set-up data logging, refer to Section 3.2.7.

3.5.5 Frost Assurance System Technology (FAST)

Theoretically, it is possible for water to exist as a super-cooled liquid at temperatures down to -40 °C (-40 °F).

A gas in equilibrium with ice is capable of supporting a greater quantity of water vapor at a given temperature than a gas in equilibrium with liquid water. This means that a measurement below 0 °C taken over water will read approximately 10% lower than the same measurement taken over ice.

When turned on and **FAST** is enabled, the S8000 makes an initial dew point measurement. If the initial measurement is between 0 °C and -40 °C then the mirror is driven down to below -40 °C to ensure the formation of ice on the mirror surface. The instrument then continues operation as normal – once ice has formed it will remain as ice until the temperature is raised above 0 °C (+32 °F).

If required, the instrument's **FAST** function can be switched on and off. To enable or disable the **FAST** function, refer to Section 3.2.6.

3.5.6 STANDBY Mode

This function is used for applications where the dew point of the sample gas changes very quickly from dry to wet, creating conditions which may cause the sensor to saturate. Alternatively it may be used in applications requiring infrequent manual measurements to be taken, where it is preferable to have the sensor disabled between measurements.

In **STANDBY** mode, drive to the Peltier heat pump is removed. While **STANDBY** mode is enabled the sensor temperature will remain constant.

The main use for this feature is during set up (when measurements are not required), i.e. when flow rates are being adjusted and the analog outputs are being configured.

3.5.7 Flood Recovery

If the sensor has detected that a flooding event has occurred, the following steps will be taken to recover the measurement:

1. The mirror temperature will be increased and, after the mirror surface has been cleared of condensate, a DCC will be initiated.
2. The instrument will indicate flood recovery is active by displaying **Flood** as the mode in the operational status display.
3. Once a DCC cycle has been completed, normal measurement will resume.

4 APPLICATION SOFTWARE

Application software which can be used for remote monitoring and data logging is available on the Michell Instruments website. A help file is included within the software for guidance on operation.

5 MAINTENANCE

There are no user-serviceable parts on the S8000, other than the removal and replacement of the AC power supply fuse and cleaning the mirror in the sensor.

5.1 Safety

This equipment operates from power supply voltages that can be lethal and at pressures (depending upon application) that could cause injury.

Ensure that any test installation meets the standards described in Section 2 of this manual.

Under NO circumstances should the instrument case be removed or the air vents covered or in any way restricted.

Maintenance and repair, other than that described in this section, must only be carried out by trained personnel and the instrument should be returned to the manufacturer for this purpose.

5.2 Fuse Replacement

If the instrument fails to operate after it has been connected to an AC power supply (85... 264 V AC, 47/63 Hz) and switched on, proceed as follows:

NOTE: Fuse replacement should be carried out by qualified personnel.

1. If the power supply cable is fitted with a fused plug, switch off the power supply, remove the plug, check and, if necessary, replace the fuse. Follow steps 2 to 6 (see *Figure 30).*

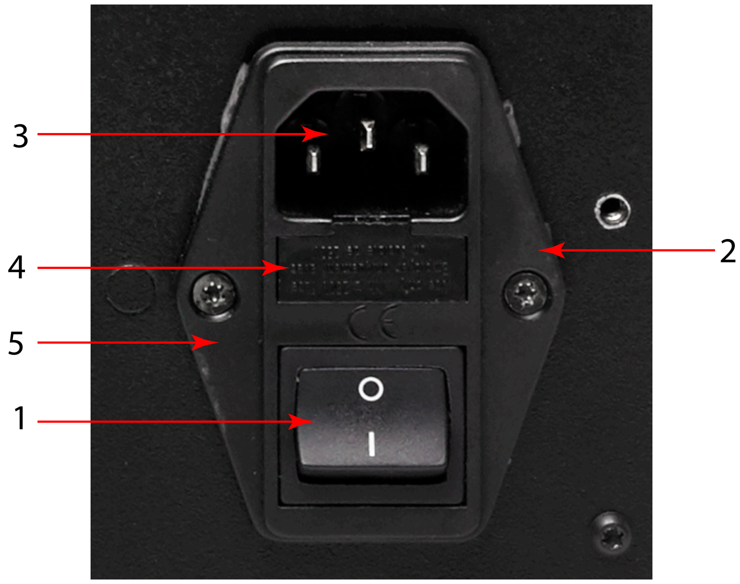


Figure 30 *Power Supply Fuse Replacement*

2. Switch the unit off, isolate the external power supply and remove the IEC power connector (2) from the power socket (3).
3. Pull out the fuse carrier (4) from the connector housing (5). A small screwdriver inserted under the lip may be useful in order to lever it out.
4. Replace the fuse cartridge. **NOTE: It is essential that a fuse of the correct type and rating is fitted to the instrument (20 mm, T-type (2.5 A anti-surge).**
5. Fit a new fuse cartridge into the fuse carrier (4) and push the fuse carrier (4) back into the power connector housing (5).
6. Push the IEC power connector (2) back into the power socket (3), turn on the external power supply and switch on the instrument (1). Check that the instrument is now operational. If the fuse blows immediately on switch-on, either contact the manufacturer or their service agent. **DO NOT ATTEMPT ANY FURTHER SERVICING PROCEDURES.**

5.3 Sensor Mirror Cleaning

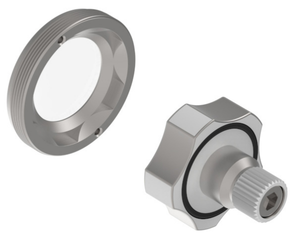
WARNING
Before removing the safety strap or opening the sensor housing it is essential to vent the system to atmospheric pressure, otherwise severe injury or damage to the equipment could result.

Throughout the life of the instrument, periodic cleaning of the mirror surface and optics window may be required. The frequency of this depends upon operating conditions and the potential in the application for contaminants to be deposited on the mirror. Sensor cleaning is mandatory if the instrument indicates an optics fault. The cleaning procedure is as follows:

Figure 31 *Sensor Mirror Cleaning*

The cleaning procedure is as follows:

1. Switch off the instrument and unscrew the blanking plug from the stainless steel sensor cover (1) on the front of the instrument.
2. Remove unscrew the large stainless steel cover (2).
3. Carefully remove the optics block (3) to reveal the mirror window (4).
4. Insert the blanking plug (1) into the mirror window (4) to remove it.



5. Clean the mirror surface and optics window with a cotton bud/Q-Tip soaked in distilled water. If the sensor has been exposed to oil based contamination then use one of the following solvents: methanol, ethanol, or isopropyl alcohol. To avoid damage to the mirror surface do not press too firmly on the cotton bud/Q-Tip when cleaning. Allow enough time for the cleaning solvent to fully evaporate before reassembly.

6. Replace the items in the reverse order. Make sure when refitting the optics block to align the gold contacts on the block with the gold contacts on the instrument.

7. Replace the large stainless steel cover, screwing it in firmly but taking care not to overtighten it.

5.3.1 Releasing the Optics Window

If the optics window is too tight to unscrew by hand (with the blanking plug) then use the Allen key supplied to loosen.

Figure 32 *Releasing Optics Window*

WARNING
Never use the Allen key to tighten the optics window as this may result in permanent damage to the instrument.

5.3.2 Fitting the Microscope (Optional)

To observe the frost formation on the chilled mirror surface, an optional microscope (Part No. S8K-RS-MCI) can be provided. The microscope allows direct viewing of the mirror surface, providing assurance that ice crystals have formed and that supercooled water is not present at temperatures below 0 °C.

When the instrument is controlling at a dew point, condensation is seen as small, bright red specks against a dark background. Liquid water is seen as rounded droplets and ice as sharp edged crystals.

1. Remove the blanking plug and screw the microscope unit into the sensor cap until about 6 threads remain showing.

Figure 33 *Fitting the Microscope*

2. If the instrument is not operating, switch it **ON** and rotate the microscope body until the mirror surface is brought into sharp focus. Two or three extra turns either way are usually sufficient.
3. To prevent stray light effects, always replace the blanking plug after removing the microscope.

6 GOOD MEASUREMENT PRACTICE

The S8000 is designed to operate in a flowing gas stream. The sampling chamber, which enables a small sample of gas to be passed over a Peltier chilled, plated copper mirror, is designed to operate at pressures up to 1 barg (14.5 psig) (low pressure version), and up to 20 barg (290 psig) max (high pressure version). For many applications, or when the internal sample pump is in use, the sample chamber operates at atmospheric pressure with the sample gas being exhausted to atmosphere.

The sensor is designed for operation with flow rates of 0.3 and 1 Nl/min (0.6 and 2.1 scfh), although it will operate successfully at flow rates as low as 0.1 Nl/min (0.2 scfh). It is important to ensure that the flow rate through the sample line, connecting the source to the S8000, is high enough to avoid log time lags in response to humidity changes at the sample source.

Ideally, therefore, the flow rate should be set between 0.5 and 1.0 Nl/min (1.0 and 2.1 scfh), 1.6 Nl/min (1.6 scfh) [±0.2 Nl/min (±0.4 scfh) being the recommended optimum].

Unless the optional sample pump is fitted, flow regulation is not provided within the S8000 instrument. Gas flow must therefore be regulated outside the instrument, typically on the **GAS IN** side for atmospheric measurements, by means of a precision needle valve. Always use high quality valve gear, coupling connections and pipework.

Avoid pressure gradients in the system by placing excessive flow restriction on the **GAS OUT** side of the system. In applications where the test gas has a very high flow rate, an instrument by-pass arrangement is preferable to a flow restrictor after the sensor.

6.1 Sampling Hints

Ensuring reliable and accurate moisture measurements requires the correct sampling techniques, and a basic understanding of how water vapor behaves. This section aims to explain the common mistakes and how to avoid them.

Sampling Materials – Permeation and Diffusion

All materials are permeable to water vapor since water molecules are extremely small compared to the structure of solids, even including the crystalline structure of metals. The graph above demonstrates this effect by showing the increase in dew point temperature seen when passing very dry gas through tubing of different materials, where the exterior of the tubing is in the ambient environment.

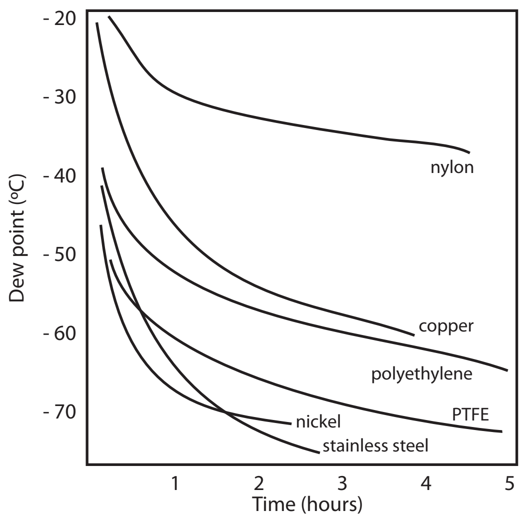


Figure 34 *Material Permeability Comparison*

What this demonstrates is the dramatic effect that different tubing materials have on the humidity levels of a gas passed through them. Many materials contain moisture as part of their structure and when these are used as tubing for a dry gas the gas will absorb some of the moisture. Always avoid using organic materials (e.g. rubber), materials containing salts and anything which has small pores which can easily trap moisture (e.g. nylon).

As well as trapping moisture, porous sampling materials will also allow moisture vapour to ingress into the sample line from outside. This effect is called diffusion and occurs when the partial water vapour pressure exerted on the outside of a sample tube is higher than on the inside. Remember that water molecules are very small so in this case the term 'porous' applies to materials that would be considered impermeable in an everyday sense – such as polyethylene or PTFE. Stainless steel and other metals can be considered as practically impermeable and it is surface finish of pipework that becomes the dominant factor. Electropolished stainless steel gives the best results over the shortest time period.

Take into consideration the gas you are measuring, and then choose materials appropriate to the results you need. The effects of diffusion or moisture trapped in materials are more significant when measuring very dry gases than when measuring a sample with a high level of humidity.

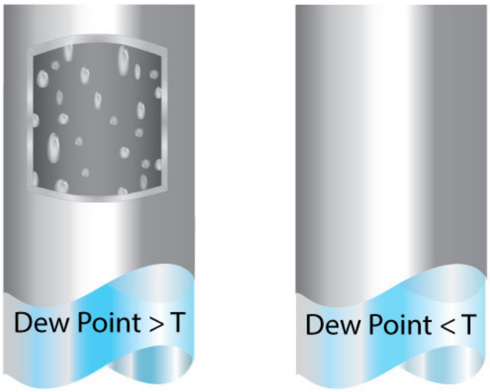
Temperature and Pressure effects

As the temperature or pressure of the environment fluctuates, water molecules are adsorbed and desorbed from the internal surfaces of the sample tubing, causing small fluctuations in the measured dew point.

Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid to the surface of a material, creating a film. The rate of adsorption is increased at higher pressures and lower temperatures.

Desorption is the release of a substance from or through the surface of a material. In constant environmental conditions, an adsorbed substance will remain on a surface almost indefinitely. However, as the temperature rises, so does the likelihood of desorption occurring.

Ensuring the temperature of the sampling components is kept at consistent levels is important to prevent temperature fluctuation (i.e. through diurnal changes) continually varying the rates of adsorption and desorption. This effect will manifest through a measured value which increases during the day (as desorption peaks), then decreasing at night as more moisture is adsorbed into the sampling equipment.



If temperatures drop below the sample dew point, water may condense in sample tubing and affect the accuracy of measurements.

Maintaining the temperature of the sample system tubing above the dew point of the sample is vital to prevent condensation. Any condensation invalidates the sampling process as it reduces the water vapour content of the gas being measured. Condensed liquid can also alter the humidity elsewhere by dripping or running to other locations where it may re-evaporate.

Although ambient pressure does not change drastically in a single location, the gas sample pressure does need to be kept constant to avoid inconsistencies introduced by adsorption or desorption. The integrity of all connections is also an important consideration, especially when sampling low dew points at an elevated pressure. If a small leak occurs in a high-pressure line, gas will leak out, however, vortices at the leak point and a negative vapour pressure differential will also allow water vapour to contaminate the flow.

Theoretically flow rate has no direct effect on the measured moisture content, but in practice it can have unanticipated effects on response speed and accuracy. An inadequate flow rate may:

- Accentuate adsorption and desorption effects on the gas passing through the sampling system.
- Allow pockets of wet gas to remain undisturbed in a complex sampling system, which will then gradually be released into the sample flow.
- Increase the chance of contamination from back diffusion. Ambient air that is wetter than the sample can flow from the exhaust back into the system. A longer exhaust tube can help alleviate this problem.
- Slow the response of the sensor to changes in moisture content.

An excessively high flow rate can:

- Introduce back pressure, causing slower response times and unpredictable changes in dew point
- Result in a reduction in depression capabilities in chilled mirror instruments by having a cooling effect on the mirror. This is most apparent with gases that have a high thermal conductivity such as hydrogen and helium.

System design for fastest response times

The more complicated the sample system, the more areas there are for trapped moisture to hide. The key pitfalls to look out for here are the length of the sample tubing and dead volumes.

The sample point should always be as close as possible to the critical measurement point to obtain a truly representative measurement. The length of the sample line to the sensor or instrument should be as short as possible. Interconnection points and valves trap moisture, so using the simplest sampling arrangement possible will reduce the time it takes for the sample system to dry out when purged with dry gas.

Over a long tubing run, water will inevitably migrate into any line, and the effects of adsorption and desorption will become more apparent.

Dead volumes (areas which are not in a direct flow path) in sample lines, hold onto water molecules which are slowly released into the passing gas. This results in increased purge and response times, and wetter than expected readings. Hygroscopic materials in filters, valves (e.g. rubber from pressure regulators) or any other parts of the system can also trap moisture.

Plan your sampling system to ensure that the sample tap point and the measurement point are as close as possible to avoid long runs of tubing and dead volumes.

Filtration

All trace moisture measurement instruments and sensors are by their nature sensitive devices. Many processes contain dust, dirt or liquid droplets. Particulate filters are used for removing dirt, rust, scale and any other solids that may be in a sample stream. For protection against liquids, a coalescing or membrane filter should be used. The membrane provides protection from liquid droplets and can even stop flow to the analyser completely when a large slug of liquid is encountered, saving the sensor from potentially irreparable damage.

7 CALIBRATION

7.1 Traceability

The calibration of this instrument is traceable to national standards. For this reason the instrument can only be calibrated in an accredited e.g. NIST or UKAS accredited, standards laboratory.

If these facilities do not exist, the instrument must be returned to the manufacturer, Michell Instruments, or an approved agent (for contact information go to www.ProcessSensing.com).

The **DCC** function can be disabled for calibration purposes (refer to Section 3.2.6).

A calibration certificate bearing a three point calibration is issued with each instrument. If required, an option is available to add further specific calibration points. Contact Michell Instruments for further information (for details visit www.ProcessSensing.com).

MICHELL Instruments

CERTIFICATE OF CALIBRATION

The under-mentioned item has been calibrated at the following points in the Michell Instruments' Humidity Calibration Laboratory against Test Equipment traceable to the NATIONAL PHYSICAL LABORATORY, Middlesex, United Kingdom and to the NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY, Gaithersburg, Maryland, USA.

Certificate Number	54321	*Ack Number*	A32123
Test Date	6 Feb 2015	*Test Equipment*	Q0238
Instrument Serial Number	123456		
Product Type	S8000		

Generated Dewpoint °C	*Instrument Display Dewpoint °C*	*Instrument Display Correction °C*
-59.4	-59.3	-0.10
-30.6	-30.6	0.00
10.1	10.0	+0.10

Comments:
Calibration PASS. The results are within specification at the measured points.

NOTE Traceability to National Physical Laboratory is over the range -90°C to +90°C.
Traceability to National Institute of Standards and Technology is over the range -75°C to +20°C
Uncertainty of measurement:
+/- 0.20 @ +20°C DP increasing linearly to +/- 0.40 @ -60°C DP then rising linearly to +/- 0.63 @ -75°C DP
+/- 0.31 between +20°C DP and +82°C DP
The uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95 %

Approved Signatory *6 Feb 2015*

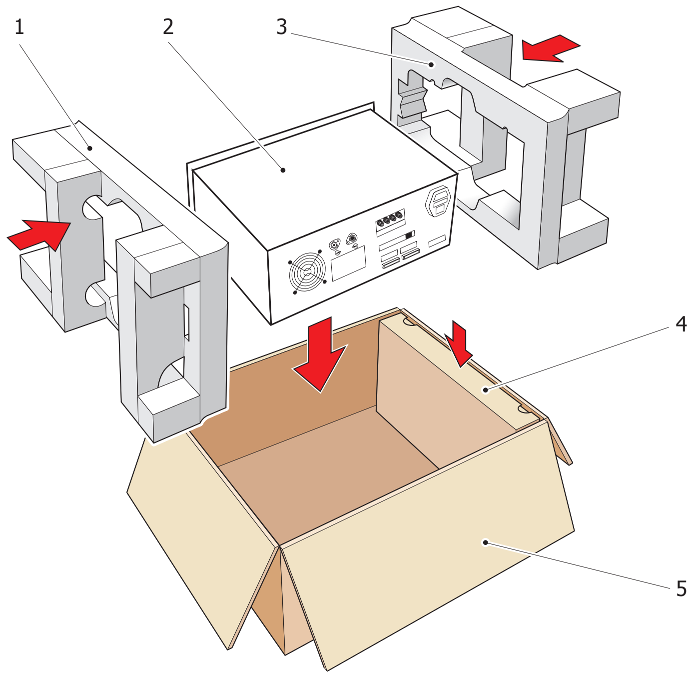
Michell Instruments Ltd.
www.michell.com

Figure 35 *Typical Calibration Certificate*

8 PREPARATION FOR SHIPPING

For shipping purposes, the instrument should be packed into its original carton, the latter providing the recommended degree of protection during transit. To prepare the instrument for shipping, proceed as follows.

1. Switch off the instrument and remove the power supply cable. If the instrument is rack mounted, first remove it from the rack, and remove the rack mount wings.
2. Remove the (optional) microscope and re-fit the blanking plug.
3. Remove the (optional) remote PRT.
4. If fitted, remove the USB communications cable.
5. Remove the analog and alarm output connectors.
6. Remove any connections to the 4-wire PRT output binding posts.
7. Remove the connections to the **GAS IN** and **GAS OUT** ports.
8. Pack the instrument in its original case as shown in *Figure 36.* **NOTE: The accessories should be packed in the box (4). Unless returning for repair, it is not necessary to return either the microscope or the analog and alarm connectors. All cables and the remote PRT probe (if supplied) should be returned for checking.**
9. Enclose a packing list detailing all equipment contained in the box and seal the box. Ideally, for extra security, the box should be banded.



1 Side packing
2 S8000 Instrument
3 Side packing
4 Accessories box
5 Carton

Figure 36 *Instrument Packing Details*

Appendix A

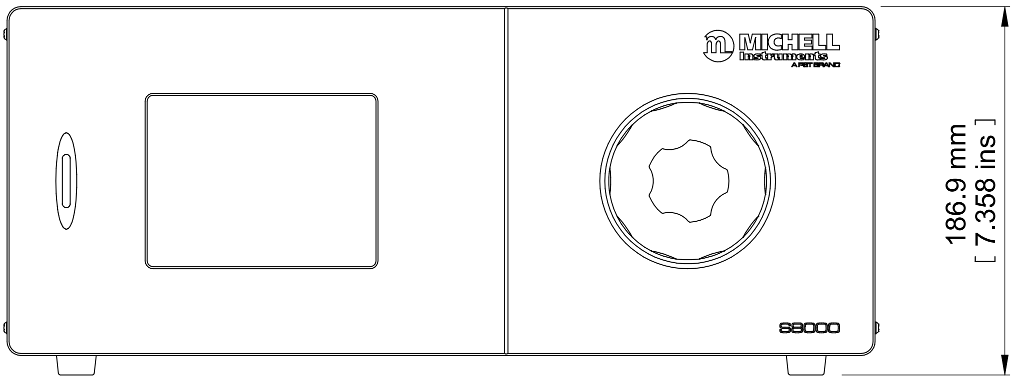
Technical Specifications

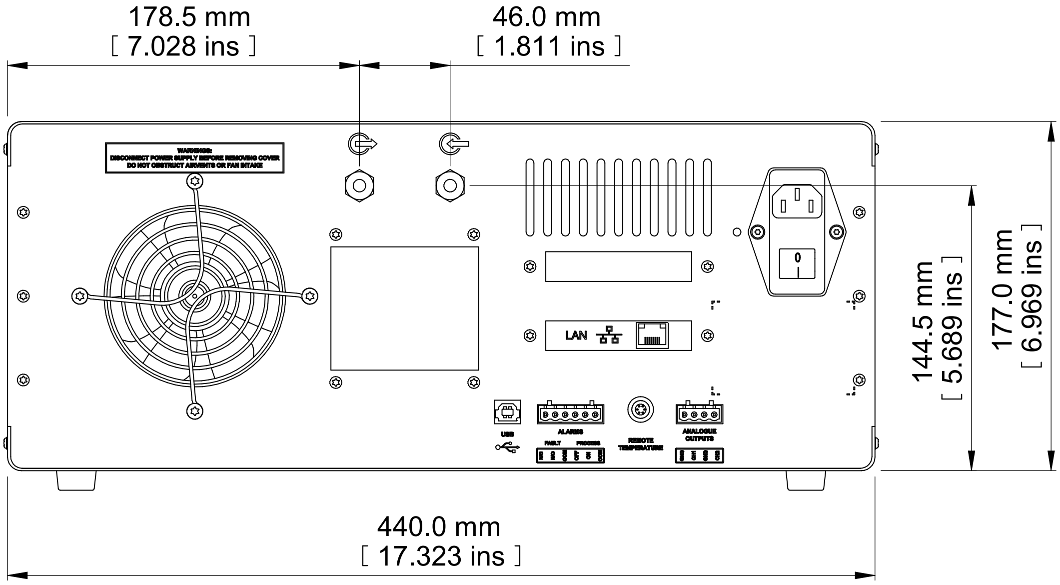
Appendix A Technical Specifications

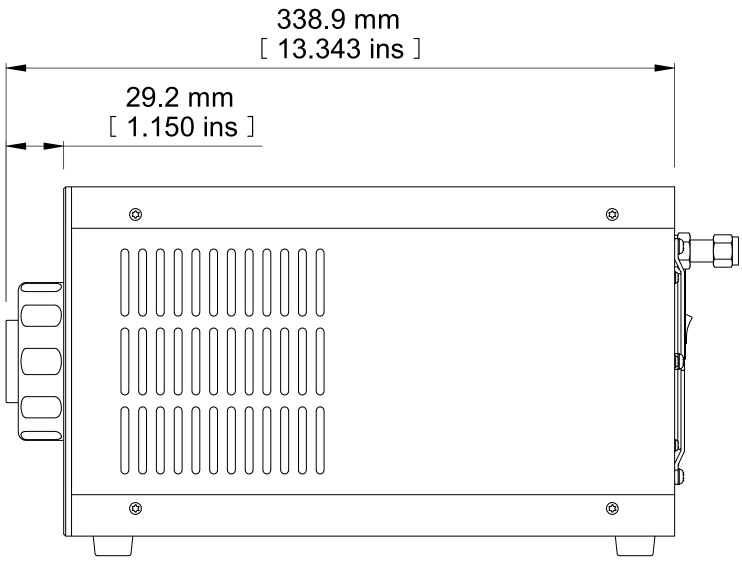
Dew-Point Sensor Performance	
Measurement Technology	Chilled Mirror
Accuracy*	±0.1 °C (±0.18 °F)
Reproducibility	±0.05 °C (±0.09 °F)
Measurement Range	-60...+40 °Cdp (-76...+104 °Fdp)
Operating Pressure **Low Pressure Version** **High Pressure Version**	 0...1 barg / 14.5 psig 0...20 barg / 290 psig
Sample Flow Rate	0.1...1 Nl/min (0.2...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	2 m (6.6’) (250 m (820’) max)
Flow Sensor	
Measurement Accuracy	Typical ±5 % uncalibrated
Measurement Range	0...1000 ml/min
Integrated Pressure Sensor (Optional)	
Measurement Range	0...25 bara (0...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** **Digital** **Alarm**	 Two channels, user-selectable 4...20 mA, 0...20 mA or 0...1 V Modbus RTU over USB or Modbus TCP over Ethernet 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-32) — 32Gb max. that allows 24 million logs or 560 days, logging at 2-second intervals
Environmental Conditions	-20...+40 °C (-4...+104 °F)
Power Supply	85...264 V AC, 47/63 Hz
Power Consumption	120 V A
EMC - Class A Emissions **Industrial Location Immunity**	Complies with EN 61326-1:2021
Mechanical Specifications	
Dimensions	187 x 440 x 343 mm (7.36 x 17.32 x 13.5”) h x w x d
Weight	12.3 kg (27.11 lb)
General	
Process Connections	6 mm Swagelok® (MALE)
Storage Temperature	-20...+50 °C (-40...+122 °F)
Calibration	3-point traceable in-house calibration as standard UKAS accredited calibrations optional – please consult Michell Instruments

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

A.1 Dimensions







Appendix B

Modbus Register Map

Appendix B Modbus Register Map

Register Types	
Type	**Description**
uint16	unsigned 16 bit value
uint32	unsigned 32 bit value over two registers Register names ending with _MS contain the upper 16 bits Register names ending with _LS contain the lower 16 bits
flags	unsigned 16 bit value where each bit represents a flag, value can be a combination of flags
float	IEEE754 binary32 compatible floating point number Register names ending with _MS contain the upper 16 bits including the sign and exponent Register names ending with _LS contain the lower 16 bits
boolean	unsigned 16 bit value with only two valid values, 0 = off/disabled/no, 1 = on/enabled/yes

Address	Access	Data Type	Register Map Definition	Max.	Min.	Default
Instrument Info						
0	R|W|F	uint16	MODBUS_ADDRESS	255	1	1
1	R	uint16	INSTRUMENT_ID	42251	42251	42251
2	R	uint32	INSTRUMENT_SERIAL_MS	4294967295	0	0
3	R		INSTRUMENT _SERIAL_LS			
4	R	uint16	INSTRUMENT_FIRMWARE_VERSION	65535	0	
			Version * 1000 (1012 = 1.012)			
5	R	uint16	REGISTER_MAP_VERSION	65535	0	
			Version * 1000 (1012 = 1.012)			
Measured and Calculated Values						
6	R	float	DEWPOINT_MS [°C/°F]	1000	-1000	N/A
7	R		DEWPOINT_LS [°C/°F]			
8	R	float	AMBIENT_TEMP_MS [°C/°F]	1000	-1000	N/A
9	R		AMBIENT_TEMP_LS [°C/°F]			
10	R	float	PRESSURE_MS [P]	1000	-1000	N/A
11	R		PRESSURE_LS [P]			
12	R	float	RH_MS	100	0	N/A
13	R		RH_LS			
14	R	float	PPMV_MS	999999.9	0	N/A
15	R		PPMV_LS			
16	R	float	PPMW_MS	999999.9	0	N/A
17	R		PPMW_LS			
18	R	float	ABSOLUTE_HUMIDITY_MS	999999.9	0	N/A
19	R		ABSOLUTE_HUMIDITY_LS			
20	R	float	MIXING_RATIO_MS	2	0	N/A
21	R		MIXING_RATIO_LS			
22	R	float	WETBULB_MS [°C/°F]	1000	-1000	N/A
23	R		WETBULB_LS [°C/°F]			
24	R	float	WVP_MS	1000	-1000	N/A
25	R		WVP_LS			
26	R	float	FLOW_MS	2000	0	N/A
27	R		FLOW_LS			
28	R	float	PERCENT_VOLUME_MS	100	0	N/A
29	R		PERCENT_VOLUME_LS			
36	R	uint16	TEMPERATURE_UNIT	1	0	0
			0 = °C 1 = °F			

Address	Access	Data Type	Register Map Definition	Max.	Min.	Default
37	R	uint16	PRESSURE_UNIT	4	0	3
			0 = PSIG 1 = PSIA 2 = BARG 3 = BARA 4 = KPA			
38	R	uint16	DECIMAL_PLACES	3	1	2
Instrument Status						
45	R	uint16	OPERATING_MODE	14	0	N/A
			0 = NO_CHANGE 1 = SYSTEM_FAILURE 2 = STANDBY 3 = MEASURE 4 = DCC 5 = HOLD 6 = FAST 7 = MAXCOOL 8 = FLOOD_RECOVER 9 = PRT_SWITCH			
46	R	uint16	MODE_HRS_LEFT	100	0	N/A
47	R	uint16	MODE_MINS_LEFT	60	0	N/A
48	R	uint16	MODE_SECS_LEFT	60	0	N/A
49	R	uint16	SENSOR_STATUS	4	0	N/A
			0 = Unknown 1 = Cooling 2 = Heating 3 = In-Control 4 = Idle			
50	R	flags	FAULT_STATUS_1	65535	0	0
			32768 = Mirror PRT failure 16384 = Ambient PRT failure 8192 = Chiller PRT failure 4096 = Sensor thermistor failure 2048 = Mirror temperature too high 1024 = Stirling emergency error 512 = Optics setpoint search failed 256 = Optics outside max. operating limit 128 = Optics outside min. operating limit 64 = Cooling saturated timeout 32 = Heating saturated timeout 16 = RESERVED 8 = Pressure input failure 4 = Optics contamination 0 = No flags (OK)			
51	R	flags	FAULT_STATUS_2	65535	0	0
			32768 = AMBIENT_PRT_OPEN_CIRCUIT 16384 = PRESSURE_INPUT_OPEN_CIRCUIT 2048 = FLASH_LOADING_FAILED 1024 = FLASH_SAVING_FAILED 0 = NO FLAGS (OK)			
			RESERVED			
53	R	flags	ALARMS_STATUS	3	0	0
			0 = No Alarm 1 = System 2 = Process			
			RESERVED			
Additional Operating Values						
55	R	uint16	LOGGING_STATUS	9	0	0

Address	Access	Data Type	Register Map Definition	Max.	Min.	Default
			0 = Not Fitted 1 = No Card 2 = Ready 3 = Logging 4 = Writing 5 = Mount Error 6 = Write Error 7 = Mounting 8 = Write Protected 9 = Unknown			
56	R	boolean	DATA_HOLD_ACTIVE	1	0	0
57	R	boolean	DISPLAY_HOLD_ACTIVE	1	0	0
58	R	uint16	PRT_MODE	1	0	0
			0 = Internal PRT Measurement 1 = External PRT Measurement			
80	R	float	FILM_THICKNESS_MS	16777215	0	N/A
81	R		FILM_THICKNESS_LS			
82	R	uint16	OPTICS_CONDITION	200	0	N/A
			200 % = double film 100 % = correct film 0 % =zero film			
83	R	int16	PELTIER_DRIVE_PERCENT	100	-100	N/A
84	R	float	CFNG_TEMP_MS [°C/°F]	80	-100	N/A
85	R		CFNG_TEMP_LS [°C/°F]			
86	R	flags	CFNG_STATUS	7	0	N/A
			0 = OK 1 = emergency alarm (chiller shutdown) 2 = input out of range alarm 4 = temperature / vibration alarm (temporary chiller shutdown)			
87	R	uint16	CFNG_MODE	1	0	N/A
			0 = Automatic setpoint 1 = Manual setpoint			
88	R	float	CFNG_SETPOINT_MS [°C/°F]	[40 °C]	[-100 °C]	N/A
89	R		CFNG_SETPOINT_LS [°C/°F]			
User Configuration – Calculation Parameters						
200	R|W|F	uint16	SET_TEMP_UNIT	1	0	0
			0 = °C 1 = °F			
201	R|W|F	uint16	SET_PRESSURE_UNIT	4	0	3
			0 = PSIG 1 = PSIA 2 = BARG 3 = BARA 4 = KPA			
202	R|W|F	float	ATMOSPHERIC_PRESSURE_MS [P]	999999.9	0	1.01325
203	R|W|F		ATMOSPHERIC_PRESSURE_LS [P]			
204	R|W|F	boolean	PRESSURE_CORRECTION_ENABLED	1	0	0
			0 = off 1 = on			
205	R|W|F	boolean	FORCE_WATER	1	0	0
			0 = off 1 = on			
206	R|W|F	boolean	RH_WMO	1	0	0
			0 = off 1 = on			
207	R|W|F	boolean	PPM_V_ON_WET	1	0	0

Address	Access	Data Type	Register Map Definition	Max.	Min.	Default
			0 = off (dry) 1 = on (wet)			
208	R|W|F	float	MOL_WEIGHT_MS	999999.9	0	28.9645
209	R|W|F		MOL_WEIGHT_LS			
User configuration – DCC/FAST						
220	R|W|F	boolean	DCC_SETPOINT_MODE	1	0	1
			0 = absolute 1 = relative			
221	R|W|F	int16	DCC_TEMPERATURE [°C/°F**]	25000	0	2000
			setpoint in degrees = value / 100			
222	R|W|F	boolean	DCC_INTERVAL_MODE	1	0	0
			0 = manual dcc's 1 = auto (timed) dcc's			
223	R|W|F	uint16	DCC_INTERVAL_MINS	65535	0	240
224	R|W|F	uint16	DCC_DURATION_MINS	65535	0	2
225	R|W|F	float	FAST_SETPOINT_MS [°C/°F]	[-2 °C]	[-22 °C]	[-3 °C]
226	R|W|F		FAST_SETPOINT_LS [°C/°F]			
227	R|W|F	boolean	FAST_ENABLE	1	0	1
			0 = disabled 1 = enabled			
			RESERVED			
229	R|W|F	uint16	STABILITY_BAND [°C/°F]	[20.0 °C]	[0.1 °C]	[0.2 °C]
			band (degrees) = value / 1000			
User configuration – Chiller						
232	R|W|F	float	CFNG_MANUAL_SETPOINT_MS [°C/°F]	[40.0 °C]	[-100.0 °C]	[0.0 °C]
233	R|W|F		CFNG_MANUAL_SETPOINT_LS [°C/°F]			
234	R|W|F	boolean	CFNG_MODE	1	0	1
			0 = Automatic setpoint 1 = Manual setpoint			
User configuration – Hold Settings						
238	R|W|F	uint16	DATA_HOLD_TIMEOUT_MINS	60	20	45
239	R|W|F	boolean	ENABLE_DATA_HOLD	1	0	1
			0 = disabled 1 = enabled			
User configuration – Temperature Sensor						
240	R|W|F	boolean	AMBIENT_SENSOR_SOURCE	1	0	0
			0 = External 1 = Manual			
241	R|W|F	float	MANUAL_AMBIENT_MS [°C/°F]	[150.0 °C]	[-60.0 °C]	[23.0 °C]
242	R|W|F		MANUAL_AMBIENT_LS [°C/°F]			
User configuration – Pressure Sensor						
			RESERVED			
			RESERVED			
			RESERVED			
			RESERVED			
User configuration – Analog Output Settings						
270	R|W|F	uint16	ANALOG_1_TYPE	2	0	1
			0 = 0-20mA 1 = 4-20mA 2 = 0-1V			
271	R|W|F	uint16	ANALOG_1_PARAMETER	9	0	0

Address	Access	Data Type	Register Map Definition	Max.	Min.	Default
			0 = Dewpoint 1 = Temperature 2 = Pressure 3 = %rh 4 = Water content: ppm_V 5 = Water content: ppm_W 6 = Mixing ratio 7 = Absolute humidity 8 = Wetbulb 9 = Water vapour pressure 10 = Water content: percent volume 11 = Flow			
272	R|W|F	float	ANALOG_1_RANGE_LOW_MS	1999999.9	-300	-50
273	R|W|F		ANALOG_1_RANGE_LOW_LS			
274	R|W|F	float	ANALOG_1_RANGE_HIGH_MS	1999999.9	-300	50
275	R|W|F		ANALOG_1_RANGE_HIGH_LS			
276	R|W|F	uint16	ANALOG_1_ALARM_SOURCE	3	0	0
			0 = None 1 = System 2 = Process 3 = System & Process			
			RESERVED			
279	R|W|F	uint16	ANALOG_2_TYPE	2	0	1
			0 = 0-20mA 1 = 4-20mA 2 = 0-1V			
280	R|W|F	uint16	ANALOG_2_PARAMETER	9	0	1
			0 = Dewpoint 1 = Temperature 2 = Pressure 3 = %rh 4 = Water content: ppm_V 5 = Water content: ppm_W 6 = Mixing ratio 7 = Absolute humidity 8 = Wetbulb 9 = Water vapour pressure 10 = Water content: percent volume 11 = Flow			
281	R|W|F	float	ANALOG_2_RANGE_LOW_MS	1999999.9	-300	0
282	R|W|F		ANALOG_2_RANGE_LOW_LS			
283	R|W|F	float	ANALOG_2_RANGE_HIGH_MS	1999999.9	-300	100
284	R|W|F		ANALOG_2_RANGE_HIGH_LS			
285	R|W|F	uint16	ANALOG_2_ALARM_SOURCE	3	0	0
			0 = None 1 = System 2 = Process 3 = System & Process			
User configuration – Process Alarm Settings						
290	R|W|F	uint16	PROCESS_ALARM_PARAMETER	11	0	0
			0 = Dewpoint 1 = Temperature 2 = Pressure 3 = %rh 4 = Water content: ppm_V 5 = Water content: ppm_W 6 = Mixing ratio 7 = Absolute humidity 8 = Wetbulb 9 = Water vapour pressure 10 = Water content: percent volume 11 = Flow			

Address	Access	Data Type	Register Map Definition	Max.	Min.	Default
291	R|W|F	uint16	PROCESS_ALARM_TYPE	4	0	1
			0 = Off 1 = Over setpoint 2 = Under setpoint 3 = Inside band 4 = Outside band			
292	R|W|F	float	PROCESS_ALARM_HYSTER_MS	300	0	0.2
293	R|W|F		PROCESS_ALARM_HYSTER_LS			
294	R|W|F	float	PROCESS_ALARM_SETPOINT_A_MS	1999999.9	-300	-10
295	R|W|F		PROCESS_ALARM_SETPOINT_A_LS			
296	R|W|F	float	PROCESS_ALARM_SETPOINT_B_MS	1999999.9	-300	0
297	R|W|F		PROCESS_ALARM_SETPOINT_B_LS			
298	R|W|F	boolean	PROCESS_ALARM_OPTICS	1	0	0
			0 = Off 1 = Optics warning activates process alarm			
User configuration – System Alarm Settings						
301	R|W|F	boolean	NOT_MEASURE_ALARM	1	0	0
			0 = Off 1 = System alarm activated when not in measurement mode			
			RESERVED			
304	R|W|F	uint16	SET_SERIAL_TYPE	65535	0	0
			737 = Activate legacy serial comms mode (replaces Modbus)			
User configuration – Ethernet						
310	R	uint16	ETH_STATUS	2	0	0
			0 = Error / Not fitted 1 = OK 2 = Configuring			
311	R|W	uint16	ETH_IP_1	255	0	0
312	R|W	uint16	ETH_IP_2	255	0	0
313	R|W	uint16	ETH_IP_3	255	0	0
314	R|W	uint16	ETH_IP_4	255	0	0
315	R|W	uint16	ETH_SUBNET_1	255	0	0
316	R|W	uint16	ETH_SUBNET_2	255	0	0
317	R|W	uint16	ETH_SUBNET_3	255	0	0
318	R|W	uint16	ETH_SUBNET_4	255	0	0
319	R|W	uint16	ETH_GATEWAY_1	255	0	0
320	R|W	uint16	ETH_GATEWAY_2	255	0	0
321	R|W	uint16	ETH_GATEWAY_3	255	0	0
322	R|W	uint16	ETH_GATEWAY_4	255	0	0
User configuration – RTC						
330	R|W	uint16	RTC_YEAR	99	17	N/A
331	R|W	uint16	RTC_MONTH	12	1	N/A
332	R|W	uint16	RTC_DAY	31	1	N/A
333	R|W	uint16	RTC_HOURS	24	0	N/A
334	R|W	uint16	RTC_MINUTES	59	0	N/A
User configuration – Display Parameters						
0	R|W|F	uint16	LANGUAGE	9	0	0

Address	Access	Data Type	Register Map Definition	Max.	Min.	Default
			0 = English 1 = German 2 = Spanish 3 = French 4 = Italian 5 = Portuguese 6 = USA 7 = Russian 8 = Japanese 9 = Chinese			
336	R|W|F	uint16	DECIMAL_PLACES	3	1	2
337	R|W|F	boolean	ENABLE_DISPLAY_HOLD	1	0	0
			0 = Disabled 1 = Enabled			
338	R|W|F	uint16	PARAMETER_1	11	0	0
			0 = Dewpoint 1 = Temperature 2 = Pressure 3 = %rh 4 = Water content: ppm_V 5 = Water content: ppm_W 6 = Mixing ratio 7 = Absolute humidity 8 = Wetbulb 9 = Water vapour pressure 10 = Water content: percent volume 11 = Flow			
339	R|W|F	uint16	PARAMETER_2	11	0	1
			as PARAMETER_1 above			
340	R|W|F	uint16	PARAMETER_3	11	0	11
			as PARAMETER_1 above			
			RESERVED			
400	R|W|F	boolean	FLOOD_DETECT_ENABLE	1	0	0
401	R|W|F	float	DP_SEARCH_TEMP_LIMIT_MS [°C only]	120	-150	-100
402	R|W|F		DP_SEARCH_TEMP_LIMIT_LS [°C only]			
410	R|W|F	uint16	PRT_MODE	1	0	0
			0 = Internal PRT Measurement 1 = External PRT Measurement			
Advanced User Debug						
800	R	uint16	OPTICS_DRIVE	65535	0	N/A
801	R	uint32	REFLECTED_READING_MS	16777215	0	N/A
802	R		REFLECTED_READING_LS			
803	R	uint32	SCATTERED_READING_MS	16777215	0	N/A
804	R		SCATTERED_READING_LS			
805	R	float	RATIO_READING_MS	100	-100	N/A
806	R		RATIO_READING_LS			
807	R	uint32	DCC_REFLECTED_MS	16777215	0	N/A
808	R		DCC_REFLECTED_LS			
809	R	uint32	DCC_SCATTERED_MS	16777215	0	N/A
810	R		DCC_SCATTERED_LS			
811	R	float	DCC_RATIO_MS	100	-100	N/A
812	R		DCC_RATIO_LS			
813	R	uint32	CLEAN_REFLECTED_MS	16777215	0	N/A
814	R		CLEAN_REFLECTED_LS			
815	R	uint32	CLEAN_SCATTERED_MS	16777215	0	N/A
816	R		CLEAN_SCATTERED_LS			
817	R	uint16	CLEAN_DRIVE_LEVEL	65535	0	N/A

Address	Access	Data Type	Register Map Definition	Max.	Min.	Default
User configuration – Feature Unlock						
900	R	uint32	SECURITY_CODE_MS	4294967295	0	~
901	R		SECURITY_CODE_LS			
902	W	uint32	FEATURE_CODE_MS	4294967295	0	N/A
903	W		FEATURE_CODE_LS			
904	R	uint16	FEATURE_FEEDBACK / RESERVED	65535	0	N/A
Instrument Control						
1000	W	uint16	SET_MODE	16	0	N/A
			1 = Standby 2 = DCC 4 = Maxcool 8 = Cancel maxcool 16 = Calibrate optics (optics reset)			
Debugging / Live Calibration – Ethernet						
2770	R	uint16	REG_ETH_DEBUG_CODE	0	0	N/A
			0 = OK 1 = IDLE 2 = CONFIGURING 3 = FAIL_CONFIG_TIMEOUT 4 = FAIL_CONFIG_RESPONSE 5 = FAIL_MENU_TIMEOUT 6 = FAIL_MENU_RESPONSE 7 = FAIL_DISCARD_MENU_TIMEOUT 8 = FAIL_SETTINGS_TIMEOUT 9 = FAIL_WAIT_IP_TIMEOUT 10 = FAIL_WAIT_IP_RESPONSE 11 = FAIL_WAIT_GATEWAY_TIMEOUT 12 = FAIL_WAIT_GATEWAY_RESPONSE 13 = FAIL_WAIT_SUBNET_TIMEOUT 14 = FAIL_WAIT_SUBNET_RESPONSE 15 = FAIL_WAIT_TELNET_TIMEOUT 16 = FAIL_WAIT_TELNET_RESPONSE 17 = FAIL_WAIT_SAVE_TIMEOUT 18 = FAIL_WAIT_SAVE_RESPONSE 19 = FAIL_WAIT_SAVED_TIMEOUT 20 = FAIL_DISCARD_SAVE_TIMEOUT 21 = FAIL_GET_SETTINGS			

Appendix C

Default Values

Appendix C Default Values

The default values for the HMI Settings are as follows:

Main Page	
Top	Dew point
Middle	Temperature
Bottom	Pressure
Flow	Fixed
Outputs	
1	4...20 mA, dew point, -60...+20 °C
2	4...20 mA, ppm_V, 0...3000
3	4...20 mA, flow, 0...1000 ml
Alarm	0 °Cdp
Display	
Resolution	2 decimal places
Primary Unit	°C
Pressure unit	bara
Stability	0:01
FAST	ON
PRT Mode	Internal
Language	English
Brightness	100
DCC	
Display Hold	OFF
Period	0:02
Reset Optics	reset
Set point	Δ 30
Interval	4:00
Output Hold	0:20
Logging Interval	0:05

Appendix D

Quality, Recycling & Warranty Information

Appendix D Quality, Recycling & Warranty Information

Michell Instruments is dedicated to complying to all relevant legislation and directives. Full information can be found on our website at:

www.ProcessSensing.com/en-us/compliance

This page contains information on the following directives:

- Anti-Facilitation of Tax Evasion Policy
- ATEX Directive
- Calibration Facilities
- Conflict Minerals
- FCC Statement
- Manufacturing Quality
- Modern Slavery Statement
- Pressure Equipment Directive
- REACH
- RoHS
- WEEE
- Recycling Policy
- Warranty and Returns

This information is also available in PDF format.

Appendix E

Return Document & Decontamination Declaration

Appendix E Return Document & Decontamination Declaration

Decontamination Certificate

IMPORTANT NOTE: Please complete this form prior to this instrument, or any components, leaving your site and being returned to us, or, where applicable, prior to any work being carried out by a Michell engineer at your site.

Instrument			Serial Number	
Warranty Repair?	YES	NO	Original PO #	
Company Name			Contact Name	
Address				
Telephone #			E-mail address	
Reason for Return /Description of Fault:				

Has this equipment been exposed (internally or externally) to any of the following? Please circle (YES/NO) as applicable and provide details below		
Biohazards	YES	NO
Biological agents	YES	NO
Hazardous chemicals	YES	NO
Radioactive substances	YES	NO
Other hazards	YES	NO
Please provide details of any hazardous materials used with this equipment as indicated above (use continuation sheet if necessary)		
Your method of cleaning/decontamination		
Has the equipment been cleaned and decontaminated?	YES	NOT NECESSARY

Michell Instruments will not accept instruments that have been exposed to toxins, radio-activity or bio-hazardous materials. For most applications involving solvents, acidic, basic, flammable or toxic gases a simple purge with dry gas (dew point <-30°C) over 24 hours should be sufficient to decontaminate the unit prior to return.
Work will not be carried out on any unit that does not have a completed decontamination declaration.

Decontamination Declaration

I declare that the information above is true and complete to the best of my knowledge, and it is safe for Michell personnel to service or repair the returned instrument.

Name (Print)		Position	
Signature		Date	

MICHELL Instruments

F0121, Issue 2, December 2011

NOTES: