



OptiCal Humidity and Temperature Calibrator User's Manual



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OptiCal

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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 is 85 to 264 V AC, 47/63 Hz.

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. Refer to www.michell.com for details of Michell Instruments' worldwide offices contact information.

Calibration

The OptiCal contains a high precision Optidew chilled mirror hygrometer. In order to maintain full traceability the complete OptiCal instrument should be returned annually for a service and calibration to the manufacturer, Michell Instruments, or one of their accredited service agents.

Safety Conformity

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

Abbreviations

The following abbreviations are used in this manual:

°C	degrees Celsius
°F	degrees Fahrenheit
AC	alternating current
DC	direct current
cm ³	cubic centimeters
gkg ⁻¹	grams per kilogram
gm ⁻³	grams per cubic meter
Hz	Hertz
in	inch(es)
in ³	cubic inches
kg	kilogram
lbs	pounds
mA	milli Ampere
max	maximum
min	minimum
mm	millimeter
N/C	normally closed
N/O	normally open
%	percentage
RH	relative humidity
RS232	serial data transmission standard
T	temperature
USB	Universal Serial Bus
V	Volts

Warnings

The following general warning listed below is applicable to this instrument. It is 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.

1 INTRODUCTION

1.1 Description

The Michell OptiCal is a stable and accurate calibration solution for humidity sensors over the 10 to 90%RH and +10 to +50°C (+50 to +122°F) range. The stand-alone, 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 five interchangeable ports to accommodate virtually any brand, type or model of sensor. The environment within the insulated calibration chamber is temperature controlled using a four-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. Response time to a humidity or temperature step change is typically quicker than ten 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 desiccant changes color to indicate when it needs to be recharged, and is visible through a clear window on the front of the unit. Recharge the desiccant following the instructions in Section 2.4. 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 (refer to Section 2.2). Apart from periodic calibration of the chilled mirror reference, no other maintenance is necessary. The only external service required is a single phase power supply.

1.2 System Components

1.2.1 Front Panel

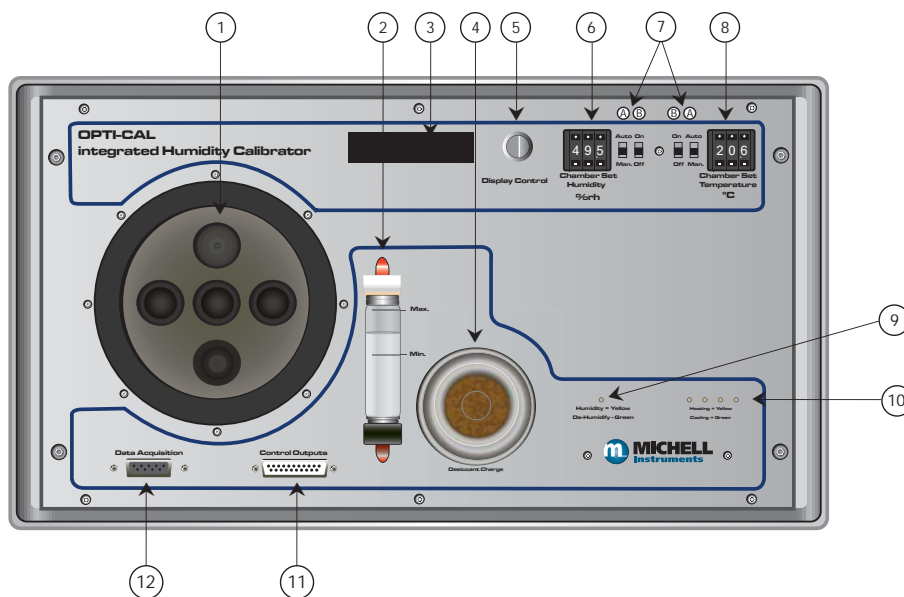


Figure 1 *OptiCal - Front View*

1. Chamber door
2. Water reservoir
3. Optidew chilled mirror reference VFD display
4. Desiccant cell and indicator window
5. Display control
6. Relative humidity set point (%RH)
7. **A** Manual/auto switches for relative humidity / temperature control
MAN - Front panel switches control relative humidity / temperature set points
AUTO - Remote RS232 / OptiSoft controls relative humidity / temperature set points (see Section 3.4)
8. Temperature set-point (°C)
9. Humidity control indication LED
 Humidify (yellow)
 De-humidify (green)
10. 4-Zone chamber temperature control indication LEDs
 Heating (yellow)
 Cooling (green)
11. Control outputs
12. RS232 digital communications connector

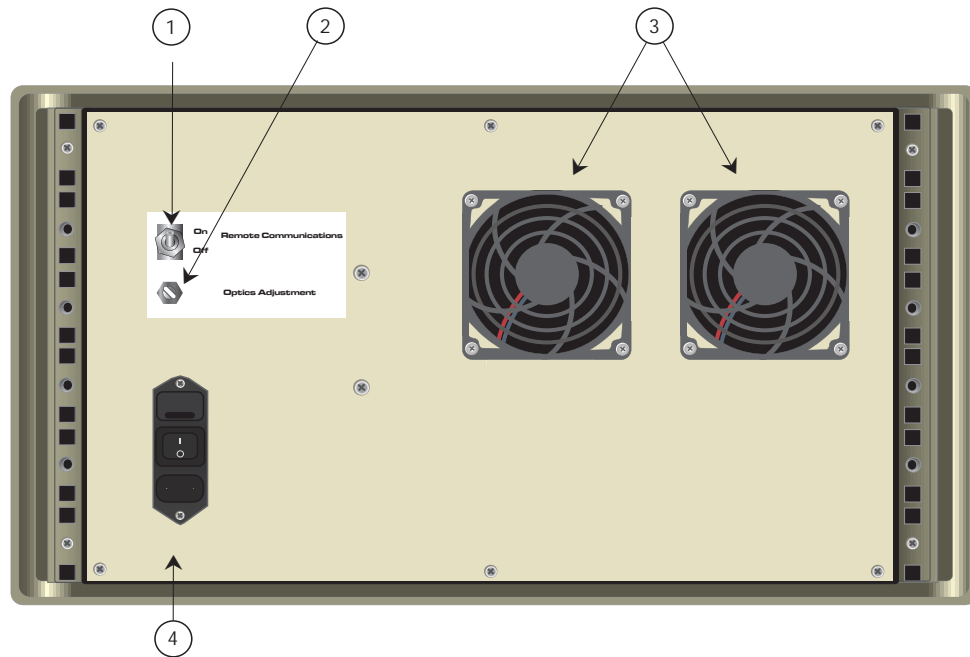
Back Panel

Figure 2 *OptiCal - Back Panel*

1. Remote Communications Switch to enable remote chamber control
2. Optidew chilled mirror reference optics adjustment potentiometer (refer to Section 4.2)
3. Ventilation fans
4. Electrical mains connector, on/off switch and power input fuse

Accessories

The OptiCal humidity and temperature generator is delivered with the following standard accessories:

- Bottle of distilled water
- Desiccant cell filled with indicating silica gel
- HT961T00 control probe + temperature probe
- Chamber door (according to customer specification)
- IEC mains cord set
- Calibration certificate for internal reference probe
- Certificate of conformity (graph)
- User's manual
- RS232 cable
- Application software
- Calibration certificate for Optidew chilled mirror reference instrument

2 INSTALLATION



Before using the OptiCal make sure that Sections 2.1, 2.2 and 2.4 are read thoroughly.

The OptiCal enclosure is designed for bench top mounting in a laboratory type environment. It must be positioned in a clean and level location with sufficient clearance at the rear of the enclosure for adequate ventilation.



The OptiCal is not designed to be fully portable. However, it can easily be moved to any suitable location for use. Before moving, ensure that any water in the reservoir is drained and that the RH control probe and the temperature probe in the chamber are removed.

The OptiCal should NOT be moved while in operation.

2.1 Installing the Relative Humidity and Temperature Control Probes

The relative humidity control probe and the Pt100 temperature probe are both supplied as accessories with the OptiCal, and are removed during transportation.

To install the probes, remove the chamber door and plug in the probes as shown in *Figure 3*.

This internal RH control probe is delivered with its own calibration certificate.

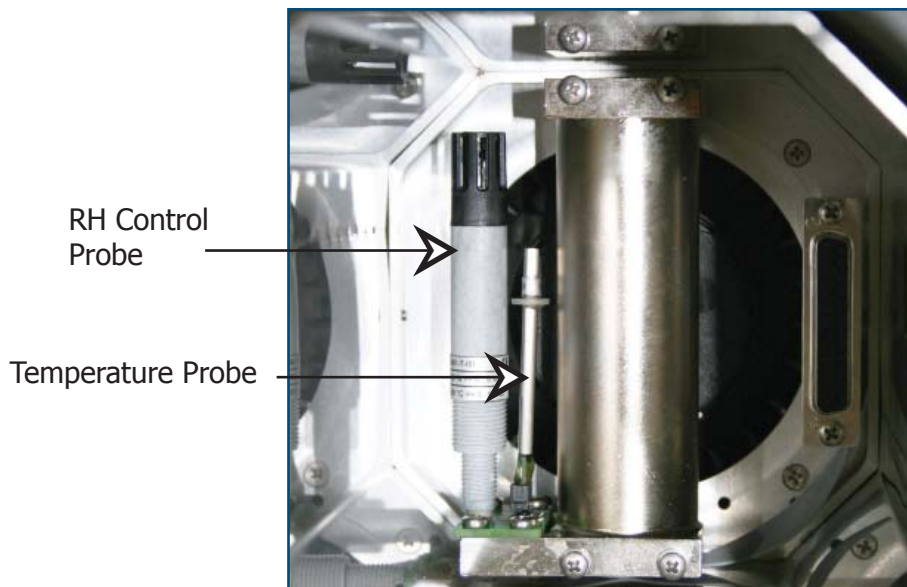


Figure 3 Probe Installation



The RH control probe and the temperature probe must always be removed during transportation.

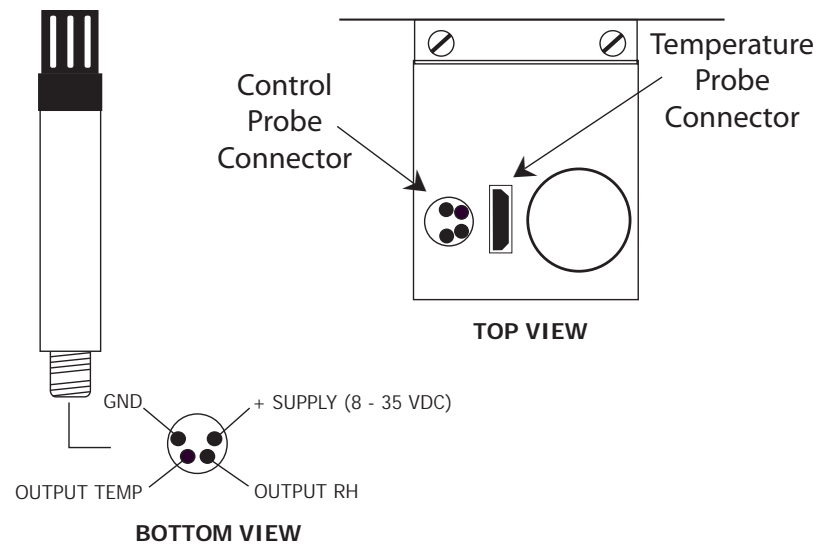


Figure 4 *Location of Probes Inside the Climate Chamber*

2.2 Filling the Water Reservoir

Before operation the water reservoir located on the front panel must be filled with distilled water (supplied with the instrument).



Do not use tap water or demineralized water!



Figure 5 *Filling the Water Reservoir*

Use the filter bottle supplied to fill the water reservoir.

1. Remove the red plastic cap from the top of the reservoir.
2. Carefully fill with clean distilled water to a level between the two indicator lines.
3. Replace the red cap on the water reservoir after filling.



Do NOT fill above the MAX indicated line as this may cause liquid to enter the humidity chamber and adversely affect the control process.

2.3 Draining the Water Reservoir

Drain the water reservoir before transporting, or if the system is accidentally overfilled.

To empty the water reservoir:

1. Remove the red caps from the bottom and top of the water reservoir.
2. Drain the water into a suitable container.
3. Tilt the OptiCal to empty it completely.
4. Re-fit the red cap after emptying.



Figure 6 *Emptying the Water Reservoir*



It is essential to drain the water reservoir before transporting or when the system is not going to be used for a few weeks.

Do not re-use any of the drained water within the system.

2.4 Desiccant

The OptiCal has a container filled with a desiccant which is used to dry the chamber air.



Figure 7 *Desiccant Replacement*

The desiccant container can be accessed by following these steps:

1. Remove the clear plastic screw cap on the front panel.
2. Pull out the desiccant container using finger tips.
3. Fill with desiccant up to the tapered thread as shown below.



Figure 8 *Level of Silica Gel Required*

The natural color of the desiccant (dry silica gel) should be orange. As moisture is absorbed the color will gradually change to transparent.

When the desiccant has become transparent, this is an indication that the instrument's ability to generate low humidity is reduced. It is recommended that the silica gel is replaced or regenerated at this time.

The silica gel can be regenerated by emptying it completely from the desiccant chamber and drying it in an oven for approximately 3 hours at a temperature between 130°C (266°F) and 160°C (320°F). After drying it in an oven, allow the silica gel to cool before refilling the desiccant chamber and refitting the chamber into the generator. Ensure that the screw lid is correctly fitted.

Frequency of desiccant regeneration or replacement is dependant entirely upon the length of time in operation. Typically, given a normal calibration profile and operation cycle, the OptiCal can continually generate accurate and stable chamber humidity for a period of several weeks before regeneration or replacement of the silica gel is necessary.

2.5 Power Supply

A single mains power supply between 85 to 264 V AC is required to operate the unit.

The power supply connection is a 3 pin IEC plug located on the rear panel of the instrument. The **ON/OFF** switch and the power input fuse are in the same location, adjacent to the power socket.

A 3-core power cable is provided, the free end of which should be wired to a suitable earthed plug or directly connected via a fused power spur. The power cable conductors are color coded according to the international convention:

Brown	L	(Live)
Blue	N	(Neutral)
Green/Yellow	E	(Earth/GND)



The instrument must be connected to an electrical earth for safety purposes.

3 OPERATION

3.1 Preparation

3.1.1 Installing Relative Humidity Instruments for Calibration

Relative humidity probes can easily be installed into the humidity chamber through the ports in the door. The amount and size of the ports are supplied per customer specification.

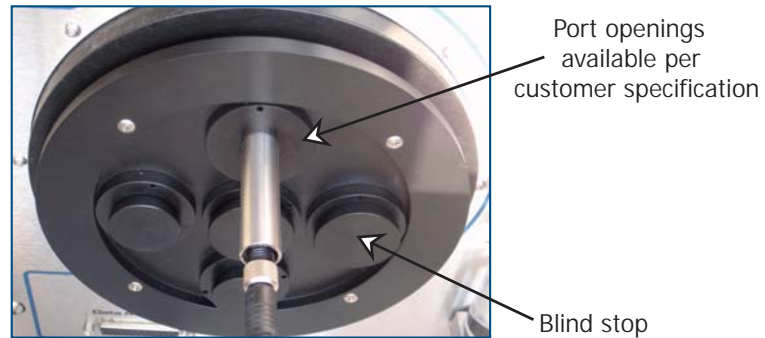


Figure 9 *Probe Ports*

NOTE: Ports which are not being used should be covered with a blind stop to exclude temperature and relative humidity influences from outside the chamber.

NOTE: If a door without ports (A000268) is used, the probes under calibration must be placed inside the measurement chamber. To ensure good air flow, do not overfill the chamber with probes.

The ports adapters can be changed using a port adapter removal tool (A000265) available from Michell Instruments.



Figure 10 *Port Adapter Removal Tool*

Insert the two pegs on the adapter tool into the corresponding holes on the port adapters and turn counter-clockwise to loosen, and clockwise to tighten.



Figure 11 *Port Adapters and Removal Tool*

3.2 Start-Up

After installing the calibration instruments, switch on the OptiCal by using the **ON/OFF** switch on the rear panel of the instrument.

3.3 Local Control of Chamber Temperature and Humidity Set Points

The desired percentage of relative humidity and temperature (in °C) can be manually set by using the humidity and temperature setting switches when the **AUTO/MAN** switches are in the **MAN** position. Humidity or temperature control can be enabled or disabled individually using the associated **ON/OFF** switch.

NOTE: Sufficient time must be allowed for the OptiCal to thermally stabilize before monitoring the humidity and temperature readings.

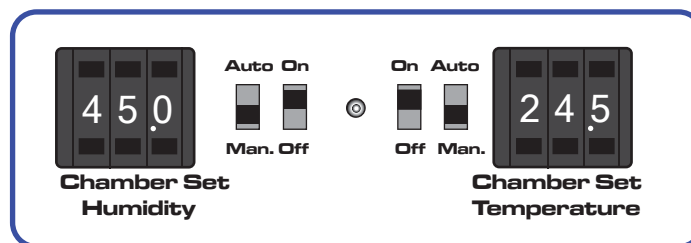


Figure 12 *Humidity and Temperature Setting Switches*

1. Put the **AUTO/MAN** switches into the **MAN** position.
2. Put the **ON/OFF** switches into the **ON** position.
3. Set the **REMOTE COMMUNICATION** switch on the back of the instrument to the **OFF** position.

3.4 Remote Control of Chamber Temperature and Humidity Set Points

To enable remote control of temperature and humidity set points follow the instructions below:

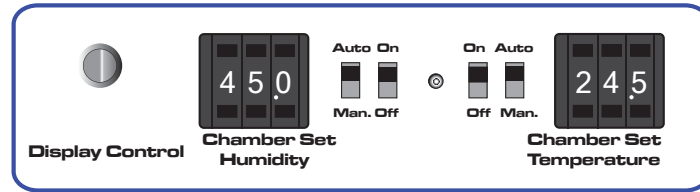


Figure 13 Humidity and Temperature Setting Switches

1. Put the **AUTO/MAN** switches into the **AUTO** position.
2. Put the **ON/OFF** switches into the **ON** position.
3. Set the **REMOTE COMMUNICATION** switch on the back of the instrument to the **ON** position.
4. Put the Optidew in **REMOTE** Mode. Refer to Section 4.1.
5. The OptiCal temperature and humidity set points can now be controlled from the OptiCal application software. Refer to Section 3.4.3 and Section 3.4.4.

NOTE: If the OptiCal is used with manual set-points, put the switches into the **MAN** position (refer to Section 3.3).

3.4.1 Digital Communications

Located on the front panel is a 9 way 'D' connector, which is used to communicate with Opti-Soft application software or with an ASCII terminal program (see Section 5).

The communication interface is RS232.

Pin number	RS232
2	Tx
3	Rx
5	GND

NOTE: To enable remote control of the chamber set points, both the front panel **AUTO/MAN** switches should be set to **AUTO** and the rear panel **REMOTE COMMUNICATIONS** switch set to **ON**. The Optidew should also be in **REMOTE** Mode. Refer to Section 3.4.2 and Section 4.1.

3.4.2 Putting the Optidew in Remote Mode

On start-up, the Optidew reference is automatically in **LOCAL** Mode. Once the display has stopped showing the start-up banner it is possible to change between the two modes by simply holding down the **DISPLAY CONTROL** button for approximately 7 seconds. In **REMOTE** Mode the display will show **REMOTE MODE**, indicating that communication with a PC via the RS232 port is possible.

3.4.3 Remote Control - Manual Set Point Control

Opti-Soft has the facility to manually control the OptiCal via the manual control window. To set the required %RH and temperature values, adjust the controls and press the **Apply** button.

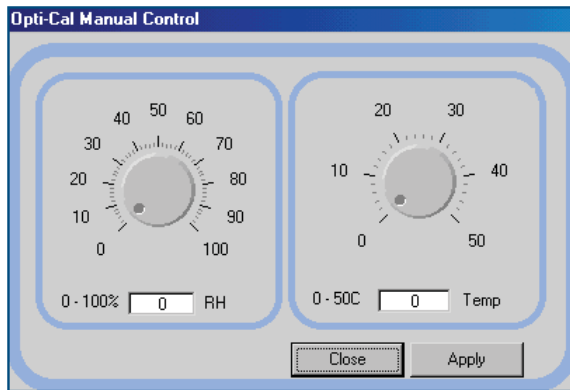


Figure 14 *OptiCal Manual Control*

3.4.4 Remote Control - Automatic Set Point Control

Opti-Soft provides a programming facility for the OptiCal, where the user can design, open and save programs with up to 10 dwell-points.

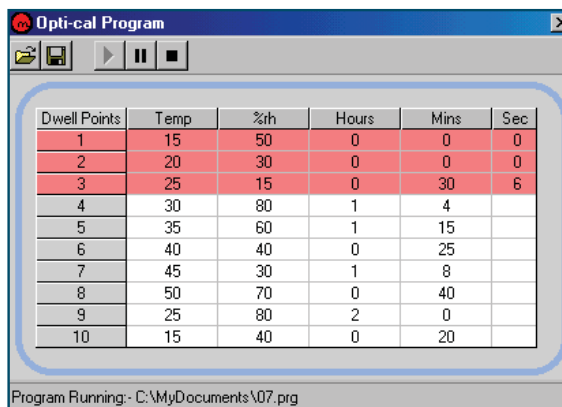


Figure 15 *OptiCal Programming*

Program progress is shown by the color change in the program table and the dwell time of the active dwell point is decremented every second to show the time remaining.

3.5 Typical Response Times for Various Step Changes

Typical response times for various step changes are shown in Table 1 below. T100 represents the total time taken to reach stability at the new set-point.

T63 and T95 values represent the time taken to reach 63% and 95% respectively of the step change in relative humidity and/or temperature. (Start temperature = 23°C / Start RH = 50%)

Temperature	°C	RH %	T63	T95	T100
Step 1	15	20	≤12	≤23	≤26
Step 2	15	50	≤2	≤3	≤5
Step 3	15	80	≤3	≤7	≤9
Step 4	25	20	≤3	≤5	≤14
Step 5	25	80	≤3	≤8	≤10

The time taken depends on the quality of the desiccant and the overall temperature of the OptiCal calibration chamber

Time in minutes

Table 1 Typical Response Times for Step Changes

The OptiCal can also be used with relative humidity generation only or with temperature generation only.

For example: If the calibration on the instruments is done and new instruments need to be inserted, both switches can be set to **OFF**. This will cause the pump to switch off in order to save energy.

If only temperature calibration is needed, humidity generation can be switched off. **NOTE: In this instance, the pumps will also stop.**

The minimum chamber temperature that can be reached is about 10°C (18°F) below ambient temperature. The maximum chamber temperature is limited to about +52°C (+125°F).

3.6 Control Outputs



Warning:
Maximum 100 mA per channel
Maximum relay voltage 30 V

Pin Number	Description
1	4-20 mA temperature output (chilled mirror)
2	0 V
3	4-20 mA %RH output (chilled mirror)
4	0 V
5	N/C
6	0-10 V temperature output (control probe)
7	0 V
8	0-10 V %RH output (control probe)
9	Chilled mirror, clean optics / alarm relay N/O
10	Chilled mirror, clean optics / alarm relay COM
11	Chilled mirror, clean optics / alarm relay N/C
12	Chilled mirror status relay N/O
13	Chilled mirror status relay COM
14	Chilled mirror status relay N/C

4 OPTIDEW REFERENCE INSTRUMENT

The OptiCal is supplied with an integrated Optidew chilled mirror reference instrument to provide a fundamental and traceable reference measurement of the humidity within the chamber, while being totally independent from the controlling relative humidity probe. The advantage of this technique is to isolate the control of the chamber from the control system of the chilled mirror sensor to provide a fast responding and highly stable system.

4.1 Optidew Display

The Optidew reference has an integral VFD (Vacuum Fluorescent Display) mounted on the front panel of the OptiCal instrument. To the right of the display is a single multi-function button which enables the user to select between the Optidew's two modes of operation and scroll through the measured and calculated parameters such as ambient temperature or relative humidity, and indications of system status. The mode can be either **LOCAL** or **REMOTE**. In **LOCAL** Mode the integral display is active and data such as temperature and relative humidity are displayed on the VFD screen. In **REMOTE** Mode the display is inactive and the RS232 output is enabled and available via the 9 pin RS232 communication connector.

Start-up banner

When power is applied to the OptiCal, the Optidew reference display will initially show test characters for approximately 0.5 seconds, after which the start-up banner will be displayed for approximately 7 seconds. The instrument will start up in **LOCAL** Mode in which case the display is active and the RS232 output is not available.

Remote Mode for communication with a PC

On start-up, the Optidew reference is automatically in **LOCAL** Mode. Once the display has stopped showing the start-up banner it is possible to change between the two modes by simply holding down the **DISPLAY CONTROL** button for approximately 7 seconds. In **REMOTE** Mode the display will show **REMOTE MODE**, indicating that communication with a PC via the RS232 port is possible.

LOCAL Mode

rh	49.9	%
t	10.0	°C

REMOTE Mode

* REMOTE MODE *

4.1.1 Selecting Which 'Screen' to View on the Display

After the start-up banner has ended, the display will show Screen 1. This displays the status of the Optidew chilled mirror reference instrument, i.e. DCC and ambient temperature. To scroll to Screen 2 - firmly but momentarily press the multifunction button. It is not possible to view any other screens until the **DATA HOLD** period is complete. Note that there may be a small delay before the display changes to the next screen - this is normal. After the **DATA HOLD** period has finished, Screen 3 will appear. All eight screens can now be accessed by depressing the multi-function button.

4.1.2 Description of Screens 1- 8

Below is a description of the parameters and system status information shown on each screen (see *Figure 16*).

Screen 1: Displays the status of the Optidew chilled mirror reference instrument

It will show **DCC**, **DATA HOLD**, **OPTICS ALARM** or **MEASURE** according to the current status of the Optidew chilled mirror reference instrument.

Screen 2: Peltier power and the Mirror condition

Peltier power indicates how much the heat pump is depressing in order to measure the dew point. When the peltier power has a value of 100% and does not reduce over an extended period of time, it means that the heat pump is at maximum depression. In normal operation this indicates that the dew point is lower than the present mirror temperature and therefore cannot be measured.

Alongside the peltier power value is an indicator that shows the control stability. When this indicator shows **CNTRL**, it indicates the system is controlling the mirror temperature on the dew point. **COOL** indicates the system is depressing the heat pump in order to form dew on the mirror surface. **HEAT** indicates a rapid increase in dew-point level, whereby the system needs to increase the temperature of the mirror surface to read this new dew-point value.

The mirror condition indicates the amount of signal received back from the mirror which includes both the level of moisture and contamination on the mirror surface. In **DCC** mode this display will only show the amount of mirror contamination and, if greater than 80% after a **DCC**, will initiate an optics alarm condition.

Screen 3: Humidity in %RH and ambient temperature

Screen 4: Humidity in dew-point and ambient temperature

Screen 5: Humidity in gkg^{-1} and ambient temperature

Screen 6: Humidity in gm^{-3} and ambient temperature

Screen 7: The first line in this screen displays $\Delta (t - t_{dp})$. This is the difference between ambient temperature and dew point. Note that this parameter will be equal to 0 if the dew point is higher than the ambient temperature (e.g. during a **DCC** cycle). The second line displays the ambient temperature.

Screen 8: The first line displays a_w which is equivalent to %RH/100. The second line displays ambient temperature.

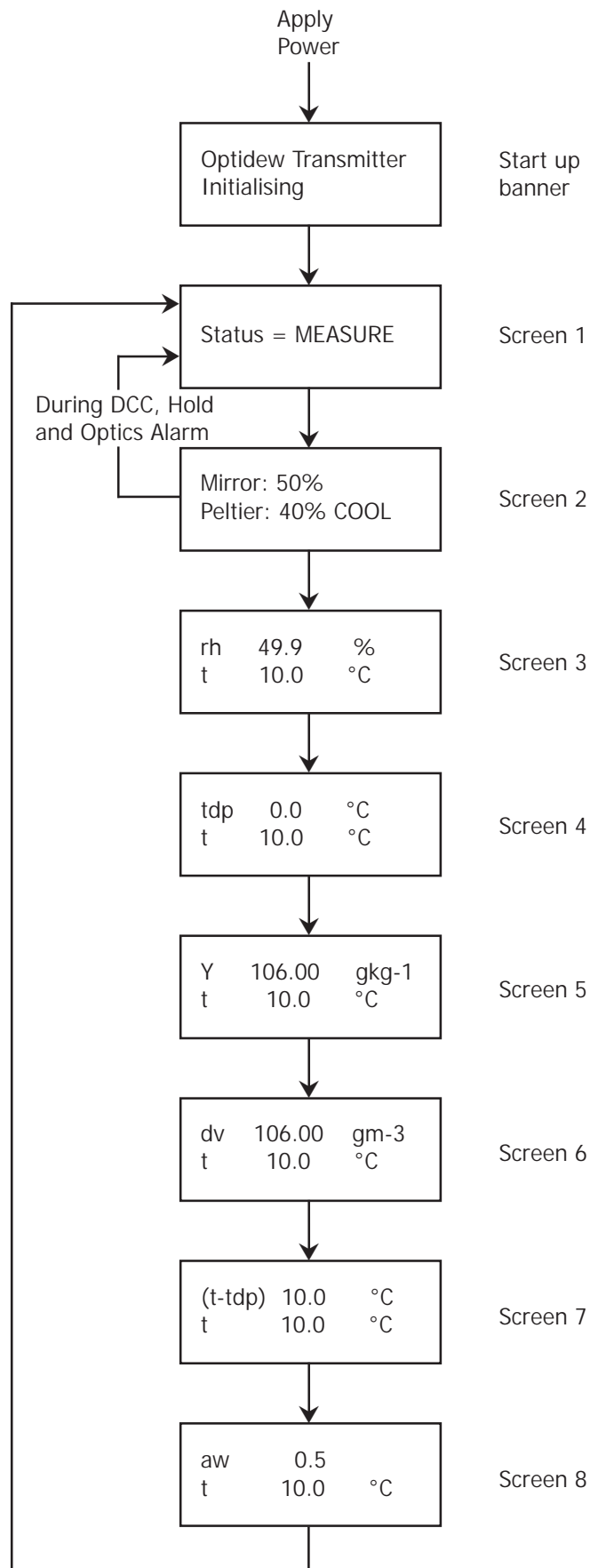


Figure 16 Optidew Chilled Mirror Reference Display and Navigation

4.2 Maintenance



Failure to follow these maintenance procedures may result in premature wear or damage to the heat pump.

4.2.1 Removing the Chilled Mirror Reference Sensor for Mirror Cleaning

1. Remove the 4 screws securing the top lid to the OptiCal.

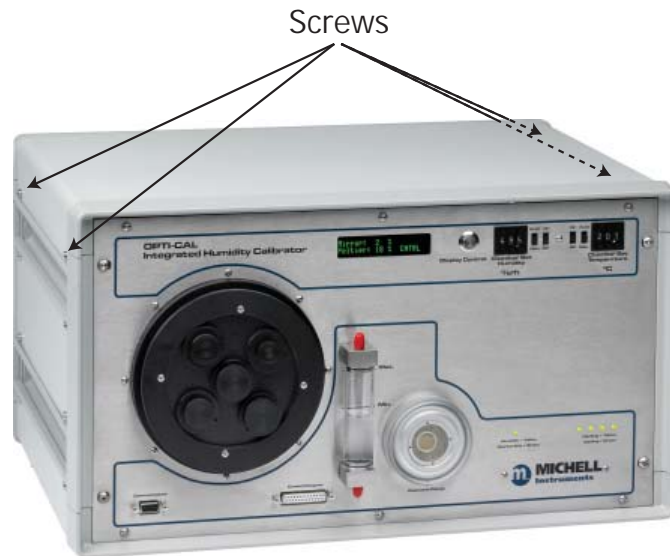
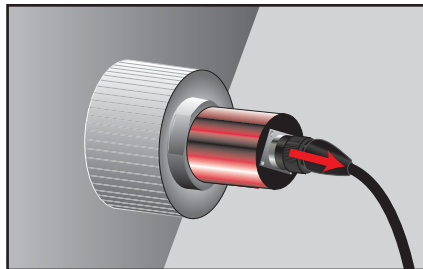
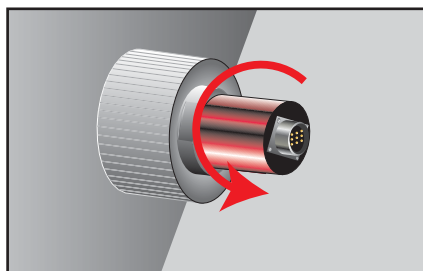


Figure 17 Lid Screw Locations

2. Disconnect the sensor cable from the Optidew sensor.



3. Unscrew the Optidew sensor from the side of the chamber.



4. Clean the sensor mirror according to the instructions in the next section.

4.2.2 Sensor Mirror Cleaning

Throughout the life of the instrument, periodic cleaning of the mirror surface and optics window may be required. Sensor cleaning is mandatory if the instrument indicates an optics fault.

The cleaning procedure is as follows:

1. Switch off the instrument and remove the sensor from its sample block.
2. 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 the cleaning solvent to fully evaporate.
3. Reset the mirror condition according to the instructions in Section 5.2.

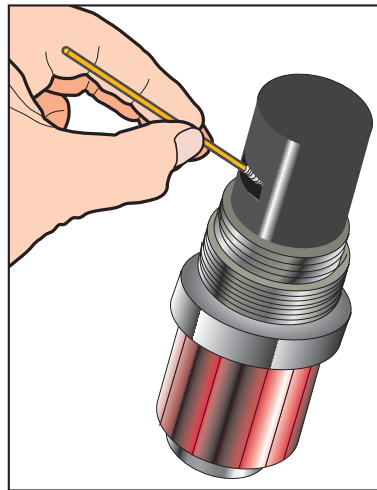


Figure 18 *Sensor Mirror Cleaning*

4.2.3 Resetting the Mirror Condition

This is an important part of the normal operation of the instrument. The mirror condition should be reset:

- after the mirror has been cleaned.
- if the mirror condition shows **LOW** or flashing 0% on the display or application software during a DCC cycle.
- if the mirror condition is greater than 10% during a DCC cycle.

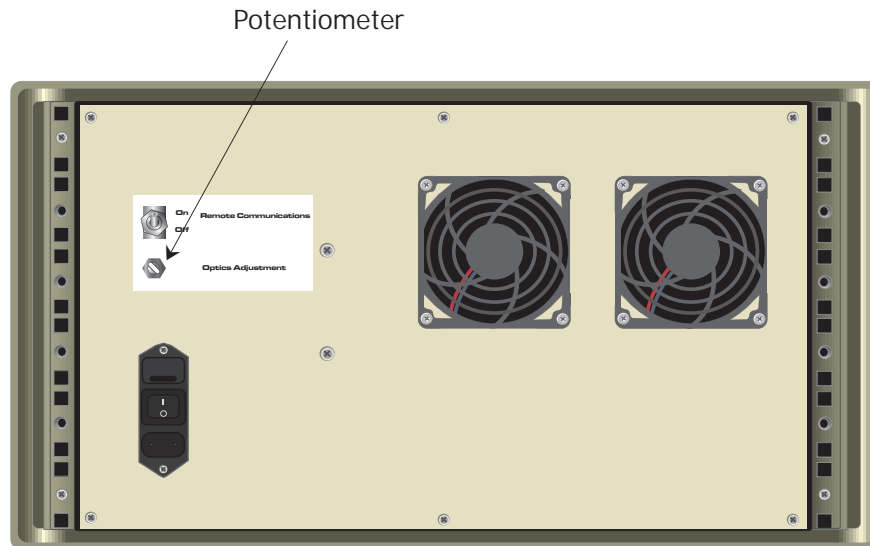


Figure 19 Potentiometer Location

Procedure (using display or application software)

NOTE: The instructions on the next page can be followed for adjustment using RS232 serial commands, if more convenient.

1. Clean the mirror according to the instructions above.
2. Cycle power to the instrument to initiate a DCC cycle.

The instrument will now be in DCC for 4 minutes – it is important that the adjustments are only made in this mode. If the instrument comes out of DCC (the status LED will no longer be illuminated), just cycle power to the instrument.

3. Observe the mirror condition on the display, or the application software.
4. Adjust the potentiometer until the mirror condition is 0 - 2%.

If the mirror condition shows **LOW** (on the display) or flashing 0% (on the application software) then it is under-range and a positive adjustment is required.

NOTE: During adjustment there will be a delay of approximately 5 seconds before the mirror condition value updates to the actual value.

5. Cycle power to the instrument.

Procedure (using RS232 serial commands)

1. Connect to the instrument using the RS232 connection.
2. Send the following commands, one after the other:

Command	Description
st	Stops all continuous output to the serial port
gofth	Continuously outputs signal mirror level, between 0 and 1023
abc	Starts a DCC cycle

The instrument will now be in DCC for 4 minutes – it is important that the adjustments are only made in this mode. During this time adjust the potentiometer until the signal level is 150 ± 10 .

If the instrument comes out of DCC (the status LED will no longer be illuminated) send the **abc** command again.

3. Once adjustment is complete, cycle power to the instrument.

4.2.4 Re-calibration of the Chilled Mirror Reference

As with all high quality measuring instruments, regular re-calibrations of the integral chilled mirror reference against a standard is recommended. This can only be achieved by exposure of the sensor to sample gases of known moisture content, while comparing readings against a calibrated reference instrument traceable to national standards. It is recommended that the entire instrument is returned to Michell Instruments on an annual basis for calibration and routine maintenance and service.

The accuracy and integrity of the Optidew reference will highlight any drift in the accuracy of the controlling %RH probe, which will be seen as a difference between the set point for %RH and temperature and the values measured by the reference instrument. When these differences become significant, then a replacement %RH probe will be required.

5 APPLICATION SOFTWARE

The application software is an interface to the OptiCal. It provides a display of the measured and calculated parameters, system status, charting and logging, statistical information and a facility to view and change the system parameters. To set up the Digital Communications refer to Section 3.4.1.

NOTE: Communication with the software is only possible when the unit is in REMOTE Mode (see Section 4.1).

5.1 Virtual Hygrometer

The **Virtual Hygrometer** window provides a display for the instrument by showing the measured parameters and status.

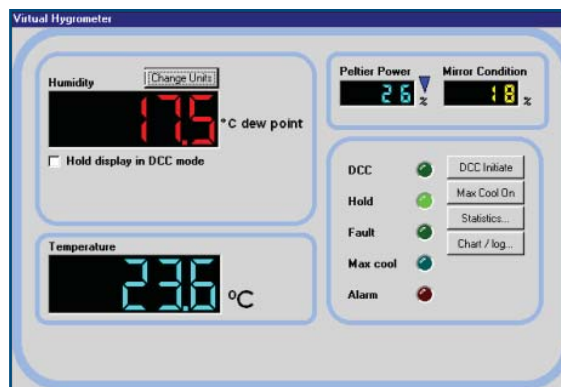


Figure 20 *Virtual Hygrometer Window*

The **Humidity** display has the ability to show dew point ($^{\circ}\text{C}/^{\circ}\text{F}$), %RH, gm^{-3} , gkg^{-1} , $\Delta(t - t_{dp})$ or a_w by clicking on the **Change Units** button. Selecting one of these options will show the measured or calculated value, but will not change the Channel 1 mA output of the instrument, as this can only be done via the Parameter Setup window (see Section 5.3). When the software is executed, it will default to the present setting of Channel 1 mA output. The ambient temperature is constantly shown in the lower display. **NOTE: The humidity display will blink if the dew point is higher than the temperature, e.g. during DCC. This is normal and not a fault.**

Mirror Condition indicates the amount of signal received back from the mirror, which includes both the level of moisture and contamination on the mirror surface. In **DCC** mode this display will only show the amount of mirror contamination and, if greater than 80% after a **DCC**, an optics alarm condition will initiate.

Instrument status is shown via the five colored indicators. In **DCC** (initiated automatically or by the **DCC Initiate** button), both the **DCC** and **Hold** indicators will illuminate showing the **DCC** status and the hold on Channel 1 mA output. When the **DCC** period ends, the **DCC** indicator will turn off leaving only the **Hold** indicator illuminated until the system enters the measurement phase. The **Fault** indicator will illuminate after a **DCC** if cleaning of the mirror surface is required. Refer to Section 4.2 for details of mirror cleaning.

The **Alarm** indicator will illuminate when the measured variable exceeds the alarm set point (if selected) (refer to Section 5.3).

Max Cool can be initiated by the **Max Cool On** button. Once initiated, the **Max Cool** indicator will illuminate and the system will drive the heat pump into maximum depression. This feature can be used to ascertain if the measured dew point is within the measurement capability of the instrument.

Clicking on the **Statistics** button allows maximum, minimum and average values of the measured parameters to be viewed. See Section 5.5.

Charting and logging of the measured values can be initiated by clicking on the **Chart/ log** button. See Section 5.4.

The **Hold display in DCC mode** check box stops the system from updating the display during **DCC**, when enabled. The display is held when **DCC** is initiated and is not updated until both **DCC** and **Hold** periods have expired.

5.2 OptiCal Remote Chamber Control

The OptiCal chamber relative humidity and temperature set points can be controlled remotely from within OptiSoft. Refer to Section 3.4.

5.3 Parameter Setup

The **Parameter Setup** window allows the setting and ranging of Channel 1 and 2 mA outputs, the duration for **DCC**, **Measurement** and **Hold**, and the values for atmospheric pressure and alarm set points.

Parameter		Options	
Display Units		Deg C	Deg F
mA Output		4-20	0-20
Channel 1	Ch1 mA Output	t _{dp}	gm ⁻³
		rh	gkg ⁻¹
		Δ(t-t _{dp})	
	Ch1 mA Max	100	rh
	Ch1 mA Min	0	rh
Channel 2	Ch2 mA Output	(Temperature only)	
	Ch2 mA Max	100	T
	Ch2 mA Min	0	T
	DCC (Duration)	60	Seconds
	Measurement (Duration)	240	Mins
	Pressure	101.3	KPa Not measured (User input only)
	Min Hold Time	240	Seconds
	Alarm Setpoint	Δ(t-t _{dp}) Temp	
		t _{dp} rh gkg ⁻¹ gm ⁻³	Off

= current instrument setting
 = change underway

Figure 21 Parameter Setup Window

The Display Units and Channel 1 mA output are selected by clicking the left hand mouse button in the relevant box. This will change the settings of both the instrument and the virtual hygrometer window. Changing the mA outputs from 4-20 mA to 0-20 mA & vice versa will change both Channel 1 & Channel 2 mA outputs.

The maximum and minimum values of Channel 1 and Channel 2 are -200 to $+1000$ respectively, therefore allowing the range of the outputs to be anywhere between these limits. The values for Max and Min must be integer values with a difference between them of at least $1^{\circ}\text{C}/\text{F}$.

If Channel 1 is to be set for %RH, gm^{-3} , gkg^{-1} , or $\Delta (t - t_{dp})$, then the minimum value of Channel 1 Min should be 0, as a negative value for these parameters is not possible.

The pressure value is used to correct gm^{-3} and gkg^{-1} for atmospheric pressure. By entering the atmospheric pressure the display and Channel 1 mA output (if either gm^{-3} or gkg^{-1} is selected) will both be corrected accordingly.

The Alarm can be set to **OFF** or set to be active on any of the process variables i.e. dew point, ambient temperature, temperature difference, %RH, gm^{-3} or gkg^{-1} as shown above. The set point needs to be an integer value between -200 and $+1000$, although negative set points are only valid for dew point and ambient temperature. If the process variable exceeds the set point, the **Alarm** indicator on the virtual hygrometer will illuminate and the Optics Fault/Alarm relay will change state.

To change any of the values, enter the required value and click on the return key. The background of the text box will change to yellow to indicate that the change is taking place. When confirmation has been received that the instrument has accepted the change, the background will change back to green.

NOTE: When the Parameter Setup window is open, the values in the Virtual Hygrometer window are frozen. The Parameter Setup window needs to be closed for the software to resume normal display mode.

5.4 Charting and Logging

Clicking on the **Chart/log** button in the **Virtual Hygrometer** window brings up the **Chart / log control panel** window.

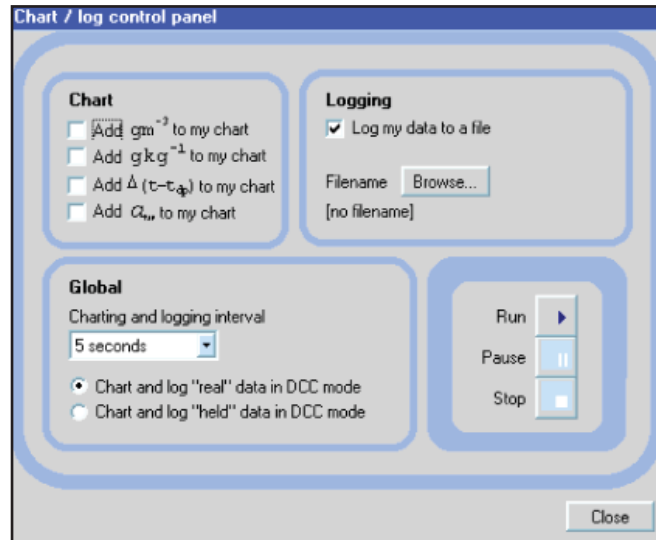


Figure 22 *Chart/Log Control Panel Window*

The chart, in its default configuration, displays dew point, temperature and %RH. However, gm^{-3} , g kg^{-1} and $\Delta(t - t_{dp})$, can be added by clicking in the appropriate check box.

Within the **Global** section, you can select the charting and logging interval from a minimum of 5 seconds to a maximum of 1 hour. It offers the facility to log the temperature of the mirror while in **DCC** and **Hold**, or hold the measured value while in these modes and chart the held data values accordingly.

To log the measured and calculated humidity values to a data file for further analysis, click on the check box in the **Logging** section and specify a file name by clicking on the **Browse** button. If a log file is not required simply uncheck the box.

To **Run**, **Pause** and **Stop** the charting and logging facility, use the chart control buttons accordingly.

Clicking on the **Run** button will bring up the chart as shown below. The chart shows the measured and calculated humidity values selected in the **Chart** section, with an assigned identifiable color for each value. It is possible to scale, zoom and scroll both X and Y axis of the chart by using the controls in the **Chart Settings** window, which can be activated by clicking on the **Chart Settings** button.

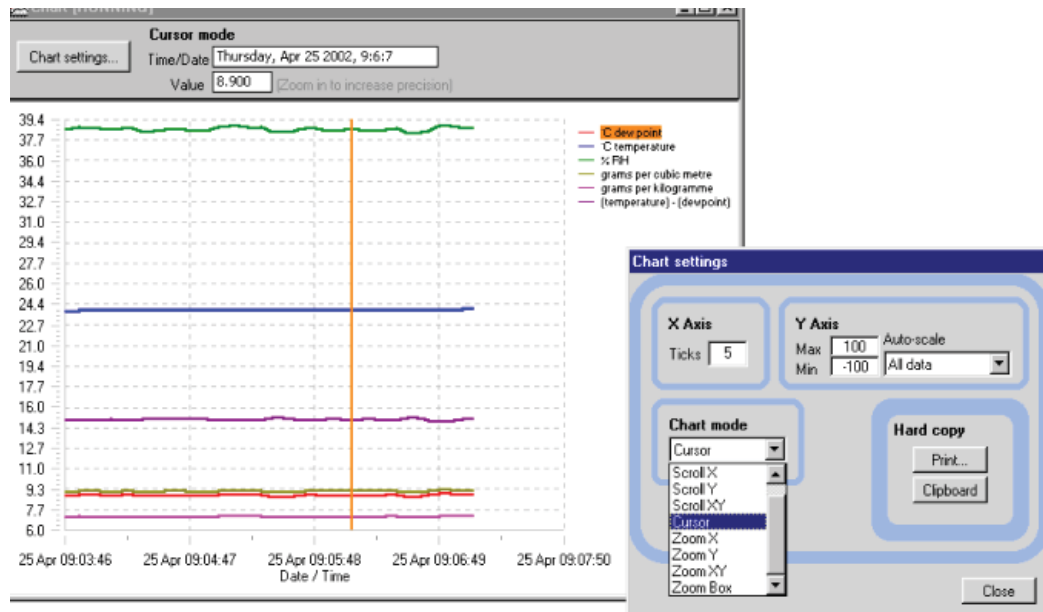


Figure 23 *Chart Window*

The X & Y axes can be individually scaled. The X-axis can be scaled by using the **ZoomX** feature in the **Chart mode** section, while the Y-axis can be scaled by changing the min and max values, or selecting a parameter in the **Auto-scale** list, which scales the Y-axis to the actual values of the parameter.

There are a number of modes associated with the chart, which can be selected from the **Chart mode** list; Plot, Scroll (X, Y, & XY), Cursor, Zoom (X, Y, & XY) and Zoom Box. In order to use the scrolling and zooming modes, make your selection and click the left mouse button on the chart itself, moving the mouse across the chart accordingly with the left mouse button held down. This will zoom or scroll the chart accordingly.

Individual data points can be selected from the chart by using the cursor mode. Select the parameter in question by clicking on a legend on the right hand side of the chart (°C dew point is shown as selected above) and moving the cursor to the point of interest - the actual value with its time stamp will be displayed above the chart.

5.5 Statistics

Clicking on the **Statistics** button on the **Virtual Hygrometer** window will display the **Basic statistics** window as shown below:

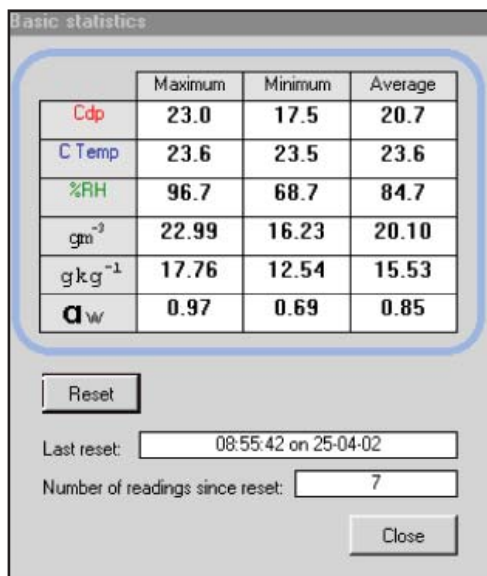


Figure 24 *Basic Statistics Window*

This window shows the maximum, minimum and average of each parameter since the program began taking readings from the instrument, or since the re-set button was pressed.

5.6 Control Parameters



The control parameters (protected by a password) should only be amended by trained personnel in order to adjust the system for operation in extreme conditions.

Contact a Michell Technical Representative for details.
(www.michell.com)

5.7 Calibration Correction

The OptiCal will be delivered with a Calibration certificate for the Optidew chilled mirror reference instrument detailing the deviation at each measurement point from a known reference value. Data provided on the Calibration certificate is normally arranged as shown in the following extracts:

Extract from a UKAS Calibration Certificate:

Generated Dew point °C	Test Hygrometer			
	Dew-point Temperature °C	Sensor Temperature °C	Correction Required °C	Expanded Uncertainty °C
-39.89	-40.11	-20	+0.22	±0.26
-20.10	-20.31	0	+0.21	±0.22
0.39	0.20	21	+0.19	±0.18

Extract from a Standard Calibration Certificate:

Generated Dew point °C	Instrument Display °C
-40.1	-40.2
-20.1	-20.1
0.2	0.1

Figure 25 Extracts From Calibration Certificates

From time to time the Optidew reference instrument may be calibrated by an external calibration agency, where similar data will be provided.

The **Calibration Correction** window is a utility that allows an authorized user to input calibration information in order to effect a real-time correction of the displayed, charted and logged data within the Opti-Soft application software.

Data for dew-point temperature and ambient temperature, both in units of °C, may be entered for correction purposes, along with the original Calibration certificate reference number and date of calibration, providing full traceability of data. Once the correction data has been applied, by clicking on the check box, the main **Virtual Hygrometer** window will indicate that corrected data is being displayed and will show the Calibration certificate number and date. This information is also saved to the **Log** file for data export.

Figure 26 shows the **Calibration Correction** window. Four sets of data may be entered:

DP Ref	Dew-point data for the reference hygrometer used to calibrate the Optidew (sometimes called the actual dew point or the standard)
DP Reading	Measured dew-point value of the Optidew under test
Temp Ref	Temperature data from the reference thermometer
Temp Reading	Measured temperature value of the Optidew under test

Data can be entered for between 3 and 11 different dew-point and temperature calibration points. If no data is inserted, no calibration correction is possible. Data should be entered with the highest dew-point and temperature values at the top of the page, in descending value order to the bottom. If out-of-sequence data or spurious characters are entered, the software will raise a warning message and bad data must be re-entered.

The **Calibration Certificate Number** field is an optional entry field and is alphanumeric. Any information entered into this field will be displayed on the main **Virtual Hygrometer** window when calibration correction is enabled. In addition it will be saved to the **Log** file. Similarly, the date of calibration may be entered for display and logging when correction is enabled.

Once all necessary data has been entered in the **Calibration Correction** window, click on the **Use Calibration Data to Correct Measure Values** check box and then click on **Apply** and **Close** to return to the main **Virtual Hygrometer** display. Upon the next update, the corrections entered will be applied to all displayed and logged data, and a legend above the display will indicate this fact. To remove **Calibration Correction**, de-select the check box and click on **Apply**, then on **Close**.

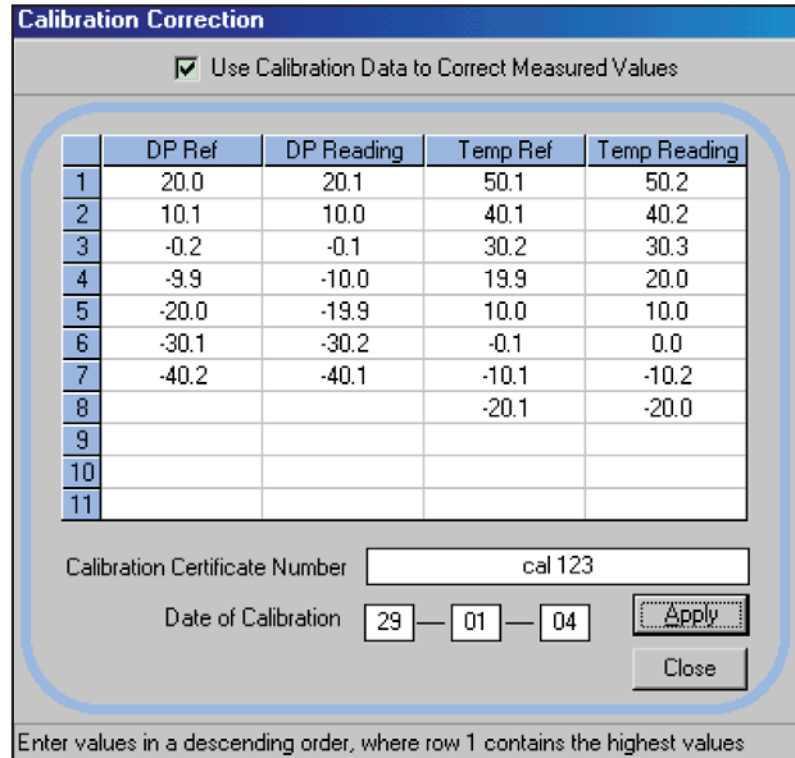


Figure 26 Calibration Correction Window

NOTE: Enter the calibration data in descending order so the highest values are in row 1 as shown above.

5.8 Change of Password

The initial password is **Michell**. This can be changed after entering the **Control and Calibration Data** windows. Selecting the **Change Password** menu item will display the following window where you can enter a new password with up to 20 alphanumeric characters. The password is not case sensitive.



Figure 27 Change Password Window

6 TROUBLESHOOTING

Problem	Possible Solution
No drying	Change desiccant Water in chamber; dry the chamber
No humidifying	Water level too low
No drying and humidifying	Switch 2 is off
No heating or cooling	Switch 3 is off
No display	Fuse on back panel
No external control	Front panel switches set to AUTO Rear panel Remote Communication switch set to ON

Appendix A

Technical Specifications

Appendix A 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) +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
Reference	
Accuracy	Dew Point: ±0.2°C Temperature: ±0.1°C
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) 500Ω Maximum Load Resistance Digital: RS232 @ 9600 baud rate Alarm: volt free contact, 30 V 100 mA max
General	
Probe Ports	Up to 5 - sensor body diameters 5 - 25mm (0.2 - 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") (w x h x d)
Instrument Dimensions	520 x 290 x 420mm (20.5 x 11.4 x 16.5") (w x h 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)

Appendix B

EC Declaration of Conformity

Appendix B EU Declaration of Conformity

EU Declaration of Conformity

Manufacturer: **Michell Instruments Limited**
48 Lancaster Way Business Park
Ely, Cambridgeshire
CB6 3NW. UK.



On behalf of the above named company, I declare that, on the date that the equipment accompanied by this declaration is placed on the market, the equipment conforms with all technical and regulatory requirements of the directives.

Opti-Cal Humidity Calibrator

and complies with all the essential requirements of the EU directives listed below.

2004/108/EC EMC Directive
2006/95/EC Low Voltage Directive (LVD)

and (effective from 20th April 2016)

2014/30/EU EMC Directive
2014/35/EU Low Voltage Directive (LVD)

(effective from 22nd July 2017)

2011/65/EU Restriction of Hazardous Substances Directive (RoHS2)

RoHS2 EU Directive 2011/65/EU (Article 3, [24]) states, "*industrial monitoring and control instruments means monitoring and control instruments designed exclusively for industrial or professional use*". (mandatory compliance effective date 22nd July 2017).

and has been designed to be in conformance with the relevant sections of the following standards or other normative documents.

EN61326-1:1997 Electrical equipment for measurement, control and laboratory use -- EMC requirements --Class B (emissions) and Industrial Locations (immunity).

EN61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

Andrew M.V. Stokes, Technical Director

April 2016

EUD OPTC Issue 02

Appendix C

Quality, Recycling & Warranty Information

Appendix C Quality, Recycling & Warranty Information

C.1 Pressure Equipment Directive (PED) 97/23/EC

The above Directive has been implemented in United Kingdom Law by the Pressure Equipment Regulations 1999.

The Regulations require that all pressure equipment and assemblies within the scope of the Pressure Equipment Directive must be safe when placed on the market or put into service.

Michell Instruments' products have been assessed and, as referenced against the Classification Charts detailed in Annex II of the Directive, do not fall into the requirements for CE marking compliance with the Pressure Equipment Directive.

Article 3, paragraph 3 states that any product containing a pressurized fluid that does not qualify for compliance should, nevertheless, be constructed with Sound Engineering Practice (SEP).

Michell Instruments attests here that its products have been designed, manufactured & tested to assure safe operation, and in accordance with Sound Engineering Practices.

C.2 Recycling Policy



Michell Instruments is concerned with the protection of the environment. It is our commitment to reduce and eliminate from our operations, wherever possible, the use of substances which may be harmful to the environment. Similarly, we are increasingly using recyclable and/or recycled material in our business and products wherever it is practical to do so.

To protect natural resources and to promote material reuse, please separate batteries from other types of waste and recycle responsibly. If batteries are not properly disposed of, these substances can cause harm to human health and the environment.

The product that you have purchased may contain recyclable and/or recycled parts and we will be happy to provide you with information on these components if required. For further information please see the following sections.

C.3 WEEE Compliance

Directive 2012/19/EU 4 July 2012 on Waste Electronic and Electrical Equipment (WEEE)

The Waste Electronic and Electrical Equipment (WEEE) Directive places rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

Michell Instruments is in full compliance with the WEEE Directive and is registered with an approved recycler (Registration No. WEE/JB0235YW) and treats the requirement of the directive and the protection of the environment with the utmost importance. All Michell Instruments' products are appropriately marked indicating their requirement for recycling.

It may be required to return certain instruments for treatment at the end of their working life.

Feb 2013

C.4 RoHS2 Compliance

Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011

The Restriction of Hazardous Substances (RoHS) Directive places rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

According to the EC Directive 2002/95/EC, Michell Instruments' products qualify as Category 9, Control and Monitoring Equipment. Under the 2002/95/EC Directive, Category 9 products are exempt from compliance with the Directive.

However, the careful design of all Michell Instruments' products takes into consideration the requirements of the Directive and, wherever possible, compliance is achieved. All future products will be developed entirely using compliant materials. Furthermore, Michell Instruments is taking active steps to remove non-compliant materials and components from existing products wherever these may occur. Presently, none of the non-compliant materials are known to occur in Michell Instruments' products.

The new Directive 2011/65/EU (RoHS2) entered into force on 21 July 2011 and required all Member States to transpose the provisions into their respective national laws by 2 January 2013.

Under the provisions of the RoHS2 EU Directive 2011/65/EU (Article 3, [24]) defines 'Control and Monitoring Equipment' specifically as 'monitoring and control instruments designed exclusively for industrial or professional use'.

RoHS2 EU Directive 2011/65/EU states the closing date for compliance of any Control and Monitoring Equipment product sold into the EU market place as 22nd July 2017.

However, the careful design policy of all Michell Instruments' products continues to attain compliance in the shortest practical timescales and strives to ensure that less than 0.1% of total mass per product, of all non-compliant materials, appear within them. Michell Instruments continues to monitor suppliers and material sources to ensure that compliance of goods provided is maintained.

January 2013

C.5 Warranty

Unless otherwise agreed, the Supplier warrants that, as from the date of delivery for a period of 12 months, the goods and all their component parts, where applicable, are free from any defects in design, workmanship, construction or materials.

The Supplier warrants that the services undertaken shall be performed using reasonable skill and care, and be of a quality conforming to generally accepted industry standards and practices.

Except as expressly stated, all warranties whether express or implied, by operation of law or otherwise, are hereby excluded in relation to the goods and services to be provided by the Supplier.

All warranty services are provided on a return to base basis. Any transportation costs for the return of a warranty claim shall reside with the Customer.

C.6 REACH Compliance

Regulation (EC) No. 1907/2006

Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Michell Instruments is a manufacturer of moisture measurement and gas analysis instrumentation and is a 'downstream' user of chemicals, as described by the EU Council Directive 76/769/EEC. The products we supply are not raw chemical products (goods).

Under normal and reasonably foreseeable circumstances of application, the goods supplied to you shall not contain or release any prohibited chemicals. No listed SVHC (Substances of Very High Concern) appear within products manufactured by Michell Instruments. Therefore the 0.1% mass per product, or total usage of 1 tonne/year, will never be exceeded. For these reasons we are neither required by obligation for registration nor for the creation of material safety data sheets (MSDS) for our products.

Our continued review of the SVHC Candidate List and latest additions is to ensure we remain compliant.

Michell Instruments maintains a hazardous material register in which MSDS data sheets are collated, and we will check that our suppliers will comply to REACH requirements for all materials and substances we use in the processes of our manufacturing.

In the unlikely event that any chemicals of concern appear in our products in quantities greater than 0.1% of total mass per product we will immediately inform you by correspondence according to the REACH Article 33 requirements. Our current appraisal is, however, that we do not expect or foresee such an incidence.

January 2013

C.7 Calibration Facilities

Michell Instruments' calibration facilities are among the most sophisticated in the world and have been recognized for their excellence.

Traceability to the National Physical Laboratory (NPL) UK is achieved through our UKAS Accreditation (Number 0179). This covers dew point over the range -90 to +90°C (-130 to +194°F) and also Relative Humidity.

Dew-point calibrations are also traceable to the National Institute for Standards & Technology (NIST) USA over the range -75 to +20°C (-103 to +68°F).

NOTE: Standard traceable calibration certificates for instruments and sensors are not issued under our UKAS accreditation. UKAS certificates are usually to special order and are clearly identified.

C.8 Return Policy

If a Michell Instruments' product malfunctions within the warranty period, the following procedure must be completed:

1. Notify a Michell Instruments' distributor, giving full details of the problem, the model variant and the serial number of the product.
2. If the nature of the problem indicates the need for factory service then the instrument should be returned to Michell Instruments, carriage prepaid, preferably in the original packaging, with a full description of the fault and the customer contact information.
3. Upon receipt, Michell Instruments will evaluate the product to determine the cause of the malfunction. Then, one of the following courses of action will be taken:
 - If the fault is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
 - If Michell Instruments determines that the fault is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs, at standard rates, will be provided. Upon receipt of the owner's approval to proceed, the product will be repaired and returned.

C.9 Manufacturing Quality

Michell Instruments is registered with the British Standards Institute for Quality Assurance to:

BS EN ISO 9001: 2008

Rigorous procedures are performed at every stage of production to ensure that the materials of construction, manufacturing, calibration and final test procedures meet the requirements laid down by our BSI approved Quality System.

Please contact Michell Instruments (www.michell.com) if the product does not arrive in perfect working order.

Appendix D

Return Document & Decontamination Declaration

Appendix D 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	



F0121, Issue 2, December 2011

NOTES:



<http://www.michell.com>