Optisure Remote Optical Hygrometer

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SAFETY

The Manufacturer has designed this product to be safe when operated correctly.

1. Please pay careful attention to the Safety Instructions outlined on this page and elsewhere in this manual. They have been designed to protect the user from personal injury and the equipment from damage.

2. Please observe the installation advice and any operational limitations given in this manual.

3. This equipment must only be used for the purpose for which it was designed.

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 85VAC to 264VAC 47Hz to 63Hz. Refer to Specification.

Pressure safety

Before pressurizing, the user must insure 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 290 psig (20 barg). When an internal sample pump is installed this is limited to atmospheric pressure. 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 C - 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.

EC Declaration of Conformity

EC Declaration of Conformity

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

CE

We declare under our sole responsibility that the product:

S8000 Remote

complies with all the essential requirements of the EC directives listed below.

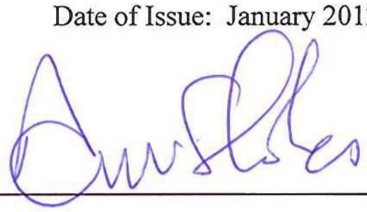
2004/108/EC	**EMC Directive**
2006/95/EC	**Low Voltage Directive (LVD)**

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

EN61326-1: 2006	Electrical equipment for measurement, control and laboratory use – EMC requirements – Group 1, Class A equipment. Emissions and Basic Immunity. IEC61000-3 & IEC61000-4
EN61010-1:2001	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

Andrew M.V. Stokes, Technical Director

Date of Issue: January 2012



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
atm	pressure unit (atmosphere)
bar	pressure unit (=100 kP or 0.987 atm)
°C	degrees Celsius
°F	degrees Fahrenheit
COM	common
DC	direct current
dp	dew point
ENT	enter (select)
EU	European Union
ft	foot (feet)
g/kg	grams per kilogram
g/m^3	grams per cubic meter
HMI	Human Machine Interface
Hz	Hertz
IEC	International Electrotechnical Commission
in	inch(es)
Nl/min	normal liters per minute
lb	pound
mA	milliampere
max	maximum
min	minute(s)
mV	millivolt(s)
N/C	normally closed
N/O	normally open
No	number
ppm_V	parts per million (by volume)
ppm_W	parts per million (by weight)
PRT	Platinum resistance thermometer (typically type Pt100)
psig	pound(s) per square inch (gauge)
rh	relative humidity
RTU	Remote Terminal Unit
scfh	standard cubic feet per hour
SD	card storage device card (memory card for storing datalog files)
sec	second(s)
temp	temperature
USB	Universal Serial Bus
V	Volts

Warnings

The following 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 Optisure Remote hygrometer is a high precision instrument used for the measurement of moisture content in air and other gases. Relative humidity and other calculated parameters based on dew point, pressure and temperature of the sample gas can also be displayed. Gases can be sampled at a maximum pressure of 290 psig (20 barg).

The Optisure Remote employs an advanced chilled mirror technique which enables it to directly measure dewpoints in the range -40 to +194°F (-40 to +90°C). Section 1.1 details the operating principle.

1.1 Operating Principle

The Optisure Remote hygrometer operates on the chilled mirror principle, whereby the sample gas is passed over a polished mirror surface - the temperature of which is controlled by a peltier heat pump.

The mirror is cooled until moisture condenses on its surface. 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 it at the dew point.

The system operates by illuminating the mirror with an LED. The light reflected back is measured by a photodetector and this amount of light is recorded as a reference point. As moisture builds up on the mirror, the level of light reflected will decrease. By comparing this signal with the reference point at any time, the system will be able to control the peltier drive circuit to either heat or cool the mirror in order to find and maintain the dew point.

The core of the mirror contains a Pt100 platinum resistance thermometer which accurately measures the mirror surface temperature - this temperature is equal to the dew point.

2 INSTALLATION

2.1 Safety

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

2.2 Unpacking the Instrument

Inside the shipping box should be the transportation case containing the OPTISURE Remote and all the accessories
listed below:

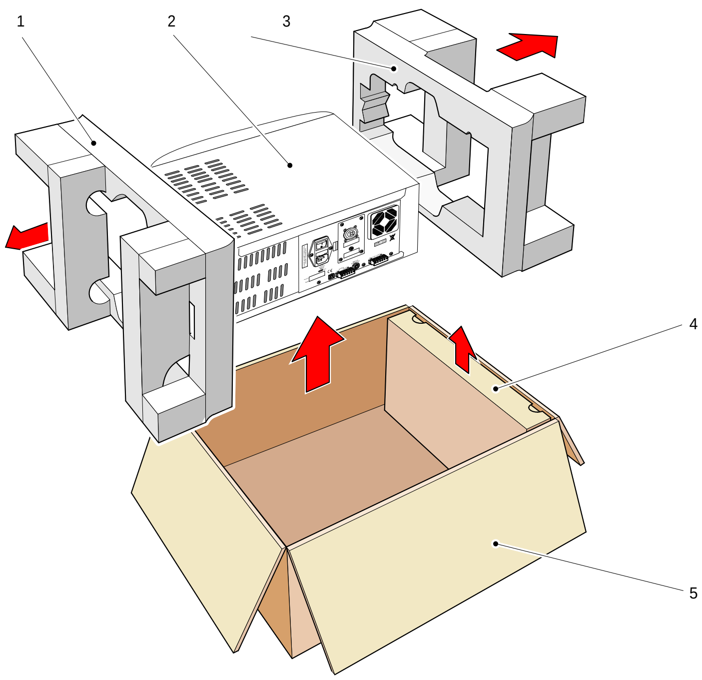


Figure 2.1 *Unpacking the Optisure Remote Hygrometer*

- Open the transportation case (5) and unpack carefully as follows. Save all the packing materials for the purpose of returning the instrument for re-calibration or any warranty claims.
- Remove the accessories box (4).
- Lift out the instrument (2) together with its end packing pieces (1) and (3).
- Remove the end packing pieces (1) and (3) set the instrument down at the site of installation.

The accessories box should contain the following items:

1. Traceable calibration certificate
2. SD memory storage card
3. Optics cleaning kit
4. USB communications cable
5. Remote Pt100 temperature probe
6. IEC power cable
7. Sensor cable
8. Application software CD
9. Screwdrivers
10. Dewpoint sensor
11. Pressure transducer and cable (optional)

If there are any shortages please notify Kahn Instruments immediately.

2.3 Operating Requirements

2.3.1 Environmental Requirements

The operational range of the Optisure Remote sensor is dependant on the temperature of the environment in which it is installed. The sensor is able to measure dewpoints down to 108°F below ambient temperature, and anywhere up to (but not including) the point of condensation. At higher ambient temperatures, the cooling ability of the sensor may be slightly reduced.

2.3.2 Electrical Requirements

The Optisure Remote requires the following electrical supply:

- 85 V to 264 V AC, 47 to 63 Hz, 100 VA max
- Alarm outputs 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, 1A. **NOTE: THIS RATING MUST NOT BE EXCEEDED.**

2.4 Conversion of Optisure Remote to Rack Mount

To convert an Optisure Remote to a rack mounted version a rack mounting kit (Optional - Part No. S8K-PKI) is required.

This conversion pack comprises two steel wings (3) and eight cap screws (1), each wing bolting to the side of the instrument with four screws as shown in *Figure 2.2*.

Figure 2.2 *Conversion of Horizontal to Rack Mount*

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

To remove the rack support wings remove the unit from the rack (if necessary) and follow the directions above, in reverse.

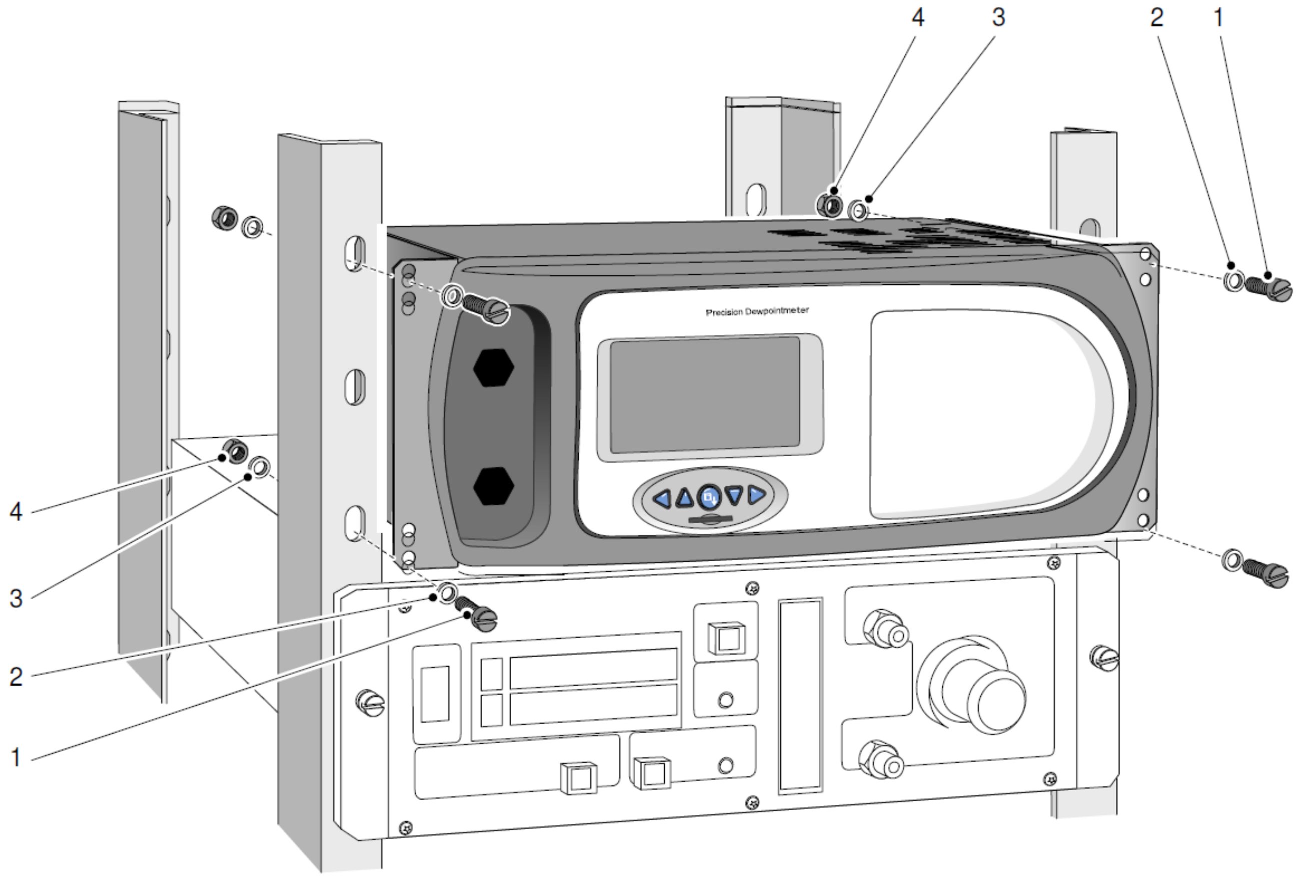


Figure 2.3 *Rack Installing Method*

1. Remove the connector blocks from the alarm and analog output sockets.
2. If necessary, remove any covers from the rack cabinet to gain access to the rear and side.
3. Connect the analog and alarm output connector blocks to the internal rack wiring (refer to Sections 2.6.2 & 2.6.3), insuring that there is sufficient free cable to permit withdrawal of the instrument from the rack.
4. Slide the instrument into the rack and support its weight while the four mounting screws are inserted.
5. Insure that the front panel of the instrument is flush and square with the front of the rack and tighten the mounting screws.
6. Insert the analog and alarm connectors into their respective sockets on the rear of the instrument (refer to Sections 2.6.2 & 2.6.3) and connect the external PRT probe and USB communications cable and connector as appropriate.
7. Connect the power supply cable and switch the ON/OFF switch to ON.
8. Reinstall any covers to the rack as necessary.

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

2.5 Exterior Layout

The controls, indicators and connectors associated with the Optisure Remote are located on the front and rear panels of the instrument.

The controls and indicators relating to the operator interface are located on the front panel. The analog outputs, USB communications port, combined power supply input socket/power on/off switch, remote sensor connector, alarms, pressure transducer connector and the trace heated line power connector are located on the rear panel.

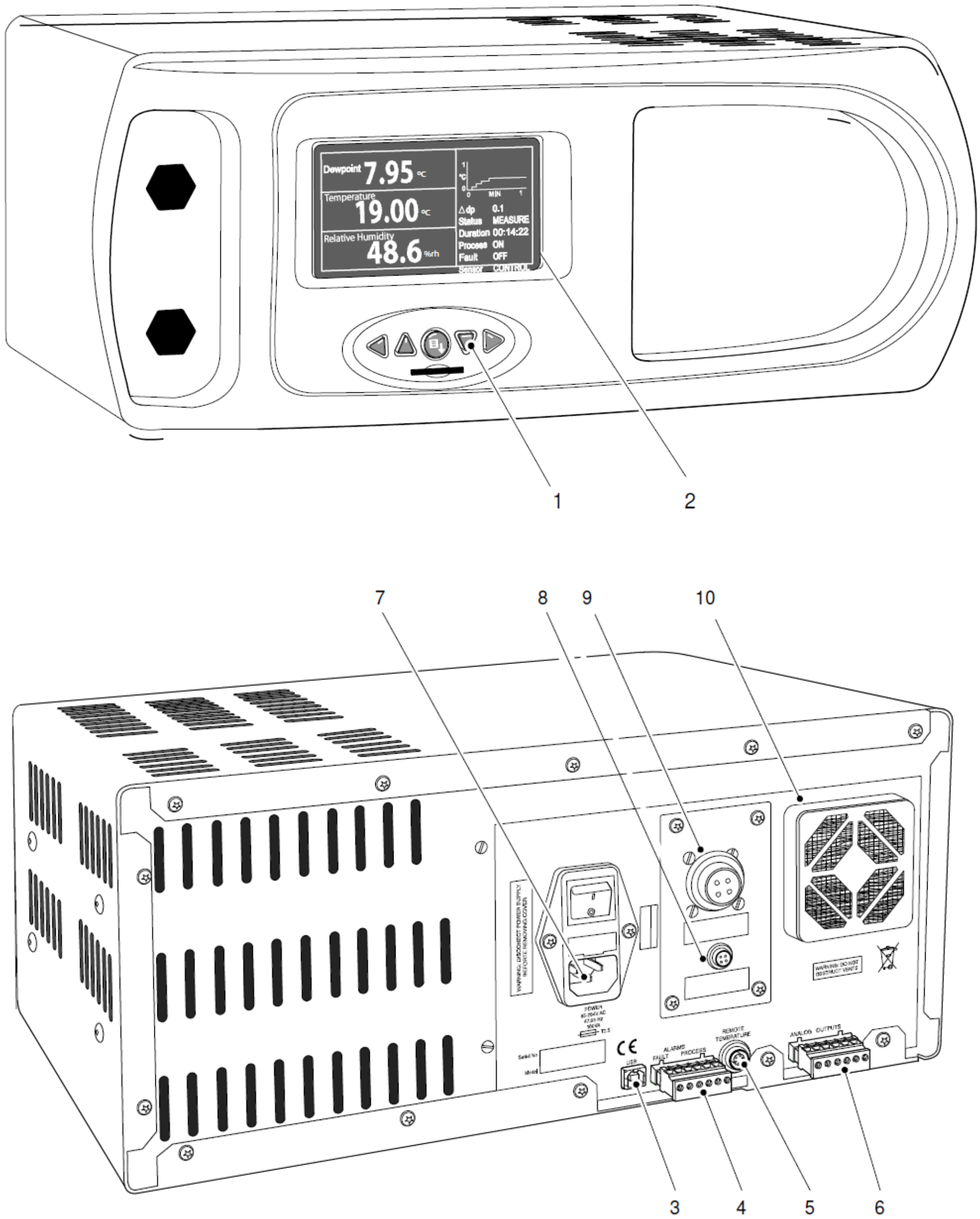


Figure 2.4 *Exterior Layout*

2.5.1 Controls and Indicators

Panel	No.	Description
Front	1	**Instrument display** - Partitioned to show 4 main panes each of which can be configured to display one of the eight available output parameters. A second area of the display shows a stability graph, and other process related data. Refer to Section 3.4.
Front	2	**Function keys** - Refer to Table 3.1 for the details of these keys.
Rear	3	**USB communications port -** Used for connection to an external computer system for running application software (optional).
Rear	4	**Alarms -** Socket for 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 2.6.3.
Rear	5	**Remote temperature probe** - Socket for remote Pt100 temperature probe - 6-pin Lemo socket.
Rear	6	**Analog output connector** - Three, 2-wire output channels, CH1, CH2 and CH3, each of which may be configured to give either a 0-20mA, or a 4-20mA current loop output or a 0 to 1000 mV voltage signal representing any one of the measured or calculated output parameters selected. Spans for each signal output are separately configurable. Refer to Section 2.6.2.
Rear	7	**IEC Power supply input socket and power on/off switch -** Contains integral power on/off switch and fuse. Universal power input 85 V to 265 V AC, 47/63 Hz, fuse, T2.5A 20x5mm slow blow.
Rear	8	**Pressure transducer connector** - Used for connecting an external pressure transducer to the instrument.
Rear	9	**Sensor connector -** Used for connecting the chilled mirror sensor to the instrument via the sensor cable.
Rear	10	Fan Filter

Table 2.1 Controls and Indicators

2.6 Back Panel Connections

These tasks should be undertaken only by competent personnel.

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 shown in *Figures 2.5* to *2.8* and should be made as follows:

2.6.1 Power Supply Input

The AC power supply is a push fit into the power input socket as shown in *Figure 2.5*. The method of connection is as follows:

1. Insure that both ends of the power cable are potential free i.e. not connected to an AC power supply.
2. Check that the ON/OFF switch (1) on the power supply connector is switched to OFF.
3. Push the IEC connector (3) firmly into the power input socket (2).
4. Connect the free end of the power cable to a suitable AC power supply source (voltage range 85 V to 264 V AC, 47/63 Hz) and switch on the AC supply. The instrument may then be switched on, as required, by the power ON switch.

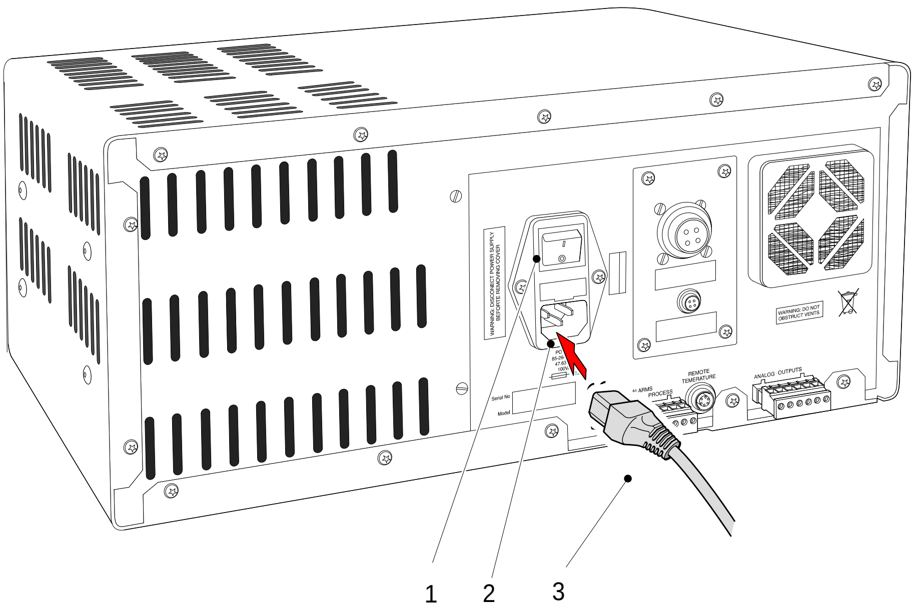


Figure 2.5

2.6.2 Analog Output Connections

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

Each of these outputs can be set-up as either a current loop signal (either a 4-20 mA or 0-20 mA current loop) or alternatively, as a 0-1000 mV voltage signal. 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 page (refer to Section 3.6.2).

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 **DCC**. 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, 4-20 mA
Channel 2: Temperature, 4-20 mA
Channel 3: % RH, 4-20 mA current loop

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

The three analog output ports connections are made via a single 6-way, push fit connector block as shown in *Figure 2.6*. 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.

For each output:

1. Remove the terminal block fitted into the analog output socket.
2. Strip back the wire for the common (black) connection to the **CH1** output, exposing approximately 6mm (0.25 in) wire insert the wire into the **COM1** terminal way and screw into the block. **Do not overtighten the screw.**
3. Strip back the wire for the signal (e.g. red) connection to the **OP1** output, exposing approximately 6mm (0.25 in) wire, insert the wire into the **OP1** terminal way and screw into the block. **Do not overtighten the screw.**
4. Repeat operations 1 and 2 for the other analog outputs, selecting a different color wire for the **OP2** and **OP3** outputs.
5. Locate the terminal block over the connector labelled **ANALOG OUTPUTS** and push the terminal block firmly into the connector.

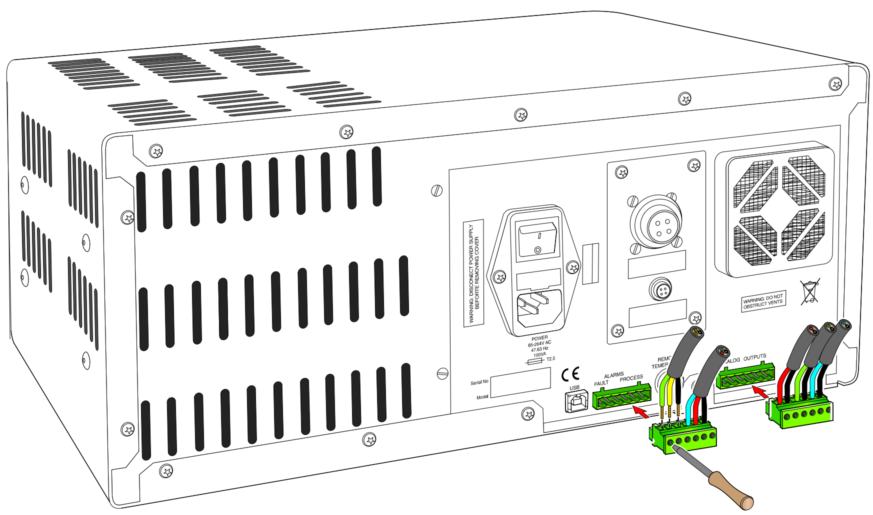


Figure 2.6 *Alarm and Analog Output Connectors*

2.6.3 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 page, (refer to Section 3.6.2), 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 Dewpoint parameter.

The Fault alarm is a non-configurable alarm which continuously monitors the degree of contamination of the chilled mirror. During normal operational conditions this alarm will be off. If the optics or the mirror contamination exceeds 100% of the film thickness, or if a fault exists on the Pt100, the alarm is triggered and the relay contacts will change state.

This fault is also reported to the status area of the Front Page display.

The two alarm output ports are connected to the instrument via a single 6-way, push-fit connector block as shown in *Figure 2.6*. 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 be used for each of the **COM** (common) lines and a separate color for each of the **N/O** and **N/C** lines.

DANGER
Electric
Shock Risk

WARNING: Alarm leads MUST be potential free when wiring to the connector block.

For each output:

1. Strip back the wire for the common (black) connection to the **COM** connector way for the **FAULT** alarm contact set, exposing approximately 0.25 in (6mm) wire and clamp into the screw block **COM** terminal way. **Do not overtighten the screw.**

2. Strip back the wire for the **N/O** (e.g. green) connection to the **N/O** connector way for the **FAULT** alarm contact set, exposing approximately 0.25 in (6mm) wire and clamp into the screw block **N/O** terminal way. **Do not overtighten the screw.**

3. Strip back the wire for the **N/C** (e.g. blue) connection to the **N/C** connector way for the **FAULT** alarm contact set, exposing approximately 0.25 in (6mm) wire and clamp into the screw block **N/C** terminal way. **Do not overtighten the screw.**

4. Repeat operations 1 to 3 for the **PROCESS** alarm contact set, using appropriate colored wires.

5. Locate the terminal block over the connector labelled **ALARMS** and push the terminal block firmly into the connector.

2.6.4 Remote PRT Probe

1. Rotate the body of the PRT probe connector until it locates in the socket labeled **REMOTE TEMPERATURE** (See *Figure 2.7).*
2. Push the connector into the socket until it locks. **NOTE: Do not attempt to force it into the socket. If it will 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 and then gently pull the connector body out of the socket. **NOTE: Do not attempt to pull it out with the cable, make sure that the collar is first released.**

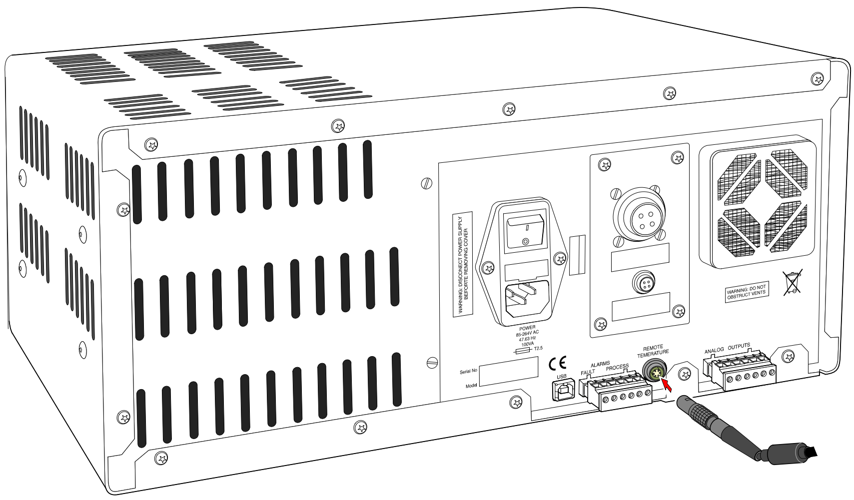


Figure 2.7 *Remote PRT Connection*

2.6.5 Remote Pressure Transducer (Optional)

1. Rotate the body of the pressure transducer connector until it locates in the socket labelled **PRESSURE TRANSDUCER.**
2. Push the connector into the socket until it locks. **NOTE: Do not attempt to force it into the socket. If it will 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 back along its axis, away from the instrument, to release the lock and then gently pull the connector body out of its socket. **NOTE: Do not attempt to pull it out with the cable, make sure that the collar is first released.**

2.6.6 USB Communications Port Connector

This communications port connector cable is supplied as standard.

1. Check the orientation of the connector and gently push it into the socket labelled **USB** (see *Figure 2.8*).
2. To remove the connector, pull it out of the socket by holding the connector body. **Do not attempt to remove it from the socket by pulling on the cable.**

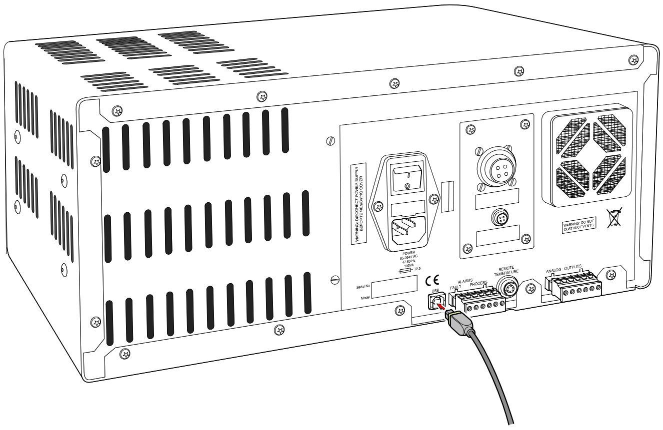


Figure 2.8 *USB Port Connection*

2.6.7 Dewpoint Sensor Connection

The dewpoint sensor contains the optical system and the chilled mirror. It is also fitted with a bayonet connector to allow it to be controlled by the instrument.

Figure 2.9 *Dewpoint Sensor*

1. Before connecting insure that the sensor mirror surface is fully cleaned. See Maintenance (Section 5) for cleaning details.
2. If the sensor is installed within a sealed gas system it must be installed securely without any possibility of leaks. Insure that the sample flow across the sensor is correctly regulated.
3. The gas connections for the remote sensor are either via a permanently installed sample port into which the remote sensor can be inserted or via a sensor block (see *Figure 2.10*) immediately attached to the sensor around which the sample circulates. Gas sample entry into the sensor block is via couplings that can be installed via ⅛" NPT female threads. A washer is provided to seal the connection between the sensor and block.

4. If the sensor is to be positioned into a sealed but open environment e.g. a glove box, environmental chamber or area to be monitored, insure the sensor is suitably secured to prevent any movement and that it is located in a position that will see a representative flow of the sample to be measured.

5. Connect the remote sensor cable to the sensor and to the instrument via the connector on the rear panel. The connector is a 2-part bayonet fitting. Insert the cable part and rotate until the polarization lugs engage. Rotate the outer collar of the cable-mounted- part in a clockwise direction, and, at the same time, push the connector halves together to assist the mating. The connection is made in a ¼ of a turn of the outside collar part.

6. If the remote temperature probe is to be utilized, insure that the probe is suitably secured to prevent any movement and that it is located in a position that will see a representative flow of the sample to be measured.

Figure 2.10 *Sample Block*

2.7 Pressure Measurements (Optional)

As an option, an external pressure transducer can be connected to the OPTISURE Remote and either installed into a sampling system, or connected directly into the sample line, if conditions permit. If equipped, this allows for online measurement and monitoring of pressure of the sample.

The pressure measured by this sensor is then used internally in the calculation of all pressure related parameters.

If a pressure transducer is not installed then 101.3 kPa is used as the basis of all calculations. The optional pressure transducer is ranged from 0 to 377 psig (0 to 25 barg).

3 OPERATION

As supplied, the Optisure Remote 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 - should this become necessary.

3.1 General Operational Information

While the instrument can physically operate in a flowing gas stream of between 0.1 and 2 Nl/min, (0.2 and 4.2 scfh), Kahn Instruments recommends operating at approximately 1.0 scfh (0.5 Nl/min) which is the flow-rate used during calibration. Operating at an alternative rate could impact the instrument's response time.
If the instrument is to monitor the conditions in an environment make sure the sensor is located in a representative position, i.e. not under an air conditioning vent.

The available options for sensor installation are

- via a permanently installed sample port into which the remote sensor can be inserted **or**
- via a sensor block immediately attached to the sensor around which the sample circulates **or**
- in an ambient environment where the sample is diffusing through the sensor.

The sample inside the sensor is passed over a Peltier chilled, gold-plated mirror. The instrument controls the mirror temperature to a point where a level of condensate is maintained on the mirror surface. The temperature of the mirror is then measured as the dew point.

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

3.2 Preparation for Operation

On delivery the instrument will have been set-up with a standard set of default parameters defining the operation of the instrument. These parameters can be changed as required by means of the Setup Menu page (refer to Section 3.6.2).

3.2.1 Sample Flow Adjustment

- The sample flow can be measured by installing a flow meter into the sample line, preferably after the Dewpoint sensor.
- The ideal flow setting is between 0.2 to 4.2 scfh (0.1 to 2 Nl/min).
- The sample flow can be adjusted by the installation of a needle valve in the sample line. If a pressurized sample is to be measured at atmospheric, then the needle valve needs to be installed and adjusted upstream of the sensor. For measurements at sample pressure, the flow adjustment should be made downstream of the sensor.

3.3 Function keys

The function keys, located below the display, are used to select operations from the Main Menu level, to enter sub-menu levels and to select and enter parameter variables within those menu levels.

The SD card reader, used for data storage during data logging operations, is located below the function keys.

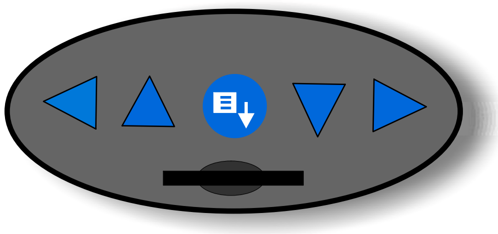


Figure 3.1 *Function Keys*

The function keys are shown in *Figure 3.1*. Table 3.1 describes the operation of the keys.

Key	Function
▼	**Scroll down key.** From the Front Page display this key is used to scroll down the displayed parameter panes to highlight, in reverse video, the parameter of choice (e.g. dewpoint). If required, the highlighted parameter can then be changed by means of the ◀ (left) and ▶ (right) keys to highlight one of the six remaining parameters. This parameter can then be selected for display by pressing the Enter key. From the main pop-up menu this key is used to scroll down through the available options. Within sub-menus this key is used to scroll down and highlight options available for selection within the sub-menu. Within sub-menu levels requiring values to be entered this key is used to reduce the currently selected value.
▲	**Scroll up key.** Operates in a similar manner to the ▼ (down) key but scrolls up. Within sub-menu levels requiring values to be entered this key is used to increase a currently selected value.
▶	**Scroll right key.** From a highlighted pane in the Front Page display this key is used to scroll down and highlight one of the six remaining parameters available for display.
◀	**Scroll left key.** From a highlighted pane in the Front Page display this key is used to scroll up and highlight one of the six remaining parameters available for display. Also used to step back one menu level.
	**Enter or Select key.** Operation of this key from the Front Page display causes the Main Menu to be displayed. Options highlighted by use of the ▲ (up) and ▼(down) keys are selected by operation of this key. Within the Variable Menu Pages this key is used to select the highlighted option.

Table 3.1 Function key operations

3.4 Instrument Display

The display and the associated function keys form the operator interface.

Figure 3.2 shows a typical Front Page (default) display while the instrument is running in the **MEASURE** mode.

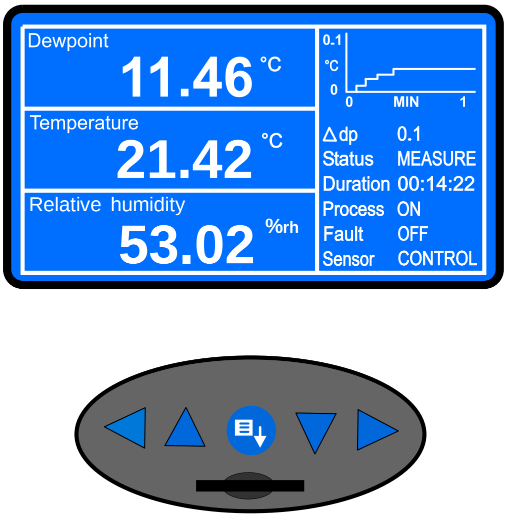


Figure 3.2 *Typical Front Page Display*

The instrument display is divided into two sections. Operational data (measured, or data calculated from measured parameters) is shown in the three horizontal panes on the left of the display. Operational status information is shown in a separate display area on the right hand side.

3.4.1 Operational Data Display

Each of the three operational data panes can be configured to display one of the following parameters:

1. Dewpoint
2. Temperature
3. Moisture content (ppm_V)
4. Moisture content (ppm_W)
5. Moisture content (g/kg)
6. Moisture content (g/m^3)
7. % Relative humidity, %rh
8. Temperature difference
9. Pressure (see also Section 2.7)

The parameters displayed are operator selectable and, by default, are set (from the top of the display) to Dewpoint, Temperature and Relative Humidity.

An example of the method of setting up the parameter to be displayed is shown graphically in *Figure 3.3* and is as follows:

1. Press the ▼ (down) key. This switches the display to highlight the top pane.
2. Use a combination of the ▼ (down) and ▲ (up) keys to highlight the required pane.
3. Use a combination of the ◀ (left) and ▶ (right) keys to scroll through the list of parameters available for display. **NOTE: A parameter can only be displayed on the screen once. If it is already displayed, it is not available for display in a second pane on the same screen.**
4. When the required parameter is displayed press the (Enter) key. The display then reverts to a now-revised Front Page.

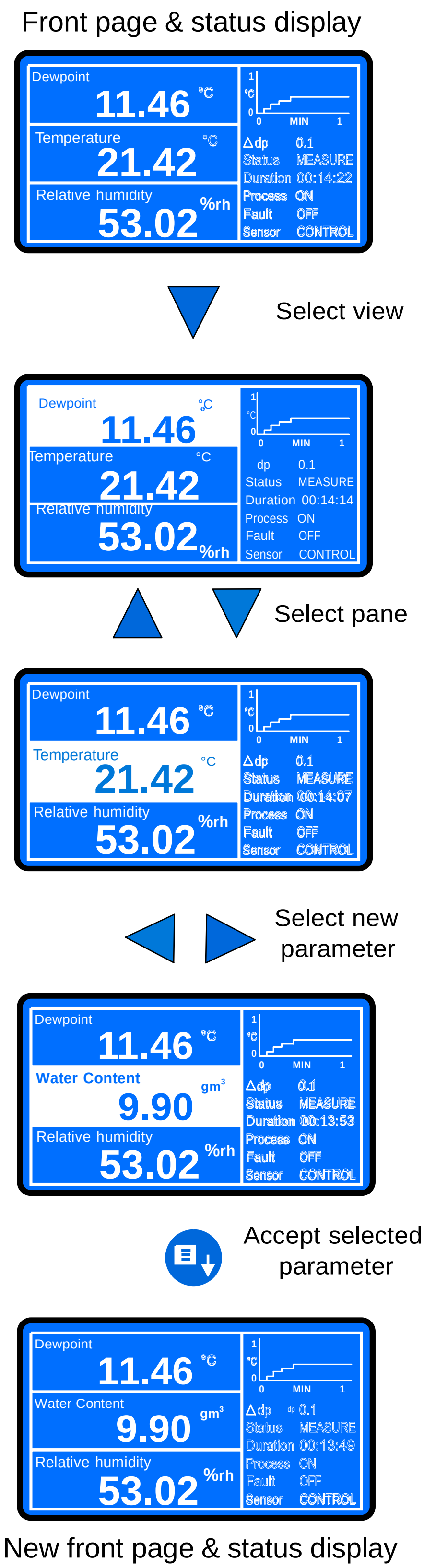


Figure 3.3 *Set-Up Display*

3.4.2 Operational Status Display

The status display is shown on the right hand side of the display and details the following:

1. **Stability graph** which shows measured dew point over a user-optional duration. This time variable (Stability Time), is set-up within the Display Set-Up Menu (refer to Section 3.6.2).
2. **Δ dp value** representing the change in dew point over the stability duration as shown on the graph.
3. **Status indicator** which reports which operational phase the instrument is currently in. This will be either **DCC**, **HOLD** or **MEASURE**.
4. **Duration indicator** which reports back the time (in Hours:Minutes:Seconds format) remaining in the phase currently being displayed in the Status line. If **DCC** is OFF, then this display line will appear as --:--:--
5. **Process** This, two state, ON/OFF notification indicates whether a parameter process alarm is either ON or OFF. A process alarm can be set on any parameter and its set-point and ON/OFF control are set-up via the Alarm Set-Up Menu (refer to Section 3.6.2).
6. **Fault** This status line is used to monitor the optical system and the degree of mirror contamination. During normal operation, under no fault conditions, this will read OFF but will be set to ON if there is either a fault with the optics or dp temperature measurement or if the mirror contamination exceeds 100% of the film thickness.
7. **Sensor** This status line indicates the operational mode of the sensor. This can be either **CONTROL**, **HEATING** or **COOLING**.

3.5 Menu Structure

The Optisure Remote has a three level menu structure, the top level of which (Main Menu), is accessed from the Front Page by pressing the (Enter) key (see also Table 3.1). This causes the Main Menu to pop-up and overwrite the central area of the current display as shown in *Figure 3.4*. Within this pop-up menu five options are available: **EXIT, DCC ON/OFF, MAXCOOL MEASURE, STANDBY/OPERATE** and **SETUP.**

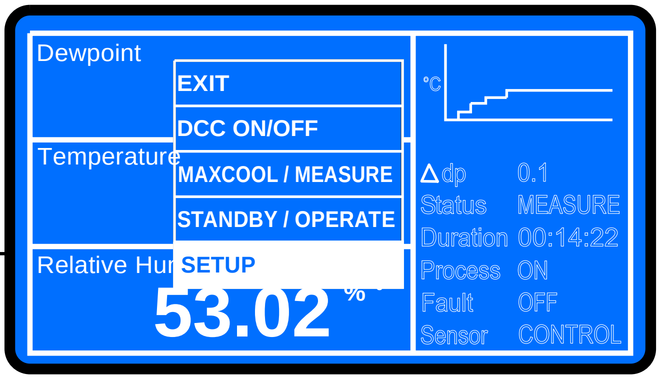


Figure 3.4 *Main Menu*

These options are selected by means of the ▲ (up) and ▼ (down) keys. As each option is highlighted, it is presented in a reverse video box. Pressing the (Enter) key then provides access to the operations associated with that option.

Selecting the **EXIT** option returns the operator to the Front Page.

The next three options, **DCC ON/OFF, MAXCOOL/MEASURE** and **STANDBY/OPERATE** are two-state, context-sensitive, instrument control commands which are toggled from one state to another by means of the (Enter) key. For example, if **DCC** is ON, **DCC OFF** (the only other possible operation) is displayed in the Main Menu. Operation of the (Enter) key will toggle **DCC** to OFF and next time the menu is called **DCC ON** will be displayed. The **MAXCOOL/MEASURE** and **STANDBY/OPERATE** command menu options also operate in a similar manner, displaying the only option available when the Main Menu is called. Section 3.6 describes the operations of these functions.

When the **SETUP** option is highlighted, pressing the (Enter) key provides access to a second menu level, the Setup Menu page. This menu and subsequent associated sub-menus (the Variables Menu Pages) are presented not as pop-ups but as full page screens.

The options on the Setup Menu page are similarly scrolled by means of the ▲ (up) and ▼ (down) keys and pressing the (Enter) key when an option is highlighted provides access to a third level (Variable Menu Pages**)**, associated with the selected option.

Within the third level Variable menu pages, the ◀ (left) and ▶ (right) keys are used to scroll the individual fields and the ▲ (up) and ▼ (down) keys are used to change parameter values. Operation of the (Enter) key then sets the selected value into the appropriate field.

Both the second (Setup Menu page) and third level (Variable Menu Pages**)**, each have an **EXIT** option.

In the Setup Menu page, selecting the **EXIT** option followed by operation of the (Enter) key, returns to the Front Page display.

To quit the Variable Menu Pages and return to the Setup Menu page, press the ◀ (left) key.

Once the set-up parameters have been fixed, only Main Menu operations tend to be used on a daily basis.

Details of the set-up parameters and their default values can be found in Appendix B.

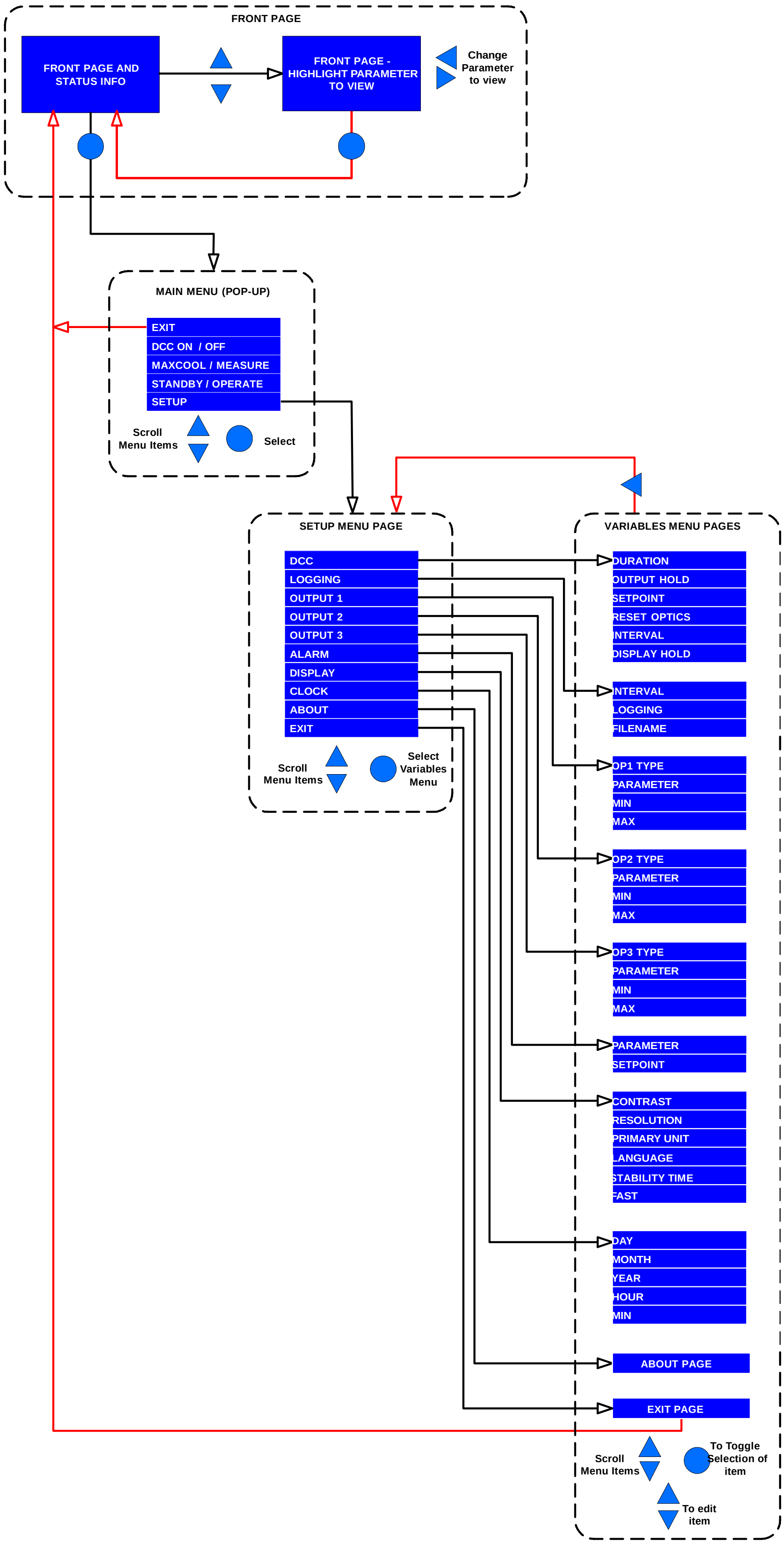


Figure 3.5 *Menu Structure*

3.6 Operational Functions

3.6.1 Operating Cycle

The default parameters set-up for the instrument define an operating cycle, see *Figure 3.6.*

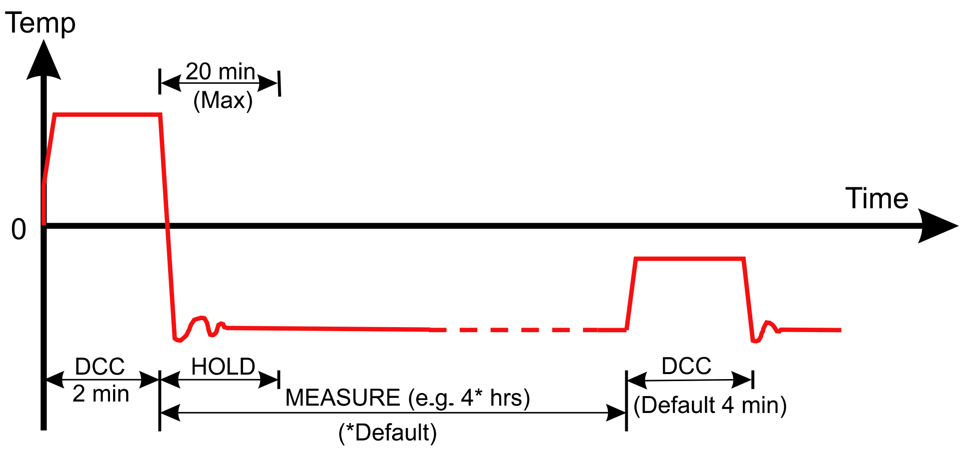


Figure 3.6 *Typical Operating Cycle*

At initial switch-on the instrument enters a **DCC** cycle for 2 minutes. Initially, the mirror will be at or close to ambient temperature and the Peltier heat pump attached to the mirror drives the mirror temperature up 36°F (20°C) above the ambient temperature to insure that all moisture is driven off the surface of the mirror.

During the **DCC** period, the **STATUS** area of the display will indicate **DCC** and the interval timer will count down the time until measurement resumes. The **SENSOR** area of the display will initially show **HEATING**, followed by **CONTROL** and then **COOLING** after the initial **DCC** period has expired.

During the **DCC** process, Data Hold retains the analog outputs at the value(s) read before **DCC** commenced. Data Hold typically lasts 4 minutes from the start of a **DCC** cycle, or until the instrument has reached the dewpoint. 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 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 'home-in' on the dew point. The length of this stabilization time depends upon the temperature of the dew point. When the measurement is stable the **Sensor** 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**.

3.6.2 SETUP

SETUP mode is used for changing system control parameters, each of which are selected from the Setup Menu page.

Initially, when the Setup Menu page is opened, **DCC** is highlighted and all the sub-menus and data fields relating to **DCC** are shown, together with their current settings. For first time operation these will be the default settings relating to **DCC**.

To select any of the other parameters, e.g. **LOGGING**, **OUTPUT 1,** etc., use the ▲ (up) and ▼ (down) keys to scroll through the list.

When it is highlighted, any Setup Menu page item can be selected by pressing the (Enter) key. This then highlights the first item (e.g. **DURATION**) of a sub-menu relating specifically to that function. Use the ▲ (up) and ▼ (down) keys to scroll through the list to select the required sub-menu (**DURATION**) in this example and press the (Enter) key. The value field relating to the selected sub-menu is then highlighted.

The value field can now be changed by means of the ▲ (up) and ▼ (down) keys. When the required value has been reached, pressing the (Enter) key accepts the new value and the display is returned to the sub-menu for the selected option.

To return to the Setup Menu page, from any part of the sub-menu list, press the ◀ (left) key.

Other parameter values are changed by highlighting the required sub-menu option and changing the associated parameter values in a similar manner to that described above. Table B.1 lists all the Setup Menu page options, the individual sub-menu options and, where appropriate, the default values applied to each data field.

3.6.3 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 36°F (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 removes the effect of contamination on accuracy.

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.

This command is used to turn the **DCC** function either ON or OFF. During normal operation this command will be set to ON.

For special reasons 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.

NOTE: The DCC command is context sensitive i.e. if DCC is ON, the Main Menu shows only DCC OFF as being selectable. Similarly if DCC is OFF, only DCC ON is shown.

3.6.4 MAXCOOL Function

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

- to determine what temperature the mirror can be driven down to with reference to the sensor body. This temperature is indicated on the display.
- to determine 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 dewpoints where, possibly due to a high ambient temperature, the Peltier heat pump is unable to depress the temperature far enough to reach the dew point.
- to determine 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.

3.6.5 Frost Assurance System Technology (FAST)

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

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 32F (0°C) taken over water will read approximately 10% lower than the same measurement taken over ice.

When turned on, the OPTISURE Remote's **FAST** system identifies when the measured dew point is between -40°F and +32°F (-40°C and 0°C) and automatically decreases the mirror temperature until a pre-determined film thickness of condensate is detected, thereby ensuring a guaranteed frost formation. The mirror temperature is then increased to above the initial measured dew point, but maintained below +32°F (0°C), and the excess condensate is driven off the mirror. The system then controls for dew point based on the frost formation.
Once ice has formed it will remain as ice until the temperature is raised above +32°F (0°C). The measurement state can then be guaranteed.

If required, the instrument's **FAST** function can be switched on and off as follows:

1. Select **SETUP** from the Main Menu.
2. Use the ▼ (down) key to select **DISPLAY** from the Setup Menu page.
3. Press the (Enter) key to enter the display menu and then use the ▲ (up) and ▼ (down) keys to highlight **FAST**.
4. Press the (Enter) key to enter the **FAST** parameter field and use either the ▲ (up) and ▼(down) keys to change the parameter field to ON.
5. Press the (Enter) key to set **FAST** to ON.
6. Press the ◀ (left) key to return to the Setup Menu page and the ▼ (down) key to highlight **EXIT**.
7. Press the (Enter) key to quit the Setup Menu page.
8. To return the instrument to internal monitoring, repeat operations 1 to 5 above, selecting **INT** at Step 4.
9. To cancel the **FAST** function, repeat steps 1 to 8 above, setting the parameter field in Step 4 to OFF. Pressing the (Enter) key in Step 5 then turns off the **FAST** function.

3.6.6 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, allowing the sensor to settle naturally at the ambient temperature and so eliminate the possibility of sensor saturation.

The main use for this feature is during set-up, for instance where flow rates are being adjusted and the analog outputs are being configured, where measurements are not required during this period.

This feature is also used to inhibit **MEASURE** mode while the mirror is being cleaned.

3.6.7 Data Logging

The **LOGGING** function provides the facility to log, at operator specified intervals, real-time values of all the
instrument's parameters and to store these logged results on an SD memory card. To set-up this facility, proceed as follows:

1. Select **SETUP** from the Main Menu and press the (Enter) key to display the Setup Menu page.
2. Press the ▼ (down) key to highlight **LOGGING** and press the (Enter) key twice to enter e.g. the **INTERVAL** field.
3. Use the ▲ (up) and ▼ (down) keys to set the required **INTERVAL** duration and press the (Enter) key.
4. Insert a formatted SD card in the slot immediately below the function keys.
5. Press the ▼ (down) key to highlight **LOGGING** and press the (Enter) key twice to enter the selection field (which initially will be set at NO).
6. Press the ▲ (up) key to select Yes and press the (Enter) key. **NOTE: If an SD card has not been installed, it will not be possible to select Yes and an error message CARD NOT FITTED! will be displayed.**
7. A file name, based on time/date is automatically allocated and will be written into the File name field as soon as an SD card is inserted.
8. Quit the Setup Menu page by using the ◀ (left) key selecting **EXIT** with the ▼ (down) key and pressing the (Enter) key.

4 APPLICATION SOFTWARE

Application software for the Optisure Remote is supplied on a CD.

The latest version of this application software is also always available from Kahn Instruments.

To install on a PC, place the CD in the CD drive and follow the application set-up wizard. If the CD does not auto-run, double click the application set-up file on the CD. The following authorization code is required during the installation process: 7316-KAHN-OPTI

Once installed, and a PC connected to the Optisure Remote via the cable provided, (refer to Section 2.6.7), starting the Optisure Remote Application Software package will then display the current status of the instrument.

Section 4.1 gives further details on the installation of the Application software.

The application software is capable of emulating all the instrument’s control, set-up and logging functions and provides an expanded parameter display by simultaneously displaying all the measured and calculated parameters.

An expanded stability graph (scales definable), is also provided for displaying any combination of the nine measured or calculated parameters against a time base.

The main toolbar includes the principal operation comments, **DCC ON, MAXCOOL ON** and **STANDBY** (refer to
Section 2.6 for details of the use of these commands).

Datalogging set-up and control commands are also contained on the main toolbar and are used to set-up logging profiles. When using the application software, all datalog files are stored on the host.

Context sensitive help files provide details on the operational use of the application software.

Figure 4.1 *Typical Application Software Screen*

The Optisure Remote has a Modbus communications interface via the USB port. This enables remote access to the instrument's configuration and data logging facilities. This protocol offers two-way communication between a host (PC) (known as the master unit), to one or more instruments (termed slave units).

Once communication is established by the master unit, reading or writing to holding registers within an addressed slave unit is possible. The master unit can obtain measured values and status information by reading registers and can respond to data contained within these registers by writing back.

The following tables list these registers, as they apply to the Optisure Remote, and specify the number and data formats that apply to each register.

A copy of the application software is contained on the CD delivered with the instrument.

1. Double click the zip file to open the Optisure application software and launch the OPTISURE.exe file. Follow the set-up procedure.
2. Select the language to be used during the installation.
3. Exit all other Windows programs before running the Setup program.
4. Accept the licensing agreement.
5. The System information window will specify whether or not the PC meets or exceeds the minimum requirement for Optisure application software.
6. Enter the following authorization code: 7316-KAHN-OPTI.
7. Amend the destination directory if desired. The default directory is C:\Program Files\Optisure Application Software.
8. Select the program folder. The default program folder is Kahn\Optisure Application Software.
9. Launch the installation from the installation summary window.
10. Restart the computer to finalize the installation.

If the software installation has been successful, Windows should recognise the Optisure USB connection and automatically load the relevant drivers. This can be checked in Windows Device Manager and, if successful, is listed under the Ports (COM & LPT) category.

To select the Device Manager, click Start and select Control Panel. Double click on the System icon and select the Hardware tab. Select Device Manager. Failing this a prompt will show to load these drivers which can be installed from the CD supplied.

To communicate with the Optisure Remote, the software needs to know which communications (USB) port the Optisure Remote is connected to. On first launch, the software will ask for the communications port number, which can be either automatically detected or manually selected. A screen shot of the communications window is shown in *Figure 4.3*.

Figure 4.2 *Communications Window*

Clicking Auto-detect will prompt the software to search for the Kahn Instruments USB driver in Windows Device Manager. From that, it will determine which USB port the Optisure Remote is connected to and establish a connection automatically.

Manual selection of a communications port is provided in the unlikely event that the software cannot auto-detect it.

NOTE: Upon successfully establishing communication, record the port number and, in future, skip this window by checking the 'Use this port & Skip this screen every time' option.

Once communications have been established, click the OK button to go to the Options window. The latter provides two choices; Data acquisition and Edit variables. Choose either Data acquisition if continuous charting, display and logging of instrument readings is required, or Edit variables if only the editing of instrument variables (configuration) is required.

5 MAINTENANCE

There are few user-serviceable parts on the Optisure Remote. These include cleaning the mirror in the sensor, the removal and replacement of the fan filter element and the removal and replacement of the AC power supply fuse.

5.1 Safety

DANGER
Electric
Shock Risk

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

Insure that any test installation meets the standards described in Section 2.3 of this handbook.

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 V to 264 V, 47/63 Hz) and switched on, proceed as follows:

1. If the power supply cable is equipped with a fused plug, switch off the power supply, remove the plug, check and, if necessary, replace the fuse. If the instrument still fails to operate, after fitting the fuse and switching the power supply on, proceed as follows (see *Figure 5.1*).

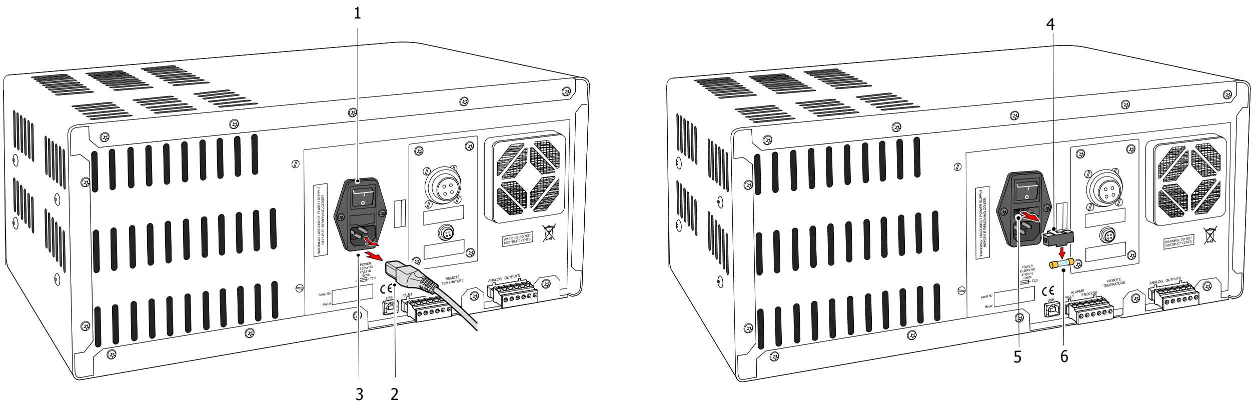


Figure 5.1 *Power Supply Fuse Replacement*

2. Switch the instrument's ON/OFF switch (1) to OFF, isolate the external power supply and remove the IEC power connector (2) from the instrument's power socket (3).

3. Locate the fuse holder (4) and pull it out of the connector housing (5). A small screwdriver inserted under the lip may be useful in order to pry it out.

4. Replace the fuse cartridge (6). **NOTE: It is essential that a fuse of the correct type and rating is installed in the instrument (T2.5A 20 x 5mm Ceramic Slow-blow Fuse).**

5. Fit a new fuse cartridge (6) into the fuse holder (4) and push the fuse holder (4) back into the power connector housing (5).

6. Replace the IEC power connector (2) into the power socket (3), switch 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 Fan Filter Cleaning

To maintain adequate cooling, it is essential that the fan filter be checked at periodic intervals and kept clean. The frequency of checking will depend upon the working environment but checking and cleaning at three-monthly intervals is recommended.

The fan is located on the rear panel. *Figure 5.2* shows the method of removing the fan filter.

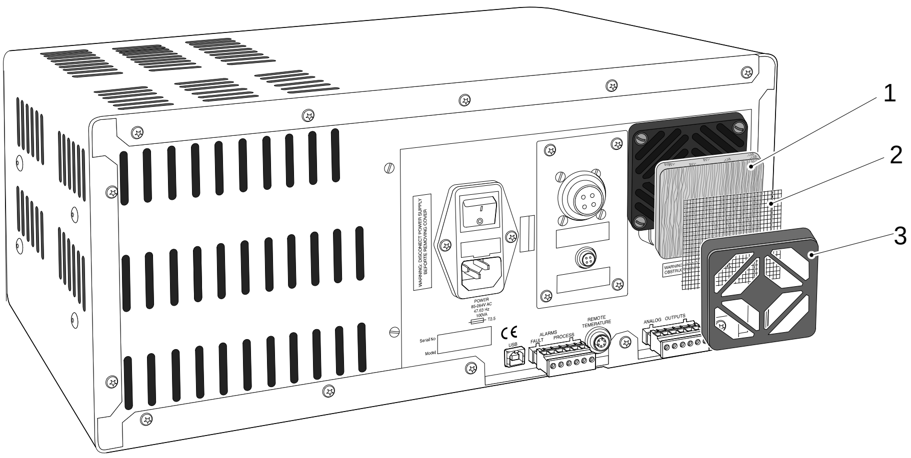


Figure 5.2 *Remove and Replace Fan Filter*

1. Switch off the instrument.

2. Grip the fan filter case (3) and pull it away from the fan body. The case is a push fit. If it does not come away easily, there is a small slot located under the fan case for the insertion of a screwdriver to assist in prying it off.

3. The fan case (3) comes away with the gauze (2) and the filter element (1).

4. Clean the gauze (2) with a moist, lint-free cloth.

5. Wash the filter element (1) in water containing a mild detergent, rinse and allow to dry. If the filter element is damaged, replace the element.

6. Clean the fan housing.

7. Fit the gauze (2) and the filter element (1) into the filter case (3) and push the assembly back onto the fan housing until it clips into position.

5.4 Sensor Mirror Cleaning

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:

1. Switch off the instrument and remove the sensor from its sample block.
2. Clean the mirror surface and optics window with a 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 Q-Tip when cleaning. Allow the cleaning solvent to fully evaporate.

6 GOOD MEASUREMENT PRACTICE

The Optisure Remote is designed to operate either in a flowing gas stream or in an environmental monitoring situation. Its sensor, which measures the moisture content of the sample using a Peltier chilled, gold-plated copper mirror, is designed to operate at pressures up to 290 psig.

When installed within a sealed gas system the sensor is designed for operation with flow rates of 0.2 and 4.2 scfh, (0.1 to 2.0 Nl/min). It is important to insure that the flow rate through the sample line, connecting the source to the OPTISURE sensor, is high enough to avoid long time lags in response to humidity changes at the sample source.

6.1 General Guidelines

General guidelines to be followed when setting-up a sampling system are as follows:

- **Insure that the sample is representative of the gas under test**

  The sample point should be as close to the critical measurement point as possible.

- **Minimize the “dead space” in sample lines**

  Avoid the use of too many T-pieces, in-line couplings or other unnecessary tubing. Sample tubing should, ideally, be specially designed for each application rather than adapted from that previously installed for another application. Dead space in sample lines increases response time by holding water molecules which are more slowly released to the passing gas sample.

- **Remove any particulate matter or oil from the gas sample**

  Particulates entering the instrument’s sensor chamber will cause contamination of the optical components and the mirror which will result in the necessity for more frequent cleaning. If the likelihood of the presence of particulates such as degraded desiccant and rust particles is possible, use a particulate filter on the sample input line. Refer to Kahn Instruments for technical advice.

- **Use high quality sample pipe fittings**

  Wherever possible, always use stainless steel tubing and fittings. This is particularly important at low dewpoints since other materials, e.g. nylon, have hygroscopic characteristics and adsorb moisture on the walls of the tubing, giving rise to slower measurement response and in certain circumstances, false dewpoints.

  For temporary applications, or where stainless steel tubing is not feasible, high quality PTFE tubing, which exhibits similar qualities to stainless steel, may be used.

  In order to maximize response time, always use the shortest run of tubing and the smallest diameter possible, taking care not to induce pressure differentials by aiming for too high a flow rate through too small a diameter.

  Kahn Instruments supplies a range of precision pressure fittings suitable for use with the Optisure Remote. Contact Kahn Instruments for details of the items available.

- **Gas samples**

  Generally, if the sample gas (in conjunction with water vapor) is not corrosive to base metals it will be suitable for measurement by the Optisure Remote. Gases containing entrained solids should be filtered before application to the Optisure Remote.

  Care should be taken with gas mixtures containing potentially condensable components in addition to water vapor, e.g. oil, to Insure that only water vapor is able to condense onto the chilled mirror surface.

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 accredited, standards laboratory.

If these facilities do not exist, the instrument must be returned to Kahn Instruments.

The **DCC** function can be disabled for calibration purposes (refer to Section 3.6.3).

A calibration certificate bearing a four point calibration is issued with each instrument. If required, an option is available to add further specific calibration points. Contact Kahn Instruments for further information.

Appendix A

Technical Specifications

Appendix A Technical Specifications

Performance	
Measurement Range	-40 to +194°Fdp (-40 to +90°Cdp)
Units	°F and °C for dew point and temperature %RH, g/m^3, g/kg, ppm_V , ppm_W (SF_6), for calculated humidities
Resolution	0.02°F (0.01°C)
Accuracy	0.18°F (0.1°C) for dew point and temperature
Measurement Response Speed	0.8°F /sec (1°C /sec)
Repeatability	±0.01°F (±0.05°C)
Remote Temperature Probe	4-wire Pt100 ambient temperature measurement
Remote Pressure Transducer Range	0 to 25 bara
Remote Pressure Transducer Accuracy	0.25% FS

Operating Conditions	
Sensor Pressure	0 - 290 psig (0 - 20 barg)
Sample Flow Rate	0.2 to 4.2 scfh (0.1 to 2 Nl/min)
Sensor Operating Temperature Range	+14 to +194°F (-10 to +90°C)
Storage Temperature	+14 to +140°F (-10 to +60°C)
Electrical Output/Input	
Outputs	3 analog outputs User-definable for hygrometric units and flexible configuration for 0-20 mA, 4-20 mA or 0 to 1 V
Process Alarm	Change-over relay contacts (30 V, 1 A) for hygrometric units and set-points, with user-configurable set-points
Fault Alarm	Changeover relay contacts (30 V, 1 A) for mirror contamination, optical and temperature measurement fault. Pre-set
Communications	Modbus RTU protocol @ 9600 baud rate data using USB interface
Power Supply	85 V to 246 V AC, 47 to 63 Hz
Power Consumption	100 W
Mechanical Specifications	
HMI	High definition, blue LCD User-adjustable contrast Menu navigation via five button keypad
Dimensions (Instrument)	180 x 400 x 320mm (7.1 x 15.7 x 12.5") h x w x d
Dimensions (Sensor)	Ø45 x 128mm with M36 x 1.5-6g mounting thread
Cable Lengths	2, 5 or 10m
Weight	17.41 lb (7.9 kg)

General	
Detection System	Single optics detection system
Data Logging	SDHC Card (512Mb supplied) and USB interface SDHC Card (FAT-16) - 32Gb max. that allows 2.70 million logs or around 43 years, logging at 5 second intervals
Calibration	4-point traceable in-house calibration as standard. UKAS accredited calibrations optional - please consult Kahn

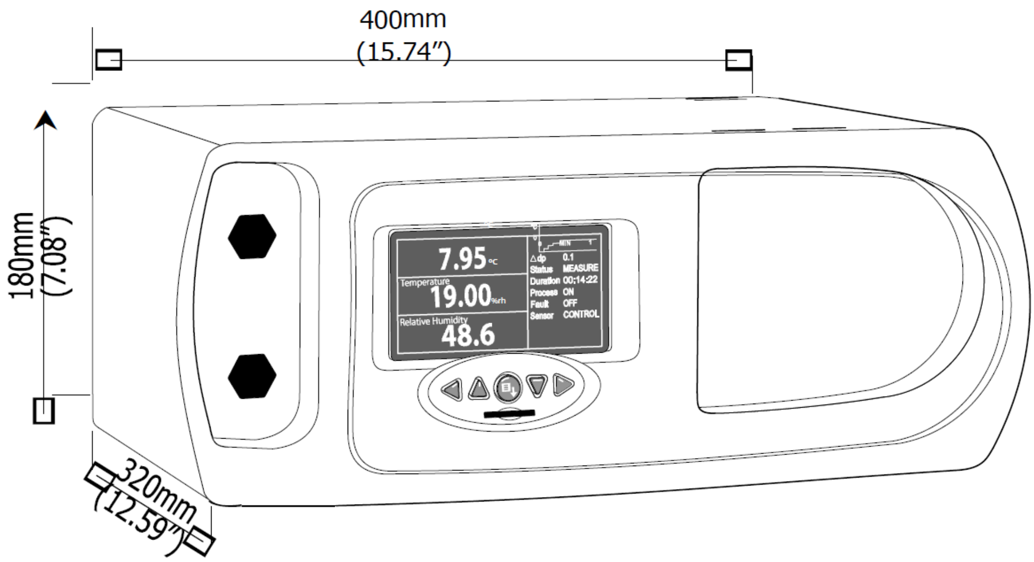


Figure A.1 *Optisure Remote Dimensions*

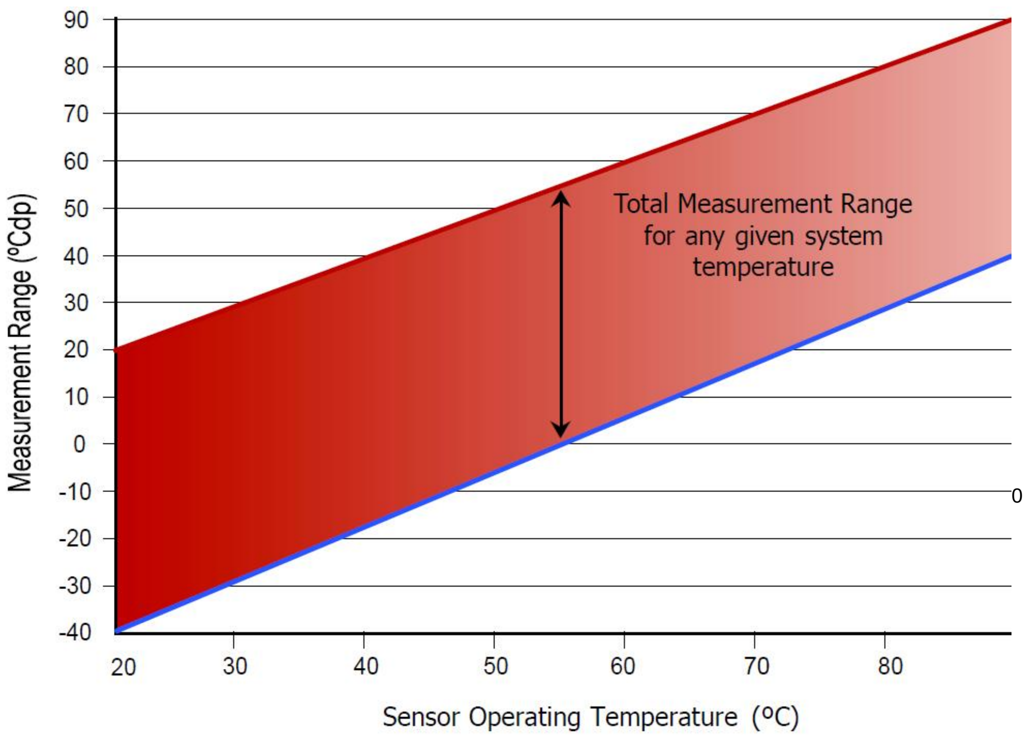


Figure A.2 *Optisure Remote Measurement Range*

Appendix B

Default Set-Up Parameters

Appendix B Default Set-Up Parameters

Function	Field	Setting	Unit	Remarks
DCC	DURATION OUTPUT HOLD SETPOINT RESET OPTICS INTERVAL DISPLAY HOLD	2 20 20 Yes? 04:00 NO	min min °C/°F h:m	Sets duration of Sets maximum output hold time after **DCC**. Sets No. degrees heated above mirror temp. Select as required. Sets **MEASURE** period. If set to Yes, display readings are held during & **HOLD** period. If set to No, display always tracks measured parameters.
LOGGING	INTERVAL LOGGING FILENAME	5 No N/A	sec	Sets interval between consecutive log points. Defines if logging required. Automatically added when SD card inserted.
OUTPUT 1	OP1 TYPE PARAMETER MIN MAX	4-20 DP -60 +40	mA °C/°F °C/°F	Sets output type (4-20mA, 0-20mA or 0-1V). Sets output parameter monitored (list of 8). Defines upper span limit. Defines lower span limit.
OUTPUT 2	OP2 TYPE PARAMETER MIN MAX	4-20 PPMV 0 3000	mA °C/°F °C/°F	Sets output type (4-20mA, 0-20mA or 0-1V). Sets output parameter monitored (list of 8). Defines upper span limit. Defines lower span limit.
OUTPUT 3	OP3 TYPE PARAMETER MIN MAX	4-20 %rh 0.2 1	mA Nl/min Nl/min	Sets output type (4-20mA, 0-20mA or 0-1V). Sets output parameter monitored (list of 8). Defines upper span limit. Defines lower span limit.
ALARM	PARAMETER SETPOINT	DP 0		Defines process parameter to be monitored. Sets process alarm trigger point.
DISPLAY	CONTRAST RESOLUTION PRIMARY UNIT LANGUAGE STABILITY TIME FAST PRT	75 2 ENG 1 ON N/A	% °C/°F English min	Sets contrast level - adjust to suit Sets display resolution (No. decimal places) Sets temperature unit °C or °F. Sets display language. Sets time scale for stability graph. Sets Frost Assurance facility ON/OFF.
CLOCK	MONTH DAY YEAR HOUR	NOV* 10* 07* 16:45*	 h:m	Adjust to local time as required. Set to local time and date at despatch. **** Note: Current time (example only)***
ABOUT	Software issue information			Displays current instrument and display firmware issue details (for information only)
EXIT				Select to return to Front page display

Table B.1 Default set-up parameters

Appendix C

Formatting SD Cards

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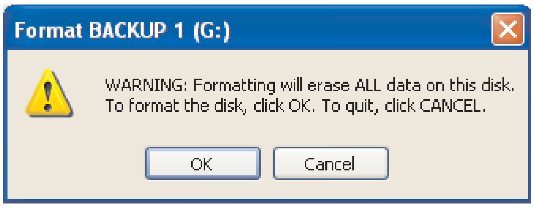
1. Formatting SD cards

Before an SD card can be used for the storage of datalog results, it must first be formatted.

Initially, the card must be connected to a card reader which must in turn be connected to the host computer. Most proprietary card readers connect to the host via a USB port. Almost all laptop/notebook PC's are equipped with an SD card reader slot.

The formatting procedure is as follows.

1. Insert the card into the card reader, and open Windows Explorer. The card will be reported as **Removable storage device.**
2. Right click the card icon and select **Format** from the pop-up menu (refer to Figure A1, opposite).
3. The Format dialog box is now presented as shown in Figure A2, and the disk C**apacity** is reported on the top line (1). This will depend upon the type of disk used (512 MB in this example).
4. In the **File system** box (2), Figure A2, select FAT (this selects FAT 16). **DO NOT** select FAT 32 or NTFS.
5. In the **Allocation unit size** box (3), leave this set to **Default allocation size**.
6. If required, in the **Volume label box** (4), enter a volume label e.g. Optisure.
7. The SD card requires a full format so leave the **Quick format** box (5) unchecked.
8. Click the **Start** button (6). the following message will now appear. Click **OK** to proceed.



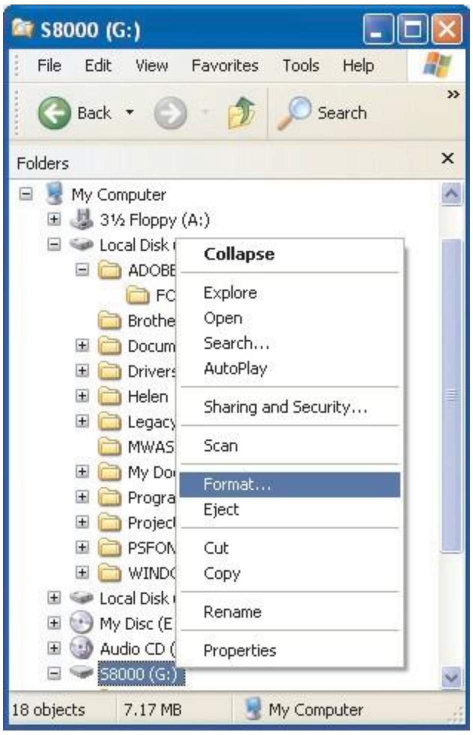


Figure C1 - Select Format

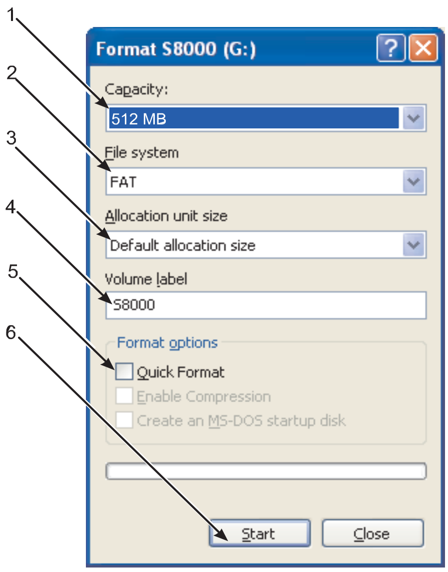


Figure C2 - Set Format Properties

9. The formatting process now begins and a progress bar indicates that formatting is in progress (See Figure A3). The formatting time depends upon the computer processor's speed and the capacity of the disk being formatted. Typically, a 512MB disk will take around 7 seconds.

10. A status indicator reports **Format complete** as soon as the formatting process has finished, see Figure A4. The disk can then be removed from the drive.

To remove the disk from the drive first push it in to remove the lock and then withdraw from the drive slot.

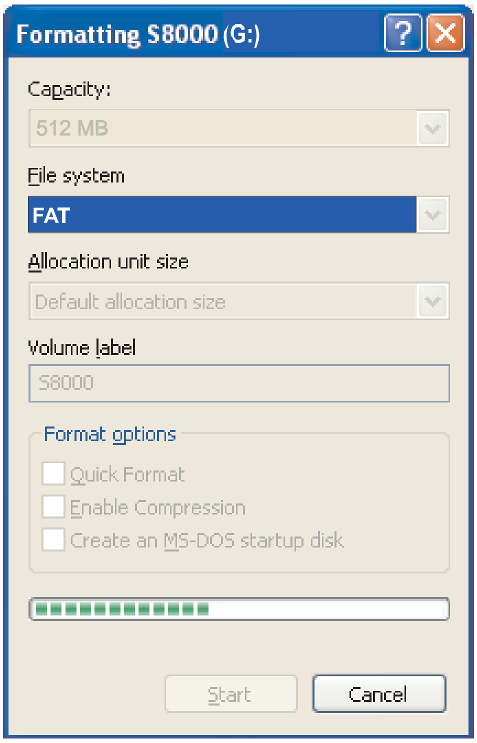


Figure C3 -Format Progress

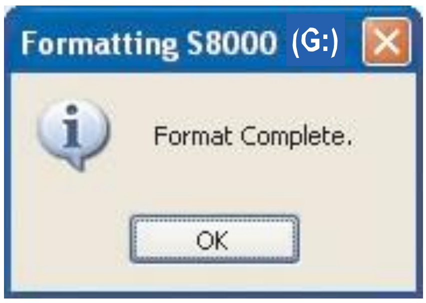


Figure C4 - Format Complete

Appendix D

Calculations

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D Calculations

D.1 Moisture Content

The accuracy of the humidity calculations was determined by comparing the displayed value to corresponding values calculated from the formulas below using a PRT simulator to set a dew point value and the Kahn Humidity Calculator to calculate the water vapor pressure (wvp).

$$ppm(v)\ (dry) = (wvp/(101325-wvp) * 10^6$$

$$ppm(v)\ (wet) = (wvp/101325) * 10^6$$

$$ppm(w)\ SF6\ (wet\ \&\ dry) = ppm(v) * 0.12334954$$

$$g/kg = ppm(v) * 0.0006212138$$

$$g/m^3 = (217/(273.15 + Dp)) * (wvp/100)$$

Note: ppm(v) can be calculated on a dry or wet basis depending upon bit 10 in the units-command register, which can be set via the application software.

D.2 Temperature - dewpoint

PRT simulators are used to simulate the dewpoint and ambient temperature sensors. For each pair of temperature readings the instrument display is read and the actual t-dp readings recorded. Each of these readings is then compared against calculated t-dp, readings using the same input parameters to the Kahn Humidity Calculator.

D.3 °C to °F calculation

PRT simulators are used to input simulated temperatures, measured in °C, into both measurement channels. For each measurement channel, the corresponding display is set to read the input temperature in °F.

For each channel, the temperature reading on the instrument display, corresponding to the series of simulated PRT inputs, is read and recorded. Each of these readings is then compared against a corresponding temperature calculated from the following formula.

Conversion
formula.

°F = ((°C*9)/5) +32C.4% RH Calculation

PRT simulators are used to input simulated dewpoint and ambient temperatures, measured in °C, into both measurement channels.

For each pair of inputs, the reading on the instrument's %RH display is recorded. Each of these readings is then compared against a corresponding %RH value calculated by inputting the same parameters to the Kahn Humidity Calculator.

D.4 Conversion of bara to psia and kPa

Use a calibrated 4 to 20 mA source to simulate a range of applied pressures covering the instruments full pressure measurement span of 0 to 8 bara (0.5 bar/mA). Note: The Optisure is currently limited to 30 psig (2 bara).

For each input current, record the display reading for all three units.

For each display reading, calculate the corresponding pressure in the relevant units from the following formula.

Psia = ((bara-1)*14.5) + 14.7

Kpa = bara*100

Appendix E

Specification

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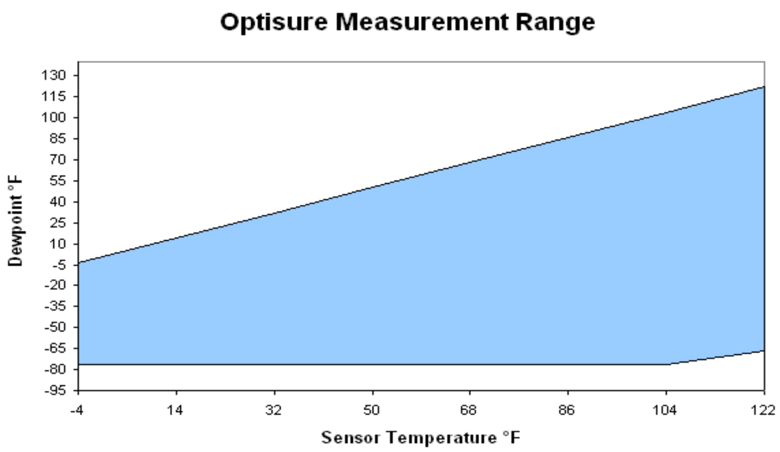
<table>
<tr><th>PARAMETER</th><th>SPECIFICATION</th></tr>
<tr><td>Measurement Range</td><td>-76°Fdp to +104°Fdp (-60°Cdp to +40°Cdp)

</td></tr>
<tr><td>Units</td><td>°C and °F for dewpoint and temperature.
%rh, gm^{-3}, gkg^{-1}, ppmv, ppmw(SF_6), for calculated humidities.
Pressure Option: bara, psia, kPa, for pressure. Accuracy 0.25%.</td></tr>
<tr><td>Resolution</td><td>To 0.001 for all units and user selectable.</td></tr>
<tr><td>Accuracy</td><td>±0.18°F (±0.1°C) for dew-point and temperature.
0.25% FS for pressure.</td></tr>
<tr><td>Measurement Response Speed</td><td>Times from a DCC to a stability of ±0.36°Fdp (±0.2°Cdp).
<table>
<tr><th>DP (°F)</th><th>Time</th></tr>
<tr><td>+50</td><td>40 sec</td></tr>
<tr><td>+14</td><td>1 min to a dewpoint & 12 min to a frost point</td></tr>
<tr><td>-22</td><td>7 min 30 sec</td></tr>
<tr><td>-58</td><td>10 min</td></tr>
<tr><td>-76</td><td>20 min</td></tr>
</table></td></tr>
<tr><td>Sensitivity</td><td>0.0018°F (0.001°C)</td></tr>
<tr><td>Dp and Temp. Repeatability</td><td>± 0.09 °F (0.05 °C).</td></tr>
<tr><td>Remote Temperature Probe Input</td><td>4-wire PT100 or PT1000 (user selectable) ambient temperature measurement.</td></tr>
</table>

PARAMETER	SPECIFICATION
Sensor Pressure	0-250 psig (17 bar); with the internal sample pump, the unit is limited to atmospheric pressure.
Sample Flow Rate	0.2 to 2.0 scfh (0.1 to 1 $lmin^{-1}$)
Internal Flow Transducer/Meter	Single point calibration at optimum flow.
Detection System	Temperature regulated emitter with dual optic detection.
HMI	High definition, blue LCD. User adjustable contrast. Menu navigation via five button keypad.
Outputs	3 analog outputs. User definable for hygrometric units and flexible configuration for 0 to 20mA, 4 to 20mA or 0 to1V. Pressure Option: bara, psia, kPa, for pressure. Accuracy 0.25%.
Process Alarm	Changeover relay contacts (30V, 1A) for hygrometric units and Set-points, with user configurable set-points.
Fault Alarm	Changeover relay contacts (30V, 1A) for mirror contamination, Optical and Temperature measurement fault. Pre-set.
Communications	Modbus RTU protocol @9600 baud rate data using USB interface.
Data Logging	SD Card (512mb supplied) and USB interface. SD Card (FAT-16) - 2Gb max. that allows 24 million logs or 560 days, logging at 2 second intervals.
Operating Range	-4°F to +122°F (-20°C to +50°C) temperature. Up to 90% relative humidity.
Storage Temperature	-40°F to +140°F (-40°C to +60°C).
Dimensions	**Vertical:** 17.5" high x 7.9" wide x 13.8" deep. (16.4" deep when microscope mounted). **Horizontal:** 7.3" high, x 17.3" wide x 13.8" deep. (16.4" deep when microscope mounted).
Weight	**Vertical:** 24 lbs **Horizontal:** 22 lbs
Power Supply	85VAC to 264VAC, 47 to 63 Hz, 100VA.
Power Consumption	100W
Pressure Input (Option)	4-20mA pressure transmitter for pressure correction of ppm(v) and ppm(w).
EMC - Class A Emissions	Complies with EN61236:1997 (+A1/A2/A3)
Industrial Location Immunity	Complies with EN61236:1997 (+A1/A2/A3)

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Appendix F

Modbus

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F.1 MODBUS RTU communications

F1.1 Introduction

Optisure Hygrometers have a Modbus communications interface via the USB port, that enables remote access to the instrument's configuration and data logging facilities. This protocol offers two-way communication between a host (PC), known as the master unit, to one or more instruments, termed slave units.

Once communication is established by the master unit, reading or writing to holding registers within an addressed slave unit is possible. The master unit can obtain measured values and status information by reading registers and can respond to data contained within these registers by writing back.

The following tables list these registers, as they apply to the Optisure Hygrometer and specify the number and data formats that apply to each register.

F.2 Basic MODBUS operation

There are two possible MODBUS transmission modes: ASCII and RTU (Remote
Terminal Unit). The Optisure Hygrometer is classed as an RTU.

Communication between a host system (e.g. PC) operates on a Query-Response Cycle (see the Figure D1 below), where a specific Modbus function code, embedded in the query message, tells the addressed slave device what actions to perform using the information contained in the data bytes.

An error checkfield provides a method for the slave to validate the integrity of the message contents. If the slave makes a normal response, the function code in the response is an echo of the function code in the query and the data bytes will contain data collected by the slave e.g. holding register values or status information. If an error occurs, the function code is incremented by 80H (most significant bit set to 1) to indicate that the response is an error response, and the associated data bytes contain a code to define the error.

The error check field, CRC (Cyclic Redundancy Check), allows the master to confirm that the message contents are valid.

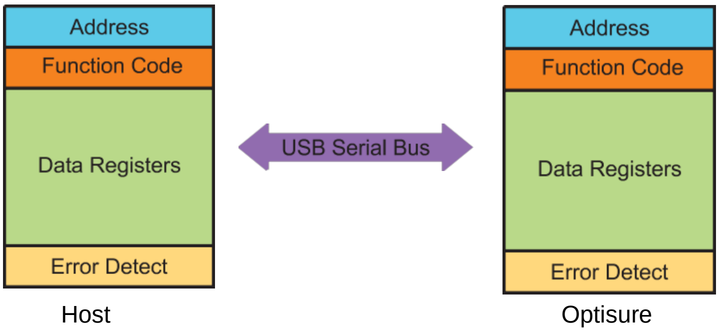

Figure F1 - Modbus Connection

F2.1 MODBUS RTU connections and protocol

The physical connection from the master to the Optisure Hygrometer uses a USB connection cable between the host and the instrument's communications connector. Refer to Section 3.5.6 for details of the connection of this cable.

The serial port protocol is as

follows: Baud Rate: 9600
Start Bits: 1
Data bits: 8
Parity: None
Stop bits: 2

Typically, a Modbus RTU message is structured as follows,

Byte 1	Slave Address	Value 1-247
Byte 2	Modbus Function Code	Value 3 *(e.g read register)*
Byte 3	Start Address (Low byte)	Value 0 - 255
Byte 4	Start Address (High byte)	Value 0 - 255
Byte 5	No. Registers to read (Low byte)	Value 0 - 255
Byte 6	No. Registers to read (Low byte)	Value 0 - 255
Byte 7	Error Check Value	

F2.2 Register map

All the data values relating to the Optisure Hygrometer are stored in holding registers. Each of these registers is two bytes (16-bits wide). Some of these registers contain instrument specific values e.g. its own unique system address, emitter drive values etc. and others are used to hold specific real time data e.g. measured dewpoint temperature.

Each MODBUS message has a two part address code, one for the low byte, bits 0 through 7 and one for the high byte, bits 8 through 15. The facility exists for multiple registers, specified by a high and low byte contained in the query message, to be addressed and read by the same message.

Table D1 describes the instrument's registers with their respective address locations, together with their relevant register configurations and register map definitions.
Note: Hexadecimal (Hex) addresses marked with an asterisk in Table D1 denote instrument specific parameters stored in the instrument's flash memory.

The register maps following Table D1, Tables D2 to D14, define the data allocated to each bit/byte of that specific register.

Address dec	Address hex	Function	Read/ Write	Default Value Hex	Register Config-uration	Register Map definition
0	0000*	Instrument Address	R/W	0001	H	INSTID
1	0001	Dew point Value – Hi Word	R		N	HUMIDITY_HI
2	0002	Dew point Value – Lo Word	R		N	HUMIDITY_LO
3	0003	Ambient Temperature – Hi Word	R		N	AMBTEMP_HI
4	0004	Ambient Temperature – Lo Word	R		N	AMBTEMP_LO
5	0005	RH	R		A	RH
6	0006	Pressure Value	R		J	PRESSURE
7	0007	Ppmv – Hi Word	R		N	PPMV_HI
8	0008	Ppmv – Lo Word	R		N	PPMV_LO
9	0009	Ppmw(sf6) – Hi Word	R		N	PPMWSF_HI
10	000A	Ppmw(sf6) – Lo Word	R		N	PPMWSF_LO
11	000B	g/m^3 - Hi Word	R		N	GM3_HI
12	000C	g/m^3 - Lo Word	R		N	GM3_LO
13	000D	g/kg – Hi Word	R		N	GKG_HI
14	000E	g/Kg – Lo Word	R		N	GKG_LO
15	000F	Flow Value	R		H	FLOW_RATE
16	0010	Mirror Condition	R		J	MIRROR_COND
17	0011	Heat Pump Drive	R		H	HP_DRIVE
18	0012	Status	R		D	STATUS
19	0013*	DCC duration + Hold Time Duration minutes	R/W		K	DCC_HOLD_TIME
20	0014*	Measurement Time Hours + Minutes	R/W		K	MEASURE_TIME
21	0015*	Phase Time Hours	R		H	PHASE_TIME_HRS
22	0016	Phase Time Minutes + Phase Time Seconds	R		K	PHASE_TIME_MIN_SEC
23	0017*	Film thickness setting	R/W		A	FILM_THICKNESS
24	0018	Live film thickness value	R		A	LIVE_FILM_THICKNESS
25	0019*	Analogue 1 output maximum value	R/W		M	MAX_MA1
26	001A*	Analogue 1 output minimum value	R/W		M	MIN_MA1
27	001B*	Analogue 2 output maximum value	R/W		M	MAX_MA2
28	001C*	Analogue 2 output minimum value	R/W		M	MIN_MA2
29	001D*	Analogue 3 output maximum value	R/W		M	MAX_MA3
30	001E*	Analogue 3 output minimum	R/W		M	MIN_MA3
31	001F*	Analogue output configuration 1	R/W		B	OP_SELECTION1
32	0020*	Analogue output configuration 2	R/W		B	OP_SELECTION2
33	0021*	Logging Interval	R/W		H	LOG_INTERVAL
34	0022*	Units/ Command	R/W		E	UNITSCOMMAND
35	0023*	Mirror Temp Set-Point during DCC	R/W		M	MIRROR_TEMP _SETP
36	0024*	Emitter Drive	R/W		H	EMITTERDRIVE
37	0025	Stability Time	R/W		H	STABILITY_TIME
38	0026	RTC Year(val1) + Month (val2)	R/W		K	YEARMONTH
39	0027	RTC Date (val1) + Hours(val2)	R/W		K	DATEHRS
40	0028	RTC Mins(val1) + Secs (val2)	R/W		K	MINSSECS
41	0029*	Display Setting 1	R/W		F	DISPLAY_SETTING1
42	002A*	Display Setting 2	R/W		F	DISPLAY_SETTING2
43	002B	N/A				
44	002C	N/A				
45	002D	N/A				
46	002E	Filename DDMM or MMDD	R		L	FILENAME_DDMM
47	002F	Filename HHMM	R		L	FILENAME_HHMM
48	0030*	Firmware Version Number	R		A	FIRM_VER
49	0031*	N/A				
50	0032*	N/A				
51	0033*	N/A				
52	0034*	Process Alarm Configuration / Display Contrast	R/W		P	ALARMCONFIG_DISPCONT
53	0035*	Process Alarm Set Point	R/W		M	PROCESSALARM_SP_HI

Table F1 - Modbus Holding Register Map

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r

Value

Sign bit= 1 for -ve values (signed int)
7FFF = 327.67
BFFF = -327.68
The value in bits (15 to 0) + 1 is divided by 100 to give 0.01 resolution for dewpoint and temperature values

Table 02 - Register Configuration A

15	14	13	12	11	10	9	8	1	6	5	4	3	2	1	0
Analogue 0/P 2								Analogue 0/P 1							
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
DP = 00000000 Temp= 00000001 ppm(v) = 00000010 ppm(w) sf6 =00000011 g/kg = 00000100 g/m^3 = 00000101 pressure= 00000110 flow = 00000111 rh = 00001000 temp difference= 00001001								DP = 00000000 Temp= 00000001 ppm(v) = 00000010 ppm(w) sf6 =00000011 g/kg = 00000100 g/m^3 = 00000101 pressure= 00000110 flow = 00000111 rh = 00001000 temp difference= 00001001							

Table 03 - Register Configuration A

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
								Analogue O/P 3							
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
		Analogue O/P 3 00 = 0 - 20mA 01 = 4 - 20mA 10 = 0 - 1V		**Analogue O/P 2** 00 = 0 - 20mA 01 = 4 - 20mA 10 = 0 - 1V		**Analogue O/P 1** 00 = 0 - 20mA 01 = 4 - 20mA 10 = 0 - 1V		DP = 00000000 Temp = 00000001 ppm(v) = 00000010 ppm(w) sf6 =00000011 g/kg = 00000100 g/m^3 = 00000101 pressure = 00000110 flow = 00000111 rh = 00001000 temp difference = 00001001							

Table 04- Register Configuration B

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r/w	r/w	r/w	r/w	r	r	r	r	r/w	r/w	r	r	r	r	r	r
1 = Optics Reset	1 = Display Hold	1 = Max Cool Initiate	1 = DCC Initiate	1 = Start Logging 0 = Stop Logging	1 = FAST (Frost Assurance)	1= Fault Alarm	1 = Humidity Alarm	1 = External PRT	1 = Initiate Standby	In Control = 00H Heating = 01H Cooling = 10H		Measurement = 0000H DCC = 0001H Data Hold = 0010H Max Cool = 0100H Standby = 1000H			

Table F5 - Register D Status Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
Language English = 0000 Chinese = 1111				Reset Defaults	1 = FAST Enable	1 DP = 00H 2 DP = 01H 3 DP = 10H		N/A	N/A	Psig = 00H Barg = 01H kPa = 10H		Measurement = 0000H DCC = 0001H Data Hold = 0010H Max Cool = 0100H Standby = 1000H			

Table F6 - Register E Units

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Disp ay 2								**Display 1**							
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
DP = 00000000 Temp = 00000001 ppm(v) = 00000010 ppm(w) sf6 =00000011 g/kg = 00000100 g/m^3 = 00000101 pressure = 00000110 flow = 00000111 rh = 00001000 temp difference = 00001001								DP = 00000000 Temp = 00000001 ppm(v) = 00000010 ppm(w) sf6 =00000011 g/kg = 00000100 g/m^3 = 00000101 pressure = 00000110 flow = 00000111 rh = 00001000 temp difference = 00001001							

Table F7 - Register F Display Setting A

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Main Value to Log								**Display 3**							
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
DP, Temp, Press and Flow are logged by default ppm(v) = 00000010 ppm(w) sf6 =00000011 g/kg = 00000100 g/m^3 = 00000101 pressure = 00000110 flow = 00000111 rh = 00001000 temp difference = 00001001								DP = 00000000 Temp = 00000001 ppm(v) = 00000010 ppm(w) sf6 =00000011 g/kg = 00000100 g/m^3 = 00000101 pressure = 00000110 flow = 00000111 rh = 00001000 temp difference = 00001001							

Table F8 - Register F Display Setting B

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w

Unsigned Integer range 65535

Table F9 - Register Configuration H

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r

Value

Sign bit = 1 for -ve values (signed int)
7FFF = 3276.7
8FFF = -3276.8
The value in bits (15 to 0) + 1 is divided by 10 to give 0.1 resolution for dewpoint and temperature values

Table F10 - Register Configuration J

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w

Val1 Val2

Val1 & 2 are in BCD, therefore 10H = 10, 58H = 58 and 09H = 9, so as a result, A to F are not valid values

Table F11 - Register Configuration K

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w

Val1 Val2

Values in HEX i.e. 17th March = 11H for Val1 and 03H for Val 2.

Table F12 - Register Configuration L

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r

Value

Sign bit = 1 for -ve values (signed int)
7FFF = 32767
8FFF = -32768

Table F13 - Register Configuration M

Register Configuration N - Floating Point Representation

The humidity values for sensors 1 & 2 are represented in IEEE-754 single precision floating point format, in order to cater for the wide range in the value of ppm(v). This format is 'Big Ended' which means that the high byte is at a lower address in memory than the Lo byte, and is represented as such in the register memory map. The IEEE-754 format is shown below.

Bit 31 Sign bit 0 = + 1 = -	Bits 30 to 23 Exponent Field Has +127 bias value	Bits 22 to 0 Mantissa Decimal representation of binary, where 1.0 ≤ value < 2.0

Examples of floating point to HEX are shown below.

Example 1
+10.3

Sign bit
= 0

Exponent = 3, therefore exponent field = 127 + 3 = 130 , and bits 30 to 23 = 10000010. The

mantissa = 1.2875 which in binary representation = 1.01001001 1001 1001 1001
1
0
1
.

Adjusting the mantissa for the exponent moves the decimal point to the right if positive and to the left if negative.

As the exponent is = 3 then the mantissa becomes = 1010.0100 1100 1100
1100
1101,
therefore:-
1010 = $(1x2^3 + (0x2^2) + (1x2^1) + (0x2^0)$ = 10
and
0100 1100 1100 1100 1101 = $(0x2^{-1})$ +$(1x2^{-2})$ + -----+ $(1x2^{-20})$ =
0.3

Therefore the word value = 0100 0001 0010 0100 1100 1100 1100
1101
=
4124CCC
D

Consequently for sensor 1, register 0001 = 4124 and register 0002 = CCCD.

Example 2 -
0.0000045

Sign bit
= 1

Exponent = -18, therefore exponent field = 127 + (-18) = 109, and bits 30 to 23 =

011011
01.

The mantissa = 1.179648 which in binary representation = 1.00101101111111010110101.

i.e. (1x2-18) +(1x2-21) + (1x2-23) etc = 0.0000045

Therefore the word value = 1011 0110 1001 0110 1111 1110 1011 0101

= B696FEB5

Consequently for sensor 1 register 0001 = B696 and register 0002 = FEB5.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Process Alarm Configuration								**Display Contrast**							
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
DP = 00000000 Temp = 00000001 ppm(v) = 00000010 ppm(w) sf6 =00000011 g/kg = 00000100 g/m^3 = 00000101 pressure = 00000110 flow = 00000111 rh = 00001000 temp difference = 00001001								0 - 255							

Table F14 - Register Configuration P

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