Hydro-Com User Guide

To re-order quote part number: HD0273

Revision: 1.1.0

Revision date: March 2009

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CUSTOMER RESPONSIBILITY

The customer in applying the product described in this documentation accepts that the product is a programmable electronic system which is inherently complex and which may not be completely free of errors. In doing so the customer therefore undertakes responsibility to ensure that the product is properly installed commissioned operated and maintained by competent and suitably trained persons and in accordance with any instructions or safety precautions made available or good engineering practice and to thoroughly verify the use of the product in the particular application.

ERRORS IN DOCUMENTATION

The product described in this documentation is subject to continuous development and improvement. All information of a technical nature and particulars of the product and its use including the information and particulars contained in this documentation are given by Hydronix in good faith.

Hydronix welcomes comments and suggestions relating to the product and this documentation

ACKNOWLEDGEMENTS

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Revision History

Revision No.	Software version	Date	Description of change
1.0.0	1.10	06/2005	Original version
1.0.1.	1.10	01/2006	Typographical errors amended
1.1.0	1.62	03/2009	New version containing changes for Ethernet adapter and new measurement modes

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1 Introduction

Hydro-Com is a software tool used to configure, maintain and calibrate systems incorporating Hydronix microwave moisture sensors.

The program is designed for use on PC-compatible machines running Microsoft Windows 2000 and XP. An older version, v1.30 is available for customers using Windows 98SE, and ME.

The utility allows the user to:

- Configure a networked system using the RS485 interface of the sensors.
- Change the factory default settings of the sensors.
- Log readings into a file for further analysis
- Upgrade the firmware in the sensors.
- Perform material calibrations.
- Diagnose sensor and integration problems.
- Change settings in local Ethernet Adapters

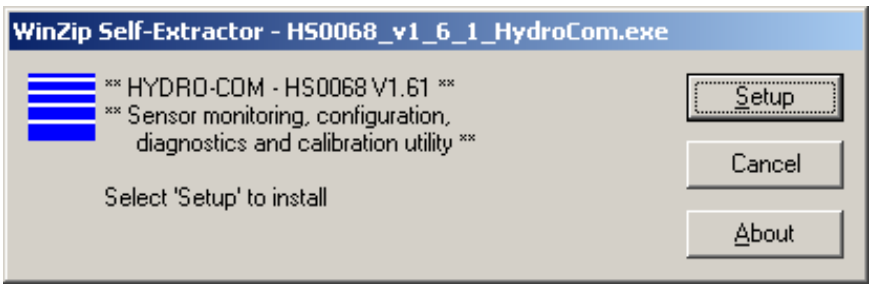
Refer to Engineering Note EN0040 for information on how to connect Hydronix sensors to a PC. This is available for download at http://www.hydronix.com

Notes:

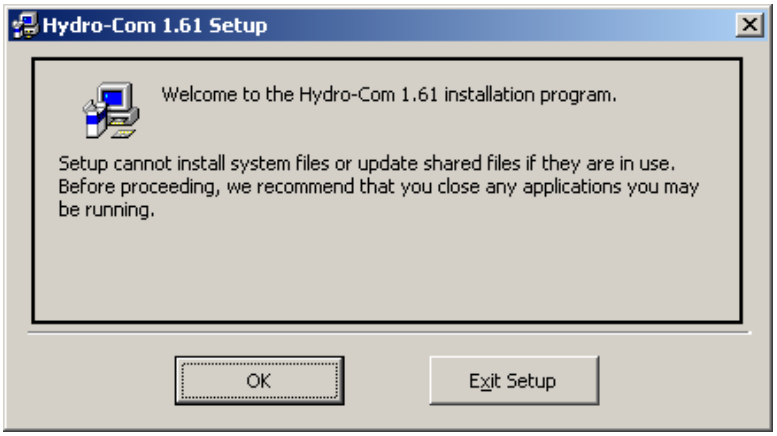
2 Software Installation

Hydro-Com can be downloaded from the Hydronix Website at http://www.hydronix.com/

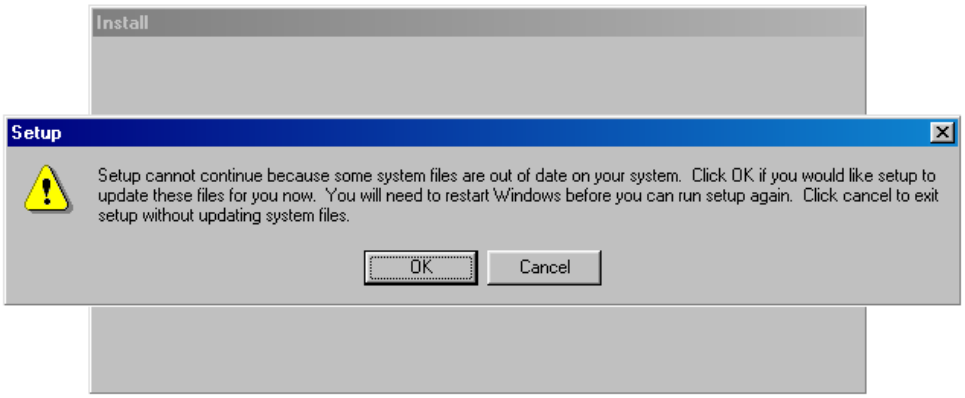
The utility installation file is a self-extracting executable (.exe). Once downloaded, the software can be installed by double clicking on the file. The following box will appear. Press 'Setup' to begin the installation.



It is advisable to close down any applications before software installation.



Depending on the PC Operating System, a warning message may appear which instructs the user that a system restart is required to complete the installation. If so, restart the computer and start the installation once again by selecting the install executable file (.exe).

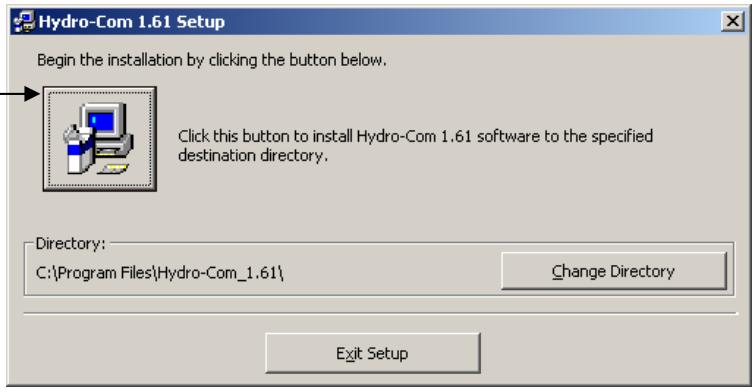


The following box will then appear prompting the user to select the location for the install files. The default location on the computer is in C:\Program Files\Hydro-Com_x.yy where x.yy is the Hydro-Com version number.

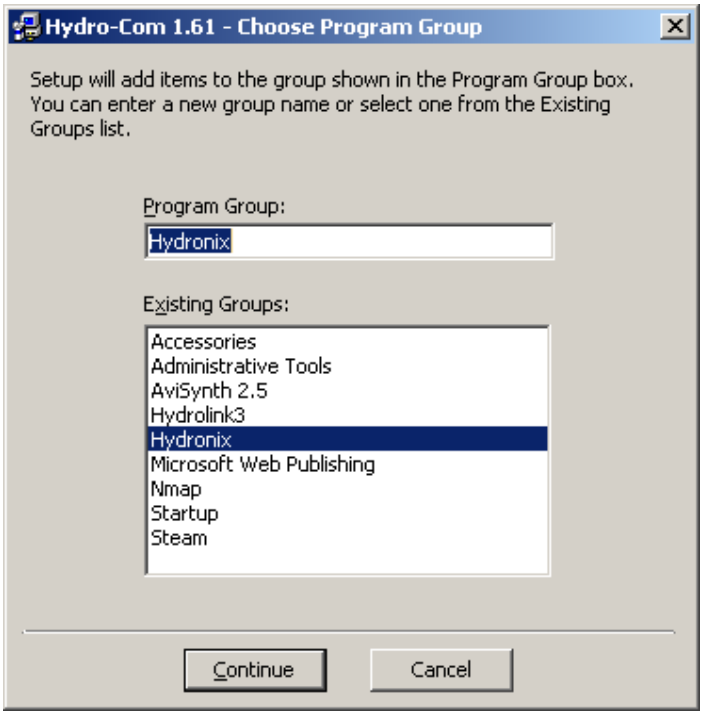
If required the location can be altered by using the 'Change Directory' button.

Install the software in the selected directory by pressing the button as shown.

Click this button to install Hydro-Com



At the end of the installation a shortcut is created in the 'Start' menu. The title of this can be changed here if required in the 'Program Group:' field. The default shortcut group is 'Hydronix'. Pressing 'Continue' will complete the installation.



1 Hydro-Com Overview

Hydro-Com is a complete customer utility designed to replace previous Hydronix utilities. It allows the user to configure any of the latest generation of Hydronix digital moisture sensors.

Hydro-Com is separated into a number of pages, allowing users to configure sensors on the RS485 network, monitor and log sensor readings to a file, customise by altering the internal configuration, calibrate the sensor to the material, diagnose problems and upgrade the firmware.

2 Toolbar Menus

2.1 Operating Language

The default language is English, but other languages may be selected from the tool bar. The language can only be changed on the sensor page. When the language is changed, the utility automatically begins a new search for connected sensors.

2.2 Communications

Available serial communication ports (“Com ports”) are detected automatically when the utility starts up, and when the system detects a change of attached USB devices. Ethernet adapters can be searched for and added to the “TCP/IP” menu.

The first time Hydro-Com is used, it will use the first available port if one is installed. After that the last used port or first available will be selected at start-up. Users can only change the com port number on the sensor page. When the Com port or Ethernet adapter is changed, the utility automatically begins a new search for connected sensors.

2.3 Help

A comprehensive help file is included in the language selected when Hydro-Com was installed.

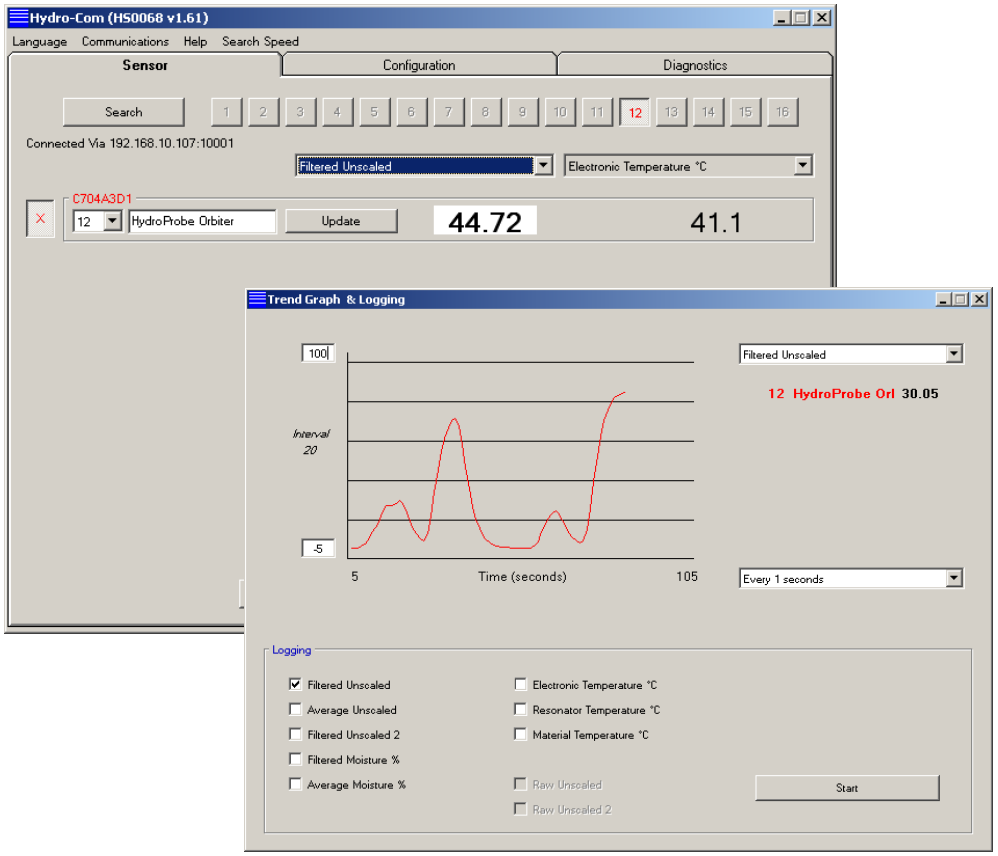
2.4 Search Speed

The search speed can be varied if there are suspected timing issues with the RS485 link (for example, a long cable run). This only affects the initial sensor search.

3 Sensor Page

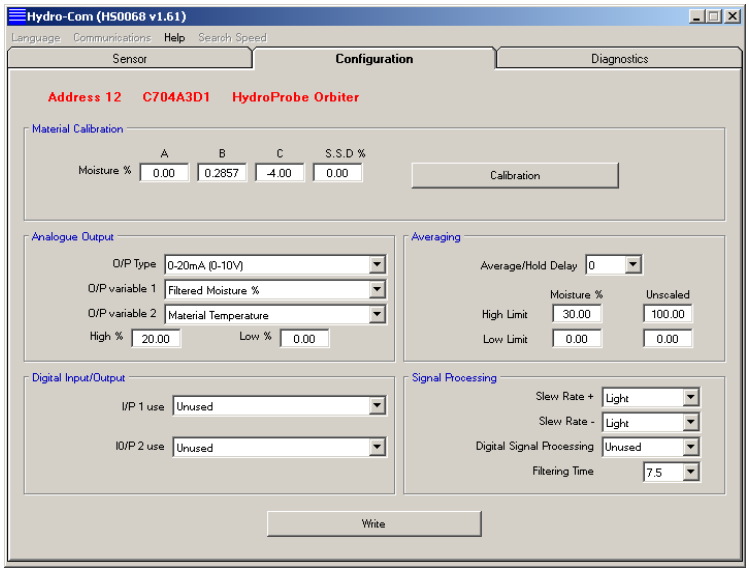
The sensor page is the default display when Hydro-Com is started. This page shows the status of all connected sensors, allows configuration of the network by renaming and readdressing sensors, and allows the readings of up to six sensors to be read simultaneously.

This page also contains a further link to a trend graph and logging page which can be used to observe long-term trends and for recording sensor readings into a formatted text file.



4 Configuration Page

The configuration page allows users to view or change the internal parameters of the sensor to suit the application. Changes may include optimisation of the filtering or batch averaging, or the setup of the analogue output.

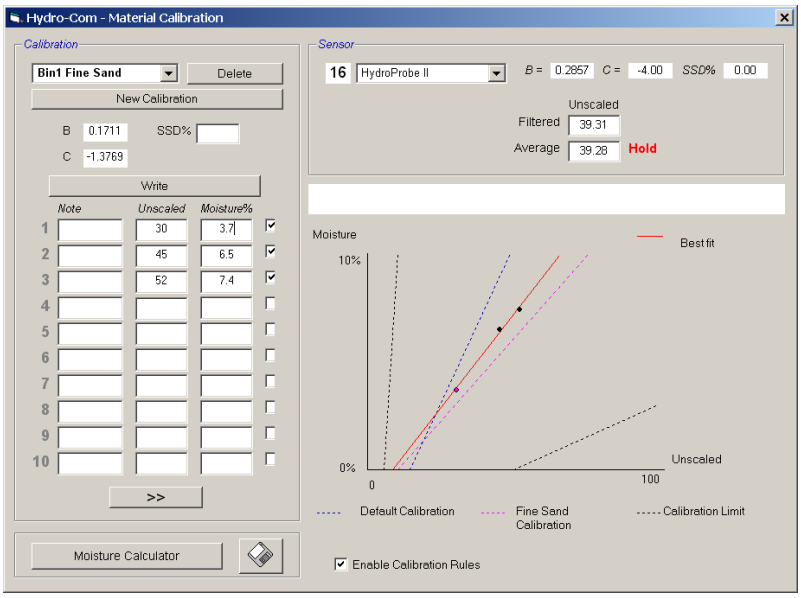


The sensor can be calibrated to the material it is measuring. The calibration window is accessed from the configuration page.

The material calibration window, as shown below, is similar to the dedicated Hydronix calibration utility Hydro-Cal. Hydro-Com users do not need to download Hydro-Cal for calibration purposes.

4.1 Calibration Window

The calibration window contains a database which can be updated to provide a multipoint calibration for improved accuracy. This application is primarily intended to be used to calibrate a Hydro-Probe II sensor measuring materials in bins or on conveyors. In particular it will enable a user to sensibly calibrate the sensor when only one set of calibration data is available. The function also incorporates certain calibration rules and safeguards which will aid the user in obtaining reasonable and accurate results despite typical problems that can arise whilst trying to achieve a good calibration.



5 Diagnostics Page

The diagnostics page contains data to help diagnose problems with a sensor in the field. The available temperatures and the frequency response from the microwave resonator can be read simultaneously. Some important status flags are also available, indicating if the sensor readings are within the set valid range and the digital inputs are functioning correctly.

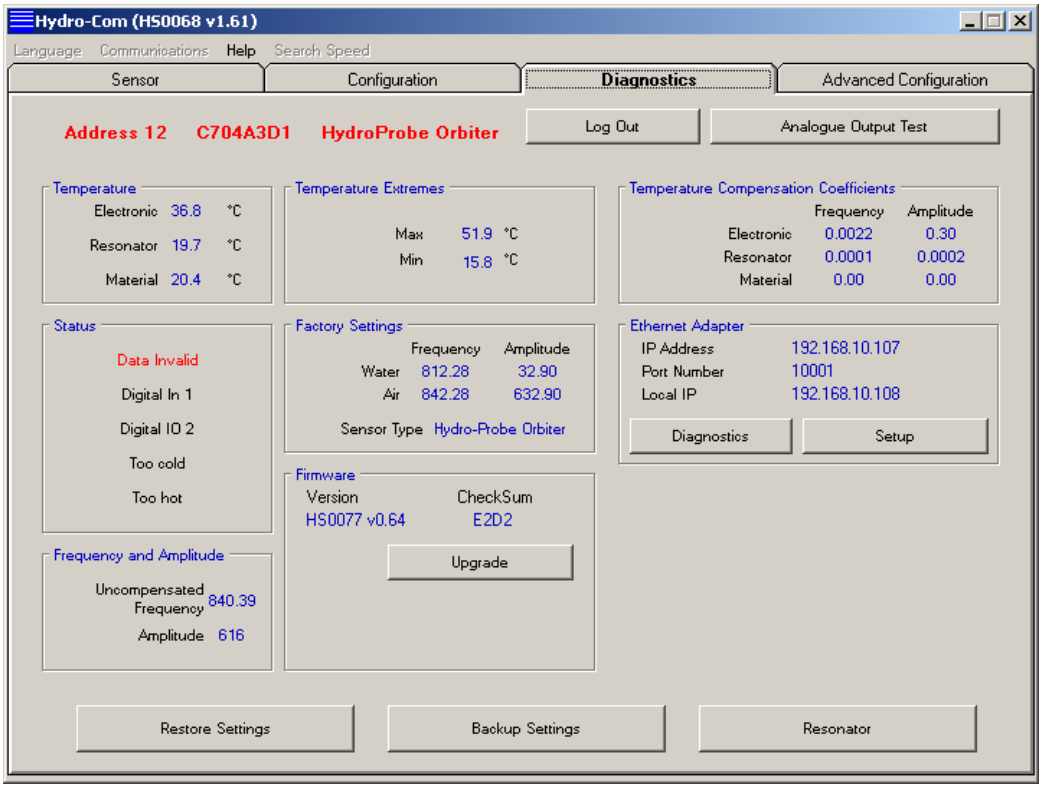
It is also possible to check the analogue outputs. The diagnostics page contains a link to a testing facility enabling the user to force the analogue output to a known value. This is important when checking the correct operation of both the sensor output and the related analogue input port such as a PLC input card.

Log in is possible using the passwords listed in Appendix C.

After logging in, the sensor firmware can be upgraded using a special upgrade feature, as described in the section Performing Air and Water Factory Calibration on page 37 of this manual.

The factory settings and temperature compensation coefficients are displayed on this tab and can be changed by logging in and selecting the Advanced Configuration tab.

When connected to an Ethernet Adapter, a panel is displayed which details the link and contains a diagnostic button for viewing connection data and a settings button (after logging in) for configuring the adapter.



6 Advanced Configuration Page

Note: this page is only available when the password protection function has been enabled

The advanced configuration page gives access to temperature compensation coefficients and air/water (factory) calibration. These are not normally needed to be changed.

6.1 Security Settings

The check boxes disable edits on the configuration page and deleting calibration points on the calibration page.

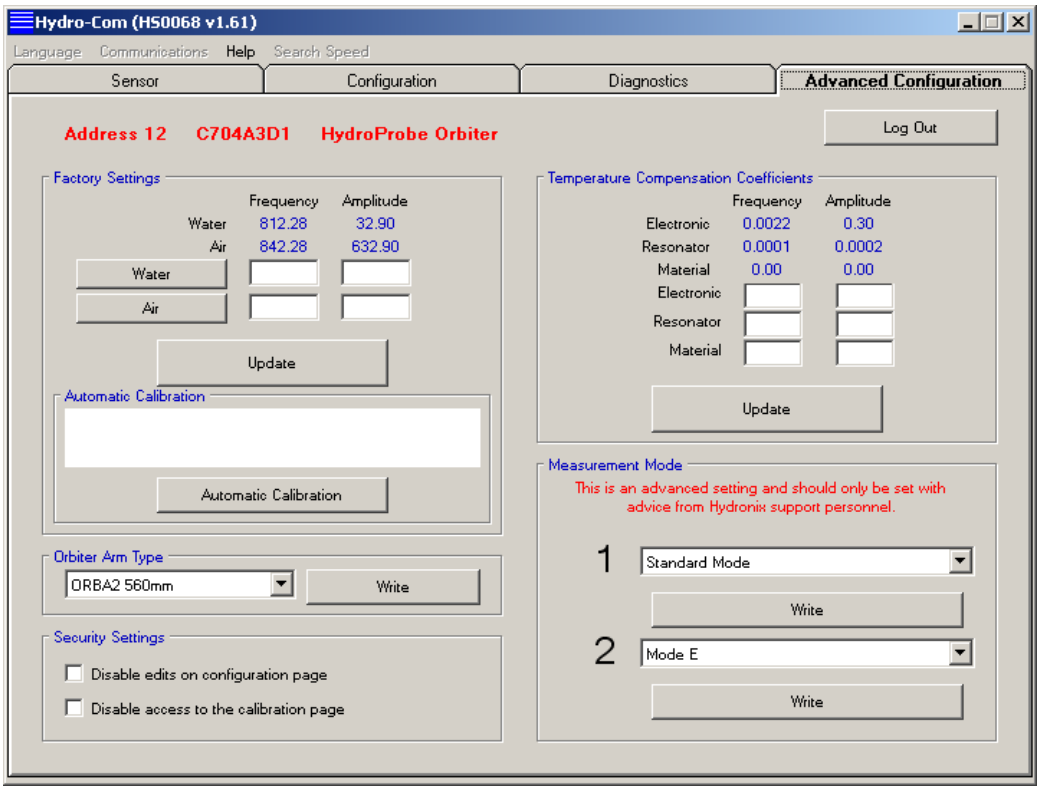
Depending on the sensor connected, there are a number of other options available.

6.2 Orbiter Arm Type

If available, the Hydro-Probe Orbiter arm type will need to be set to tell the head unit what style and size arm is attached. The options are ORBA1, ORBA2-560mm, ORBA2-700mm, ORBA2-1200mm and ORBA2-1400mm.

6.3 Measurement Mode

If available, this option sets the measurement analysis mode for the two unscaled outputs. The options are Standard Mode, Mode V and Mode E. These measurement modes are discussed in the relevant product user guides.



1 Communications

The Communications menu allows the user to change the method of digital connection to the sensor. This can be a COM Port, a USB module or an Ethernet Adapter.

When a USB adapter is connected to the PC, the Communications menu will automatically update to list the COM Ports that are currently available on the computer. The USB driver will automatically assign a virtual COM Port to the USB adapter.

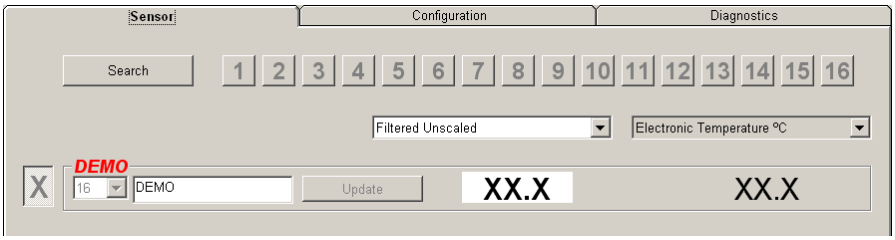
To connect to an Ethernet adapter, the network must first be searched to find local adapters. This search can be initiated by selecting Communications and then TCP/IP and then “Search for Ethernet Adapters”.

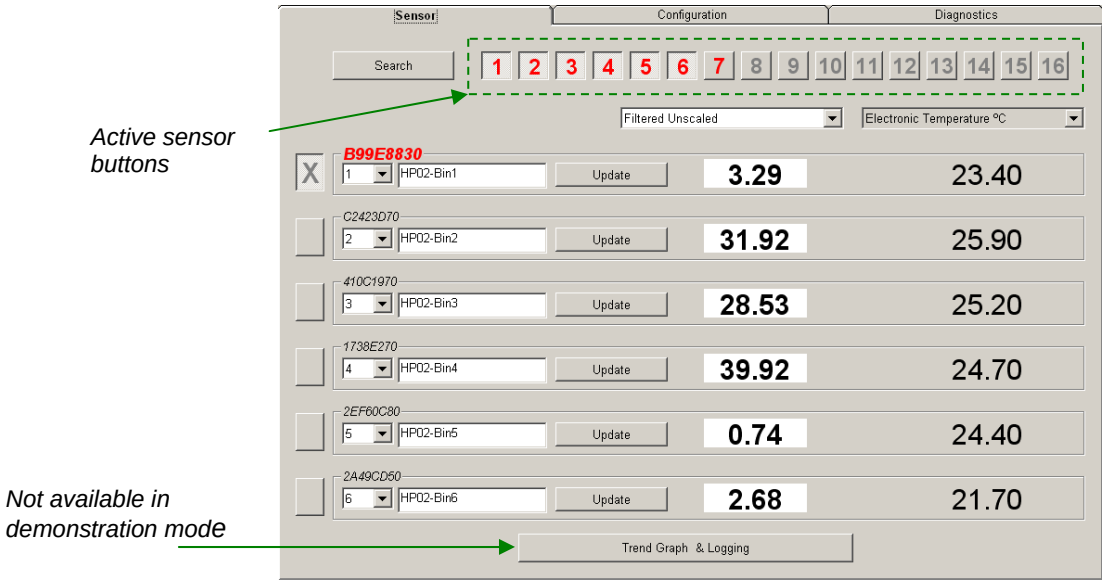
2 Active Sensors

When the utility is started (or the search button is pressed) the Hydronix moisture sensors transmitting on the RS485 network are detected. Up to 16 sensors may be used on a single network and each is identified by a network address in the range 1 through 16.

If no sensors are found, the following message will appear. If a sensor is connected to the computer then follow the instructions in Chapter 11 for hints on how to establish communications.

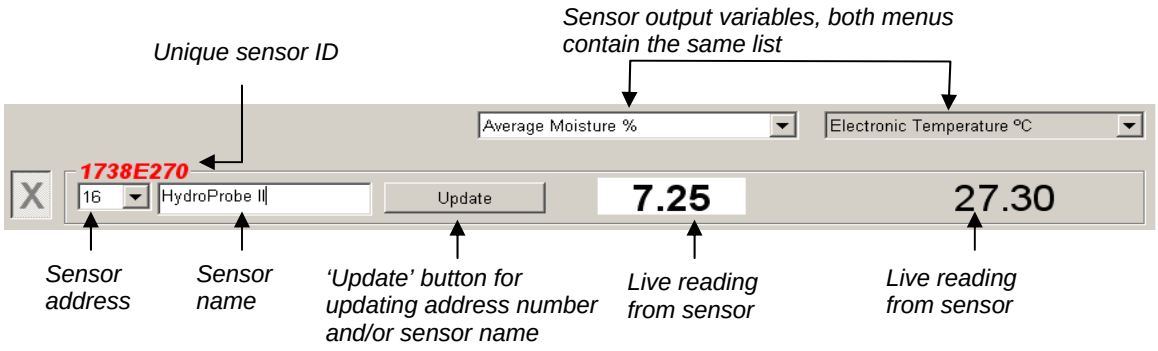
When no sensors are found, Hydro-Com reverts to demonstration mode as shown below, enabling the user to browse the different pages and menus for reference. This mode also allows setup of an Ethernet adapter from the diagnostics page.



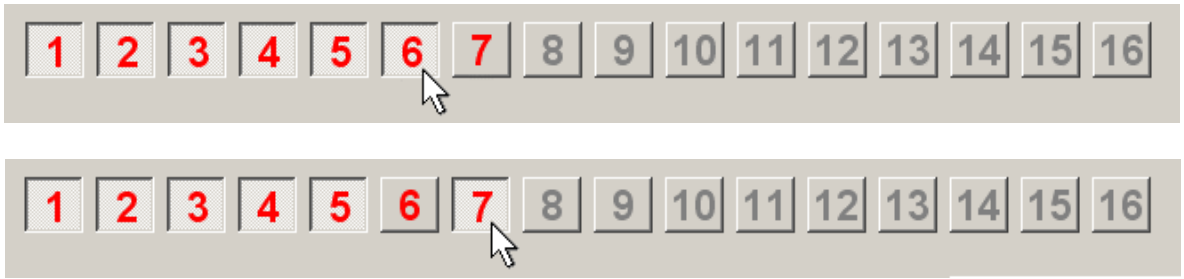


Sensors that are found on the RS485 network are identified by their address number displayed on the active sensor buttons as shown. Up to 6 active sensors at a time can be viewed in Hydro-Com as shown.

Each sensor is displayed with its address number, unique ID, sensor name and live readings as chosen using the sensor output variable drop-down list.



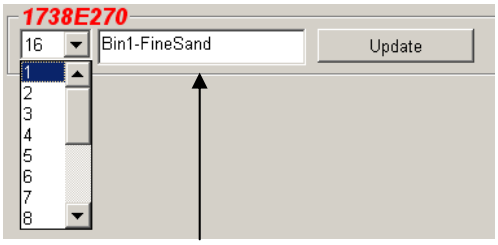
A maximum of six sensors can be shown at any one time. The first six found will automatically be selected. In order to view other sensors one or more active sensors will first have to be deselected.



2.1 Configuring the RS485 Network

During manufacture, Hydronix assigns each sensor a unique ID and a **common network address of 16**. When more than one sensor is connected on a network, each must be assigned a different network address otherwise the network will fail to operate correctly. There is also the facility for a user-defined name for each sensor.

Since new sensors will always appear at network address 16, they should be added to the network individually and their network addresses reassigned using the following procedure:

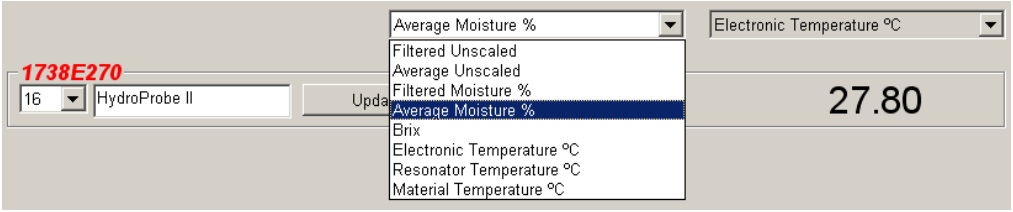
1	Temporarily disconnect any sensor having an existing network address of 16 by unplugging the connector.	
2	Connect the new sensor to the network by plugging in its 10-way connector. Press the 'Search' button to locate this new sensor at address 16.	
3	Select an unused network address from the address drop-down list.	 User defined sensor name
4	Rename the sensor if appropriate using the sensor name box.	
5	Press the 'Update' button. The new sensor will be renamed internally and will reappear at the address specified.	
6	Attach a label to the sensor to indicate its new network address to prevent later confusion.	
7	Repeat steps 2 through 6 for any further sensors being installed at this time.	

2.2 Troubleshooting the network

If a new sensor does not appear in the **Active sensors** list.

- Check power and all connections to the sensor.
- If you have other sensors connected, temporarily disconnect these – the 'new' sensor may have already been configured to a conflicting network address and will need to be changed.
- Try a slower search (selected on the Search Speed menu) – this allows the sensor more time to respond to Hydro-Com (for example if it is on a long cable run)

2.3 Sensor Measurements



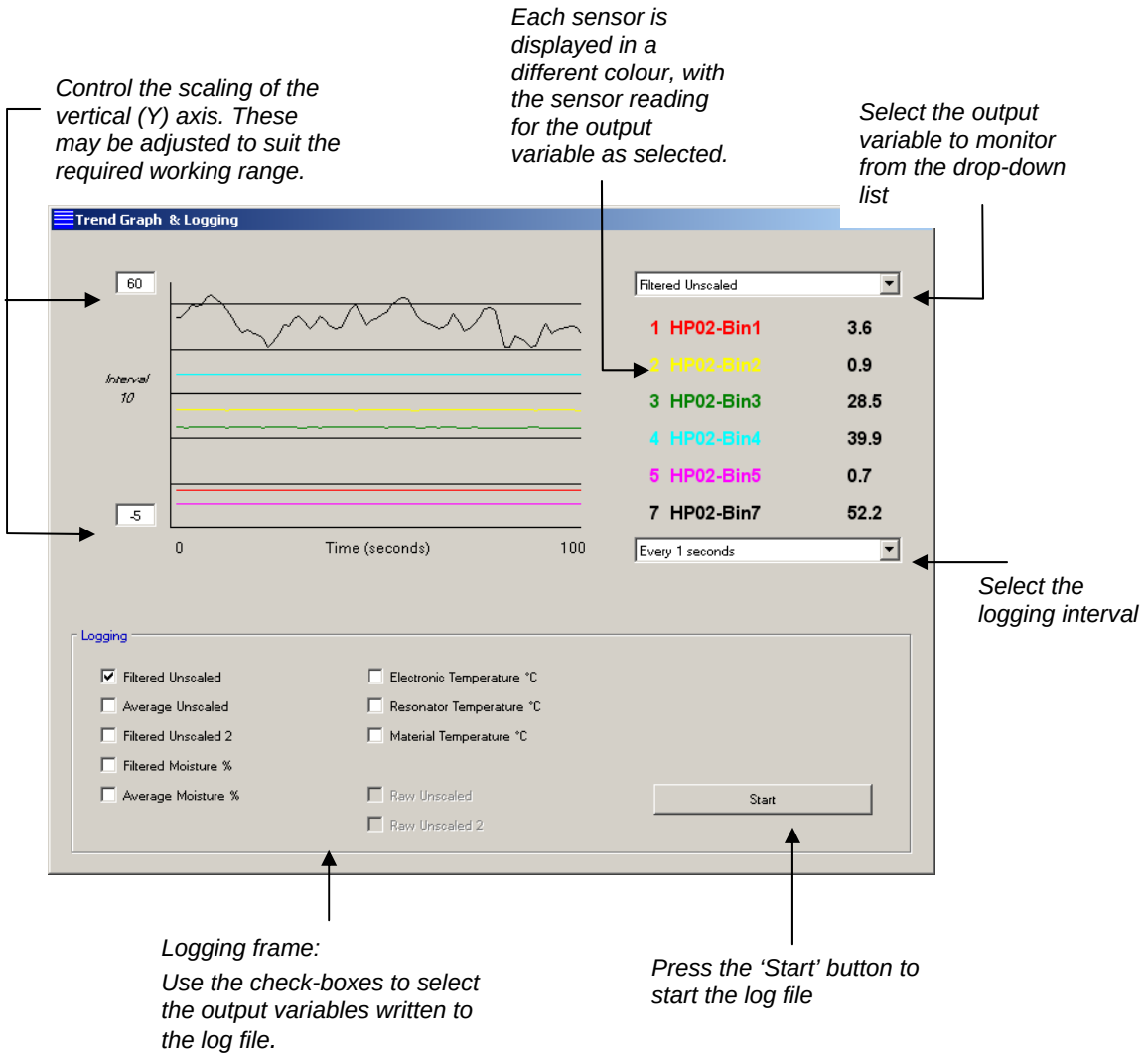
The two drop-down lists can be set to display any of the variables generated within a given sensor. The items are identical in each menu. Note that not all the variables in the list are available in each sensor model. (See 'Hardware' in Appendix D for more information.) If a

variable is selected which is not available in the connected sensor, then the reading will be blank.

Full descriptions of sensor output variables are described in Appendix B.

2.4 Trend Graph and Logging

Pressing the 'Trend Graph and Logging' button on the sensor page enables the data trend and logging function. Here it is possible to graphically monitor any output variable, and also log data to a file. Each active sensor selected from the sensor page is displayed on this page.



2.4.1 Trend Graph

The scaling on the horizontal (X) axis is fixed at 100 points. The time over this period is 100 multiplied by the logging interval, which is selected using the logging interval drop-down list. For example logging at 5 seconds per reading, the horizontal axis will span 500 seconds.

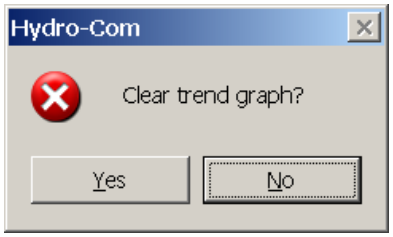
Hydro-Com can be configured to log every 1, 2, 3, 5, 10 or 60 seconds, the maximum log rate is determined by the number of sensors active. The table below shows the maximum log rate against the number of active sensors.

Active sensors	Maximum logging rate
1	Every 1 second
2	Every 1 second
3	Every 2 seconds
4	Every 3 seconds
5	Every 5 seconds
6	Every 5 seconds

If the logging rate is not as fast as required, then the number of sensors active on the network should be reduced by going back to the sensor page and deselecting sensors that are not necessary for logging.

To show a different output variable (temperature/moisture/unscaled) on the trend graph, select the required reading from the output variable drop-down list. The trend graph will quickly change to show the new selection.

If a new logging interval is selected from the drop-down list, the following message appears notifying that the data will be cleared. Click 'Yes' to begin logging at the new interval. Selecting 'No' will keep the logging interval the same and the data will remain in memory.



2.4.2 Logging to File

Sensor data can be saved to file using the 'Start' and 'Stop' buttons within the 'Logging' box. The specified data is logged to a text file with the file extension '.txt'. The data in this file is formatted with tab separators so that it can be imported into a suitable program like Microsoft Excel, for further graphical analysis.

Before pressing the 'Start' button the user must select which output variables to log to the file using the check boxes provided. When the start button is pressed a 'Save As' box will appear where the file name and location should be specified. Data will then be logged at the specified time interval, against both system clock time and elapsed time.

2.4.3 Logging Raw Data

All current Hydronix sensors have an internal sample rate of 25 times per second. This is internally filtered and the standard logging reads this value as per the selection for the time.

However if one of the ‘Raw Unscaled’ or ‘Raw Unscaled 2’ options are selected as the output variable to monitor, then the ‘Raw Unscaled’ logging options become enabled and the other options disabled.

The ‘Raw Unscaled’ logging allows the raw internal sensor value to be logged. This can be very useful if the actual sensor performance is being monitored.

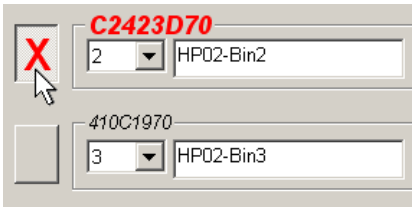
Note that this mode will log the raw sensor data at 25 entries every second and as such can create extremely large log files.

On sensors that support multiple measurement modes, Raw Unscaled 2 can be logged instead of Raw Unscaled.

This page is used to configure the selected sensor for the application. In many cases the factory default settings will be appropriate but these may be changed if required.

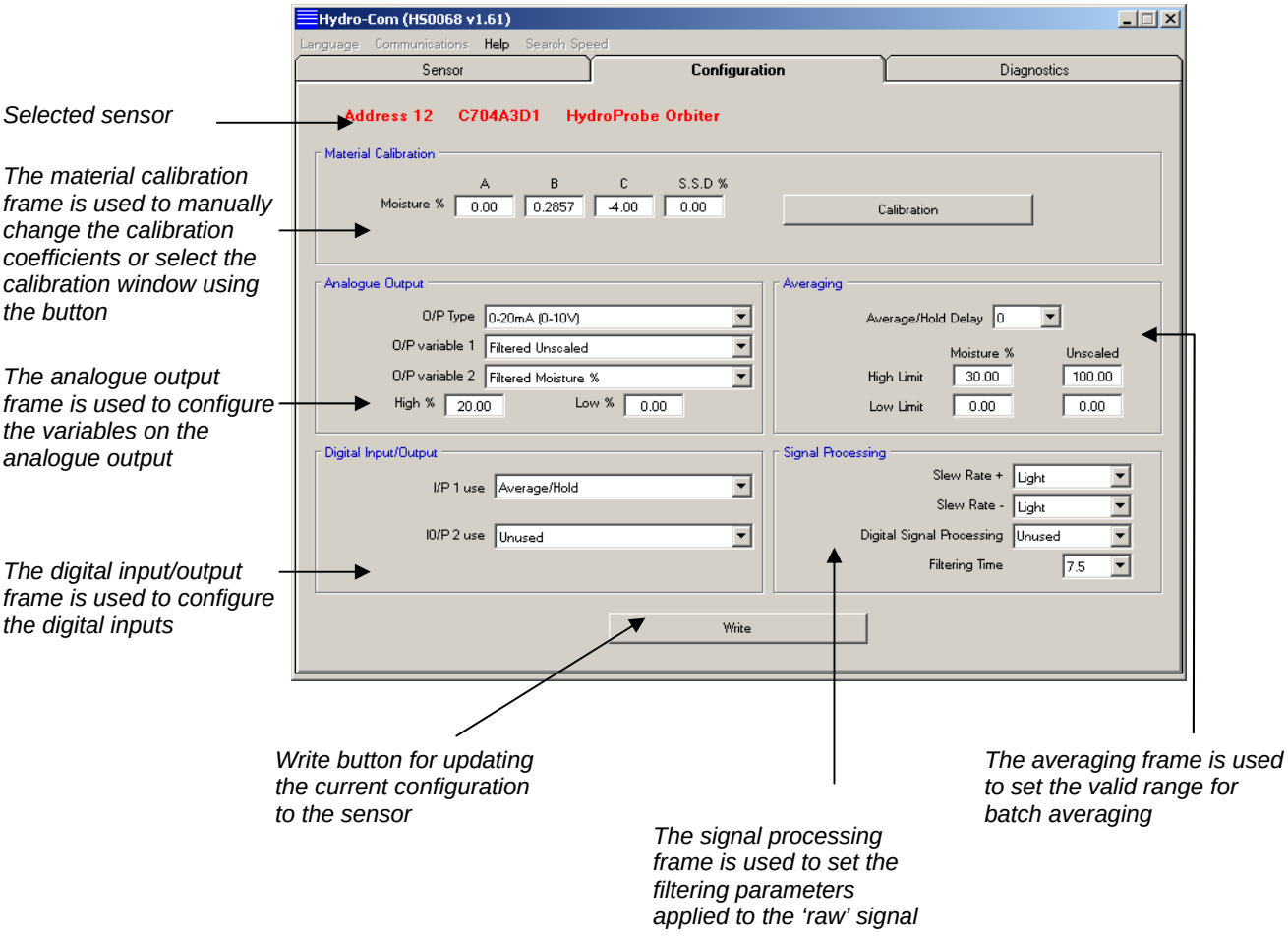
1 Selecting the Sensor

To view or change the configuration parameters for a sensor, the particular sensor must be selected on the sensor page by selecting the red cross next to the sensor as shown below.



Once the correct sensor is selected, the internal configuration parameters for that sensor are read when the configuration page is selected, and the sensor ID, address and name are shown at the top of the page.

2 Configuration Page



2.1 Write Button

When the contents of the page are set as required for the application, click on the 'Write' button to load all settings into the sensor.

2.2 Material Calibration Frame

2.2.1 Moisture %:

The A, B, C and SSD parameters are the scaling factors used to calculate moisture. These coefficients are determined from the material calibration. Changing these values will therefore alter the calibration.

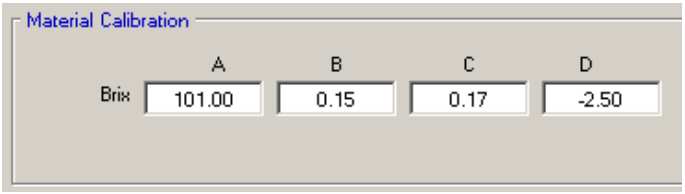
The % moisture in a material is calculated by scaling the unscaled reading from the sensor using the equation of the form:

$m\% = Ax^2 + Bx + C - SSD$ (x = Unscaled reading)

SSD is the Surface Saturated Dry value of the material and is specific to the material used. See 'Moisture Calibration' in Chapter 9 for more information.

2.2.2 Brix (Hydro-Probe SE sensors only):

If the chosen sensor is a Hydro-Probe SE, the calibration frame will change to also show A, B, C and D parameters used to calculate BRIX, commonly used in the sugar industry.



Brix values from the sensor are calculated from unscaled values using an equation of the form

$Brix = A - B\,e^{Cx} + Dx^2$ (x = Unscaled reading)

2.3 Calibration Button

Displays the calibration page for material calibration. Calibrations can be stored in a database. Please refer to the calibration section of this manual for full information

2.4 Signal Processing Frame

Some applications may require different levels of filtering. The parameters for the filtering algorithms are configured in this frame.

2.4.1 Slew Rate Filters

These filters set rate limits for large positive and negative changes in the 'raw' signal. This is helpful in applications where inherent irregularities in the signal would tend to make it unstable, for example a mixer floor sensor where blades are regularly passing the sensor face. It is possible to set limits for positive and negative changes separately:

The options for both the + and - slew rate filters are: None, Light, Medium and Heavy.

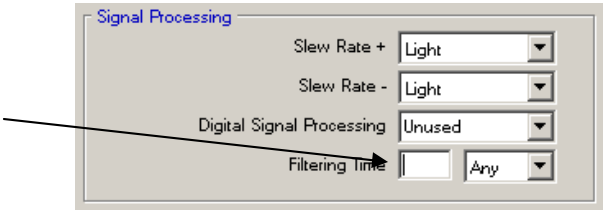
2.4.2 Digital Signal Processing (when available)

After the slew rate filters the signal is passed through a digital filter which uses a special algorithm to filter out the noise. There are six settings for the digital filter: Unused, Very Light, Light, Medium, Heavy and Very Heavy.

2.4.3 Filtering Time

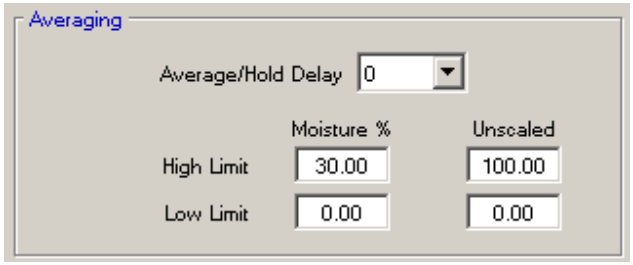
This sets the smoothing time applied to the slew rate limited or digitally filtered signal which is useful when there is a lot of noise or variation in the signal. Standard times are 0, 1, 2.5, 5, 7.5 and 10 seconds. Note that some sensor firmware versions can be configured with a larger filtering time (from 7 to 100 seconds) for special applications. Hydro-Com will detect if this facility is available in the current firmware version of the selected sensor and if so, an 'any' option in the drop-down list is provided where a filtering time can be entered, as shown.

Enter a filtering time between 7-100 seconds



2.5 Averaging Frame

These parameters determine how the data is processed for batch averaging when using the digital input or remote averaging.



2.5.1 Average/Hold Delay

When using the sensor to measure the moisture content of aggregates as they are discharged from a bin or silo, there is frequently a short delay between the control signal issued to begin the batch and the material beginning to flow over the sensor. Moisture readings during this time should be excluded from the batch average value as they are likely to be unrepresentative static measurements. The 'Average/Hold' delay value sets the duration of this initial exclusion period. For most applications 0.5 seconds will be adequate but it may be desirable to increase this value.

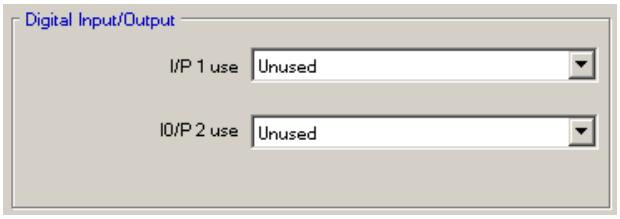
Options are: 0, 0.5, 1.0, 1.5, 2.0, 5.0 seconds

2.5.2 High Limit and Low Limit:

This refers to both moisture % and unscaled units. It is used to set the valid range for meaningful data whilst calculating the average value. When the sensor reading falls outside these limits it is not included in the average calculation and at the same time the 'Data Valid' flag (see 'Status' in the diagnostics page) is raised. If the data falls below the lower limit, the 'Bin Empty' condition is activated for those sensors whose digital output can be configured to indicate this.

2.6 Digital Input/Output Frame

The sensor provides one or two digital inputs (depending upon hardware version, see Appendix D for more details). For hardware versions containing two digital inputs, the second digital channel may be configured as an output.



The digital inputs can be configured as follows:

2.6.1 Input 1 Use:

Unused: The digital input is ignored.

Average/Hold: Input is used to control the start and stop period for batch averaging. When the input signal is activated (+24 VDC), the 'Filtered' values (unscaled and moisture) start to average (after a delay period set by the 'Average/Hold Delay' parameter). When the input is then deactivated (0V), averaging is stopped and the average value is held constant so that it can be read by the batch controller PLC. When the input signal is activated once again the average value is reset and averaging commences.

Moisture/temperature: This allows the user to switch the analogue output between the normal moisture variable and temperature. This is useful when the temperature is required whilst still using only one analogue output. With the input low the analogue output will indicate the appropriate moisture variable (unscaled or moisture%). When the input is activated the analogue output will indicate the temperature (in degrees centigrade). Note that for the Hydro-Probe Orbiter, Hydro-Mix VII and Hydro-Probe SE this will be the material temperature. For the Hydro-Probe II and Hydro-Mix V and VI sensors this temperature will be the resonator temperature.

Temperature scaling on the analogue output is fixed - zero scale (0 or 4mA) corresponds to 0ºC and full scale (20mA) to 100ºC.

2.6.2 Input/Output 2 Use:

Unused: The digital input is ignored.

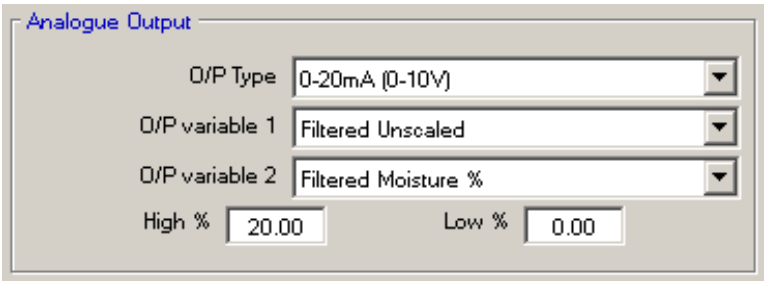
Moisture/temperature: As above.

Bin Empty: (Output) On this setting, the probe output is activated to indicates that the probe is in air, and can be used to indicate an aggregate bin is empty. It is activated when the signals (moisture% OR unscaled) drop below the low limit parameters in the averaging frame.

Data Invalid: (Output) The output is activated to indicate that the sensor reading (moisture% and/or unscaled) is outside the valid range set by 'Low Limit' and 'High Limit' parameters in the averaging frame.

2.7 Analogue Output Frame

The working range of the current loop output can be configured to suit the equipment to which it is connected. This analogue output is normally configured to be proportional to the percentage moisture reading. However it is possible to make the analogue output represent other types of output variables which are selectable from the analogue output frame.



2.7.1 Output Type:

0-20mA	This is the factory default. The addition of an external 500R precision resistor converts to 0 – 10 V
4-20mA	This is a standard 4 – 20 mA output.
Compatibility	This mode produces an analogue current with an inverted exponential characteristic that is compatible with earlier analogue versions of the Hydronix moisture sensors (Hydro-Probe and Hydro-Mix IV). A 500 R precision resistor is required to convert to voltage. This configuration must ONLY be used with a Hydro-Control IV or a Hydro-View.

2.7.2 Output Variable 1:

Filtered Moisture %:	This is scaled from the 'Filtered Unscaled' variable using the A, B, C and SSD coefficients. See Appendix B for more information.
Average Moisture %:	This is scaled from the 'Average Unscaled' variable using the A, B, C and SSD coefficients. See Appendix B for more information.
Filtered Unscaled:	This is the 'Raw Unscaled' variable which has been processed using the filtering parameters in the 'Signal Processing' frame. See Appendix B for more information. Newer model sensors may have a second 'Filtered Unscaled 2' which can be set to use a different measurement mode.
Average Unscaled:	This is the 'Filtered Unscaled' variable processed for batch averaging using the parameters in the 'Averaging' frame. See Appendix B for more information.
Brix:	(Applies to Hydro-Probe SE sensors only). This is scaled from the 'Filtered Unscaled' variable using the A, B, C and D Brix coefficients. See Appendix B for more information.
Material Temperature:	(Applies to certain sensors only). The temperature scaling is fixed - zero scale (0 or 4mA) corresponds to 0ºC, full scale (20mA) to 100ºC. See Appendix B for more information.

2.7.3 Output Variable 2:

(Hydro-Probe Orbiter, Hydro-Mix VII and Hydro-Probe SE sensors only). The options are the same as for Output Variable 1.

2.7.4 Low % and High %.

These two values set the moisture range on the analogue output when using 'moisture%' type output variables (Raw, Filtered or Average). The default values are 0% and 20%.

Example:

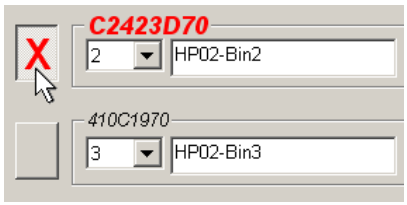
Output type 0-20 mA – 0 mA represents 0% and 20mA represents 20 %

Output type 4-20 mA – 4 mA represents 0% and 20mA represents 20 %

These settings have no effect if an 'Unscaled' type output variable is selected, in which case zero output (0mA or 4mA) always corresponds to Unscaled 0.0 (air reading) and a full-scale output (20mA) to Unscaled 100.0 (water).

1 Selecting the Sensor

To view or change the configuration parameters for a sensor, the particular sensor must be selected on the sensor page by selecting the red cross next to the sensor as shown below.



Once the correct sensor is selected, the internal configuration parameters for that sensor are read when the configuration page is selected, and the sensor ID, address and name are shown at the top of the page.

The screenshot below shows information available on the Diagnostics page. Details on the individual frames can be found in the Advanced Configuration Section.

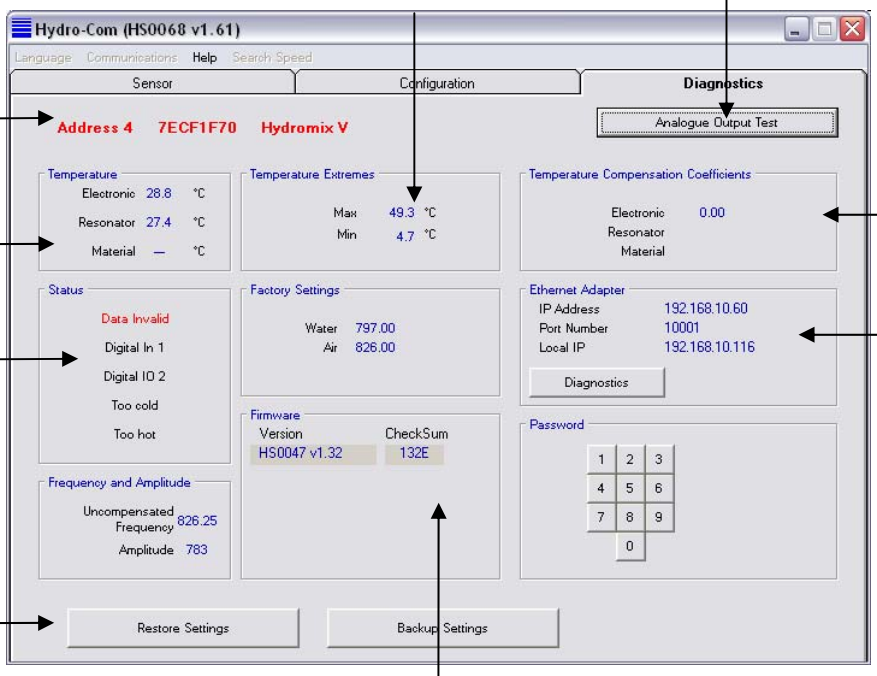
***Temperature frame**:*
Displays the electronics, resonator and material temperatures measured by the sensor

***Temperature compensation coefficients frame**:*
Displays the temperature coefficients

***Temperature extremes frame**:*
Displays the maximum and minimum internal (electronic temperature recorded by the sensor

***Analogue output test button** :*
Allows the user to test the analogue outputs

Selected sensor



***Status frame**:*
Displays status flags for the selected sensor

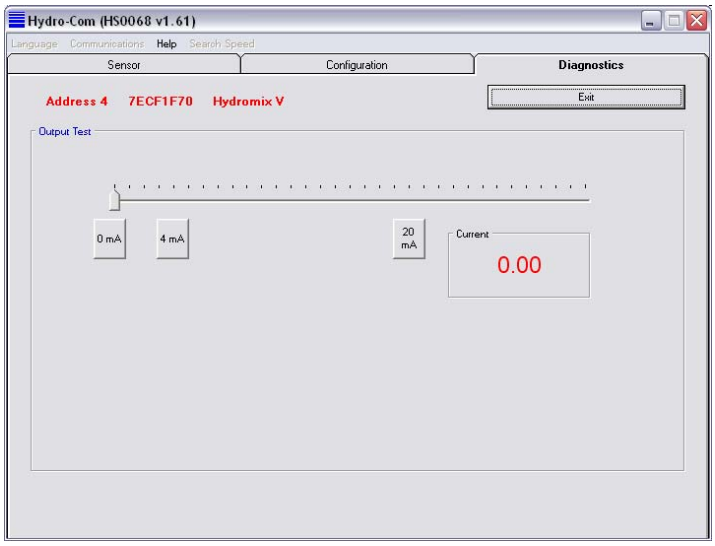
***Firmware frame**:*
Displays the current sensor firmware

***Ethernet Adapter frame**:*
Displays details about current Ethernet Adapter and allows diagnostics and settings

***Frequency and amplitude frame**:*
Live frequency and amplitude of the microwave response.

2 Analogue Output Test

The analogue output test is accessed using the 'Analogue Output Test' button. When pressed the diagnostics page changes to the following.



This function can be used to verify operation of the analogue output or calibrate the interface such as a batch controller PLC or an external indicator.

The analogue output is controlled using the 0mA, 4mA and 20mA pushbuttons and associated slider. This will force the indicated value to the output. For sensors with an available second analogue output a second slider is shown for testing the second output.

To return to the main diagnostics page press the 'Exit' button.

3 Status Frame

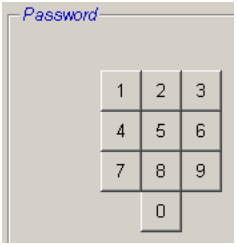
When any of the following conditions occurs, the indicator changes to red. The indicators, where applicable, are interpreted as follows:

Data Valid/Invalid:	Indicates if the sensor readings (moisture and/or unscaled) are within the low and high limits set in the 'Averaging' frame in the configuration.
Digital Input 1:	Indicates the on/off status of the first digital input.
Digital Input/output 2:	Indicates the on/off status of the second digital input/output.
Too cold:	The temperature measured by the sensor is close to 0ºC.
Too hot:	The temperature is greater than the sensor's operating temperature

4 Firmware Frame

The version number and checksum fields indicate the version of firmware installed in the sensor. The firmware is held in flash memory and may be upgraded from a file held on disk. Information on upgrading the sensor firmware can be found in the Advanced Configuration Section.

5 Password Protected Functions

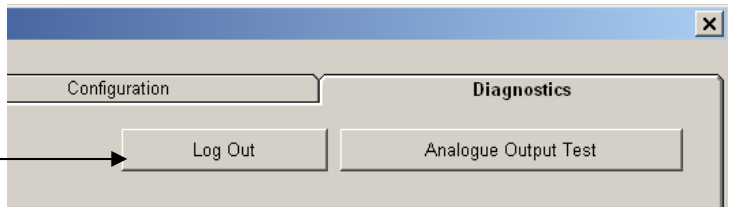


Part of the diagnostics page is protected with passwords which are designed to prevent operators changing important settings unintentionally. These passwords should be known by supervisors or the installation engineers and are shown in Appendix C. The page can be removed from this manual for security reasons if desired.

There are two levels of password protection. The lower level password provides access for upgrading firmware only, whereas the higher level password provides access to firmware upgrade, temperature compensation factors and the air and water factory calibrations.

To uncover the protected functions the password should be entered by pressing the appropriate buttons on the password keypad. The password protection can be re-enabled at any stage by pressing the 'Log Out' button.

Log out of the password-protected area



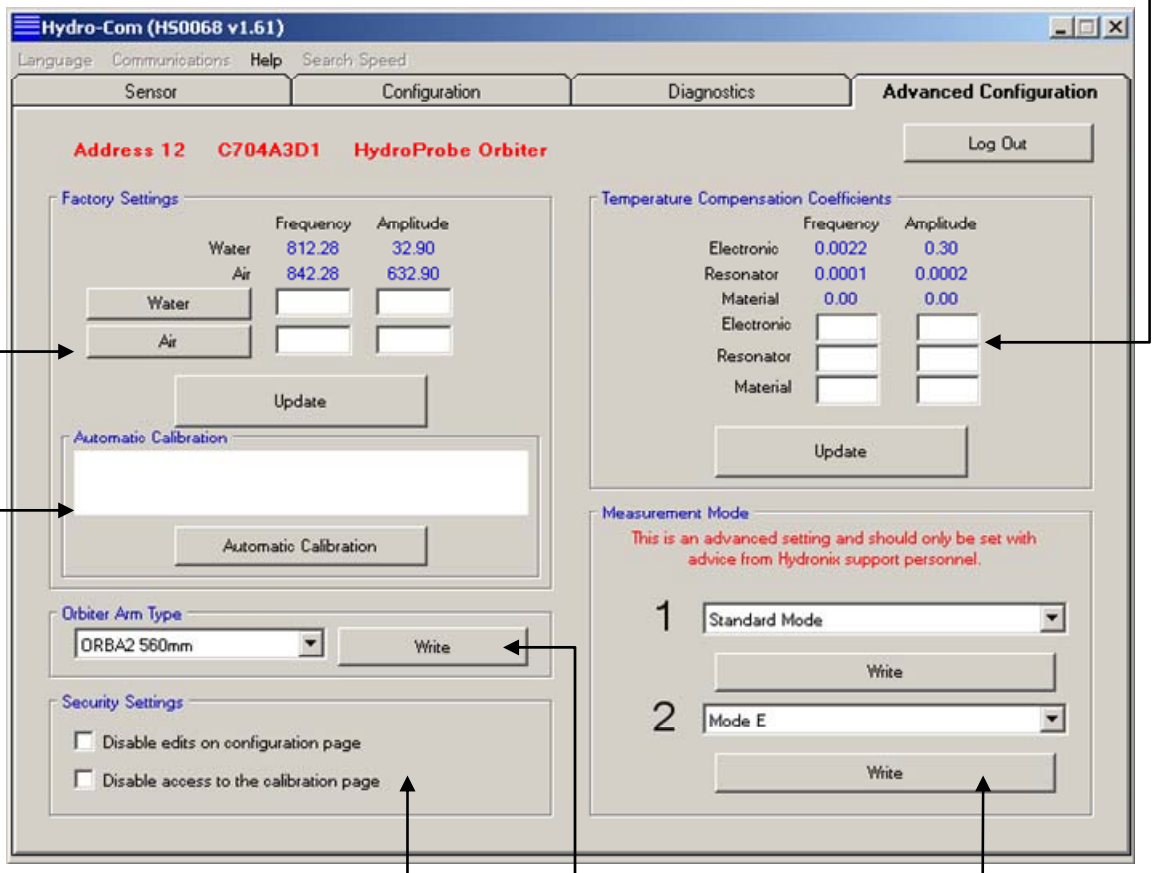
Notes:

1 Advanced Configuration Page

The Advanced Configuration Page is available when the password function on the Diagnostics Page has been activated.

***Factory settings frame**:*
Displays the factory set air and water measurements in the sensor and allows recalibration if necessary

***Temperature compensation coefficients frame**:*
Allows editing the temperature coefficients



***Automatic Calibration frame**:*
If supported, Allows calibration of a new arm or ceramic head

***Orbiter Arm Type frame**:*
Allows selection of the arm type fitted to an Orbiter head unit

***Security Settings frame**:*
Allows restriction of access to the configuration and calibration pages

***Measurement Mode frame**:*
Allows selection of the measurement mode used for the unscaled measurement

1.1 Temperature Compensation Coefficients Frame

The temperature compensation coefficients can be set here by entering the required values and then pressing update.

Note: These values should not be changed unless advised by a Hydronix Engineer.

1.2 Orbiter Arm Type Frame

New Hydro-Probe Orbiter head units have an option for setting the arm type that is attached. Simply select the arm type from the list.

1.3 Measurement Mode Frame

New sensors have different options for the way that the unscaled value is calculated.

Note: These values should not be changed unless advised by a Hydronix Engineer.

1.4 Security Settings Frame

These options restrict edits to the sensor configuration and stop users from deleting data from the calibration page (users are still able to add new calibration points and to enable/disable points in the calibration).

1.5 Automatic Calibration Frame

When a Hydro-Probe Orbiter has its arm changed, or if a Hydro-Mix ceramic is changed it should be recalibrated. Whilst it is always best to perform an Air and Water Factory Calibration (see Performing Air and Water Factory Calibration in this section) this function gives a way of performing an Automatic Calibration.

1.6 Factory Settings Frame

To ensure adequate matching between sensors, all measurements are made with reference to factory calibrated readings established for air and water. It is not necessary to alter these in normal operation

Note: Changing the calibration may adversely affect the operation of your sensor. If recalibration is needed, please contact Hydronix Technical Support

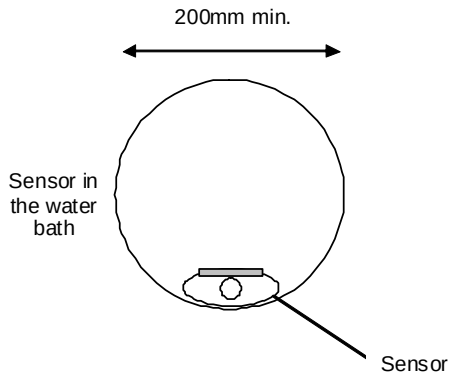
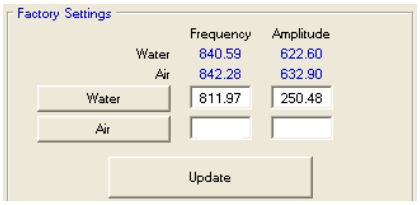
1.7 Firmware Frame

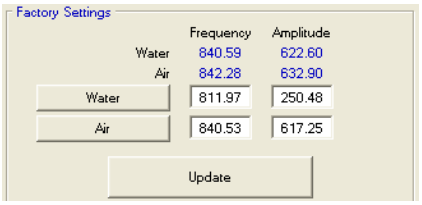
The firmware upgrade feature of Hydro-Com uses a single upgrade file which contains the firmware data for all Hydronix sensors. Hydro-Com will then pick the relevant firmware for the specific sensor and upload the data. This feature will prevent incorrect firmware uploading to a sensor which can make a sensor inoperable.

Clicking the upgrade button will invoke a file open box. Select the appropriate upgrade file and confirm the selection. The upgrade process typically takes a few minutes - a status message shows progress during this time. The upgraded firmware will begin to run automatically on completion.

Before you proceed: It is imperative that sensor power and communication is maintained whilst the upgrade is in progress otherwise there is a possibility that the flash memory will be left in an indeterminate state, rendering the sensor inoperative and therefore requiring further servicing.

2 Performing Air and Water Factory Calibration

Clean the sensor	Ensure any deposits of material are removed from the sensor face.
Fill a circular plastic bucket with clean fresh water at 20ºC	The level of water needs to cover the sensor ceramic face-plate, and at least 200mm of water is needed in front of the ceramic. The water temperature must be accurate to within ±1ºC as this is used as a reference for the in-built temperature compensation system.
Add salt	Add 0.5% by weight of salt – e.g. 50g per 10 litres of water
Position sensor in the water	For a Hydro-Probe Orbiter, it is suggested that the sensor is held in the bucket offset to one side with the face towards the centre of the bucket, hence the measurement is carried out with a full bucket of water in front.  Minimum water depth 200mm
Allow the working temperature of the sensor to stabilise	Allow the sensor's working temperature to stabilise to 20±1ºC
Enable the Advanced Configuration Page the click on the 'Water' button in the Factory Settings section	The software will make a new measurement and this frequency reading will be displayed in the water reading box. 
Remove the sensor from the water	
Air reading	The air reading should be made with the face-plate clean, dry and free from obstructions. Press the 'Air' button. The software will make a new measurement and this frequency reading will be

	displayed in the air reading box. 
Update factory settings	Press the 'Update' button to update the new factory settings

Note: New sensors have two calibrated settings, frequency and amplitude. For these sensors the calibration process will set the air and water readings for both of these settings

2.1 Automatic Calibration (Autocal)

(Hydro-Probe Orbiter and Hydro-Mix VII Only)

When fitting a new sensing arm to a Hydro-Probe Orbiter, or replacing the ceramic on a Hydro-Mix the air and water factory calibrations need to be updated. However, if the sensor is installed in a mixer, it is not always possible to manually perform the air and water readings. To help with this issue an alternative function called Autocal may be used. This makes an air reading and then estimates the water reading based on a constant air-water difference. This facility is only available when the selected sensor is a Hydro-Probe Orbiter or a Hydro-Mix VII.

Note: For conveyor belts or freefall applications, an air and water calibration is still required.

During the Autocal procedure, the ceramic face must be clean, dry and free from obstruction. Once the 'Automatic Calibration' button is pressed, the Autocal measurement will start and should take approximately 30 seconds. The sensor will then be ready for use in the mixer.

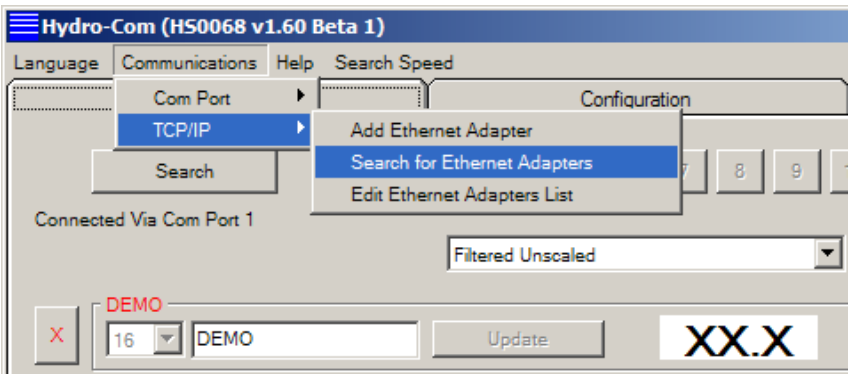
Note: For most consistent performance it is recommended that a full air and water calibration is performed.

1 Ethernet Adapter defaults

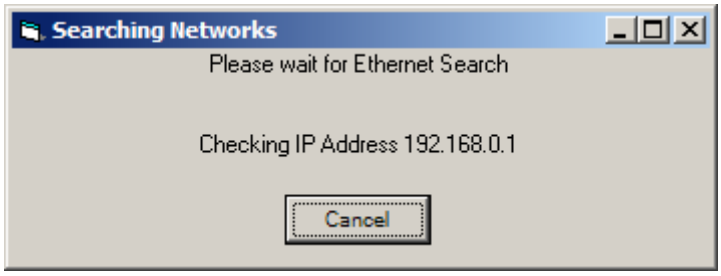
By default, the Ethernet Adapter will use an automatically generated IP Address, which will be allocated by the network DHCP server. As this may change after a few days or weeks, it is recommended that a fixed IP Address is used for the Ethernet Adapter. The allocated address should be on the same subnet as the address allocated by DHCP, but outside the range of DHCP addresses. Contact the Network Administrator to find a suitable address.

2 Finding an Ethernet Adapter automatically

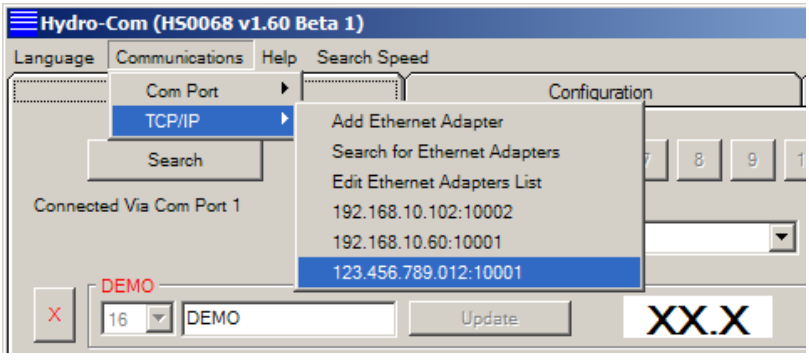
Communication with Hydronix sensors is carried out with the Hydro-Com Utility. To start go to the Communications->TCP/IP menu in Hydro-Com and select “Search for Ethernet Adapters”.



The program will display a search window and query the network for any sensors attached.

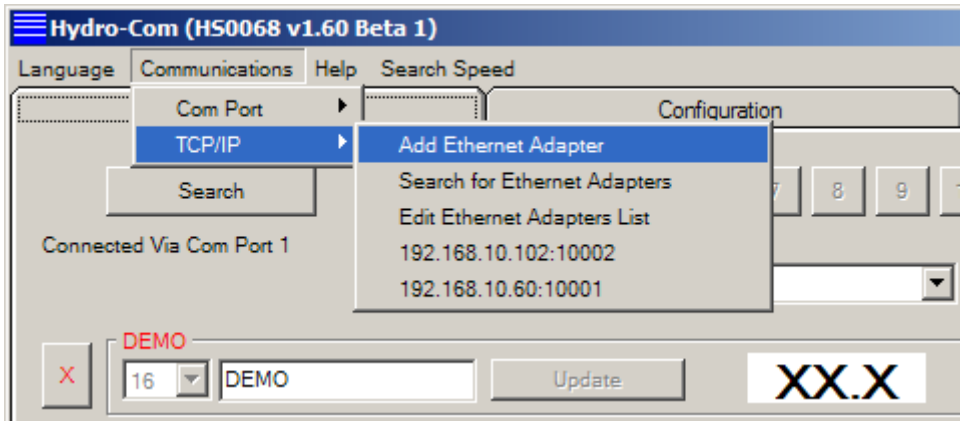


The adapter will be added to the list, select it to connect.

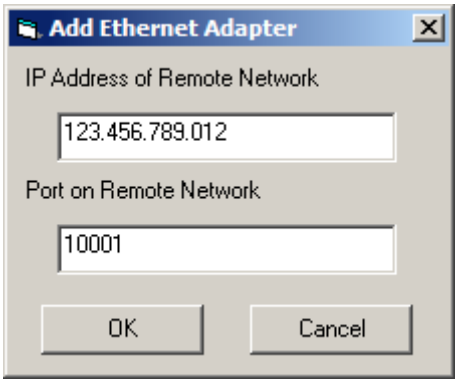


3 Adding an Ethernet Adapter manually

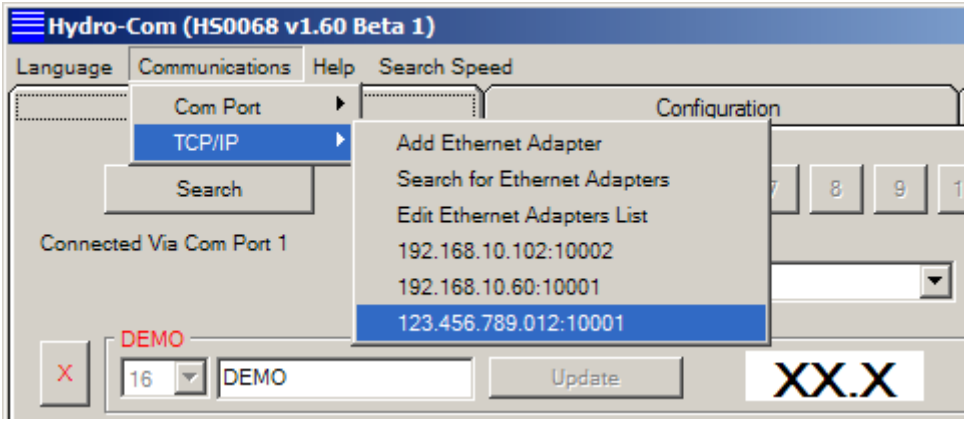
In order to manually enter an Ethernet Adapter's IP Address select Communications->TCP/IP->Add Ethernet Adapter.



In the dialog box that is shown, enter the IP Address and Port Number (usually 10001) of the Ethernet Adapter

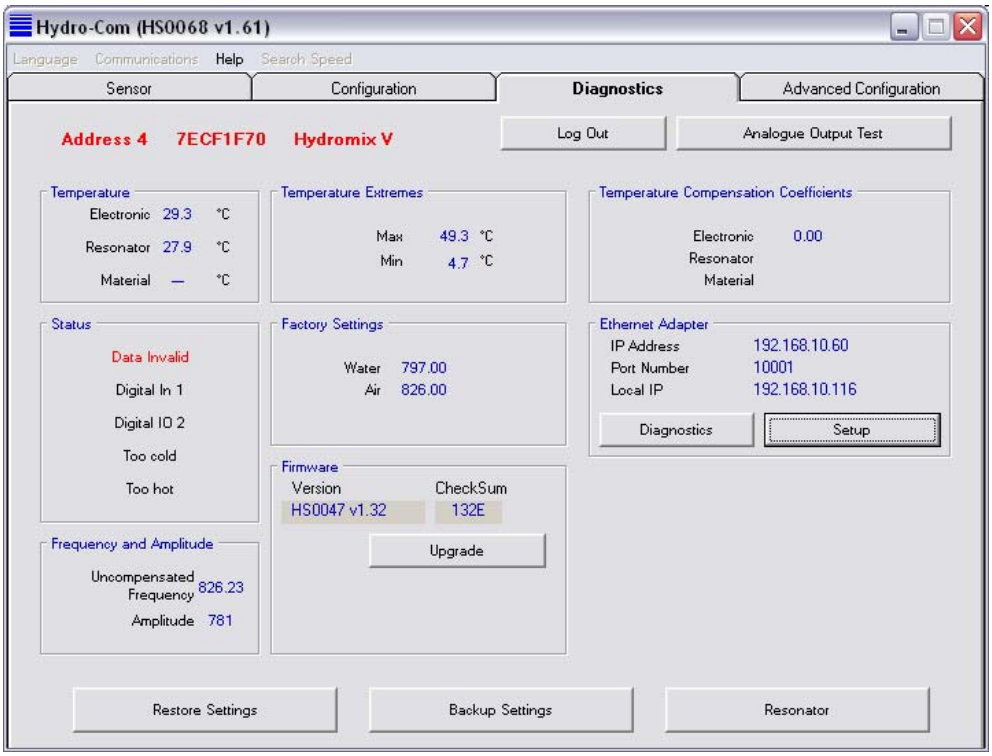


The adapter will be added to the list, select it to connect.

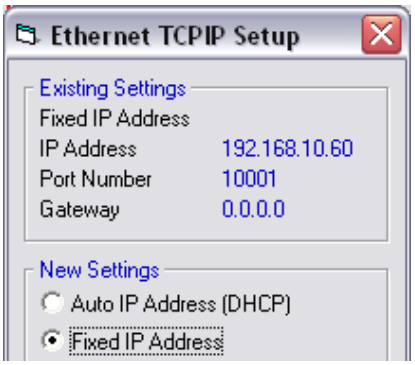


4 Changing the Ethernet Adapter IP Address

Once Hydro-Com is connected to an Ethernet Adapter, go to the “Diagnostics” tab, login using the high level password, then click on the button “Settings” in the Ethernet Adapter frame



To fix the IP Address, click on “Use fixed IP Address” and enter the IP Address in the box provided. It is recommended to leave the Port Number and Gateway set to the defaults. Click “Set” and then after the progress bar has completed and the new information has been written, click “Exit” to close the dialog and go back to the main screen.



When a fixed IP Address has been assigned, it is recommended to write the address on the front of the Ethernet Adapter in the space provided.

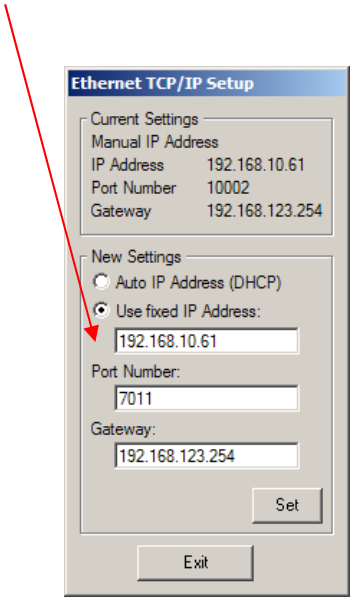
5 Remote (Internet) Connection

Sensors connected to an Ethernet Adapter can also be accessed remotely over the Internet. In order to do this, it is necessary to open up a port in the Firewall of the network on which the Ethernet Adapter is installed. Contact the Network Administrator for details of doing this. When opening the Port, all incoming traffic to that port should be directed to the IP Address of the Ethernet Adapter and port 10001. Make a note of the network’s IP Address on the Internet and the number of the port opened up. The table below shows the settings used in this example:

Company Network Settings		**Ethernet Adapter Settings**	
IP Address	Opened Port	IP Address	Port Number
123.456.78.901	7011	192.168.10.61	10001

The port 7011 on the Firewall is opened up and all traffic to this port is forwarded to 192.168.10.61 port 10001.

If the Firewall does not allow a completely flexible configuration of port forwarding then either open up port 10001 on the Firewall and leave the Ethernet Adapter port set as 10001, or alternatively alter the port of the Ethernet Adapter to be the same as the port opened in the Firewall. This is done by entering the new value in the Port Number box when setting the fixed IP Address:

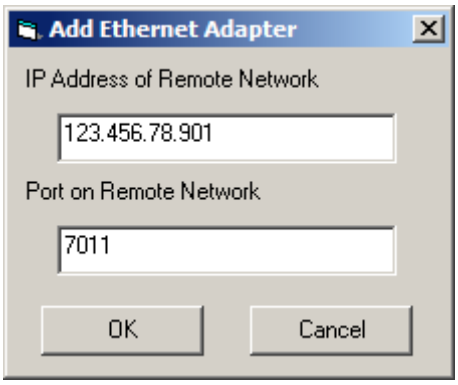


Certain port numbers are reserved for internal use by the Ethernet Adapter and should not be used:

Port Number	**Function**
1 – 1024	Commonly used Internet Ports
9999	Ethernet Adapter Reserved functionality
14000 – 14009	
30704	
30718	

Hydro-Com prevents you from setting these port numbers.

Install Hydro-Com on the remote machine. As before, select Communications->TCP/IP->Add Ethernet Adapter. In the Add Ethernet Adapter window, enter the IP Address of the Firewall and the Port opened.



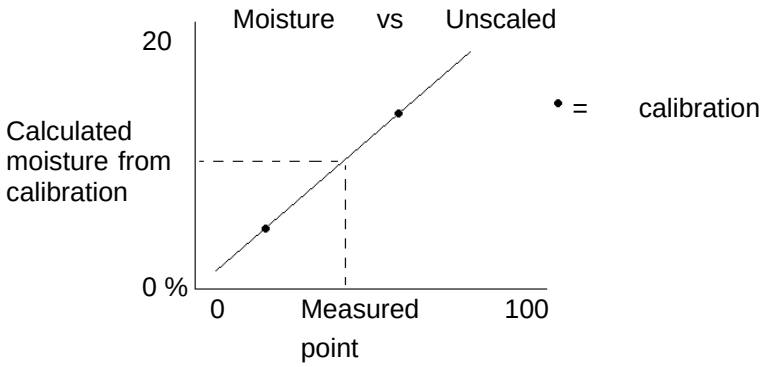
The Hydro-Com calibration page is accessed from the configuration page. (This page is similar to the dedicated Hydronix calibration utility 'Hydro-Cal'. There is no extra functionality in Hydro-Cal so Hydro-Com users do not need to download Hydro-Cal for calibration purposes).

1 Introduction to Material Calibration

For applications where a moisture value is required to be directly output from a sensor, the sensor will require calibrating to the material that is to be measured.

The Hydro-Com calibration utility is used to enter unscaled values and corresponding moisture values derived from taking and drying samples. This utility is intended for use with sensors measuring in flowing materials, such as in bins or on conveyor belts. The calibration procedure for mixer applications where water is added under controlled conditions for the moisture to reach a specified value is performed by the mixer control system or the Hydro-Control V

Each material has its own unique electrical characteristic. The raw output of a Hydronix sensor is an unscaled value ranging from 0 to 100. Each sensor is set so that a zero (0) unscaled value relates to the measurement in air and 100 relates to water. The unscaled reading for example from a sensor measuring *fine* sand at 10% moisture content will be different from the unscaled reading (from the same sensor) when measuring *coarse* sand at 10% moisture content. For highest accuracy it is necessary to 'calibrate' the sensors for different materials. *A calibration simply correlates the unscaled reading to 'real' moisture values which have to be determined in the laboratory using a method called 'bake-out' or 'desiccation'.*



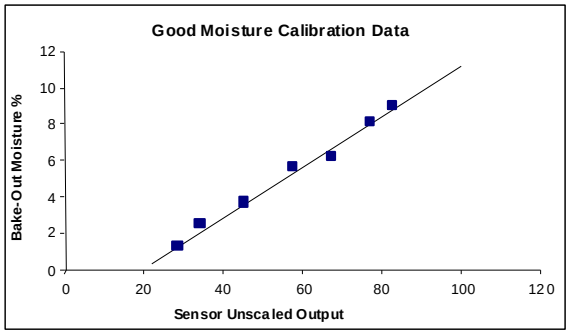
The range in moisture for sand can vary from typically 0.5% (the absorbed moisture value or Surface Saturated Dry value (SSD) which is obtained from material suppliers) to approximately 20% (saturated). Other materials can have an even greater range. Over this moisture range for most materials, the reading from a Hydronix sensor is linear. For linear relationships a calibration can be performed from only two points. Once these points are made a straight line can be defined, as shown below.

The equation of the line through the calibration points is used to calculate 'true' moisture from the unscaled reading. This equation is defined by a slope (B) and offset (C). These values are therefore calibration coefficients and can be stored inside the sensor if required. The conversion to moisture% is therefore:

Moisture% = B*(unscaled reading) + C – SSD

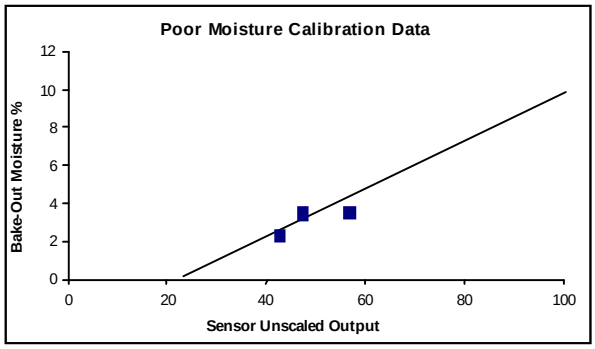
The SSD value is included in case it is required to output moisture values in excess of the material's absorbed moisture. In most cases this is set to zero.

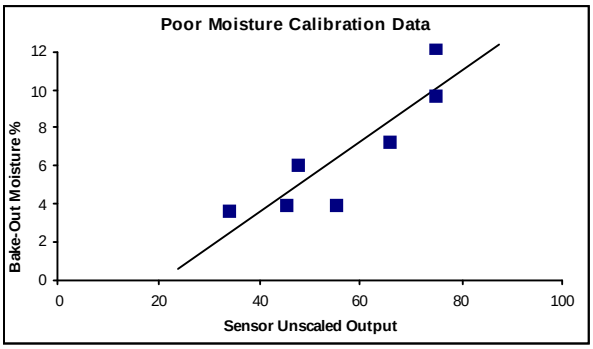
A good calibration is made by measuring material samples and taking readings over the full working moisture range of the material. As many points as practical should be made as more points provides higher accuracy. The graph below shows a good calibration with high linearity.



Calibration inaccuracy is likely to result if:

- Too small a sample of material is used for 'baking-out'.
- A very small number of samples are used (in particular 1 or 2 points).
- Samples are taken close to the same moisture content, like the calibration graph shown below (left). A good range is necessary.
- There is a large 'scatter' in the readings as shown in the calibration graph below (right). (This generally implies an unreliable or inconsistent approach to taking 'bake-out' samples or poor sensor positioning with inadequate material flow over the sensor.)
- If the averaging facility is not used to ensure representative moisture reading for the entire batch.





The Hydro-Com utility incorporates certain calibration rules to aid the user in obtaining reasonable and accurate results despite any problems such as those mentioned above, (see 61Appendix A).

2 Moisture Calibration

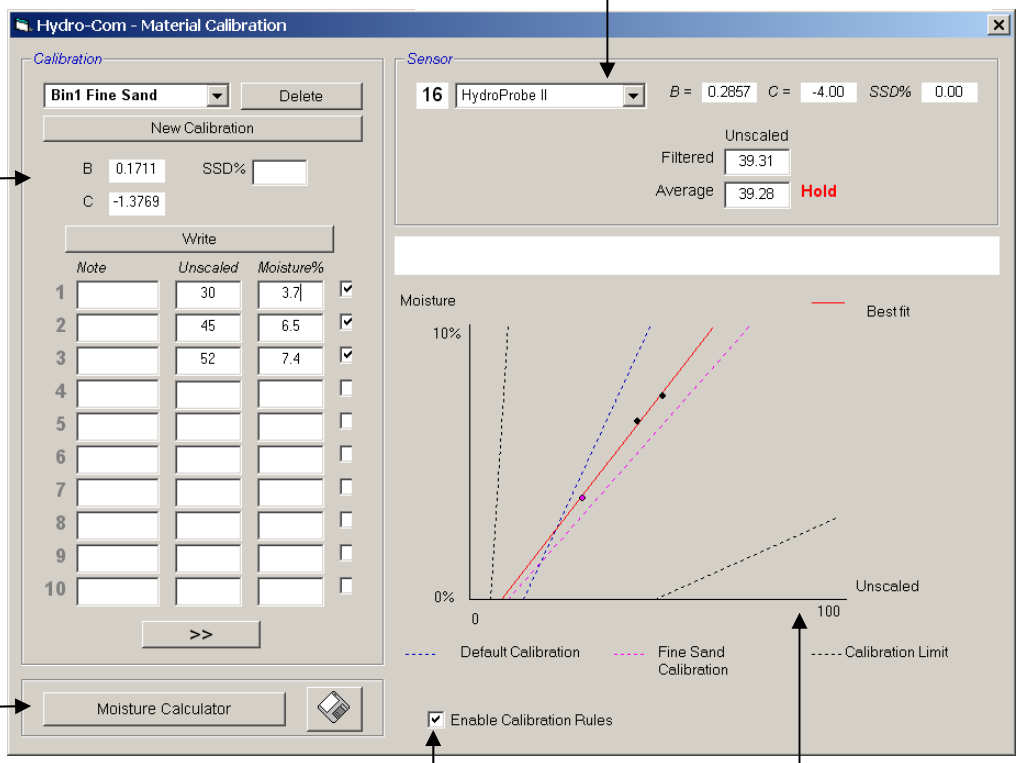
In order to simplify the calibration procedure Hydro-Com has the ability to check input calibration values against a set of rules (see Appendix A). These rules inform the user when input values may result in an abnormal moisture calibration. They are most accurate for sands and small stone (less than 10mm). If used for other materials, they may try to force a less accurate calibration. If this is the case the rules can be disabled.

The calibration function in Hydro-Com allows the user to input material calibration data which is then stored on the computer and can be written as calibration coefficients into the sensor.

The utility is divided in to four areas, as shown below.

***Calibration frame**:*
This is used for entering data into the table. All calibrations are stored in a database

***Sensor frame**: Displays information on the sensors currently connected to the computer along with live output readings*



Moisture calculator and database save facility

Graph shows calibration points from the selected calibration along with a 'best fit' line.*

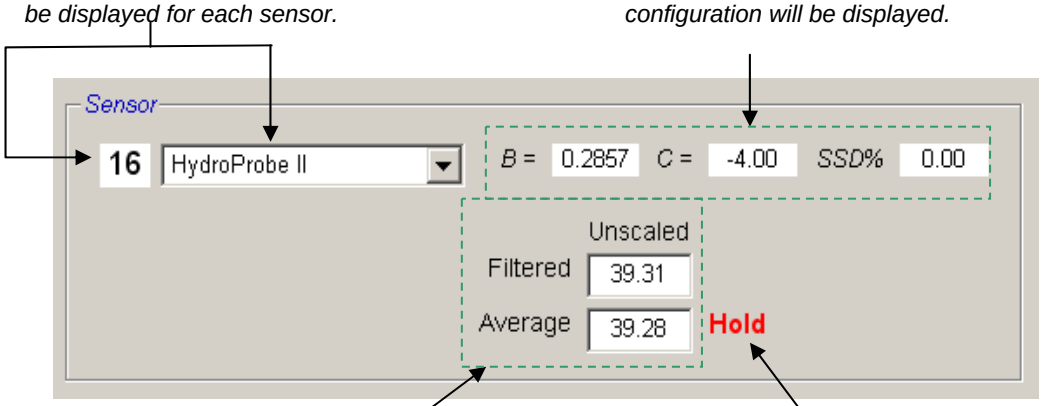
Uncheck this box to disable the calibration rules for calibrating materials other than sands

* A best fit line is a line that mathematically best 'fits' through a series of points, as shown above

2.1 Sensor Frame

Connected sensors pull-down list
The sensor name and sensor address number will be displayed for each sensor.

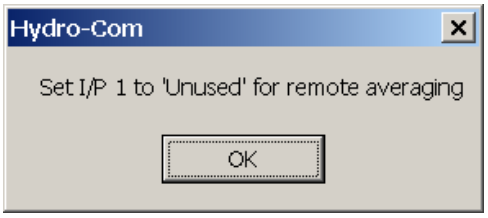
For the selected sensor, the current calibration-coefficients stored in its configuration will be displayed.



Live 'Unscaled' readings from the selected sensor, required for the material calibration. For more information on these readings, see appendix B.

***Average/Hold indicator**: Used to indicate when batch averaging is taking place. This can be either from the digital input or remote averaging. When this changes to **Average**, the filtered unscaled is currently being averaged. When averaging is finished the 'Average' unscaled value is held constant and the label changes to **Hold**.*

When each sensor is selected in the sensor pull-down list, the calibration utility first determines how the digital input is configured to see if remote averaging can be used. If for the selected sensor the digital input is set to 'Unused' the 'Start Remote Averaging box will appear. For sensors configured with the digital input set to 'Average/Hold', the following warning box will appear instructing users that remote averaging is unavailable.



2.1.1 Averaging

Averaging the output of a sensor over a period of time is essential for representative sampling in most applications. In the case of a Hydro-Probe II mounted in a sand bin, once the gate opens the sand starts to flow until the gate closes. As the readings vary during this time the only way in which to obtain a representative unscaled value is by continuously averaging during the flow.

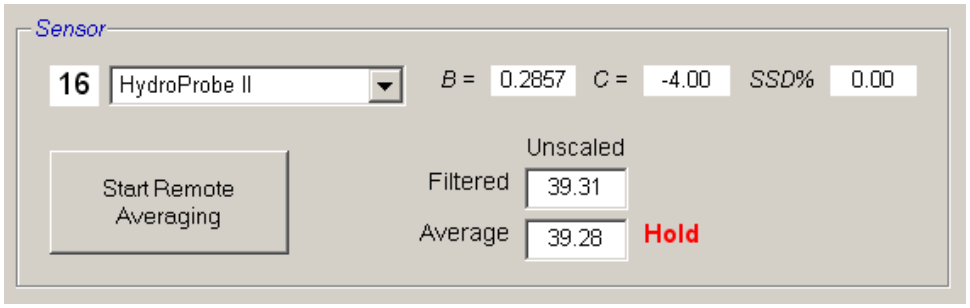
Digital input 1 can be used to determine when to average. For a bin installation the sensor input could be generated from the bin-gate switch to give a +24VDC input when the gate is open.

In this case the configuration of the sensor has to be set to 'Average/Hold' for this purpose.

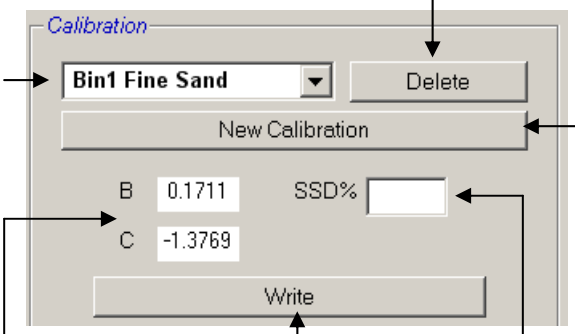
2.1.2 Remote Averaging

If however, the installation is without an input that can switch to control the averaging function, Hydro-Com has the facility to manually select the start and stop period of averaging. This is called 'remote averaging'. Remote averaging is only possible if the first digital input is set to 'Unused'.

If the first digital input is set to 'Unused' then a 'Start Remote Averaging' box will appear as shown below:



2.2 Calibration Frame



Delete button:
Deletes the current calibration.

Calibration database drop-down list:
All calibrations stored will be displayed in a drop-down list from which the user can select a calibration.

New calibration button:
A new calibration can be started by pressing the 'New Calibration' button and typing a new calibration name into the text box and pressing 'OK'.

Calibration coefficients:
This shows the calibration coefficients (B and C) resulting from the selected calibration. A linear regression is performed on the data to provide the best-fit straight line through the data.

Write button:
Sends the calibration coefficients to the chosen sensor.

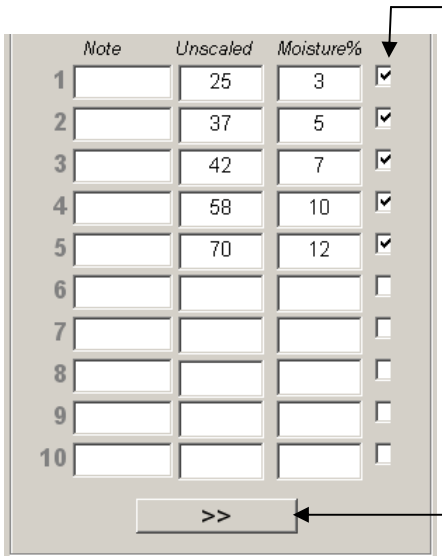
SSD field:
The Saturated Surface Dry value for the material. This is used if it is intended that the sensor is to output free moisture values above SSD. SSD values will normally be found in the specification for the material. If ***total moisture*** *values are required this field should be set to zero.*

2.2.1 Calibration Data Values

The user may enter up to 20 sets of unscaled and corresponding moisture% values for each calibration in the text boxes provided.

When the user enters data into a text box the corresponding point on the graph is highlighted.

Note that the first column titled 'Note' is a general information box – this may be left blank or could be used for entering the date or operators name etc.

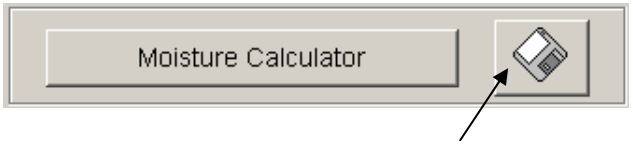


Data values selection:

The user can select which of the 20 sets of values (points) should be used in drawing the graph and the calculation of the calibration coefficients.

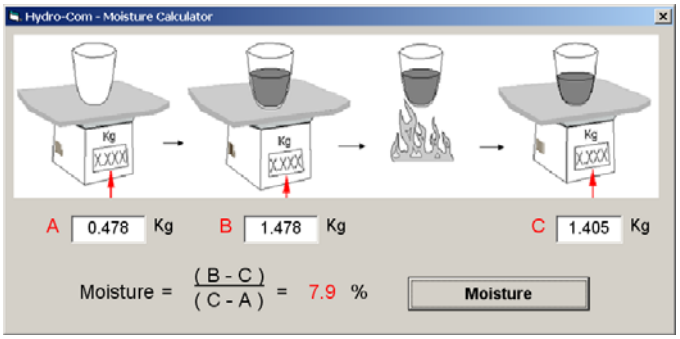
The user can switch between the first and second set of 10 values.

2.3 Moisture Calculator and Calibration Save to Disk Frame



The disk button can be used to store the complete database to a file. When clicked, the user must specify a file name and location. The data for all the calibrations will be written to a text file.

The true moisture content is required for each calibration point. The method for taking samples is described in the following section, but to aid calculating the moisture of the sample when drying the material, the 'Moisture Calculator' button has been included. When pressed the following box appears where the weights can be entered.



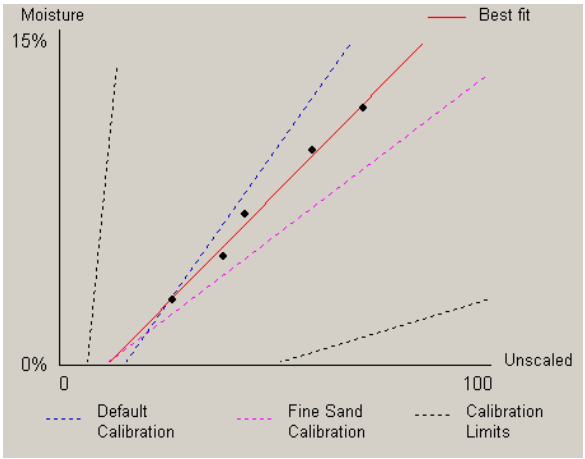
A = Weight of the container

B = Weight of the container + wet material

C = Weight of the container + dry material

The moisture is then calculated as shown using the 'Moisture' button. The value displayed can then be used in the calibration table as shown overleaf.

2.4 Calibration Graph



Moisture % vs. Unscaled Calibration Graph: The calibration data is displayed in a graphical form together with two default sand calibrations and the maximum and minimum calibration slopes defined by Hydronix, see Appendix A for more information.

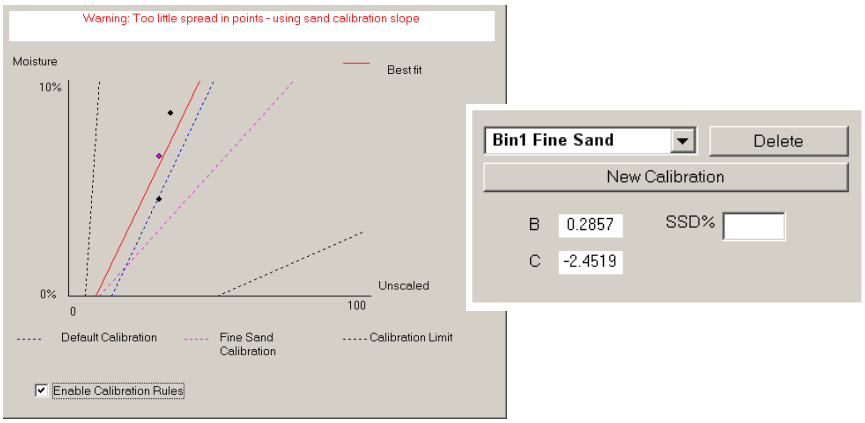
2.5 Effect of the Calibration Rules

The calibration data points define a mathematical best fit line and it is this line, described using the two variables B and C, which defines the calibration. The effect of the rules is to improve this calibration line if the calibration data does not satisfy the criteria as described in Appendix A, in such cases the mathematical best fit line is modified.

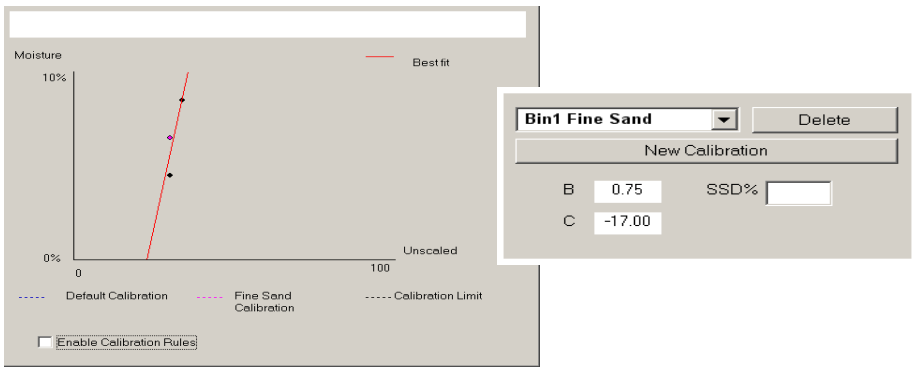
For standard sands the rules should be enabled so that data not fitting the criteria as set in Appendix A will be corrected for, providing a better calibration. It should be noted that the calibration rules have been designed around a sensor mounted at the suggested angle. See the individual sensor user manuals for more information.

If however different materials are being measured or the installation is different from the suggested method, then it may be necessary to disable the rules using the check-box below the graph. This is application specific and should be determined by the engineer commissioning the equipment.

In the graph below, 3 calibration points have been entered into the table with the calibration rules enabled. The data does not satisfy the complete criteria and as a result, a warning message is displayed as shown. The B and C calibration coefficients that describe this line have been included also.



If for this same data set, the calibration rules are disabled, the graph changes to exclude all the dashed lines and the calibration line is drawn as a mathematical best fit line. No warning message is given and the resultant calibration coefficients are included for comparison below.



3 Brix Calibration

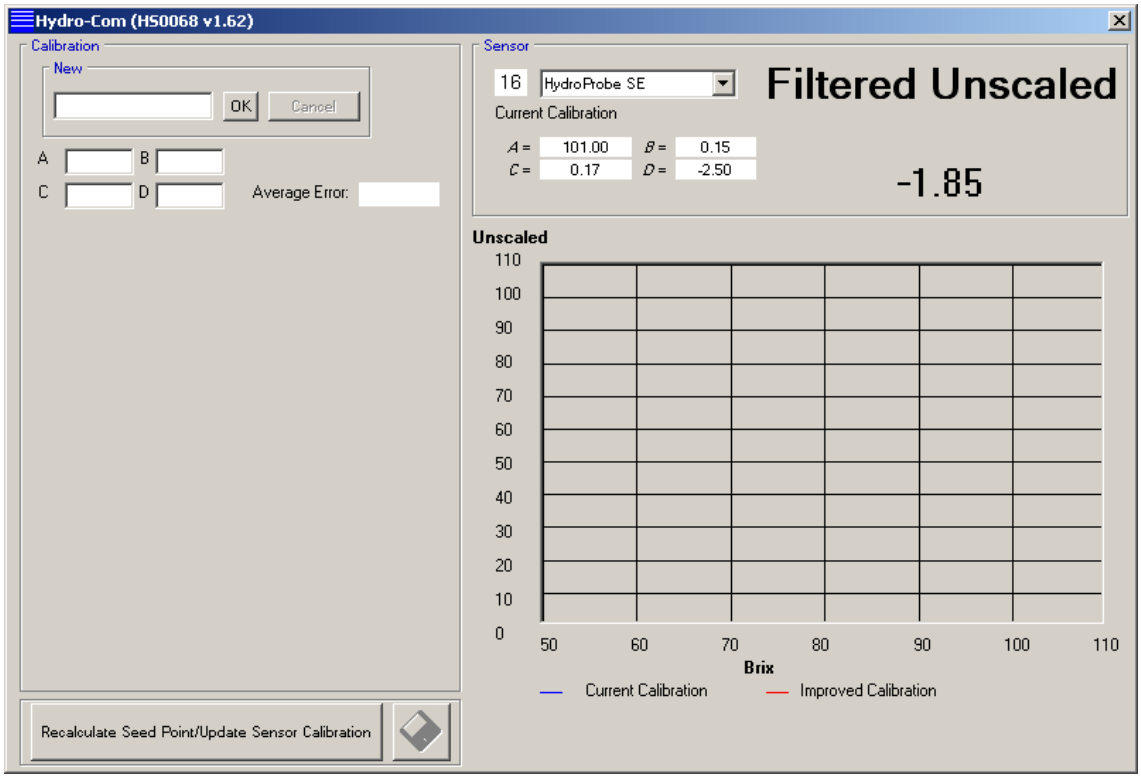
Some Hydronix sensors have the ability to measure the Brix content of a liquid. This is a measure of the amount of dissolved sugar there is in a liquid and is used mainly in the food industry.

Brix is measured in a way which is not proportional to the moisture in the material, which is what the Hydronix sensors are designed to measure. To create a calibration line to calculate Brix from the unscaled value a different equation is used. This equation is:

$$Brix = A - B \cdot e^{(C \cdot us)} + D \cdot us^2$$

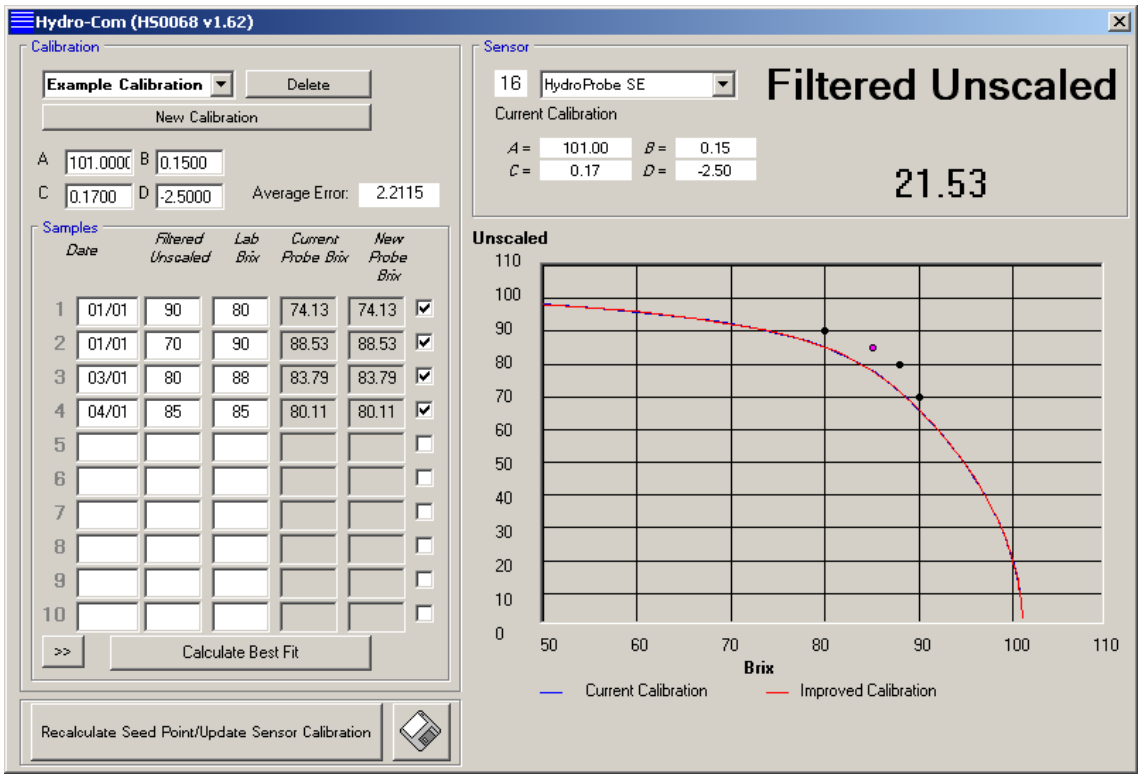
where **us** is the unscaled value from the sensor. This equation gives an exponential curve.

When using the sensors to measure Brix, the sensor must still be calibrated to the process being monitored. If the sensor is set to output Brix, then when the Calibration button is pressed, a different screen will come up to the moisture calibration page.

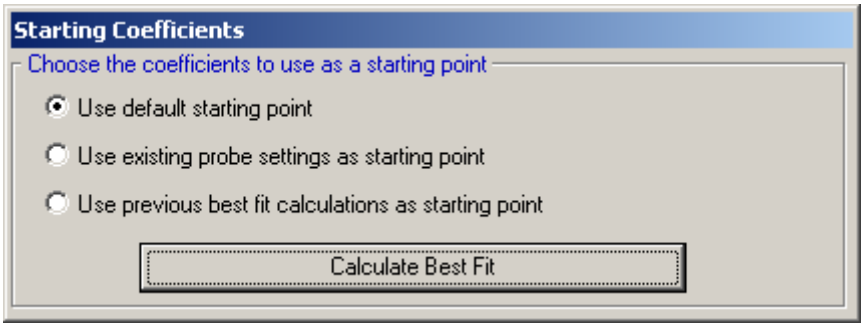


To calibrate the sensor, a number of points need to be recorded at different Brix.

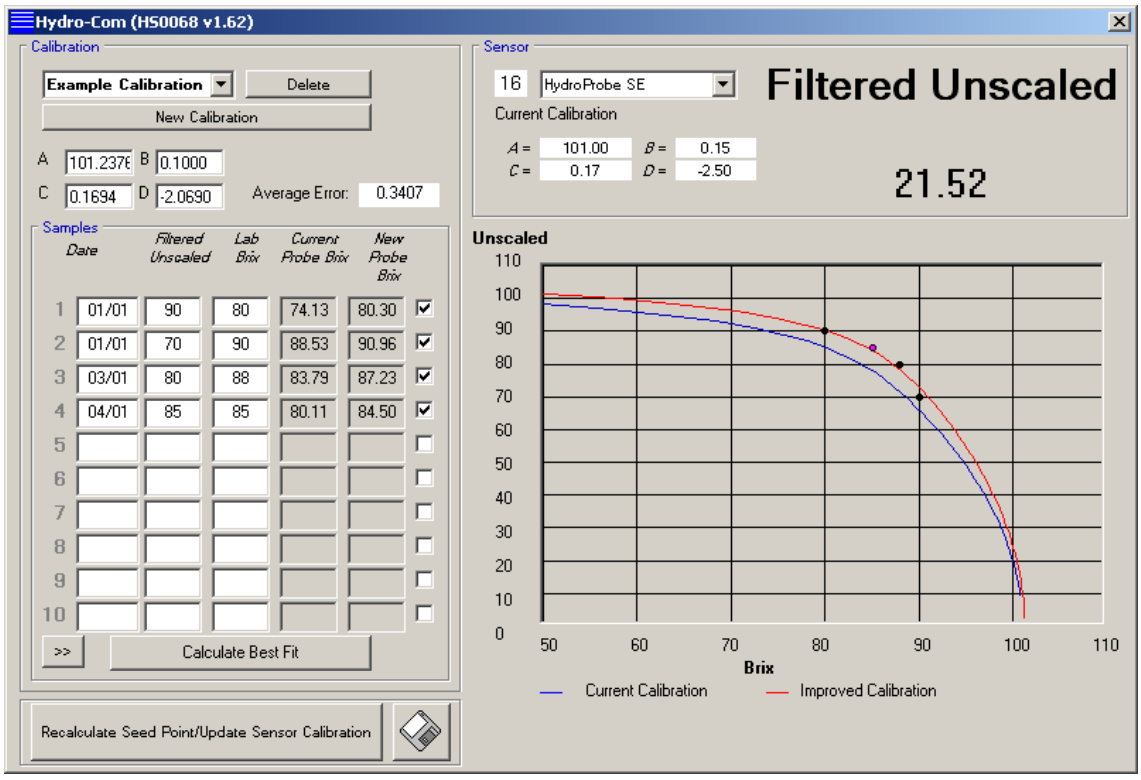
The unscaled reading needs to be recorded whilst the process is running and a sample needs to be taken of the liquid the sensor is measuring. The sample then needs to have the Brix content measured and this pair of results can be entered into Hydro-Com.



Once a number of points have been entered into the list, the “Calculate Best Fit” button should be clicked.



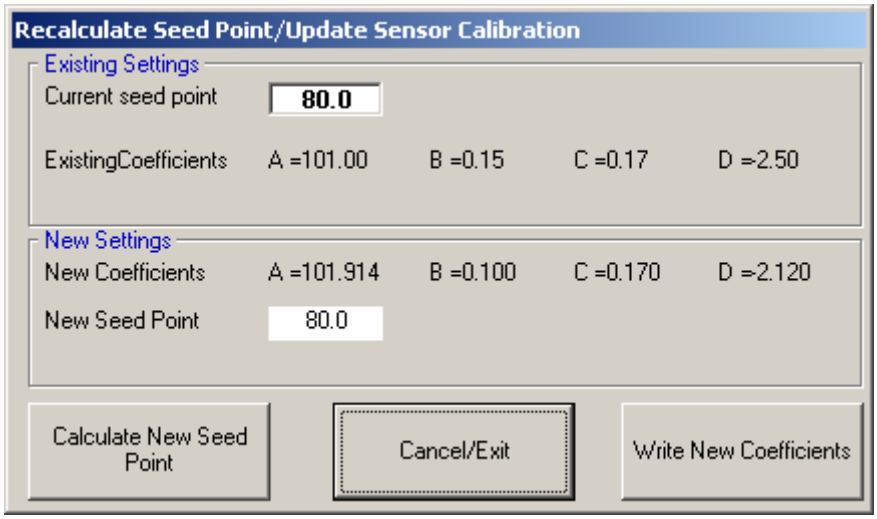
Select “Use default starting point” and press the “Calculate Best Fit” button.



Hydro-Com will then calculate a line that tries to include all of the points entered. It displays the new line as a red line and the last line as a blue line.

If a point is a long way from the line, it is probable that a mistake was made during the calibration process. The point can be ignored without removing it from the data set by un-ticking the box at the right hand side of the table.

When a calibration line has been calculated, it can be written to the sensor using the "Recalculate Seed Point/Update Sensor Calibration" button. Pressing this will display the following screen:



3.1 Calculate New Seed Point

This function is used if the calibration of a sensor is being adjusted and a fixed point (The "seed" point) is being used by the control system and wants to be retained. It takes a known

Brix value (entered into the Current seed point box) and converts it to the value it will be with the new calibration.

3.2 Write New Coefficients

This button writes the calibration to the sensor enabling the sensor to output a Brix value.

1 Hints:

- Wear safety glasses and protective clothing to guard against expulsion of material during the drying process.
- Do not attempt to calibrate the sensor by packing material on the face. The readings obtained will not be representative of those from a real application.
- Whilst recording the sensor unscaled output, always sample where the sensor is located.
- When calibrating coarse aggregates, do not use a calibration method that uses very small samples, for example 'Speedy' or infra-red balance.
- Never assume that material flowing out of two gates in the same bin is the same moisture content and do not attempt to take samples from the flow in both gates to get an average value – always use two sensors
- Always use averaging
- Ensure the sensor sees a representative sample of material

2 Equipment:

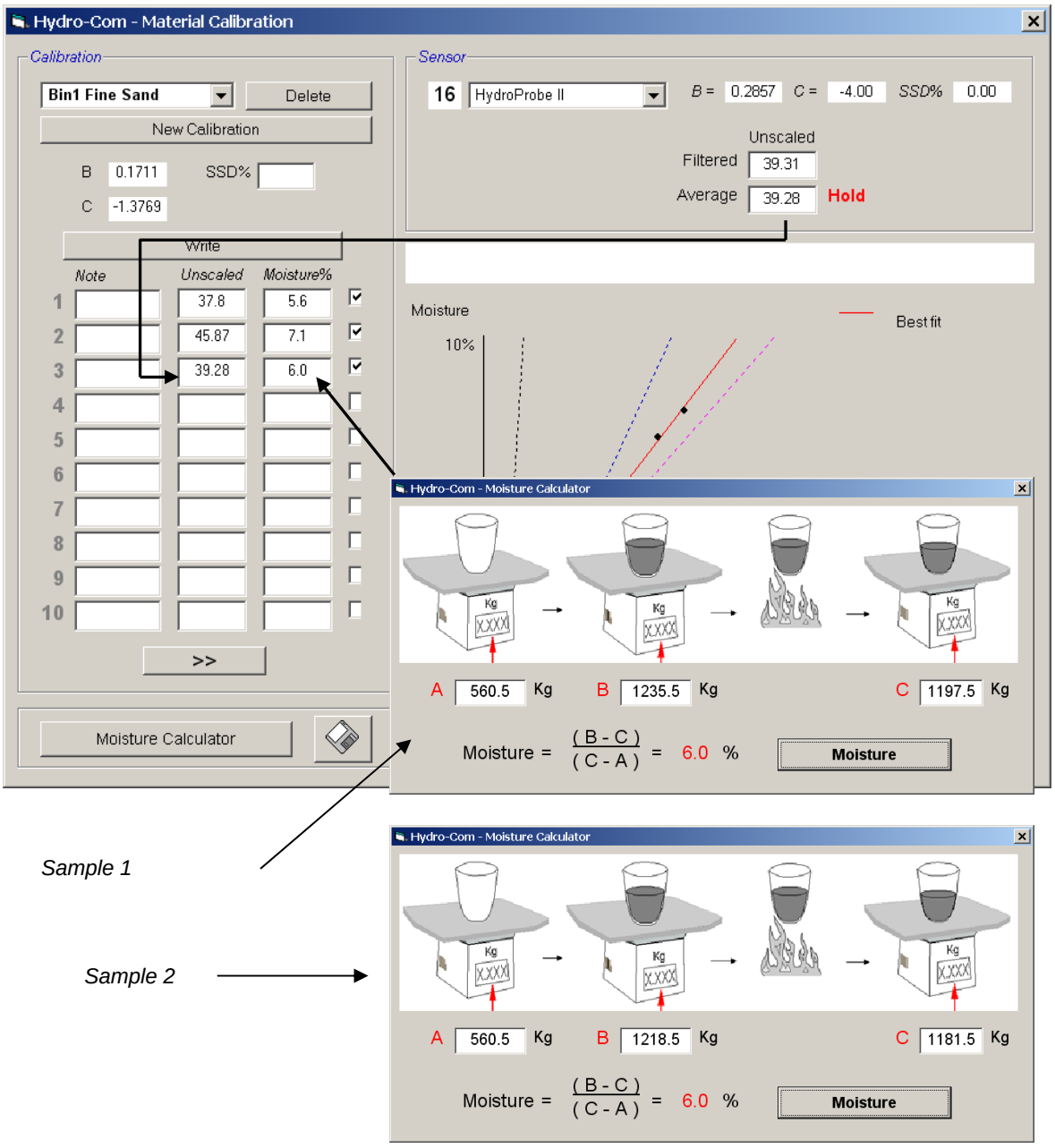
- *Weighing scales* - to weigh up to 2kg, accurate to 0.1g
- *Heat source* – for drying samples, such as electric hot plate.
- *Container* – with re-sealable lid for storing samples.
- *Polythene bags* – for storing samples prior to drying
- *Scoop* – for collecting samples
- *Safety equipment* – including glasses, heat resistant gloves and protective clothing

3 Calibration Procedure

1. Ensure Hydro-Com is running with the calibration page open.
2. Create a new calibration
3. Select the correct sensor from the pull-down list in the sensor frame.
4. When batching, look at the Average/Hold status next to the 'Average' reading from the sensor. The optimum installation is one where the digital input is wired into the bin-gate switch. When the bin opens the status should change to Average and when closed it should show Hold.
5. For the next batch take a sample. Using the scoop, collect a series of small samples from the flow to yield around 5-10kg of material in the container. The material MUST be collected at a position close to the sensor and therefore the sensor reading relates to the particular batch of material passing the sensor.
6. Return to the computer and record the 'Average Unscaled' output, which should show the Hold status.
7. Mix the collection of samples, remove approximately 1kg, dry it thoroughly and calculate the moisture content using the moisture calculator. Take care not to lose any of the samples during the drying process. A good test to ensure the material is thoroughly dry is to stir it around to distribute the moisture and re-heat.
8. Repeat step 7 for another 1Kg sample. If the moisture differs by more than 0.3%, then one of the samples was not dried out completely and the test has to be restarted.
9. Record the average moisture of the two samples in the calibration table. This 'Moisture' and 'Unscaled' value make up one calibration point. Tick this point to include the values in the calibration.
10. Repeat steps 5-9 for additional calibration points. Choose a different time of day or different time of the year to ensure a wide range of moistures are sampled.

A good calibration is one where the calibration points cover the complete working moisture range of the material, and all points lie on or near to a straight line. If any calibration points are suspected to be wrong then they can be excluded from calibration by deselecting their corresponding tick box. It is generally recommended that a spread of at least 3% will give best results

11. When the calibration is finished, update the new calibration coefficients to the correct sensor by pressing the 'Write' button. The B, C and SSD values in the sensor frame will then match those values in the calibration frame. The moisture% output from the sensor should represent true moisture of the material. This can be verified by taking further samples and checking the laboratory moisture against the sensor output.



Q: *Hydro-Com doesn't detect any sensor when I press search.*

A: If there are many sensors connected on the RS485 network ensure that each sensor is addressed differently as described in configuring the RS485 network (page 21). Ensure the sensor is correctly connected, that it is powered from a suitable 15-30VDC source and the RS485 wires are connected through a RS232-485 converter in to the serial port of a PC. On Hydro-Com ensure the correct COM port is selected.

– – –

Q: *How often should I calibrate the sensor?*

A: Recalibration is not necessary unless the gradation of the material changes significantly or a new source is used. However it is a good idea to take samples (see Chapter 10) regularly on site to confirm the calibration is still valid and accurate. Put this data in a list and compare them with the results of the sensor. If the points lie near to or on the calibration line then the calibration is still good. If there is a continuous difference you have to recalibrate. There are applications where customers have not had to recalibrate in 5 years.

– – –

Q: *If I have to exchange the sensor in my sand bin do I have to calibrate my new sensor?*

A: Normally no, assuming the sensor is mounted in exactly the same position. Write the calibration data for the material to the new sensor and the moisture readings will be the same. It would be wise to verify the calibration by taking a sample as shown in the section on 'Calibration Procedure' (page 55), and checking this calibration point. If it lies near to or on the line then the calibration is still good.

– – –

Q: *What should I do if there is little variation of moisture in my sand/gravel on the day I calibrate?*

A: If you have performed a number of bake out tests and there is little variation in moisture (1-2%), then settle for one good calibration point by averaging the unscaled readings and bake-out moistures. Hydro-Com will allow you to produce a valid calibration (using the calibration rules in Appendix A) until further points can be made. When the moisture changes at by least 2% then sample again and enhance the calibration by adding more points.

– – –

Q: *If I change the type of sand I am using do I need to recalibrate?*

A: Depending on the sand type, recalibration may or may not be necessary as many of them work on the same calibration. The calibration rules contain two standard sand calibrations sets, fine and normal grade sand. It would be wise to verify the calibration by taking a sample as shown in the section 'Calibration Procedure' (page 55), and checking this calibration point. If it lies near to or on the line then the calibration is still good.

– – –

Q: *What output type should I set my sensor to after calibration?*

A: This depends on the system requirements. In most cases the sensor analogue output is connected to the control system PLC. For a calibrated sensor, this analogue output should be set for either 'Filtered Moisture%' or when the digital input is used for averaging, set to 'Average Moisture%'.

– – –

Q: *There seems to be a scatter in the points I have made in my calibration, is this a problem and is there something I can do to improve the calibration result?*

A: If you have a scattering of points through which you are trying to fit a line, then there is a problem with your sampling technique. Concentrate on what you do while you take samples and ensure the sensor is mounted properly in the flow. If the sensor position is correct and the sampling is done as explained in Chapter 10, then this should not happen. Try to use an 'Average Unscaled' value for your calibration. The averaging period can be set either with the 'Average/Hold' input or using 'Remote Averaging'.

– – –

Q: *I want to use remote averaging but the box does not appear for my sensor*

A: Remote averaging is only available when the digital input is set to 'unused'. If the input is set

to ‘Average/Hold’ then it is not possible to use ‘Remote Averaging’.

– – –

Q: *What range of moisture values should I aim for in my calibration?*

A: It is recommended that the final calibration should use values that represent the driest and wettest material that you encounter. This makes the measurement very accurate over the range you are working with.

– – –

Q: *The sensor readings are changing erratically, not consistent with the changes in moisture in the material. Is there a reason for this?*

A: It is possible that some material is building up on the sensor face during the flow, and so despite there being a change in moisture of the material, the sensor only ‘sees’ the material in front of it and so the reading could stay reasonably constant, then after some time, the old material could fall off and new material is flowing over the sensor face giving a big erratic change. To check if this is the case, try hitting the sides of the bin/silo to knock off any fouling material and see if the readings change. Also check the mounting angle of the sensor.

NOTE: DO NOT HIT THE SENSOR

The ceramic should be mounted at an angle which allows material to pass continuously. The Hydro-Probe II sensor has two lines, A and B, on the rear plate label. Correct alignment is where either line A or B is horizontal, indicating the ceramic is at the correct angle as suggested in the Hydro-Probe II User Guide (HD0127).

– – –

Q: *Does the angle of the sensor affect the reading?*

A: It is possible that changing the angle of the sensor can affect the readings. This is due to a change in compaction or density of the material flowing past the measurement face. In practice, small changes in the angle will have a negligible effect on the readings but a large change in the mounting angle (>10 degrees) will affect the readings and ultimately the calibration will become invalid. For this reason we always suggest when removing any sensor and then refitting, to position it to the same angle.

– – –

The following table lists the most common faults found when using the sensor. If you are unable to diagnose the problem from this information then please contact Hydronix Technical Support

1 Symptom: Near constant moisture reading

Possible explanation	Check	Required result	Action required on failure
Empty bin or sensor uncovered	Sensor is covered by material	100mm minimum depth of material	Fill the bin
Material 'hanging up' in bin	Material is not hanging up above sensor	A smooth flow of material over the face of the sensor when the gate is open	Look for causes of erratic flow of material. Reposition sensor if problem continues.
Build-up of material on sensor face	Signs of build-up such as dried solid deposit on ceramic face	Ceramic faceplate should be kept clean by the action of material flow	Check angle of the ceramic in range of 30° to 60°. Reposition sensor if problem continues
Incorrect input calibration within control system	Control system input range	Control system accepts output range of sensor	Modify control system, or reconfigure sensor
Sensor in alarm condition – 0mA on 4-20mA range	Moisture content of material by bake-out	Must be within working range of sensor	Adjust sensor range and/or calibration
Interference from mobile phones	Use of mobile phones close to sensor	No RF sources operating near to sensor	Prevent use within 5m of sensor
Average/Hold switch has not operated	Apply signal to digital input	Average moisture reading should change	Verify with Hydro-Com diagnostics
No power to sensor	DC power at junction box.	+15Vdc to +30Vdc	Locate fault in power supply/ wiring
No sensor output at control system	Measure sensor output current at control system	Varies with moisture content	Check cabling back to junction box
No sensor output at junction box	Measure sensor output current at terminals in junction box.	Varies with moisture content	Check sensor output configuration
Sensor has shut down	Disconnect power for 30 seconds and retry or measure current drawn from power supply.	Normal operation is 70mA – 150 mA	Check operating temperature is within specified range

Internal failure or incorrect configuration	Remove sensor, clean face and check reading (a) with ceramic face open and (b) with hand pressed firmly on ceramic face. Activate Average/Hold input if required	Reading should change over a reasonable range	Verify operation with Hydro-Com diagnostics.

2 Symptom: Inconsistent or erratic readings that do not track moisture content

Possible explanation	**Check**	**Required result**	**Action required on failure**
Debris on sensor	Debris, such as cleaning rags hanging over sensor face	The sensor must always be kept clear of debris	Improve material storage. Fit wire mesh grids to tops of bins
Material 'hanging up' in bin	Material is hanging up above sensor	A smooth flow of material over the face of the sensor when gate is open	Look for causes of erratic flow of material. Reposition sensor if problem continues
Build-up of material on sensor face	Signs of build-up such as dried solid deposit on ceramic face	Ceramic face should always be kept clean by the action of the material flow	Change angle of the ceramic in range 30° to 60°. Reposition sensor if problem continues.
Inappropriate calibration	Ensure calibration values are appropriate to working range.	Calibration values spread throughout range avoiding extrapolation.	Perform further calibration measurements.
Ice forming in material	Material temperature.	No ice in material	Do not rely on moisture readings
Average/Hold signal is not in use	Control system is calculating batch average readings.	Average moisture readings must be used in batch weighing applications.	Modify control system and/or reconfigure sensor as required.
Incorrect use of Average/Hold signal	Average/Hold input is operating during the main flow of material from the bin	Average/Hold should be active during main flow only – not during jogging period.	Modify timings to include main flow and exclude jogging from measurement.
Inappropriate sensor configuration	Operate the Average/Hold input. Observe sensor behaviour.	The output should be constant with Average/Hold input OFF and changing with the input ON.	Sensor output configured correctly for the application.
Inadequate ground connections	Metalwork and cable ground connections	Ground potential differences must be minimized	Ensure equipotential bonding of metalwork.

Appendix A

1 Calibration Rules

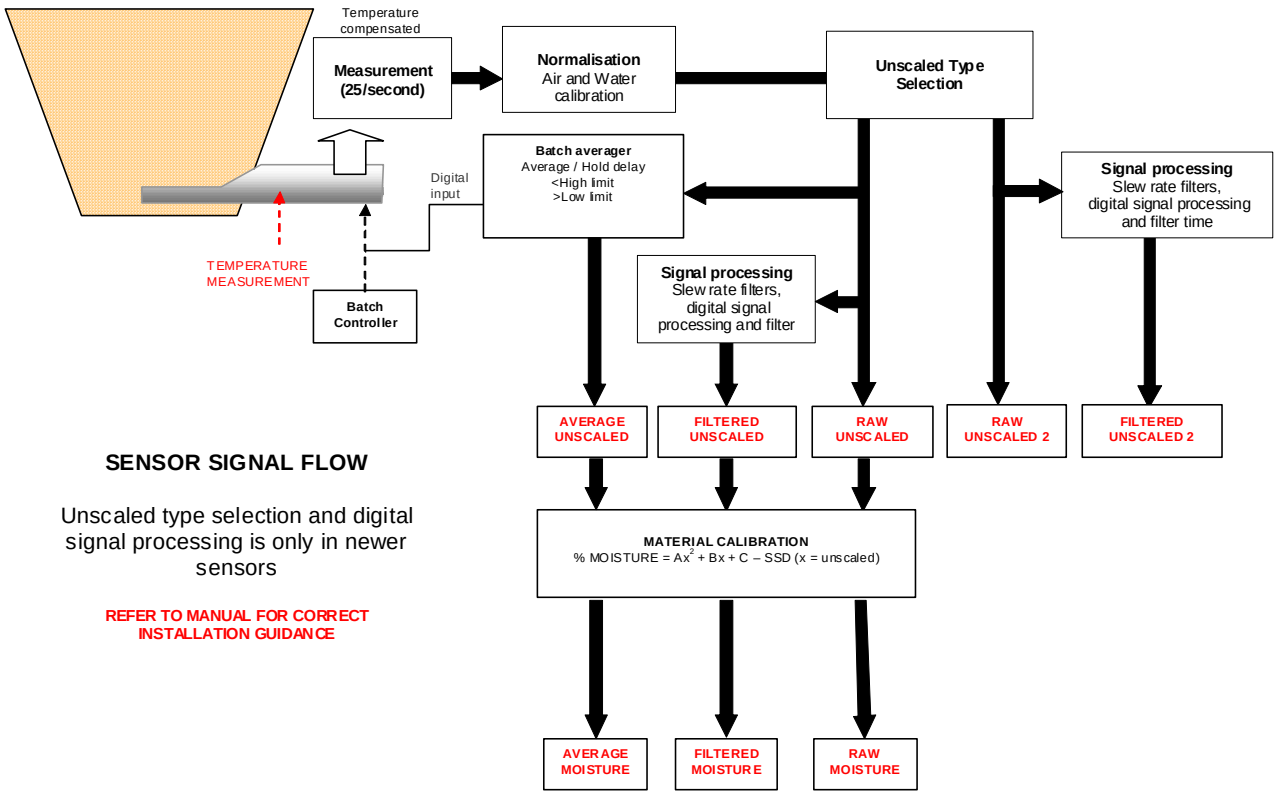
- Limiting slopes (B) for any calibration will be a maximum of 2.0 and a minimum of 0.06.
- Default sand calibration will have a slope of 0.2857 and an intercept (C) of -4.
- Default fine sand calibration will have a slope of 0.1515 and an intercept of -1.5151.
- One-point calibrations:
  - The calibration slope will be set to be the average of the two known sand calibrations.
  - If the unscaled value at zero moisture is less than 5 the unscaled value at zero moisture will be set to be 5 and a new calibration slope calculated through this point and the single point entered.
  - If the unscaled value at zero moisture is greater than 50 the unscaled value at zero moisture will be set to be 50 and a new calibration slope calculated through this point and the single point entered.
  - If the resulting slope is greater than the maximum or less than the minimum calibration slopes then no calibration will be carried out and the user will be informed of this.
- More than 1 point calibration – spread in points: Moisture < 1% or unscaled < 2
- A single point calibration will be carried out.
- More than 1 point calibration – spread in points: Moisture < 3% or unscaled < 6
  - If the calculated slope is greater than the sand calibration slope set the calculated slope to the sand calibration slope - If the calculated slope is less than the fine sand calibration slope set the calculated slope to the fine sand calibration slope – otherwise leave the slope as it is. (Recalculate intercept value from average from all points)
  - If the unscaled value at zero moisture is less than 5 the unscaled value at zero moisture will be set to be 5 and a new calibration slope calculated through this point and the average of the points entered.
  - If the unscaled value at zero moisture is greater than 50 the unscaled value at zero moisture will be set to be 50 and a new calibration slope calculated through this point and the average of the points entered.
  - If the resulting slope is greater than the maximum or less than the minimum calibration slopes then no calibration will be carried out and the user will be informed of this.
- More than 1 point calibration – spread in points: Moisture > 3% and unscaled > 6
  - Calibration slope is calculated and the user is warned if:
    - If the unscaled value at zero moisture is less than 5.
    - If the unscaled value at zero moisture is greater than 50.
    - If the resulting slope is greater than the maximum or less than the minimum calibration.

Appendix B

1 Description of Output Variables

The full description of all the available output variables for Hydronix sensors are listed below.

The signal flow through a Hydronix sensor such as the Hydro-Probe II is detailed below. This shows the output variables and how they are derived. All Hydronix sensors operate in the same manner, however there is added functionality with different sensors. See the hardware reference in Appendix D for more information.



1.1 Filtered Unscaled:

This will represent a reading which is proportional to moisture and ranges from 0 to 100. The Filtered Unscaled is derived from the raw unscaled processed using the filtering parameters in the 'Signal Processing' frame in the configuration page.

An unscaled value of 0 is the reading in air and 100 would relate to a reading in water. This has been set at the time of manufacture using air and water measurements stored internally. This factory calibration can be changed if required on the diagnostics page using the high-level password.

1.2 Average Unscaled:

This is the 'Filtered Unscaled' variable processed for batch averaging using the parameters in the 'Averaging' frame on the configuration page.

Batch averaging is a process of averaging readings over a set period of time. This may be useful as readings naturally vary. In the case of a Hydro-Probe II mounted in a sand bin, once the gate opens the sand starts to flow until the gate closes. If the readings are varying it

might be difficult to obtain a single representative reading. Therefore having an average value over the time the gate was open can be vital in obtaining more accurate readings.

For more information on how the average value is derived, see the section ‘High Limit and Low Limit’, on page 27.

1.3 Filtered Moisture %:

This will represent a reading which is equal to moisture of the material. ‘Filtered Moisture %’ is NOT a direct reading from the sensor, it is scaled value from the 'Filtered Unscaled' (F.U/S.) variable using the A, B, C and SSD coefficients such that:

‘Filtered Moisture %’ = $A*(F.U/S.)^2 + B*(F.U/S.) + C - SSD$

These coefficients are derived solely from the material calibration and so the accuracy of the moisture output is dependant on how good the calibration is.

SSD is the Saturated Surface Dry (absorption) figure of the material in use and allows the displayed percentage moisture reading to be expressed in SSD form (free moisture only).

1.4 Average Moisture %:

This is the 'Filtered Moisture %’ variable processed for batch averaging using the parameters in the 'Averaging’ frame on the configuration page.

Batch averaging is a process of averaging readings over a set period of time. This may be useful as readings naturally vary. In the case of a Hydro-Probe II mounted in a sand bin, once the gate opens the sand starts to flow until the gate closes. If the readings are varying it might be difficult to obtain a single representative reading. Therefore having an average value over the time the gate was open can be vital in obtaining more accurate readings.

For more information on how the average value is derived, see section ‘High Limit and Low Limit’ on page 27.

1.5 Brix

(**Hydro-Probe Orbiter and Hydro-Probe SE sensors only):**

This will represent a reading which is equal to BRIX used for the sugar industry. This is scaled from the 'Filtered Unscaled' variable using the A, B, C and D coefficients as follows

$Brix = A - B\,e^{Cx} + Dx^2$ (x = Filtered unscaled reading)

1.6 Electronic Temperature ºC

Temperature of the electronic assembly in degrees Celsius.

1.7 Resonator Temperature ºC

Temperature of the resonator in degrees Celsius. This is in close contact with the material and is therefore feasible to use this as an *indicator* for the temperature of the material.

1.8 Material Temperature ºC

(Hydro-Probe Orbiter and Hydro-Probe SE sensors only):

Fast response temperature measurement of the material in degrees Celsius.

Appendix C

1 Supervisor Passwords

The low level password (used to access the firmware upgrade facility) is 3737.

The high level password (used to access the advanced diagnostic facilities) is 0336.

NOTE: You may wish to remove this page from the guide to prevent unauthorised use of these passwords.

Notes:

Appendix D

1 Hardware Reference

The Hydronix microwave sensors are always being improved and developed. Improvements can include changes in hardware specifications.

Although all of the following sensors have the basic functionality of digital RS485, 1st Digital Input and 1st Analogue Output, the following table will summarise extra functionality with the different sensors.

Sensor	Ver.	Firmware	2nd Digital Input / Output`	2nd Analogue Output	Brix Output	Material Temp. (fast response)	Digital Signal Processing	Alternative Measurement Techniques	Unscaled 2
Hydro-Probe II	1	HS0029							
	2	HS0046	✓						
Hydro-Mix V and VI	1	HS0045							
	2	Hs0047	✓						
Hydro-Probe Orbiter	1	HS0063	✓	✓	✓	✓			
Hydro-Probe SE	1	HS0070	✓	✓	✓	✓			
Hydro-Mix VII	1	HS0077	✓	✓			✓	✓	✓

Notes:

Appendix E

1 Document Cross Reference

This section lists all of the other documents that are referred to in this User Guide. You may find it beneficial to have a copy available when reading to this guide.

Document Number	Title
EN0040	Engineering Note – Wiring a Sensor to a PC
HD0127	Hydro-Probe II User Guide

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