

# Hydro-Mix VII User Guide

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To re-order quote part number:	HD0412
Revision:	1.4.0
Revision date:	November 2013

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

## ACKNOWLEDGEMENTS

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## ***Revision history***

<b>Revision No</b>	<b>Date</b>	<b>Description of Change</b>
1.0.0	March 2010	Original version
1.0.1	April 2010	Minor Format Change
1.1.0	August 2011	Digital Input Connection added
1.1.1	February 2012	Minor Format Change
1.2.0	May 2012	Chapter 3 updated
1.3.0	August 2013	Chapter 2 installation options updated and corrosion protection section added.
1.4.0	November 2013	Protection ring details updated



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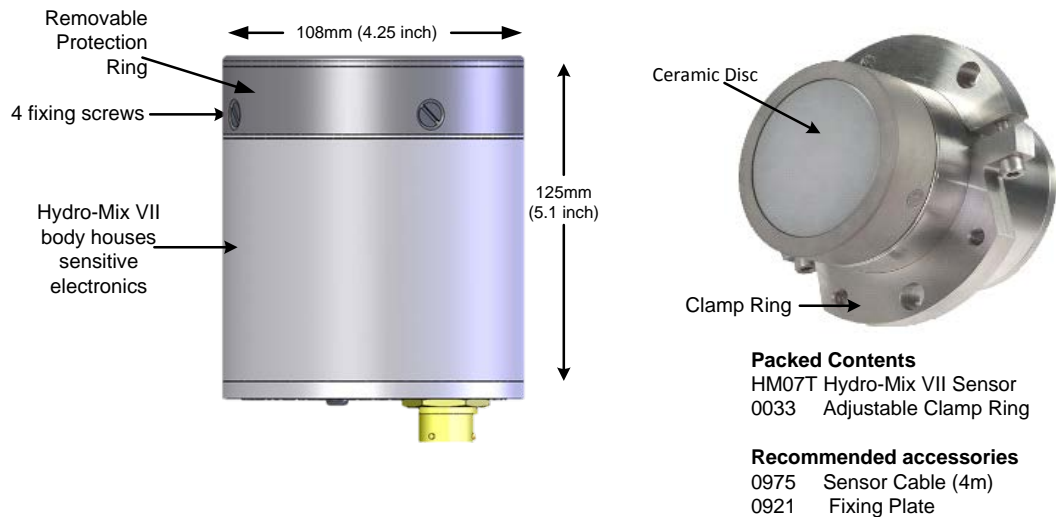
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**Figure 1: The Hydro-Mix VII and Adjustable Clamp Ring**

Available accessories:

Part No	Description
0021	Fixing Plate for welding to mixer
0033	Adjustable Clamp Ring (supplied with sensor). Additional rings can be ordered
0035	Blanking Plate (for covering hole in the mixer when sensor is removed)
HS02	Hydro-Skid – Mounting option for belt conveyors
0975	4m Sensor Cable
0975-10m	10m Sensor Cable
0975-25m	25m Sensor Cables
0116	Power Supply – 30 Watt for up to 4 sensors
0049A	RS232/485 converter (DIN rail mounting)
0049B	RS232/485 converter (9 pin D type to terminal block)
SIM01A	USB Sensor Interface Module including cables and power supply
EAK01	Ethernet Adapter Kit including Power Supply
EPK01	Optional Ethernet Power Adapter Kit
0900	Replacement Ceramic Kit (Ceramic Disc, Protection Ring and Ceramic Retaining Ring)
0910	Replacement Ceramic Kit (Ceramic and Protection Ring kit)
0920	Replacement Ceramic Kit (excluding Protection Ring)
0930	Replacement Protection Ring (including screws)

Hydro-Com configuration and diagnostics software is available for free download from [www.hydronix.com](http://www.hydronix.com).

## 1 Introduction

The Hydro-Mix VII digital microwave moisture sensor with integral signal processing provides a linear output (both analogue and digital). The sensor may be easily connected to any control system and is ideally suited to measure the moisture of materials in mixer applications as well as other process control environments.

The sensor reads at 25 times per second, which enables rapid detection of changes in moisture content in the process, including determination of homogeneity. The sensor may be configured remotely when connected to a PC using dedicated Hydronix software. A large number of parameters are selectable, such as the type of output and the filtering characteristics.

The sensor is constructed to operate under the most arduous conditions with a wear life of many years. The Hydro-Mix VII should never be subjected to unnecessary impact damage as it houses sensitive electronics. In particular, the replaceable ceramic faceplate, although extremely hardwearing, is brittle and may crack if subjected to severe impact.

### **CAUTION – NEVER HIT THE CERAMIC**



Care should also be taken to ensure that the Hydro-Mix VII has been correctly installed and in such a manner to ensure representative sampling of the material concerned.

### 1.1 Suitable applications

The Hydro-Mix VII microwave moisture measuring sensor may be successfully used in the following applications:

- Static pan mixers
- Planetary mixers
- Turbo mixers
- Single and twin shaft horizontal mixers
- Ribbon mixers
- Flush mounted in chutes or similar applications

**NOTE:** *For rotating pan mixers such as the Eirich and Croker liner mixers, a static mounted Hydro-Probe Orbiter is recommended.*

## 2 Measuring techniques

The Hydro-Mix VII uses the unique Hydronix digital microwave technique that provides a more sensitive measurement compared to analogue techniques.

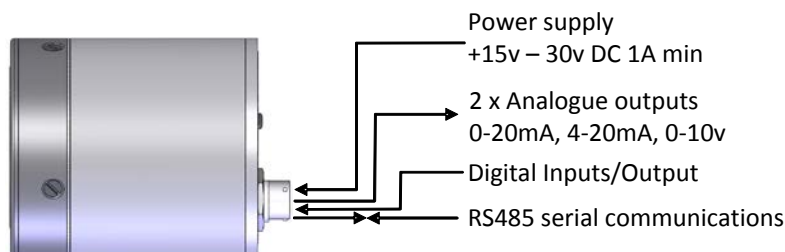
## 3 Sensor connection and configuration

As with other Hydronix digital microwave sensors, the Hydro-Mix VII may be remotely configured using a digital serial connection and a PC running Hydro-Com sensor configuration and calibration software. For communication with a PC, Hydronix supply RS232-485 converters and a USB Sensor Interface Module (See page 29).

There are three basic configurations by which the Hydro-Mix VII can be connected to a mixer control system:

- Analogue output – A DC output is configurable to:
  - 4-20 mA
  - 0-20 mA
  - 0-10 V output can be achieved using the 500 Ohm resistor supplied with the sensor cable.
- Digital control – an RS485 serial interface permits direct exchange of data and control information between the sensor and the plant control computer or Hydro-Control system. USB and Ethernet adapter options are also available
- Compatibility mode - this is a legacy mode which allows a Hydro-Mix VII to connect to a Hydro-Control IV or Hydro-View unit.

The sensor may be configured to output a linear value of between 0-100 unscaled units with the recipe calibration being performed in the control system. Alternatively it is also possible to internally calibrate the sensor to output a real moisture value.



**Figure 2: Connecting the sensor (overview)**

## 1 General to all applications

A significant benefit of the Hydronix system is that only one sensor is required in the mixer. However, it is important that it is positioned correctly in relation to the mixer floor, aggregate and water inlets, and other moving parts such as blades and paddles. Although paddles or scraper blades can be a useful mechanism to keep the sensor free from material build up, they could cause damage to an incorrectly positioned sensor. It will be necessary to periodically check the position as the mixer blades, paddles and floor wear.

The sensor will occasionally need to be adjusted downwards in the mixer, as the mixer floor wears, to maintain the correct position in relation to the mixer floor. Additionally the blades will need to be adjusted to maintain the efficiency of the mixing action and cleanliness of the sensor faceplate.

If the sensor is allowed to protrude into the mixer it will be susceptible to damage from the mixer blades/paddles as well as from aggregates becoming trapped between the paddles, mixer floor and exposed side wall of the sensor.

***NOTE: Damage caused under these circumstances will not be covered by warranty***

For accurate and representative moisture measurement the sensor must be in contact with the moving stream of material. It is equally important that no material can build up over the sensor face to obscure the sensor readings.

Follow the advice below for good sensor positioning:

- It is a good idea to provide a small inspection lid in the mixer cover, so that during mixing, and when the mixer is empty, the sensor face may be observed without having to raise the main cover plate.
- If the floor is not level, fit the sensor in the highest point in the floor.
- Ensure that the sensor is fitted away from the water, cement and aggregate entry points.
- If the mixer surface is curved, for example in a side wall or horizontal shaft mixer, ensure that the sensor does not protrude to hit the blades and that it is flush to the inside radius of the mixer.
- Avoid areas of severe turbulence. The best signal will be obtained where there is a smooth flow of material over the sensor.
- The sensor should be positioned where it will see a continuous sample of the flowing material and where the sweeping action of the blades ensures no build up of material on the face of the sensor.
- Position the sensor away from any electrical interference (See Chapter 3).
- Position the sensor so that it may be easily accessible for routine maintenance, adjustment and cleaning.

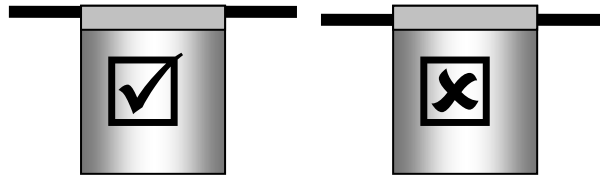
## 2 Positioning the sensor

The sensor may be installed into many types of mixer or application.

In most cases the sensor will work exceptionally well with the standard filtering parameters. Some mixer types and certain applications may require further adjustments to the internal filtering parameters of the sensor. For further information, please contact your dealer or e-mail Hydronix at: [support@hydronix.com](mailto:support@hydronix.com).

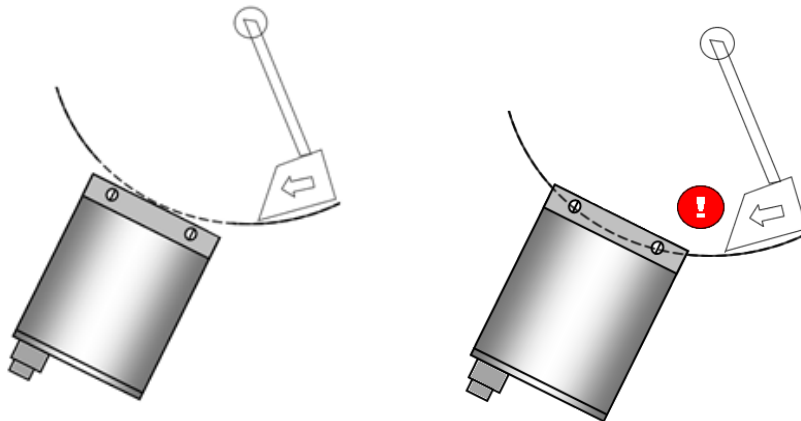
### 2.1 General mounting advice

For installations in flat surfaces, the top of the sensor must be flush with the floor of the mixer.



**Figure 3: Mounting in flat surface**

When installing the sensor in curved surfaces, ensure that the centre of the ceramic is flush with the radius of the mixer wall.



**Figure 4: Mounting in a curved surface**

In all installations, it is recommended that the sensor is fitted in an area where it is away from any possible collection of 'sitting' water. It is also necessary to monitor the position of the sensor over time as the mixer floor wears, and adjust the sensor as necessary to maintain the recommendations above. This is usually best done as part of the standard maintenance procedure at the site where the sensor is installed.

## 2.2 Turbo mixers

The sensor should be positioned in the floor of turbo mixers.

When the sensor is mounted in the floor, it should be approximately 2/3 distance from the mixer centre to the side wall.

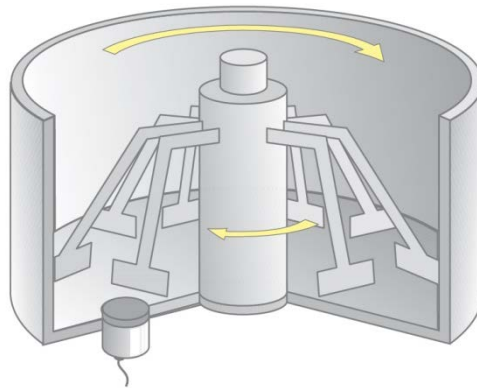


Figure 5: Position of sensor in a turbo mixer

## 2.3 Planetary mixers

The sensor should be fitted in the base of the planetary mixer, ideally in a position where the flow of material is smoothest, away from the area of severe turbulence caused by the mixing action of the blades. This is normally close to the side wall of the mixer. Therefore it is generally recommended that the sensor be positioned with the inner edge approximately 10 cm to 15cm (4-6 inches) from the side wall of the mixer. The minimum distance should never be less than 5cm (2 inches). See the advice for flat surface mounting on page 14.

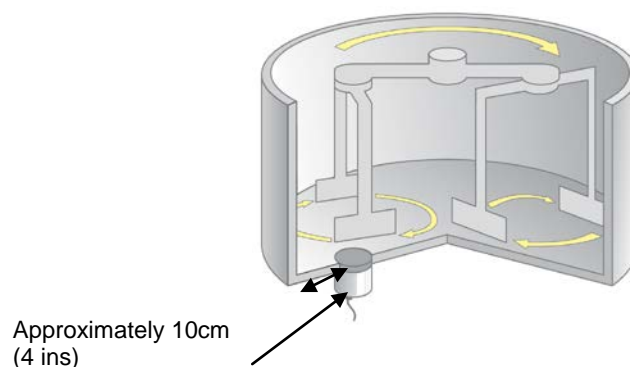
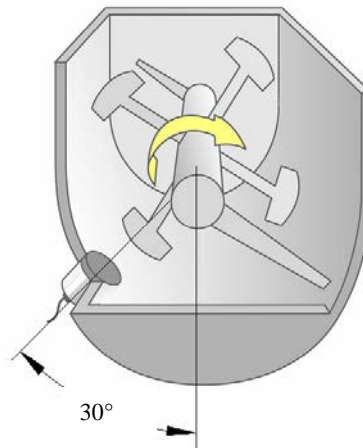


Figure 6: Position of sensor in a planetary mixer

## 2.4 Single shaft horizontal and ribbon mixers

The sensor is generally best positioned near the base of horizontal mixers 30 degrees above the base to prevent water pooling in the base covering the sensor face. It should be placed approximately half way along the length of the mixer. See guidance for mounting in curved surfaces on page 14.

**NOTE:** The sensor should be on the 'up' stroke of the mixer

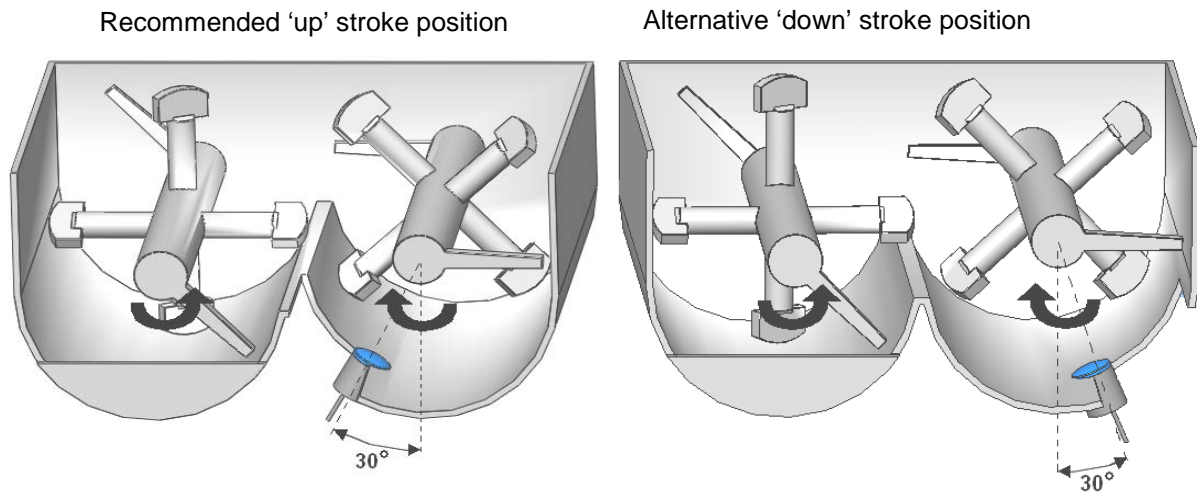


**Figure 7: Position of sensor in a horizontal shaft or ribbon mixer**

## 2.5 Twin shaft horizontal mixers

The best position on horizontal twin shaft mixers is half way along the length of the mixer, near the base at approximately 30 degrees above the base to prevent water pooling in the base covering the sensor face.

The sensor should be mounted on the 'up' stroke of the mixer. If this is not possible, for example when the mixer unloading doors obstruct this area, then it should be positioned on the opposite side on the 'down' stroke. See guidance for installation in curved surfaces on page 14.



**Figure 8: Position of sensor in a twin shaft horizontal mixer**



## 2.6 Organic material mixers

### 2.6.1 Twin shaft

It is recommended that the Hydro-Mix should be located in the end wall between the two shafts. The sensor should be located at a level lower than the shafts to maintain complete coverage of the ceramic face plate. See Figure 9

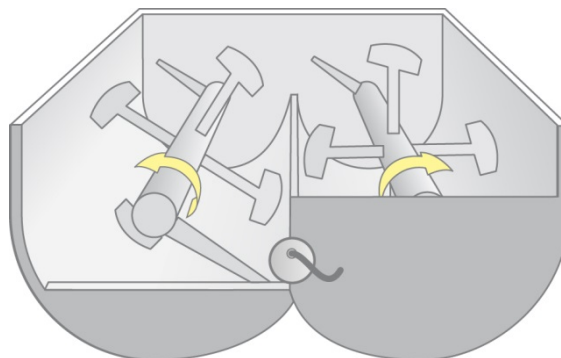


Figure 9: Hydro-Mix installed in an organic material mixer

### 2.6.2 Single shaft

Single shaft mixers should have the sensor installed in the end wall at 30° from the centre.

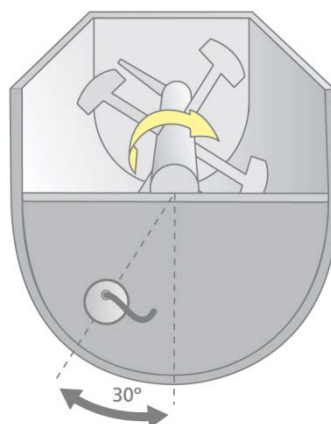


Figure 10: Hydro-Mix installed in a Single shaft mixer

## 2.7 Screw conveyor

The Hydro-Mix can be used in a screw conveyor. It is recommended that it is installed at 30° above the base. It is essential to make sure that the sensor is located so there is enough material to cover the ceramic faceplate with a minimum 100mm depth. See Figure 11

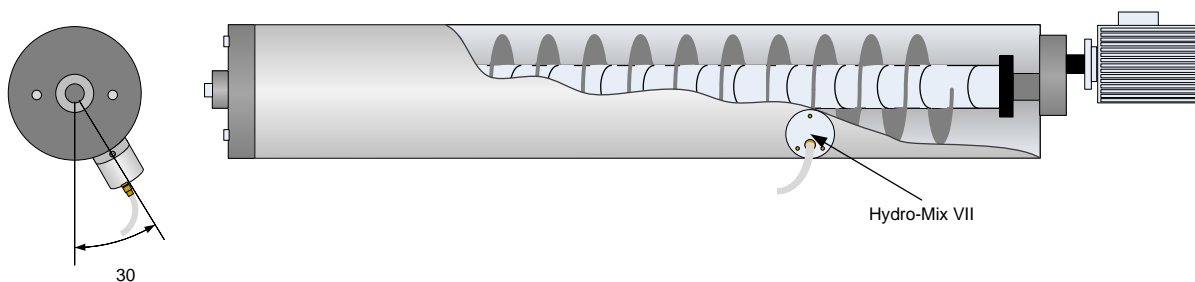


Figure 11: Hydro-Mix installed in a screw conveyor

## 2.8 Conveyor belt applications using Hydro-Skid

The Hydro-Skid is a mounting device designed to enable a Hydronix Hydro-Mix moisture sensor to ride over the surface of flowing material on a belt conveyor. Measurements are then taken by the flush mounted sensor as the material passes underneath.

The Hydro-Skid should be installed above the conveyor belt. The arm must be installed so that the Hydro-Skid faces towards the pantograph arm fixings. For correct operation the Hydro-Skid must be installed parallel to the conveyor belt. See the Hydro-Skid user guide for installation guidance.

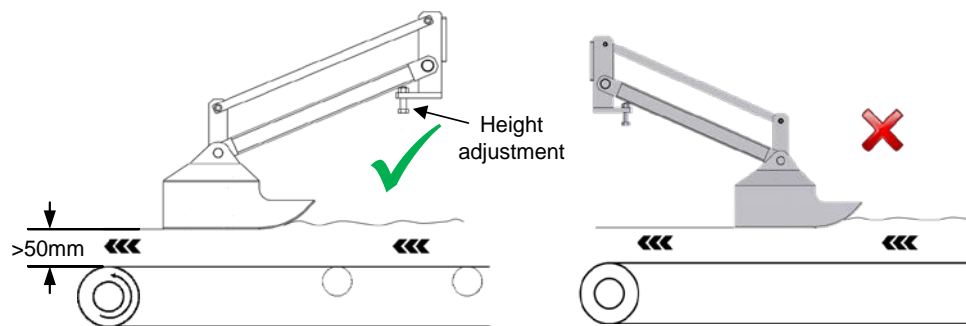


Figure 12: Hydro-Skid installation

## 3 Corrosion protection

In situations where corrosive materials are in use, there is potential for the cable connector to be damaged. It is therefore necessary to provide some protection to minimise the corrosion. Protection from this corrosion is possible with a few simple adjustments made to the installation of the sensor.

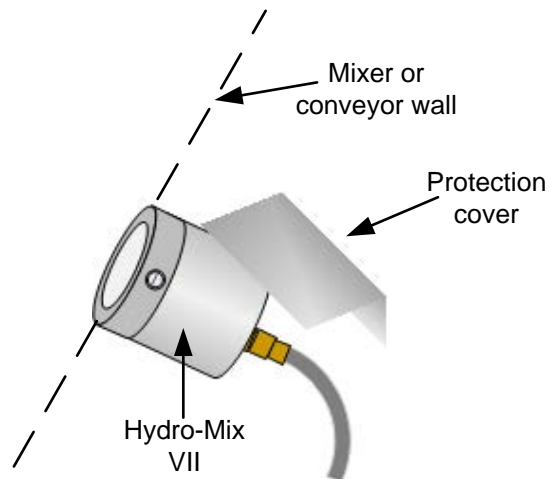
***It is always best to try and locate the sensor so no material comes into contact with the connection end of the sensor.***

### 3.1 Sensor position

To avoid possible corrosion it is recommended to install the sensor in a location, if possible, where material will not fall onto the connector. If this is not possible additional protection should be provided.

#### 3.1.1 Protection cover

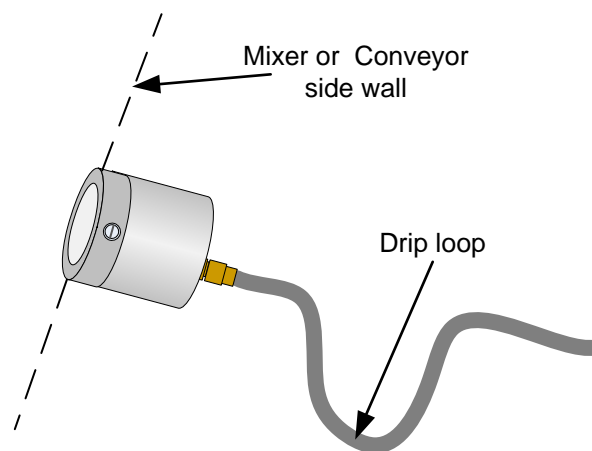
To increase the protection from falling material a cover over the top of the sensor, to deflect the material away from the connector, can be installed. See Figure 13



**Figure 13: Hydro-Mix with deflector plate installed**

### 3.2 Drip loop

Some corrosion is possible if the moisture run off from the material reaches the connector. This will be increased if the moisture is able to run along the sensor cable and collect at the connector. This can be reduced by installing the cable with a drip loop. This will cause the moisture to drip off of the cable before it reaches the connector. See Figure 14



**Figure 14: Hydro-Mix installed with a drip loop**

If the connector is still getting wet or covered by the material, self-amalgamating tape can be used to seal it and stop the water causing corrosion. It is, however, preferential to keep the material away from the connector as this will be the best method of stopping the possibility of corrosion.

## 4 Installing the sensor

The Hydro-Mix VII is fitted to the mixer using a Fixing Plate (part no 0021) welded to the permanent floor or side wall of the mixer and the Adjustable Clamp Ring assembly (part no 0033) which is supplied with the sensor.

The Adjustable Clamp Ring Assembly facilitates the correct positioning and subsequent height adjustment of the sensor.

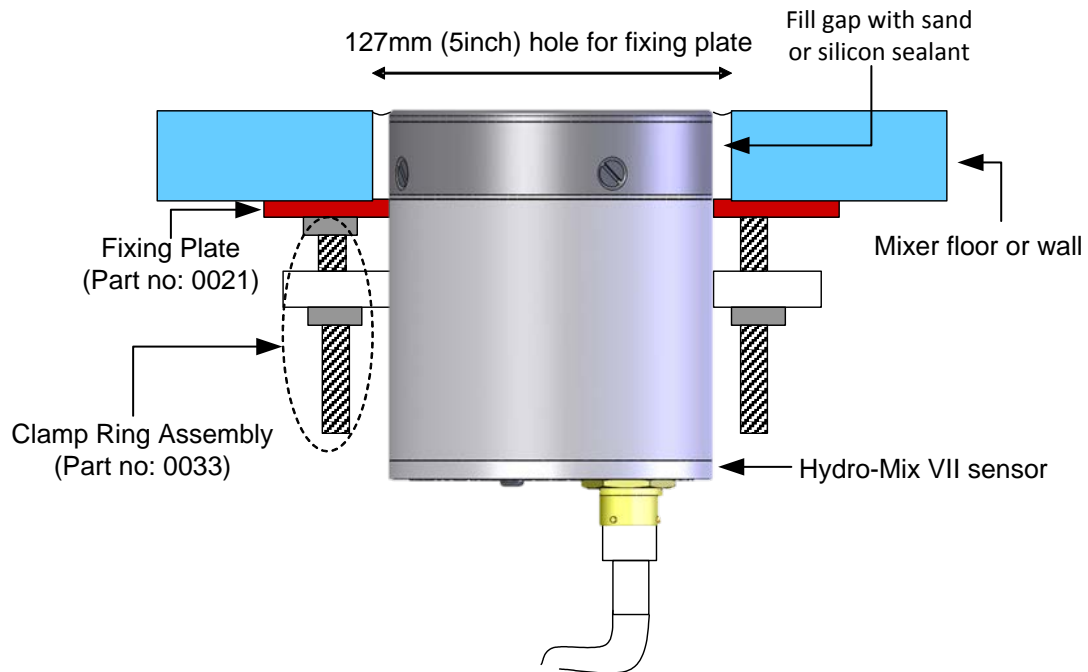


Figure 15: Sensor installation

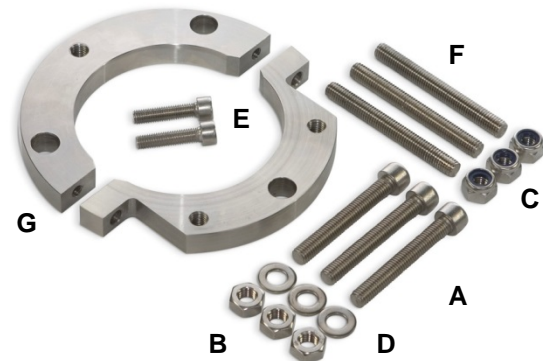
### 4.1 Cutting hole in the mixer and fitting the Fixing Plate (0021)

A hole should be cut into the mixer before welding the fixing plate. The recommended cut-out hole size is 127mm (5 inches) to allow for tolerances in the hole. The actual size of the sensor is 108mm (4.25 inches). Having cut the hole in the mixer and checked the clearance for the sensor, the fixing plate should be welded to the mixer. Whilst welding the sensor must be removed to protect the electronic circuitry within it.

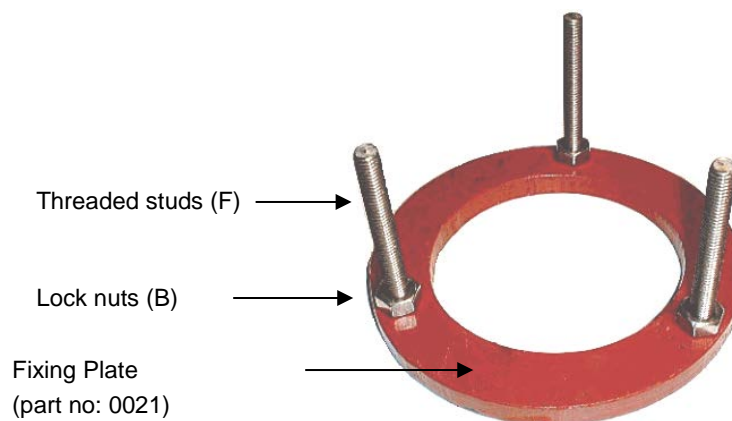
## 4.2 Fitting the Adjustable Clamp Ring assembly to the sensor

The Adjustable Clamp Ring comprises the following components:

- A. 3 x M10 screws
- B. 6 x M10 lock nuts (Three shown)
- C. 3 x M10 Nyloc nuts
- D. 3 x washers
- E. 2 x M8 screws
- F. 3 x M10 threaded stud
- G. Clamp Ring

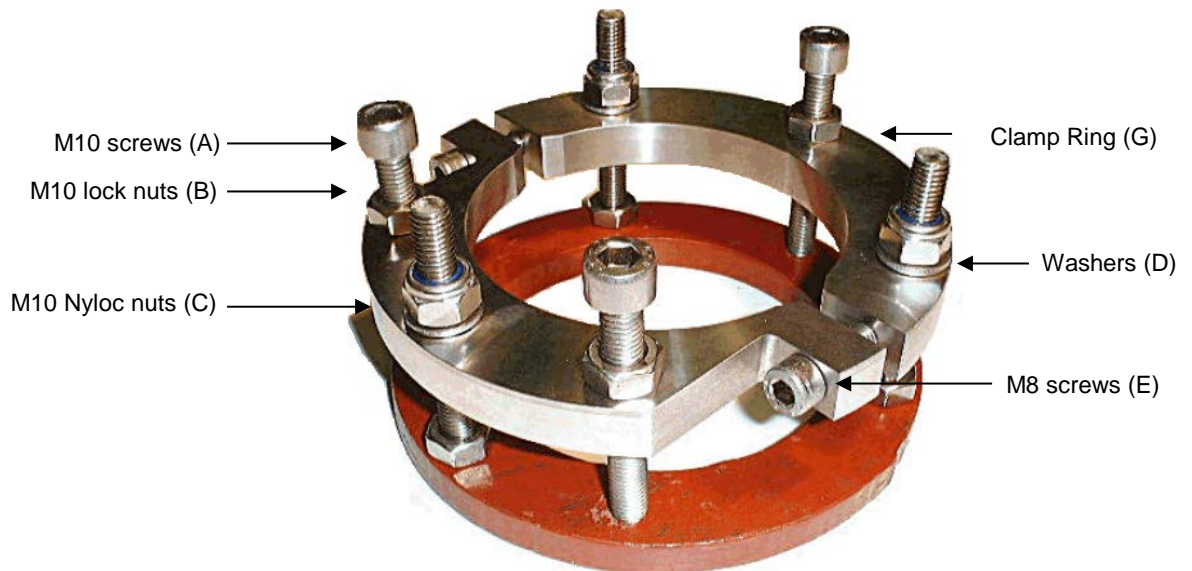


**Figure 16: Adjustable Clamp Ring components**



**Figure 17: Fixing Plate prepared for attaching Clamp Ring**

1. Screw the 3 threaded studs (F) to the Fixing Plate (already welded to the mixer), and tighten securely using 3 lock nuts (B)
2. Fit the Clamp Ring (G) onto the sensor using the 2 x M8 screws (E). Position the Clamp Ring so that adjustment is possible with the ceramic head level with the mixer floor or side wall.
3. Fit the Clamp Ring and sensor assembly over the threaded studs of the Fixing Plate and use the Nyloc nuts (C) and washers (D) to position the sensor with the ceramic level with the mixer floor or side wall



**Figure 18: Adjustable Clamp Ring assembled and fitted to Fixing Plate**

4. Fit the three screws (A) along with the 3 remaining lock nuts (B) to the Clamp Ring to **push** against the Fixing Plate.
5. **CHECK** again to ensure that the sensor head is in the correct position, using a steel rule and ensure that the mixer blades and scrapers clear the ceramic face by manually rotating the blades.
6. Fully tighten the complete assembly including the lock nuts.
7. Once the sensor has been correctly fitted and adjusted, fill the gap around the sensor with silicone sealant (preferred) or compacted sand.



**Figure 19: Adjustable Clamp Ring (0033) fitted to Fixing Plate (0021) and Hydro-Mix VII**

### 4.3 Adjusting the sensor



**NEVER HIT THE CERAMIC**

**THE CERAMIC IS VERY HARDWEARING BUT IS BRITTLE AND WILL CRACK IF STRUCK**

The ceramic face plate of the sensor is extremely resistant to abrasion. The mixer wear plates will wear more rapidly than the ceramic. Consequently from time to time it will be necessary to adjust the sensor so that it maintains the same relative position to the wear plates (following this procedure a recalibration of the recipes may be required).

### 4.4 To move the sensor IN to the mixer

1. Clean out compacted sand or silicone sealant from around the sensor.
2. Loosen the lock nuts B and screws A.
3. Tighten nuts C evenly (max 50Nm or 37ft/lb) until the sensor is in the desired position.
4. Tighten screws A (20Nm or 15ft/lb).
5. Tighten lock nuts B (40Nm or 30 ft/lb).
6. Fill the gap around the mixer with silicone sealant (preferred) or compacted sand.

### 4.5 To move the sensor OUT of the mixer

1. Clean out compacted sand or silicone sealant from around the sensor.
2. Loosen lock nuts B and nuts C.
3. Tighten screws A evenly (max 60Nm or 45ft/lb) until the sensor is in the desired position.
4. Tighten nuts C (20Nm or 15ft/lb).
5. Tighten lock nuts B (40Nm or 30ft/lb).
6. Fill the gap around the mixer with silicone sealant (preferred) or compacted sand.

### 4.6 Removal of the sensor

Clean out compacted sand or silicone sealant from around the sensor.

Remove nuts C and carefully ease the sensor and clamp ring assembly from the mixer.

If the sensor is to be removed and the mixer used, a sensor blanking plate (part no: 0035) can be used to seal the hole.

## 5 Replacing the Ceramic Disc

Should the ceramic face plate of the sensor become damaged it can easily be replaced. It is advised that a replacement kit (part no: 0900) is held in reserve in case of this event. Full instructions on replacing the ceramic can be found in the installation instructions accompanying the replacement kit or the Ceramic Disc Replacement Instructions HD0411.





Hydronix supplies cable 0975 for use with the Hydro-Mix VII, this is available in different lengths. Any extension cable required should be connected to the Hydronix sensor cable using a suitable screened junction box. See (Technical Specification, Chapter 8 for cable details).

The Hydro-Mix VII is also directly backward compatible with older 0090A cables (as used with the previous model Hydro-Mix VI sensor). When connecting to a 0090A cable it is not possible to use the 2<sup>nd</sup> analogue output provided by the Hydro-Mix VII.

For Hydro-Mix VII installations using both Analogue Outputs, it is necessary to use Sensor Cable part number 0975.

It is recommended to allow the sensor to stabilise for 15 minutes after applying power before use.

## 1 Installation guidelines

Ensure that the cable is of a suitable quality (see Technical specification, Chapter 8).

Ensure that the RS485 cable is taken back into the control panel. This can be used for diagnostic purposes and takes the minimum of effort and cost to connect at the time of installation.

Route the signal cable away from any power cables, in particular the mixer power supply.

Check that the mixer is properly grounded.

***Note that there is an M4 threaded hole provided on the bottom of the Hydro-Mix VII for a ground connection if required.***

The sensor cable should **only** be grounded at the mixer.

Ensure that the cable screen is **not** connected at the control panel.

Ensure that there is continuity of the screen through any junction boxes.

Keep the number of cable joins to a minimum.

## 2 Analogue outputs

Two DC current sources generate analogue signals proportional to separately selectable parameters (e.g. filtered unscaled, filtered moisture, average moisture, etc). See Chapter 4 'Configuration' or the Hydro-Com User Guide HD0273 for further details. Using the Hydro-Com or direct computer control, the output may be selected to be:

- 4-20 mA
- 0-20 mA - 0-10 V output can be achieved using the 500 Ohm resistor supplied with the sensor cable.

Sensor cable (Part no 0975) connections (for new installations):

Twisted Pair Number	MIL spec pins	Sensor connections	Cable colour
1	A	+15-30V DC	Red
1	B	0V	Black
2	C	1 <sup>st</sup> Digital input	Yellow
2	--	-	Black (Cut back)
3	D	1 <sup>st</sup> Analogue Positive (+)	Blue
3	E	1 <sup>st</sup> Analogue Return (-)	Black
4	F	RS485 A	White
4	G	RS485 B	Black
5	J	2 <sup>nd</sup> Digital input	Green
5	--	-	Black (Cut back)
6	K	2 <sup>nd</sup> Analogue Positive (+)	Brown
6	E	2 <sup>nd</sup> Analogue Return (-)	Black
	H	Screen	Screen

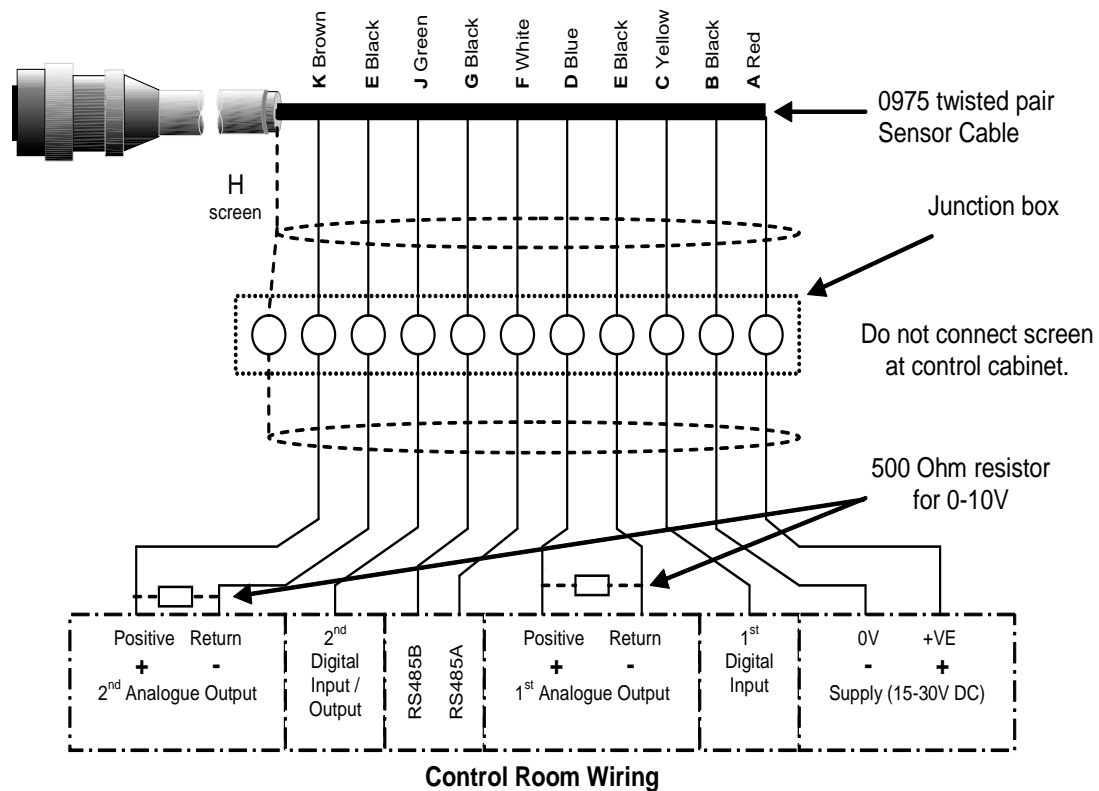


Figure 20: 0975 Sensor cable connections

**Note:** The cable screen is grounded at the sensor. It is important to ensure that the plant where the sensor is installed is properly grounded.

### 3 RS485 multi-drop connection

The RS485 serial interface allows up to 16 sensors to be connected together via a multi-drop network. Each sensor should be connected using a waterproof junction box.

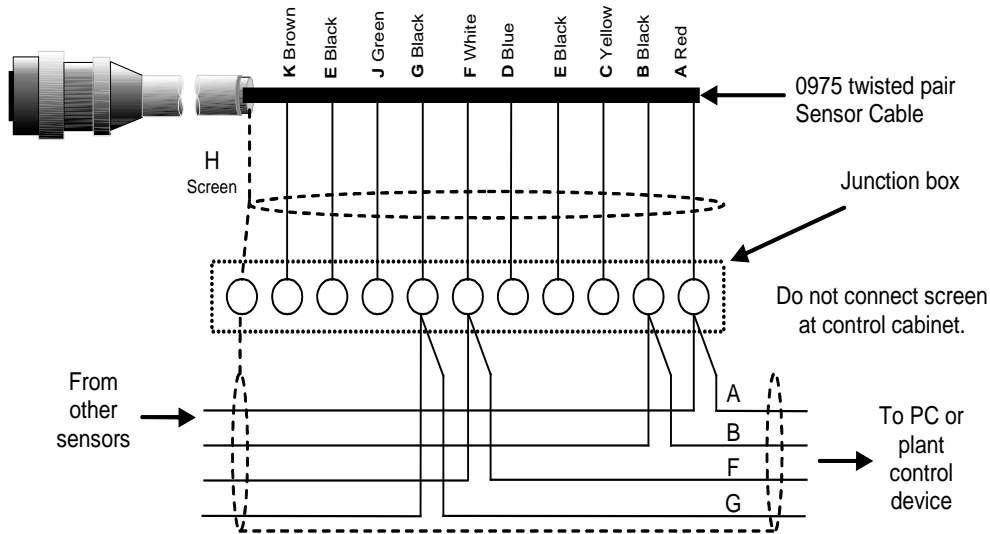


Figure 21: RS485 multi-drop connection

### 4 Hydro-Control IV / Hydro-View connection

To connect to a Hydro-Control IV or Hydro-View, the Hydro-Mix VII needs to be set to compatibility mode. To operate in this mode the output type needs to be set to ‘Compatibility’ using Hydro-Com, see Chapter 4 ‘Configuration’. The 500 Ohm resistor supplied with the cable is required to convert the analogue current output to a voltage signal. This should be fitted as shown in Figure 22 at the Hydro-Control IV or Hydro-View.

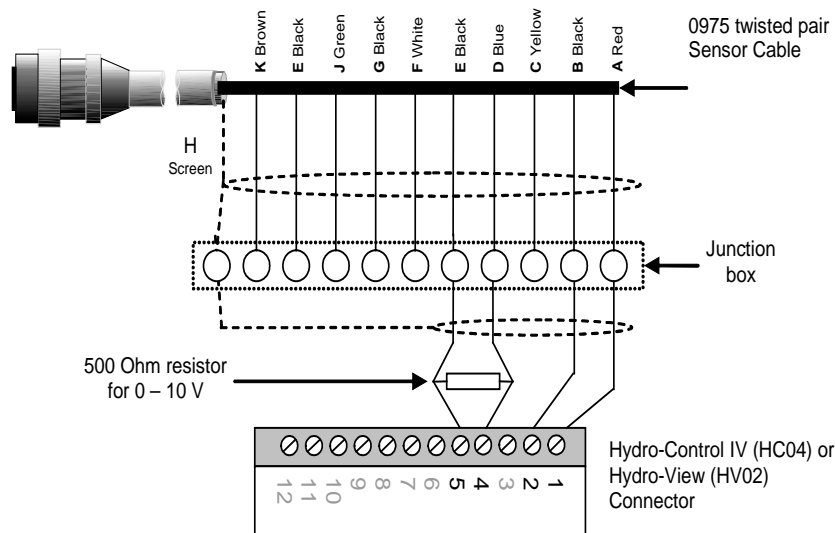


Figure 22: Connecting to a Hydro-Control IV or Hydro-View

## 5 Digital input/output connection

The Hydro-Mix VII has two digital inputs, the second of which can also be used as an output for a known state. Full descriptions of how the digital inputs/outputs can be configured are included in Chapter 4. The most common use of the digital input is for batch averaging, where it is used to indicate the start and end of each batch. This is recommended as it provides a representative reading of the full sample during each batch.

An input is activated using 15 – 30 Vdc into the digital input connection. The sensor power supply may be used as an excitation supply for this, or alternatively an external source may be used as shown below.

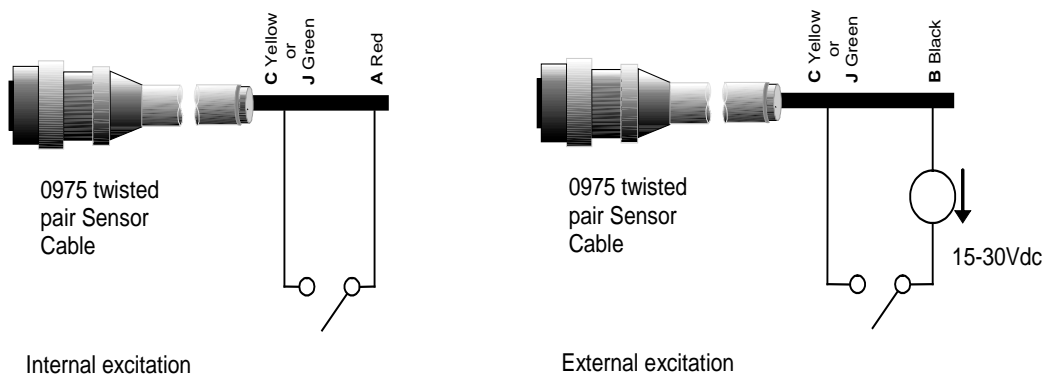
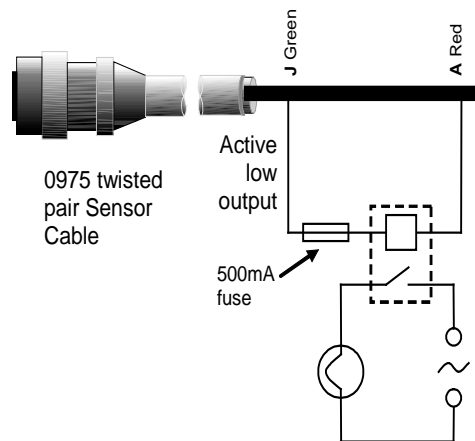


Figure 23 – Internal/external excitation of digital input 1 & 2

When the digital output is activated the sensor internally switches pin J to 0V. This can be used to switch a relay for a signal such as 'bin empty' (see Chapter 4). Note that the maximum current sink in this case is 500mA and in all cases over current protection should be used.



Digital Output switch – example using 'Bin Empty' signal to turn on a lamp

Figure 24 - Activation of digital output 2

## 6 Connecting to a PC

A converter is required to connect the RS485 interface to a PC. Up to 16 sensors may be connected at any time.

RS485 line termination will not normally be required in applications with up to 100 m of cable. For longer lengths connect a resistor (approximately 100 Ohm) in series with a 1000pF capacitor across each end of the cable.

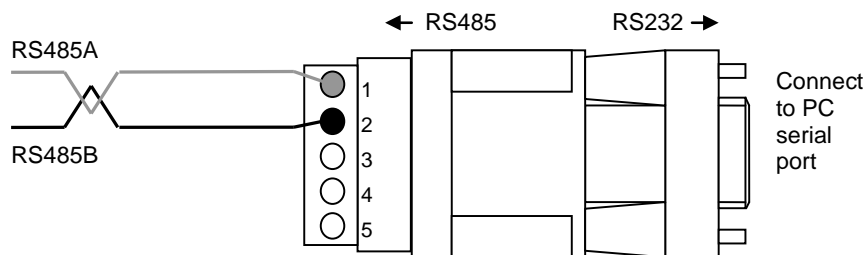
It is highly recommended that the RS485 signals be run to the control panel even if they are unlikely to be used as this will facilitate the use of diagnostic software should the need arise.

There are four types of converter supplied by Hydronix.

### 6.1 RS232 to RS485 converter – D type (part no: 0049B)

Manufactured by KK systems, this RS232 to RS485 converter is suitable for connecting up to six sensors on a network. The converter has a terminal block for connecting the twisted pair RS485 A and B wires and can then be connected directly in to the PC serial communication port.

Hydronix Part No 0049B



6 dipswitches control the configuration of the converter. For both the 0049 and 0049B these should be set to:

Switch 1 ON	Switch 3 OFF	Switch 5 OFF
Switch 2 OFF	Switch 4 ON	Switch 6 OFF

**Figure 25: RS232/485 converter connections (0049B)**

### 6.2 RS232 to RS485 converter – DIN rail mounting (part no: 0049A)

Manufactured by KK systems, this powered RS232 to RS485 converter is suitable for connecting up to 16 sensors on a network. The converter has a terminal block for connecting the twisted pair RS485 A and B wires and can then be connected to a PC serial communication port.

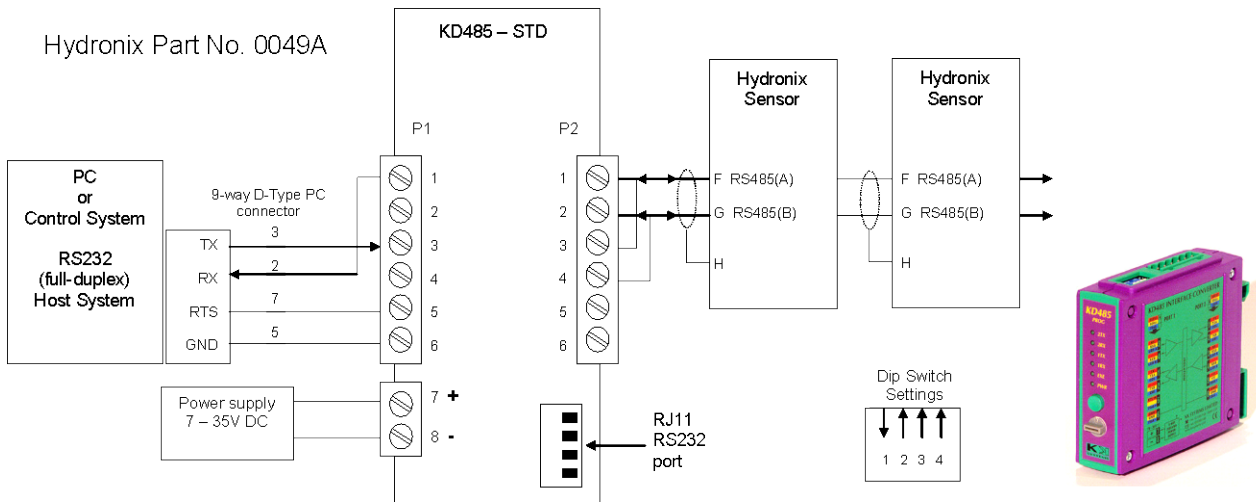


Figure 26: RS232/485 converter connections (0049A)

### 6.3 USB Sensor Interface Module (part no: SIM01A)

Manufactured by Hydronix, this USB-RS485 converter is suitable for connecting up to 16 sensors on a network. The converter has a terminal block for connecting the twisted pair RS485 A and B wires, and then connects to a USB port. The converter does not require external power, although a power supply is supplied and can be connected providing power to the sensor. See USB Sensor Interface Module User Guide (HD0303) for further information.

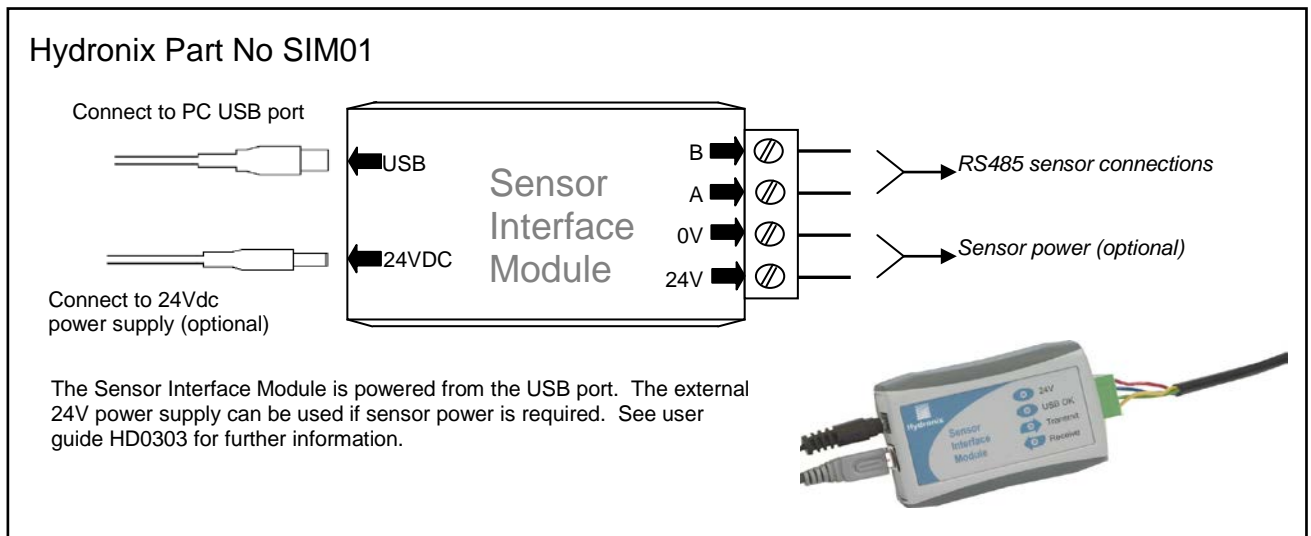


Figure 27: RS232/485 converter connections (SIM01A)

### 6.4 Ethernet Adapter Kit (part no: EAK01)

Manufactured by Hydronix, the Ethernet adapter is suitable for connecting up to 16 sensors to a standard Ethernet network. An optional Ethernet Power Adapter Kit (EPK01) is also available which eliminates the need for additional expensive cables to be run to a remote location which does not have local power. If this is not used then the Ethernet adapter will require a local 24v power supply.

Hydronix Part No: EAK01

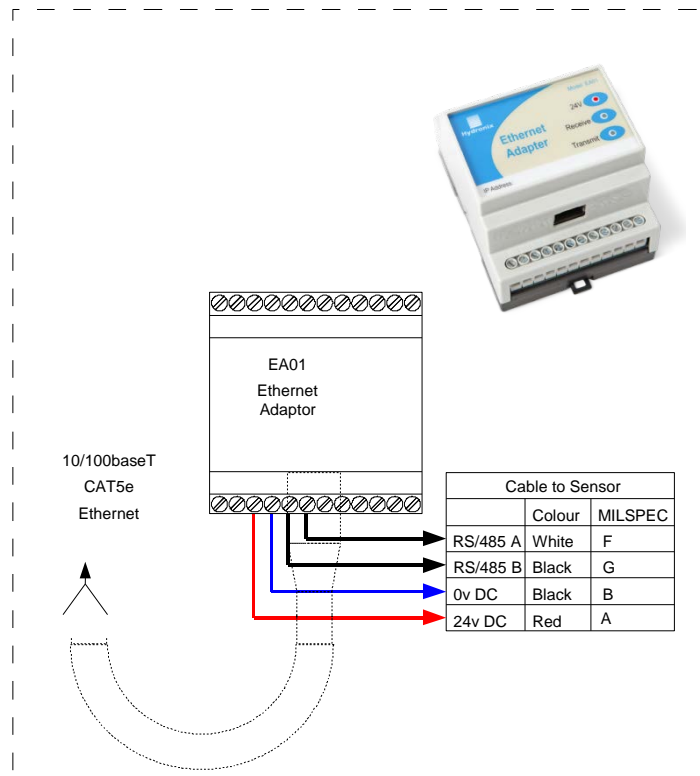


Figure 28: Ethernet Adaptor Connections (EAK01)

Hydronix Part No: EPK01

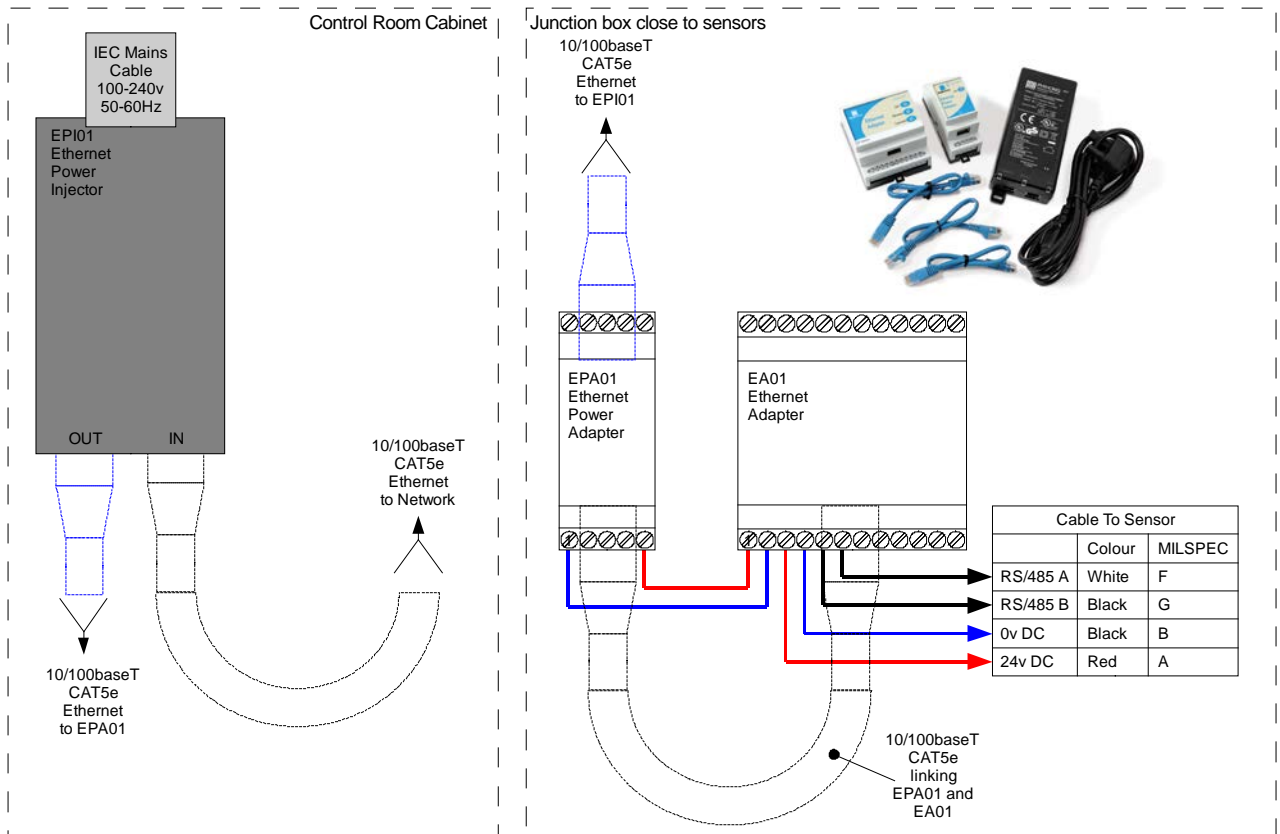


Figure 29: Ethernet Power Adapter Kit connections (EPK01)



## 1 Configuring the Sensor

The Hydro-Mix VII has a number of internal parameters which can be used to optimise the sensor for a given application. These settings are available to view and change using the Hydro-Com software. Information for all settings can be found in the Hydro-Com User Guide (HD0273).

Both the Hydro-Com software and the User Guide can be downloaded free of charge from [www.hydronix.com](http://www.hydronix.com).

All Hydronix sensors operate in the same way and use the same configuration parameters. However, not all the functions are used in mixer sensor applications. (Averaging parameters, for example, are typically used for batch processes).

## 2 Analogue output setup

The working range of the two current loop outputs can be configured to suit the equipment to which it is connected, for example a PLC may require 4 – 20 mA or 0 – 10V DC etc. The outputs can also be configured to represent different readings generated by the sensor e.g. moisture or temperature.

### 2.1 Output type

This defines the type of analogue outputs and has three options:

- 0 – 20mA: This is the factory default. The addition of an external 500 Ohm precision resistor converts to 0 – 10V DC.
- 4 – 20mA.
- Compatibility: This configuration must only be used if the sensor is to be connected to a Hydro-Control IV or Hydro-View. A 500 Ohm precision resistor is required to convert to voltage.

### 2.2 Output variable 1 and 2

These define which sensor readings the analogue output will represent and has 4 options.

**NOTE: This parameter is not used if the output type is set to 'Compatibility'**

#### 2.2.1 Filtered Unscaled

The Filtered Unscaled represents a reading which is proportional to moisture and ranges from 0 – 100. An unscaled value of 0 is the reading in air and 100 would relate to a reading in water.

#### 2.2.2 Average Unscaled

This is the 'Raw Unscaled' variable processed for batch averaging using the averaging parameters. To obtain an average reading, the digital input must be configured to 'Average/Hold'. When this digital input is switched to high, the raw unscaled readings are averaged. When the digital input is low, this average value is held constant.

#### 2.2.3 Filtered Moisture %

If a moisture output is required, the 'Filtered Moisture %' can be used, which is scaled using the A, B, C and SSD coefficients and the 'Filtered Unscaled' reading (F.U/S) such that :

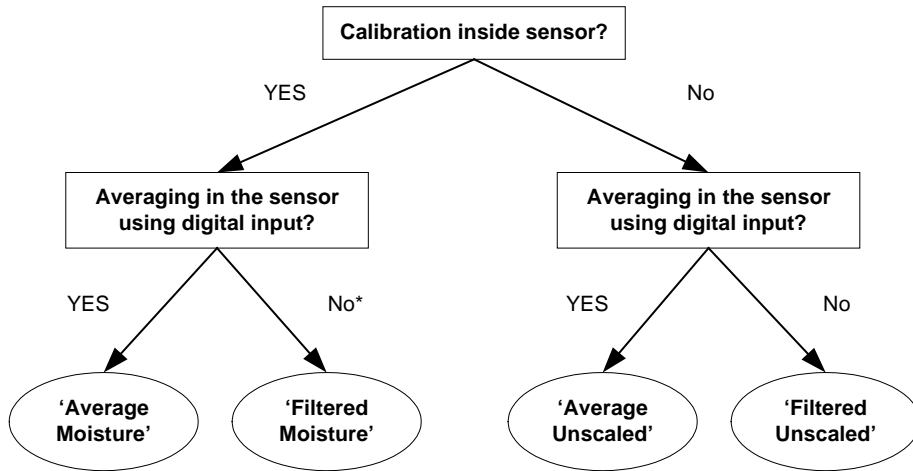
$$\text{Filtered Moisture \%} = A \times (F.U/S)^2 + B \times (F.U/S) + C - \text{SSD}$$

These coefficients are derived solely from a material calibration and so the accuracy of the moisture output is dependent upon how good the calibration is.

The SSD coefficient is the Saturated Surface Dry offset (water absorption value) for the material in use and allows the displayed percentage moisture reading to be expressed in surface (free) moisture only.

### 2.2.4 Average Moisture %

This is the 'Raw Moisture %' variable processed for batch averaging using the averaging parameters. To obtain an average reading, the digital input must be configured to 'Average/Hold'. When this digital input is switched high, the Raw Moisture readings are averaged. When the digital input is low this average value is held constant.



\*It would be advisable to average in the control system here

Figure 30: Guidance for setting output variable

### 2.3 Low % and High%

**NOTE:** These parameters are not used if the output type is set to 'Compatibility'.

These two values set the moisture range when the output variable is set to 'Filtered Moisture %' or 'Average Moisture %'. The default values are 0% and 20% where:

0 - 20mA    0mA represents 0% and 20mA represents 20%

4 - 20mA    4mA represents 0% and 20mA represents 20%

These limits are set for the working range of the moisture and must be matched to the mA to moisture conversion in the batch controller.

## 3 Digital inputs/output setup

The Hydro-Mix VII has two digital inputs/output; the first can be configured as an input only. The second can be either an input or output.

The first digital input can be set to the following:

- Unused:                      The status of the input is ignored
- Average/Hold              This is not applicable to a mixer application, but may apply in chutes or other flush mount applications. It is used to control the start and stop period for batch averaging. When the input signal is activated, 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, 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:** Allows the user to switch the analogue output between the unscaled or moisture (whichever is set) and temperature. This is used when the temperature is required whilst still using only one analogue output. With the input inactive, the analogue output will indicate the appropriate moisture variable (unscaled or moisture). When the input is activated, the analogue output will indicate the material temperature (in degrees centigrade).

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

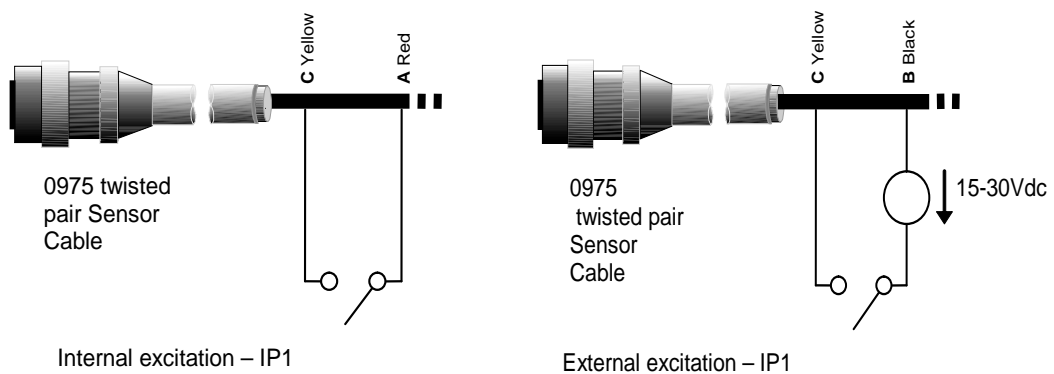
The second digital input/output can also be set to the following outputs:

**Bin Empty:** This output is energised if the unscaled value goes below the Low Limits defined in the Averaging section. This can be used to signal to an operator when the sensor is in air (as the sensor's value goes to zero in air) and can indicate a vessel empty state.

**Data Invalid:** This output is energised if the unscaled value goes outside of any of the limits defined in the averaging section, so it could be used to provide a high and low level alarm output.

**ProbeOK:** This option is not used for this sensor.

An input is activated using 15 – 30V DC into the digital input connection. The sensor power supply may be used as an excitation supply for this, or alternatively an external source may be used as shown below.



**Figure 31: Internal/external excitation of the digital input**

## 4 Filtering

The default filtering parameters can be found on Page 59 or in Engineering Note EN0059.

The raw unscaled reading, which is measured 25 times per second, contains a high level of 'noise' due to irregularities in the signal from the mixer blades and pockets of air. As a result, this signal requires a certain amount of filtering to make it usable for moisture control. The default filtering settings are suitable for most applications, however they can be customised if required to suit the application.

It is not possible to have default filtering settings that are ideally suited to all mixers because every mixer has a different mixing action. The ideal filter is one that provides a smooth output with a rapid response.

The raw moisture % and raw unscaled settings should **not** be used for control purposes.

The raw unscaled reading is processed by the filters in the following order; first the slew rate filters limit any step changes in the signal, then the Digital Signal Processing filters remove any high frequency noise from the signal and finally the smoothing filter (set using the filtering time function) smoothes the whole frequency range.

The Digital Signal Processing filter implements a sixth order low pass Butterworth filter that attenuates signals above a defined cut-off frequency. The advantage of this filter over smoothing is that the signals below the cut-off frequency are allowed through, for example, the change of the moisture in the material, but signals above the cut-off frequency are attenuated. The result of this is a smooth signal that responds rapidly to changes in moisture.

The smoothing filter applies to the whole of the frequency range of the signal, and so as well as smoothing the noise in the signal, it also smoothes the response to the changes in moisture. This results in a signal that responds slowly to those changes in moisture. The advantage is that where the mixer cycle itself introduces a low frequency noise on the signal, the smoothing filter can remove this at the expense of the response time.

### 4.1 Slew rate filters

These filters set rate limits for large positive and negative changes in the raw signal. It is possible to set limits for positive and negative changes separately. The options for both the 'slew rate +' and the 'slew rate -' filters are: None, Light, Medium and Heavy. The heavier the setting, the more the signal will be 'dampened' and the slower the signal response.

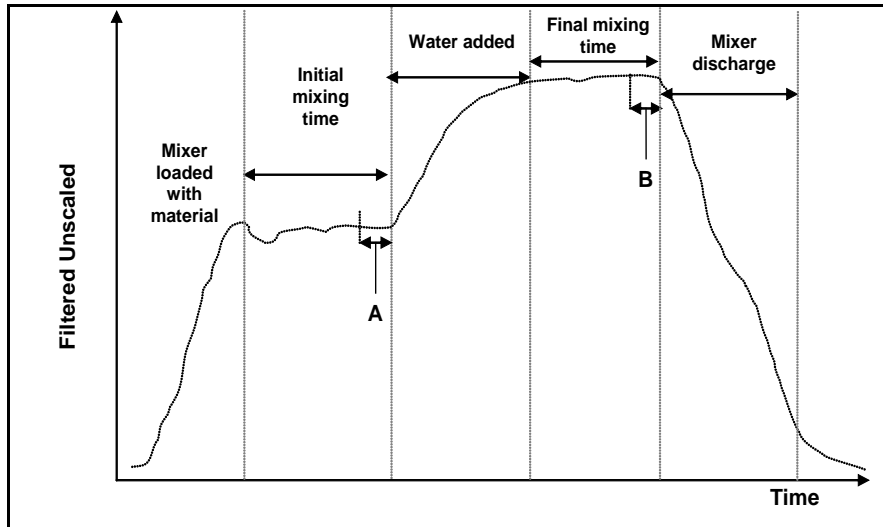
### 4.2 Digital Signal Processing

The signal is passed through a Digital Signal Processing filter. This removes noise from the signal using an advanced algorithm. Settings are None, Very Light, Light, Medium, Heavy and Very Heavy.

### 4.3 Filtering time

This smoothes the signal after it has passed through the slew rate and Digital Signal Processing filters. Standard times are 0, 1, 2.5, 5, 7.5, and 10 seconds, although it is possible also to set this up to 100 seconds for specific applications. A higher filtering time will slow the signal response.

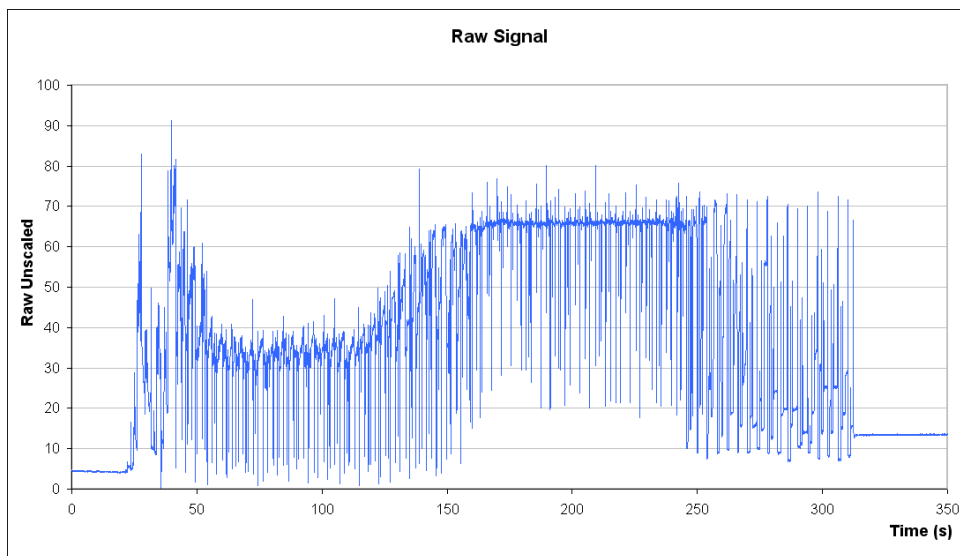
Figure 32 is a typical moisture curve during a batching cycle of concrete. The mixer starts empty and as soon as material is loaded, the output rises to a stable value, Point A. Water is then added and again the signal stabilises at Point B, at which point the batch is complete and the material is discharged. The main points to note with this signal are the points of stability because these signify that all the materials (aggregates, cement, colourings, chemicals etc.) are completely mixed together, i.e. the mix is homogeneous.



**Figure 32: Typical moisture curve**

The degree of stability at points A and B can have a significant effect on accuracy and repeatability. For example, most automatic water controllers measure the dry moisture and calculate how much water to add to the mix, based on a known final reference in a particular recipe. Therefore it is vital to have a stable signal in the dry mix phase of the cycle at point A. This enables the water controller to take a representative reading and make an accurate calculation of the water required. For the same reasons, stability at the wet end of the mix (Point B) will give a representative final reference indicating a good mix when calibrating a recipe.

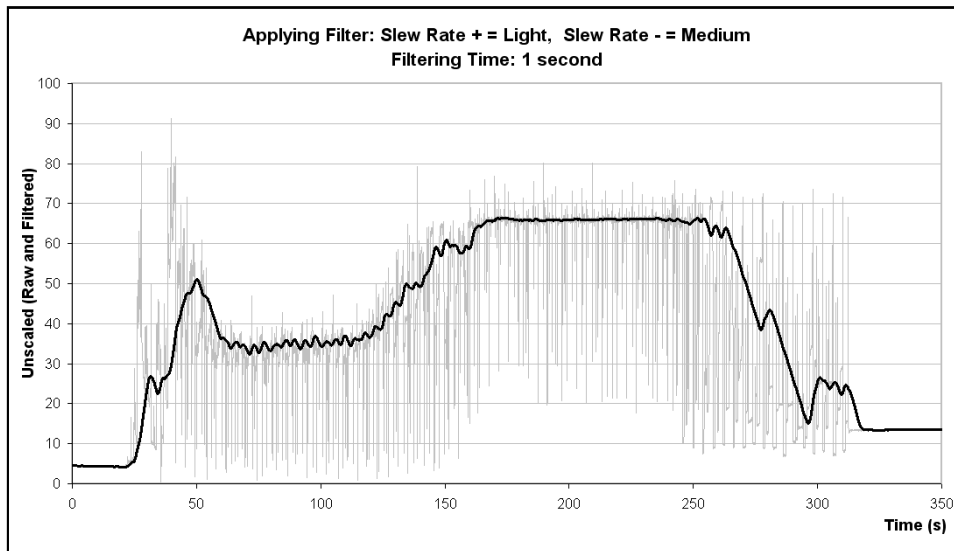
Figure 32 shows an ideal representation of moisture over a cycle. The output of this is the 'Filtered Unscaled' reading. The next graph (Figure 33) shows raw data recorded from a sensor over an actual mix cycle, clearly indicating the large spikes caused by the mixing action.



**Figure 33: Graph showing raw signal during mix cycle**

The following two graphs illustrate the effect of filtering the same raw data shown above. Figure 34 shows the effect of using the following filter settings which create the 'Filtered Unscaled' line on the graph.

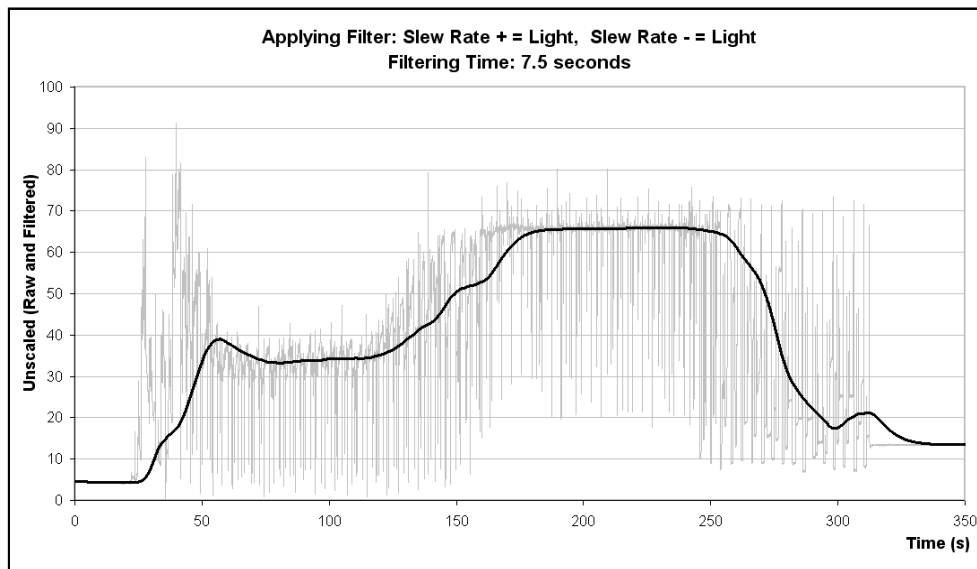
- Slew rate + = Medium
- Slew rate - = Light
- Filtering time = 1 second



**Figure 34: Filtering the RAW signal (1)**

Figure 35 shows the effect of the following settings:

- Slew rate + = Light
- Slew rate - = Light
- Filtering time = 7.5 seconds



**Figure 35: Filtering the RAW signal (2)**

In Figure 35 it is clear that the signal at the dry phase of the mix cycle is more stable which is more advantageous when making the water calibration.

For most mixer applications, the filter settings can be left at the default values which will adequately filter out the noise, with the aim of providing a smooth signal. Should there be a requirement to change the filtering then the aim is to provide as fast a response as possible whilst maintaining signal integrity. Signal stability is important, and mixing times have to be set appropriately in accordance with the mixer due to the variation in efficiency of mixers.

The default filtering parameters can be found on Page 59 or in Engineering Note EN0059.

## 4.4 Averaging parameters

These parameters determine how the data is processed for batch averaging when using the digital input or remote averaging. They are not normally used for mixing applications or continuous processes.

### 4.4.1 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 and 5.0 seconds.

### 4.4.2 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' label changes to 'Data Invalid'. 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.

## 5 Alternative Measurement Techniques

The Hydro-Mix VII has the option of selecting alternative measurement techniques.

There are three measurement modes supported by the HS0077 firmware, Standard Mode, Mode V and Mode E. In most cases Standard Mode will give excellent results and the sensor parameters may be left in their factory settings.

### 5.1 Standard Mode

This is the standard measurement mode which is currently used in most Hydronix sensors. It is best to use this mode if there are no reasons to choose one of the alternative modes. This mode should work best for aggregates and concrete applications. Standard Mode uses only the change in the resonant frequency of the sensor to measure changes in moisture.

### 5.2 Modes V and E

Modes V and E combine the change in the resonant frequency with the change in the amplitude of the microwave resonator to determine the change in moisture. The two modes respond differently to changes in moisture and density. Either mode V or E may be more appropriate for certain materials or applications. When to use an alternative mode is described below.

### 5.3 When to use alternative measurement techniques

The most appropriate mode will be determined by the requirements of the user, the application and the material being measured.

Precision, stability and density fluctuations as well as the working moisture range are all factors that may determine the choice of measurement mode.

Standard Mode is often associated with flowing sand and aggregates and concrete mixer type applications.

Modes V and E are often associated with lower density materials such as grain or other organic materials. They are also associated with any material that has a variable bulk density that correlates to moisture content. Modes V and E may also be beneficial for high intensity mixing applications of high density material and for other mixing applications with distinct changes in density over time (including aggregates and concrete).

The objective is to choose the technique that gives the most desirable (often smoothest) signal response and most accurate moisture determination.

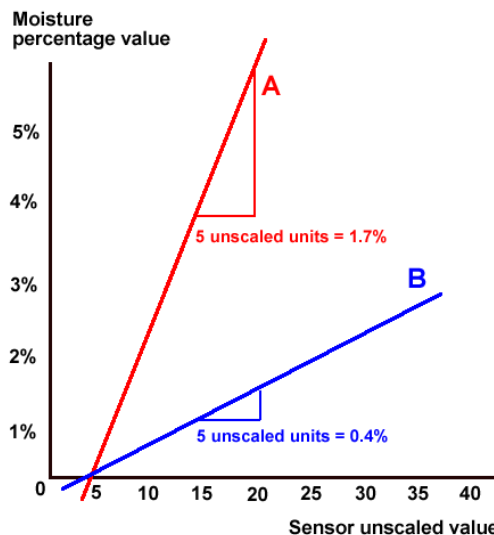
## 5.4 Effects of selecting different modes

Each mode will give a different relationship between the sensor's 0-100 unscaled values and the moisture percentage.

When measuring in any material it is usually beneficial that a large change in unscaled sensor readings equates to a small change in moisture levels. This will give the most precise calibrated moisture reading (see Figure 36: Relationship of unscaled values to moisture. This assumes that the sensor remains capable of measuring across the full moisture range required and that the sensor is not configured to be impractically overly sensitive.

In certain materials such as organic products the relationship between unscaled values and moisture means that a smaller change in unscaled values gives a large change in the moisture value when operating in Standard Mode. This makes the sensor less precise and too sensitive, which is undesirable.

If this were plotted with moisture on the Y axis and sensor unscaled values on the X axis, the calibration line is very steep (see Figure 36: Relationship of unscaled values to moisture. The ability to select the fundamental measurement technique allows the user to choose the technique that most flattens the relationship between unscaled values and moisture (see Figure 36, line B). The mathematical algorithms employed in the sensor have been specially devised to respond in a different manner dependant on the material being measured. All modes will all give a stable linear output however, line 'B' will give better precision and accuracy. Modes V and E will also be less susceptible to density fluctuations.



**Figure 36: Relationship of unscaled values to moisture**

To determine which mode is the most appropriate it is recommend to run trials for a given material, mixer type or application. Before doing so it is recommend that you contact Hydronix to seek advice on our recommended settings for your given application.

Trials differ dependant on the application. For a measurement taken over time it is recommended to record the sensor's output from each of the different measurement modes in the same process. Data can easily be recorded using a PC and the Hydronix Hydro-Com



software, these results may then be plotted in a spreadsheet. When viewed in graph form it is often self-evident which mode gives the desired performance characteristics.

For further analysis, including sensor filtering analysis Hydronix can also offer advice as well as software to enable the experienced user to achieve the best possible settings for a sensor.

Hydro-Com software and the user guide may be downloaded from [www.hydronix.com](http://www.hydronix.com).

When using the sensor to obtain an output signal that is calibrated to moisture (an absolute moisture measurement) it is recommended to calibrate using the different measurement modes and to compare results (see Calibration page 43).

For further information please contact the Hydronix support team at [support@hydronix.com](mailto:support@hydronix.com)



## 1 Sensor Integration

The sensor may be integrated into a process in one of two ways :-

The sensor may be configured to output a linear value of between 0-100 unscaled units with a material or recipe calibration being performed in an external control system. This is the preferred configuration for mixing applications.

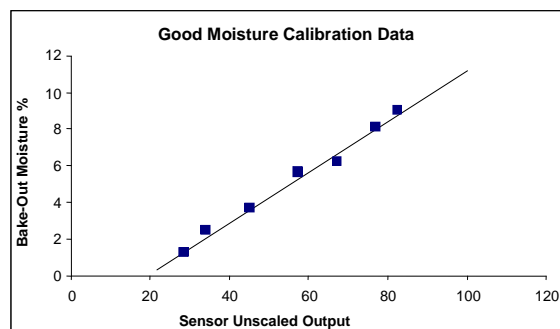
*Or*

internally calibrated using the Hydro-Com sensor configuration and calibration software to output an absolute moisture percentage value.

## 2 Sensor Calibration

### 2.1 Absolute moisture percentage calibration

This method requires the user to ascertain the relationship between the unscaled values of the sensor and the material moisture percentage (Figure 36). Detailed instructions on how to configure and calibrate the sensor are available in the Hydro-Com user guide.



### 2.2 Calibrating in an external control system

This configuration is recommended for mixing applications.

The sensor's averaging and/or filtering and signal smoothing functions may be applied to the unscaled value and output directly to an external control system.

For many mixing applications the object of controlling the moisture addition is to ensure that a repeatable moisture target is achieved batch after batch. Often this target point is derived through experience and monitoring the process. In order to achieve repeatability it is not necessary to give the final moisture target a moisture percentage value in order to perform the water addition calculation or progressively add water to a set target.

Water addition is in one of two ways :-

#### 2.2.1 Calculation based water addition

A moisture reading is taken in the homogenous dry material and a calculation is made of the amount of water required to achieve the required target. This method requires a calibration routine to determine the ratio between a change in the sensor's unscaled values to a change in moisture percentage. This effectively calculates a gradient of unscaled values to moisture percentage (see Figure 37) Because the sensor's output are linear and fully temperature stable, once this gradient is known the control system can calculate from any dry reading the water required to reach a given target for a known recipe. The calculations and target are often calculated in terms of unscaled units only.

Whilst it is possible to perform a moisture sample test on the final product to determine its moisture content this is often impractical and the theoretical value or recipe design value is used.

Advice on controlling this process can be found in Chapter 6.

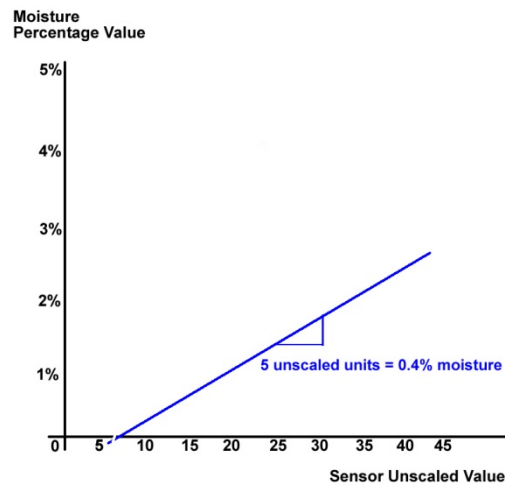


Figure 37: Gradient of unscaled values to moisture percentage

## 2.2.2 Progressive Water Feed

Referred to as AUTO-Mode when using the Hydronix Hydro-Control water controller.

This method continuously adds water until a set target has been achieved. Water addition rates and determination of stability at the target point should be considering in the control algorithm.

This method is less effected by variable batch sizes and varying ratios of ingredients in the mixer

For further advice on any of these methods please contact the Hydronix support team: [support@hydronix.com](mailto:support@hydronix.com)

For most applications the default measurement mode, filtering and signal smoothing settings of the sensor will be suitable.

A more desirable output may be achieved by adjusting the filtering and signal smoothing parameters in the sensor (see Filtering, Chapter 4).

Selecting an alternative measurement mode (see Alternative Measurement Techniques, Chapter 5) may give a more desirable signal response, but before doing so, it is worth considering the application advice set out below. It is also recommended that you contact the Hydronix support team, [support@hydronix.com](mailto:support@hydronix.com)

For many applications it is also worth reviewing the application process. The sensor itself is a precise instrument, its practical performance in a given application is largely a function of the application itself. For example, in a mixing application the sensor will output a stable signal once the material is homogenous. If the mixing equipment is not capable of achieving homogeneity (or of achieving this in the allotted time) the sensor signal will be conducive of the heterogeneity of the material (usually a variable or undulating reading).

Other key factors worth considering are :-

## 1 General to all Applications

- **Power Up:** It is recommended to allow the sensor to stabilise for 15 minutes after applying power before use.
- **Positioning:** The sensor should be in contact with a representative sample of the material.
- **Flow:** The sensor should be in contact with a consistent flow of material.
- **Material:** If the ratio of ingredients or additives of the underlying material or blend changes this may affect the moisture reading.
- **Material particle size:** If the particle size of the material being measured changes this may affect the rheology of the material for a given moisture content. Increased fine material often leads to a 'stiffening' of the material for a given moisture content. This 'stiffening' should not automatically be construed as a reduction in moisture. The sensor will continue to measure moisture.
- **Material build up:** Avoid material build up on the Ceramic Disc.

## 2 Mixing Applications

The moisture reading from the sensor can only indicate what is happening in the material or mixer. The speed of the reading, or the time taken to reach a steady reading when the materials are homogeneous, reflects the effectiveness of the mixer. By taking some simple precautions the overall performance can be considerably improved and the cycle time reduced with consequent financial savings.

Look at the mixing process. Check how the water disperses. If added water sits on top of the material for a time before dispersing, then spray bars may be required to disperse the water into the mixer more quickly to shorten the mixing time. Spray bars are more effective than single water inlets. The wider the area the water sprays, the faster it will mix into the material.

It is also possible to add water too quickly during a mixing process. Adding water faster than the mixer's ability to blend the added water into the mix may increase the overall mixing time. Ensuring that a mixer is properly maintained with blade clearances as per the manufactures specifications will increase the efficiency of the mixer.

The user may also find it beneficial to understand the ability of a pan mixer to mix both horizontally and vertically. A speed of the vertical mixing action (which cannot be seen so easily by eye) can be recorded by a floor mounted moisture sensor. This is the difference in time

between the time that the water addition was made and the time that the sensor registers an increase in moisture at or near the mixer floor.

### 3 Concrete Mixing

This section is specific to concrete mixing but may also be relevant to other mixing applications.

#### 3.1 Ingredients

If the aggregate masses are not corrected for high moisture contents, then the aggregate/cement ratio will change considerably, having an adverse effect on consistency and concrete performance.

If the aggregates are very wet, as may be the case at the beginning of the day due to water draining in the storage bin then there may be more water in the aggregates than the mix requires.

The moisture content of the aggregates should be above the saturated surface dry (SSD).

Hot cement can affect consistency (workability) and thus water demand.

Changes in ambient temperature can affect water demand.

Where possible, the cement addition should follow within a few seconds after the commencement of the addition of sand and aggregates. Combining the materials together in this way will greatly assist the mixing process.

#### 3.2 Consistency

The Hydro-Mix VII measures moisture, not consistency.

Many factors affect consistency, but may not affect moisture content. These might include:

- Aggregate grading (coarse/fine ratio)
- Aggregate/cement ratio
- Admixture dosage dispersion
- Ambient temperature
- Water/cement ratio
- Ingredient temperature
- Colours

#### 3.3 Mix Times and Batch Sizes

Minimum mix times are a function of the mix design (ingredients and mixer) not just the mixer so different mix designs may require different mix times.

Keep batch sizes as consistent as possible e.g. 2.5m<sup>3</sup> + 2.5m<sup>3</sup> + 1.0m<sup>3</sup> is not as good as 3 x 2.0m<sup>3</sup>.

Keep the dry mix time as long as possible. It is possible to reduce the wet mix time if the final homogeneity is not as critical.

#### 3.4 Control System Calibration and Integration

There are several methods in which the sensor may be used to control water addition in to a mixing process. The Sensor Integration and Calibration Chapter on page 43 covers this topic in detail.

The suggestions below refer to the method of calculation based water addition only. The calculation and control of the water addition may be either done by the Hydronix Hydro-

Control water controller or by a third party control system. The advice below is based on generally accepted principles, however, third party control systems may differ in their approach and advice should be sought from the supplier.

Maximum repeatability of viscosity will be achieved by ensuring that the dry weight of materials in the mixer are correctly proportioned, this may require weight correction on the weighed weights of materials that vary in moisture content to correct for moisture. For this the Hydro-Probe sensor is recommended.

When calculating the water to be added to the mix, the accuracy of the calculation is affected by the total batch weight, e.g. 2 different batch sizes of the same moisture content will require 2 different amounts of water to be added in order to achieve the same moisture percentage. Failure to correct for moisture in the aggregates leads to varying total batch weights and less accuracy in the calculation. This also results in under yielding and is consequently an inefficient use of cement.

A different calibration may be required for large variations in batch weights (e.g. half batches).

When performing a calibration it is advised that both the dry and wet mix times are extended to ensure that both are homogeneous.

Calibrate when conditions and ingredients are typical e.g. not first thing in the morning when the aggregates are very wet, or when the cement is hot.

When using a calibration-based water addition method, it is essential to obtain a correct dry reading.

The dry mix time must be long enough to obtain stability of the signal.

## 4 Routine maintenance

Ensure the ceramic is always flush with the mixer wear plates.

Fit the adjustable clamp ring (part no 0033) for ease of adjustment and extraction.

Keep the mixer blades adjusted to 0-2mm above the mixer floor. This will have the following benefits:

- All the residual mix is discharged when emptying the mix.
- Mixing action close to the floor of the mixer is improved, thereby improving the reading of the sensor.
- Reduced cycle times will result in savings on power and wear.
- Regular inspection of the Protection Ring. If the wear has reached the 4mm mark, replace the Protection Ring (see Figure 38). If it is not replaced the ceramic retaining ring can become damaged, this could result in the sensor needing to be returned for repair. Full instructions on replacing the ceramic can be found in the installation instructions accompanying the replacement kit or the Ceramic Disc Replacement Instructions HD0411.



Figure 38: Protection Ring

**REMEMBER – DO NOT HIT THE CERAMIC**





The following tables list the most common faults found when using the sensor. If you are unable to diagnose the problem from this information, please contact Hydronix technical support.

## 1 Sensor Diagnostics

### 1.1 Symptom: No output from sensor

Possible explanation	Check	Required result	Action required on failure
Output is working but not correctly	Perform simple test with hand on sensor	Milliamp reading within the normal range (0-20mA, 4-20mA)	Power down and re-power sensor
No power to sensor	DC power at junction box	+15Vdc to +30Vdc	Locate fault in power supply/wiring
Sensor has temporarily locked up	Power down and re-power sensor	Sensor functions correctly	Check power
No sensor output at control system	Measure sensor output current at control system	Milliamp reading within the normal range (0-20mA, 4-20mA). 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	Milliamp reading within the normal range (0-20mA, 4-20mA). Varies with moisture content	Check sensor connector pins
Sensor MIL-Spec connector pins are damaged	Disconnect the sensor cable and check if any pins are damaged	Pins are bent and can be bent to normal to make electrical contact	Check sensor configuration by connecting to a PC
Internal failure or incorrect configuration	Connect the sensor to a PC using the Hydro-Com software and a suitable RS485 converter	Digital RS485 connection is working. Correct the configuration	Digital RS485 connection is not working. Sensor should be returned to Hydronix for repair.

## 1.2 Symptom: Incorrect analogue output

Possible explanation	Check	Required result	Action required on failure
Wiring problem	Wiring at the junction box and PLC	Twisted pairs used for complete length of cable from sensor to PLC, wired in correctly	Wire correctly using specified cable in the technical specification
Sensor's analogue output is faulty	Disconnect the analogue output from the PLC and measure with an ammeter	Milliamp reading within the normal range (0-20mA, 4-20mA)	Connect sensor to a PC and run Hydro-Com. Check analogue output on the diagnostics page. Force the mA output to known value and check this with an ammeter
PLC analogue input card is faulty	Disconnect the analogue output from the PLC and measure the analogue output from the sensor using an ammeter	Milliamp reading within the normal range (0-20mA, 4-20mA)	Replace analogue input card

## 1.3 Symptom: Computer does not communicate with the sensor

Possible explanation	Check	Required result	Action required on failure
No power to sensor	DC power at junction box	+15Vdc to +30Vdc	Locate fault in power supply/ wiring
RS485 incorrectly wired into converter	Converter's wiring instructions and A and B signals are the correct orientation.	RS485 converter correctly wired	Check PC Com port settings
Incorrect serial Com Port selected on Hydro-Com	Com Port menu on Hydro-Com. All available Com Ports are highlighted on the pull down menu	Switch to the correct Com Port	Possible Com port number used is higher than 10 and therefore not selectable in the menu on Hydro-Com. Determine the Com Port number assigned to the actual port by looking at the PC device manager

Com port number is higher than 10 and is not available to use in Hydro-Com	The Com Port assignments in the PC's Device Manager window	Renumber the Com Port used for communication with the sensor, to an unused port number between 1 and 10	Check sensor addresses
More than one sensor has the same address number	Connect to each sensor individually	Sensor is found at an address. Renumber this sensor and repeat for all the sensors on the network	Try an alternative RS485-RS232/USB if available

#### 1.4 Sensor output characteristics

	Filtered Unscaled Output (values shown are approximate)				
	RS485	4-20mA	0-20 mA	0-10 V	Compatibility mode
Sensor exposed to air	0	4 mA	0 mA	0V	>10V
Hand on sensor	75-85	15-17 mA	16-18 mA	7.5-8.5 V	3.6-2.8V



## 1 Technical Specifications

### 1.1 Dimensions

Diameter: 108mm  
Length: 125mm (200 including connector)  
Fixing: A 127mm diameter cut hole.

### 1.2 Construction

Body: Stainless steel  
Faceplate: Ceramic  
Protection ring: Hardened steel

### 1.3 Penetration of field

Approximately 75 -100mm dependent upon material

### 1.4 Operating temperature range

0 – 60°C (32 – 140°F). The sensor will not work in frozen materials

### 1.5 Power supply voltage

15 – 30 VDC. 1 A minimum required for start-up (normal operating power is 4W).

### 1.6 Connections

#### 1.6.1 Sensor cable

Six pairs twisted (12 cores total) screened (shielded) cable with 22 AWG, 0.35mm<sup>2</sup> conductors.

Screen (shield): Braid with 65% minimum coverage plus aluminium/polyester foil.

Recommended cable types: Belden 8306, Alpha 6373

Maximum cable run: 200m, separate to any heavy equipment power cables.

#### 1.6.2 Digital (serial) communications

Opto-isolated RS485 2 wire port – for serial communications including changing operating parameters and sensor diagnostics.

### 1.7 Analogue outputs

Two configurable 0 – 20mA or 4 – 20mA current loop outputs available for moisture and temperature. The sensor outputs may also be converted to 0 – 10 Vdc.

## 1.8 Digital inputs

One configurable digital input 15 – 30 V DC activation

One configurable digital input/output – input specification 15 – 30 V DC, output specification: open collector output, maximum current 500 mA (over current protection required).

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

A: If there are many sensors connected on the RS485 network, ensure that each sensor is addressed differently. Ensure the sensor is correctly connected, that it is powered from a suitable 15-30Vdc source and the RS485 wires are connected through a suitable RS232-485 or USB-RS485 converter to the PC. On Hydro-Com ensure the correct COM port is selected.

Q: *What should I set the analogue output variable to if I want to monitor moisture in the mix?*

A: It is recommended that the analogue output is set to 'Filtered Unscaled'. This variable is proportional to moisture and the moisture outputs from the sensor are calculated directly from this value. The Filtered Unscaled output is a direct measurement from the microwave response which is scaled between 0 and 100, and filtered to reduce the noise on the signal.

Q: *Why does the sensor output negative moisture when the mixer is empty?*

A: The moisture output from the sensor is calculated using the 'Filtered Unscaled' reading and the calibration coefficients in the sensor, A, B, C and SSD, such that

$$\text{moisture\%} = A(\text{US})^2 + B(\text{US}) + C - \text{SSD} \quad (\text{US} = \text{unscaled})$$

These factors are normally used for bin applications with the Hydro-Probe II, but are used in the exactly the same way with the Hydro-Mix VII. With these factors unchanged (A=0, B=0.2857, C=-4, SSD=0) and the mixer empty (air measurement = 0 unscaled) then it can be shown that the moisture is -4%.

Q: *What calibration is required for my Hydro-Mix VII?*

A: When using a mixer sensor for concrete production it is normal to connect the sensor to a batch controller or Hydro-Control unit, which manages the moisture during batching. The sensor is not calibrated directly. Instead a series of recipe calibrations within the batch controller are made for each different mix design, each carrying their own reference to which concrete of the correct consistency can be made. Each mix design should have its own recipe because each combination of materials has an effect on the microwave response.

Q: *Do Hydronix sensors have to be calibrated to an exact moisture percent?*

A: Although possible, for most applications exact moisture of the mix is not necessary. All that is needed is a reference target that is known to produce a good mix. Therefore, in the majority of situations, the analogue output from the sensor is set for Filtered Unscaled (0 – 100). A set point is recorded at the end of each batch and stored in the recipe where it is used as the final target.

Q: *If I make a mix with the same quantities of dry materials but with different colours, do I need to have a different recipe?*

A: Yes, pigments whether they are powder or liquid additives affect the measurement and as a result every different colour will require a different recipe and calibration.

Q: *If I make regular half batches of a particular mix, do I need to have a separate recipe for this?*

A: A variation in batch quantities can have a small effect on the amplitude of the output which may benefit from a separate recipe and calibration. The sensor cannot discriminate when it is exposed to material or not. Therefore, in all cases, when reduced batches are made and moisture control is required, it is very important to check if the sensor surface is continually covered by material by looking into the mixer during mixing. As a rule, the accuracy of the signal is not guaranteed if the batch is at, or less than, half the capacity of the mixer.

Q: *If I change the ceramic on my sensor, do I have to recalibrate the sensor?*

A: No, the sensor will not need to be re-calibrated but the recipe calibrations should be checked. If there is any difference in consistence of the final mixes, then the recipes will need to be

recalibrated.

Q: *If I have to exchange the sensor in my mixer do I have to recalibrate my recipes?*

A: It is prudent to check the recipe calibrations if your sensor has been moved or exchanged.

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

A: In this case the installation should be completely checked. Is the ceramic cracked? Is the sensor mounted flush and are the mixer blades adjusted as recommended in the routine maintenance section. If the problem persists then check the output when reading only air, and check also by placing sand over the sensor. If the output is still erratic then the sensor could be faulty and you should contact your dealer or Hydronix for technical support. If the readings are OK but appear erratic during mixing then try and connect to a PC and run Hydro-Com to check the configuration filter settings. Default settings can be found on Page 59 or in Engineering Note EN0059.

Q: *My sensor takes a very long time to detect the water that goes into the mixer. Can I speed this up?*

A: This could indicate that the mixer has a poor vertical mixing action. Look at how the water goes into the mixer. Try to spray the water into the mixer in as many places as practical. Check the filter settings and if they are too high reduce the filtering time. This should not be done to the detriment of the signal stability, as unstable signals may affect the amount of water calculated and hence the quality of the final mix. In some cases it has been found that the configuration of the paddles in the mixer has been misaligned. Be sure to check the specifications on your mixer to be certain of the proper mixing action.

Q: *My water controller is a dribble feed system which progressively adds water to reach a final set point. What filter settings do I need for this?*

A: Dribble feed systems do not need to have a stable signal at the end of a dry mixing time and so it should not be necessary to filter as much as you would if you were calculating a one off amount of water to add. The sensor needs to respond as quickly as possible because the moisture reading has to keep up with the water going in otherwise too much water can be put in without being detected. Recommended settings would be light for both slew rate filters, with a minimum filtering time of 2.5 seconds, maximum 7.5 seconds.

Q: *How can I reduce my mix cycle times?*

A: There is no single, simple answer to this. The following could be considered:

- Look at how the mixer is charged with material. Can the materials be loaded in a different sequence that will save some time?
- Is it possible to wet the incoming aggregates with a large percentage of the total water at the instance material goes into the mixer. This would reduce the dry mixing time.
- Are you continuing to mix the material for a long time after the moisture signal is stable? If so you need only to mix up until you reach stability for 5-10 seconds.
- If you want to save time on the dry or the wet mixing times, always maintain a long enough dry mixing time as this is the most important factor for determining the water.
- You can take out some of the wet mixing time as this may be less important as the correct amount of water has already gone into the mixer, if you do this then be aware that the final released mix may not be homogeneous.
- When running mixes using lightweight aggregates, be certain to keep the lightweight as close to or above the SSD. This will help reduce mixing time because less pre-wet water is being used.
- When using a Hydro-Control, check also to see if there are timers being used after the mixer is charged (prior to the start signal) and after the mix complete (prior to the mixer discharge). These timers are not needed.



Q: *Is the mounting position of the sensor important?*

A: The mounting position of the sensor within the mixer is very important. Refer to Chapter 3 Mechanical installation. .

Q: What is the *maximum* length of cable I can use?

A: See Chapter 8, 'Technical specification'



The complete set of default parameters are shown in the tables below. This information is also listed in Engineering Note EN0059, available for download from [www.hydronix.com](http://www.hydronix.com)

## 1 Parameters

### 1.1 Firmware version HS0077

Parameter	Range/options	Default Parameters	
		Standard Mode	Compatibility Mode
<b>Analogue output configuration</b>			
Output type	0-20mA 4-20mA Compatibility	0 – 20 mA	<i>Compatibility</i>
Output variable 1	Filtered moisture % Average moisture % Filtered unscaled Filtered unscaled 2 Average unscaled	Filtered unscaled	<i>N/A</i>
Output variable 2			
High %	0 – 100	20.00	<i>N/A</i>
Low %	0 – 100	0.00	<i>N/A</i>
<b>Moisture calibration</b>			
A		0.0000	<i>0.0000</i>
B		0.2857	<i>0.2857</i>
C		-4.0000	<i>-4.0000</i>
SSD		0.0000	<i>0.0000</i>
<b>Signal processing configuration</b>			
Smoothing time	1.0, 2.5, 5.0, 7.5, 10	7.5 sec	<i>7.5 sec</i>
Digital Signal Processing	Very Light, Light, Medium, Heavy, Very Heavy, Unused	Unused	<i>Unused</i>
Slew rate +	Light, Medium, Heavy, None	Light	<i>Light</i>
Slew rate -	Light, Medium, Heavy, None	Light	<i>Light</i>
<b>Averaging configuration</b>			
Average hold delay	0.0, 0.5, 1.0, 1.5, 2.0, 5.0	0.0 sec	<i>0.0 sec</i>

High limit (m%)	0 – 100	30.00	<i>30.00</i>
Low limit (m%)	0 – 100	0.00	<i>0.00</i>
High limit (us)	0 – 100	100.00	<i>100.00</i>
Low limit (us)	0 – 100	0.00	<i>0.00</i>
<b><i>Input/Output configuration</i></b>			
Input Use 1	Unused Average/hold Moisture/temp	Moisture/temp	<i>Unused</i>
Input/output Use 2	Unused Moisture temp Bin empty Data invalid	Unused	<i>Unused</i>
<b><i>Measurement Mode</i></b>			
	Standard Mode V Mode E	Standard Mode	Standard Mode

### 1.1.1 Temperature Compensation

The temperature compensation settings are individual to the unit and set in the factory during manufacturing. These should not be changed.

If needed, the factory settings specific to that unit can be obtained by contacting Hydronix.

## 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.

<b>Document Number</b>	<b>Title</b>
HD0411	Ceramic Disc Replacement Instructions
HD0273	Hydro-Com User Guide
HD0303	USB Sensor Interface Module User Guide
EN0059	Engineering Note – Sensor Default Parameters
EN0066	Engineering Note – When to replace a Hydro-Mix Ceramic Retaining Ring
HD0551	Hydro-Skid User Guide



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