Hydro-Mix VI

User Guide

To re-order quote part number:	HD0304
Revision:	1.2.0
Revision date:	September 2007

Copyright

Neither the whole or any part of the information contained in nor the product described in this documentation may be adapted or reproduced in any material form except with the prior written approval of Hydronix Limited, hereinafter referred to as Hydronix.

© 2006

Hydronix Limited

7 Riverside Business Centre

Walnut Tree Close

Guildford

Surrey GU1 4UG

United Kingdom

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

Hydronix, Hydro-Probe, Hydro-Mix, Hydro-View and Hydro-Control are Registered Trade Marks of Hydronix Limited
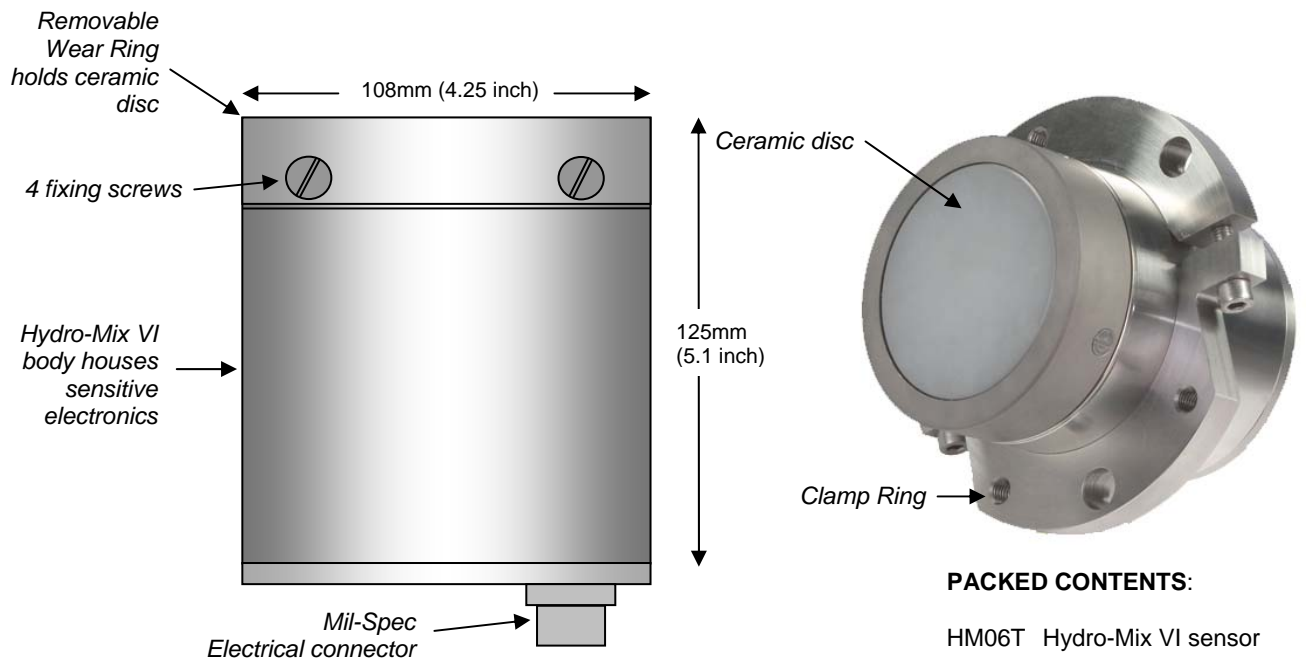
Revision history

Revision No.	Date	Description of change
1.0.0	January 2006	Original version
1.1.0	May 2006	Addition of Appendix A – Default sensor parameters
1.2.0	September 2007	Addition of Appendix B – Replacement Ceramic Instructions

Table of Contents

Table of Figures

Removable Wear Ring holds ceramic disc

4 fixing screws

Hydro-Mix VI body houses sensitive electronics

108mm (4.25 inch)

125mm (5.1 inch)

Mil-Spec Electrical connector

Ceramic disc

Clamp Ring

PACKED CONTENTS:

HM06T Hydro-Mix VI sensor

0033 Adjustable clamp ring

Minimum accessories (if ordered)

0090A Sensor cable (4m)

0021 Fixing plate

Figure 1 - The Hydro-Mix VI and clamp ring

Available accessories:

0021	Fixing plate for welding to mixer
0033	Adjustable clamp ring (supplied with sensor). (Additional rings can be ordered if required)
0035	Blanking plate for blanking hole in the mixer when sensor is removed
0090A	4m sensor cable
0090A-10m	10m sensor cable
0090A-25m	25m sensor cable
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
0815	Replacement ceramic kit (ceramic and protection ring kit)
0830	Replacement ceramic kit (excluding protection ring)
0840	Replacement wear ring (including screws)

Hydro-Com configuration and diagnostics software is available for free download from www.hydronix.com

Introduction

The Hydro-Mix VI 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, this 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 VI should never be subjected to unnecessary impact damage as it houses sensitive electronics. In particular, the 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 VI has been correctly installed and in such a manner to ensure representative sampling of the material concerned.

Suitable applications

The Hydro-Mix VI 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.

Measuring techniques

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

Sensor connection and configuration

As with other Hydronix digital microwave sensors, the Hydro-Mix VI may be remotely configured using a digital serial connection and a PC running Hydro-Com diagnostics software. For communication with a PC Hydronix supply RS232-485 converters and a USB Sensor Interface Module (See page 26).

There are three basic configurations by which the Hydro-Mix VI can be connected to the 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.
- Compatibility mode - this allows a Hydro-Mix VI 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.
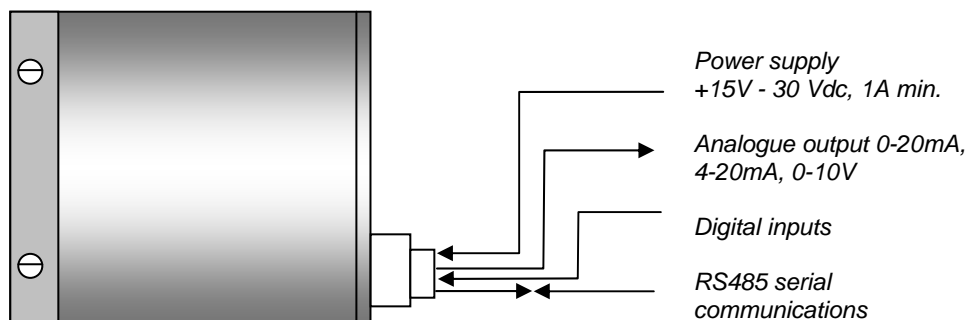

*Power supply
+15V - 30 Vdc, 1A min.*

*Analogue output 0-20mA,
4-20mA, 0-10V*

Digital inputs

*RS485 serial
communications*

Figure 2 - Connecting the sensor (overview)

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.

General to all applications

Always ensure that the sensor is correctly positioned in relation to the mixer floor and other moving parts such as 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 out from the mixer to maintain the correct position. In addition, the blades will need to be lowered to maintain efficiency of the mixing action and cleanliness of the sensor faceplate.

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.

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.

Damaged caused under these circumstances will not be covered by warranty

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 optimal 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.

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.

General mounting advice

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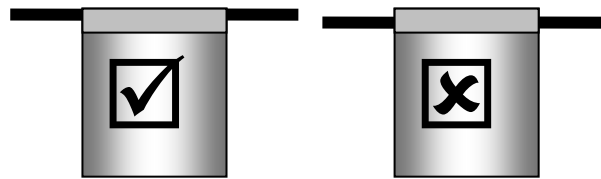

Figure 3 - Mounting in flat surface

When installing the sensor in curved surfaces, ensure that the centre of the ceramic is flush with the radius of the mixer wall.
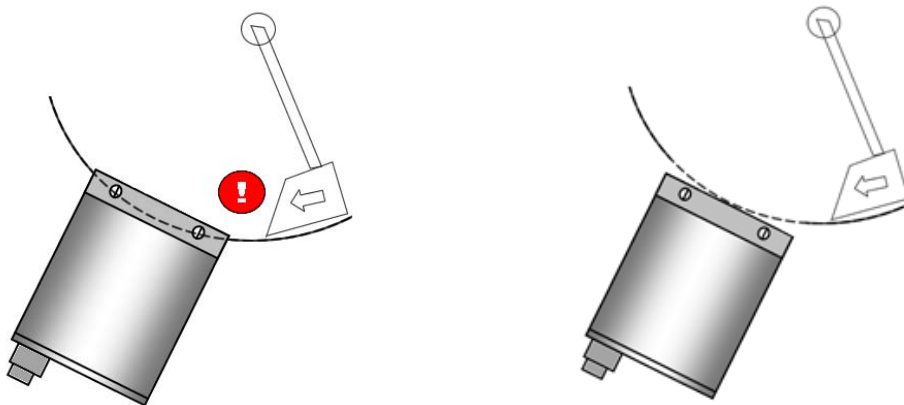
Figure 4 - Mounting in curved surface

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.

Turbo mixers

The sensor may be positioned in the floor or side wall of static pan mixers. Generally, floor mounting is recommended as the mixer can be used with small batch sizes. If the side wall installation is used it **must** be ensured that there is sufficient material to cover the sensor.

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

If the sensor is mounted in the side wall, it should be positioned approximately 60mm above the floor of the mixer.
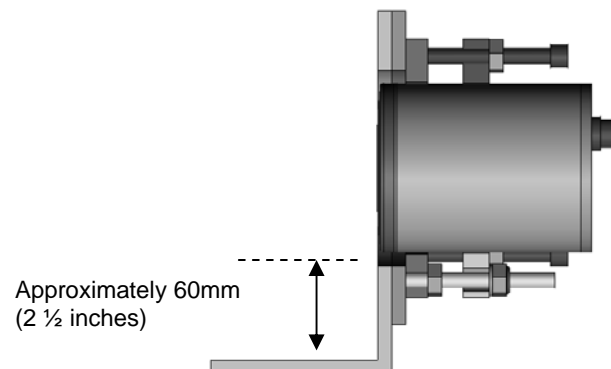
Figure 6 - Position of sensor in side wall of mixer

Planetary mixer

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. There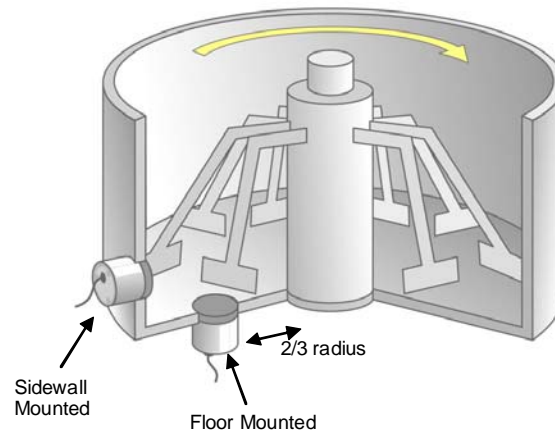fore it is generally recommended that the sensor be positioned with the inner edge approximately 10 cm to 15cm (4-6 inches) from the side wall of the mixer. The minimum distance should never be less than 5cm (2 inches). See the advice for flat surface mounting on page 12.

Approximately 10cm (4ins)
Minimum 5cm (2ins)
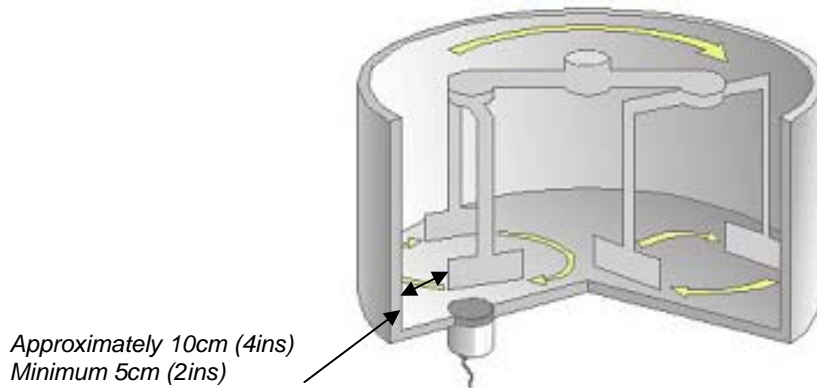
Figure 7 - Position of sensor in a planetary mixer

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 12.

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

30°
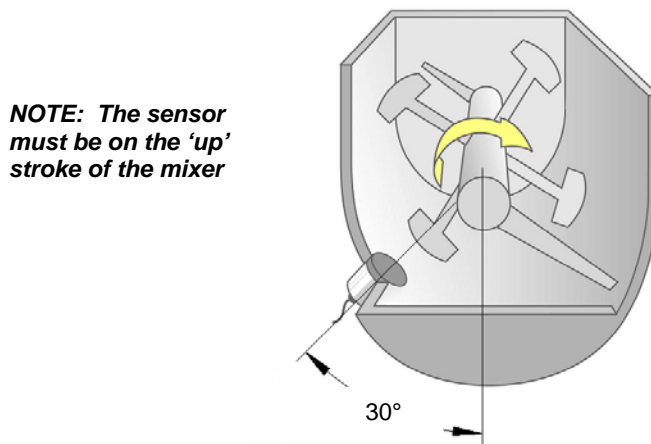
Figure 8 - Position of sensor in a horizontal shaft or ribbon mixer

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 12.

Recommended 'up' stroke position   *Alternative 'down' stroke position*
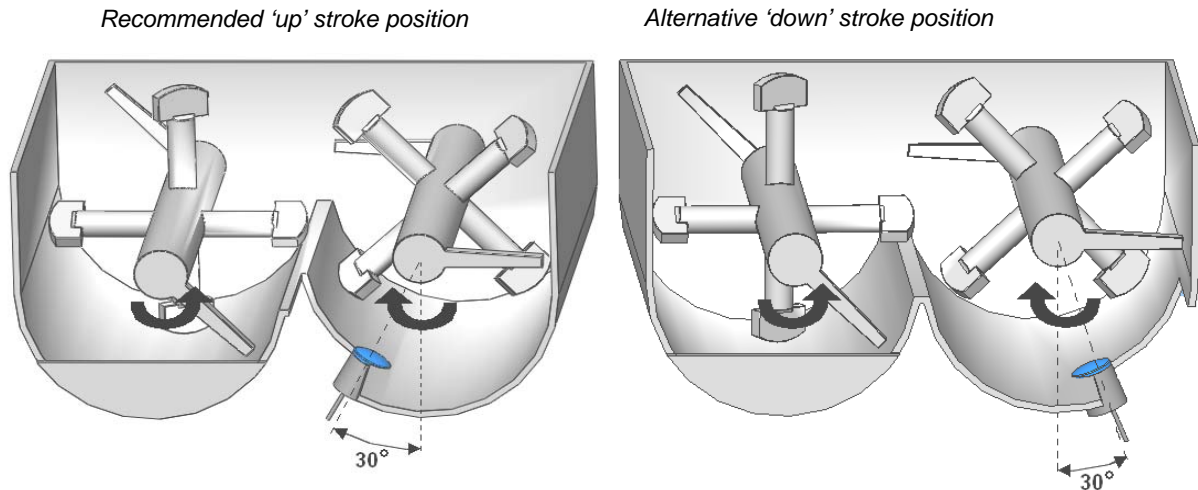
Figure 9 - Position of sensor in a twin shaft horizontal mixer

Installing the sensor

The Hydro-Mix VI 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.
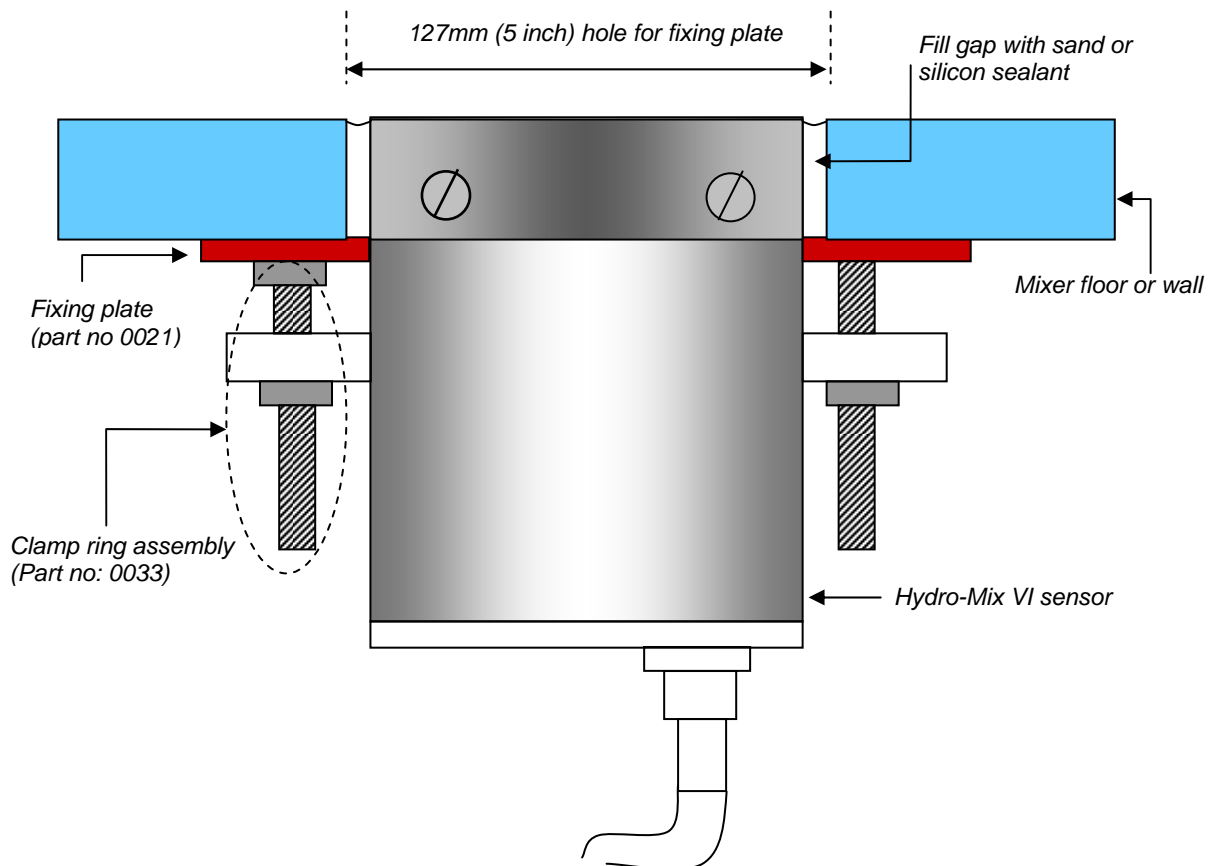
Figure 10 - Sensor installation

Cutting hole in mixer and fitting fixing plate

A hole should be cut into the mixer before welding the fixing plate. The recommended minimum cut-out hole size is 127mm (5 inches). 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.

Fitting the clamp ring to the sensor

The clamp ring comprises the following components:

A. 3 x M8 screws
B. 6 x M8 lock nuts (Three shown)
C. 3 x M8 Nyloc nuts
D. 3 x washers
E. 2 x M6 screws
F. 3 x M8 threaded stud
G. Clamp ring
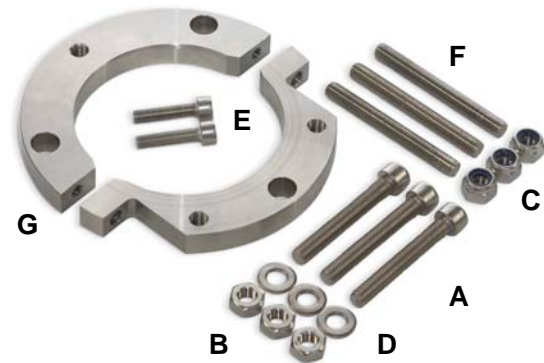
Figure 11 - Clamp ring components
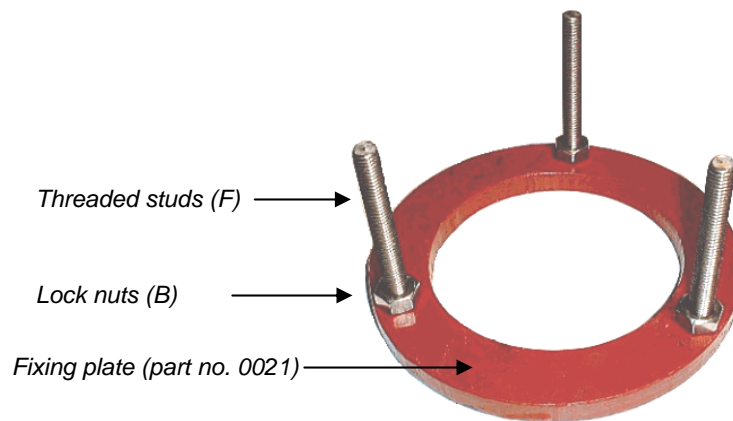
Figure 122 Fixing plate prepared for attaching clamp ring

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.
3. Fit the clamp ring (G) onto the sensor using the 2 x M6 screws (E). Position the clamp ring so that adjustment is possible with the ceramic head level with the mixer floor or side wall.

4. 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

M8 screws (A)
M8 lock nuts (B)
M8 Nyloc nuts (C)
Clamp ring (G)
Washers (D)
M6 screws (E)
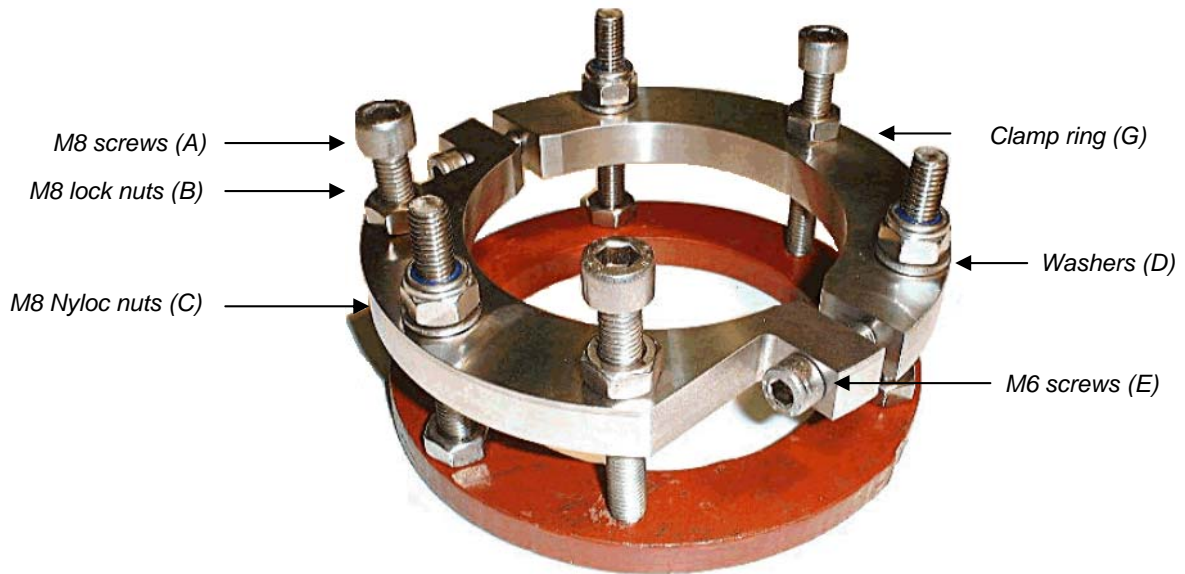
Figure 13 - Clamp ring assembled and fitted to fixing plate

5. Fit the three screws (A) along with the 3 remaining lock nuts (B) to the clamp ring to **push** against the fixing plate.

6. 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 plate by manually rotating the blades.

7. Fully tighten the complete assembly including the lock nuts.

8. Once the sensor has been correctly fitted and adjusted, fill the gap around the sensor with silicone sealant (preferred) or compacted sand.

Figure 14 - Clamp ring (0033) fitted to fixing plate (0021) and Hydro-Mix VI

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).

To move the sensor IN to the mixer

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

To move the sensor OUT of the mixer

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

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.

Replacing the ceramic

Should the ceramic face plate of the sensor become damaged it can easily be replaced by end users or their dealer. It is advised that a replacement kit (part no 0830) is held in reserve in case of this event. Full instructions on replacing the ceramic can be found in Appendix B or in the installation instructions accompanying the replacement kit.

Notes:

Chapter 3   Electrical Installation and Communication

The Hydro-Mix VI must be connected using the Hydronix sensor cable (part no 0090A), available in different lengths to suit the installation. 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).

Installation guidelines

- Ensure that the cable is of a suitable quality (see Chapter 8 'Technical Specification').
- 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 VI 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.

Analogue output

A DC current source generates an analogue signal proportional to one of a number of 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.

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

Table 1 - Sensor cable (Part no 0090A) connections
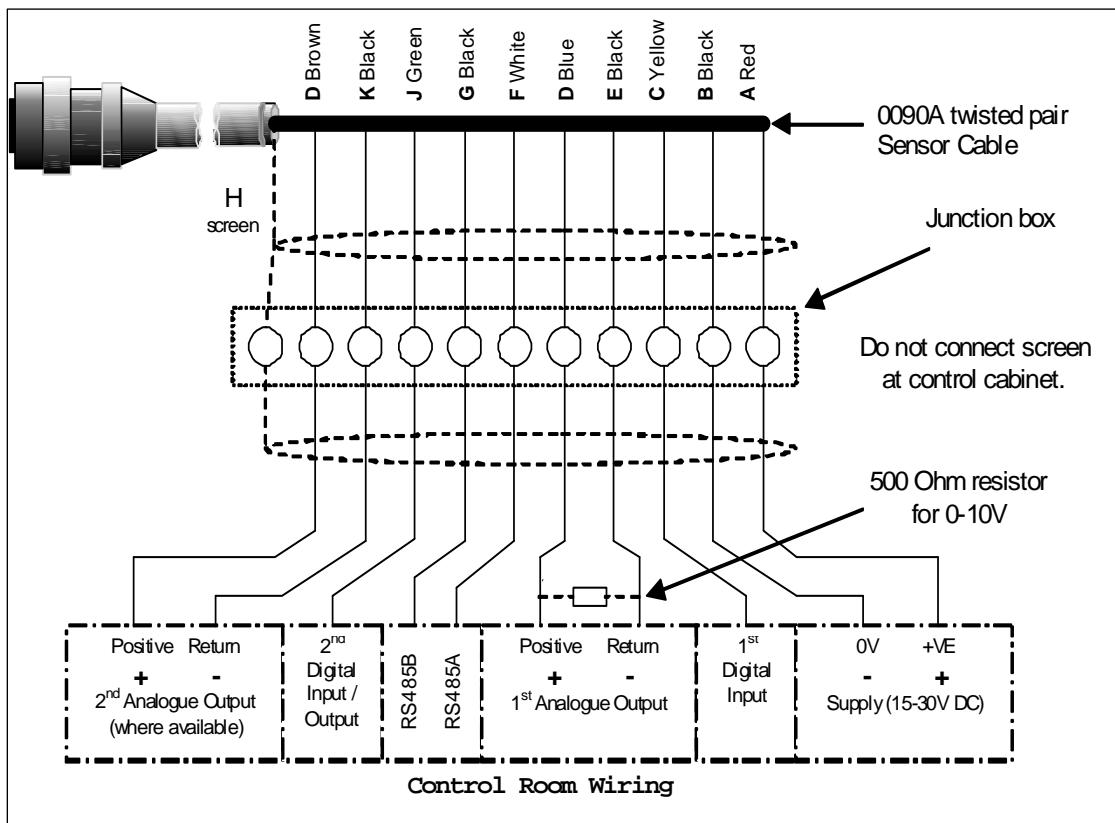
Figure 15 - Sensor cable connections

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.

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.
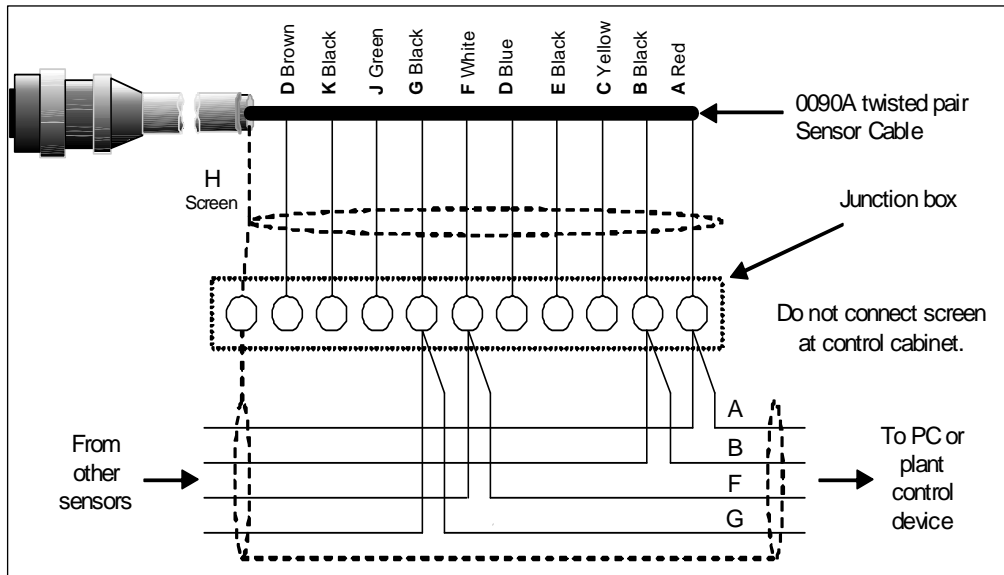
Figure 16 - RS485 multi-drop connection

Hydro-Control IV/ Hydro-View connection

To connect to a Hydro-Control IV or Hydro-View, the Hydro-Mix VI 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 19 at the Hydro-Control IV or Hydro-View.

Figure 17 - Connecting to a Hydro-Control IV or Hydro-View

Connecting to a PC

A converter is required to connect one or more sensors to a PC when checking diagnostics and configuring the sensor. There are three types of converter supplied by Hydronix.

RS232/485 converter – D type (Part no: 0049B)

Manufactured by KK systems, this RS232/485 converter is suitable for connecting typically 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.

RS232/485 converter – DIN rail mounting (Part no: 0049A)

Manufactured by KK systems, this powered RS232/485 converter is suitable for connecting any number of 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.

USB Sensor Interface Module (Part no: SIM01A)
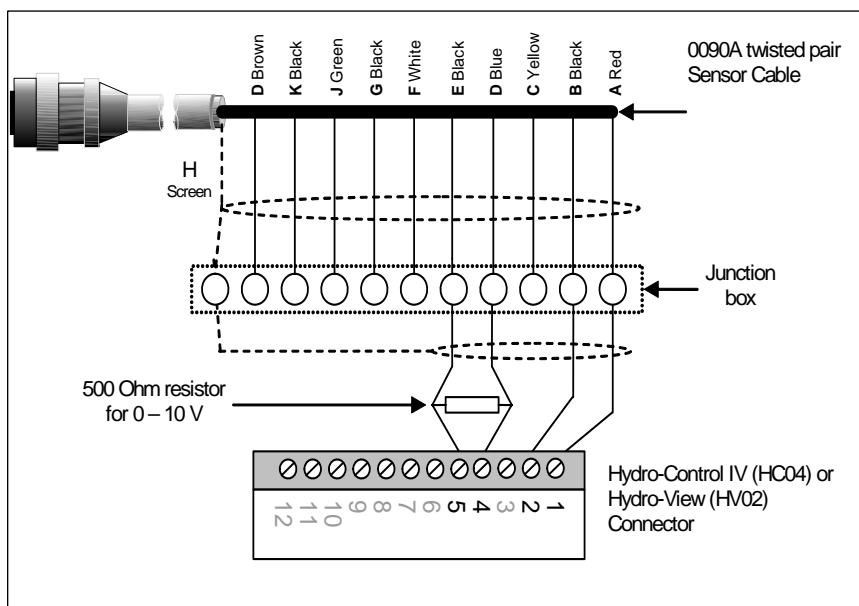
Manufactured by Hydronix, this USB-RS485 converter is suitable for connecting any number of sensors on a network. The converter has a terminal block for connecting the twisted pair RS485 A and B wires, and then connects to a USB port. The converter does not require external power, although a power supply is supplied and can be connected providing power to the sensor. See USB Sensor Interface Module User Guide (HD0303) for further information.

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 a 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 it will facilitate the use of diagnostic software should the need arise.

Hydronix Part No 0049B

← RS485   RS232→

RS485A

RS485B

Connect
to PC
serial
port

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 |
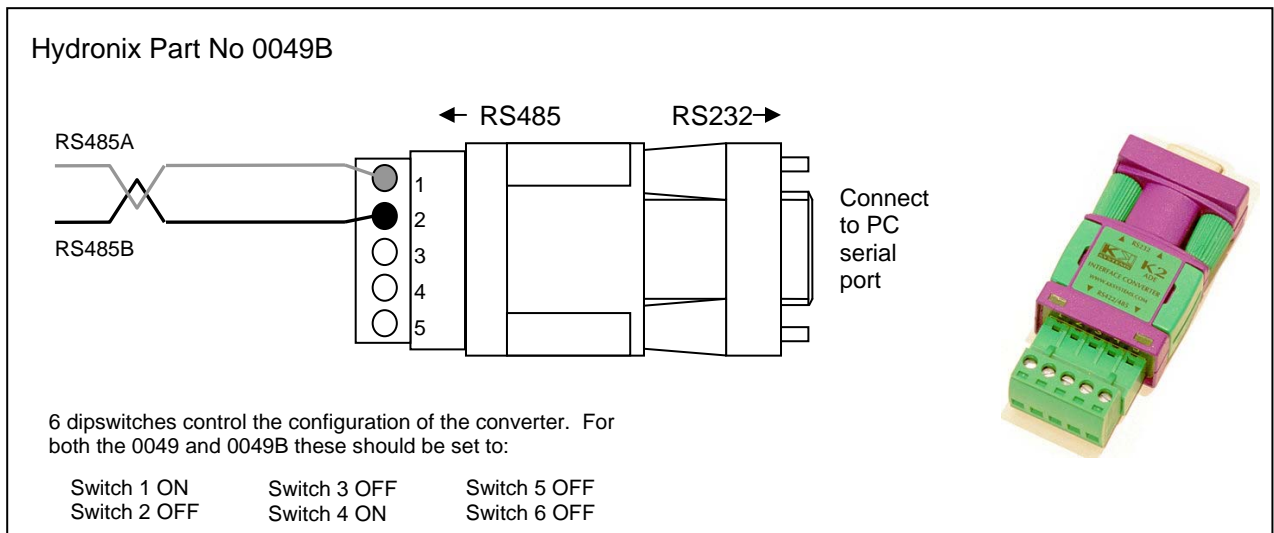
Figure 18 - RS232/485 converter connections (1)

Hydronix Part No. 0049A   KD485 – STD

P1   P2

PC
or
Control System

RS232
(full-duplex)
Host System

9-way D-Type PC
connector

TX   3
RX   2
RTS   7
GND   5

Hydronix
Sensor

Hydronix
Sensor

F RS485(A)   F RS485(A)
G RS485(B)   G RS485(B)
H   H

Power supply
7 – 35V DC

7 +
8 -

RJ11
RS232
port

Dip Switch
Settings

1 2 3 4
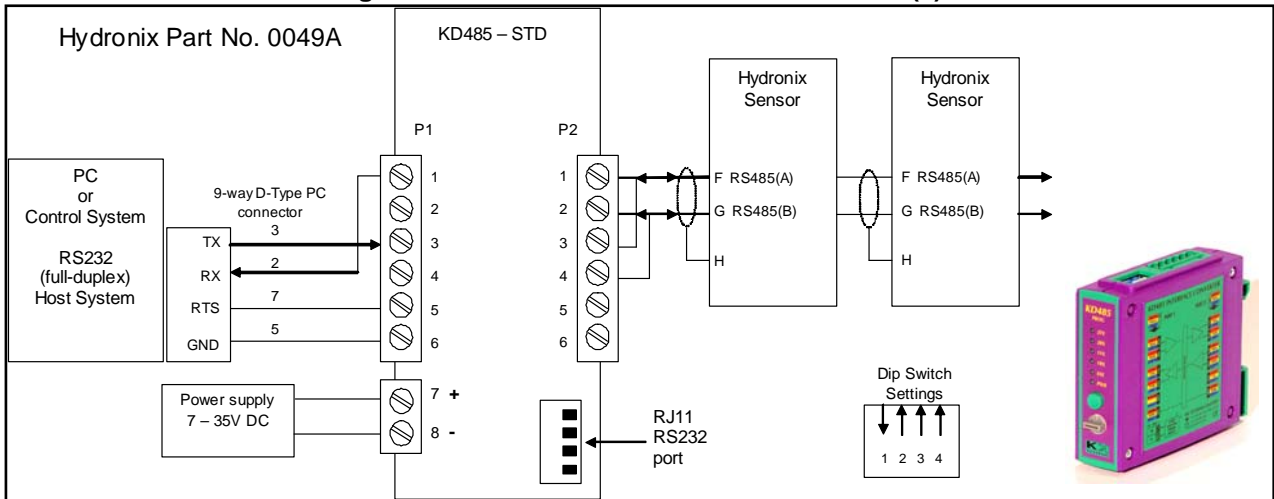
Figure 19 - RS232/485 converter connections (2)

Hydronix Part No SIM01

Connect to PC USB port

USB

Sensor
Interface
Module

B
A
0V
24V

RS485 sensor connections

Sensor power (optional)

24VDC

*Connect to 24Vdc
power supply (optional)*

*The Sensor Interface Module is powered from the USB port. The external
24V power supply can be used if sensor power is required. See user
guide HD0303 for further information.*

Figure 20 - RS232/485 converter connections (3)

Notes :

The Hydro-Mix VI may be configured using the Hydro-Com software which can be downloaded free of charge from www.hydronix.com as can the Hydro-Com User Guide (HD0273).

Configuring the sensor

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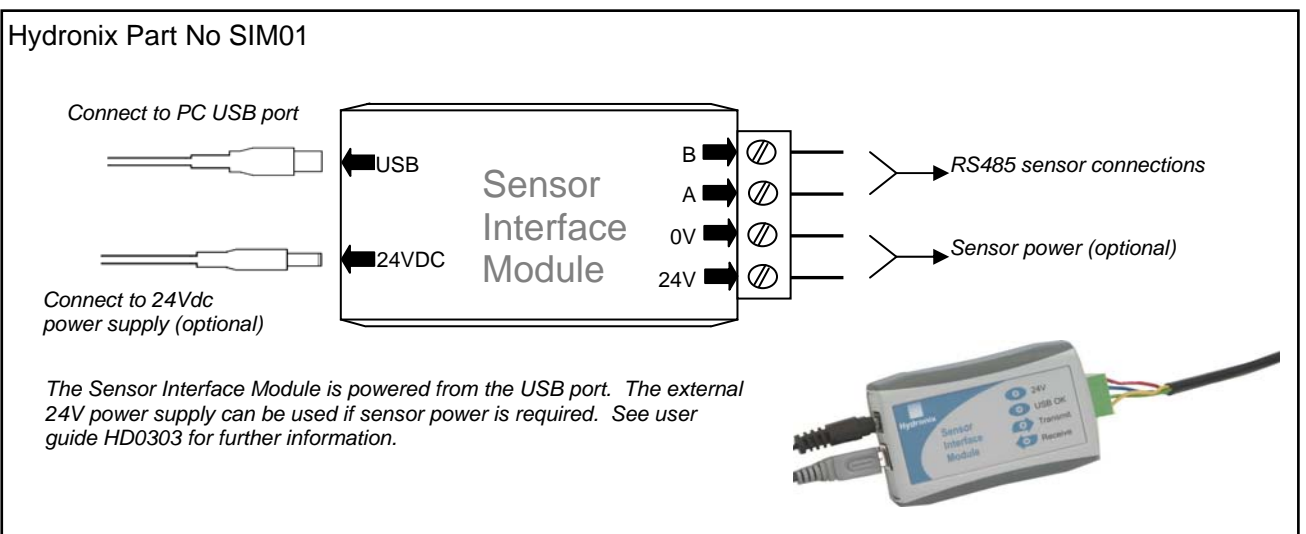vailable to view and change using the Hydro-Com software. Information for all settings can be found in the Hydro-Com User Guide (HD0273).

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 applications with the Hydro-Probe II). Only the parameters used in mixer applications are covered in this section.

The relevant parameters for mixer applications are those which set up the analogue output, filtering, and in some instances, the digital input.

Analogue output setup

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

Output type

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

- 0 – 20mA: This is the factory default. The addition of an external 500 Ohm precision resistor converts to 0 – 10 Vdc.
- 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.

Output variable 1 and 2 (available in some sensors according to version)

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

These define which sensor readings the analogue output will represent. The Filtered/Unscaled output is a reading which is proportional to moisture and ranges from 0 – 100. **This is the recommended setting.**

The Filtered Moisture output is the alternative setting. This is derived from the unscaled reading by scaling it with a set of material calibration coefficients. These are the A, B, C and SSD (saturated surface dry) values in the configuration which in nearly all cases are not set for the specific material being measured. If A, B and C values are not specifically set for the material, then the Filtered Moisture output will not represent actual moisture.

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 %'. 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.

Digital inputs/output

The Hydro-Mix VI has two digital inputs/output; the first of which can be configured as an input only, whereas the second can be either an input or output. The digital output is not applicable to mixer sensors and therefore the second digital input/output is not considered here.

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 active, 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.

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.
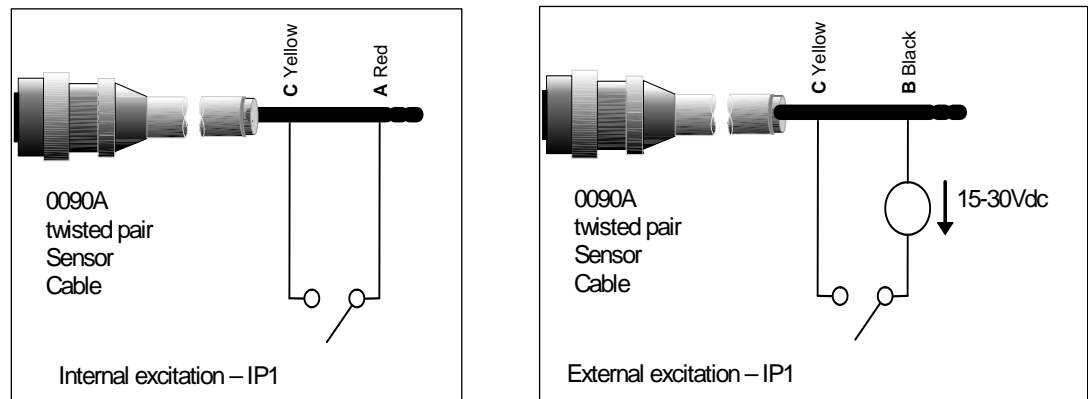

Figure 21 - Internal/external excitation of the digital input

Filtering

The default filtering parameters can be found in Engineering Note EN0027.

In practice, the raw output, 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.

To filter the raw unscaled reading, the following parameters are used:

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.

Filtering time

This smoothes the slew rate limited signal. Standard times are 0, 1, 2.5, 5, 7.5, and 10 seconds, although it is possible also to set this to 100 seconds for specific applications. A higher filtering time will slow the signal response.

Figure 26 (overleaf) 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.
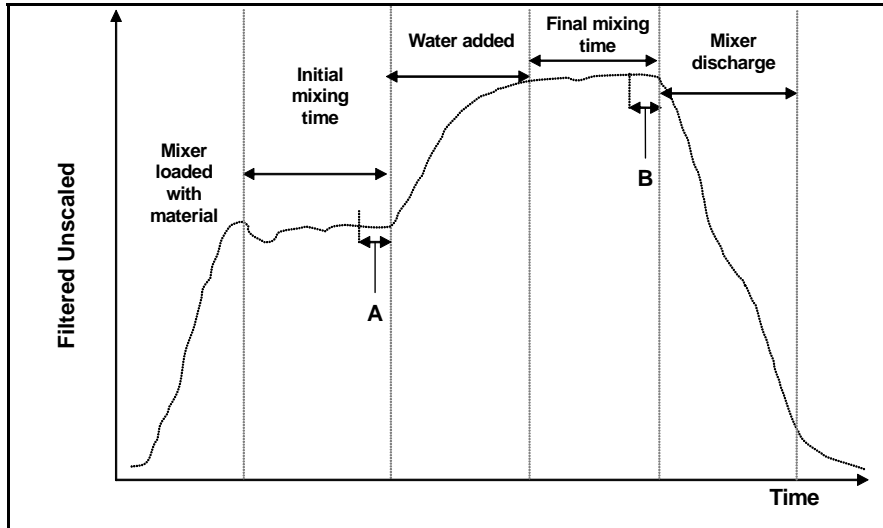
Figure 22 - Typical moisture curve

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 26 shows an ideal representation of moisture over a cycle. The output of this is the 'Filtered Unscaled' reading. The graph below (Figure 27) shows raw data recorded from a sensor over an actual mix cycle, clearly indicating the large spikes caused by the mixing action.
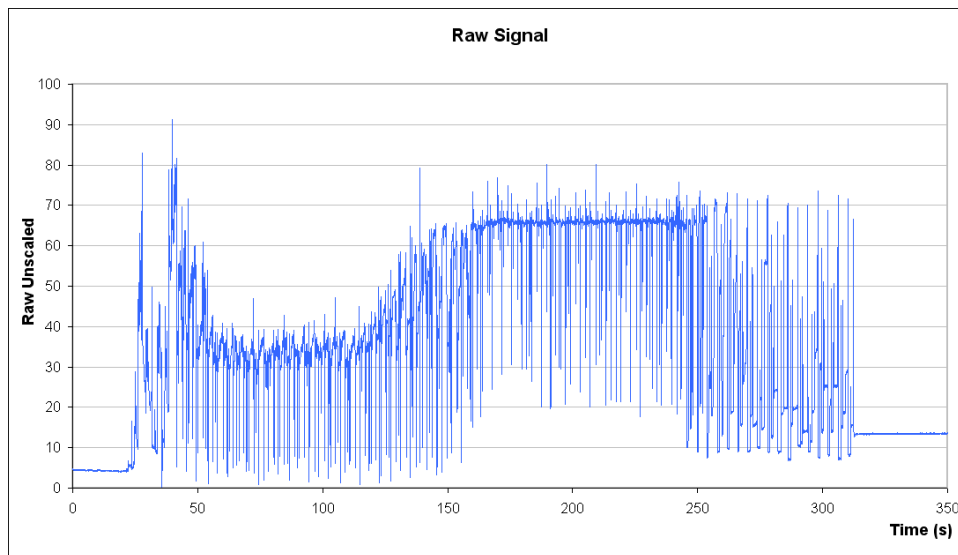

Figure 23 - Graph showing raw signal during mix cycle

The two following graphs illustrate the effect of filtering the same raw data shown above. Figure 28 shows the effect of using the following filter settings which create the 'Filtered Unscaled' line on the graph.

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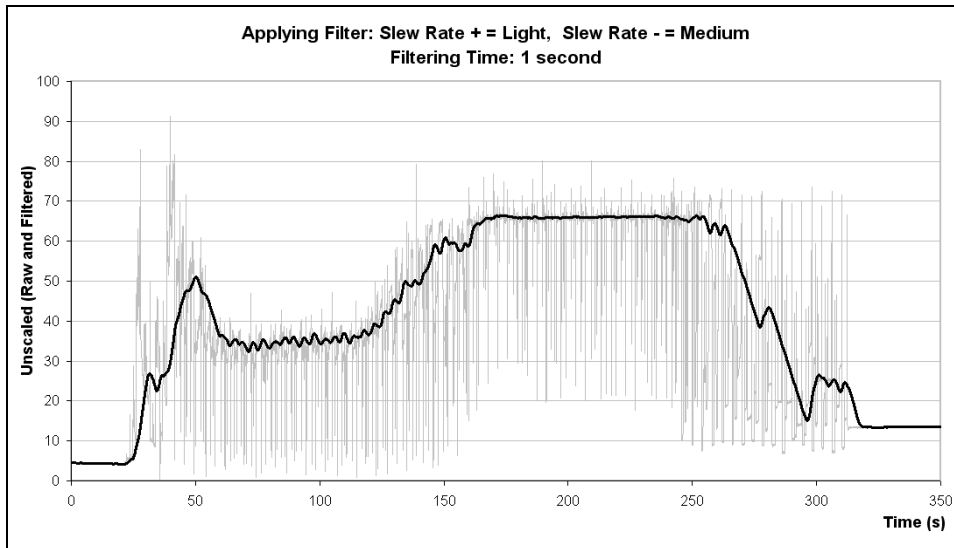Filtering time   =   1 second

Figure 24 - Filtering the RAW signal (1)

Figure 29 shows the effect of the following settings:

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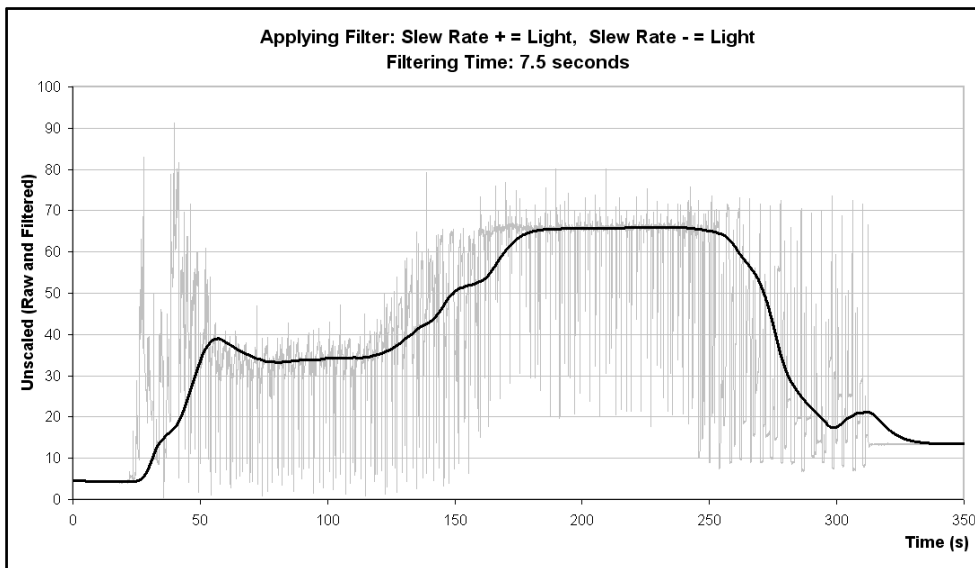Filtering time   =   7.5 seconds

Figure 25 - Filtering the RAW signal (2)

In Figure 29 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 in Engineering Note EN0027.

The moisture reading from the sensor can only indicate what is happening in your mixer. The speed of 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.

Mixer

- Look at the mixing process. Check how the water disperses. If water sits on top of the aggregates for a time before dispersing, then spray bars will 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.

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.

Consistency

The Hydro-Mix VI 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

Calibration based water addition

- When calibrating, omit the admixtures.
- When performing a calibration it is advised that both the dry and wet mix times are extended to ensure that both are homogeneous.
- A different calibration may be required for large variations in batch volume (e.g. half batches).
- 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.
- Dry mix time must be long enough to obtain stability of the signal.
- Good measurement takes time.

Mixing

- Minimum mix times are a function of the mix design (ingredients and mixer) not just the mixer.
- Different mixes may need different mix times.
- Keep batch sizes as consistent as possible e.g. $2.5m^3 + 2.5m^3 + 1.0m^3$ is not as good as $3 \times 2.0m^3$.
- Keep the premix time as long as possible, to the detriment of the wet mix time if necessary.

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.
  - Wear on the mixer floor plates will be reduced.
  - Reduced cycle times will result in savings on power and wear.

REMEMBER – DO NOT HIT THE CERAMIC

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. 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

$$moisture\% = A(US)^2*B(US)+C-SSD \qquad (US = unscaled)$$

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 VI. 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 VI?*

A: When using a mixer sensor for concrete production it is normal to connect the sensor to a batch controller or Hydro-Control, 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 product 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 in Engineering Note EN0027.

        – – –

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?
- Can you 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 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.

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	Output similar to as shown in table 2.	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.	Digital RS485 connection is not working. Sensor should be returned to Hydronix for repair.

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

Table 2 – Sensor output characteristics

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

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.

Dimensions

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

Construction

- Body: Stainless steel
- Faceplate: Ceramic
- Wear ring: Hardened steel

Penetration of field

- Approximately 75 -100mm dependent upon material

Operating temperature range

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

Power supply voltage

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

Connections

Sensor cable

- Six pairs twisted (12 cores total) screened (shielded) cable with 22 AWG, 0.35mm^2 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.

Digital (serial) communications

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

Analogue output

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

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).

The complete set of default parameters are shown in the tables below. This information is also listed in Engineering Note EN0027, available for download from www.hydronix.com

Firmware versions HS0047 Version 1.25 or later

Parameter	Range/options	Default Parameters	
		Standard Mode	Compatibility Mode
Analogue output configuration			
Output type	0-20mA 4-20mA Compatibility	0 – 20 mA	Compatibility
Output variable 1	Filtered moisture % Average moisture % Filtered unscaled Average unscaled	Filtered unscaled	N/A
High %	0 – 100	20.00	N/A
Low %	0 – 100	0.00	N/A
Moisture calibration			
A		0.0000	0.0000
B		0.2857	0.2857
C		-4.0000	-4.0000
SSD		0.0000	0.0000
Signal processing configuration			
Smoothing time	1.0, 2.5, 5.0, 7.5, 10	7.5 sec	7.5 sec
Slew rate +	Light Medium Heavy Unused	Light	Light
Slew rate -	Light Medium Heavy Unused	Light	Light
Averaging configuration			
Average hold delay	0.0, 0.5, 1.0, 1.5, 2.0, 5.0	0.0 sec	0.0 sec
High limit (m%)	0 – 100	30.00	30.00
Low limit (m%)	0 – 100	0.00	0.00
High limit (us)	0 – 100	100.00	100.00
Low limit (us)	0 – 100	0.00	0.00
Input/Output configuration			
Input Use 1	Unused Average/hold Moisture/temp	Moisture/temp	Unused
Input/output Use 2	Unused Moisture temp Bin empty Data invalid Probe OK	Unused	Unused
Temperature compensation			
Electronics temp. coeff		0.016	0.016

Firmware HS0047 pre version 1.25, and firmware version HS0045.

Parameter	Range/options	Default Parameters	
		Standard Mode	**Compatibility Mode**
Analogue output configuration			
Output type	0-20mA 4-20mA Compatibility	0 – 20 mA	Compatibility
Output variable 1	Filtered moisture % Average moisture % Filtered unscaled Average unscaled	Filtered unscaled	N/A
High %	0 – 100	20.00	N/A
Low %	0 – 100	0.00	N/A
Moisture calibration			
A		0.0000	0.0000
B		0.2857	0.2857
C		-4.0000	-4.0000
SSD		0.0000	0.0000
Signal processing configuration			
Smoothing time	1.0, 2.5, 5.0, 7.5, 10	5.0 sec	5.0 sec
Slew rate +	Light Medium Heavy Unused	Medium	Medium
Slew rate -	Light Medium Heavy Unused	Heavy	Heavy
Averaging configuration			
Average hold delay	0.0, 0.5, 1.0, 1.5, 2.0, 5.0	0.0 sec	0.0 sec
High limit (m%)	0 – 100	30.00	30.00
Low limit (m%)	0 – 100	0.00	0.00
High limit (us)	0 – 100	100.00	100.00
Low limit (us)	0 – 100	0.00	0.00
Input/Output configuration			
Input Use 1	Unused Average/hold Moisture/temp	Moisture/temp	Unused
Input/output Use 2 *	Unused Moisture temp Bin empty Data invalid Probe OK	Unused	Unused
Temperature compensation			
Electronics temp. coeff		0.01	0.01

* Second digital input/output is not available in older firmware HS0045
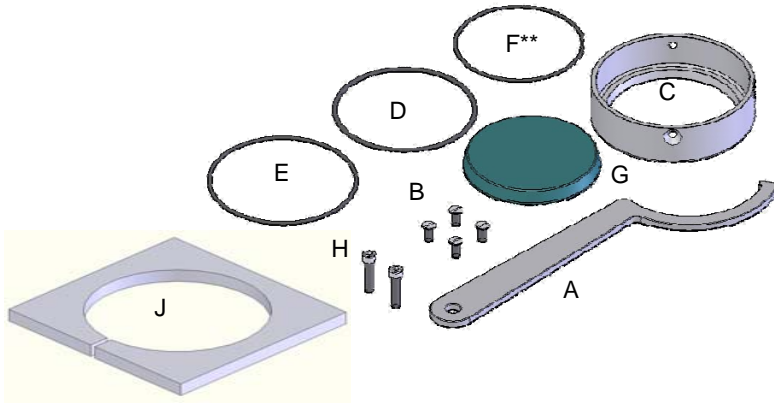
CONTENTS OF REPLACEMENT KIT

A. 'C' Spanner.
B. M5x10 slotted counter-sunk stainless steel screws (x4).
C. Protection Ring.
D. 'O' ring (90 I/D x 2.5 section).
E. 'O' ring (95 I/D x 2.0 section).
F. 'O' ring (3.239" I/D x 0.070" section). **
G. Ceramic Disc.
H. M5x25 stainless steel screws (x2).
I. Sachet of grease (not shown)
J. Assembly Jig

REMOVAL OF CERAMIC DISC

1. Unscrew 4 screws (B) and remove the Protection Ring (C).
2. If there is no mark aligning the Ceramic Securing Ring (K) with the Ceramic Support, draw one (as shown) as a guide for re-assembly.
3. Fit 2 screws (H) in to opposite sides of the Ceramic Support. This will enable the body to be laid flat and prevent it from rotating when unscrewing the Ring (K). Alternatively use Ceramic Tightening Jig (J - **Part#0034**) in a vice.
4. Use 'C' Spanner (A) to unscrew ring (K). Remove Ring (K) and retain for re-assembly. Remove Ceramic Disc (G) and 'O' rings (D, E and F**).

Grease thread

D

B
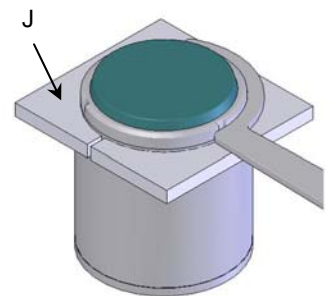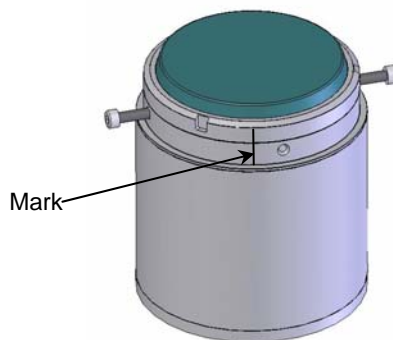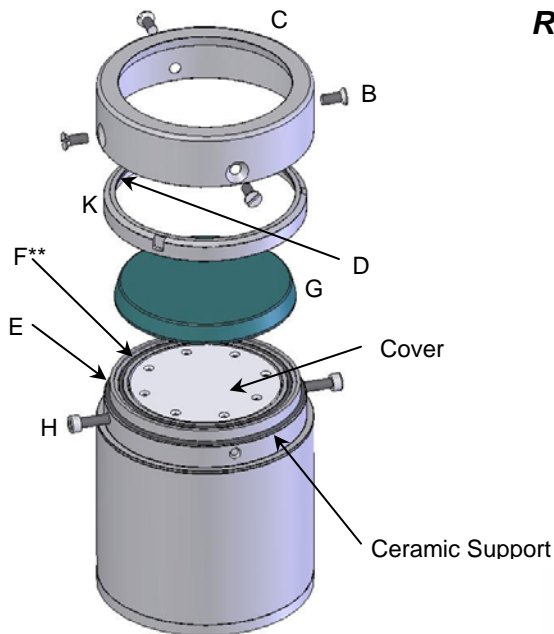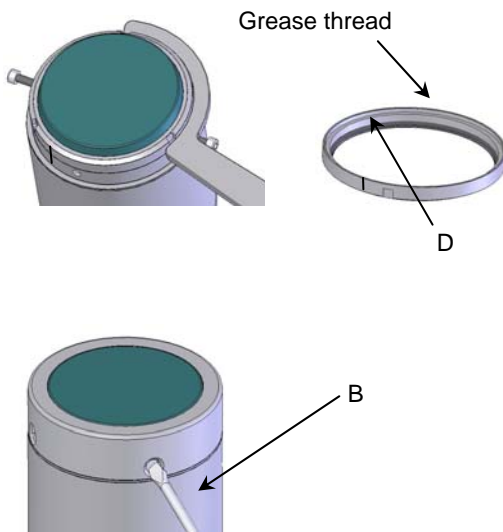
RE-ASSEMBLY WITH NEW CERAMIC DISC

1. Clean and degrease Cover, Ceramic Support and Ring (K).
2. Using the grease supplied (I), lightly grease the 'O' rings D,E and the thread in the Ceramic Securing Ring (K).
3. Place 'O' ring (E) over the Ceramic Support to the base of the thread.
4. Grease 'O' ring (F) with the grease (I) and place in the groove around the Cover. **
5. Place Ceramic Disc (G) over the Cover and locate it in the recess of the Ceramic Support.
6. Place 'O' ring (D) in to the groove at the base of the thread in the Ceramic Securing Ring (K)
7. Place Ring (K) (with the 'O' ring in place) over the Ceramic and Ceramic Support. Carefully tighten using the 'C' Spanner so that the two marks line up. This is the minimum tightness recommended. If possible tighten the Ring further.
8. Place the Protection Ring over the Ceramic and secure with 4 screws (B) ensuring they are properly tightened.
9. Recalibrate the sensor to 'air and water' to ensure the sensor output characteristics remain unchanged (See Hydro-Com User Guide HD0273).

** Early models may not have a groove in the Ceramic Support for o-ring 'F'. On these models omit o-ring 'F'.

INDEX