

# Moisture Monitor Pro



## Product Manual

# Moisture Monitor Pro

## Product Manual

**Version 3.5**

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**Prepared by: Dryer Master Inc.**

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## To Our Customer

Thank you for purchasing the Moisture Monitor Pro from Dryer Master®. The Moisture Monitor Pro is a robust system which is simple to use and can be applied to many grain moisture measurement applications.

The Moisture Monitor Pro is part of the Dryer Master family of moisture monitoring and moisture control systems that have at their heart Dryer Master's stainless-steel fin type capacitance-based moisture sensors. These sensors were initially developed to drive Dryer Master's industry leading computerized drying control systems, where they are placed at the inlet and the outlet of the dryer. With over 30 years of field proven experience the sensors are now being offered as part of the Moisture Monitor Pro moisture monitoring solution.

We trust that you will be pleased with the operation of the Moisture Monitor Pro and that you will enjoy benefits similar to those provided by the world-renowned Dryer Master® moisture control system.

Dryer Master Inc.



# 1 Introduction

This document provides the operational specification for a moisture monitoring system which displays product moisture and product temperature. The system consists of a display unit and either one or two moisture sensors. Both the display unit and the sensors require less than 15 watts of power and are powered from a low voltage 24-volt direct current instrumentation power supply. Depending on the options chosen, the system may include other components and devices.

## 1.1 Moisture measurement technology

The Dryer Master moisture sensor measures the dielectric properties, in effect the capacitance of the product, in the vicinity of the sensor fin. This method is the most effective in measuring the total water in a given volume of product. The installation ensures a large sample of product is presented to the sensor at all times. This large sample contributes to a better product moisture representation than other methods and generally provides a very good representation of the product in the total sample stream. This technology is particularly suited to the measurement of product with moisture gradients. A moisture gradient occurs any time product is processed such as by heating or cooling but not limited to either. The sensor's robust construction and conservative installation specifications ensure long product life.

## 1.2 Information display

The information display is a micro PLC (Programmable Logic Controller) with an integrated graphics color LCD display and touchscreen keypad. This combination of integrated items is also referred to as an OCS (Operator Control Station). The Dryer Master moisture sensor calibration software embedded in this device provides the same reliability and accuracy as that in Dryer Master computerized drying control systems.

## 1.3 Versatility

The MMP can be operated in a number of configurations. It can be set up to display the readings for one or two sensors, measuring any of up to 16 different product choices. It can be used for continuous flowing products or for products exiting a pulse discharge type dryer where the sensor goes empty between discharges.

## 2 System Overview

### 2.1 Display Unit/Enclosure

The display unit is the information provider. Real time product moisture and product temperature information, as well as alarms and moisture trends, can be shown. Product selection, sensor calibration, alarms and system setup are all functions accomplished through menus accessed via the touch screen keypad.

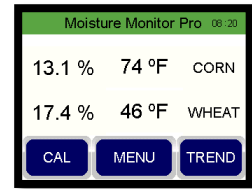


Figure 1 Main Screen

### 2.2 Moisture Sensor(s)

The Moisture Monitor Pro can be used with either one or two moisture sensors. Each moisture sensor should be located in what is called a “compacted product flow” situation. Flow past the sensor should be no faster than 1” per second (2.5 cm/second). Even and consistent product flow is key to obtaining stable moisture readings.



Figure 2 Moisture Sensor

### 2.3 Moisture sensor chute (optional)

Two versions (bypass or inline) of the optional Dryer Master rotary feed chutes are available to simplify sensor installation. The chutes provide a compacted metered flow past the sensor and are particularly useful if sampling product exiting a dryer. For situations where the sensor will go empty between dryer discharges, a gravity feed chute is also available.



Figure 3 Rotary Feed Chute (bypass)

### 2.4 Calibration button (optional)

An optional illuminated calibration push button may also be used to standardize and simplify calibration (for use with advanced calibration). When the operator presses the push button, the lamp will flash and gather information during the period the button lamp is flashing (30 seconds). The operator simultaneously takes a gradual sample during the period the lamp is flashing. The operator then obtains the bench top value of the sample and enters it into the Moisture Monitor Pro. The system then updates the sensor calibration using the operator value and the value it calculated as the average moisture reading for the sample period.

### 2.5 Smartphone access

The MMP comes with a built-in web server allowing process data to be forwarded to a smartphone via a network connection (the smartphone must be on the same WiFi network as the MMP). The smartphone display shows process information as well as process history, alarms and graphs.

### 2.6 Data storage

Data is stored on a micro-SD card inside the enclosure. For easy data access there is a USB port on the bottom of the enclosure. Using a USB the operator can download historical process data (in .csv format) for later insertion into a spreadsheet program.

### 3 System Operation

The Main Screen of the Moisture Monitor Pro displays product moisture(s), product temperature(s) and product name(s). The system self-configures depending upon whether there are one or two sensors being used. If there are two sensors connected, the display shows both sensors. If only one is connected, then only one is displayed.

The Moisture Monitor Pro user interface is via the touch screen. The F(unction) keys are generally not used in daily operation.

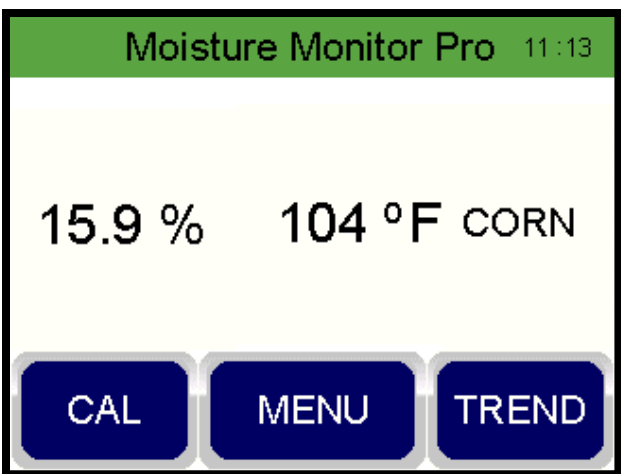


Figure 4 Main Screen - single sensor – std. configuration

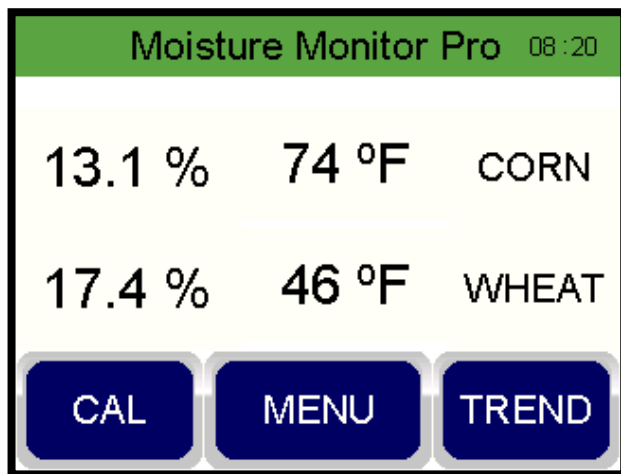


Figure 5 Main Screen - two sensors – std. configuration

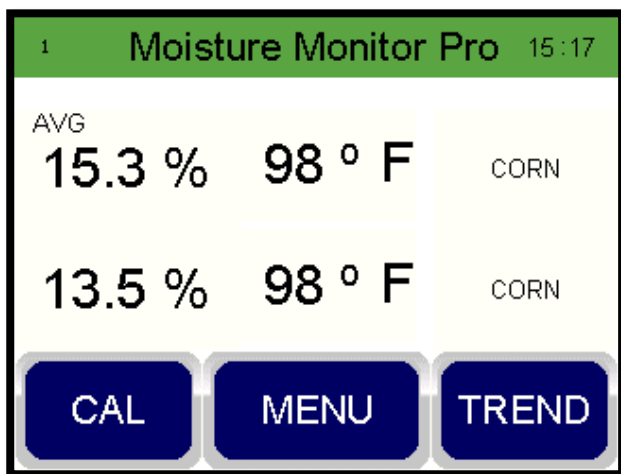


Figure 6 Main Screen with 2 sensors (pulse discharge installation). – sensor 1 is displaying the average reading from the previous batch. Sensor 2 is showing live data.

#### 3.1 Main Screen display:

1. Product moisture
2. Product temperature
3. Product name

#### 3.2 Menu Buttons:

Buttons are activated by touching the button on the screen.

**CAL:** to go to the moisture calibration screen.

**TREND:** to bring up graphs.

**MENU:** to bring up the extended menu.

### 3.3 Sensor Calibration: (CAL button)

There are two sensor calibration methods: basic and advanced. The selection of the method is made in the **SYSTEM SETUP** section under **calibration** settings (**SYSTEM SETUP** is reached by pressing the **MENU** key). If two sensors are connected, pressing the **CAL** button will bring up the choice of sensors.

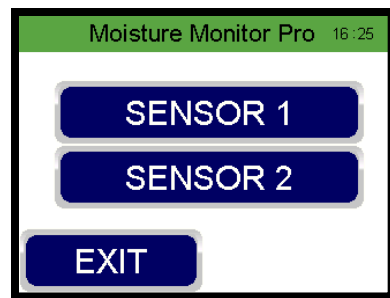


Figure 7 Sensor Selection

#### 3.3.1 Basic Method

The Standard calibration method permits quick adjustment of the displayed moisture by directly adjusting the displayed moisture. For best results, calibrate when the displayed reading is relatively stable. You don't want the moisture to be changing up and down too much while you are doing your test. This is the preferred option if using the pulse discharge configuration.

Steps:

1. Note the displayed moisture.
2. For best results collect product by taking a number of small product samples over a 30 second period.
3. Mix this large product sample and perform a number of off-line manual tests. It is suggested that 3 manual tests should be taken and averaged to get an average reading.
4. Again note the displayed moisture. If the change displayed is less than 0.5%, adjust the value in the calibration screen to reflect the test average, using the "+" and "-" keys.
5. When done, press the **SAVE** key, and a **CALIBRATION COMPLETE** button will appear.
6. If the difference in moisture between step 1 and step 4 is greater than 0.5% use discretion in adjusting.
7. Repeat as necessary.

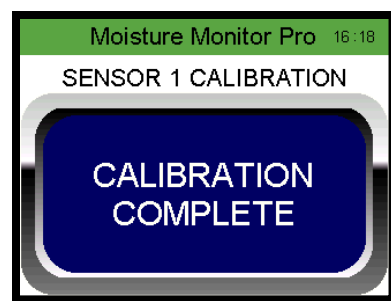
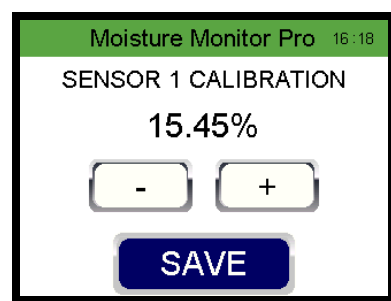


Figure 8 Calibration Screens - Basic Method

### 3.3.2 Advanced Method

The advanced method can be used with or without an optional calibration push button. Note that if the sensor is part of a pulse discharge operation the "BATCH TIME" must be greater than 30 seconds or else the sensor will empty during the calibration. If the "BATCH TIME" is less than 30 seconds the operator must use the standard method.

Without the calibration button:

1. Press **CAL** and select the sensor if there are two sensors
2. Press **START**. The Moisture Monitor Pro will calculate an average moisture reading over the next 30 seconds. The display will initially return to the Main Screen, and you will see the **CAL** button flashing.
3. After 30 seconds it will return to the calibration entry screen.
4. During this 30 second time period, take a number of small product samples at the sensor.
5. Mix this large product sample and perform a number of manual tests. It is suggested that 3 manual tests should be taken and averaged to get an average reading.
6. The MMP screen will now show the calculated 30 second average (ONLINE SAMPLE).
7. Press the highlighted "MANUAL SAMPLE" and a keypad will come up. Using the keypad, enter the manual sample reading from step 4, and then press **ENTER**.
8. Once the calibration is accepted a **CALIBRATION COMPLETE** button will appear. Press the button to clear it and return to the Main Screen.

Note:

To cancel a calibration, Press **CANCEL** on the sample entry screen.

To return to the Main Screen until you have finished running your tests, press **EXIT**. On the Main Screen the **CAL** button will be solid green. To return to the sample entry screen press **CAL**.

There is an additional setting available if you need a long period in which you want to run your sample before entering the value and want to be automatically returned to the sample entry screen after a period of time. Under **SYSTEM SET-UP**, go to Calibration Settings, and enter a value for Cal Return Time. If you enter for example 300 seconds, the calibration entry screen will automatically load after 300 seconds, without you having to push the **CAL** button.

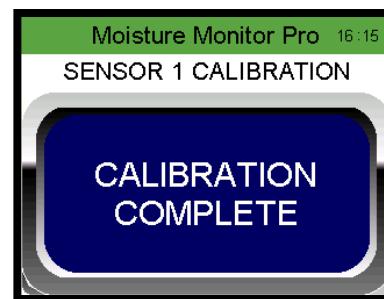
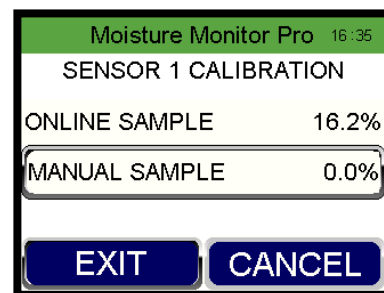
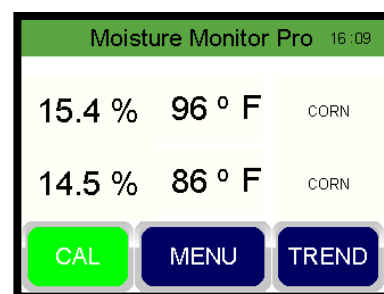
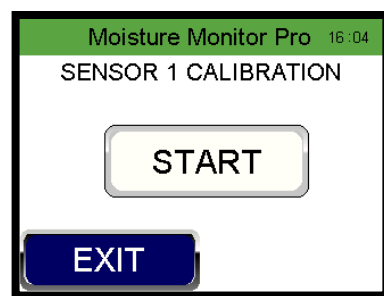
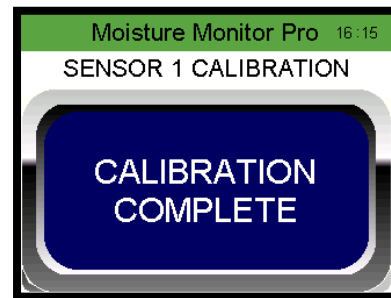
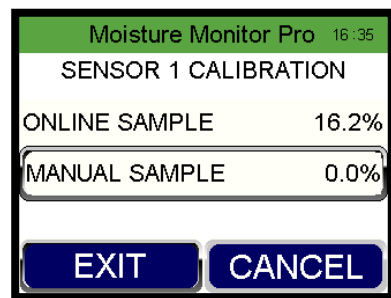


Figure 9 Advanced method without calibration button

With the calibration button

1. Press the calibration button at the sensor.
2. The button lamp will flash for 30 seconds and the Moisture Monitor Pro will calculate an average moisture reading over the next 30 seconds.
3. During this 30 second time period take a number of small product samples at the sensor.
4. Mix this large product sample and perform a number of manual tests. It is suggested that 3 manual tests should be taken and averaged to get an average reading.
5. The MMP screen will now show the calculated 30 second average (ONLINE SAMPLE).
6. Press the highlighted "MANUAL SAMPLE" and a keypad will come up. Using the keypad, enter the manual sample reading from step 4, then press **ENTER**.
7. Once the calibration is accepted a **CALIBRATION COMPLETE** button will appear. Press the button to clear it and return to the Main Screen.

*Figure 10 Enter Manual Sample Reading*

Note:

To cancel a calibration, Press **CANCEL** on the sample entry screen.

To return to the Main Screen until you have finished running your tests, press **EXIT**. On the Main Screen the **CAL** button will be solid green. To return to the sample entry screen press **CAL**.

There is an additional setting available if you need a long period in which you want to run your sample before entering the value and want to be automatically returned to the sample entry screen after a period of time. Under **SYSTEM SET-UP**, go to Calibration Settings, and enter a value for Cal Return Time. If you enter for example 300 seconds, the calibration entry screen will automatically load after 300 seconds, without you having to push the **CAL** button.

### 3.4 Trend: (TREND button)

Pressing the **TREND** button brings up the moisture graph. If two sensors are being used, the Moisture S1 graph will appear first. To access the Moisture S2 graph touch the Moisture S1 graph. This will toggle to Moisture S2 and vice versa. To view the temperature graph, press the **TEMPERATURE** button. Press the graph on screen to toggle between temperature graphs. The scales for the graphs are set under **SYSTEM SETUP**, Trending options.

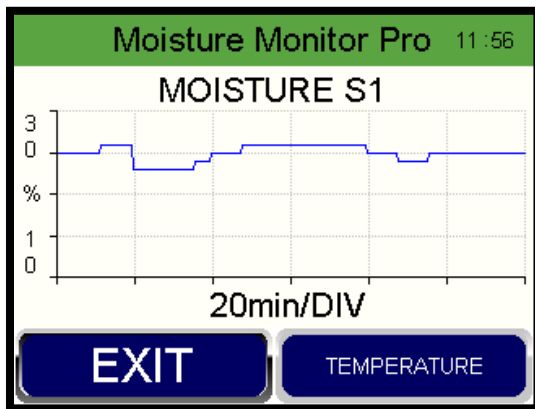


Figure 12 Moisture Trend Graph

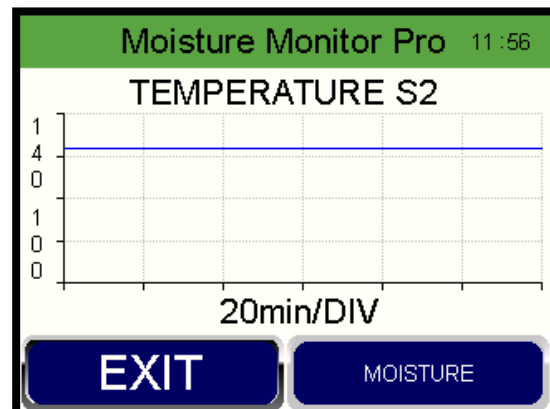


Figure 11 Temp Trend Graph

### 3.5 Expanded Menu Screen: (MENU button)

Pressing the **MENU** button brings up the expanded menu screen. The six additional buttons allow the operator to access all the key settings for the system. The key setup settings are accessed through the **SYSTEM SETUP** button. These settings are password protected and should be reviewed before operating the system. They are addressed in section 4.

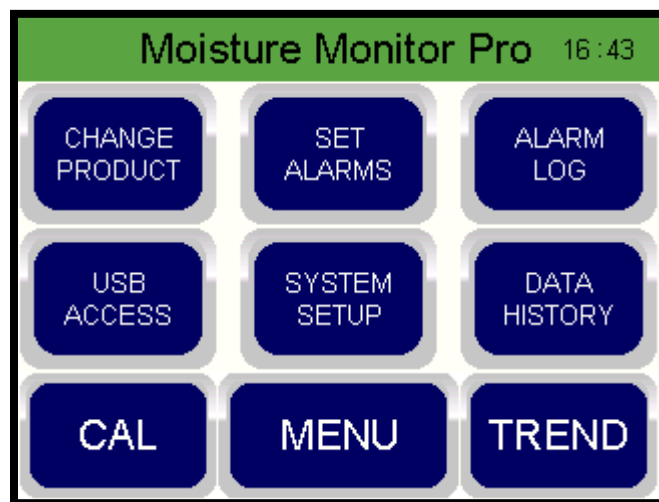


Figure 13 Extended Menu

### 3.5.1 Extended Menu Items


If two moisture sensors are being used, the settings that are applicable to each sensor separately, will start with a sensor selection screen. Simply select the sensor you want to adjust.

### 3.5.2 Change Products:

Press **CHANGE PRODUCT** on the extended menu screen. To change the product, press the **CHANGE** button until you reach the product you want. Press **EXIT** to save and return to the Main Screen.

There are 16 product names available (Corn, Wheat, Beans, Canola, Barley, Malt Barley, Oats, Rice, Sorghum, Sunflower, Lentils, Chickpeas, Peas, Other 1, Other 2, Other 3). If you are measuring a different product, you can use any of the product names as long as you configure the parameters for the product correctly in the **system setup**.

### 3.5.3 Set Alarms:

Press **SET ALARMS** on the extended menu screen. The first screen is to choose which product alarms to set. Press  for the next screen that is for selecting the moisture or temperature alarm menu. Within those menus there are four levels of alarms that can be set for each sensor above and below the normal ranges:

CH -> Critical High Moisture Limit  
 WH -> Warning High Moisture Limit  
 Normal Moisture Range  
 WL -> Warning Low Moisture Limit  
 CL -> Critical Low Moisture Limit

CH -> Critical High Temperature Limit  
 WH -> Warning High Temperature Limit  
 Normal Temperature Range  
 WL -> Warning Low Temperature Limit  
 CL -> Critical Low Temperature Limit

Alarms are used as a tool to alert the operator to a situation deemed important.

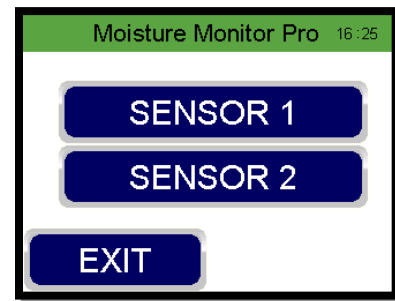


Figure 14 Sensor Selection Screen

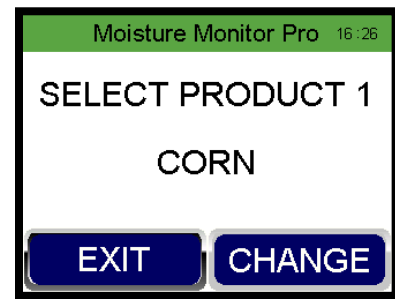


Figure 15 Change Product Screen



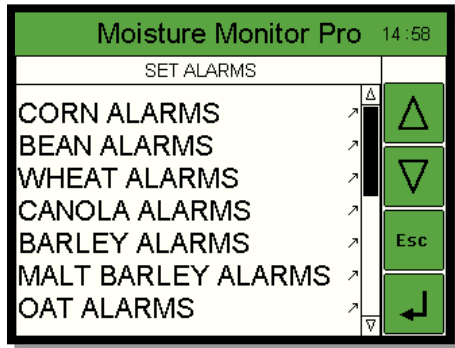


Figure 20 Select Product Alarms

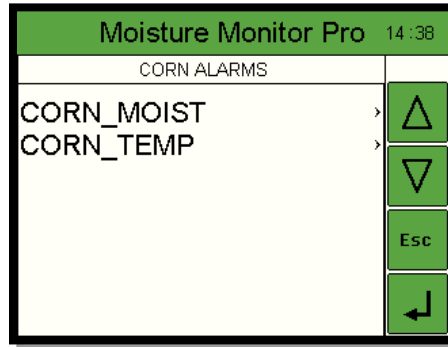


Figure 19 Select Moisture or Temperature Alarms

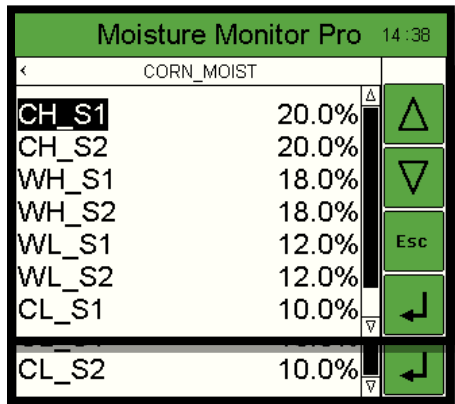


Figure 18 Set Moisture Alarm Limits

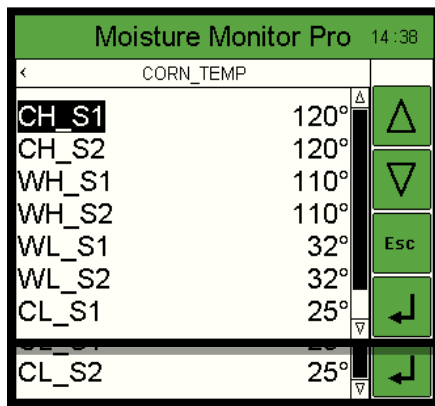


Figure 17 Set Temperature Alarm Limits

An active alarm will trigger the sonalert. To acknowledge the alarm and stop the sonalert, press the **ACTIVE ALARM** button.

When a warning alarm limit is reached, the display on the Main Screen will turn red and a red **ACTIVE ALARM** button will appear.

When a critical alarm limit is reached, the displayed value will be in red and will also be flashing.

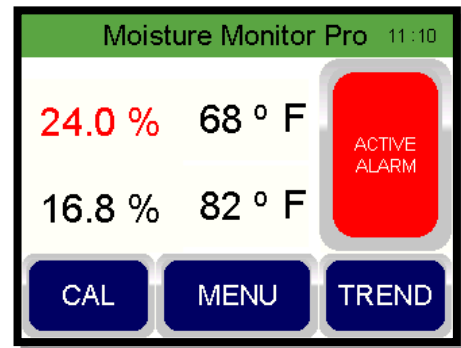


Figure 16 Active Alarm Notification

### 3.5.4 Alarm Log/Active Alarms

Press the **ALARM LOG** button on the extended menu to see a time stamped log of alarms. To see a list of active alarms, press the **ACT ALM** button. From the Active Alarms Screen, press **ALARM** to return to the log, or **EXIT** to return to the Main Screen

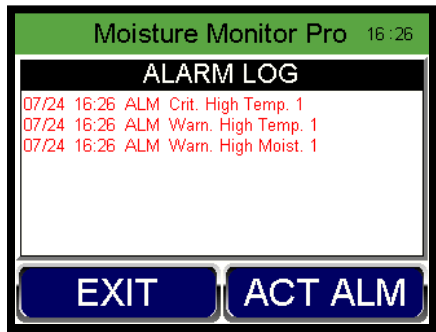


Figure 21 Alarm Log

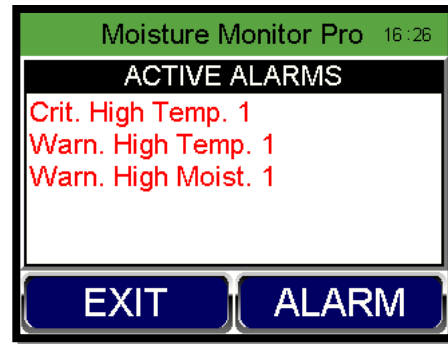


Figure 22 Active Alarm Listing

### 3.5.5 Download files to a USB

Historical moisture and temperature information along with historical calibration information is stored on a micro-SD card within the cabinet. For easy access to this information, the operator can first insert a USB device into the USB slot on the bottom of the cabinet. From the Main Screen press **MENU** for the extended menu and then **USB ACCESS**.

From the menu select either **COPY CAL FILES** to get the calibration history, or **COPY DATA FILES** to get the moisture and temperature history. The files will be downloaded to the USB device in .csv format for easy transfer to a spreadsheet program. Once the files have been downloaded a **TRANSFER COMPLETE** button will appear. Touch the button to acknowledge or **EXIT** to exit.

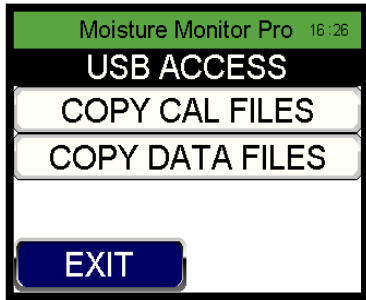


Figure 24 USB Download Option Screen

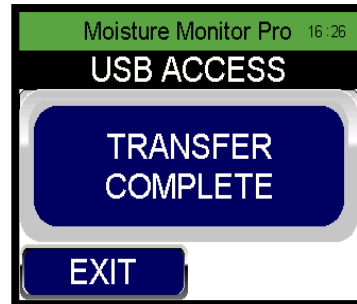


Figure 23 Transfer Complete

### Data History

Press the **DATA HISTORY** button to get 10 minute average readings for the last 2 hours of operation.

Each screen gives 30 minutes of operation. Use the **NEXT** button to go to the next screen.

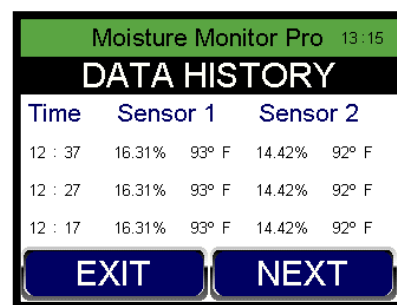


Figure 25 Sample Data History

# 4 System Setup:

Pressing **MENU** and then **SYSTEM SETUP** brings up a password entry screen. Enter the password (**6853**) to access the scrollable sub menu with the main system settings. Use the Up / Down keys to scroll, the **ENTER** key to select and the **ESC** key to exit. In addition, you can also use touch to select an option.



Figure 26 Password Entry Screen

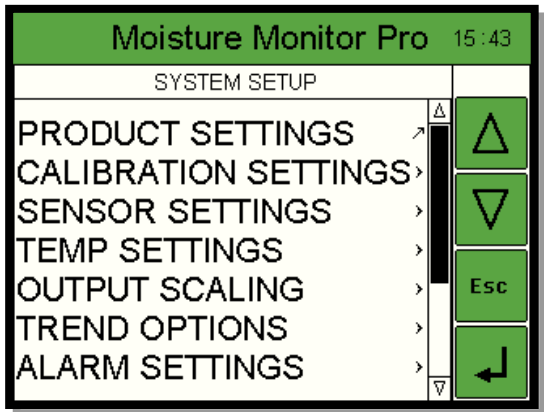


Figure 28 System Set-Up Screen (Top portion)

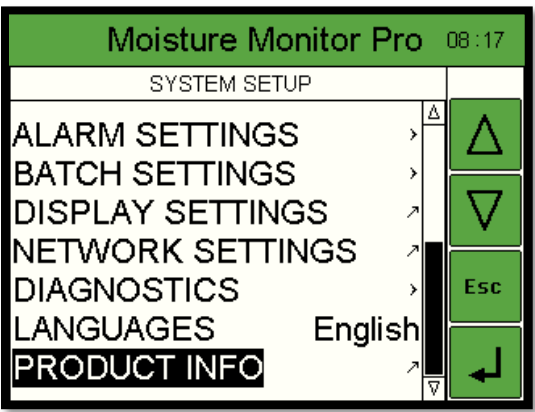


Figure 27 System Set-up Screen (Bottom portion)

## 4.1 Product Settings:

There are 16 product names available on the system. Each product has its own settings/parameters. In addition, there are settings for the second sensor if one is installed. The notation after the parameter - either S1 or S2 refers to the number of the sensor - i.e. sensor 1 or sensor 2. If you are monitoring a product not listed, you can use one of the products listed and simply update the parameters to those that match your product.

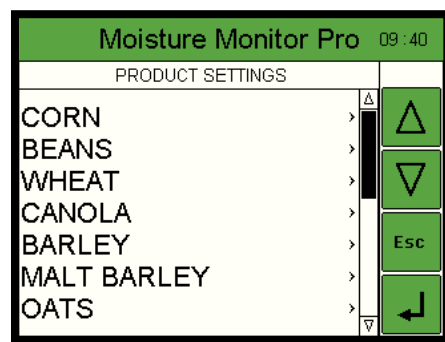


Figure 29 Products

The product slope is the important number. The slope for any product is density dependent. Products with higher densities will have a lower slope and vice versa. Corn typically has a slope of 5.0. There is a list of suggested initial product slopes for products of different densities in Section 7.3. The product offset is typically adjusted by calibrations of the sensor. The TC or temperature compensation should be set at 0, unless instructed by the Dryer Master Support Center to use another value. Standard temperature compensation is done on board at the moisture sensor, so additional TC is rarely if ever required.

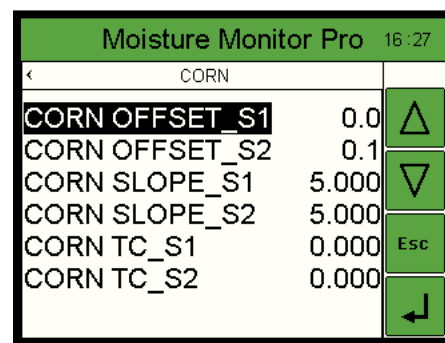


Figure 30 Product specific settings

## 4.2 Calibration Settings:

There are two calibration methods; standard and advanced. Using the standard method, the operator simply adjusts the displayed reading to match the manual sample. With the advanced method, a 30 second average of the Moisture Monitor Pro reading is used to compare to the manual test and an automatic adjustment is made. (See the calibration section for more information).

To change methods, highlight **CAL METHOD**, then press the **ENTER** key. This brings up a keypad. Use the arrow key to scroll between the two options, then press **ENTER** to save.

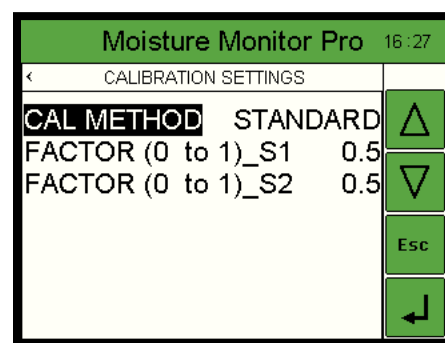


Figure 31 Calibration Settings

The "Factor" is the percentage adjustment of the difference between the manual test and the 30 second sample. Typically, this is set at 0.5 (50%). This means on any calibration only ½ of the difference is adjusted for. Since there is inherent variability in samples this avoids excessive calibration adjustments. To fully adjust for any difference, set this to 1.

*Note: For a pulse discharge operation if the "BATCH TIME" is less than 30 seconds the operator must use the standard method. The advanced method requires the sensor be full for at least 30 seconds when sampling.*

### 4.3 Sensor Settings:

S1 refers to Sensor 1, and S2 to Sensor 2.

*MOIST VOLTAGE & TEMP VOLTAGE:* Moisture and temp voltages are used for diagnostic purposes.

The *EMPTY VOLTAGE* is the voltage at which the sensor will read empty. This is typically 0.9. Below 0.9 volts the reading on the Main Screen will display "Empty".

### 4.4 Temperature settings:

The first line is the current temperature scale.

The second line allows you change between Fahrenheit and Celsius. If you change the scale, you should review your alarm limits for your temperature settings.

These remaining settings are rarely if ever adjusted. The default values are:

C (Celsius): Slope 40, Offset -40

F(Fahrenheit): slope 72, Offset -76

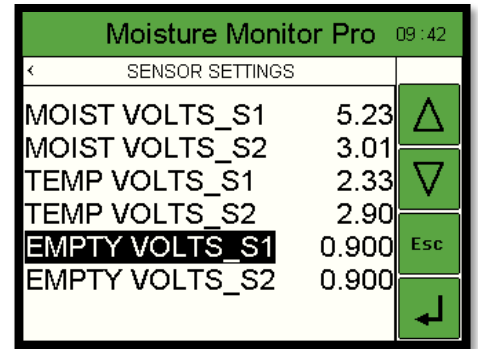


Figure 32 Sensor settings

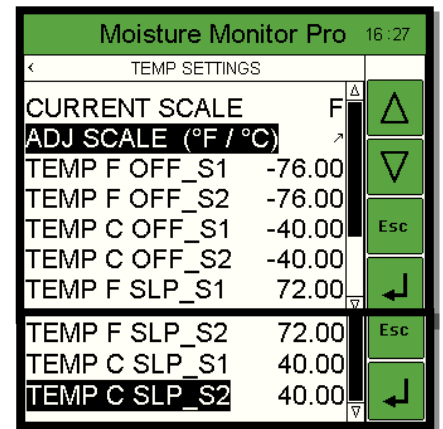


Figure 33 Temperature settings

### 4.5 Output Scaling

The Moisture Monitor Pro is able to output an analog signal for the moisture and temperature readings of each sensor. This menu section allows for the analog outputs to be scaled to a specified output range.

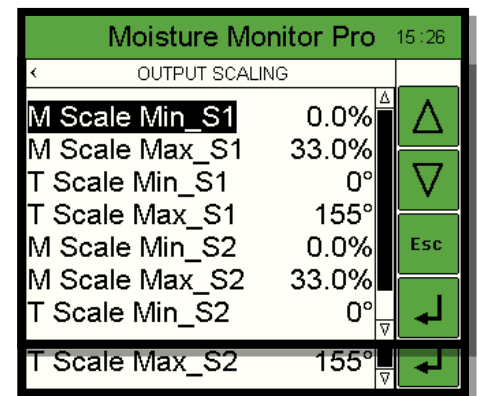


Figure 34 Output scaling

## 4.6 Trending options:

The time scale for the trend graphs is 2 hours.

There are two configurable options:

**MOISTURE RANGE:** Highlight the value and use the Up and Down keys to scroll through the available scales.

**TEMP RANGE:** Highlight the value and use the Up and Down keys to scroll through the available scales.

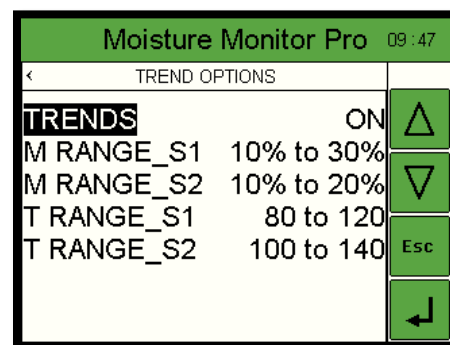


Figure 35 Trend Options

## 4.7 Alarm settings:

**ALARM DELAY** is the time (in seconds) between an alarm condition being triggered and the alarm being signaled. The short time delay is to avoid nuisance alarms where a level is triggered for only a couple of seconds.

**RMT ALARM** is the ability to trigger a remote alarm that has been setup away from the display.

**RMT ALARM** delay is the time lag (in seconds) between an alarm condition being triggered and the alarm sounding.

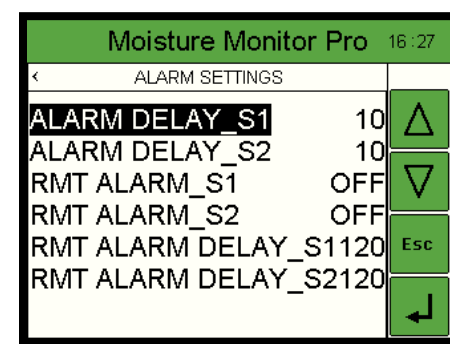


Figure 36 Alarm Settings

## 4.8 Batch Settings

For [pulse discharge installations](#), set **BATCH AVG** to **ON** for the appropriate sensor(s). In between discharges the display will show the average moisture (as well as the real time temperature) from the just completed discharge. For standard installations, **BATCH AVG** should be **OFF**.

When a discharge starts, grain will start to flow to the sensor chute. When the first grain arrives call this T1. When the sensor chute is totally full, call this T2. T2-T1 is the **FILL TIME**. As a buffer add 2 seconds to this time.

Continue to time the discharge. T3 is when the discharge is over, and the chute just starts to empty. **BATCH TIME** is T3 - **FILL TIME**. On the screen the sensor should not read empty between discharges when the dryer is running. If it does increase the buffer size, increase the **FILL TIME**, or decrease the **BATCH TIME**.

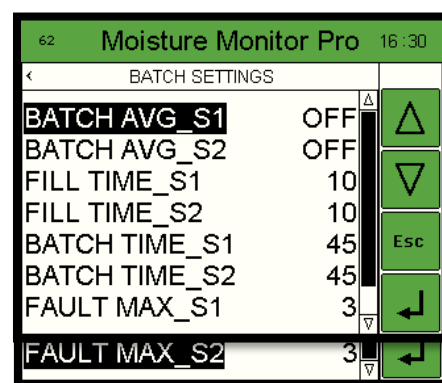


Figure 37 Batch Settings

FAULT MAX is used to try and identify a situation where it appears that the sensor is not going empty between discharges. The Default value of 3 means that if the sensor does not go empty for 3 times the combined FILL TIME + BATCH TIME, a warning will appear on the screen. If there are nuisance warnings (time between discharges is long) increase the value.

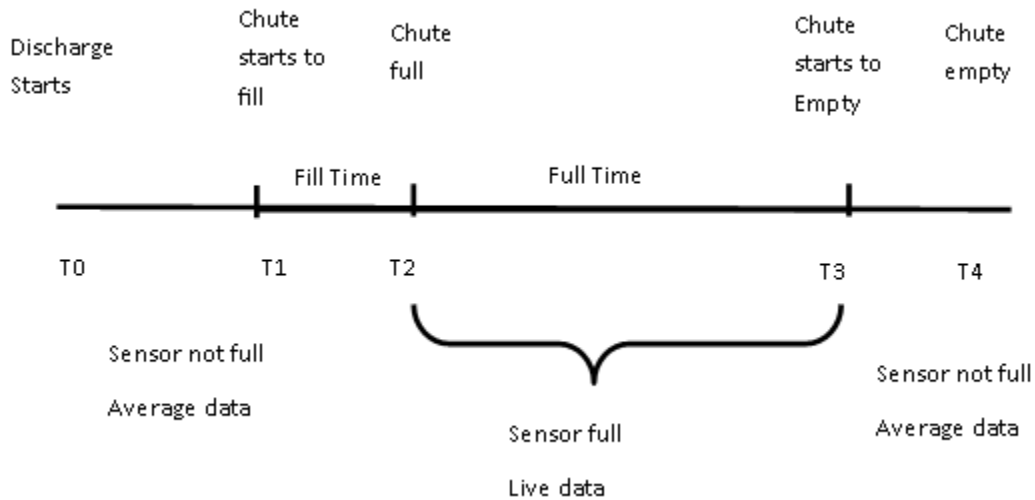


Figure 38 Fill time and Batch time

## 4.9 Display Settings

SCREEN SAVER lets the operator turn on or off the screen saver as well as the timeout interval.

DATE/TIME lets the operator adjust the displayed time.

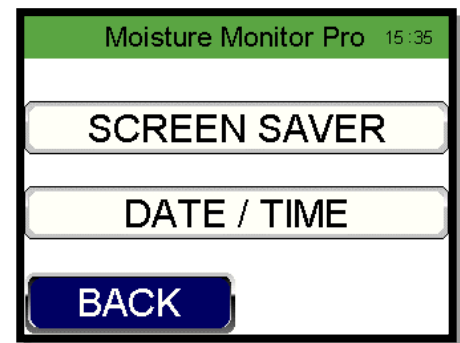


Figure 39 Display Settings

## 4.10 Network Settings

The network settings are used when setting up the Web App. Enter the values from your network setup, as described in Appendix 1, to save them on the system.

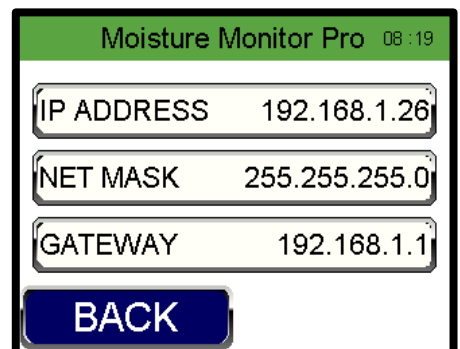


Figure 40 Network Settings

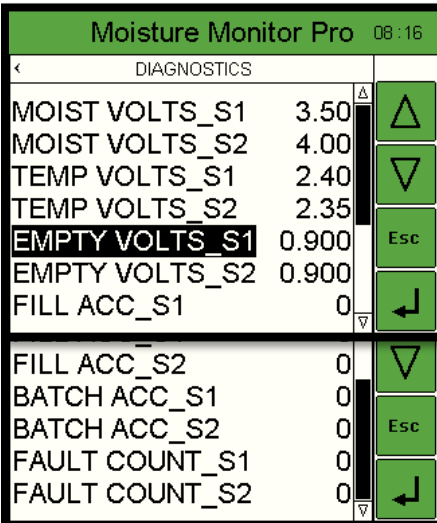
## 4.11 Diagnostics

The diagnostics screen allows the operator to view raw values in real time.

*MOIST VOLTS* is the moisture voltage from the moisture sensor. The value will be between 0-10 vdc.

*TEMP VOLTS* is the grain temperature voltage coming from the moisture sensor. This value will be between 0-10vdc.

*EMPTY VOLTS* - When the sensor *MOIST VOLTS* reads less than the *EMPTY VOLTS* value it will be deemed to be empty. The moisture sensor (*MOIST VOLTS*) should read approximately 0.8vdc when the sensor is empty. The moisture sensor has a standard empty voltage of approximately 0.8vdc. By monitoring the *MOIST VOLTS* value during an empty period, it can be determined if the *EMPTY VOLTS* value needs to be increased. For example, if the *MOIST VOLTS* value is 0.93 when the sensor is empty, the *EMPTY VOLTS* value should be increased to be above this value.



Moisture Monitor Pro 08:16	
DIAGNOSTICS	
MOIST VOLTS_S1	3.50
MOIST VOLTS_S2	4.00
TEMP VOLTS_S1	2.40
TEMP VOLTS_S2	2.35
EMPTY VOLTS_S1	0.900
EMPTY VOLTS_S2	0.900
FILL ACC_S1	0
FILL ACC_S2	0
BATCH ACC_S1	0
BATCH ACC_S2	0
FAULT COUNT_S1	0
FAULT COUNT_S2	0

Figure 41 Diagnostics for Pulse Installation

*FILL ACC* - Allows the operator to monitor the *FILL TIME* count in seconds.

*BATCH ACC* - Allows the operator to monitor the *BATCH TIME* count in seconds.

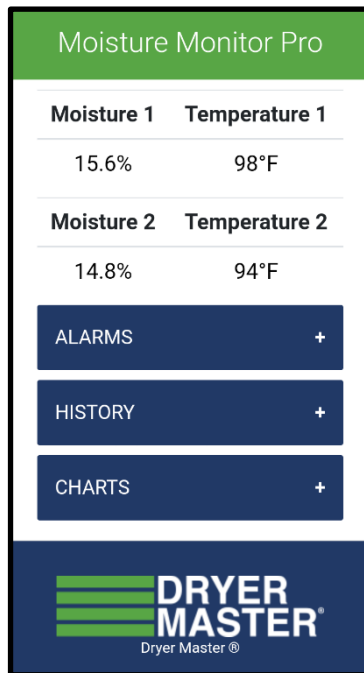
*FAULT COUNT* - The moisture sensor should go empty between discharges. Each empty reading resets the *FAULT COUNT*. Each time a *FILL TIME* + *BATCH TIME* (in seconds) elapses without an empty reading the *FAULT COUNT* is added to. When the *FAULT COUNT* = *FAULT MAX* (*BATCH SETTINGS*) a warning message to check the sensor will appear on the screen.

## 4.12 Languages

The MMP can be configured in either English or Spanish. Scroll down to the "Languages" line and press ENTER. Use the arrow keys to alternate between languages. Press Enter to select. Press ESC to return to the main screen.



## 5 Network Set-Up



To set up the MMP so that you can see it on your phone or network refer to the tutorial in Appendix 1 of this manual.

The phone app displays the moisture and temperature from 1 or 2 sensors. This is automatically configured based on the number of sensors being used.

The language used depends upon the language set on the device.

Alarms, History and Charts rate are accordion type displays. Click on the box to open the display and click again to close.

"Alarms" shows alarm history. History shows ten-minute averages.

"Charts" shows the most recent history in graphical form.

*Figure 42 Web App Display*

## 6 Electrical connections

### 6.1 Device Connections

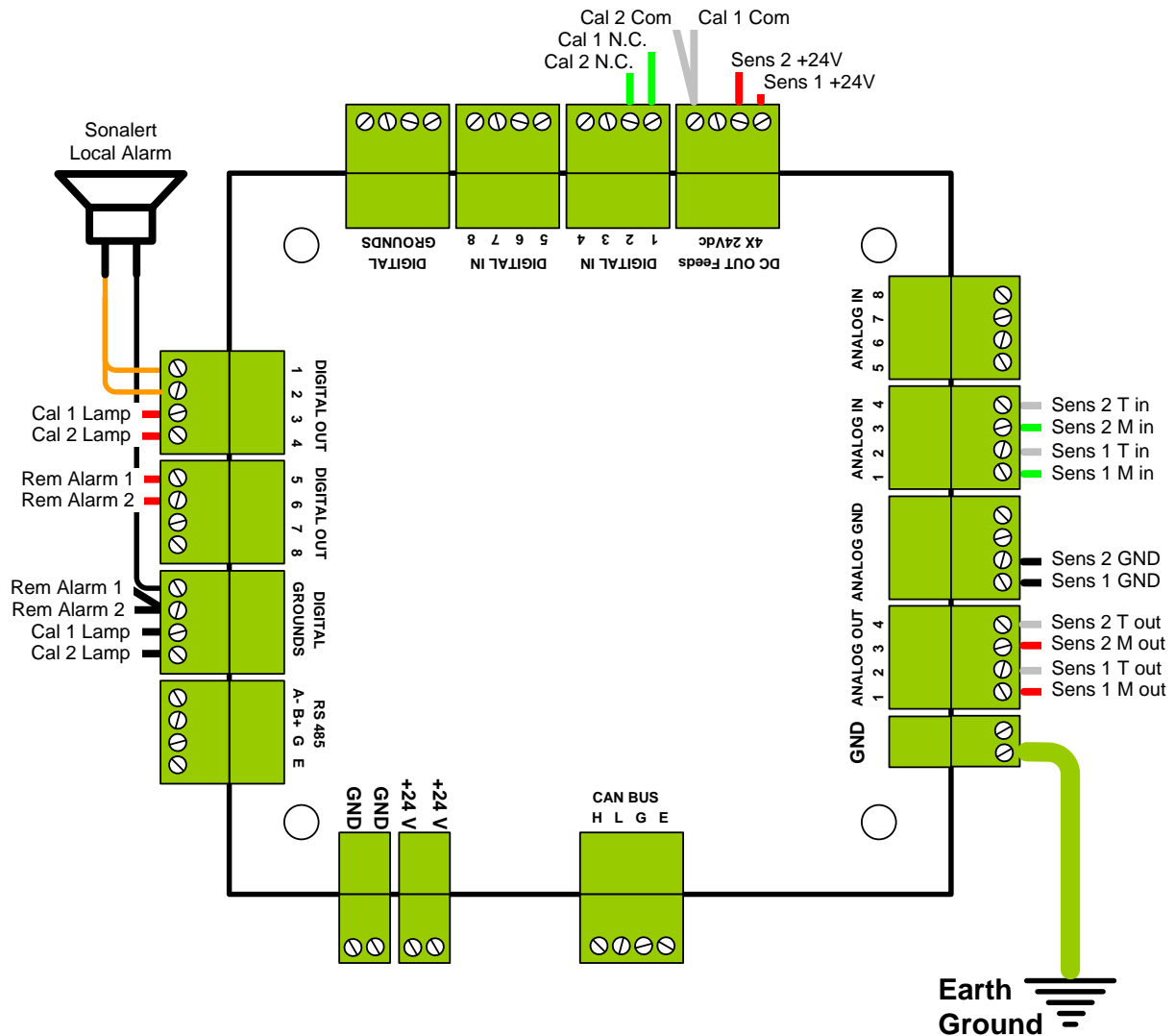


Figure 43 Connections

#### IMPORTANT:

1. All digital inputs are rated for low voltage (30 VDC maximum).
2. All digital outputs are 24vdc. 100mA per channel, to a combined total of 500 mA.
3. **The unit is powered from an ungrounded plug-in power supply. The unit must be grounded to an electrical earth ground via a separate wire at the time of installation.**

## 6.2 Device Connections, Sensors & Calibration Buttons

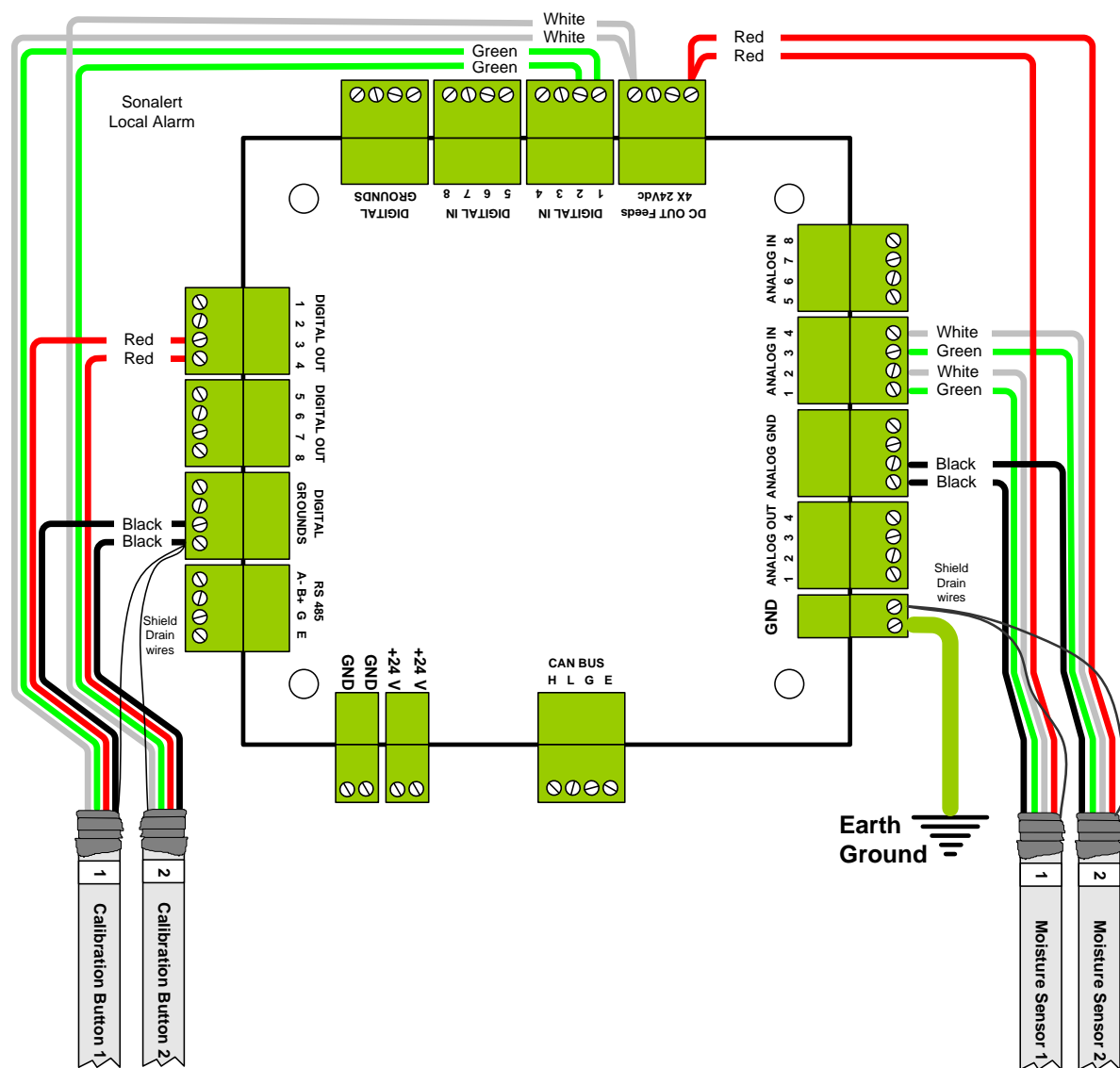


Figure 44 Device connections, sensors & calibration button

### 6.3 Device Connections, Alarm Output & Analog Output

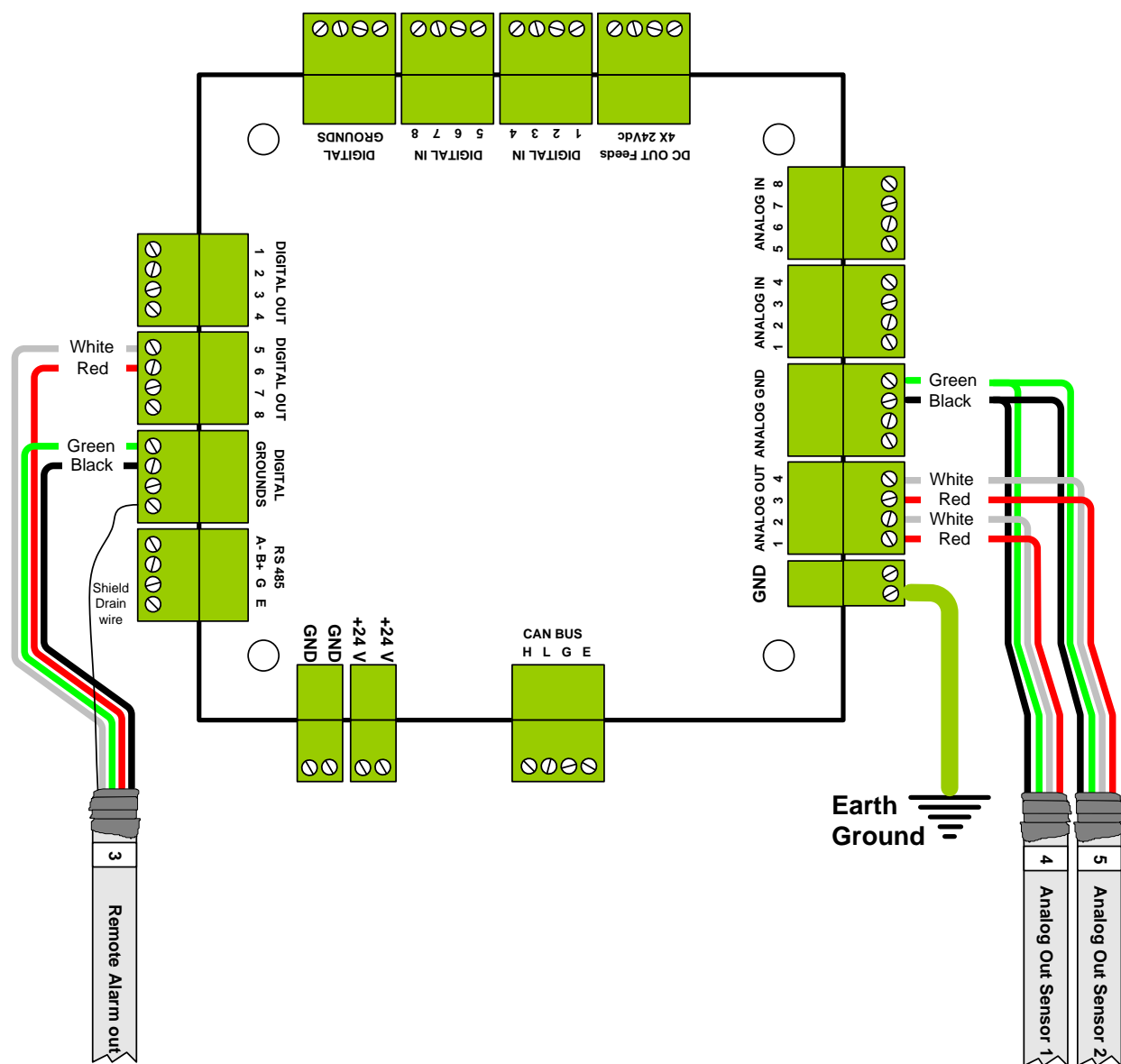


Figure 45 Device connections, Alarm Output & Analog Output

## 6.4 Field Connections.

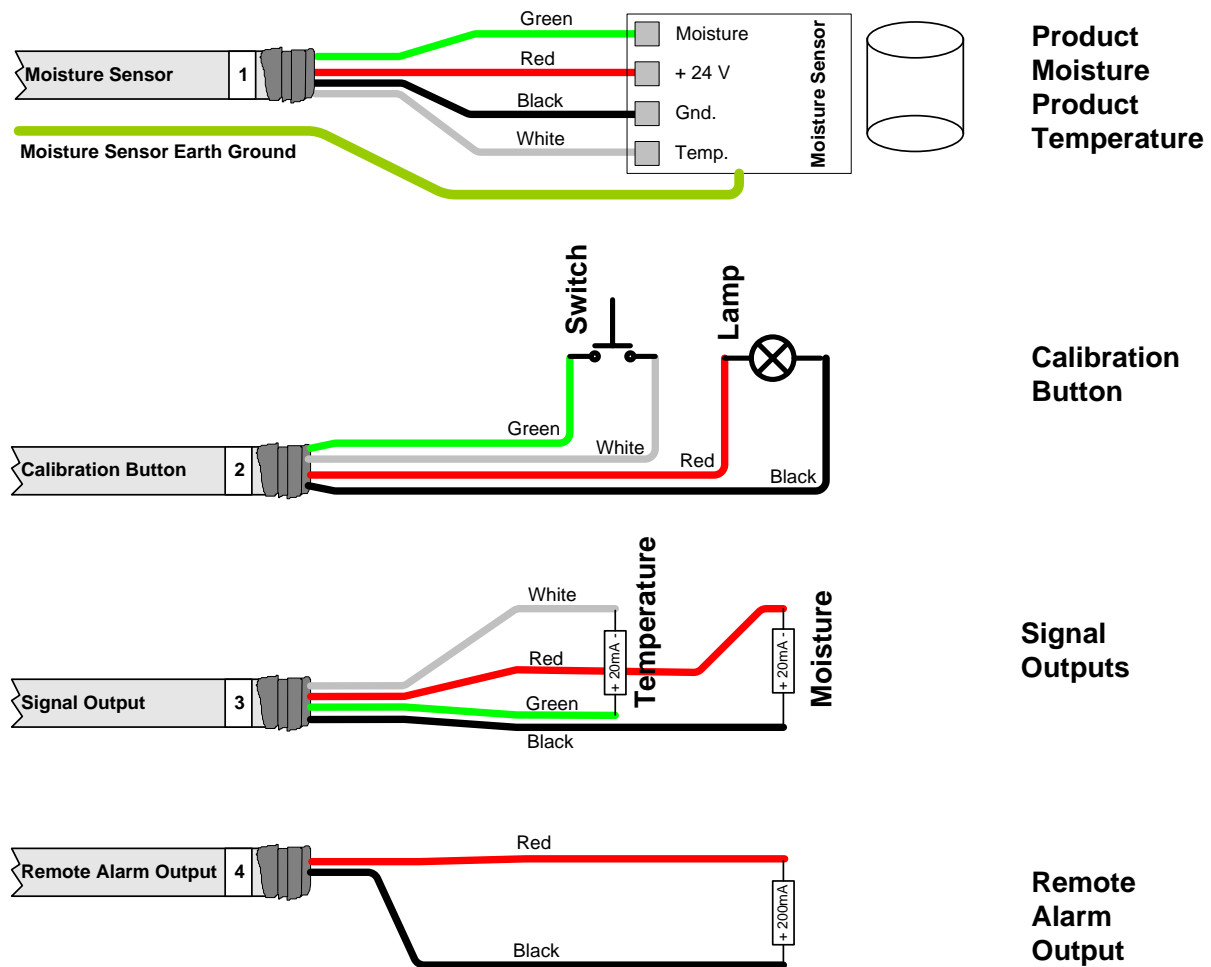


Figure 46 Field connections.

## 7 Moisture Sensor General Specifications

### 7.1 Moisture Sensor Installation

The moisture sensor, typically a Fin-style design, needs to be installed in a compacted flow situation. In most instances this will be in a chute or pipe in which the product flow is mechanically metered to a constant flow rate of less than 2.5 CM (1 inch) per second. The sensor must be mounted vertical to ensure proper product flow. Typically, the Fin sensor is mounted in a 15 – 20 cm (6 – 8 inch) square or round pipe into which a portion of the product stream is diverted. The exact dimensions of the pipe are not critical provided a good flow cross section is achieved. This pipe/chute should be completely full of compacted product during operation. The product is metered out of this pipe/chute with either a screw conveyor or a rotary valve. The speed of the conveyor or rotary valve should be such that the flow past the sensor is at less than 2.5 cm (1 inch) per second. In continuous operation with highly abrasive products, or less than 2000 lbs per hour flow, it is recommended that the flow rate be further reduced to 1 cm (0.4 inches) per second or less.

Product flow rates are approximate but must be no faster than 2.5 cm (1 inch) per second. Flow rates must be constant; change in the speed of flow will affect moisture sensor accuracy and performance.

### 7.2 Moisture Range & Temperature range.

The sensor's electronics typical operating temperature range is –10 degrees Celsius (14 degrees Fahrenheit) to 70 degrees Celsius (150 degrees Fahrenheit). Product temperature can range from –25 to 95 degrees Celsius (-13 to 200 degrees Fahrenheit) although verification of the actual product moisture at the temperature extremes becomes almost impossible. Moisture accuracy and repeatability is absolute product moisture and moisture gradient depended. Typical accuracy is +/- 0.2% moisture or 2% of scale.

The Moisture Range is a function of the product and product temperature. Sensors are available to cover moisture ranges from 0.5% to 45%, product densities from 0.15 g/cm<sup>3</sup> (10 lbs/foot<sup>3</sup>) to 1.5 g/cm<sup>3</sup> (95 lbs/foot<sup>3</sup>), and product temperatures from (negative) –25 to (plus) + 95 degrees Celsius (-13 to 200 degrees Fahrenheit).

## 7.3 Sensor signal conversion

The dielectric conversion formula is a function of the sensor and the specific product. For most products a linear conversion serves the narrow moisture range typically seen by the user. This conversion is done by the Moisture Monitor Pro system.

16 product names come preset in the Moisture Monitor Pro. However, alternate products can be measured by using one of the existing products and changing the relevant parameters under **SYSTEM SETUP** PRODUCT SETTINGS. The key setting is the product slope. The table in Figure 47 Recommended Starting Slopes, gives suggested starting slopes based upon the density of the product for which moisture is being measured.

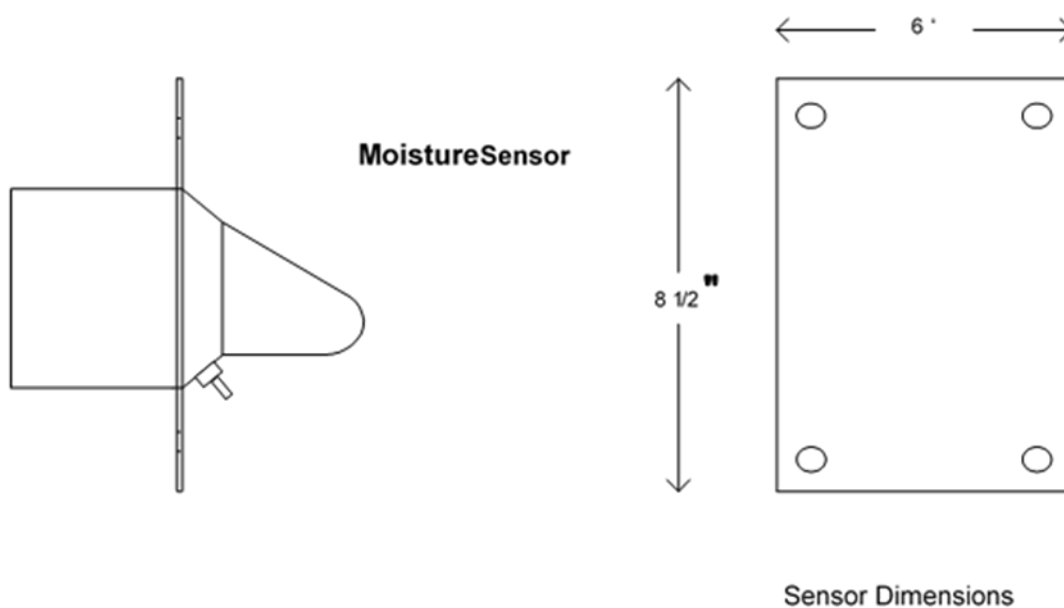
Material	(lb/ft <sup>3</sup> )		lbs/bu		(kg/m <sup>3</sup> )		recommended starting slope	recommended starting offset
	from	to	from	to	from	to		
Peanuts, unshelled	15	24	18.67	29.87	240.28	384.44	8	-2
Sunflower, unshelled	18	26	22.40	32.36	288.33	416.48		
Cat food	20	25	24.89	31.11	320.37	400.46	7	
Coffee bean, roasted	22	30	27.38	37.33	352.41	480.56		
Beans, coffee	22	40	27.38	49.78	352.41	640.74		-2
Oats	25	35	31.11	43.56	400.46	560.65		
Dog food, IAMS minichunk	26		32.36		416.48		6.5	
Corn, gluten	26	33	32.36	41.07	416.48	528.61		
Sesame seed	27	37	33.60	46.05	432.50	592.68		
Distillers grain	30		37.33		480.56			
Corn, ground	30	35	37.33	43.56	480.56	560.65	6	
Corn, meal	32	40	39.82	49.78	512.59	640.74		
Coffee bean, green	32	45	39.82	56.00	512.59	720.83		
Peanuts, shelled	35	45	43.56	56.00	560.65	720.83		
Fullers earth	35	45	43.56	56.00	560.65	720.83		0
Barley, kernal	35	40	43.56	49.78	560.65	640.74		
Sunflower seed	36		44.80		576.67		5.5	
Flax seed	40	45	49.78	56.00	640.74	720.83		
Wood pellets	40	41	49.78	51.02	640.74	656.76		
Corn, grits	40	45	49.78	56.00	640.74	720.83		
Sorghum seed	42	50	52.27	62.22	672.78	800.93	5.25	2
Rye	44		54.76		704.81			
Corn, whole kernel	45		56.00		720.83			0
Wheat, whole kernel	45	55	56.00	68.45	720.83	881.02		
Rape seed	45	50	56.00	62.22	720.83	800.93		0
Rice	45	50	56.00	62.22	720.83	800.93		
Popcorn, shelled	45	50	56.00	62.22	720.83	800.93	5	
Peas, dry	45	50	56.00	62.22	720.83	800.93		
Mustard seed	45		56.00		720.83			2
Beans, lima	45		56.00		720.83			
Beans, soy	45	48	56.00	59.73	720.83	768.89		2
Soybean, whole	47		58.49		752.87			
Navy beans, dry	48		59.73		768.89		4.5	
Millet seed	48		59.73		768.89			
Beans, navy	48		59.73		768.89			

Figure 47 Recommended Starting Slopes

## 7.4 Dryer Master 2220-11-series, Fin Sensor



Figure 48 Fin style moisture sensor



### **Caution:**

**Do not cut holes in the sensor. Use only the existing wire entry location. Entry at any other location voids the warranty.**

The moisture sensor electronics are potentially sensitive to the electromagnetic energy from nearby welding. To reduce the risks of damage, remove the sensor before welding in the immediate area. Under no circumstances may the sensor housing or connecting bolts be used as a ground for welding



## 7.5 Sensor Power requirements

The sensor requires 18 to 30 volts DC at less than 20 mA. Two output signals in the 0 to 10 volt range provide the temperature and a measure of dielectric properties of the material passing by the sensor. The sensor power requirements are low enough to permit locating the sensor in class 2 and class 3 environments using Intrinsic Safety Barrier protection.

## 7.6 Grounding

The sensors require a good ground to function dependably. Run a ground wire from the sensor chassis ground to the signal-processing Panel. The sensor chassis must be at the same ground potential as the signal grounds. Large ground potential differences may contribute to erratic operation of the sensor and possible sensor failure.

## 7.7 Signal Output

The sensor output is 0 – 10 Volts, 2 signals, dielectric (moisture) and product temperature. Minimum recommended load resistance is 10k ohm for each output. The outputs are protected from shorts to ground and supply.

The output signal is a voltage to permit locating the sensor in class 2 and class 3 environments using Intrinsic Safety Barrier protection.

## 7.8 Sensor setup & diagnostics

Note: The sensor has been prepared to operate within the specification range of the product. The Sensor setup & diagnostics sheet serves as a diagnostics tool to verify the sensors operation and functionality and provide electrical connection locations. There is no need to calibrate a new sensor. It is permissible to note the signals by stepping through the calibration procedure. This will provide a base for comparison should the sensors function come into question at some time in the future. Adjusting the hardware calibration will negate the software calibration adjustments that have taken place over time. Hardware recalibration should only be attempted if the sensor no longer functions.

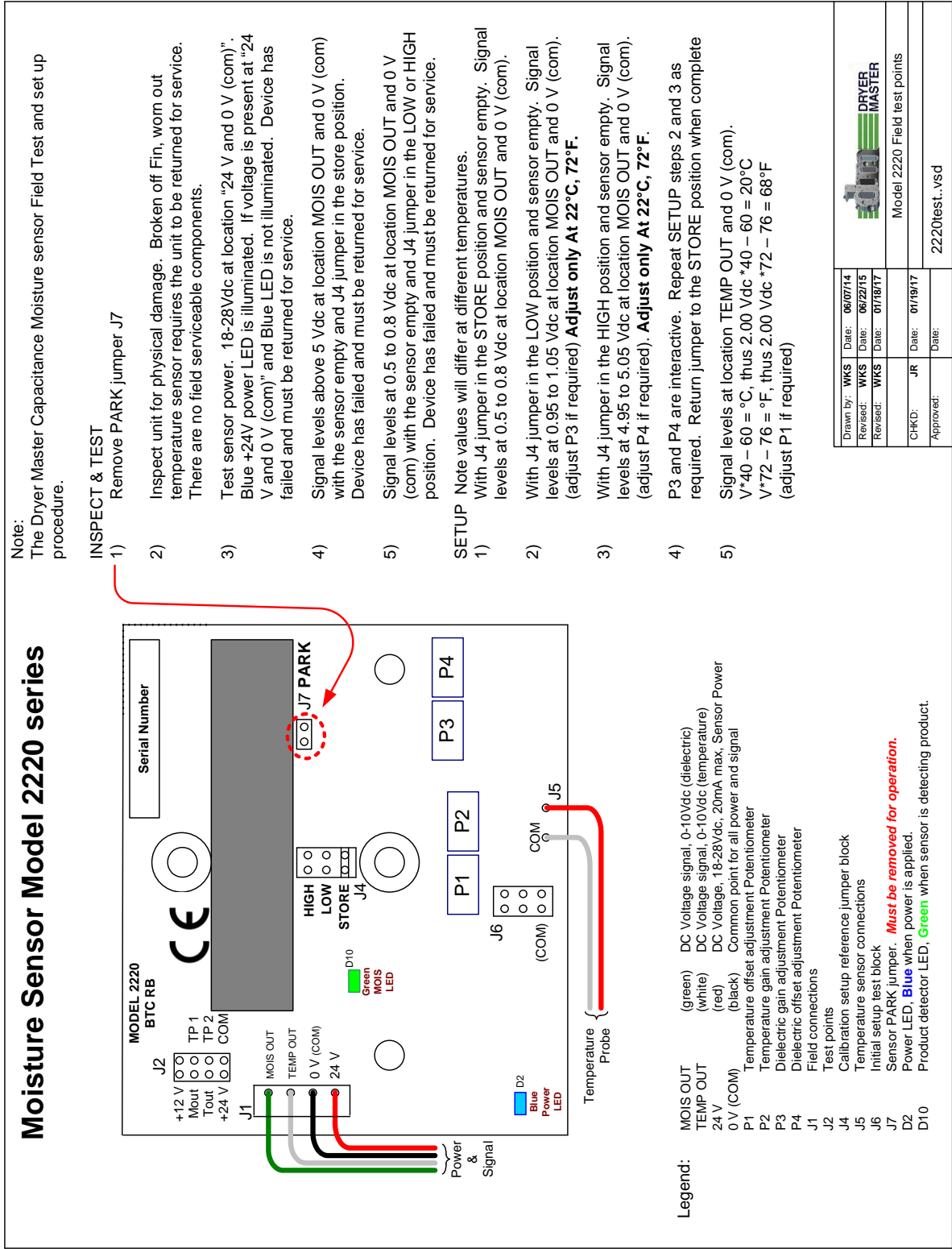


Figure 51 Sensor Set-up and Test

## 8 Moisture Sensor Installation Options

If the moisture sensor is being installed at the inlet to a dryer it does not require any mechanical metering. Instead it should be installed vertically where it will be fully covered by grain, in compacted flowing grain, and where it will see a representative sample of the grain. It should also not be installed in the hot zone of the dryer where it may be exposed to excessive condensation.

For other installations, Dryer Master offers 2 versions of its sensor chutes with rotary feed. One version is for bypass type situations and the other for inline type situations. The chutes are not required, but they can greatly help simplify installation and improve moisture measurement performance.

### 8.1 Option 1 By-Pass Method with Rotary Feed Chute – Details

With the bypass method, a portion of the grain leaving the dryer is bypassed from the main stream to where it passes by the sensor and then is returned to the main flow.

The Dryer Master rotary feed bypass chute accomplishes this. The chute requires 16 inches, 40.5 cm of vertical space.

Install the chute so that there will be a continuous flow of grain and the chute will remain full.

Ensure that the grain flowing through the chute is a good representative sample of the grain to be tested. Place the sensor in a location where it will NOT get an excess of fines or trash as this will contribute to errors or false readings. Inaccurate or false readings of the outlet sensor will adversely affect control of the dryer by the Dryer Master.

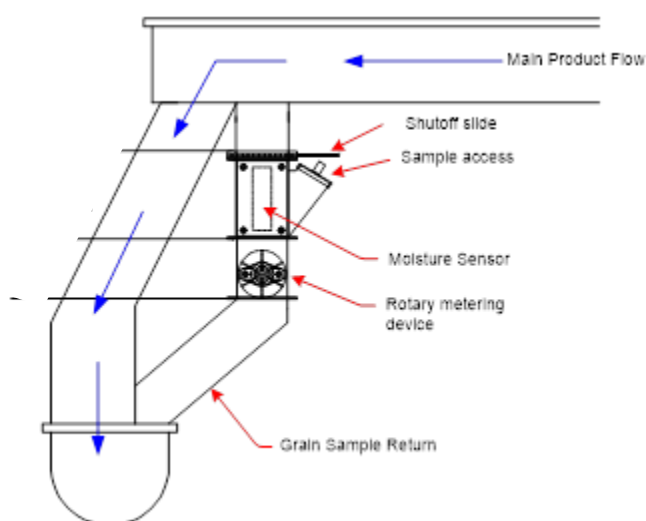


Figure 52 Bypass type installation

Locate the Sensor so it can be **safely** accessed for cleaning and taking grain samples.

**Do not cut holes in the sensor. Use only the existing wire entry location. Entry at any other location voids the warranty.**

Ensure the sensor chute empties completely when shutting down. If installed at the outlet to a dryer, make electrical connections such that the chute power is tied to the elevator control circuit. The elevator is typically the last item shut down in the shutdown sequence.

## The Bypass Chute

- Dimensions: 18 1/2" L x 8 1/2" W x 16" H (46.3 cm X 21.6 cm X 40.5 cm)
- Upper mounting flange 8 1/2" x 8 1/2" (21.6 cm X 21.6 cm)
- Built in sampling access
- Motor is IP66, 25W, 115VAC single phase, 0.43FLA reversible motor with 180:1 gear reduction (230VAC also available if required)
- The panels for the four sides of the chute are interchangeable and can be mounted in any configuration without impacting flow (but the chute should be vertical)

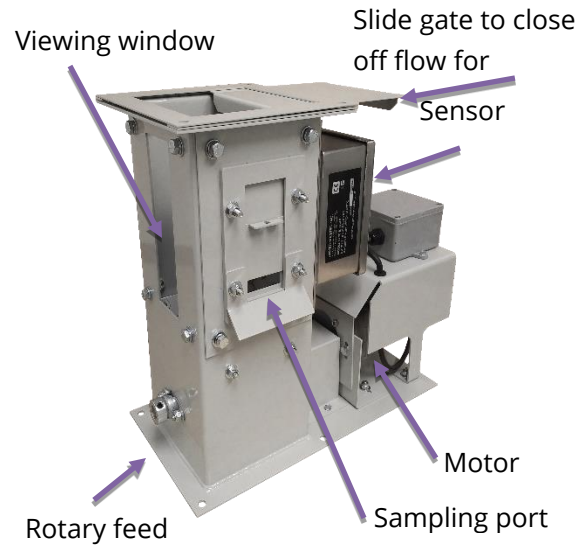


Figure 53 Outlet Fin in bypass chute

### Installation Considerations:

1. There are 4 interchangeable panels for the four sides of the chute assembly (viewing window, sampling port, sensor install, and blank) which can be mounted in any configuration.
2. The calibration button is available mounted on a plate that can be attached directly to the chute.
3. Ideally the sensor housing and chute assembly should be free of grain when the dryer is not running. This avoids having stagnant grain gumming up the assembly. **To do this the motor for the rotary feed should be wired so that it is the last thing that shuts off after the dryer shuts down.** Having the motor turn on and off with the dry conveyor or elevator will usually accomplish this.
4. To ensure proper flow, the transition piece mounted to the bottom of the chute should be the same size as the hole leaving the chute (6"X6" or 15.25 cm X 15.25 cm).

Figure 54 Calibration button w/sensor



### Installation Procedure

1. Remove the Outlet Sensor from the 6" square (15.25 cm square) chute before bolting the chute in place.
2. Make the necessary changes to the discharge system of the dryer so that there is room for the chute and rotary feeder.
3. Install the shut off slide gate above the sensor to shut off the flow to the sensor to allow cleaning out and or servicing the sensor.
4. Install bars across the opening to the sensor in the direction of grain flow. This will prevent large objects from entering the sensor.

5. Mount the chute in a vertical position.
6. Bolt the fin sensor back into the chute.
7. Attach the calibration button mounting plate to the bypass chute.



Figure 55 Example installations of bypass chute with rotary metering



## 8.2 Option 1a - Bypass Using Sampling Auger

The moisture sensor is installed in a by-pass where a portion of the grain is directed through the bypass. The grain flows through the sensor and then back into the system (Figure 13 - By-Pass auger installation). This method is used when there is less than 18" (46 cm) of vertical space at the bottom of the dryer. The fin sensor is installed in a square chute. A small slow-moving auger (30-60 bu./hr.) restricts the flow of grain so the chute remains full of compacted grain at all times.

1. Install the chute so that there will be a continuous flow of grain.
2. Make sure that the chute will always be full of grain.
3. Make sure that the grain flowing through the chute is a good representative sample of the grain to be tested. Placing the sensor in a location where it will NOT get an excess of fines or trash which will contribute to errors or false readings. Inaccurate or false readings of the outlet sensor will adversely affect control of the dryer by the Dryer Master.
4. The flow of grain through the chute should be less than one inch per second or less than 60 bu./hr. in a 6" by 6" chute (15.25 cm X 15.25 cm).
5. Locate the Outlet Sensor so it can be safely accessed for cleaning out and taking grain samples.

*Table 1: Gear reductions for metering devices*

A four-inch sampling auger is recommended. Several other options are available; see Table 1: Gear reductions for metering devices. All gear reductions given are based on a chute that is six inches by six inches. For the best flow characteristics, it is recommended that the auger be opened to the full width of the chute.

Metering Device	Approximate rpm	Gear reduction for 1500 rpm motor
6" screw conveyor standard pitch	5.5	270:1
6" screw conveyor ½ pitch	11	135:1
4" screw conveyor standard pitch	17	88:1
4" screw conveyor ½ pitch	39	44:1
4" flex screw conveyor	17	88:1

This will also reduce transition complexity. Verify the auger flow and gear box required. The table is an approximate guideline.

### *Installation Procedure*

1. Remove the Outlet Sensor from the 6" square (15.25 cm square) chute while installing and welding the transitions.
2. Make the necessary changes to the discharge system of the dryer so that there is room for the chute, sampling auger and slide gate.
3. Install the slide gate above the sensor to shut off the flow to the sensor to allow cleaning out and/or servicing the sensor.
4. Install the Chute and Sensor so the operator can inspect and clean the sensor. It must be possible to do these tasks easily and safely while the dryer is operating.

5. Install bars across the opening to the sensor in the direction of grain flow. This will prevent large objects from entering the sensor.
6. Mount the chute in a vertical position.
7. For greatest sensitivity and accuracy, it is recommended to bolt the chute such that the fin of the sensor will be oriented in the same direction as the shaft of the auger.
8. Run grain through the sampling chute and ensure the grain flows evenly past the fin. Also ensure that the auger is drawing grain from all areas of the chute. The auger has to be at least 6" below the fin to ensure this happens.

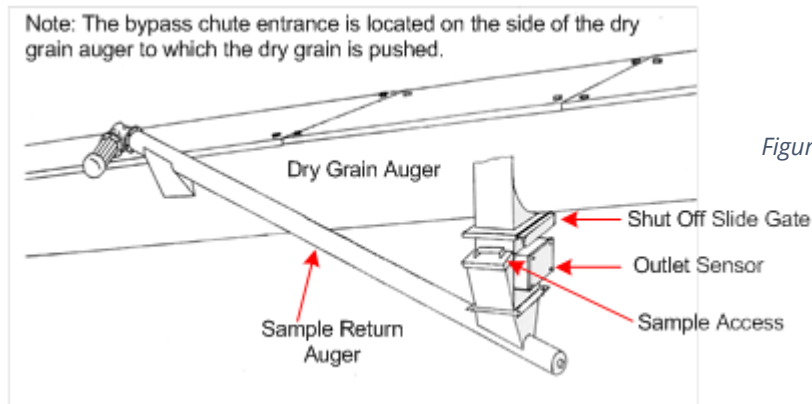
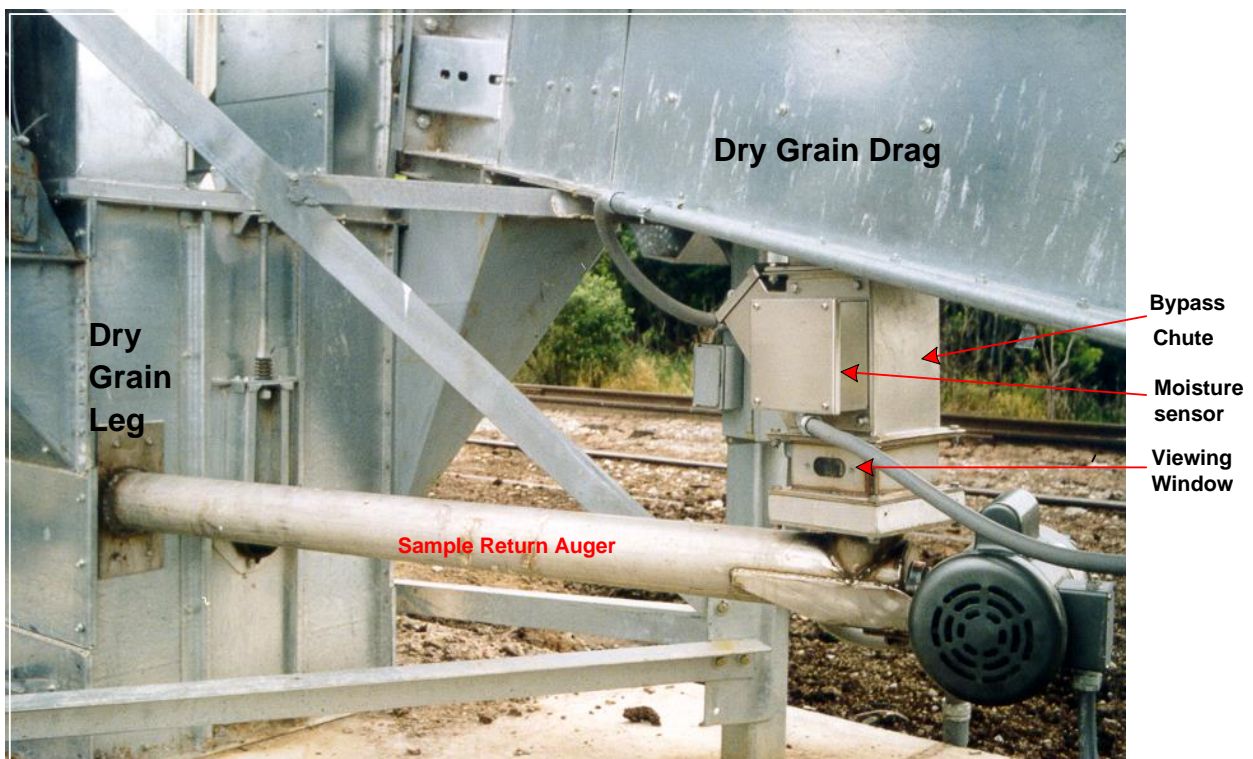


Figure 56 By-Pass auger installation

Figure 57 By-Pass auger installation



### 8.3 Option 2 In-Line Chute with Rotary Feed Method – Details

The Dryer Master In-Line chute with rotary feed is designed so that the moisture of the grain can be measured without having to divert a portion into a bypass. Some dryer manufacturers can supply a chute that will fit under their dryer to accommodate an outlet fin sensor to get a similar effect. A similar type device can be fabricated on site.



Figure 59 Inline Chute installation

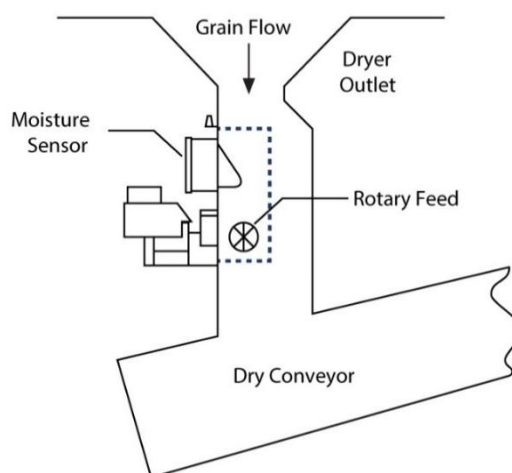


Figure 58 Inline Chute Graphic

A moisture sensor is installed in a 6" x 6" (15.25 cm X 15.25 cm) chute mounted within a larger chute that handles the full flow of grain from the dryer. The flow through the sensor chute is restricted and metered using a rotary feed. The grain that does not flow through the sensor chute flows past in the main part of the chute. This method requires a minimum of 16" of vertical space not including necessary transitions. Normally the sensor is installed under the dryer between it and the dry grain auger or drag.

Install the Chute and Sensor in a continuous flow of grain and **where the sensor will remain full**.

Install the Chute and Sensor so the operator can inspect and clean the sensor. It must be possible to do these tasks easily and **safely** while the dryer is operating.

#### Installation Procedure

1. If necessary, adjust the discharge system of the dryer so that a chute 16" high by (minimum) 16" square can be installed (Size will depend upon bushels being discharged).
2. Make sure that the centre of the flow of grain is directed at the Sensor's location and will keep the sensor full.
3. Weld or Bolt the main chute to the bottom of the dryer.
4. Create a transition between the bottom of the chute and the dry grain drag or auger.
5. Bolt the Sensor to the outside surface of the frame.
6. An access is provided for the operator to safely inspect flow and to take samples. To clear an obstruction the sensor or the chute will have to be removed.



**Do not cut holes in the outlet sensor. Use only the existing wire entry location.**  
**Entry at any other location voids the warranty.**

### The In-Line Chute

The chute is designed to be used in an inline type installation of the outlet moisture sensor. In an inline type installation a portion of the total product flow passes through the 6X6 chute with the rest flowing over the sides in the larger chute.

- Overall 18 1/4" X 10 1/4" X 18 1/2" (HXWxD) (46.3 cm X 25.4 cm X 47 cm)
- Inside chute 6"X6" (15.25 cm X 15.25 cm)
- Mounting plate is 18 1/4" X 10" (46.3 cm X 25.4 cm)
- Motor is IP66, 25W, 115VAC single phase, 0.43FLA reversible motor with 180:1 gear reduction (230VAC also available)
- Slide gate to close off flow
- Sampling port and viewing window

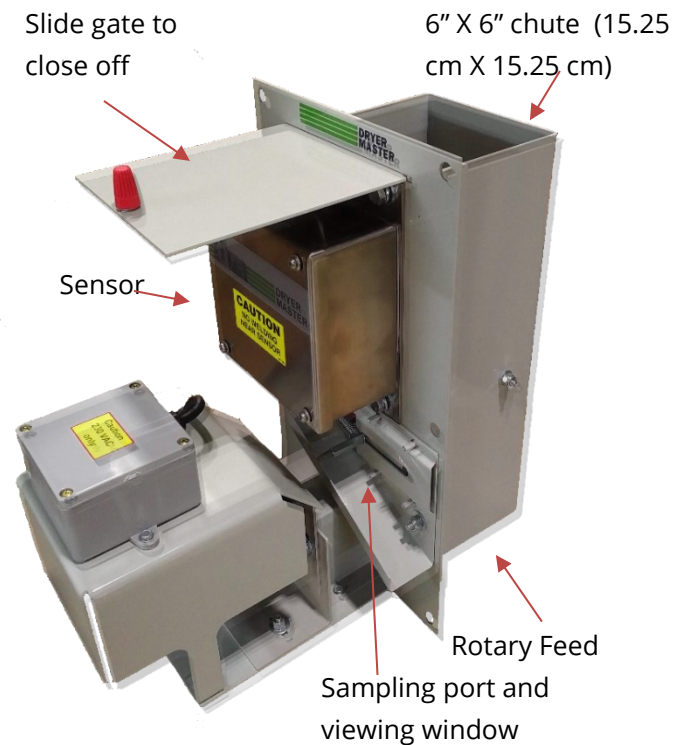


Figure 60 In-line Chute



Figure 62 In-line Chute installation example



Figure 61 In-Line chute in a Zimmerman chute

## 8.4 Inline Batching Chute

The inline batching chute is specifically for use at the outlet of pulse style (semi continuous) dryers. Unlike the rotary feed versions of the outlet sensor chutes, there is no motor. Instead the chute will fill with product when a discharge cycle starts and then empty completely once the discharge cycle ends.

This batching INLINE version of the chute is designed to be mounted within another larger chute. This chute will only function in situations where the chute fills and empties several times an hour. This chute is not available in a BYPASS version.

This chute will not function with continuously flowing grain. Use the rotary inline or bypass chute for continuous flowing grain.

Installation:

1. Mount within a larger main chute.
2. Ideally mount vertically or at least at steep enough of an angle to fill and empty properly.
3. Mount so that it will fill and empty before the start of the next discharge cycle. The chute will handle 40-100 bu./hr. and the rest of the product should overflow into the main chute. There must be enough combined space to allow for the maximum flow from the dryer.
4. Mount so that it receives as representative a sample of grain exiting the dryer as possible.
5. The viewing window is retractable to allow for a sample to be taken.
6. There is also a shut off gate at the top of the chute. After installation this gate should be open to allow product to flow past the sensor.
7. Mount the sensor only after the chute is installed. **DO NOT weld near the sensor itself.**



Figure 63 Batching Chute

## 8.5 Inlet Moisture Sensor Installation

### Sensor Location

For an inlet installation the sensor should be placed vertically at the inlet to the grain dryer (in or near the garner bin). There are two conditions that must be met for the sensor in an inlet location to operate correctly.

1. The Inlet Sensor must be completely covered by compacted grain at all times.
2. The Inlet Sensor must also receive a good (representative) sample of the grain.

These two conditions are usually met if the Inlet Sensor is located near the center of the longest vertical side of the garner bin.

**However, DO NOT locate the Inlet Sensor directly under the inlet spout.** Grain that is erratically compacted will dynamically change the relative readings of the inlet sensor contributing to false readings.

Installation should minimize the probability of steam reaching the sensor. Install the Inlet Sensor at a level higher above the hot zone than the width of the hot zone. For example, if the hot zone is a foot-wide leave at least a foot between the hot zone and the sensor. If this is not done, the static pressure in the hot zone can force moisture-laden air past the sensor. Due to the cold state of the sensor, moisture will condense from the air onto the sensor resulting in false readings.

If the sensor is placed in a location such that it will get an excess of fines or trash this will contribute to errors or false readings.

Install the Inlet Sensor in a place where water cannot run down the surface of the sensor. In the dryers which have an open top allowing rain to penetrate the grain (or excessive cold) will cause condensation to form on a fin sensor. The sensor needs to be moved to the surge hopper or other more appropriate location.



**Install inlet (wet) sensor in vertical wall of roof section at least two ducts away from end wall and**  
*Figure 64 Sample inlet sensor installation on a Grain Handler dryer*

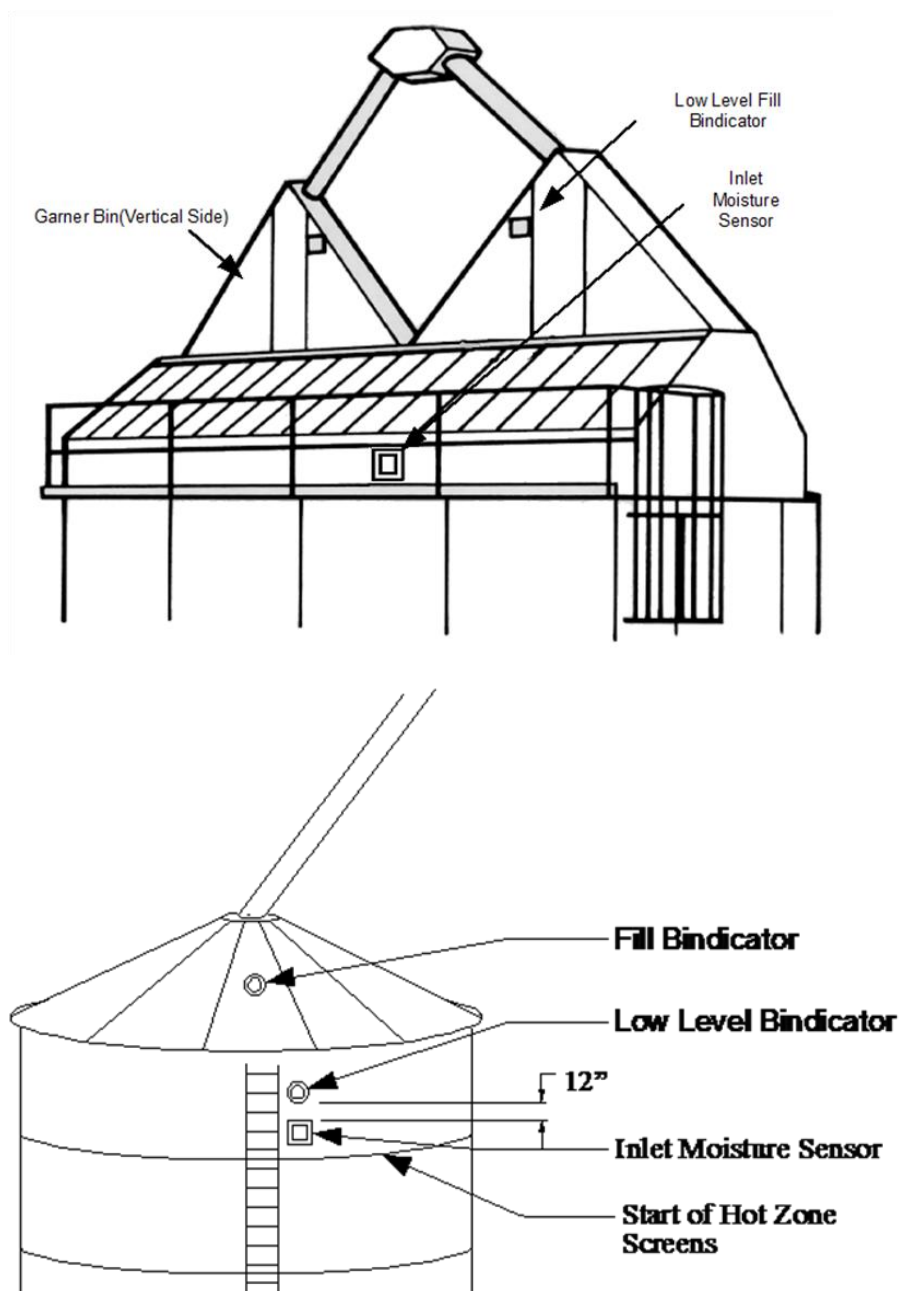


Figure 65 Sensor placement at inlet to the dryer

## Appendix 1: Connecting to the web app

# Moisture Monitor Pro Tutorial

## Connecting to the Web App

### Preface

The tutorial will provide step-by-step direction on connecting to the Web App for the Moisture Monitor Pro. **NOTE: access to the web app is only available while connected to the Wi-Fi network.**

### Requirements

- Moisture Monitor Pro
- Ethernet cable (to connect the Moisture Monitor Pro to the local network)
- A device (such as a: tablet / phone / laptop) connected to the local network by Wi-Fi or Ethernet

### Connect the Moisture Monitor Pro to the Local Network

- Use an Ethernet cable to connect the Moisture Monitor Pro to a local router or switch.

### Find IP Address and Subnet Mask of the Local Network

**Follow the section that is relevant to the device being used.**

Sections include:

- Apple Device – Connect to local network via Wi-Fi
- Android Device – Connect to local network via Wi-Fi
- Windows Laptop – Connected to local network via Wi-Fi
- Windows Laptop – Connected to local network via Ethernet

### Apple Device – Connect to Local Network via Wi-Fi

- CONNECT Apple device to the local Wi-Fi
- NAVIGATE to Apple Settings
- SELECT Wi-Fi and then SELECT the network being used
- LOCATE the section called as IPV4 Address
- RECORD the IP Address
  - For example, it will be four numbers separated by dots (e.g., 192.168.2.125)
- RECORD the Subnet Mask
  - For example, it will be another four numbers separated by dots (e.g., 255.255.255.0)
- SKIP forward in this tutorial to the section called 'Setting Up the Web App'

### Android Device – Connect to Local Network via Wi-Fi

- CONNECT Android device to the local Wi-Fi
- NAVIGATE to Android Settings
- SELECT Wi-Fi
- On the top-right corner, PRESS ⋮
- SELECT 'Advanced'
- SCROLL DOWN to the bottom
- RECORD the IP Address
  - For example, it will be four numbers separated by dots (e.g., 192.168.2.125)
- RECORD the Subnet Mask
  - For example, it will be another four numbers separated by dots (e.g., 255.255.255.0)
- SKIP forward in this tutorial to the section called 'Setting Up the Web App'



### Windows Laptop – Connected to Local Network via Wi-Fi

- CONNECT the windows device (e.g., a laptop) to Wi-Fi
  - If connected via Ethernet, then see the next section “Windows Device – Connected to Local Network via Ethernet”
- RUN Command Prompt
  - TYPE ipconfig and PRESS ‘Enter’
  - SCROLL DOWN until ‘Wireless LAN adapter Wi-Fi’ (example shown below)

#### Wireless LAN adapter Wi-Fi:

```
Connection-specific DNS Suffix . : router31b938.com
Link-local IPv6 Address . . . . . : fe80::f5fa:4a6e:5770:bb7e%13
IPv4 Address. . . . . : 192.168.1.113
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1
```

- 
- RECORD the IPv4 Address
- RECORD the Subnet Mask
- SKIP forward in this tutorial to the section called ‘Setting Up the Web App’

### Windows Laptop – Connected to Local Network via Ethernet

- CONNECT the windows device (e.g., a laptop) to Ethernet
  - If connected via Wi-Fi, then see the previous section “Windows Device – Connected to Local Network via Wi-Fi”
- RUN Command Prompt
  - TYPE ipconfig and PRESS ‘Enter’
  - SCROLL DOWN until ‘Ethernet adapter Ethernet’ (example shown below)

#### Ethernet adapter Ethernet 2:

```
Connection-specific DNS Suffix . : router31b938.com
Link-local IPv6 Address . . . . . : fe80::e929:8005:8c94:9e7a%10
IPv4 Address. . . . . : 192.168.1.116
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1
```

- 
- RECORD the IPv4 Address
- RECORD the Subnet Mask
- SKIP forward in this tutorial to the section called ‘Setting Up the Web App’

## Setting up the Web App

- COMPLETE the steps in this section only once the IP Address of the Local Network has been obtained by one of the methods outlined above.
- **PRESS 'SYSTEM SETUP' on the Extended Menu of the Moisture Monitor Pro**
- ENTER the password (**6853**)
- USE the arrow keys to scroll down to Network Settings
- PRESS 'Enter'
- SELECT the 'IP Address:' section and enter the address. Then press Enter.

The IP Address recorded in the previous section has four numbers separated by dots.

- For example: 192.168.1.113

ENTER the first three numbers and REPLACE the fourth with the number 26.

- For example: 192.168.1.26

- Once the IP Address has been input, SELECT 'NET MASK'

ENTER the subnet mask obtained recorded in the previous section.

- For example: 255.255.255.0

- Once the Net Mask has been inputted, PRESS 'Enter'
- SELECT 'GATEWAY'

ENTER the first three numbers and REPLACE the fourth with the number 1.

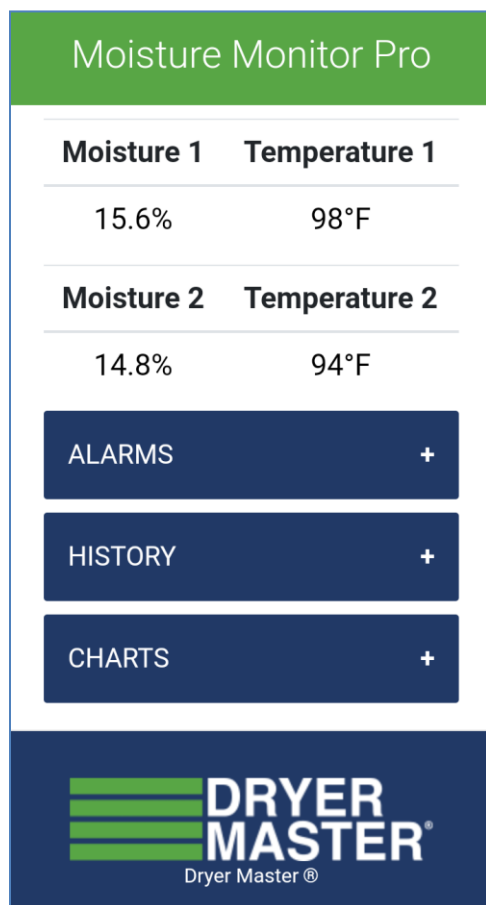
- For example: 192.168.1.1

- Once the Gateway Address has been entered, press Back and then ESC to return to the extended menu.



## Running the Web App

- OPEN any web browser on the device (e.g., tablet, phone, and laptop) that is connected to the local network by Wi-Fi or Ethernet.
  - **ENSURE the device is not connected to mobile data.**
- In the URL Address Bar of the browser, TYPE the same IP Address that was entered on the Moisture Monitor Pro, followed by: /mmp.html
  - Referring to the previous example, the URL would be: **192.168.2.26/mmp.html** . If you get an error after login, it may be because you did not add the "/mmp.html" after the IP address.
- A login screen will appear and then enter your login and password.
  - **Username: mmp**
  - **Password: dryermaster**
- The Web App should now be visible on the device:



## Appendix 2: Setting up a SCADA Network

### Moisture Monitor Pro Tutorial

#### Setting up a SCADA Network

#### Preface

The tutorial will provide step-by-step direction on a Client to the MODBUS TCP/IP Server that is made available on the PLC.

#### Requirements

- Moisture Monitor Pro PLC
- Ethernet cable (to connect the PLC to a local network router)
- A client device (such as a: an Allen-Bradley PLC) connected to a local network router by Wi-Fi or Ethernet

## Step 1: Connect the Moisture Monitor Pro to the Local Network

- Use an Ethernet cable to connect the Moisture Monitor Pro to a local network router.
- On the Moisture Monitor Pro: **MENU > SYSTEM SETUP > NETWORK SETTINGS**
- Enter the IP Address, Net Mask and Gateway of the Local Network
  - For help on this, see Appendix 1: Connecting to the web app

## Step 2: Configure Client to Request Data from the Server

**Program the Client PLC to make requests according to one of these addressing schemes:**

- **Modicon 6-Digit Addressing**
- **Decimal Addressing**
- **Hexadecimal Addressing**

**Transmission bit ordering is Big-Endian (MSB first).**

**See Appendix below for TCP/IP Server Address Mapping.**

## Step 3: Setup Client-Side Data Logging

Typically, the Client PLC can be setup to display live data on a custom HMI unit or to log data files from the SCADA network. Common types of data logging may include:

- Historical Info Logger
  - Records sensor data at a predefined interval or based on an external trigger event.
- Sensor Calibration Logger
  - Records data based on the rising-edge of the server-side calibration completion trigger. This event signal can be accessed independently for each calibration routine (see Address Mapping Table at the end of this tutorial).

## Example Client PLC Program

### Screen One : Sensor 1 - Info Registers

MODBUS TCP/IP		11 : 16
SENSOR 1 - INFO REGISTERS		
403062 -- ProdName	CORN	
403500 -- Moist_S1	16.5 %	
403502 -- Temp_S1	98 °	
003002 -- DegreeF	F	
304046 -- RTC_HOUR	11	
304045 -- RTC_MIN	15	

>>

### Screen Two: Sensor 2 - Info Registers

MODBUS TCP/IP		11 : 16
SENSOR 2 - INFO REGISTERS		
414092 -- ProdName_s2	CORN	
414014 -- Moist_S2	15.1 %	
414026 -- Temp_S2	89 °	
003002 -- DegreeF	F	
304046 -- RTC_HOUR	11	
304045 -- RTC_MIN	16	

<<

>>

### Screen Three: Sensor 1 – Alarm Registers

**MODBUS TCP/IP** 11 : 16

**SENSOR 1 - ALARM REGISTERS**

☐ 403311(b1) -- MHALbit (Moisture Critical High)  
☐ 403311(b2) -- MHWLbit (Moisture Warning High)  
☐ 403311(b3) -- MLWLbit (Moisture Warning Low)  
☐ 403311(b4) -- MLALbit (Moisture Critical Low)  
☐ 403311(b5) -- THALbit (Temperature Critical High)  
☐ 403311(b6) -- THWLbit (Temperature Warning High)  
☐ 403311(b7) -- TLWLbit (Temperature Warning Low)  
☐ 403311(b8) -- TLALbit (Temperature Critical Low)

<< >>

### Screen Four: Sensor 2 – Alarm Registers

**MODBUS TCP/IP** 11 : 16

**SENSOR 2 - ALARM REGISTERS**

☐ 403311(b9) -- MHALbit\_s2 (Moisture Critical High)  
☐ 403311(b10) -- MHWLbit\_s2 (Moisture Warning High)  
☐ 403311(b11) -- MLWLbit\_s2 (Moisture Warning Low)  
☐ 403311(b12) -- MLALbit\_s2 (Moisture Critical Low)  
☐ 403311(b13) -- THALbit\_s2 (Temperature Critical High)  
☐ 403311(b14) -- THWLbit\_s2 (Temperature Warning High)  
☐ 403311(b15) -- TLWLbit\_s2 (Temperature Warning Low)  
☐ 403311(b16) -- TLALbit\_s2 (Temperature Critical Low)

<< >>

**Screen Five: Sensor 1 – Calibration Registers**

MODBUS TCP/IP		11 : 16
SENSOR 1 - CALIBRATION REGISTERS		
003140 -- SCADA_CAL_TRIG	ON	
403712 -- Online_Sample	13.2 %	
403714 -- Manual_Sample	13.1 %	
403202 -- tmp_VDC	2.4	
403140 -- mst_slp	5.0	
403100 -- mst_off	-0.2	
<<		>>

**Screen Six: Sensor 2 – Calibration Registers**

MODBUS TCP/IP		11 : 16
SENSOR 2 - CALIBRATION REGISTERS		
003160 -- SCADA_CAL_TRIG_s2	ON	
414212 -- Online_Sample_s2	15.1 %	
414214 -- Manual_Sample_s2	15.3 %	
414012 -- tmp_VDC_s2	2.3	
414038 -- mst_slp_s2	5.0	
414042 -- mst_off_s2	0.1	
<<		

## MODBUS TCP / IP Server Address Mapping (Page 1 of 3)

MMP MODBUS TCP/IP MAPPING TABLE							Example Parameters with Modbus Poll Software (available at: <a href="http://www.modbustools.com">www.modbustools.com</a> )				
Modicon 6-Digit Address	Address Description	Data Type	Data Size	Bit Length	Action	Comments	Slave/Server ID	Function Code	Address	Quantity	Master/Client Device Formatting
304046	PLC Time - hours	uint	WORD	16	read	Internal Clock	1	4	4045	1	Unsigned
304045	PLC Time - minutes	uint	WORD	16	read	Internal Clock	1	4	4044	1	Unsigned
403062	Sensor 1 - Product Number 0 = Corn 1 = Beans 2 = Wheat 3 = Canola 4 = Barley 5 = Malt Barley 6 = Oats 7 = Rice 8 = Sorghum 9 = Sunflower 10 = Lentils 11 = Chickpeas 12 = Peas 13 = Other 1 14 = Other 2 15 = Other 3	uint	WORD	16	read	[Sensor 1] Product Selection	1	3	3061	1	Unsigned
403500	Sensor 1 - Moisture Percentage	real	DOUBLE-WORD	32	read	[Sensor 1] Moisture Value	1	3	3499	2	32-bit Float (little-endian byte swap)
403502	Sensor 1 - Temperature Degree	real	DOUBLE-WORD	32	read	[Sensor 1] Temperature Value	1	3	3501	2	32-bit Float (little-endian byte swap)
414092	Sensor 2 - Product Number 0 = Corn 1 = Beans 2 = Wheat 3 = Canola 4 = Barley 5 = Malt Barley 6 = Oats 7 = Rice 8 = Sorghum 9 = Sunflower 10 = Lentils 11 = Chickpeas 12 = Peas 13 = Other 1 14 = Other 2 15 = Other 3	uint	WORD	16	read	[Sensor 2] Product Selection	1	3	14091	1	Unsigned
414014	Sensor 2 - Moisture Percentage	real	DOUBLE-WORD	32	read	[Sensor 2] Moisture Value	1	3	14013	2	32-bit Float (little-endian byte swap)
414026	Sensor 2 - Temperature Degree	real	DOUBLE-WORD	32	read	[Sensor 2] Temperature Value	1	3	14025	2	32-bit Float (little-endian byte swap)

## MODBUS TCP / IP Server Address Mapping (Page 2 of 3)

MMP MODBUS TCP/IP MAPPING TABLE							Example Parameters with Modbus Poll Software (available at: <a href="http://www.modbustools.com">www.modbustools.com</a> )				
Modicon 6-Digit Address	Address Description	Data Type	Data Size	Bit Length	Action	Comments	Slave/Server ID	Function Code	Address	Quantity	Master/Client Device Formatting
003002	Temperature Symbol 0 = C 1 = F	bool	BIT	1	read	Temperature Settings	1	1	3001	1	Boolean
043311	Sensor 1 - Moisture - Critical High	word/binary	WORD	16	read	[Sensor 1 & 2] Moisture or Temperature Alarms	1	3	3310	1	Binary
	Sensor 1 - Moisture - Warning High										
	Sensor 1 - Moisture - Warning Low										
	Sensor 1 - Moisture - Critical Low										
	Sensor 1 - Temperature - Critical High										
	Sensor 1 - Temperature - Warning High										
	Sensor 1 - Temperature - Warning Low										
	Sensor 1 - Temperature - Critical Low										
	Sensor 2 - Moisture - Critical High										
	Sensor 2 - Moisture - Warning High										
	Sensor 2 - Moisture - Warning Low										
	Sensor 2 - Moisture - Critical Low										
	Sensor 2 - Temperature - Critical High										
	Sensor 2 - Temperature - Warning High										
	Sensor 2 - Temperature - Warning Low										
	Sensor 2 - Temperature - Critical Low										
003140	Sensor 1 - Calibration In-Progress 0 = OFF 1 = ON	bool	BIT	1	read	[Sensor 1] Advanced Calibration Mode	1	1	3139	1	Boolean
043712	Sensor 1 - Online Sample	real	DOUBLE-WORD	32	read	[Sensor 1] Advanced Calibration Mode	1	3	3711	2	32-bit Float (little-endian byte swap)
043714	Sensor 1 - Manual Sample	real	DOUBLE-WORD	32	read	[Sensor 1] Advanced Calibration Mode	1	3	3713	2	32-bit Float (little-endian byte swap)
043140	Sensor 1 - Moisture Slope	real	DOUBLE-WORD	32	read	[Sensor 1] Product Settings	1	3	3139	2	32-bit Float (little-endian byte swap)
043100	Sensor 1 - Moisture Offset	real	DOUBLE-WORD	32	read	[Sensor 1] Product Settings	1	3	3099	2	32-bit Float (little-endian byte swap)
003160	Sensor 2 - Calibration In-Progress 0 = OFF 1 = ON	bool	BIT	1	read	[Sensor 2] Advanced Calibration Mode	1	1	3159	1	Boolean
414212	Sensor 2 - Online Sample	real	DOUBLE-WORD	32	read	[Sensor 2] Advanced Calibration Mode	1	3	14211	2	32-bit Float (little-endian byte swap)
414214	Sensor 2 - Manual Sample	real	DOUBLE-WORD	32	read	[Sensor 2] Advanced Calibration Mode	1	3	14213	2	32-bit Float (little-endian byte swap)
414038	Sensor 2 - Moisture Slope	real	DOUBLE-WORD	32	read	[Sensor 2] Product Settings	1	3	14037	2	32-bit Float (little-endian byte swap)
414042	Sensor 2 - Moisture Offset	real	DOUBLE-WORD	32	read	[Sensor 2] Product Settings	1	3	14041	2	32-bit Float (little-endian byte swap)



## MODBUS TCP / IP Server Address Mapping (Page 3 of 3)

MMP MODBUS TCP/IP MAPPING TABLE							Example Parameters with Modbus Poll Software (available at: <a href="http://www.modbustools.com">www.modbustools.com</a> )				
Modicon 6-Digit Address	Address Description	Data Type	Data Size	Bit Length	Action	Comments	Slave/Server ID	Function Code	Address	Quantity	Master/Client Device Formatting
006401	Sensor 1 - Show Moisture AVG	bool	BIT	1	read	[Sensor 1] Batch Mode	1	1	6400	1	Boolean
419512	Sensor 1 - Moisture AVG Value	real	DOUBLE-WORD	32	read	[Sensor 1] Batch Mode	1	3	19511	2	32-bit Float (little-endian byte swap)
006402	Sensor 1 - Fault Alert Status	bool	BIT	1	read	[Sensor 1] Batch Mode	1	1	6401	1	Boolean
006501	Sensor 2 - Show Moisture AVG	bool	BIT	1	read	[Sensor 2] Batch Mode	1	1	6500	1	Boolean
419612	Sensor 2 - Moisture AVG Value	real	DOUBLE-WORD	32	read	[Sensor 2] Batch Mode	1	3	19611	2	32-bit Float (little-endian byte swap)
006502	Sensor 2 - Fault Alert Status	bool	BIT	1	read	[Sensor 2] Batch Mode	1	1	6501	1	Boolean
003176	Sensor 1 - Enable Batch Feature	bool	BIT	1	read/write	[Sensor 1] Batch Settings	1	1	3175	1	Boolean
419502	Sensor 1 - Fill Timer SP	uint	WORD	16	read/write	[Sensor 1] Batch Settings	1	3	19501	1	Unsigned
419517	Sensor 1 - Batch Timer SP	dint	DOUBLE-WORD	32	read/write	[Sensor 1] Batch Settings	1	3	19516	2	32-bit Unsigned (little-endian byte swap)
419508	Sensor 1 - Fault Counter Max	uint	WORD	16	read/write	[Sensor 1] Batch Settings	1	3	19507	1	Unsigned
003177	Sensor 2 - Enable Batch Feature	bool	BIT	1	read/write	[Sensor 2] Batch Settings	1	1	3176	1	Boolean
419602	Sensor 2 - Fill Timer SP	uint	WORD	16	read/write	[Sensor 2] Batch Settings	1	3	19601	1	Unsigned
419617	Sensor 2 - Batch Timer SP	real	DOUBLE-WORD	32	read/write	[Sensor 2] Batch Settings	1	3	19616	2	32-bit Unsigned (little-endian byte swap)
419608	Sensor 2 - Fault Counter Max	uint	WORD	16	read/write	[Sensor 2] Batch Settings	1	3	19607	1	Unsigned
403200	Sensor 1 - Moisture Voltage	real	DOUBLE-WORD	32	read	[Sensor 1] Diagnostics	1	3	3199	2	32-bit Float (little-endian byte swap)
403202	Sensor 1 - Temperature Voltage	real	DOUBLE-WORD	32	read	[Sensor 1] Diagnostics	1	3	3201	2	32-bit Float (little-endian byte swap)
419500	Sensor 1 - Fill Timer ACC	uint	WORD	16	read	[Sensor 1] Diagnostics	1	3	19499	1	Unsigned
419514	Sensor 1 - Batch Timer ACC	real	DOUBLE-WORD	32	read	[Sensor 1] Diagnostics	1	3	19513	2	32-bit Unsigned (little-endian byte swap)
419506	Sensor 1 - Fault Counter ACC	uint	WORD	16	read	[Sensor 1] Diagnostics	1	3	19505	1	Unsigned
414010	Sensor 2 - Moisture Voltage	real	DOUBLE-WORD	32	read	[Sensor 2] Diagnostics	1	3	14009	2	32-bit Float (little-endian byte swap)
414012	Sensor 2 - Temperature Voltage	real	DOUBLE-WORD	32	read	[Sensor 2] Diagnostics	1	3	14011	2	32-bit Float (little-endian byte swap)
419600	Sensor 2 - Fill Timer ACC	uint	WORD	16	read	[Sensor 2] Diagnostics	1	3	19599	1	Unsigned
419614	Sensor 2 - Batch Timer ACC	real	DOUBLE-WORD	32	read	[Sensor 2] Diagnostics	1	3	19613	2	32-bit Unsigned (little-endian byte swap)
419606	Sensor 2 - Fault Counter ACC	uint	WORD	16	read	[Sensor 2] Diagnostics	1	3	19605	1	Unsigned

## Appendix 3. Pulse discharge setup (Batch Settings)

A pulse discharge dryer only outputs product for set periods (with each pulse discharge). During these discharges, the moisture sensor will fill and will display real time moisture readings. When a discharge cycle has completed, product will no longer flow by the sensor, and so the chute will go empty. The MMP will then display the average reading of the past cycle until a new cycle begins and real time values are displayed again. In between cycles "AVG" will appear next to the moisture reading to indicate that it is an average reading and not real time.

The sensor for a pulse discharge dryer is typically mounted in one of the Dryer Master batching sensor chutes. There are instructions with the chute that explain how to configure the restricting flaps. The requirement is to have a product flow of less than 2.5 cm (1 inch) per second.

To setup a moisture sensor in a pulse discharge type situation the following parameters need to be configured.

1. Under **SYSTEM SETUP**, scroll down to select **BATCH SETTINGS** and press the Enter key.
2. For **BATCH AVG**, a setting of **OFF** means the sensor will run in continuous mode. A setting of **ON** means batching (for pulse discharges) has been enabled. Each sensor is independent.
3. For the next two settings the installer will need to time two events. 1) The **FILL TIME** is the time after a discharge starts AND product starts to arrive at the sensor, until the chute is full. 2) When the discharge stops, the product flow will stop and the sensor chute will start to empty. The **BATCH TIME** is the time that the sensor chute remains completely full. If these times change due to some change in the dryer discharge settings, they will need to be re-entered.

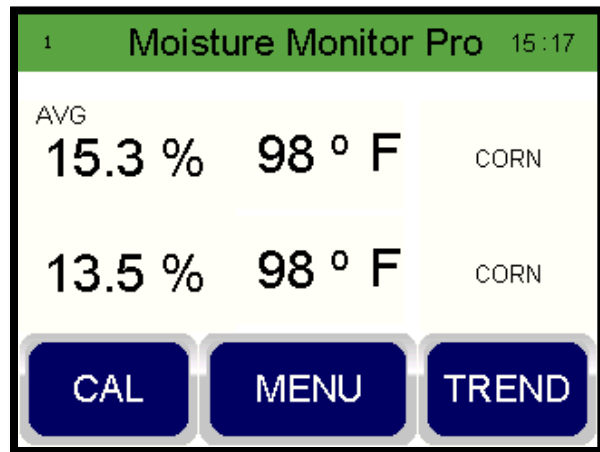


Figure 66 Main screen for pulse discharge setup. Sensor 1 displays average of last discharge cycle. Sensor 2 displays live readings.

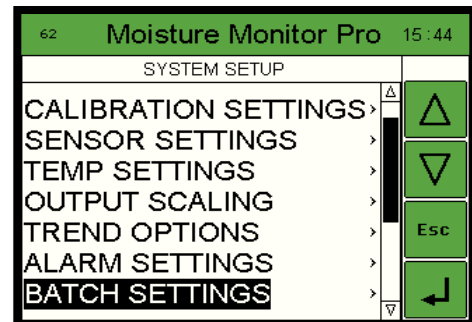


Figure 67 Scroll to Batch Settings

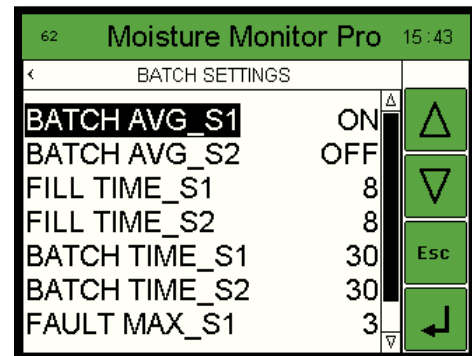


Figure 68 Batch Average selection.

As an example:

- At time 0 seconds: the operator hears a discharge start.
- At time 3 seconds: product starts to get to the chute.
- At time 9 seconds: the chute is full.
- At time 41 seconds: the product stops arriving at the chute and the chute starts to empty.  
(end time).\_

In this case:

Fill time: When the sensor is full – when sensor started to fill:  $9-3=6$  seconds ... add 2 seconds for a buffer – so 8 seconds is the “Fill Time”

Batch time: End time – Fill time – 2 seconds (buffer). So  $41-9-2=30$  as the “Batch Time”

The buffer sizes can be increased to ensure only the full sensor readings are displayed.

The MMP will display live readings during the Batch Time. Outside of the batch time the average reading of the previous batch will be displayed along with the “AVG” indication.

The FAULT\_MAX setting is designed to notify the operator if the sensor for some reason does not go empty for a number of discharges (the default is 3 cycles).

In addition, once the sensor goes empty at the end of a discharge, the AVG reading will be displayed. If the sensor stays empty for more than 15 minutes (for example, if the dryer is off and there are no discharges), then EMPTY will be displayed on the screen.

