RM-118

Installation, Operation and Maintenance Instructions

SMART MOISTURE MONITOR

ERIEZ MAGNETICS HEADQUARTERS: 2200 ASBURY ROAD, ERIE, PA 16506–1402 U.S.A.
WORLD AUTHORITY IN SEPARATION TECHNOLOGIES

Introduction

This manual details the proper steps for installing, operating and maintaining the Eriez' SMART Moisture Monitor (MM).

Careful attention to these requirements will assure the most efficient and dependable performance of this equipment.

If there are any questions or comments about the manual, please call Eriez at 814-835-6000 for Moisture Monitor assistance.

Warranty, Exclusions & Limitations

The workmanship and the materials of all products manufactured by Eriez are warranted for a period of one year from the date of shipment. This warranty covers parts and labor required to correct defects within the scope of the Corporation's warranty.

Excluded from the warranty coverage are products a) which have been subjected to electrical, mechanical or other misuse or abuse b) which have been disassembled or repaired, or attempted to be, by other than Eriez or its authorized servicing agents.

The foregoing warranty shall be in lieu of all other warranties, expressed or implied, and the Corporation expressly disclaims any warranty for merchantability or fitness for a particular purpose.

Unless otherwise agreed in writing by the Corporation, repairs and replacement parts provided by the Corporation under its warranty shall be guaranteed only for the non-expired portion of the original warranty on the repaired product.

The liability of Eriez to any purchaser or user of its products shall not in any case exceed the cost of correcting defects in a product as herein provided and, upon expiration of the two years from the date of sale, all such liability shall terminate. In no event shall the Corporation be liable for interruption of operations, loss of profit, or special or consequential damages.

Software Updates

Future revisions of the software that correct errors will be made available to customers at no charge. Improvements and enhancements to the software will be available for a nominal fee.

CAUTION

Safety labels must be affixed to this product. Should the safety label(s) be damaged, dislodged or removed, contact Eriez for replacement.

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ERIEZ SMART MOISTURE MONITOR

Please contact Eriez Customer Service Department at 814-835-6000 or service@eriez.com with your questions regarding the Eriez SMART Moisture Monitor.

Chapter 1. Introduction

1.1 Using this Manual

This manual is designed to assist you in installing, operating, and maintaining Eriez' Moisture Monitor. The manual contains the following chapters:

1) Principle of Operation
   This section covers the Near Infrared (NIR) technology used in the Moisture Monitor gauge to make the moisture measurement.

2) Gauge Description
   This section talks about the different components of the Moisture Monitor gauge and summarizes its features. Also covered in this section are the different Moisture Monitor gauge configurations and the operator interface.

3) Gauge Installation
   This section covers the Moisture Monitor gauge's mechanical installation and shows how to optimize gauge performance.

4) Power & Cable Connections
   This section explains the correct wiring for the Moisture Monitor gauge.

5) Accessories
   This section lists the different accessories which could be used along with the Moisture Monitor gauge.

6) Gauge Calibration
   This section explains how product samples are conditioned and then used to calibrate the Moisture Monitor gauge.

7) Technical Specifications
   This section lists the technical specifications of the Moisture Monitor gauge.

1.2 About the Gauge

The Moisture Monitor Gauge is a reliable moisture transmitter enclosed in a robust cast aluminum enclosure with a variety of available outputs. The Moisture Monitor gauge is made up of 5 basic components: a quartz halogen lamp, a filter wheel motor, filter wheel assembly, a Lead Sulfide detector and a single "smart" circuit board. The Moisture Monitor gauge is fully modular. Each of these components can be replaced in the field within minutes.

1.3 Unpacking

Remove the packing slip and check the actual equipment received. If you have any questions about your shipment, please call Customer Service. Upon receipt of shipment, inspect the shipping box for any signs of damage in transit. Especially take note of any evidence of rough handling. Report any apparent damage immediately to the shipping agent.

Chapter 2. Principle of Operation

Molecular bonds such as O-H in water and C-H in the case of oils and organic coatings absorb NIR light at discrete wavelengths in proportion to their concentration. Absorption is quantified by comparison of the signal at the measurement wavelength with that obtained at one or more reference wavelengths where there are no unique absorptions. Measurement is achieved by focusing light through NIR measurement and reference filters within a rotating wheel. An internal and external voltage signal is generated for each filter, the latter results from collection of back-scattered light onto a concave mirror and reflection onto the detector. The ratioed external/internal filter signals provide a voltage that is due to product, not gauge effects. Filter signals are combined within an algorithm to generate a proportional output which when calibrated provides a direct reading.

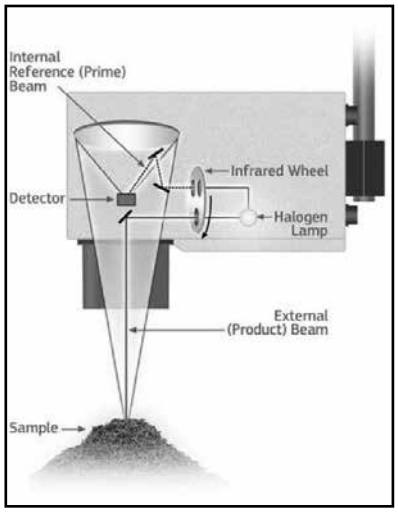


FIGURE 1
Inside of a Moisture Monitor gauge

Chapter 3.
Gauge Description

3.1 Gauge Components

The Moisture Monitor consists of an online sensor containing the near infrared optics and processing electronics. The sensor connects, via a 50 foot cable to a wall-mountable Operator Interface. AC power and output signals originate from the operator interface.

3.1.1 Light Source

A quartz-halogen light bulb running at reduced voltage generates infrared energy.

3.1.2 Filter Wheel

Six infrared and visible filters are held in a circular disc. A single timing notch is machined in the edge of the disc.

3.1.3 Filter Wheel Motor

A precision brushless DC motor is used to accurately rotate the filter wheel in front of the infrared light beam.

3.1.4 Detector

A PbS (Lead Sulfide) detector is used to convert the infrared light energy into electrical pulses.

3.1.5 Electronics

The Moisture Monitor contains the following electronic components:

• Power Supply: A 90-260-volt auto selection supply provides DC power to operate the gauge.

• Sensor Electronics: Single PCB “smart” circuit board containing central processing system, analog and serial communications.

• Operator Interface: A custom wall mountable cast aluminum enclosure with a 5.7" high resolution touch screen color display providing all set up, calibration and diagnostic data from the sensor.

3.2 Operator Interface Touch Screen

The operator interface is used to configure, calibrate and diagnose the Moisture Monitor gauge.

The operator interface is made up of 2 major components: a 5.7" high resolution touch screen and a single “smart” circuit board. These components are enclosed in an IP67 robust plastic enclosure. The operator interface could also be used as a digital read-out.

Below in Figure 2 is a screen shot showing the main screen of the operator interface:

FIGURE 2
Moisture Monitor home screen

3.2.1 Grab Sample Averaging

A short term average of the Moisture Monitor gauge’s readings may be made using the hand symbol located in the top right corner of the screen. By touching the hand symbol you will initiate the averaging function. During this time a sample of the product moving under the sensor may be taken. After a preset time period the display will show the average moisture reading for the product viewed by the gauge during that time period. If the time period is set to 0 seconds then an average may be made by making two touches of the hand symbol. One touch starts and a second touch stops the average. After 10 seconds the display will automatically return to the live reading.

3.2.2 Graphical Trend Screens

A time based trend of the measured constituent by the Moisture Monitor may be selected by simply touching the trend symbol, next to the hand symbol. An illustration of the trend screen is shown below in Figure 3:

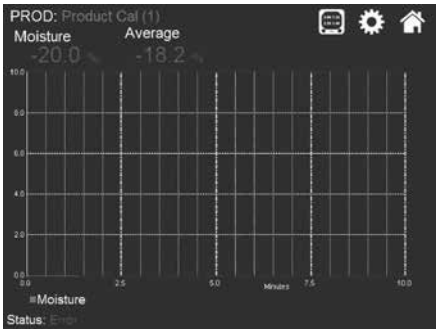


FIGURE 3
Single constituent trend screen

Gauge Description *(cont.)*

The 'X' axis min and max times for the trend shown in figures 3 are as follow:

Min: 1 minute

Max: 360 minutes

The X and Y axis's values of the trend are adjustable and could be changed by simply touching the setting button, next to the home symbol, in the top right corner as the trend is being displayed.

Figure 4 below shows the trend settings page.

FIGURE 4
Trend setting page

3.2.3 Changing Product Calibration

Selection of the Product Calibration is made by touching the Current product calibration (Product Cal (1)). A product calibration selection window will pop up. Select the new code by touching the desired code followed by the SAVE key.

Figure 5 below shows the select Cal & Constituent page in which the gauge's existing product calibrations will be listed.:

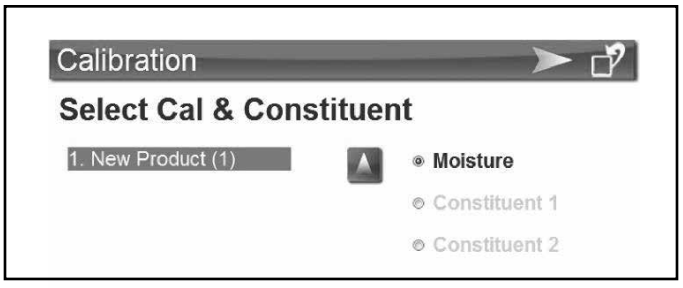


FIGURE 5
Product Selection Menu

3.2.4 User Screen

Pressing the Home symbol in the top right corner of the main screen will allow you to access an unprotected User Screen as shown in Figure 6 below. In this screen, the user may offset the gauge's zero setting, change the damp time and change the grab sample time.

In order to offset the Moisture Monitor gauge, touch the "Adjust" number and use the pop up keypad to enter the true moisture of a sample and on pressing the Enter key the gauge display will be adjusted to match the value entered.

In order to change the grab sample time, touch the "Grab Time" number and use the pop up keypad to enter the grab sample test time.

In order to change the damp time, touch the "Damp" number and use the pop up keypad to enter the new damp value. The Damp Time is a global setting that applies to all Product Calibrations.

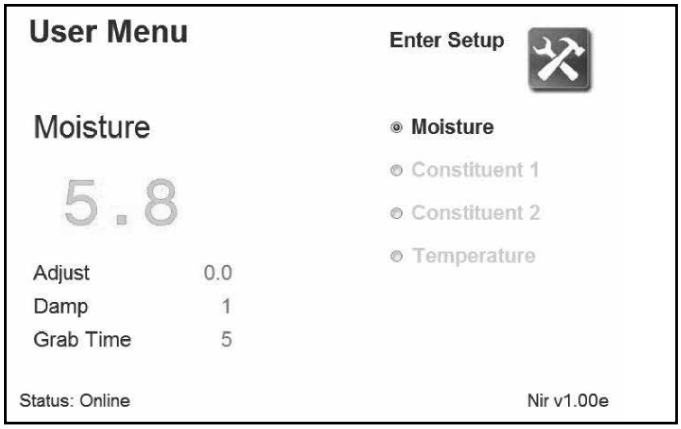


FIGURE 6
User menu front page

3.2.5 Menu Protection Password

To access the gauge setup menu, touch the blue pad next to ENTER SETUP on the LCD. The Password request screen will pop up. Enter the correct password and touch the ENTER key. This will allow access to the SETUP Menu. The default password is 0000.

FIGURE 7
Password entry page

3.2.6 Menu Selections

After entering the correct Password the Select Menu will be presented. The select menu consists of two pages. Page 1 of the user menu is shown in Figure 8 below and page 2 of the user menu is shown in Figure 9 below.

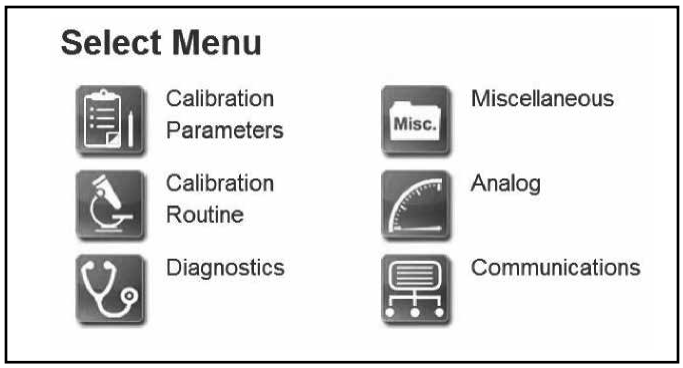


FIGURE 8
User Menu Page 1

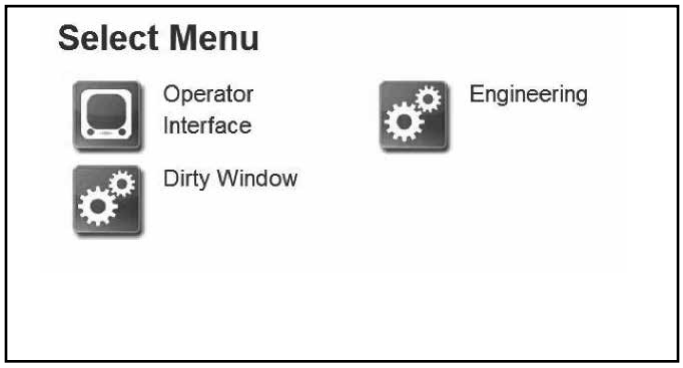


FIGURE 9
User Menu Page 2

3.2.7 Calibration Parameters

By touching the calibration parameters button, shown in Figure 8 above, you will access the Select Cal page (shown in Figure 10 below). The display will present the product calibrations saved in the gauge.

You can simply select the product calibration by touching it. Touch the right arrow on the top right corner to see the calibration parameters for the product being used as shown in Figure 10 below. Adding a new product is made by touching the NEW blue button.

⚠ CAUTION
Eriez SMART Moisture Monitor is pre-calibrated before shipping and should not be re-calibrated by the user.

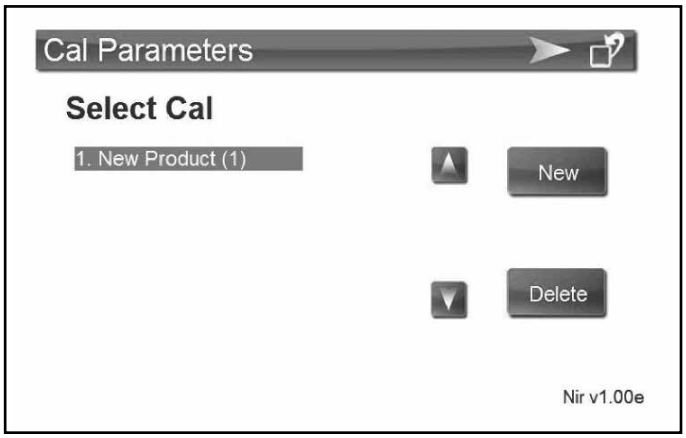


FIGURE 10
Calibration Parameters Page 1

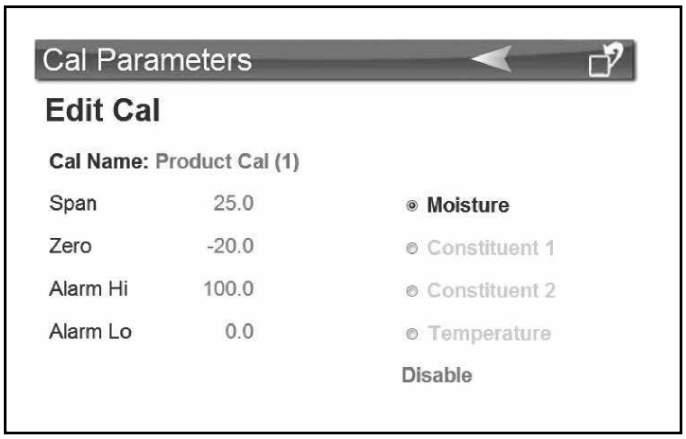


FIGURE 11
Calibration Parameters Page 2

Each Product Calibration has its individual span and zero settings.

To make a change to the values, touch the number, a numeric keypad will pop up. Type the new number and touch the ENT key.

Alarms: Setting High and Low alarm levels to each constituent will cause that constituent's reading to turn RED when either the high alarm or the low alarm is exceeded.

⚠ CAUTION
The following section is provided for informational purposes only. The user should *not* re-calibrate the Moisture Monitor.

Gauge Description *(cont.)*

3.2.8 Calibration Routine

The Calibration Routine is a linear regression routine that adjusts the gauge's calibration parameters (span and zero) so that the gauge's readings match the actual lab moisture readings. This is done by using a series of representative product sample with moisture contents covering the moisture range to be measured.

The objective of gauge calibration is to obtain a straight-line graphical relationship between the sensor's reading and the true moisture value of a series of samples as shown in Figure 12 below.

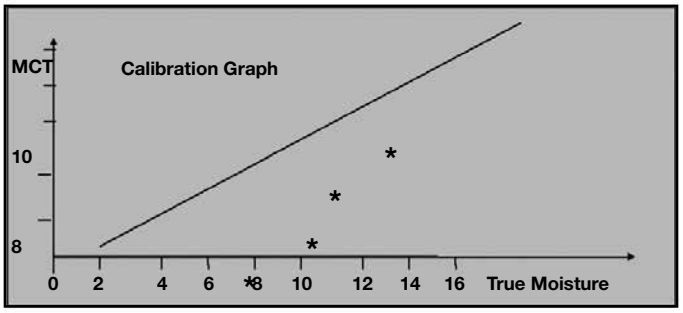


FIGURE 12
Calibration Graph

Calibration Routine Process

1- Select one of the unused Product Calibrations in the gauge.

2- Make or collect from the process a series of sample (up to 25) with moisture contents covering the range expected in the process.

3- Set the Span value to 25.0, the zero to -20 and the damp time to a value of 1.0.

4- Present the lowest moisture sample to the sensor; adjust the zero setting to make the sensor's reading agree with the true moisture content of the sample. Note the reading.

5- Present all of the samples to the sensor in turn, and make sure to note the sensor and actual lab readings for each sample.

6- Tabulate the results as shown in Table 1:

Sensor	Lab
3.7	3.7
4.5	5.2
7.6	8.3
9.5	10.3
8.2	8.9

Table 1
MCT vs Lab Readings

7- Select the Calibration Routine button in the main menu page. This will take you to the calibration page as shown in Figure 13 below.

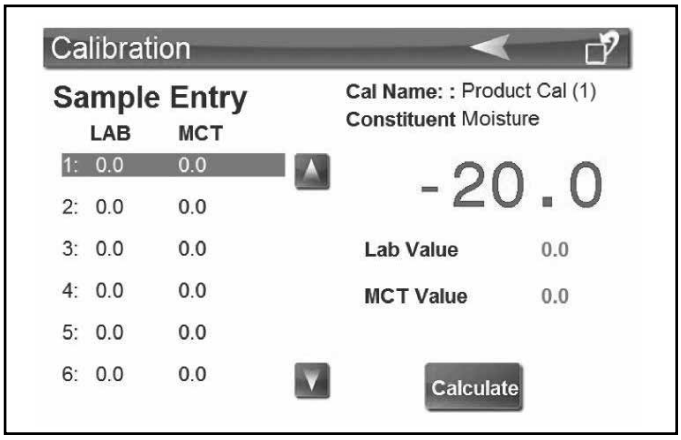


FIGURE 13
Calibration Routine Page

8- Touch the Lab Value, displayed in blue on the LCD, and enter the true moisture value for the first sample.

9- Touch the MCT Value, displayed in blue on the LCD, and enter the gauge reading for the first sample.

10- Repeat this procedure for all the samples.

11- When all sample pairs have been entered, touch the CALCULATE button. A window will pop up with the regression statistics and the values of the zero and span setting that will correctly calibrate the gauge. Touch SAVE to save the new calibration settings to the desired Product Calibration.

Please note that the up and down arrows are the page up and page down arrows. They are used to scroll the page up and / or down.

Linear Regression Statistics

The gauge's computer calculates several statistics during its calibration routine. These statistics give a measure of the accuracy and quality of the calibration.

Correlation Coefficient: This is an expression of how well the sensor readings match the true moisture values.

- 1 is perfect
- Equal to or greater than 0.9 is acceptable
- Less than 0.9 is not acceptable

Standard Error: This is an indication of the accuracy of the calibration. A perfect value is 0.0. Acceptable values are in the 0.0 to 0.5 range depending on the moisture ranges being measured.

3.2.9 Diagnostics

All gauge diagnostic values may be viewed in this menu choice. To go to the diagnostics menu, touch the DIAGNOSTICS blue button in the user menu. There are four pages of Diagnostic parameters group, the first page is called Front end and is shown in Figure 14 below:

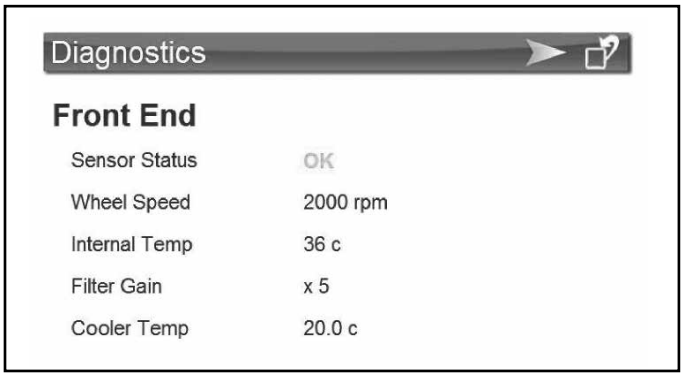


FIGURE 14
Diagnostics Menu Page 1

In the front end diagnostics page, the following are listed:

Sensor STATUS: This presents the operational status of the gauge. The sensor's microprocessor continually monitors up to 12 sensor parameters. If all are correct the status will indicate OK. If any one of the parameters is out of range then a warning message will be presented. A detailed SENSOR STATUS diagnostics list is displayed on page 2 of the diagnostics.

Wheel Speed: This is the rotational speed of the filter wheel.

Internal Temperature: This is the internal temperature of the Moisture Monitor gauge.

Filter Gain: This is the optical circuitry gain value.

Cooler Temperature: This is the actual detector's temperature.

Page 2 of the diagnostics menu displays the status of a list of the Moisture Monitor gauge components as shown in Figure 15 below. The component tab is displayed in green when its status is ok and in red when something is wrong.

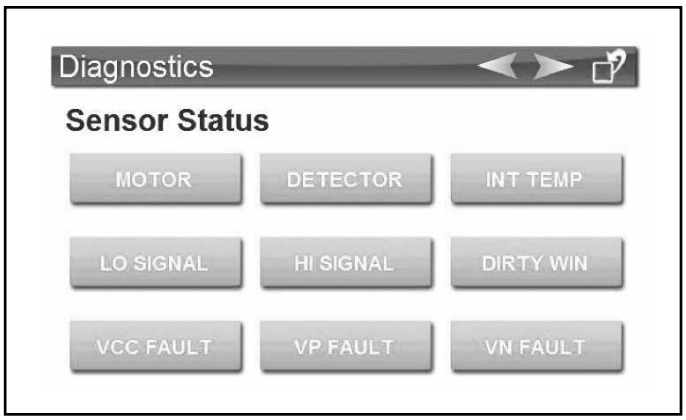


FIGURE 15
Diagnostics Menu Page 2

Page 3 of the diagnostics menu displays the main voltage values off of the main board of the Moisture Monitor gauge as shown in Figure 16 below. Value is displayed in green when status is ok and in red when status is not ok.

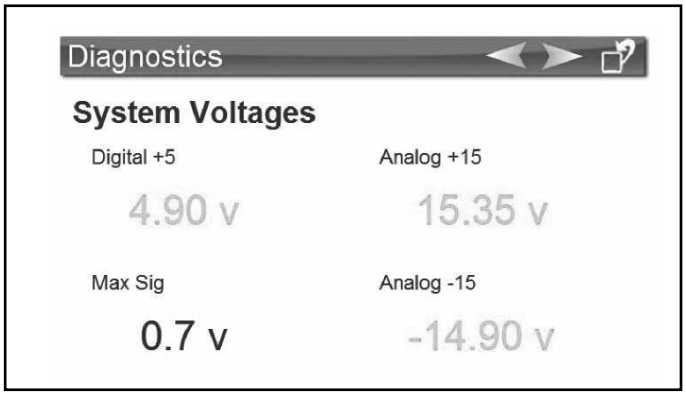


FIGURE 16
Diagnostics Menu Page 3

Gauge Description *(cont.)*

3.2.9 Diagnostics *(contd)*
Page 4 of the diagnostics menu displays the filter values, as shown in Figure 17 below, which are used to help balance the Moisture Monitor gauge.

This presents the detector signal levels for the six filters that may be fitted to the filter wheel in the Moisture Monitor gauge. Values are given for both external and internal filters. A bar graph comparison for each filters INT and EXT values may be presented by touching the F# of the filter.

The preamplifier gain value is also presented. This value is an indication of the amplification required to bring the detector signals into the range required by the processing electronics.

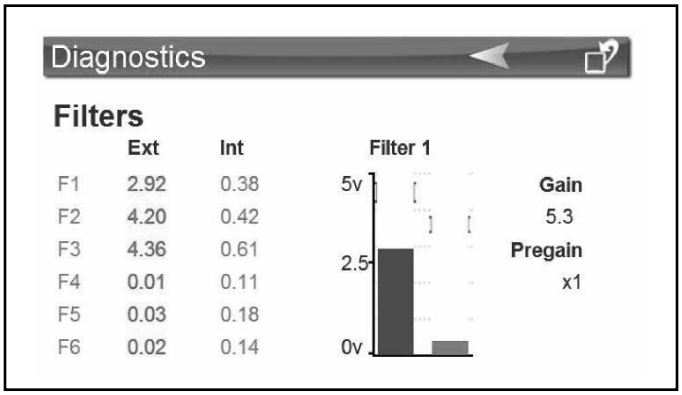


FIGURE 17
Diagnostics Menu Page 4

Ranges of Diagnostics Parameters
Table 2 below gives the range of values for each of the diagnostic parameters.

3.2.10 Miscellaneous
The miscellaneous menu, shown in Figure 18 below, provides access to change the password of the user menu and the readings decimal places. It also lists the Moisture Monitor gauge's information such as the sensor version, board type and the interface version.

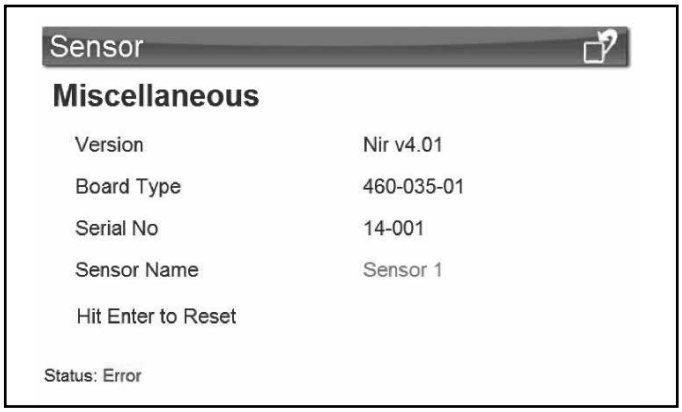


FIGURE 18
Miscellaneous Page

Parameter	Nominal Value	Min. Value	Max Value	Warning Message
Internal Filters	3–4.5	0.5	5.0	Above 4.5 "High Signals"
External Filters	3–4.5	0.5	5.0	Above 4.5 "High Signals"
+5 V	5.00	4.8	5.2	Outside Min/Max "VCC Fault"
+5 V	15.00	14.0	16.0	Outside Min/Max "VP Fault"
-15 V	15.00	14.0	16.0	Outside Min/Max "VN Fault"
Motor Speed	1000	1500	3500	Outside Min/Max "High/Low Motor
Filter Wheel Slot	No slot switch input for >400 ms			"Motor Stopped"
Gain	X5-X10	1	100	Above X64 "Low Signals"
Cooler Drive	15%	0.1%	100%	Above 75% "Cooler Fault"
Pre-Gain	1	0	2	None
Cooler Temp	20	0.2	65	0.0 "Detector Fault"
Internal Temp	35	0.0	100	Above 65 "High Board Temperature"

TABLE 2
Diagnostics Parameters Ranges

3.2.11 Analogs

This menu selection allows the user to adjust the sensor's analog output, the sensor's input and the interface analog outputs. By touching the Analog button on the user menu you will get to the Analog menu as shown in Figure 19.

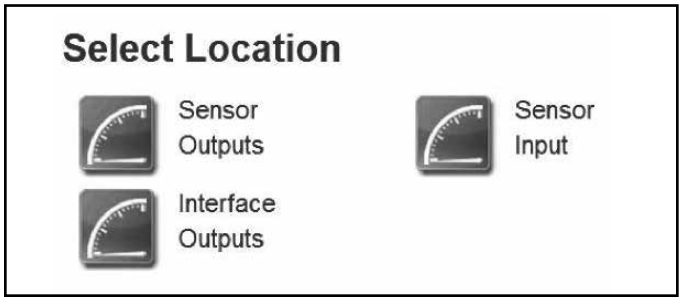


FIGURE 19
Analogs Main Menu

Sensor Outputs

This allows the user to scale the 4 – 20 mA analog output for each of the constituent(s) measured. The user could use up to 4 analog outputs and is capable of using the same constituent reading with more than one analog output. (Additional analog output connectors might be required depending on the number of analog outputs needed.)

To configure the analog output of the Moisture Monitor, touch the sensor analogs blue button and you will be directed to the following menu as shown in Figure 20 below:

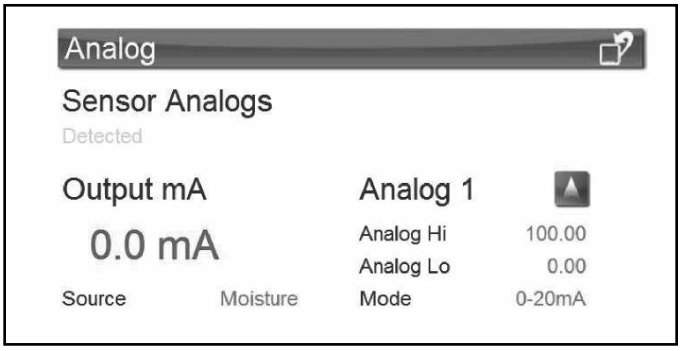


FIGURE 20
Sensor Outputs Page

The **UP** arrow in the top right of the screen will select each of the four analog outputs available from the gauge.

Analog Hi: This is the value of moisture (or other constituent) at which the gauge will output 20 mA.

Analog Lo: This is the value of moisture (or other constituent) at which the gauge will output 4 mA or 0 mA

Output mA: This is the actual mA value that is being sent out the analog channel. Measuring the analog signal with a multi-meter will give the same value as presented.

Output Mode: This allows the selection of either 0 – 20 mA or 4 – 20 mA
Please note: 0 – 10V and 0 – 5V are also available output options. Please consult the factory for more details.

Source: This allows any of the four measured constituents to be allocated to any of the Analog channels.

Tuning the Analog Output signals

The accuracy of the mA signal may be 'tuned' by using the Fix mA buttons and the Adjust button.

Instructions:
1) Touch the Fix 2 mA button.

2) Measure the mA output of the gauge

3) Touch the Adjust value to get the pop up numeric keypad. Enter the value measured instep 2. Touch the Enter key to correct the 2 mA reading.

4) Touch the Fix 18 mA button.

5) Measure the mA output of the gauge.

6) Touch the Adjust value to get the pop up numeric keypad. Enter the value measured in step 5. Touch the Enter key to correct the 18 mA reading.

7) Repeat step 2 and 5 to verify that the mA outputs are correct.

Sensor Input:
This is used when other types of sensors, such as temperature, height, color etc... are being fitted in the Moisture Monitor to scale their input and output. Sensor input type could be 4 – 20 mA, 0 – 5V or 0 – 10V.

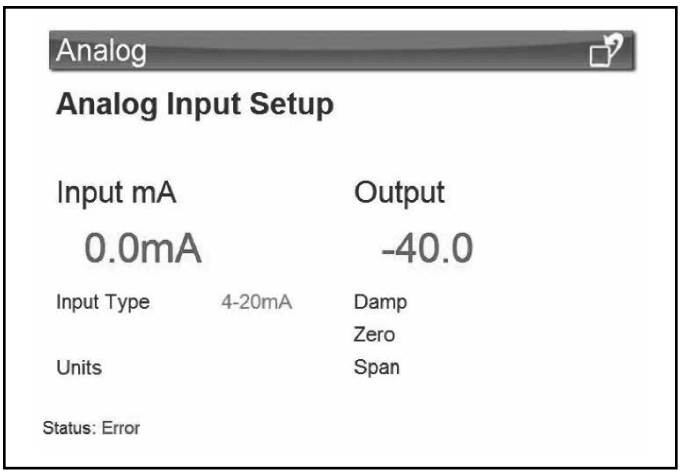


FIGURE 21
Sensor Input Page

Range Hi: This is the input sensor's value at which the gauge will match 20 mA, 5V or 10V.

Range Lo: This is the input sensor's value at which the gauge will match 4 mA, 0V or 0 V

Output: This is the actual mA value that is being sent out the analog channel. Measuring the analog signal with a multi-meter will give the same value as presented.

Input: This is the actual input value of the fitted sensor.

Damp: This is the input sensor's damp time.

Zero: This allows the user to offset the analog output.

Span: This allows the user to modify the sensitivity of the input signal.

Interface Outputs:
Analog outputs are available from the sensor, the operator interface and both. This allows the user to scale the 0 – 20 mA analog output for each of the constituent measured coming off of the operator interface. The user could use up to 4 analog outputs and is capable of using the same constituent reading with more than one analog output.

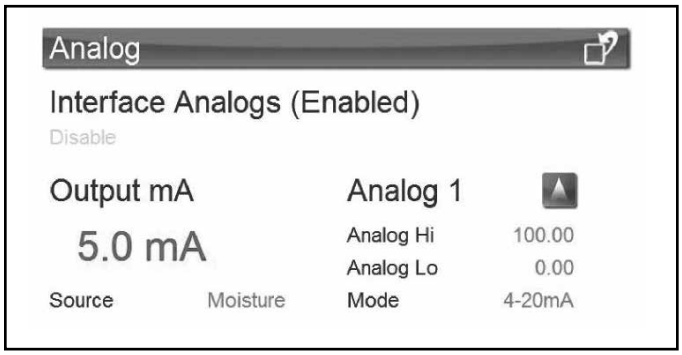


FIGURE 22
Interface Outputs Page

The **UP** arrow in the top right of the screen will select each of the four analog outputs available from the gauge.

Analog Hi: This is the value of moisture (or other constituent) at which the gauge will output 20 mA.

Analog Lo: This is the value of moisture (or other constituent) at which the gauge will output 4 mA or 0 mA

Output mA: This is the actual mA value that is being sent out the analog channel. Measuring the analog signal with a multimeter will give the same value as presented.

Output Mode: This allows the selection of either 0 – 20 mA or 4 – 20 mA.
Please note: 0 – 10V and 0 – 5V are also available output options. Please consult the factory for more details.

Source: This allows any of the four measured constituents to be allocated to any of the Analog channels.

Tuning the Analog Output Signals
The accuracy of the mA signal may be 'tuned' by using the Fix mA buttons and the Adjust button.

Instructions:
1) Touch the Fix 2 mA button.

2) Measure the mA output of the gauge

3) Touch the Adjust value to get the pop up numeric keypad. Enter the value measured in step 2. Touch the Enter key to correct the 2 mA reading.

4) Touch the Fix 18 mA button.

5) Measure the mA output of the gauge.

6) Touch the Adjust value to get the pop up numeric keypad. Enter the value measured in step 5. Touch the Enter key to correct the 18 mA reading.

7) Repeat step 2 and 5 to verify that the mA outputs are correct.

3.2.12 Digital Communications

This menu selection provides setup details of any of the serial comms or any of the optional field bus interfaces that may be installed in the Moisture Monitor. You can enter the Communications menu shown in Figure 23 below by touching the communications tab on the user menu.

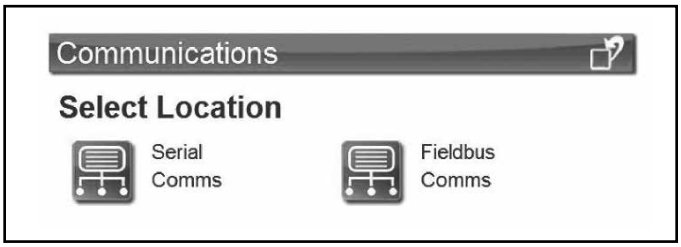


FIGURE 23
Communications Menu

Serial Comms:
This is where the user configures both the sensor and interface digital outputs.

Sensor Com 1:
User could select to use RS-485 or RS-232 to communicate with the sensor. They also could change the Baud Rate to match their device settings. The other parameters have **fixed** values and are usually auto selected.

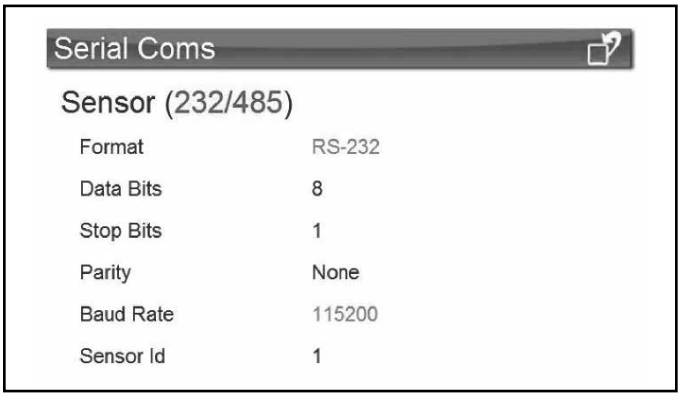


FIGURE 24
Sensor Com Page

Interface Com 1:
User could select to use RS-485 or RS-232 to communicate with the operator interface of the Moisture Monitor. They also could change the Baud Rate to match their device settings. The other parameters have fixed values and are usually auto selected.

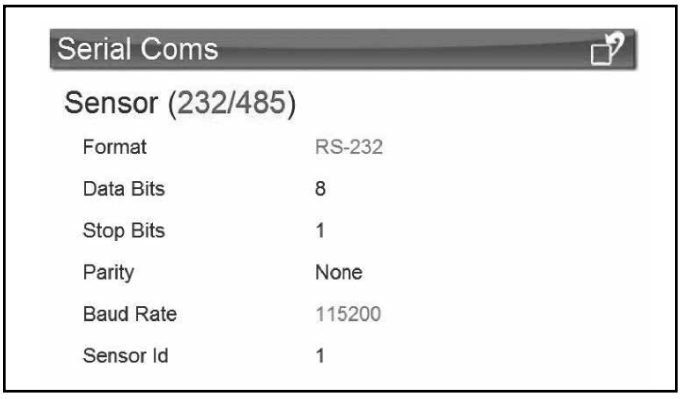


FIGURE 25
Interface Com Page

3.3 Gauge Outputs

Each Moisture Monitor measurement produces analog and digital outputs for control and communication. Bus interfaces such as Ethernet, Modbus, Profibus, etc... are also available. The Moisture Monitor has the following signal interfaces available for connection to other devices:

3.3.1. Analog Outputs

> Four, isolated 4 – 20 mA or 0 – 10 V outputs (selectable). > Load resistance 500 ohms max.

3.3.2. Digital Outputs

The Moisture Monitor provides a choice of serial output formats, RS232, RS485 and USB.

RS232 is suitable for a single gauge to computer connection over a distance of up to 100 feet (30 meters). The RS485 is suitable for connection of multiple gauges on a cable up to 3 miles long (4.86KM). USB is optional and used for direct connection to a laptop PC.

Serial Requirements:

RS232/485:

Baud Rate: 9600, 19200, 38400, 57600 and 115200 (115200 default)
Parity: None
Data Bits: 8
Stop Bits: 1

Cables:

RS 232: 9 pin 'D' serial cable wired pin to pin
RS 485: Shielded twisted pair.

Chapter 4. Gauge Installation

4.1. Sighting the Sensor

The sensor is capable of operating at any orientation provided the light beam can reflect from the surface of the product.

4.2. Vibration

The sensor mounting support and any items in contact with the sensor should be free from excessive vibration.

4.3. Strong Light

Strong infrared light or direct sunlight should not be allowed to fall on the sensor window or erroneous reading may occur.

4.4. Temperature

The sensor is designed to give satisfactory measurements within a temperature range of 32 to 120 deg. F (0 to 50 deg. C).

4.5. Humidity & Dust-Window Air Purge

The sensor should be kept clear of excess humidity. It is important to prevent condensation on the sight window. Normal atmospheric dust will not affect the sensor reading but similar to humidity, accumulation of dust on the window will impair the sensor's operation. The air purge attachment fitted to the sensor window requires a 1/4" (6mm) tube with a supply of clean oil free dry air at a pressure not exceeding 10 psi. at approximately 2 liters per minute.

4.6. Optimum Viewing Distance

The optimum viewing distance is 8" (200mm) from the bottom of the sensor but any distance between 6" and 12" (150 - 300mm) is acceptable. Variations in product pass height of +/- 1" (25mm) around the 8" (200mm) nominal are permissible.

4.7. Reflections from Material Surface

It is essential to avoid specular reflections of the transmitted light from the product. Powdered and granular products cause no problems and the sensor light beam may be mounted at any angle to the top surface of the product. The closer the beam is to 90º from the surface the better the reflected signal strengths. Highly reflective and shiny sheet materials require that the sensor be angled so that the light beam is at approx. 80º-85º to the sheet surface.

Chapter 5.
Power & Cable Connections

5.1. AC Power Connections
The Moisture Monitor Gauge is powered using the 6-foot (2mtrs) power cord connected to the rear of the sensor. The input is auto ranging and accepts 90-260VAC volts, 15 amps. Also available, optional 24VDC / 4.5A input power.

5.2. Analog & Serial Cable Connections
Customer data cables connect to the two industrial connectors on the rear of the sensor. Details of the respective connectors in these connectors are given in Section 7.0.

Chapter 6.
Guide to Gauge Calibration

Moisture
It is advisable to calibrate a sensor off-line in the event:

1. It is difficult to achieve samples over the full moisture range on-line owing to time constraints or wastage of product.
2. The exact gauge sample cannot be easily obtained for referencing purposes. This is particularly important in circumstances where the sample is non homogeneous or equilibration isn't complete.

Bulk Solids

Off-Line Calibration
If it is possible to collect samples over the full moisture range from the production line, and retain the moisture level by placing them in airtight containers over a 24 hour period, this will provide the best calibration and is preferable. It will ensure that all parameters vary, not only the moisture or constituent of interest, making the calibration more robust over time.

If not possible, collect a bulk sample from the production line when the moisture level is low. Condition samples to higher moisture levels over the moisture range (minimum moisture range of 1.0%) by adding a fine mist of water through a spray bottle.

Conditioning Samples
Condition a minimum of two or three samples (each approximately 50 cm3) to install an approximate calibration, seven or more for a full calibration. Two samples are at the lower and two samples are at the upper limits of the moisture range are required in order to establish the instrument sensitivity (span) and set the bias (zero). The fifth sample is used as a mid-point to check the linearity over the calibration range, or as an additional high or low sample to provide confidence in the span.

Obtain a bulk sample from the line, allow time for the sample to cool. Use a thermal balance on a 10g sub-sample to establish the approximate moisture level. Calculate the grammage of moisture that needs to be added to achieve the required moisture levels. Place the conditioned samples in airtight bags/ small containers ensuring there is minimum head space. Allow the contents of all bags to equilibrate over a minimum of 24 hours.

Gauging Samples
Gauge each of the samples using the default calibration (Span = 25, Zero= -20). If the sample is non-homogeneous or varies in particle size, gauge the sample at least twice, returning it to its container between measurements. Record the MCT/ average MCT values. If there is little or no difference in the reading between the highest and lowest moisture sample, double the default span and re-run the samples. Perform reference tests on each sample immediately following gauging. Oven testing is preferable to the thermal balance as all samples undergo the same test conditions.

Once all the reference values are recorded, the data pairs (gauge and corresponding reference value) can be entered either into the Cal Routine sub menu on the Operator Interface or within the PC software. A graph can be accessed showing the existing values and calibrated values. Examine the graph and manually remove any data points that appear to be outliers (outliers have a residual value > twice the standard deviation of all the residuals). Click "Calculate" to access the calibration statistics and new Span and Zero. You can save this new calibration file.

On-Line Installation and Zero Adjustment
Install the gauge on-line at the same distance from, and at the same angle to the product. An adjustment to the zero (bias) is now necessary in order to complete the calibration process as the degree of equilibration will differ from off-line samples, especially if the gauge is installed at the exit of a dryer. Zero adjustment is made by picking 3 consecutive samples from the line using the grab sample feature on the OI (hand symbol) to obtain the gauge average over the sampling interval. Each sample should be kept airtight until referenced. Once referenced, the difference between the average gauge value and the average reference value should be calculated and the gauge zero adjusted to reflect the difference. E.g lab value - gauge reading =6 – 9 = -3 results in the gauge zero being decreased by 3.

On-Line Calibration
If the process controls can be utilized to generate a range of moistures on line, and “gauge-measured” product can be picked and referenced for calibration purposes, on-line calibration is feasible.

The gauge should be installed as per the Users Manual over the production line. The OI display should be watched in order to select samples across the entire moisture range. When the displayed readout shows a value that differs from the next closest sample value, press the grab sample function and pick product in small handfuls from the line and place in an airtight container. Stop picking sample when the gauge average is displayed. Reference the collected samples in the same manner as one another, then enter the data as already described under **Gauging samples**.

Chapter 7. Customer Wiring Connections

All wiring connections are made to three quick-disconnect connectors mounted on the rear of the gauge’s enclosure. These connectors may have different signals coming to them from inside the sensor. The following diagrams show the standard configurations for these connectors.

FIGURE 33
Moisture Monitor Operator Interface

POWER

Terminal #	Input
1	Live
2	Neutral
Gnd Symbol	Ground

ANALOG Connector – Standard Configuration

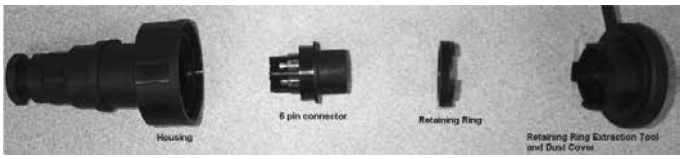
Terminal #	Signal	Constituent #
1	Gnd	1
2	4-20 mA	1
3	Gnd	2
4	4-20 mA	2
5	Gnd	3 Replaced by temperature if fitted
6	4-20 mA	3 Replaced by temperature if fitted

DIGITAL Connector (RS232, RS485 & Hold) Standard Configuration

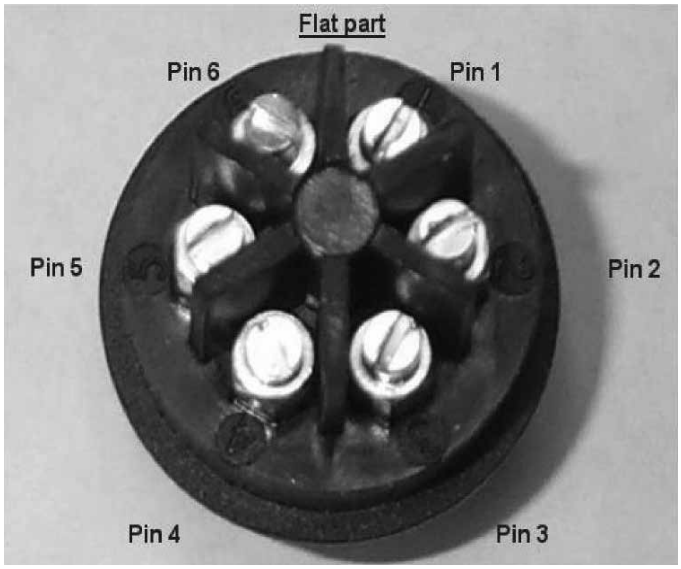
Terminal #	Signal
1	RS485 A
2	RS485 B
3	RS232 Tx
4	RS232 Rx
5	Digital Gnd
6	Hold Input

NOTE: When sensors are fitted with network interface cards this Digital connector may be wired to meet the network format or it may be replaced with the network's approved connector.

Analog / Digital Connector



Use the end of the Dust Cover to un-screw the 'Retaining Ring' in order to remove the 6 pin connector.



The 'Flat part' of the connector fits into the 'Housing', mating with a similar 'Flat part'.

Chapter 8. Specifications

MOISTURE MONITOR NIR TRANSMITTER SPECIFICATIONS

- **Measured NIR Constituents:** 1, 2 or 3 simultaneously
- **Moisture Range:** Min. 0.1%, Max. 95%
- **Coatings Range:** Min. 0.1gr./m, Max. 200 gr./m
- **Fats & Oils:** Min. 0.1%, Max. 50%
- **Repeatability:** +/- 0.2%
- **Product Distance:** 8-18 inches (200-450mm)
- **Calibration Codes:** 100
- **Response Time:** 1 – 999 seconds. Three modes available: damping, integration and gated.
- **Power:** 90-260VAC, 50/60 Hz, 40 watts
- **Outputs:** 4-20mA, 0-10V (isolated), RS-232 & RS485
- **Weight/Enclosure:** 19 lbs. (8.6kg) / IP67, Cast Aluminum
- **Ambient Temperature:** -40 to +50°C (-40 to +120°F) with water or air cooling up to 80°C (160°F)
- **Window Purge:** Air Purge Diffuser

ACCURACY:

(Subject to application and product type)

- **Moisture:** +/- 0.1%

CE COMPLIANCE:

- EMC Directives EN50081-1 & EN50082-2, EN61010-1
- Low Voltage Directives

OPERATOR INTERFACE SPECIFICATIONS:

- **Display:** 5.7 inch Color Touchscreen LCD
- **Languages:** User Selectable
- **Power:** from Moisture Monitor sensor or local
- **Cable:** 10 ft (3 meters) standard
- **Enclosure:** Cast Aluminum

DATABUS & SOFTWARE INTERFACES:

- **Optional Interfaces:** Ethernet TCP/IP, Devicenet, Modbus, Profibus
- **Software:** Windows-based program or OPC-DDE Server

Appendix I

Special Features

Backdoor Password

If the password for the SMART Moisture Monitor has been forgotten or is unknown then a special 'backdoor' password will allow the user/engineer to view and change the old password.

To use this 'backdoor' system proceed as follows:

At the Password request enter the number 6811, and then press ENTER.

This will allow access to the SETUP SELECT Menu; then select the operator interface and

then MISCELLANEOUS menu.

View or change the current PASSWORD.

Language Shortcut

To return the MCT screens to English from any other selected language enter 9999 at the password request. This will instantly set the language used on all screens to English.

Appendix II

Dry Basis

It is common for some industries, particularly the wood panel industry to calculate the moisture in the wood particles as a percentage of the dry material rather than a percentage of the wet material.

Wet % = Wet Weight – Dry
Weight Wet Weight

Dry % = Wet Weight – Dry Weight
Dry Weight

Conversion from Wet % to Dry % is as follows:
% Dry = % Wet x 100
(100-% Wet)

Conversion from % Dry to % wet is as follows:
% Wet = % Dry x 100
(100 + % Dry)

The MCT360 may be configured to present moisture on a dry basis by selecting DRY: Y in the Engineering Menu. This selection does the following to the sensor parameters:

1. The displayed moisture readings are presented in the Dry Basis.
2. An asterisk appears in front of the 'Moisture' word in the display to alert users that the sensor is in the DRY mode.
3. The Calibration routine is modified to allow dry basis values to be used.

Online Offset Adjustments

When operating in the Dry Basis Mode, a change to the Zero parameter of the calibration will not make the same adjustment to the moisture reading. This is because the moisture reading is being modified by the wet to dry conversion factor.

To allow users to make a simple offset adjustment to the sensors reading an additional calibration parameter is presented in the Cal parameters when in the Dry Basis Mode.

This is: **OFFSET**.

The default setting for it is 0.00.

To make a reduction in the displayed moisture reading of 0.5, make the OFFSET be –0.5.

To make an increase to the moisture reading of 0.8, make the OFFSET be + 0.8

When initially calibrating a sensor ALWAYS set the OFFSET to 0.00

Appendix III

Moisture Monitor Gauge Default Parameters

User Parameters – No Password needed

Sample Value 0.0
Avg Time 10.0 secs
Trend Time 60 min

Calibration and Set Up Parameters

Password needed

Parameter	**Constituent** 1
Zero	-20.0
Span	25.0
Damping	1
Alarm High	100
Alarm Low	0
Analog High	100
Analog Low	0
Analog Output	mA
Cooler Target	20C
Pre Gain	X1
Password	0000
Inst ID	9
Digits	1
Prod Code Lock	OFF
Solids	OFF

Heater Control

Target	25
Prop	10
Int	0.6
Deadband	0.2

Engineering Parameters

Special Password needed

General

Damp Mode	Yes
Bench	OFF
Max Cal	50
Pre Gain	1
Dead Band	0.1
Cooler	ON
Sampler	OFF
When sampler is	ON
Purge	10
Fill	20
Meas	10
Delay	2

Constituents

Moisture	ON
Atro	OFF
Log	OFF
Constituent 2	OFF
Log	OFF
Constituent 3	OFF
Log	OFF
Temperature	OFF

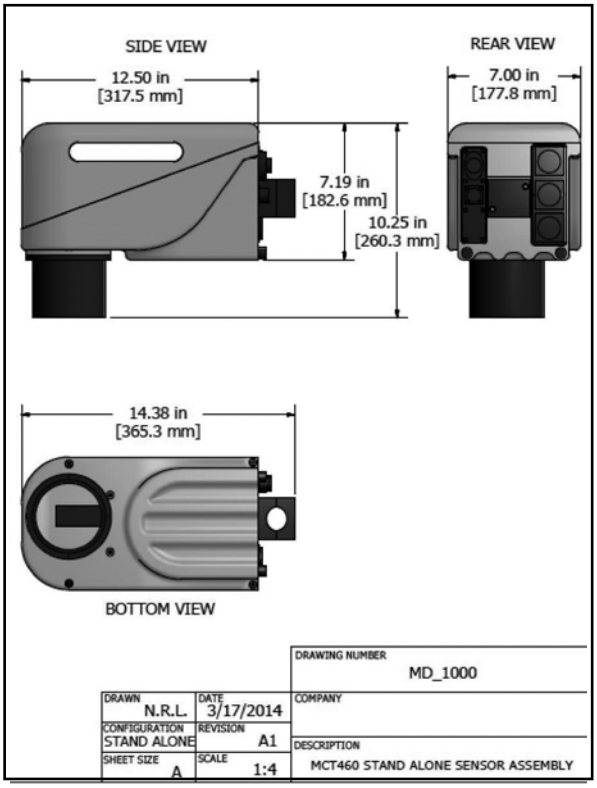
Constants

Constituent 1

K1 = 1.0
C2 = 0.3
C3 = 0.7
All others 0.0

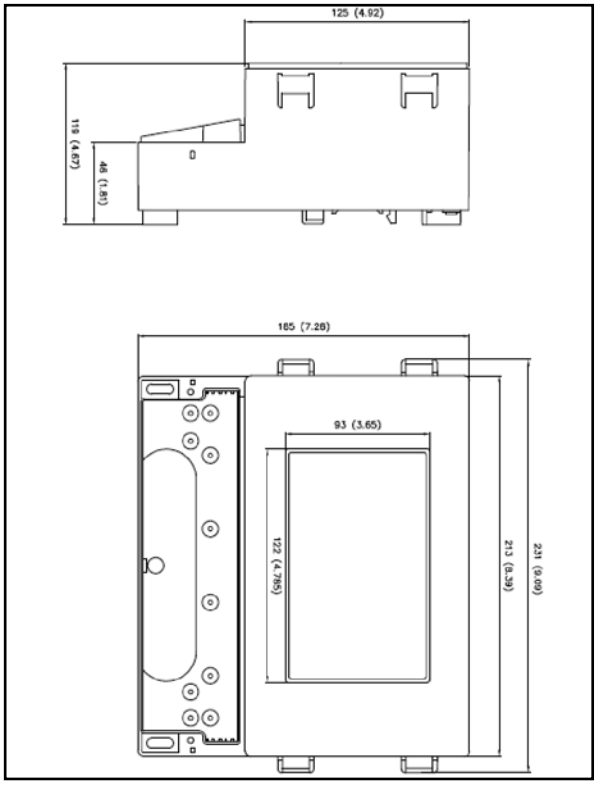
Appendix IV

Moisture Monitor Gauge's Dimensional Drawing



Appendix V

Moisture Monitor Operator Interface's Dimensional Drawing



Appendix VI
Declaration of Conformity

EUROPEAN STANDARDS

Equipment: Moisture Monitor Series Moisture Gauges
The above equipment complies with the following European Directives.

Electromagnetic Compatibility Directive	**89/336/EEC**
Amending Directive	91/263/EEC, 92/31/EEC 93/68/EEC
Low Voltage Directive	**73/23/EEC**
Amending Directive	93/68/EEC

In order to achieve this, the instrument was tested to the following standards:

For EMC
EN55022 Class B. EN61000-3-2 and EN61000-3-3 Generic Emission standard for Residential, Commercial and Light Industry.

For LVD
EN61010-1 (1993) Safety requirements for electrical equipment for measurement, control and laboratory use-General requirements

Manger Responsible: Ian Johnson

Position: QC Manager

Date: December 13th 2013

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