Honeywell

IR Moisture Measurement

System Manual

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IR Moisture Measurement

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Introduction

The purpose of this document is to enable Honeywell personnel to install, calibrate, and maintain the Infrared (IR) Moisture Measurement sensor.

The models covered in this manual include the Q4205-51 and Q4205-52 for Experion MX.

Audience

This manual is intended for use by engineers or process engineers and assumes that the reader has some knowledge of the operation of a paper machine and a basic understanding of mechanical, electrical and computer software concepts.

About This Manual

This manual contains these chapters and two appendixes.

Chapter 1, **Sensor Overview**, describes operating principles and system specifications.

Chapter 2, **System Components,** describes IR Moisture Measurement System components.

Chapter 3, **EDAQ,** describes the principles and operation of the Ethernet Data Acquisition (EDAQ) board.

Chapter 4, **Installation,** describes the installation and set up tasks for the sensor.

Chapter 5, **Software Configuration Parameters,** describes the configuration parameters related to the IR Moisture measurement system.

Chapter 6, **Operations** describes operations such reference displays, typical sampling, and dynamic calibration for the IR Moisture measurement system.

Chapter 7, **Static Calibration,** describes the static calibration process for the IR Moisture measurement system.

Chapter 8, **Preventive Maintenance,** describes a schedule for recommended ongoing maintenance tasks.

Chapter 9, **Tasks,** describes procedures for maintenance, diagnostic, and troubleshooting tasks.

Chapter 10, **Troubleshooting,** describes symptoms, alarms, possible causes, and links to associated diagnostic or troubleshooting tasks.

Chapter 11, **Transportation, Storage, and End of Life,** describes methods for storing, transporting and disposing of sensor components.

Chapter 12, **Glossary,** describes terms and acronyms used in this manual.

Appendix A, **Part Numbers**, lists current part numbers for parts and spares.

Appendix B, **Moisture Samples Worksheet**, contains an embedded version of the worksheet needed for making calibration samples.

Conventions

The following conventions are used in this manual:

ATTENTION | Text may appear in uppercase or lowercase except as specified in these conventions.

`Boldface`	Boldface characters in this special type indicate your input.
`Special Type`	Characters in this special type that are not boldfaced indicate system prompts, responses, messages, or characters that appear on displays, keypads, or as menu selections.
Italics	In a command line or error message, words and numbers shown in italics represent filenames, words, or numbers that can vary; for example, filename represents any filename. In text, words shown in italics are manual titles, key terms, notes, cautions, or warnings.
Boldface	Boldface characters in this special type indicate button names, button menus, fields on a display, parameters, or commands that must be entered exactly as they appear.

lowercase	In an error message, words in lowercase are filenames or words that can vary. In a command line, words in lowercase indicate variable input.
Type	Type means to type the text on a keypad or keyboard.
Press	Press means to press a key or a button.
`[ENTER]` or **`[RETURN]`**	**`[ENTER]`** is the key you press to enter characters or commands into the system, or to accept a default option. In a command line, square brackets are included; for example: **`SXDEF 1 [ENTER]`**
`[CTRL]`	**`[CTRL]`** is the key you press simultaneously with another key. This key is called different names on different systems; for example, **`[CONTROL]`**, or **`[CTL]`**.
`[KEY-1]-KEY-2`	Connected keys indicate that you must press the keys simultaneously; for example, **`[CTRL]-C`**.
Click	Click means to position the mouse pointer on an item, then quickly depress and release the mouse button. This action highlights or “selects,” the item clicked.
Double-click	Double-click means to position the mouse pointer on an item, and then click the item twice in rapid succession. This action selects the item “double-clicked.”
Drag X	Drag X means to move the mouse pointer to X, then press the mouse button and hold it down, while keeping the button down, move the mouse pointer.
Press X	Press X means to move the mouse pointer to the X button, then press the mouse button and hold it down.
ATTENTION	The attention icon appears beside a note box containing information that is important.
CAUTION	The caution icon appears beside a note box containing information that cautions you about potential equipment or material damage.
WARNING	The warning icon appears beside a note box containing information that warns you about potential bodily harm or catastrophic equipment damage.

1. System Overview

This manual covers both standard and medium-power IR Moisture Measurement sensors. Table 1-1 shows the model numbers and head gap measurements for each type.

Table 1-1 Model Numbers and Head Gap Measurements

Marketing Model No.	Hardware Model No.	Source Power	Head Gap	
			Inch	mm
Q4205-51	094205-51	Standard	0.4	10
Q4205-52	094205-52	Medium	0.4	10

IR Moisture Measurement sensors use the strong and very specific absorption by water of infrared radiation at a wavelength of 1.9 microns to provide a measurement of the amount of water in paper or other materials.

IR Moisture sensors are three-channel transmission sensors that measure the water weight and percent moisture when operated in conjunction with a nuclear Basis Weight Measurement sensor. The source and receiver hardware are mounted on 10-inch-by-7-inch baseplates for assembly into Experion MX heads.

The predecessor to the Q4205-52, the 4205-02, used to be referred to in some documentation as a High Power IR sensor (HPIR). This was misleading as there is an IR sensor using a significantly higher source power. The marketing model number of the high power IR sensor (HPIR) is Q4287-57. The high power IR sensor is not covered in this manual.

1.1. Standard Power Source

The standard power source employs a long-life halogen 20 W 6 V lamp powered by a DC-DC converter on a printed circuit board (PCB) that is under run at 4.4V. An elliptical reflector focuses the light at the 570 Hz tuning fork chopper. A tuning fork driver circuit drives the fork and sends its timing signal to the receiver. There it is used in the demodulation of the received signal to make the sensor insensitive to ambient light.

1.2. Medium Power Source

The medium power source uses the same 20 W halogen lamp and DC-DC converter board as the standard power source, but it uses a low-frequency (170 Hz) chopper wheel powered by a motor and Motor Controller board. The light modulation phase is monitored by a Single-Sided Detector board and the Sync Generator/Lamp Modulator board. An elliptical reflector focuses the light through the chopper wheel aperture onto the sensor window. A low-wavelength blocking filter blocks the visible light to minimize heating of the sheet.

1.3. INFRAND Optics

The sensor uses two flat quartz-Teflon diffusing reflector plates with a single-source aperture and two receiver apertures offset two inches in the machine direction (See Figure 9-5).

Light that passes from the source to the receiver and is not scattered by the sheet enters the straight-through aperture directly above the source aperture.

Light that is scattered by the sheet makes multiple passes through the sheet and enters the receiver optics via the offset aperture. For very light sheets, the average number of passes may be as high as 10; for very heavy sheets, the average number of passes is slightly more than one.

This increased sensitivity to light sheets compensates for the strong scattering of light from fibers that increase the path length inside heavy sheets and thus increases sensitivity in heavy sheets. This offset optics is called INFRAND for INfinite RANDom scattering optics.

The straight-through optics added in InfrandPLUS is further used to compensate for scattering effects and to give even greater independence of sheet composition.

InfrandPLUS employs quartz-Teflon diffusing reflector plates specially constructed for high signal transmission and independence of sheet pass line and flutter. These plates minimize the dynamic offset.

1.4. Receiver Optics

The light that reaches the offset aperture in the receiver window passes to a light pipe, is collected by a lens mounted in the lower body optics block, and is collimated into a parallel beam. The beamsplitter mounted in the upper body transmits about 60% to the REF channel filter and detector, reflecting about 30% to the MES channel filter and detector.

The light that reaches the straight-through aperture in the receiver window passes to a second light pipe, is collected by a second lens mounted in the lower body, is collimated into a second parallel beam, and is attenuated by a neutral density filter also mounted in the lower body. A second beamsplitter in the second upper body reflects about 30% to the 3RD channel filter and detector, and transmits about 60% to a mirror assembly. On InfrandPLUS sensors with the Opacity sensor, the mirror assembly is replaced by the Opacity filter and detector.

The InfrandPLUS medium power IR includes two flags: one for offset optics and one for straight-through optics. The flags are inserted by a single-contact output. They are used to attenuate the light during Background and Standardize, and for onsheet and sample measurement on lighter paper grades. In these situations, without the flags the light would be too intense and the electronics would saturate.

1.5. Receiver Electronics

The IR for each channel is detected by a PbS photoconductive detector and amplified in the Fast PbS Detector Assembly or PbS Detector Assembly. Each channel is further amplified by a Fastcard PCBA and demodulated using the phase signal from the source, resulting in a 0–10 VDC signal for reading.

The PbS detector contains a thermistor and a Peltier cooler that, along with the Temperature Control PCBA, maintain the detector temperature at a few degrees above freezing. This increases sensitivity, reduces noise, and decreases sensitivity to temperature, while the accurate temperature control (±0.005°C) maintains accurate sensitivity to the IR signal.

All of these elements are supported by the Unigauge Backplane, Type II, which passes the various signals and voltages to the other components and houses the DC-DC converters (±15V, 8V, and 250V) used to power the electronics.

1.6. Filter Selection

The three IR bandpass filters for the three channels are chosen according to the application. See Table 1-2 for the wavelengths and functions.

Table 1-2 Wavelengths and Functions

Channel	Wavelength	Function
REF	1.8 microns	Correction for effect of basis weight, dirt, drift, etc.
MES	1.9 microns	Measurement of absorption by water
3RD	1.8 microns	Straight-through signal providing optical compensation for sheet-scattering

Sheet temperature influences all IR moisture sensors to some degree because the absorption spectrum of water shifts with temperature. The shift results from the fact that water molecules tend to group together, and the number of molecules in a group influences the absorption spectrum of the molecules.

At higher temperatures, fewer molecules group together, causing the absorption to shift to lower wavelengths. InfrandPLUS minimizes the sheet temperature effect by carefully balancing the REF and MES filters.

1.7. Specifications

Table 1-3 shows the model numbers and their basis weight ranges for clean furnish.

Table 1-3 Model Numbers and Basis Weight Ranges for Clean Furnish

Marketing Model No.	Hardware Model No.	Standard/Medium Power	Basis Wt. Range	
			gsm	lbs/1000 ft2
Q4205-51	094205-51	Standard	450	92
Q4205-52	094205-52	Medium	750	155

The Medium Power Sensor is recommended for maximum basis weight of 400 to 750 gsm.

The INFRAND VI High Power Sensor (Q4287-57) may be used for 750 to 1000 gsm. For furnish containing elemental carbon from recycle or as a pigment, or iron oxide as a pigment, the basis weight range may be further reduced. For high carbon content, the range may be reduced to only half those given here.

Submit samples to the Honeywell Marketing Department for an evaluation if the choice of sensor is uncertain.

Moisture Range

The standard ranges are 2 to 10% or 12% moisture. Higher ranges are special and they will further restrict the basis weight range and degrade the accuracy. Any range of 10% up to a maximum moisture level of 30% is possible.

Repeatability

2•Sigma = ±0.1% moisture on stirred bagged samples (if heated, moisture in a sample may redistribute, thereby degrading repeatability).

Static Accuracy

2•Sigma = ±0.25% for well-made bagged calibration samples with moisture content ranging from 2% to 10%. When elemental carbon or iron oxide is present, accuracy may be degraded to 2•Sigma ≤ ±0.50%. Above 12% moisture, accuracy is also degraded to 2•Sigma = ±0.02•Sheet Moisture, or in the presence of carbon, 2•Sigma = (±0.02•Sheet Moisture + 0.25%). Note that this accuracy includes not only sensor error, but also calibration, sampling, and lab errors.

Calibration Accuracy

Mean Error ≤ ±0.10%

Dynamic Accuracy

Dynamic accuracy is the same as static accuracy for basis weights up to 300 gsm. Above that, the accuracy may be degraded to 2•Sigma ≤ ±0.50% (or static accuracy, whichever 2•Sigma is higher) due to higher process variations causing greater sampling errors. Note that this accuracy includes not only sensor error, but also calibration, sampling, and lab errors.

Flutter Sensitivity

Full range less than 0.25% moisture (≤ ±0.125%) as long as the sheet is not touching the quartz window. When the sheet touches the window, the sensor deviation may reach ±0.15%.

Sensitivity to Basis Weight

Sensitivity to Basis Weight is negligible for variations within a grade. Between grades, it is also usually negligible. Basis weight sensitivity is normally removed in the calibration by the SingleCal correction.

Sensitivity to Coatings, Additives, and Furnish

Sensitivity to Coatings, Additives, and Furnish is negligible for variations within a grade. Between grades, it is also usually negligible (rarely more than ±0.30%). Sensitivity to composition is normally removed in the calibration by Optical Correction.

Carbon Effect

When used on paper containing elemental carbon (from recycle or added as a pigment), or on paper containing iron oxide as a pigment, the sensor may read substantially low if not corrected by Carbon Correction. Calibration of Carbon Correction is normally performed with papers made with different levels of carbon or iron oxide.

Streak Sensitivity

For a Standard Power sensor, the full width at half maximum of the cross-direction sensitivity profile is from 1 cm (0.4 inch) width in cross-direction. For a Medium Power sensor, this is 2.5 cm (1 inch).

Sample Averaging

70% of response is from 2 inches (5 cm) in machine direction.

Stratification Sensitivity

Stratification sensitivity is negligible up to a basis weight of 200 gsm; less than ±0.25% moisture beyond that.

Response Time

The response times and cutoff frequencies are given in Table 1-4.

Table 1-4 Response Times and Cutoff Frequencies

	Response	Cutoff
Standard Power	2 msec	200 Hz
Medium Power	5 msec	70 Hz

Sensor Temperature Sensitivity

<0.1% moisture/10°F

Sheet Temperature Sensitivity

Sheet temperature dependence is less than ±0.003% moisture/°C.

Dynamic Moisture Loss

The flashoff (evaporation with accompanying heat loss) between the reel scanner and take-up reel is normally corrected in the software with Dynamic Correction. A temperature loss of 23°F (12.8°C) is typically accompanied by a loss of 1% moisture due to flashoff. See Table 1-5 for the typical moisture loss for various products.

Table 1-5 Typical Product Moisture Loss

Product	Moisture Loss
Tissue	1%
Newsprint	0.75%
Fine paper	0.5% to 0.75%
Board	0.25% to 0.5%

1.8. Sensor Window Cleanliness

The software contains the provision for correcting the effect of dirt buildup on the windows. Without correction, the sensor will measure lower with increasing dirt levels. The amount of dirt buildup is indicated by a decrease in the REF channel volts at Standardization relative to those at calibration time (clean windows). The dirt effect depends on basis weight and the calibration constants.

Table 1-6 contains typical sensor errors for a 50% decrease in REF volts if no Dirt Correction is used.

Table 1-6 Typical Sensor Errors without Dirt Correction

Product	ΔM% for 50% Attenuation
Tissue	-0.8 to -1.1%
Newsprint	-0.7 to -1%
Fine Paper	-0.4 to -1%
Board	-0.2 to -0.8%

1.9. Gap (Z) Sensitivity

To correct for normal scanner gap variations, the software contains the provision for correcting the moisture sensor reading using the Z-Sensor. The gap effect depends on the calibration constant EEE (degree of correction for scattering power). If no Z Correction is used, a Z deviation of -0.05 inch (1.27 mm) typically produces the moisture reading deviations shown in Table 1-7.

Table 1-7 Typical Moisture Reading Deviations without Z-Correction

EEE	ΔM% for ΔZ = -.05 Inch
0	+0.25%
0.25	+0.4%
0.5	+0.65%
0.8	+0.8%

1.10. Edge-of-Sheet

The sensor reads slightly low at the edge due to some light going around the sheet. Typically, a sensor reads low by no more than 0.25% up to 1 inch (2.5 cm) from the edge for fine paper. Tissue has less effect; board has somewhat more.

1.11. Power Requirements

Both heads require 24 VDC. The source dissipates about 20W; the receiver also dissipates about 20W.

1.12. Scattering Factor

InfrandPLUS sensors include the additional measurement of a Scattering Factor (also called Scattering Coefficient) to indicate the power of the sheet to scatter light at 1.8 micron wavelength. Due to lack of lab instruments to verify this measurement, no specifications for its accuracy are currently available.

2. Sensor Components

2.1. Hardware description - alignment

To do a hardware alignment, you need:

- A digital voltmeter with two clip leads
- An oscilloscope with two probes

2.1.1. Standard Power Source Assembly

Figure 2-1 shows the Standard Power sensor configuration.

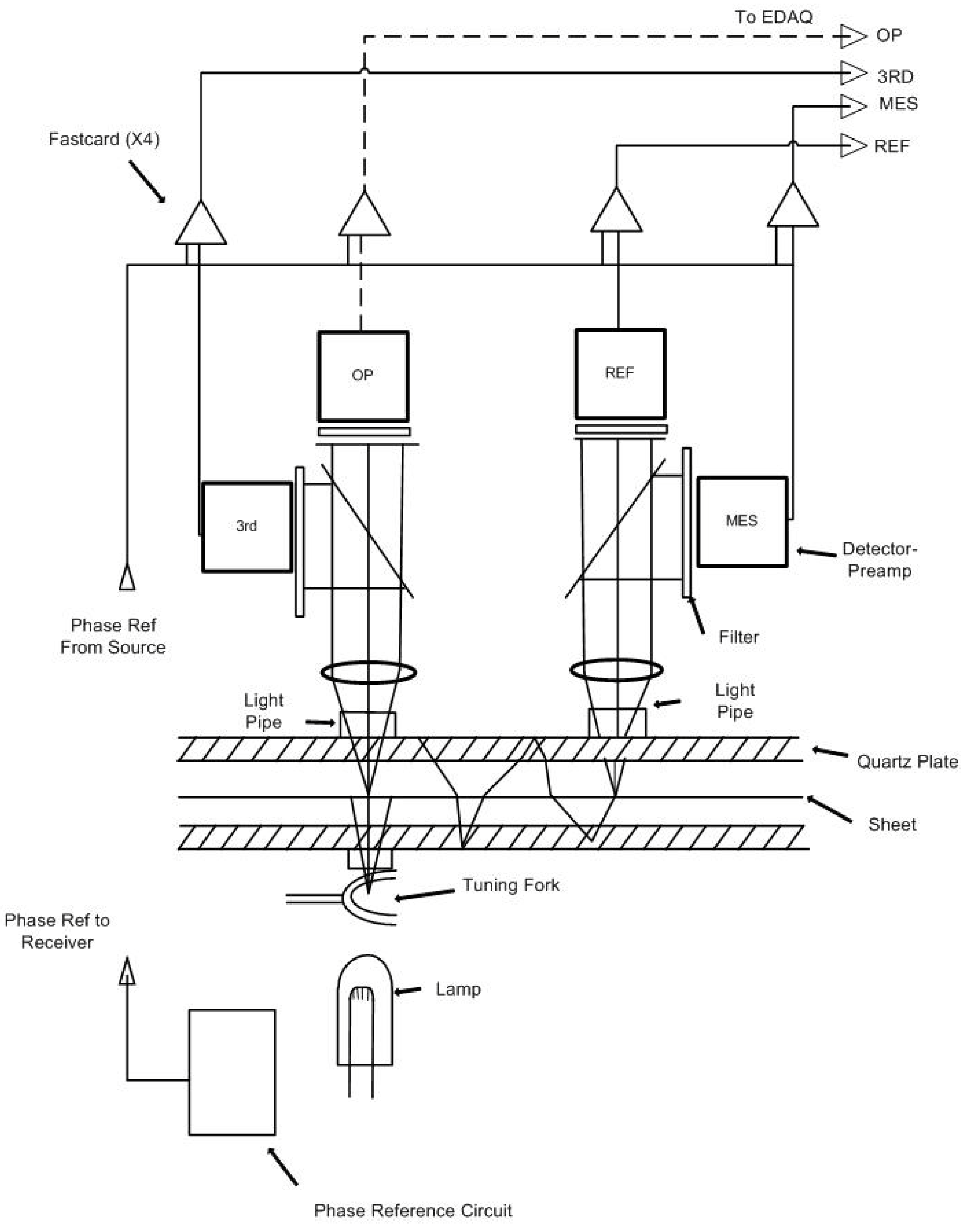


Figure 2-1 Standard Power Sensor Configuration

Figure 2-2 shows the schematic for the Standard Power Source Assembly.

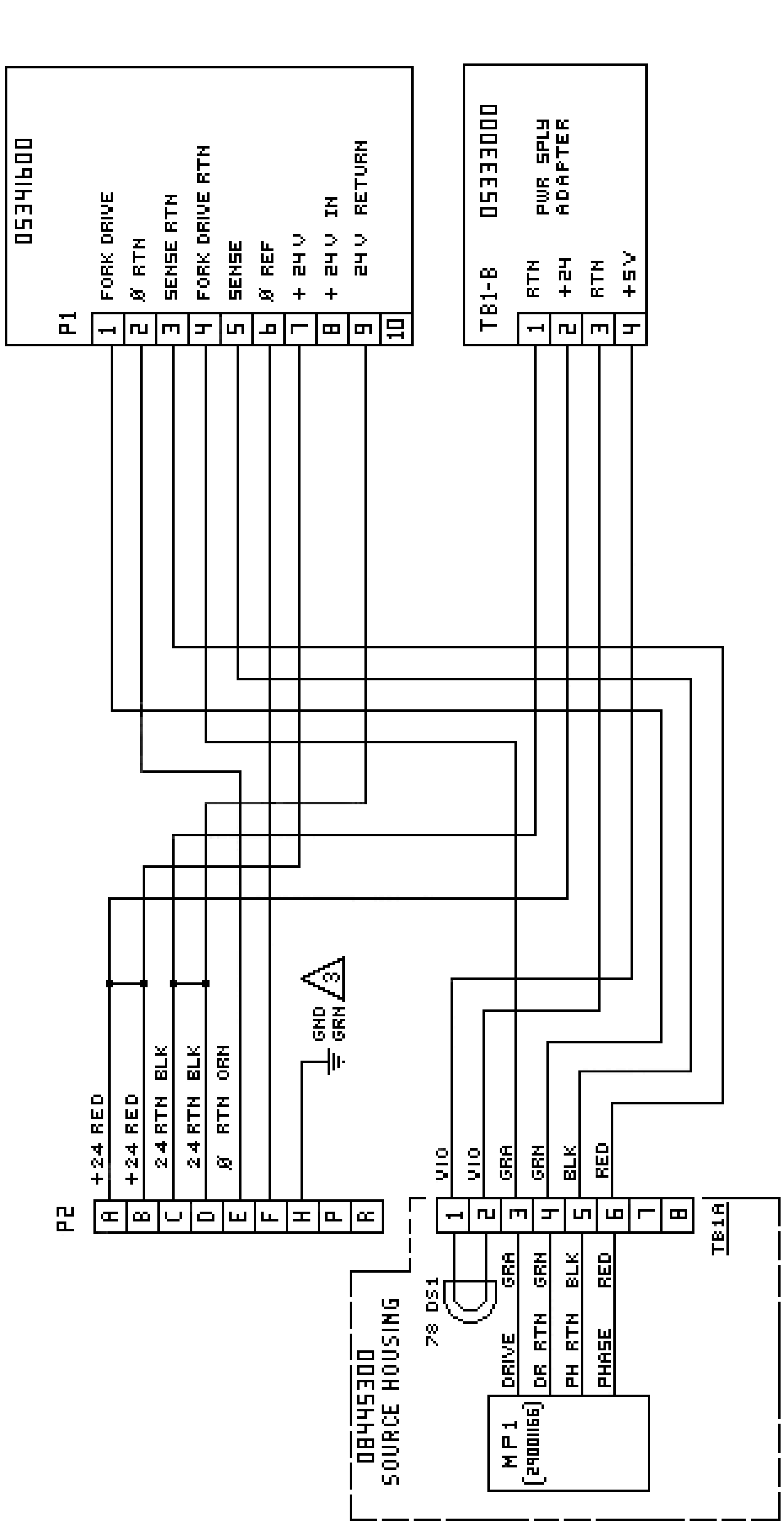


Figure 2-2 Standard Power Source Assembly Schematic

Figure 2-3 shows the Medium Power sensor configuration.

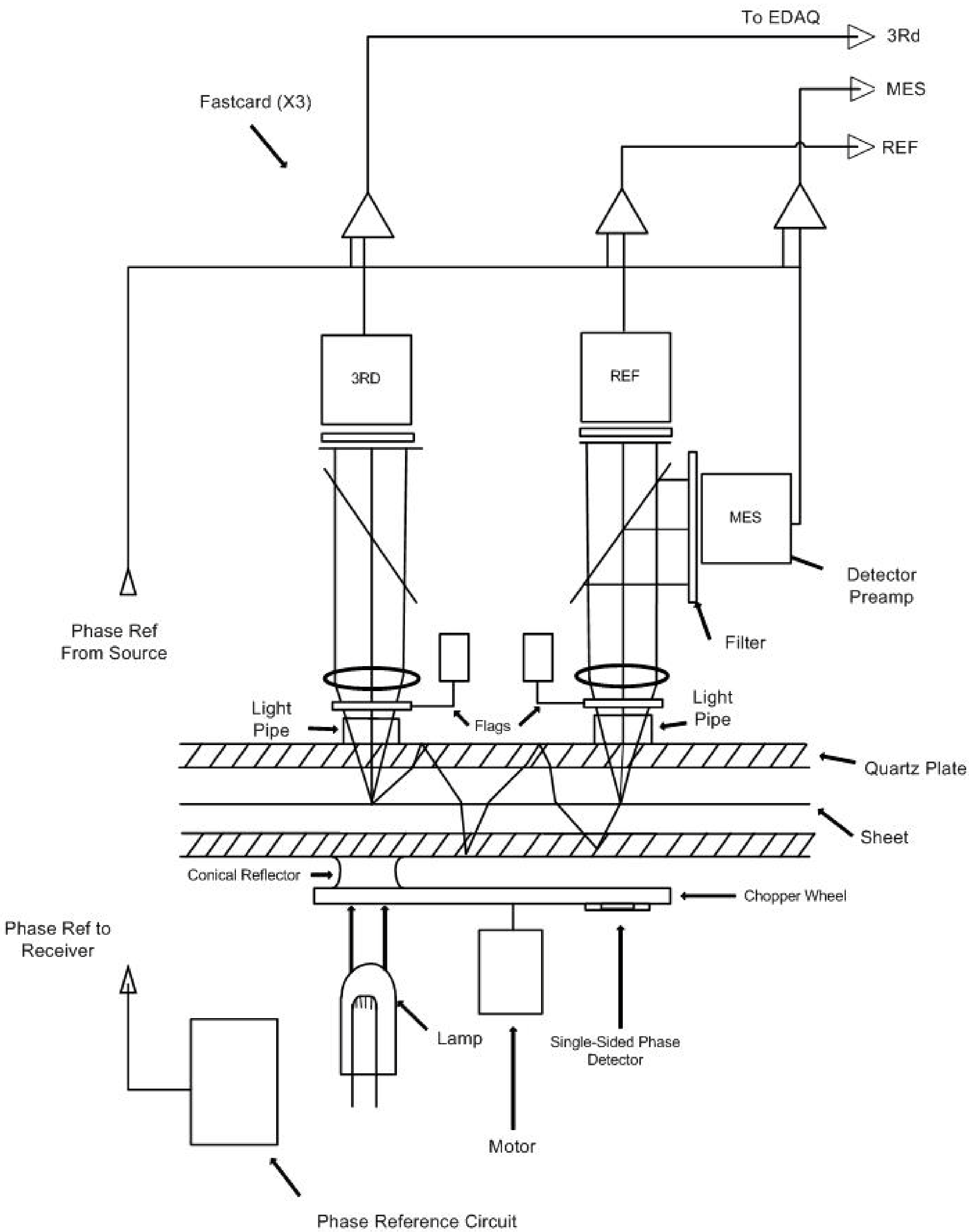


Figure 2-3 Medium Power Sensor Configuration

Figure 2-4 shows Medium Power Source Assembly schematic.

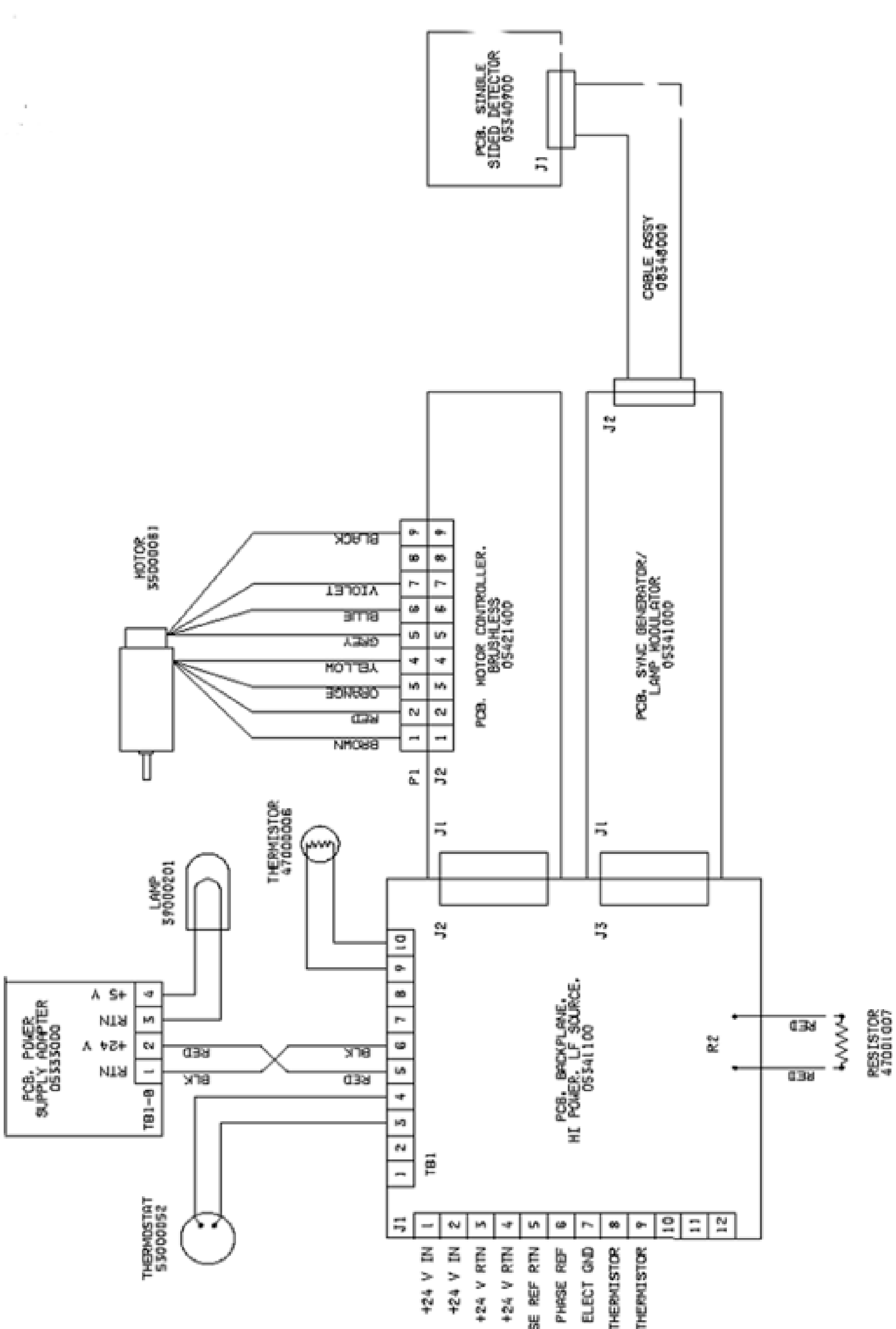


Figure 2-4 Medium Power Source Assembly Schematic

2.1.1.1. Power Supply Adapter Board

The layout of the Power Supply Adapter board (used in both Standard Power and Medium Power sources) is shown in Figure 2-5.

Check that the input voltage is 24 ± 0.5 VDC at TB1-2 (+24V) and TB1-1 (Gnd).

Check that the lamp power is 4.4 ± 0.2 VDC at TB1-4 (+) and TB1-3 (RTN).

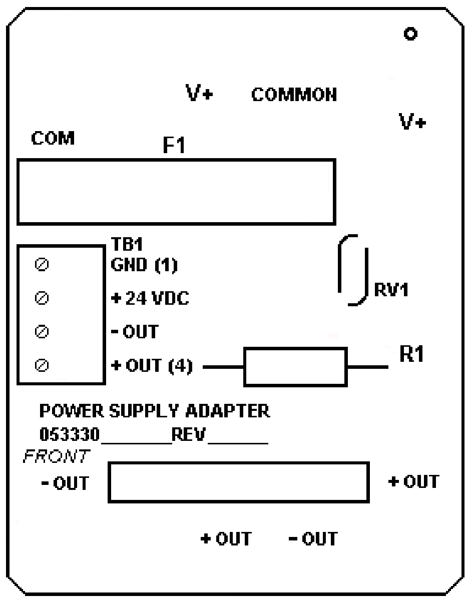


Figure 2-5 Power Supply Adapter Board

2.1.1.2. Tuning Fork Driver Board

See Figure 2-6 for the layout and a block schematic of the Tuning Fork Driver board. The R1 Gain pot attenuates the input signal from the tuning fork, which is then pre-amplified and appears at TP5.

This signal is then attenuated by an AGC circuit which is controlled by a comparison of its output with a reference to hold the amplitude at TP5 constant. The result is amplified by a push-pull amplifier and fed to the drive coil of the fork.

The TP5 signal is also used to generate a square wave for the phase signal sent to the Receiver Assembly. R2 adjusts the bias of the AGC circuit. An auxiliary circuit boosts the gain of the pre-amp when the fork is not vibrating. See Section 9.10 for alignment of the tuning fork driver board.

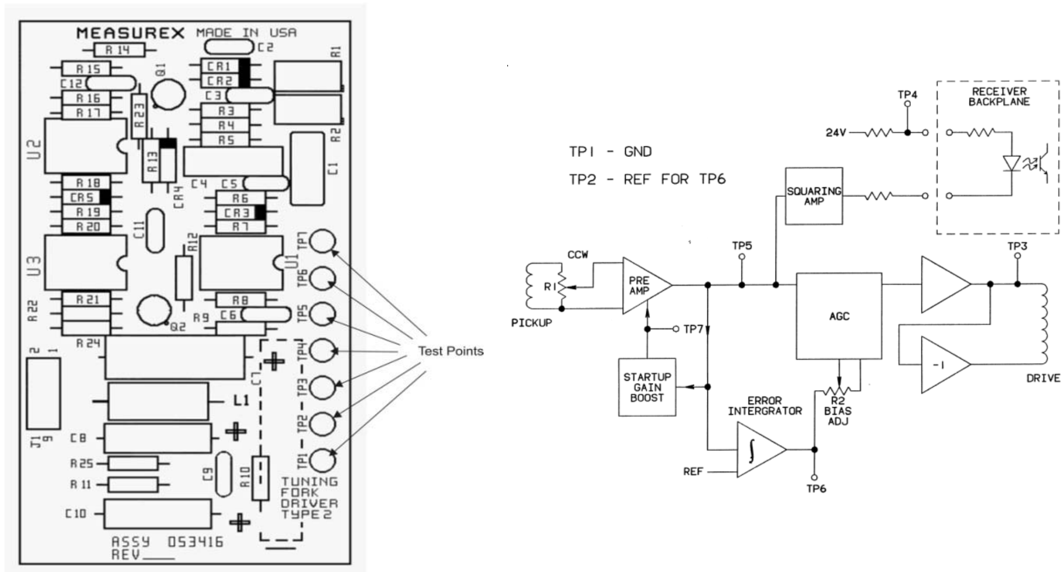


Figure 2-6 Tuning Fork Driver Board and Block Schematic

2.1.2. Medium Power Source Assembly

Figure 2-7 through Figure 2-10 show the Medium Power Source Assembly.

2.1.2.1. Medium Power Source Backplane

See Figure 2-7 for the layout of the Medium Power Source Backplane board.

Check that the lamp is on and the chopper wheel is spinning.

Check for 24 ± 0.5V at TB1-1 (+24) and TB1-2 (RTN) on the Backplane.

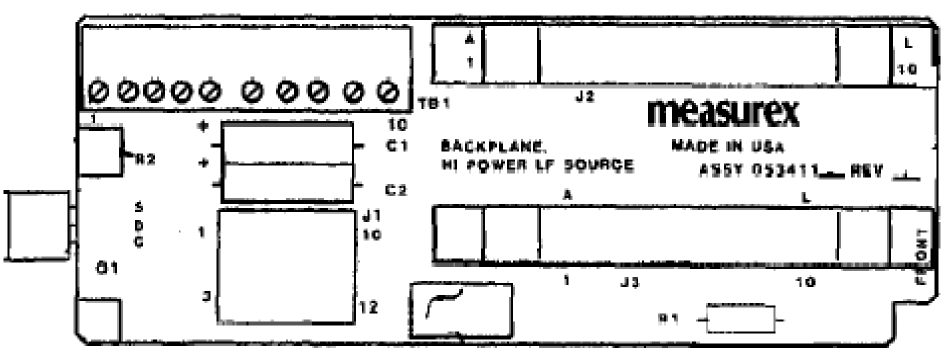


Figure 2-7 Medium Power Source Backplane Board

2.1.2.2. Power Supply Adapter Board

This board is the same as the one used by the standard power source. The board layout is shown in Figure 2-5.

Check that the input voltage is 24 ± 0.5 VDC at TB1-2 (+24V) and TB1-1 (Gnd).

Check that the lamp power is 4.4 ± 0.2 VDC at TB1-4 (+) and TB1-3 (RTN).

2.1.2.3. Sync Generator/Lamp Modulator Board

See Figure 2-8 for the layout of the Medium Power Sync Gen/Lamp Modulator board. Connect the oscilloscope probes to TP3 and TP4 with TP5 as ground. TP3 gives a clean square wave, which indicates clear detection of the chopper wheel position by the Single-Sided Detector. See Figure 2-9 for the layout of the Medium Power Single-Sided Detector board.

TP4 gives narrow clock pulses generated from the small holes in the wheel. Amplitudes should be about 9V. If the signals are not clean or of adequate magnitude, adjust the three spring-loaded mounting screws on the Single-Sided Detector to correct the signals.

TP2 gives a clean square wave of 10V amplitude. The frequency is 170 Hz (period 5.88 ms) +/- 25 Hz. If necessary, the frequency can be adjusted using the pot on top of the Motor Controller board (R2). See Figure 2-10 for the layout of the Medium Power Motor Controller board.

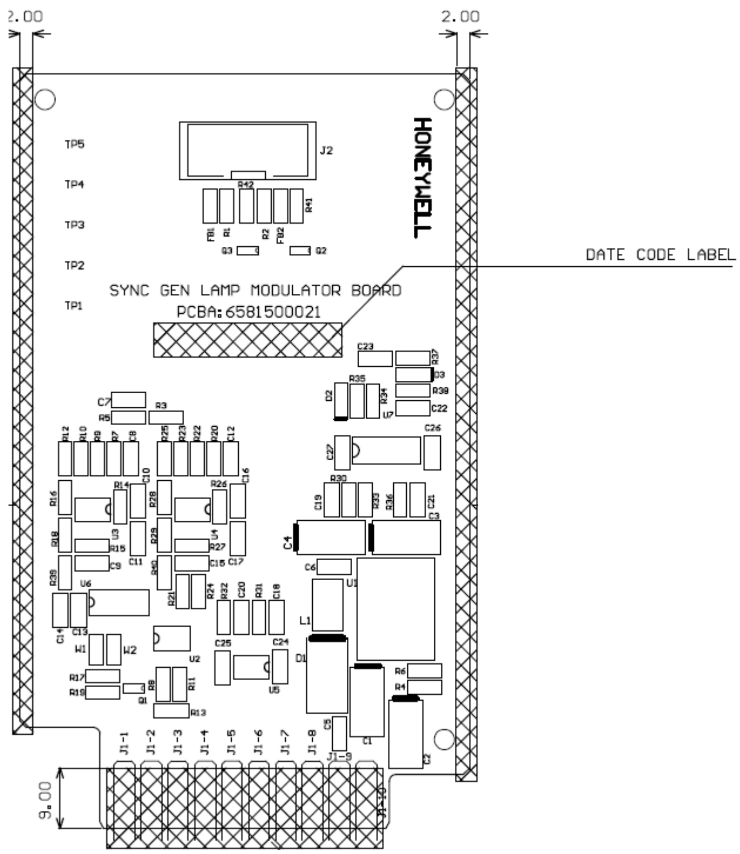


Figure 2-8 Medium Power Sync Gen/Lamp Modulator Board

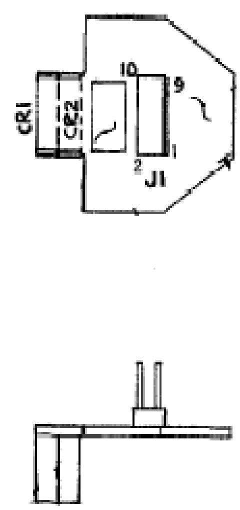


Figure 2-9 Medium Power Single-Sided Detector Board

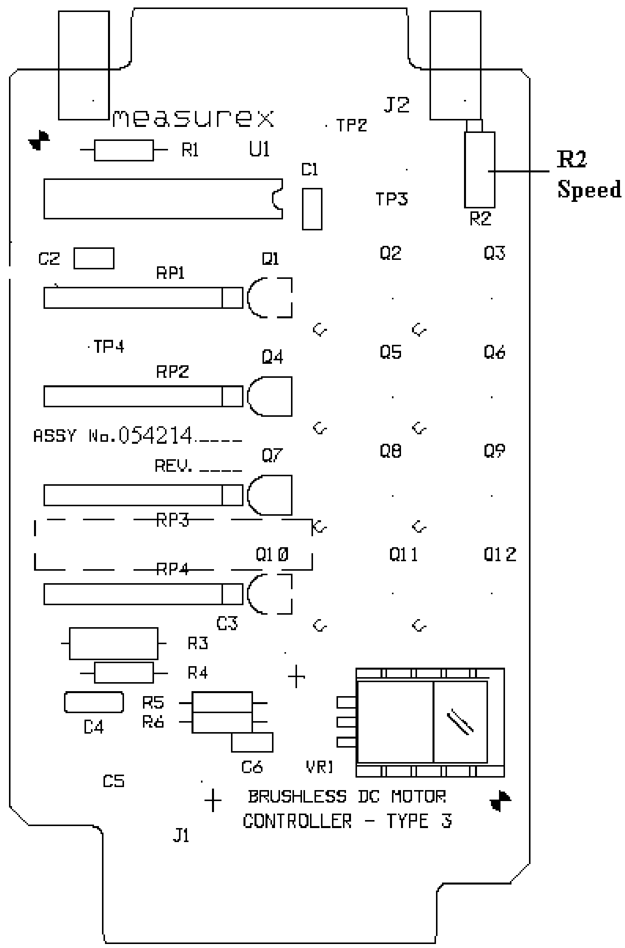


Figure 2-10 Medium Power Motor Controller Board

2.1.3. Receiver Assembly

Figure 2-11 through Figure 2-14 show the Receiver Assembly. Figure 2-11 is the assembly schematic. Figure 2-12 summarizes the test points.

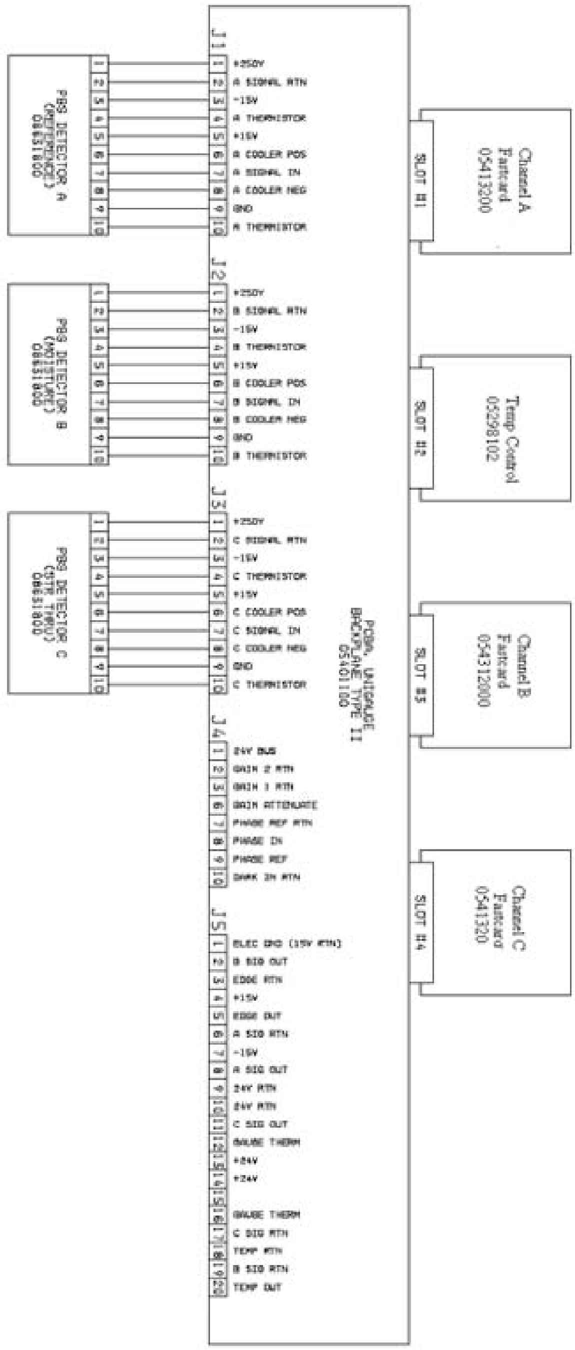
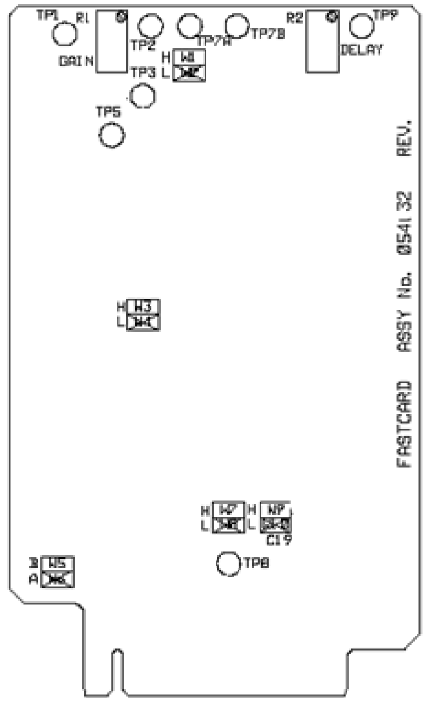


Figure 2-11 IR Receiver Assembly Schematics

Fastcard Board

TP1 GND
TP2 Preamp Signal
TP3 Amplified Signal
TP7A-TP7B Phase Signal
TP8 Added Phase Signal
TP9 Output
W1/W2, W3/W4, W7/W8, W9/W10
High/Low (Standard) Power
W5/W6 Phase A/B



Temperature Control Board

TP1 GND
TP2 Sensor Temperature =15V
TP3-TP4 Cooler A, 0.4 to 0.8 VDC
TP4-TP5 A Control, >0.8 VDC
TP5-TP6 Cooler C, 0.4 to 0.8 VDC
TP6-TP7 C Control, >0.8 VDC
TP7-TP8 Cooler B, 0.4 to 0.8 VDC
TP8-Gnd B Control, >0.8 VDC

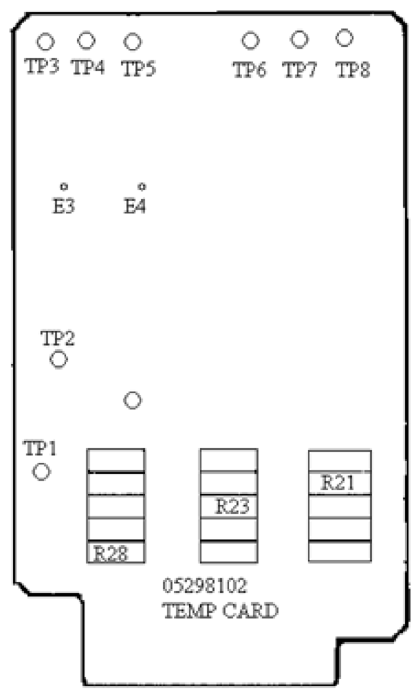


Figure 2-12 Receiver Test Points

2.1.3.1. Backplane Assembly, Type II

See Figure 2-13 for the Backplane Assembly, Type II.

1. Check the input voltage at the two pins of the DC-DC converter at the front of the Backplane. It should read 24 ± 0.5 VDC.

2. Check the voltage between TP3 on the Temperature Control board and ground TP1 on the Backplane. It should read 8.0 ± 0.5 VDC.

3. Check that there is 250 ± 5 VDC between TP8 (the protected red test point) and TP1.

4. Check the ±15 VDC by removing the Temperature control board and the first two Fastcard boards (A and B), and testing the +15 ± 0.5 VDC and -15 ± 0.5 VDC indicated outputs from the middle DC-DC converter, using TP1 as ground. Replace the boards in their appropriate slots.

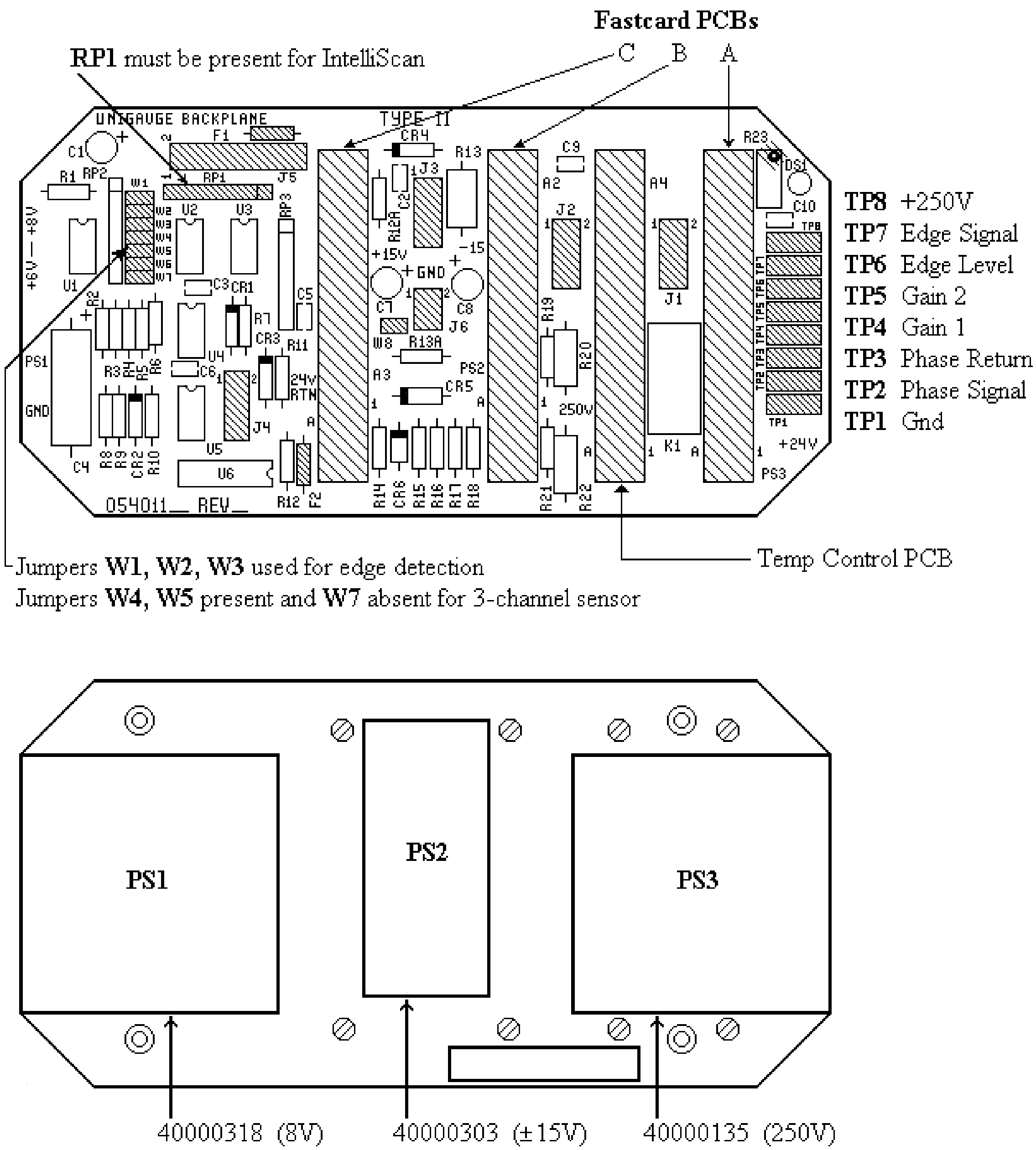


Figure 2-13 Unigauge Backplane Board, Type II

2.1.3.2. Temperature Control Board

With this board and all three Detector Preamps plugged in, check the voltages supplied to the three Peltier coolers. The test points are on the temperature control board (See Figure 2-10).

They should be between 0.4 and 0.8 VDC:

- Cooler A (REF) channel, TP3(+) to TP4
- Cooler B (MES) channel, TP7(+) to TP8
- Cooler C (3RD) channel, TP5(+) to TP6

2.1.3.3. Sensor temperature output

Remove the first Fastcard board and read the voltage between TP1 and TP2 on the Temperature control board.

Adjust R14 on the temperature control board until the voltage reading corresponds to the head temperature (±5ºF or ±2.7ºC) using Table 2-1:

Table 2-1 Relation between temperature sensor voltage output and temperature

Temperature Sensor Voltage Output (VDC)	Temp ° F	Temp ° C
2.24	59	15
2.08	62	16.7
1.94	65	18.3
1.80	68	20
1.68	71	21.7
1.57	74	23.3
1.46	77	25
1.36	80	26.7
1.27	83	28.3
1.18	86	30
1.10	89	31.7
1.03	92	33.3
0.96	95	35
0.90	98	36.7
0.835	101	38.3
0.78	104	40
0.73	107	41.7

Return the first FCA card to its slot.

2.1.3.4. Fastcard board

The layout of the Fastcard board is shown in Figure 2-12. The sensor uses a PbS detector assembly and an associated Fastcard for each channel. See Section 9.11 for alignment of Fastcard board.

2.1.3.5. Edge detection

In a few systems, the IR sensor is used for detecting the edge of the sheet during scanning. In such cases, a jumper on the Unigauge Backplane, Type II, is placed into either W1, W2 (default), or W3 to select the channel (REF, MES, or 3RD, respectively) from which the edge detect is taken.

To adjust the edge detection

1. Bring a sheet of the paper (for example, the lightest grade) into the gap so that its edge is at the cross-direction midpoint of the source spot on the sensor window.

2. Connect a voltmeter between TP7 (+) and TP1 (Gnd) of the Unigauge Backplane.

3. Adjust R23 so that TP7 is high (13 to 15 VDC) when the sheet is out of the beam, and goes low (0 to 1 VDC) when the sheet passes the middle of the beam.

2.1.3.6. Detector and filter locations

See Figure 2-14 for the standard locations of the PbS Detector Assemblies for the three channels. During installation, be sure to check the configuration you have and note it on the figure for future reference.

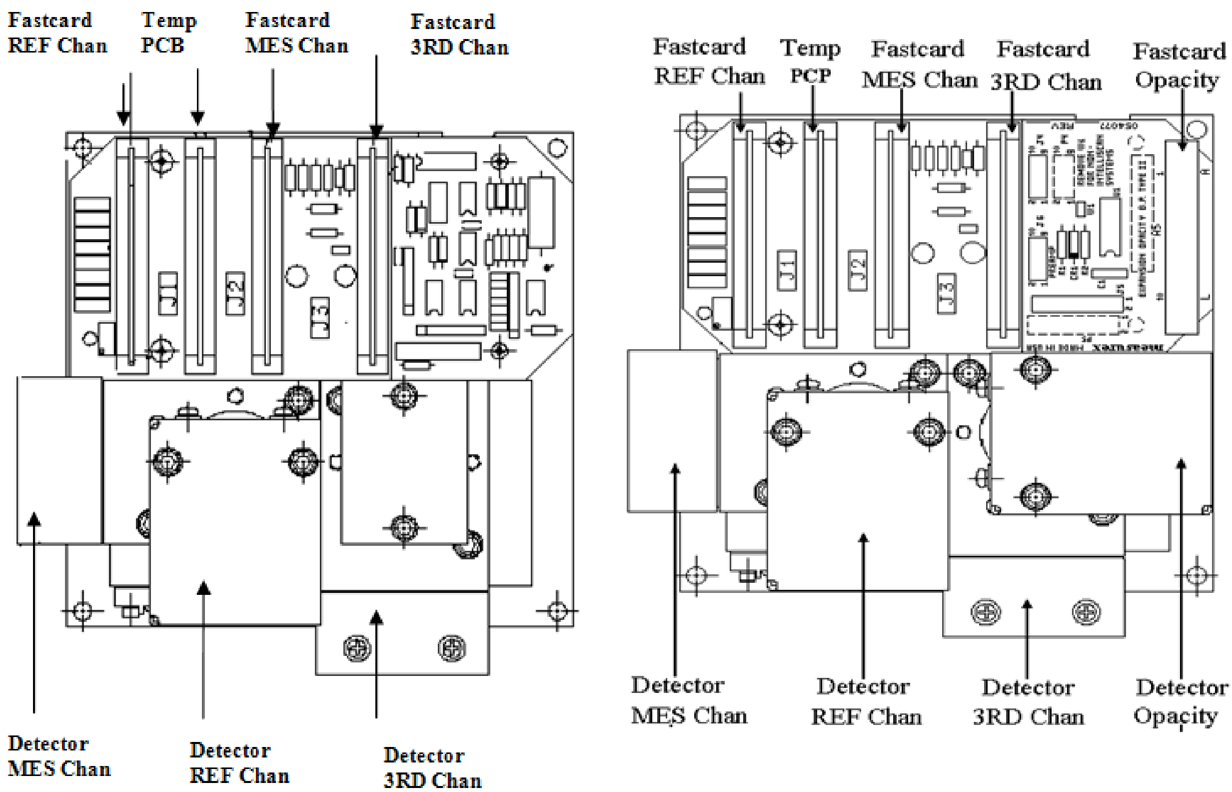


Figure 2-14 Standard Detector Location

2.2. Software description

The IR Moisture Measurement sensor uses Real-Time Application Environment (RAE) software on an Experion MX System.

2.2.1. Inputs and outputs

There are three analog voltage outputs, corresponding to the three channels: REF, MES, and 3RD.

The upper head also provides one temperature output (TEMP) for an ADC.

There are five contact inputs (24 VDC relay or solenoid): DARK, GAIN1, GAIN2, GAIN ATTENUATE, and FLAG.

- DARK zeroes the inputs from the three detectors to allow the software to read the offset due to the electronics for subtraction from all subsequent readings.
- GAIN1 provides an analog gain of about 2.85 to the 3 input signals.
- GAIN2 provides an analog gain of about 9.8 to the 3 input signals. These gains are used to increase the signal levels for heavier grades of paper.
- GAIN ATTENUATE reduces the voltage on the PbS detectors and thus reduces the signals by about a factor of 10 to 20. GAIN ATTENUATE is used to assist in measurement of the precise gains of the GAIN1 and GAIN2 functions during Background.
- In Medium Power IR sensors, FLAG inserts a strongly attenuating flag into each of the Receiver beams during Background, Standardize, and Offsheet, and for some grades while measuring in Sample, Onsheet, and Single Point modes.

2.2.2. Background

Background is scheduled periodically (typically every 8 to 24 hours) to measure the dark offsets and analog gain factors for subsequent correction of the readings. There are 4 phases to background, as shown in Table 2-2.

Table 2-2 Background Phases

Phase		Contact Output Set	REF Reading in Volts	MES Reading in Volts	3^{RD} Reading in Volts
1	Read, Store dark offsets	DARK GAIN ATTEN FLAG (Medium Power only)	Dark volt	Dark volt	Dark volt
2	Read Gain0 Phase	GAIN ATTEN FLAG (Medium Power only)	$Gain0_{REF}$	$Gain0_{MES}$	$Gain0_{3RD}$
3	Read Gain1 Phase	GAIN ATTEN GAIN1 FLAG (Medium Power only)	$Gain1_{REF}$	$Gain1_{MES}$	$Gain1_{3RD}$
4	Read Gain2 Phase	GAIN ATTEN GAIN2 FLAG (Medium Power	$Gain2_{REF}$	$Gain2_{MES}$	$Gain2_{3RD}$

Phase		Contact Output Set	REF Reading in Volts	MES Reading in Volts	3^{RD} Reading in Volts
		only)			

The results from phases 2, 3, and 4 are combined to calculate the analog gains for GAIN0, GAIN1, GAIN2, and GAIN3, respectively. These are typically 1, 2.85, 9.8, and about 28:

$$GAIN0 = 1 \qquad GAIN1 = Gain1/Gain0 \qquad GAIN2 = Gain2/Gain0$$

and

$$GAIN3 = (GAIN1) \bullet (GAIN2)$$

After dark offset correction the analog Gains for the respective phases are calculated and stored for subsequent corrections like gain-compensated channel ratios.

These results are displayed in the sensor report of the Experion MX System when the background report is selected.

$$GAIN0_{REF} = Gain0_{REF} \quad GAIN0_{MES} = Gain0_{MES} \quad GAIN0_{3RD} = Gain0_{3RD}$$

$$GAIN1_{REF} = \frac{Gain1_{REF}}{Gain0_{REF}} \quad GAIN1_{MES} = \frac{Gain1_{MES}}{Gain0_{MES}} \quad GAIN1_{3RD} = \frac{Gain1_{3RD}}{Gain0_{3RD}}$$

$$GAIN2_{REF} = \frac{Gain2_{REF}}{Gain0_{REF}} \quad GAIN2_{MES} = \frac{Gain2_{MES}}{Gain0_{MES}} \quad GAIN2_{3RD} = \frac{Gain2_{3RD}}{Gain0_{3RD}}$$

$$GAIN3_{REF} = \left(GAIN1_{REF}\right) \bullet \left(GAIN2_{REF}\right)$$

$$GAIN3_{MES} = \left(GAIN1_{MES}\right) \bullet \left(GAIN2_{MES}\right)$$

and

$$GAIN3_{3RD} = \left(GAIN1_{3RD}\right) \bullet \left(GAIN2_{3RD}\right)$$

For a Medium Power IR, these values are further multiplied by GFLAG for grades for which the flag is selected to be out during onsheet measurements.

Table 2-3 Gain Factors in 3 Channels

GAIN	REF	MES	3RD
0	1	1	1
1	$GAIN1_{REF}$	$GAIN1_{MES}$	$GAIN1_{3RD}$
2	$GAIN2_{REF}$	$GAIN2_{MES}$	$GAIN2_{3RD}$
3	$GAIN3_{REF}$	$GAIN3_{MES}$	$GAIN3_{3RD}$

The typical values of these gains are 1, 2.85, 9.8, and 28, respectively.

These Gain factors are stored and used in calculating the Gain Compensated channel ratio of the REF, MES, and 3^{RD}. The raw ratio values, RN and RN2, are explained in detail in Section 2.3 and Section 2.4.

2.2.3. Gain and Flag contact output patterns

The sensor analog Gain is grade-dependent and for Medium Power IR sensors the Flag contact output is also grade-dependent. The gain and flag settings are used to ensure that the signals onsheet are not too low and not too high. Signals that are too high may saturate the electronics and have a dramatic effect on the measurement accuracy. Set the gain settings so the channel voltages on-sheet read 8 Volts or less. Low voltages are typically not as much of a concern as signals are digitized right at the sensor by the Sensor EDAQ.

Standard Power: The Gain settings, the corresponding typical analog gain values and typical maximum basis weight for clean furnish for the Standard Power Sensor (094205-51) are:

Gain	Typical Analog Gain	Typical BW max Clean Furnish, gsm
0	1	125
1	2.9	250
2	9.8	375
3	28.5	450

Medium Power: The Gain and Flag settings, the corresponding typical analog gain values and typical maximum basis weight for clean furnish for the Medium Power IR Sensor (094205-52) are given in the next table. Flag IN and Gain 3 is not normally used because Flag OUT and Gain 0 covers the same range with a stronger signal.

Flag	Gain	Typical Analog Gain	Typical BW max Clean Furnish, gsm
IN	0	1	125
IN	1	2.9	250
IN	2	9.8	375
IN	3	28.5	400 (not used)
OUT	0	20	450
OUT	1	58	575
OUT	2	196	700
OUT	3	570	750

2.3. Reference/Standardize

A Reference or a Standardize are identical operations. The term Reference is used when it is manually requested in Maintenance mode, while a Standardize is scheduled periodically during sensor scanning in Production mode. These functions consist of: taking a reading on an empty gap to correct Sample and Onsheet readings for dirt buildup on the sensor windows, electronic drift, lamp brightness changes, and so on. In the Medium Power sensor, the flags in the receiver assembly are inserted to prevent saturation of the electronics.

The reference (or standardize) measurement gives the net open volts (Dark volt subtracted measurements) for the three channels. These net open volts are stored and used in determining the gain-compensated channel ratios of REF, MES, and 3RD, which are explained in Section 2.4.

Standardize ratios are also calculated from the net open volts as follows:

$$RS = \frac{REF}{MES} \qquad RS2 = \frac{REF}{3RD}$$

According to the gain selection, the analog REF gain factor (REFGR) is calculated. For standard power IR, REFGR=GAIN$_{REF}$.

On a Standard Power sensor, the value of REFGR is 1 for GAIN0, about 2.85 for GAIN1, about 9.8 for GAIN2, and about 28 for GAIN3.

For a Medium Power sensor, this value is further multiplied by GFLAG for grades for which the FLAG is selected to be out during Sample/Onsheet measurement. Here GFLAG is a calibration constant and is equal to the attenuation factor of the offset optics flag. For Medium Power:

$$REFGR = GAIN_{REF} \bullet GFLAG$$

The REFGR value is subsequently used in carbon correction and dirt correction.

The value DIRTY is calculated for subsequent use in Dirt correction. The DIRTY calculations are defined as Ratios of time-zero REF to now REF, time-zero MES to now MES, and time-zero 3RD to now 3RD, respectively.

In the following equation, T0 REF is a time-zero constant, which is the REF channel measurement at the calibration time.

$$DIRTY = \frac{T0\ REF}{REF} - 1$$

The sensor report displays the Dark volts, the net open volts of the three channels, and the ratios of the three channels to their time-zero calibration values respectively when a reference report is requested. This ratio is stored for subsequent use in Dirt correction. It will also display the standardize ratios: RS and RS2.

The values of RS and RS2 are compared with their time-zero calibration values: RS0 and RS20. If the absolute value of the difference between the now and time-zero values drift by more than the allowed limits (default .05), an alarm is generated.

2.4. Sample/Onsheet

The Sample and Onsheet readings involve several optional correctors. For temporary usage, these correctors can be enabled or disabled by choosing them in the recipe-based options in the Sensor Maintenance display. For permanent storage, these have to be set-up in the grade codes through the MOIP configuration table in the Recipe Maintenance display.

A sample operation request displays the measurement of the REF, MES, and 3RD channels in net volts. These measurements are used to determine the channel ratios of the RES, MES, and 3RD.

The channel ratios of the REF, MES, and 3RD are defined as:

$$\text{Channel Ratio REF} = \frac{\text{REF}_{\text{Standardize}}}{\text{REF}_{\text{Sample}}}$$

$$\text{Channel Ratio MES} = \frac{\text{MES}_{\text{Standardize}}}{\text{MES}_{\text{Sample}}}$$

$$\text{Channel Ratio 3RD} = \frac{\text{3RD}_{\text{Standardize}}}{\text{3RD}_{\text{Sample}}}$$

Based on the GAIN selection, Gain-compensated channel ratios are further computed as:

$$\text{Gain Compensated Channel Ratio REF} = (\text{Channel Ratio REF}) \bullet (\text{GAIN}_{\text{REF}})$$

$$\text{Gain Compensated Channel Ratio MES} = (\text{Channel Ratio MES}) \bullet (\text{GAIN}_{\text{MES}})$$

$$\text{Gain Compensated Channel Ratio 3RD} = (\text{Channel Ratio 3RD}) \bullet (\text{GAIN}_{\text{3RD}})$$

The raw ratios are defined as:

$$\text{RN} = \frac{\text{Gain Compensated Channel Ratio MES}}{\text{Gain Compensated Channel Ratio REF}}$$

$$\text{RN2} = \frac{\text{Gain Compensated Channel Ratio 3RD}}{\text{Gain Compensated Channel Ratio REF}}$$

The principal measurement comes from the ratio RN-1, which is proportional to the water weight. To make the measurement more accurate under a wide variety of conditions, correctors are applied sequentially. At each stage, a corrected Ratio minus one is calculated and displayed on the Sensor Maintenance display. The final corrected value is called RCOR-1; it is used to calculate the water weight. The calculations for moisture are defined in the following sections.

2.4.1. Raw ratios

For standard power, the raw ratios are:

$$RN = \frac{\text{Gain Compensated Channel Ratio MES}}{\text{Gain Compensated Channel Ratio REF}}$$

$$RN2 = \frac{\text{Gain Compensated Channel Ratio 3RD}}{\text{Gain Compensated Channel Ratio REF}}$$

$$REFA = \frac{REF_{\text{Sample}}}{REF_{\text{Standardize}} \bullet REFGR} = \frac{REF_{\text{Sample}}}{REF_{\text{Standardize}} \bullet GAIN_{\text{REF}}}$$

On a Medium Power sensor for grades for which the flags are selected to be out during Sample, Onsheet, and Single Point measurement, an additional correction is made to RN and RN2 to correct for the effects of the flags.

$$RN = \frac{\text{Gain Compensated Channel Ratio MES}}{\text{Gain Compensated Channel Ratio REF}} \bullet GFLAG2$$

$$RN2 = \frac{\text{Gain Compensated Channel Ratio 3RD}}{\text{Gain Compensated Channel Ratio REF}} \bullet GFLAG3$$

GFLAG2 and GFLAG3 are calibration constants (see Section 2.5).

$$REFA = \frac{REF_{\text{Sample}}}{REF_{\text{Standardize}} \bullet REFGR} = \frac{REF_{\text{Sample}}}{REF_{\text{Standardize}} \bullet GAIN_{\text{REF}} \bullet GFLAG}$$

2.4.2. Gap (Z) correction

The formula for Z-Correction is:

RZ-1 = (RN-1) • [1+ZCR1 • (ZCR2+REFA) • (Zmm/ZmmST-1)]

RZ2-1 = RN2 • [1+ZCR3 • (Zmm/ZmmST-1)] – 1,

where ZCR1, ZCR2 and ZCR3 are calibration constants, Zmm and ZmmST are the Z values now and at standardize, respectively.

2.4.3. Dirt correction

The formula for Dirt Correction is:

RD-1 = (RZ-1) • (1+KDTY • DIRTY • REFA)

RD2-1 = RZ2 • (1+KDT2 • DIRTY • (1-REFA))-1,

where KDTY and KDT2 are calibration constants.

2.4.4. Optical (InfrandPLUS) correction

The algorithm for Optical Correction is Honeywell confidential. It uses the ratios RD and RD2, the calibration constants EEE and FFF, and produces the ratio RT.

2.4.5. HiCurve correction

$$\mathrm{RH} - 1 = \left[\frac{\mathrm{RT}}{(1 + \mathrm{CURV} \bullet \mathrm{RT})} \right] - 1,$$

where CURV is a calibration constant

2.4.6. SingleCal (Basis Weight) correction

The algorithm for SingleCal Correction is Honeywell confidential. It uses the ratio RH, the basis weight in gsm, the calibration constants BBB and CCC, and produces the ratio RS-1. The calibration constants FFF and BWMIN are no longer used for SingleCal.

2.4.7. Low Curve correction

The Low Curve (Breakpoint) correction is used in a few low moisture applications. If RS<RBRAK (the breakpoint), then:

$$\mathrm{RL} - 1 = \mathrm{RS} - \frac{\mathrm{DDD} \bullet (\mathrm{RBRAK} - \mathrm{RS})}{\mathrm{AAA} \bullet (\mathrm{RBRAK} - 1)} - 1,$$

Where AAA and DDD are calibration constants.

2.4.8. Carbon correction

The algorithm for Carbon Correction is Honeywell confidential. It uses the ratios RL-1 and REFA, the basis weight in gsm, the calibration constants C2, C3, and GGG, and produces the ratio RK-1. The final corrected ratio is:

RCOR-1 = RK-1

2.4.9. Water weight

The water weight in gsm is calculated as:

$$\mathrm{WW} = \mathrm{DDD} + \mathrm{AAA} \bullet (\mathrm{RCOR\text{-}1})$$

2.4.10. Static percent moisture

The static percent moisture is calculated as MSTAT = 100 • WW/BW, where BW is the basis weight in gsm. During Sample mode, this is the entered basis weight target; onsheet, it is the current slice value. MSTAT is the percent moisture value reported in the Sample mode.

2.4.11. Dynamic percent moisture

Onsheet there is also the Dynamic Correction for flashoff (evaporation) from the sheet between the scanner and the reel:

$$\mathrm{MDYN} = \mathrm{MSTAT} \bullet [\mathrm{DMAE} - \mathrm{KAYE} \bullet (\mathrm{TEESH} - \mathrm{TOSH})] - \mathrm{DMBE},$$

where TEESH is the temperature value from the Sheet Temperature sensor or from the Air Gap Temperature sensor and DMAE, KAYE, TOSH and DMBE are calibration parameters.

2.4.12. Scattering factor

InfrandPLUS includes a measurement of Scattering Factor. This uses the offset and straight-through ratios with moisture corrections:

$$ROF = \frac{1 + MCOF \bullet (RN - 1)}{REFA}$$

$$RST = \frac{RN2 \bullet [1 + MCST \bullet (RN - 1)]}{REFA},$$

where MCOF and MCST are calibration constants.

The Scattering Ratio and Scattering Power are calculated:

$$RSD = \frac{RST - 1}{ROF^{ESD}},$$

where ESD is a calibration constant.

$$SD = ASD \bullet (RSD - DSD),$$

where ASD and DSD are calibration constants.

The Scattering Factor is:

$$SC = \frac{SD}{BWGSM}$$

2.5. Calibration constants

2.5.1. Time-Zero (Calibration Time) Constants

Table 2-4 shows the time-zero moisture calibration constants determined in the factory from empty-gap Standardize or Reference. These are typical values for the Standardize measurements.

Checked and re-determine these measurements in the field at installation or when the sensor is aligned or repaired.

Table 2-4 Time-Zero Moisture Calibration Constants

Name	Typical value	Description
T0 REF	7.0 to 8.0V	REF net volts at time zero
T0 MES	7.0 to 8.0V	MES net volts at time zero
T0 3RD	7.0 to 8.0V	3RD net volts at time zero
RS0	1.00 ± 0.07	Standardize ratio of REF/MES at time zero
RS20	1.00 ± 0.07	Standardize ratio of REF/3RD at time zero
GFLAG	20 ± 2	FLAG Attenuation (Medium Power IR)
GFLAG2	1.00 ± 0.1	FLAG Corrector (Medium Power IR)
GFLAG3	1.00 ± 0.1	FLAG Corrector (Medium Power IR)

2.5.2. Static Moisture Calibration Constants

Table 2-5 shows the static moisture calibration constants determined in the factory calibration. Normally, only AAA and DDD should be re-determined in the field.

Other calibration constant changes require use of the MOICAL calibration utility.

Table 2-5 Static Moisture Calibration Constants

Name	Range	Description
AAA	0.5 to 20	Water weight slope
DDD	±10	Water weight intercept
BBB	±0.01	SingleCal primary corrector
CCC	±100	SingleCal secondary corrector
CURV	±0.3	HiCurve Correction
EEE	0 to 0.5 Std Pwr 0 to 0.8 Medium Power IR	Optical Correction primary corrector
FFF	±1	Optical Correction secondary corrector
C3	20 to 200	Carbon Correction scale factor
C2	-1000 to 200	Carbon Correction basis weight offset

Name	Range	Description
GGG	0 to 1.25	Carbon Correction primary corrector

C2 must be outside of the basis weight range in gsm (that is, either negative or less than the minimum basis weight, or greater than the maximum basis weight).

2.5.3. Scattering Parameter Default Constants

Table 2-6 shows the default calibration constants normally used for the Scattering Parameter measurement.

Table 2-6 Scattering Parameter Default Calibration Constants

Name	Function	Value
ASD	Slope	35,000
DSD	Offset	0 for tissue 0.144 for all but tissue
ESD	Exponent	0.75
MCOF	Moi Corrector	0
MCST	Moi Corrector	0

2.5.4. Correctors Determined On-Site

Table 2-7 shows the calibration constants normally determined or entered on site.

Table 2-7 Calibration Constants Entered On-Site

Name	Default	Description
DMBE	0	Dynamic intercept corrector
DMAE	1	Dynamic slope corrector
KAYE	0	Dynamic temperature corrector
T0SH	100ºF	Temperature at static cal (Dynamic temp)
ZCR1	0	Z-correction for RN
ZCR2	0	Z-correction for RN
ZCR3	0	Z-correction for RN2
KDTY	0	Dirt correction for RN

Name	Default	Description
KDT2	0	Dirt correction for RN2

For the recommended values for dynamic correctors, see Subsection 6.3.3.

For the recommended values for Z Correction, see Subsection 6.3.4.1.

For the recommended values for Dirt-Correction, see Subsection 6.3.4.2.

If there is enough dirt buildup on the quartz plates to significantly reduce the volts on the offset optics channels REF and MES, then RS2 may also be lowered and go out of limits. In this case, clean the plates more often and, if necessary, increase the tolerances for the limit checks on RS2. To increase the tolerance:

1. Press **SETUP** on the horizontal dispatcher.
2. Select **Recipe Maintenance**.
3. Under **MAIN CODE TABLE**, select the **Moisture Sensor** (for example, **MOIP11) Limit Table**.
4. Increase the **Moisture Sensor ratio limit and/or ratio drift limit** value.

3. EDAQ

The Ethernet Data Acquisition (EDAQ) board is responsible for converting all analogic and digital signals to and from sensors to Ethernet.

It replaces the functionality of the National Instrument cards seen in previous Honeywell scanner systems.

The board is based on an ARM CPU running the Linux Operating System and an FPGA that controls real-time data acquisition. [1]

The EDAQ board contains a large number of input output systems, including

- Analog Inputs (16 inputs of 12 bits @ 4KHz and 8 inputs of 10 bits @ 1 Hz),
- Analog Outputs (2 @ 12 bits),
- Digital Inputs (16 @ 24V logic),
- Digital Output (16 @ 24 V logic),
- Frequency input (400 Hz -500 KHz),
- Three serial ports,
- USB (presently unused) and
- Ethernet.

Except for a few dedicated signals such as the Green Light (radiation safety), all sensor signals connect through the EDAQ to the new Experion MX MSS by Ethernet.

[1] The EDAQ contains software licensed under third party licenses including the Gnu Public License (GPL). A copy of that software and its source code can be obtained from **http://www.honeywell.com/ps/thirdpartylicenses** or found on the Experion MX distribution media under: *C:\Program Files\Honeywell\Experion MX\MSS\SenLan\Images\GPL*.

The EDAQ contains sensor specific code for all sensors. All EDAQs, including the EDAQ performing Frame Motion Control (in the end bell) and the head alley EDAQ are identical and can be interchanged.

3.1. Physical Layout

Figure 3-1 and Figure 3-2 show the EDAQ PCBA (p/n 6581500030) as it is mounted next to a sensor. To the left are the Digital and Analog I/O, which connect directly to a sensor. Below these two large connectors is a 16 pin expansion connector that is only used when the EDAQ is attached to the frame controller expansion board (p/n 6581500032).

To the right are Ethernet, some diagnostic LEDs, serial connections and temperature inputs. There are no test points for use in the field. A serial debug port is available (115200 kbs, no flow control, 8N1) that may be connected to any PC running a serial terminal program. For diagnostic purposes, service personal may be asked to connect a serial cable between this debug port and the RS-232 of any neighboring EDAQ.

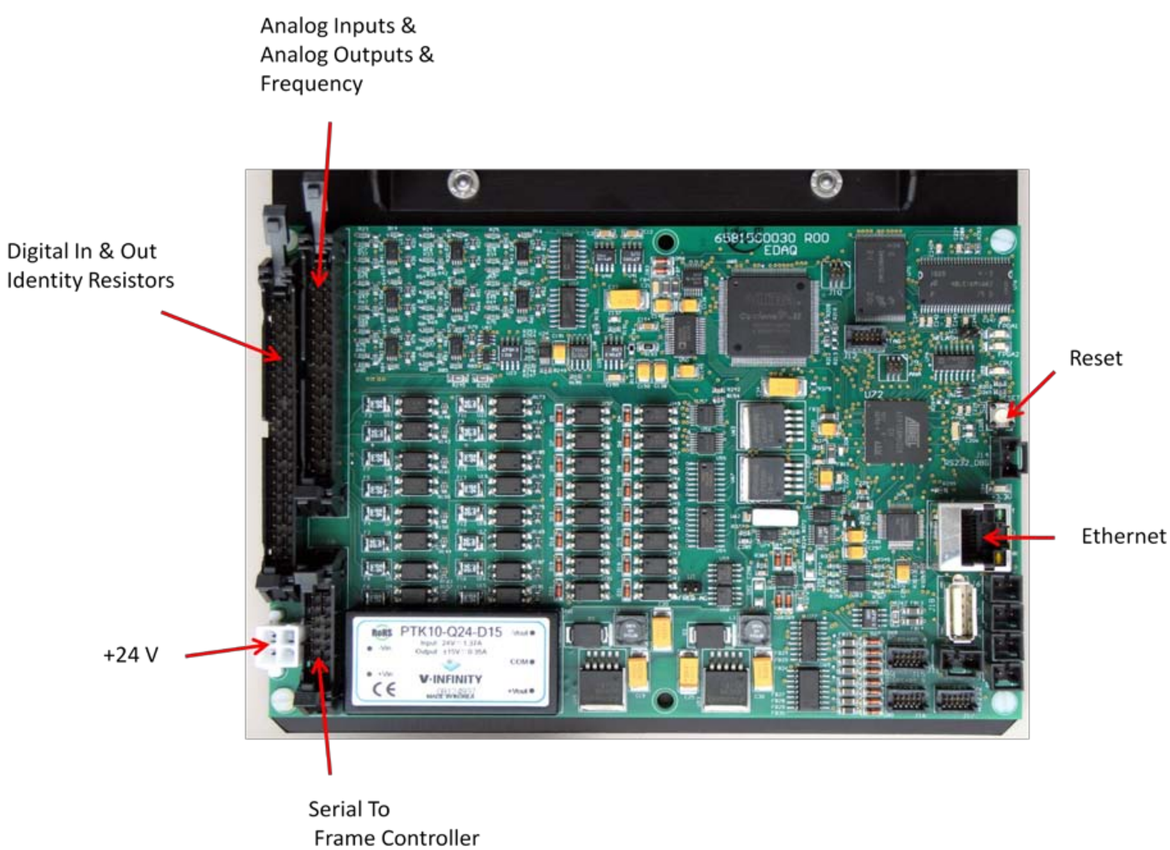


Figure 3-1 Top view of EDAQ board

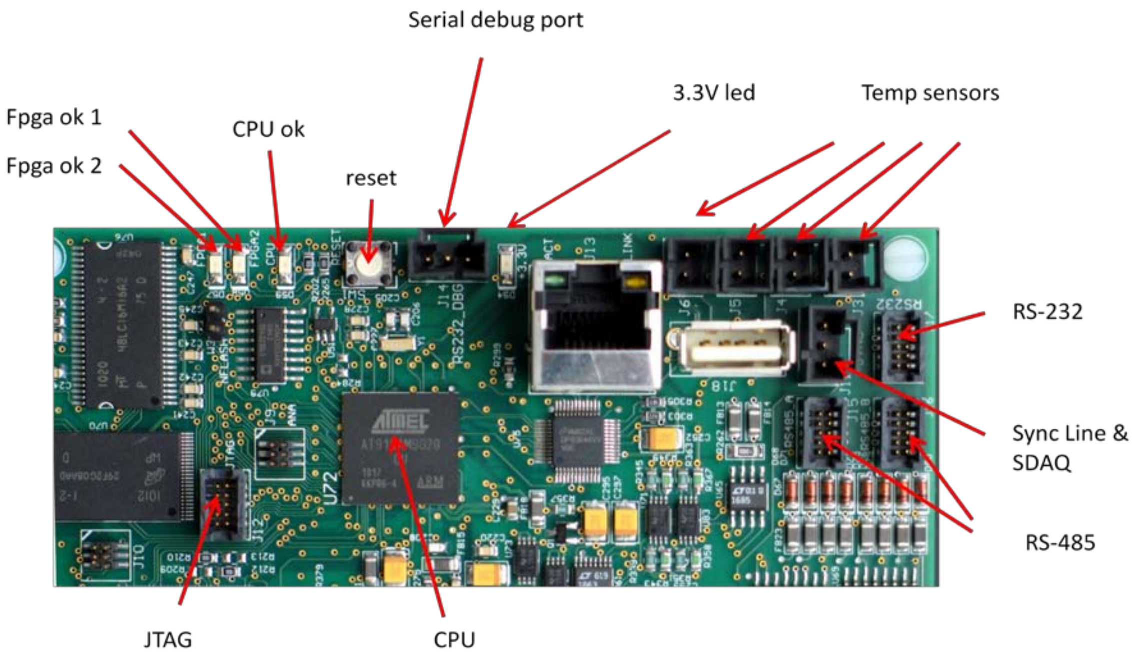


Figure 3-2 Enlarged view of the top right corner of the EDAQ to show LEDs and I/O connectors

3.2. Hardware Status Information

There are four diagnostic LEDs on the EDAQ. See Figure 3-2.

- 3.3 V LED. When lit, this indicates that all power supplies on board are functional. The signal is derived from the 3.3 V power supply, which in turn is derived from the 15 V power supply, which is derived from the +24V input.
- CPU OK LED. This LED is under control of the central ARM CPU. It will be lit when the main sensor application (edaqapp) is running on the CPU
- Fpga ok 1 (not used at present)
- Fpga ok 2. This LED will blink if the FPGA is loaded and running code

In addition, the Ethernet connector contains two LEDs: amber indicating good link to the switch, green indicating activity on the network.

3.3. EDAQ reset

A soft reset of the EDAQ may be performed through a Web interface running on the scanner MSS. This interface may be accessed from a RAE station.

A hardware reset can be performed by pressing the white button next to the debug cable. This resets both the CPU and FPGA and is equivalent to a power on/off.

3.4. EDAQ Sensor Identification and IP addressing

All EDAQs, assuming their firmware (flash code) is the same, are identical. EDAQs can be freely interchanged between sensors and the scanner end bell.

Each EDAQ contains all the code for all supported sensors and loads the appropriate software depending on the identification ID code read at boot time. Two resistors are used to uniquely identify the EDAQ.

For sensor-connected EDAQs, there is a sensor model resistor embedded in the cable harness connecting the sensor to the EDAQ. This resistor determines the Function Code. Function Codes are unique for each sensor model to the extent that the EDAQ needs to differentiate the models (for example, all Source 9 Basis Weight Measurement Sensors presently have the same Function Code, regardless of radioactive isotope).

In addition, the head power distribution board has a resistor for each EDAQ platform connector. This determines the position of the EDAQ in the head. The EDAQ can self-identify both its position and function.

Refer to the Scanner System Manual to troubleshoot if the EDAQ does not identify itself properly or how to find the correct resistor values.

Every EDAQ has a unique IP address on the scanner network. If the EDAQ can identify its position, it will set its IP address to 192.168.0.XYZ (where XYZ is the position number in the head. The Frame Controller EDAQ (FC-EDAQ) always sets itself to IP number 192.168.0.2. The MSS is always 192.168.0.1 on the scanner network and usually 192.168.10.(n+100) (where n is the number of MSSs on the same MX Experion network) on the Experion MX LAN. The MSS is assigned 192.168.10.101 at the factory, but this can be set to any IP address by using the MSS web page. Refer to the MSS chapter in your Scanner manual.

If an EDAQ fails to determine a position, it requests an address of the local DHCP server (which is either running on the FC-EDAQ or the MSS). Any laptop will get an IP address once plugged into any of the scanner Ethernet switches.

3.5. Obtaining Status Information

3.5.1. Experion MX Platform

An overall status page is available from a RAE Station under the MSS Setup Diagnostics tab. Choose the MSS Summary Page.

Figure 3-3 shows, on the left, a list of all expected EDAQs with three types of status indicators (from left to right):

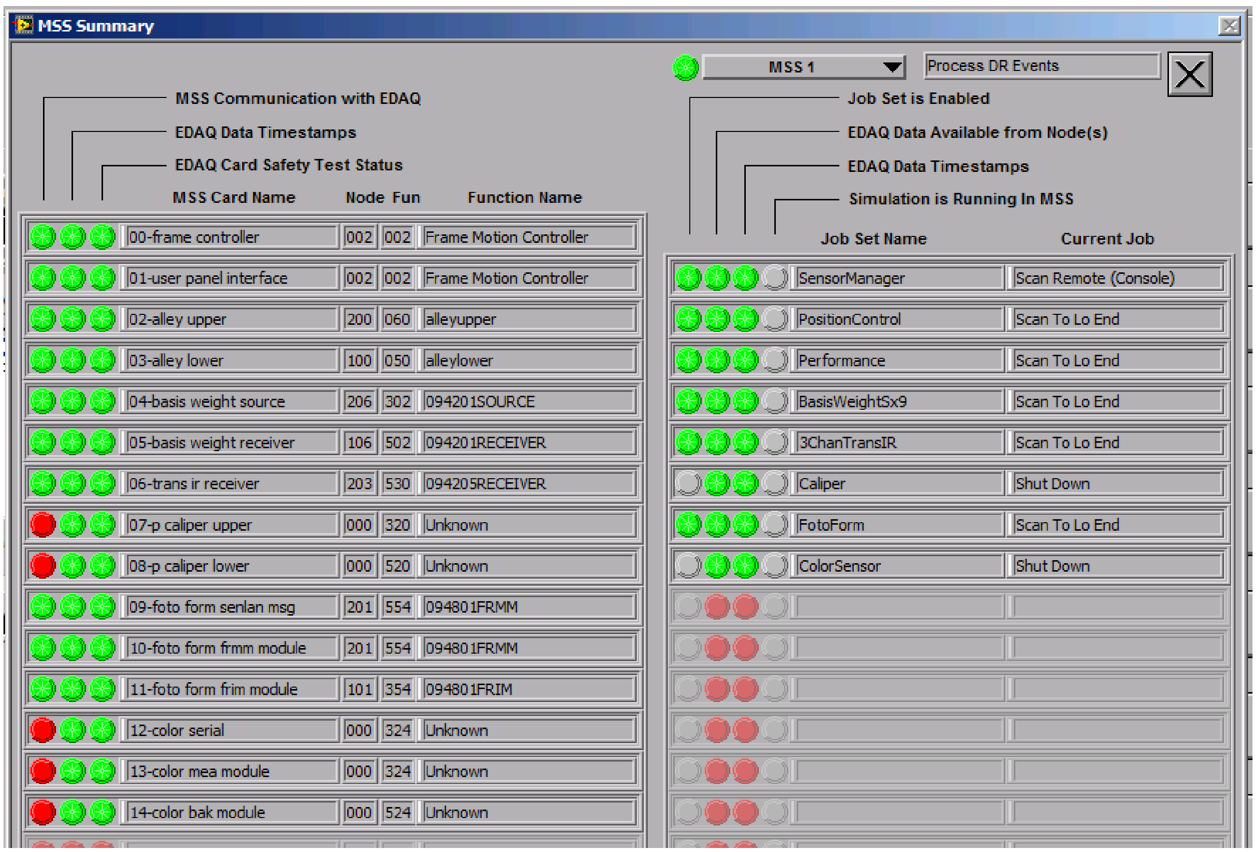


Figure 3-3 MSS Diagnostic page displaying EDAQ status

Table 3-1 MSS Summary Display Status Indicators and their meanings

Column	Description
MSS Communication with EDAQ	EDAQ is communicating (through the EDAL protocol) with the MSS
EDAQ Data Timestamps	Data that the MSS is expecting from that EDAQ is being supplied at the expected rate
EDAQ Card Safety Status	EDAQ is not reporting any errors such as interlock or motion control issues

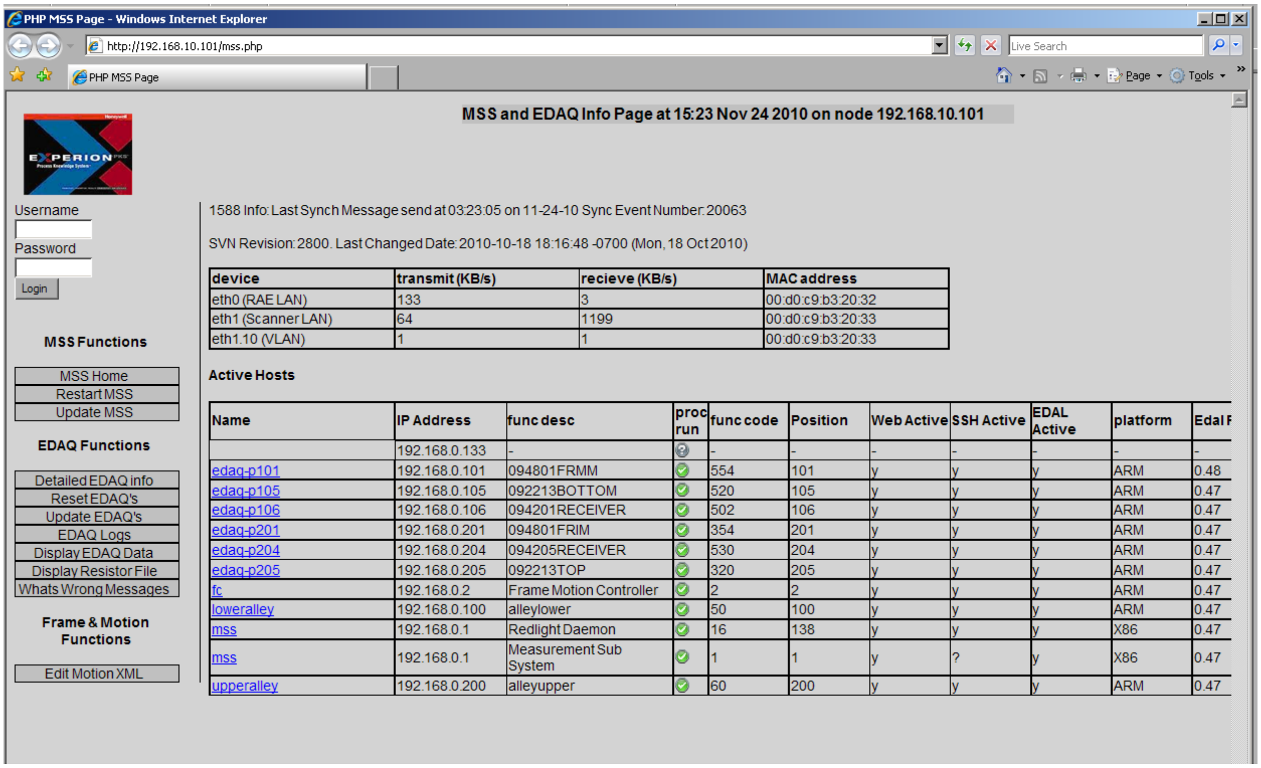
Sensors that are part of the RAE database but are not enabled on the scanner show the left most column indicator as red (caliper in the above example).

3.6. MSS and EDAQ Web Pages

Much more detail is available on the MSS and the EDAQs, which all run web-servers and can display server pages containing information on the state of the system. As a general rule, consult the MSS web pages first. They are accessible in three different ways:

- From RAE by going to the MSS Diagnostic tab, clicking on MSS Monitor, choosing the appropriate MSS and clicking on MSS web page
- By opening a browser on any computer connected to the Experion MX level network and using the address *http://192.168.10.101/mss.php* (the first MSS on the LAN) or the address set up for the MSS in the Experion MX system
- By opening a browser on any computer connected to the scanner LAN switch and using the address *http://192.168.0.1/mss.php* or *http://192.168.10.101* (for the 1st MSS on the system)

Figure 3-4 is the main MSS web page.



device	transmit (KB/s)	recieve (KB/s)	MAC address
eth0 (RAE LAN)	133	3	00:d0:c9:b3:20:32
eth1 (Scanner LAN)	64	1199	00:d0:c9:b3:20:33
eth1.10 (VLAN)	1	1	00:d0:c9:b3:20:33

Name	IP Address	func desc	proc run	func code	Position	Web Active	SSH Active	EDAL Active	platform	Edal F
	192.168.0.133	-		-	-	-	-	-	-	-
edaq-p101	192.168.0.101	094801FRMM		554	101	y	y	y	ARM	0.48
edaq-p105	192.168.0.105	092213BOTTOM		520	105	y	y	y	ARM	0.47
edaq-p106	192.168.0.106	094201RECEIVER		502	106	y	y	y	ARM	0.47
edaq-p201	192.168.0.201	094801FRIM		354	201	y	y	y	ARM	0.47
edaq-p204	192.168.0.204	094205RECEIVER		530	204	y	y	y	ARM	0.47
edaq-p205	192.168.0.205	092213TOP		320	205	y	y	y	ARM	0.47
fc	192.168.0.2	Frame Motion Controller		2	2	y	y	y	ARM	0.47
loweralley	192.168.0.100	alleylower		50	100	y	y	y	ARM	0.47
mss	192.168.0.1	Redlight Daemon		16	138	y	y	y	X86	0.47
mss	192.168.0.1	Measurement Sub System		1	1	y	?	y	X86	0.47
upperalley	192.168.0.200	alleyupper		60	200	y	y	y	ARM	0.47

Figure 3-4 Main MSS web page

The left panel shows a column of options divided into:

- MSS functions
- EDAQ functions
- Frame and Motion Functions

Enter the username (admin) and password for advanced diagnostic options that are not necessary for normal operation and not discussed in this manual.

The main panel shows two tables. The top table contains transmission volume information to and from the MSS. The device labeled **eth1** (Scanner LAN) typically shows it receiving a few MBs. The MAC addresses of the MSS are also shown – the **eth0** address is that required in the RAE setup.

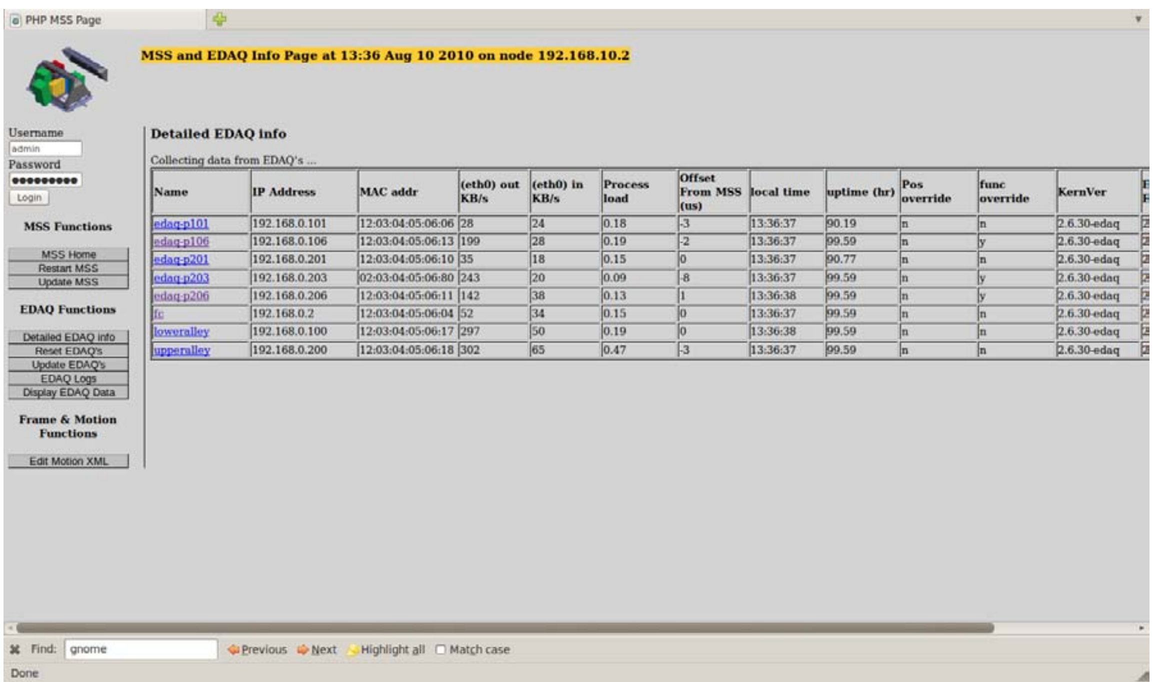
The second table lists all EDAQs discovered on the Scanner LAN, their IP numbers, a brief description (related to model number), a program status column, the associated Function Code, Position Code and whether the communication protocols are running (http, ssh and Edal, the proprietary sensor data transmission protocol).

The EDAQ network name is specified by edaq-p*XYZ* where *XYZ* is both its position and last octet of the IP address. The EDAQs attached to the head power distribution boards are known as *upper* and *lower* alley respectively. The FC-EDAQ is known as *fc*.

The Proc/Run status column is green if all processes known to run on the EDAQ are present. Hovering the cursor over the status indicator brings up a list of running and stopped processes.

More detailed information on each EDAQ can be obtained by clicking **Detailed EDAQ Info** on the left panel.

The resulting table (see Figure 3-5) shows a number of technical details that are not discussed in this document. Important columns include **Process Load** (usually less then <0.5), **local time** (matches MSS time clock shown at top) and **Offset From MSS** (less than 50 uS a few minutes after start up).


PHP MSS Page

MSS and EDAQ Info Page at 13:36 Aug 10 2010 on node 192.168.10.2

Username
admin
Password
Login

MSS Functions
MSS Home
Restart MSS
Update MSS

EDAQ Functions
Detailed EDAQ info
Reset EDAQ's
Update EDAQ's
EDAQ Logs
Display EDAQ Data

Frame & Motion Functions
Edit Motion XML

Detailed EDAQ info

Collecting data from EDAQ's ...

Name	IP Address	MAC addr	(eth0) out KB/s	(eth0) in KB/s	Process load	Offset From MSS (us)	local time	uptime (hr)	Pos override	func override	KernVer
edaq-p101	192.168.0.101	12:03:04:05:06:06	28	24	0.18	-3	13:36:37	90.19	n	n	2.6.30-edaq
edaq-p106	192.168.0.106	12:03:04:05:06:13	199	28	0.19	-2	13:36:37	99.59	n	y	2.6.30-edaq
edaq-p201	192.168.0.201	12:03:04:05:06:10	35	18	0.15	0	13:36:37	90.77	n	n	2.6.30-edaq
edaq-p203	192.168.0.203	02:03:04:05:06:80	243	20	0.09	-8	13:36:37	99.59	n	y	2.6.30-edaq
edaq-p206	192.168.0.206	12:03:04:05:06:11	142	38	0.13	1	13:36:38	99.59	n	y	2.6.30-edaq
fc	192.168.0.2	12:03:04:05:06:04	52	34	0.15	0	13:36:37	99.59	n	n	2.6.30-edaq
loweralley	192.168.0.100	12:03:04:05:06:17	297	50	0.19	0	13:36:38	99.59	n	n	2.6.30-edaq
upperalley	192.168.0.200	12:03:04:05:06:18	302	65	0.47	-3	13:36:37	99.59	n	n	2.6.30-edaq

Find: gnome Previous Next Highlight all Match case

Done

Figure 3-5 Partial display of EDAQ detailed information

4. Installation

Before installing an Infrared (IR) Moisture Measurement sensor, read about the components and operation of the sensor as detailed in Chapter 1 and Chapter 2.

4.1. Mounting and electrical connections

The receiver and source part of the moisture sensor can be installed by sliding the sensor part and sheet guide combination in the appropriate location. See your Scanner manual for details on head design.

The moisture sensor source is typically installed in the bottom head while the receiver is installed in the top head. Make sure that the Infrand plates are oriented properly. Make sure the borders around the plates appear as in Figure 4-1.

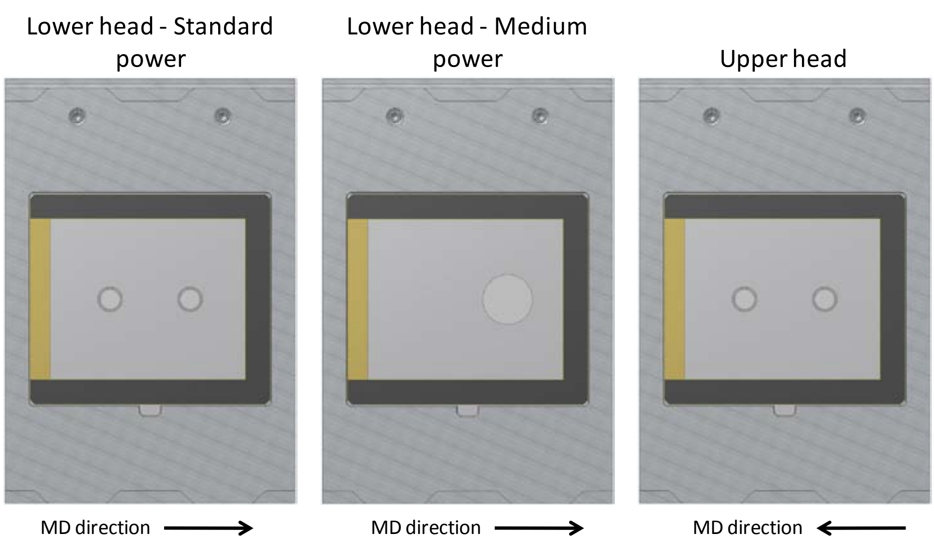


Figure 4-1 Correct orientation of Infrand plates

Only the sensor receiver uses an EDAQ. Connections to the EDAQ are shown in Figure 4-2.

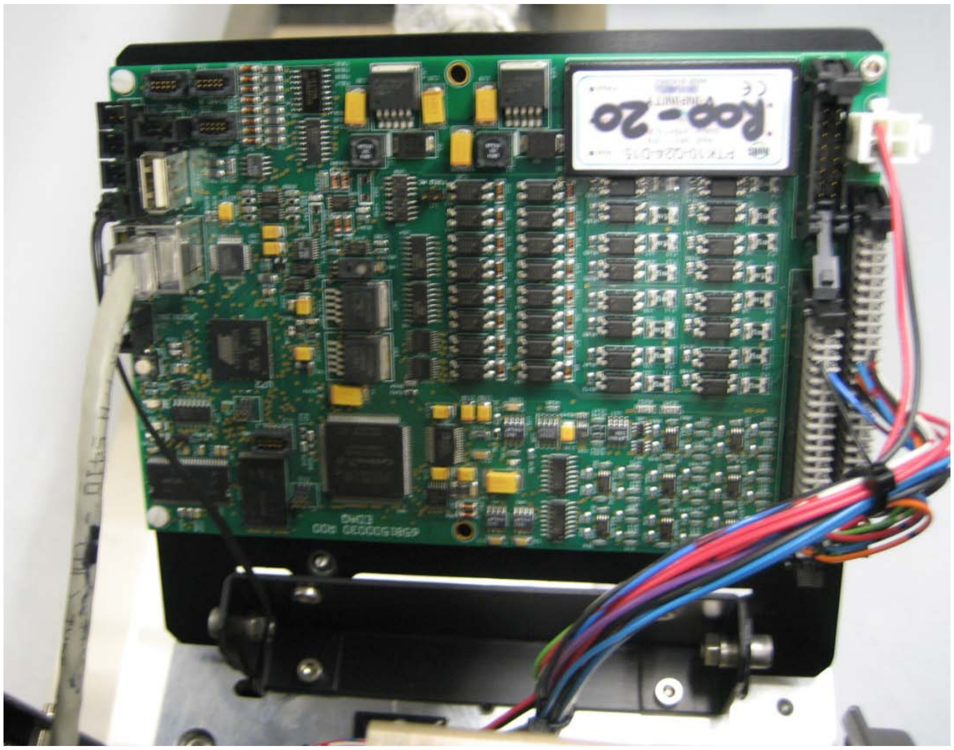


Figure 4-2 Electrical connections to EDAQ in moisture receiver

4.2. Sensor commissioning task list

1. Check that the calibration constants in maintenance mode or production mode for a given code match the ones in the calibration data sheets provided with the system.

2. Check the source alignment. For standard power sensors see Subsection 2.1.1. For Medium Power sensors see Subsection 2.1.2.

3. Check the receiver alignment (see Subsection 2.1.3.1, Subsection 2.1.3.2, and Subsection 2.1.3.4)

4. Verify the static calibration samples (see Section 7.3).

5. Recalibrate as needed (see Chapter 7).

6. Enable Z-Correction and enter the appropriate Z-Correction calibration constants (see Subsection 6.3.4).

7. Enable Dirt Correction if required and enter the appropriate Dirt Correction calibration constants (see Subsection 6.3.4).

8. Enter nominal Dynamic Correction calibration constants (see Subsection 6.3.1).

9. Perform dynamic calibration (see Section 6.3).

5. Software Configuration Parameters

This chapter describes how to setup grade codes with the proper gain settings (gain/flag for Medium Power) and calibration tables in the Experion MX software.

5.1. Gain setup

To set up gain (Gain/Flag for Medium Power):

1. Go to **Setup** and choose the **Recipe Maintenance** display.
2. Create a table for each gain setting in the following setup and configuration tables:
   - MSS Setup
   - IRP Configuration Table

The appropriate tables created can be selected in the Main Code Table of each grade code (Recipe) for the desired gain (Gain/Flag for Medium Power) settings.

You can also set up a MOIP Calibration Table for each of the recipe codes, and select the appropriate table in the Main Code Table for each of the grade codes (Recipe).

For temporary usage, the calibration constants can also be entered through the **Calibration Constants Table** under **Calibration Parameters** in the Sensor Maintenance display.

For permanent storage, enable/disable the appropriate correctors in the grade codes through the MOIP Configuration Table in the Recipe Maintenance display on the setup menu. The appropriate correctors can be enabled or disabled by setting True or False in the MOIP Configuration Table. These can also be enabled or disabled through the recipe-based options under the configuration parameters in the Sensor Maintenance display for temporary usage.

To enable a corrector, double-click on the appropriate corrector and a check mark shows in front of it to indicate that it is enabled. To disable a corrector, double-click on it again and the check mark disappears.

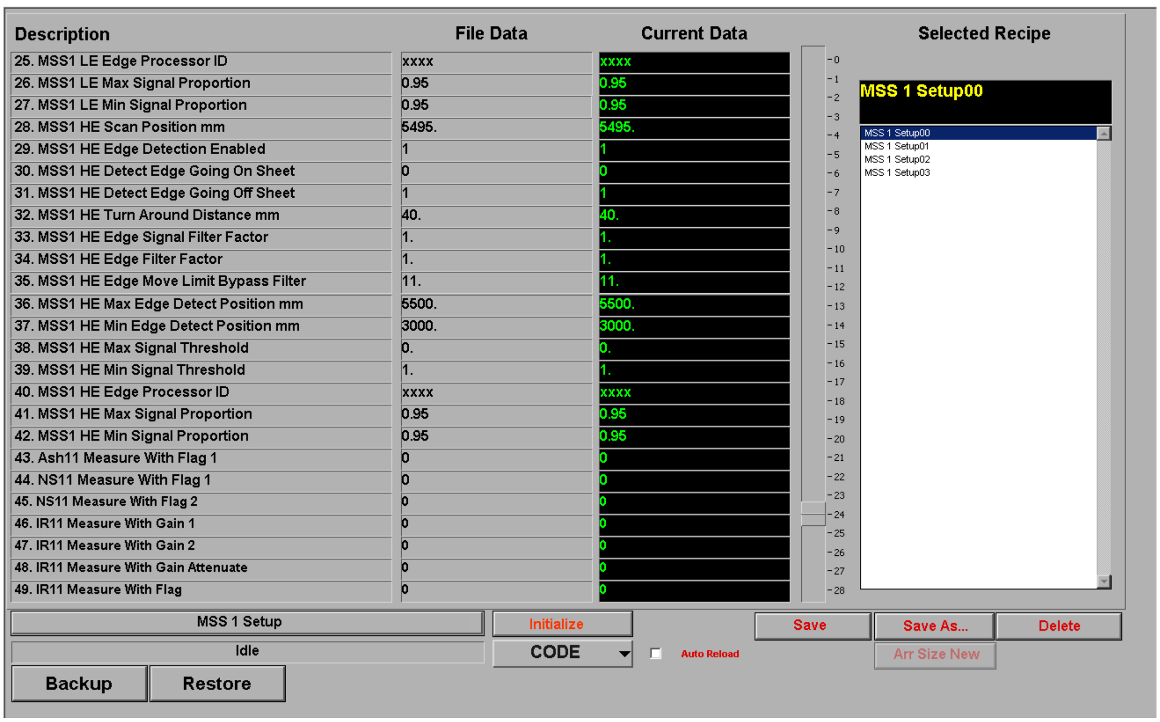
5.1.1. MSS setup

Create an MSS Setup Table for each gain (Gain/Flag for Medium Power IR); for example, MSS 1 Setup00 to MSS 1 Setup03 (see Figure 5-1).

For each MSS Setup:

1. Set the desired gain settings at the following lines: **IR11 Measure With Gain 1** and **IR11 Measure With Gain 2**. Set these locations to **1** for gain enabled or to **0** for gain disabled.

2. For Medium Power IR, also set up the **IR11 Measure With Flag**. Set this location to **1** for Flag IN or to **0** for Flag OUT.



Description	File Data	Current Data
25. MSS1 LE Edge Processor ID	xxxx	xxxx
26. MSS1 LE Max Signal Proportion	0.95	0.95
27. MSS1 LE Min Signal Proportion	0.95	0.95
28. MSS1 HE Scan Position mm	5495.	5495.
29. MSS1 HE Edge Detection Enabled	1	1
30. MSS1 HE Detect Edge Going On Sheet	0	0
31. MSS1 HE Detect Edge Going Off Sheet	1	1
32. MSS1 HE Turn Around Distance mm	40.	40.
33. MSS1 HE Edge Signal Filter Factor	1.	1.
34. MSS1 HE Edge Filter Factor	1.	1.
35. MSS1 HE Edge Move Limit Bypass Filter	11.	11.
36. MSS1 HE Max Edge Detect Position mm	5500.	5500.
37. MSS1 HE Min Edge Detect Position mm	3000.	3000.
38. MSS1 HE Max Signal Threshold	0.	0.
39. MSS1 HE Min Signal Threshold	1.	1.
40. MSS1 HE Edge Processor ID	xxxx	xxxx
41. MSS1 HE Max Signal Proportion	0.95	0.95
42. MSS1 HE Min Signal Proportion	0.95	0.95
43. Ash11 Measure With Flag 1	0	0
44. NS11 Measure With Flag 1	0	0
45. NS11 Measure With Flag 2	0	0
46. IR11 Measure With Gain 1	0	0
47. IR11 Measure With Gain 2	0	0
48. IR11 Measure With Gain Attenuate	0	0
49. IR11 Measure With Flag	0	0

Figure 5-1 MSS Setup Table

5.1.2. MOIP Configuration Table

Create a MOIP Configuration Table for each calibration group; for example, MOIP11 Configuration Table00 to MOIP11 Configuration Table01 (see Figure 5-2).

For each table, set the value to **True** if the corresponding corrector is used; for example, dynamic intercept, hi curve and single cal correctors.

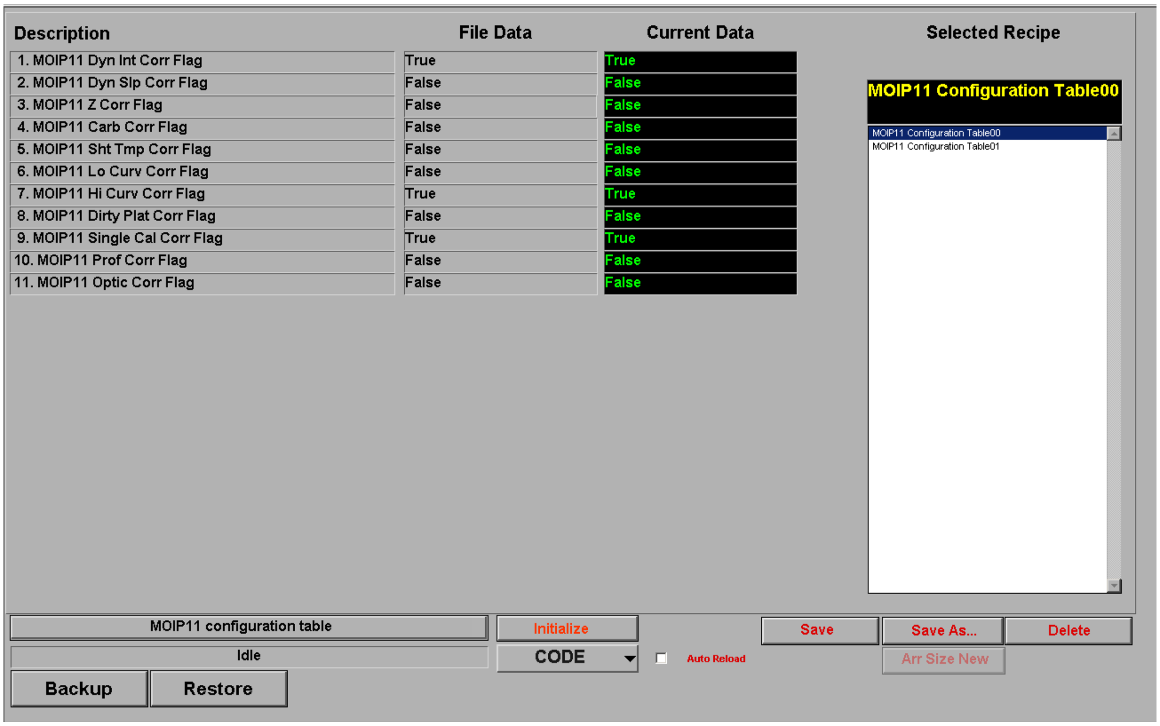


Figure 5-2 MOIP Configuration Table

5.1.3. MOIP Calibration Table

Create a MOIP Calibration Table for each calibration group; for example, MOIP11 Calibration Table00 to MOIP11 Calibration Table01 (see Figure 5-3). Enter the appropriate calibration constants in each table.

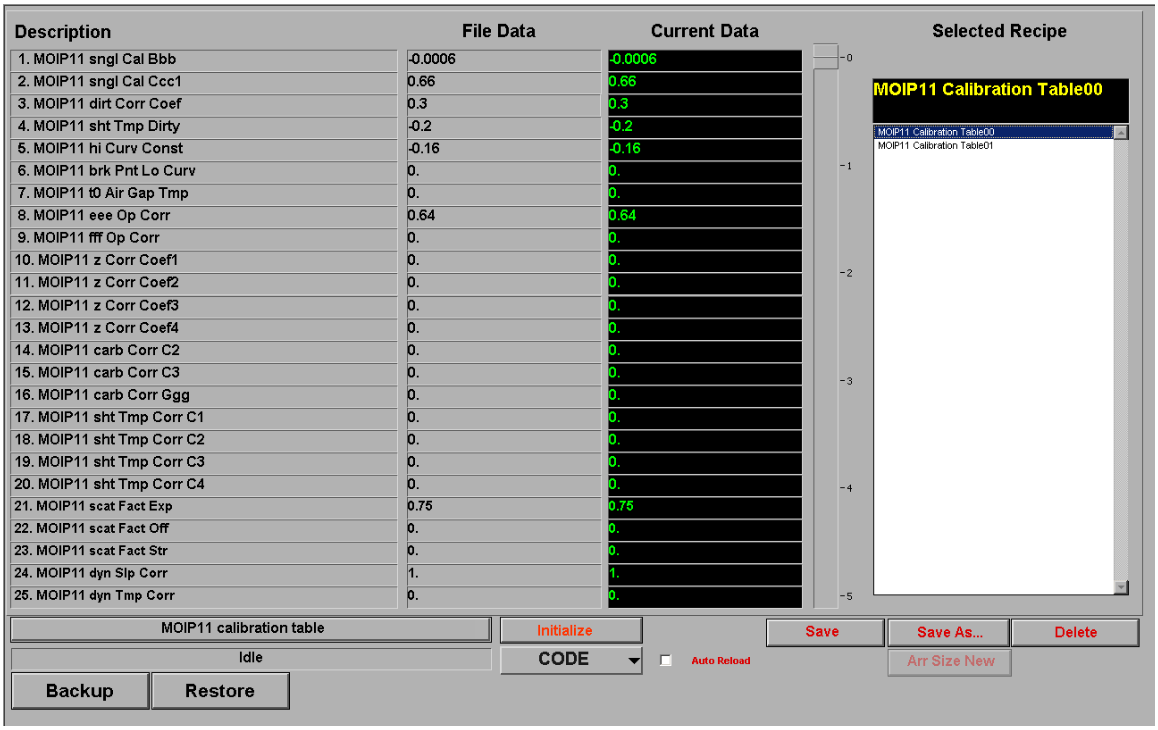


Figure 5-3 MOIP Calibration Table

5.1.4. MOIP Limit Table

Allowed dark volt range, drift and ratio limits can be changed in the MOIP Limit Table. Default values are in Figure 5-4.

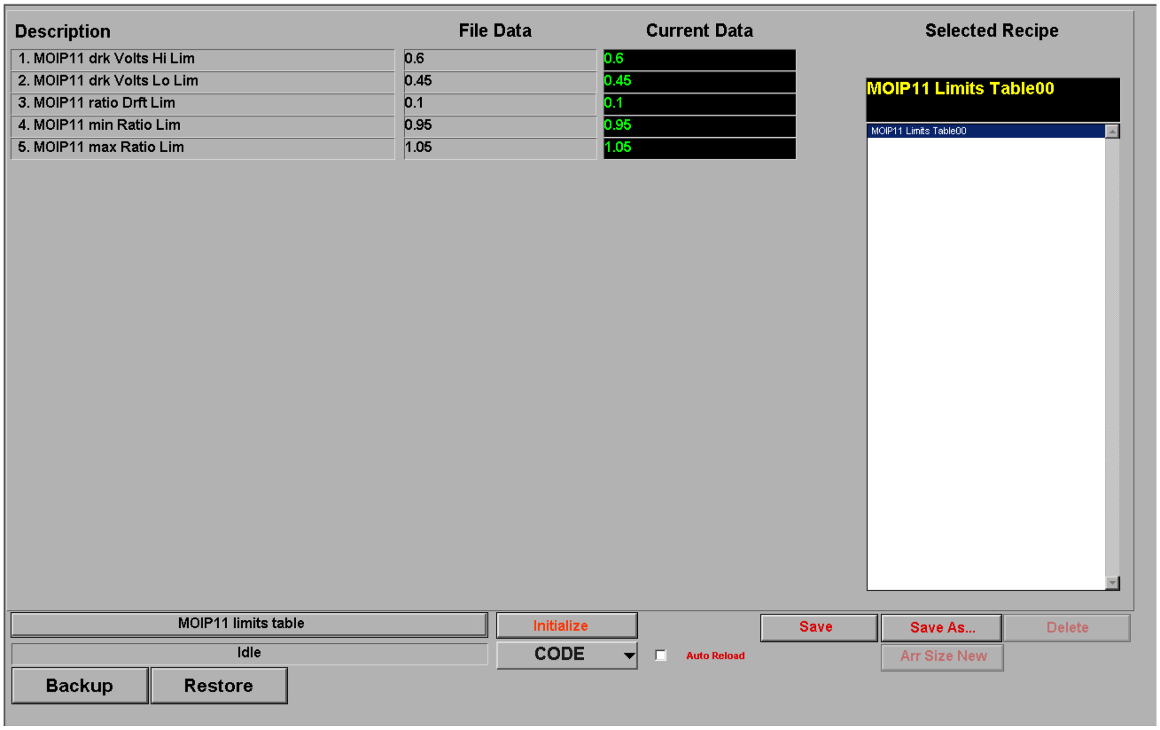
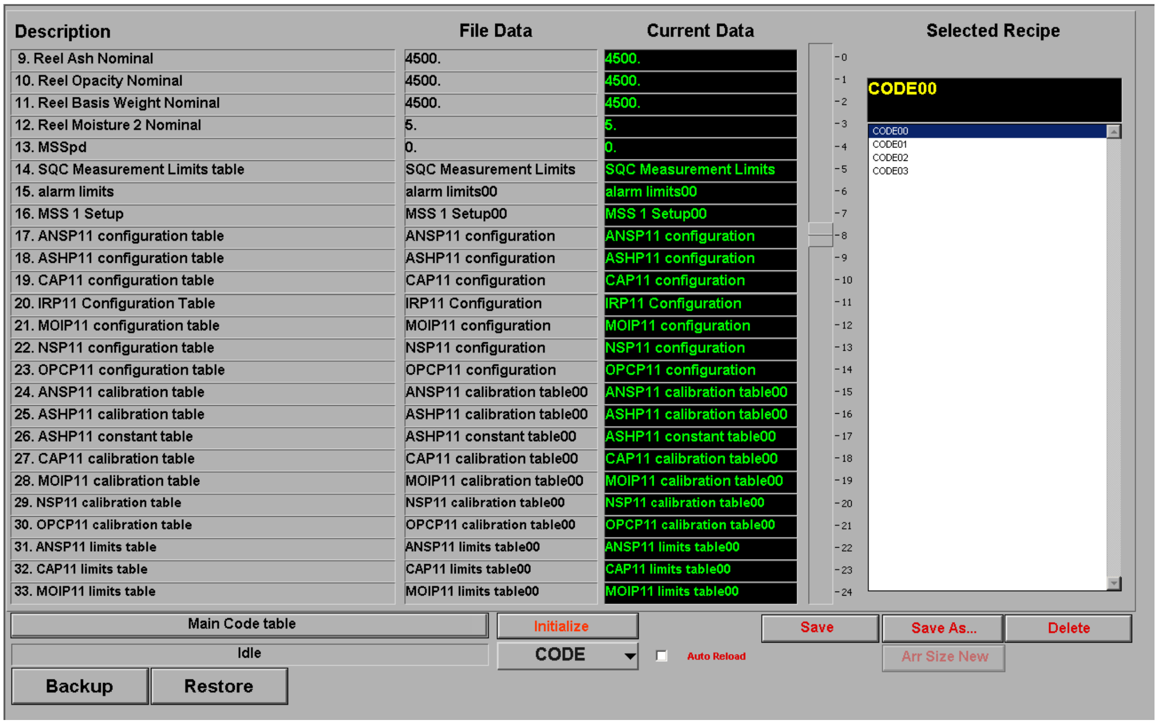


Figure 5-4 MOIP Limit Table

5.1.5. Main Code Table

Create a grade code (Recipe) for each gain (Gain/Flag for Medium Power IR); for example, Code00 to Code03.

For each Main Code Table in a grade code, select the appropriate tables created for MSS Setup, MOIP Configuration Table, MOIP Calibration Table and MOIP Limit Table (see Figure 5-5).



Description	File Data	Current Data
9. Reel Ash Nominal	4500.	4500.
10. Reel Opacity Nominal	4500.	4500.
11. Reel Basis Weight Nominal	4500.	4500.
12. Reel Moisture 2 Nominal	5.	5.
13. MSSpd	0.	0.
14. SQC Measurement Limits table	SQC Measurement Limits	SQC Measurement Limits
15. alarm limits	alarm limits00	alarm limits00
16. MSS 1 Setup	MSS 1 Setup00	MSS 1 Setup00
17. ANSP11 configuration table	ANSP11 configuration	ANSP11 configuration
18. ASHP11 configuration table	ASHP11 configuration	ASHP11 configuration
19. CAP11 configuration table	CAP11 configuration	CAP11 configuration
20. IRP11 Configuration Table	IRP11 Configuration	IRP11 Configuration
21. MOIP11 configuration table	MOIP11 configuration	MOIP11 configuration
22. NSP11 configuration table	NSP11 configuration	NSP11 configuration
23. OPCP11 configuration table	OPCP11 configuration	OPCP11 configuration
24. ANSP11 calibration table	ANSP11 calibration table00	ANSP11 calibration table00
25. ASHP11 calibration table	ASHP11 calibration table00	ASHP11 calibration table00
26. ASHP11 constant table	ASHP11 constant table00	ASHP11 constant table00
27. CAP11 calibration table	CAP11 calibration table00	CAP11 calibration table00
28. MOIP11 calibration table	MOIP11 calibration table00	MOIP11 calibration table00
29. NSP11 calibration table	NSP11 calibration table00	NSP11 calibration table00
30. OPCP11 calibration table	OPCP11 calibration table00	OPCP11 calibration table00
31. ANSP11 limits table	ANSP11 limits table00	ANSP11 limits table00
32. CAP11 limits table	CAP11 limits table00	CAP11 limits table00
33. MOIP11 limits table	MOIP11 limits table00	MOIP11 limits table00

Figure 5-5 Main Code Table

Table 5-1 is the summary table of gain setup for the InfrandPLUS Standard Power IR Moisture Sensor for scanner #1 and sensor #1.

Table 5-1 Summary table of gain setup for the standard power moisture sensor

Gain Setting	**Gain 0**	**Gain 1**
MSS 1 Setup	*MSS 1 Setup00:* IR11 Measure With Gain 1 = 0 IR11 Measure With Gain 2 = 0	*MSS 1 Setup01:* IR11 Measure With Gain 1 = 1 IR11 Measure With Gain 2 = 0

Gain Setting	**Gain 2**	**Gain 3**
MSS 1 Setup	*MSS 1 Setup02:* IR11 Measure With Gain 1 = 0 IR11 Measure With Gain 2 = 1	*MSS 1 Setup03:* IR11 Measure With Gain 1 = 1 IR11 Measure With Gain 2 = 1

Grade Code	Code00	Code01
Gain Setting	Gain 0	Gain 1
MSS 1 Setup	*MSS 1 Setup00*	*MSS 1 Setup01*

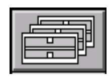
Grade Code	Code02	Code03
Gain Setting	Gain 2	Gain 3
MSS 1 Setup	*MSS 1 Setup02*	*MSS 1 Setup03*

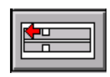
ATTENTION	For Medium Power IR, in addition to the Gain settings set the **IR11 Measure With Flag** to **1** for Flag IN and to **0** for Flag OUT in MSS 1 Setup.

6. Operations

6.1. Maintenance Mode setup

To set up Maintenance Mode:

1. Bring the head(s) offsheet. Press  to bring up the Scanner Control display.

2. Select the appropriate scanner(s) and press  on the Scanner Control display to take the selected head(s) offsheet.

3. Load a grade code.

   a. Press **Retrieve/Save Recipes…** on the Sensor Maintenance display to bring up the **Scanner modes & Maintenance recipes** (see Figure 6-1).

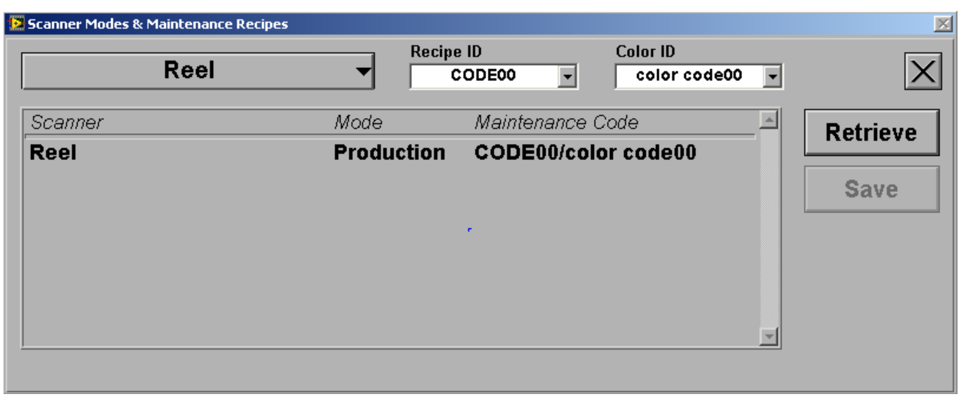


Figure 6-1 Scanner Modes & Maintenance Recipes Display

   b. Select the appropriate scanner.

   c. Under Recipe ID, select the code.

d. Under Color ID, select a grade code that is set up for the particular gain of interest.

e. Press **Retrieve**.

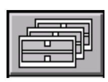
f. Close the Scanner Modes & Maintenance Recipes display.

4. Select Maintenance Mode in the drop down selector on the sensor Maintenance page. Use the same selector to return to Production Mode.

6.2. Scanning in Production Mode

Before scanning, make sure that the proper recipe codes have been retrieved and that proper correctors have been enabled in the recipe-based options (See Chapter 5).

To start scanning:

1. Press the  button on the top horizontal dispatcher to bring up the Scanner control display, as shown in Figure 6-2.

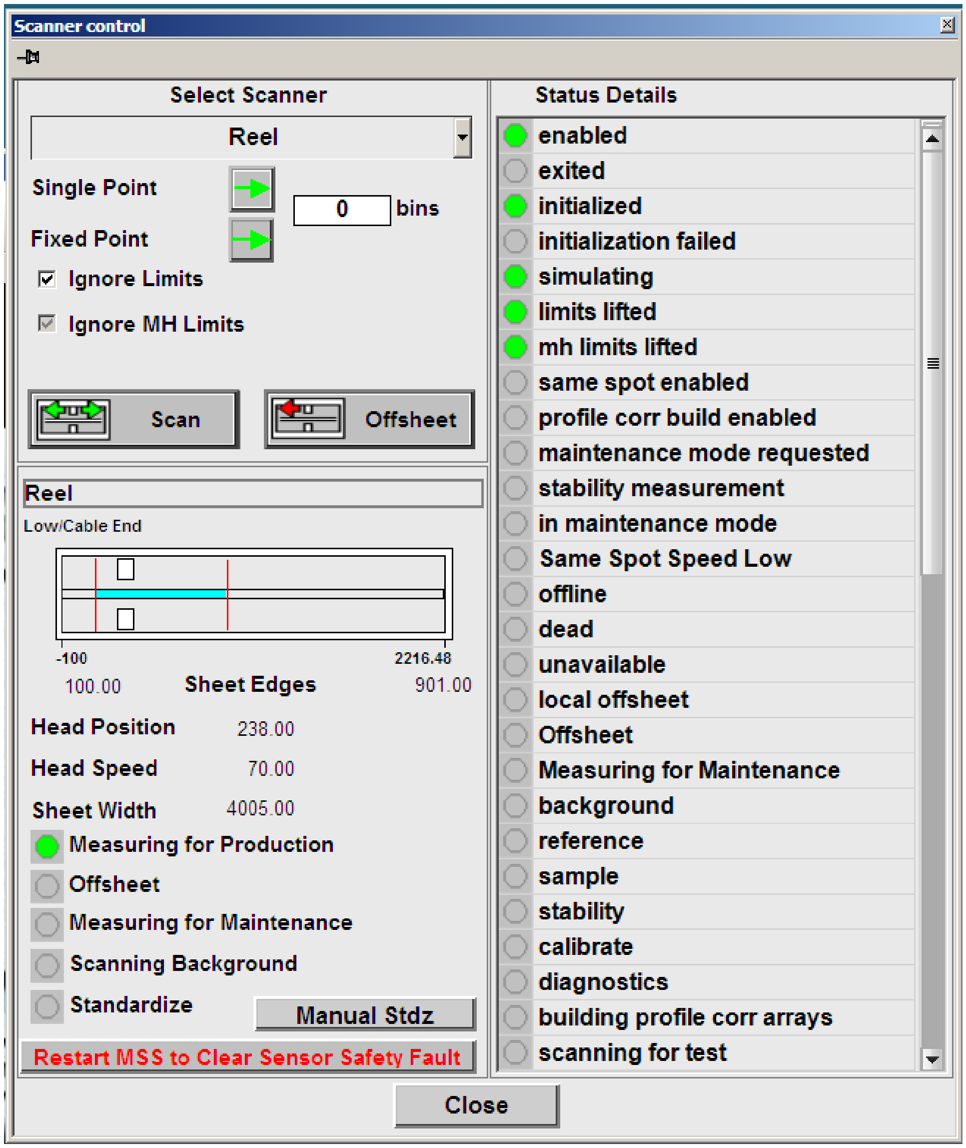
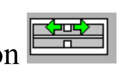


Figure 6-2 Scanner Control Display

2. In the Scanner control display, press the scan button  to scan the head. Before the sensor starts scanning, it takes the background and Reference reading from all of the sensors (basis weight, Moisture, and so on) and stores it.

6.2.1. Types of scan and sensor data snapshot

While scanning, you can choose the position snapshot, the partial scan snapshot, or the single point by selecting the appropriate button in the Sensor maintenance display (see Figure 6-3).

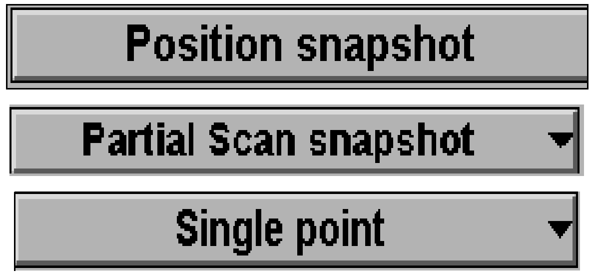


Figure 6-3 Selector Bars for snapshot options

For the single-point snapshot, it is necessary to single point the head to the desired position.

1. Send the head Offsheet,
2. Enter the single point position (in terms of bins) in the Scanner Control display
3. Press the Single Point button (see Figure 6-2).

For the position snapshot and partial scan snapshot, the head should be scanning.

For the position snapshot, you can set the position on the Sensor Maintenance of the Production display and the measurement readings can be monitored on the Sensor Maintenance display as shown in Figure 6-4.

For the partial scan snapshot, select **Partial Scan** snapshot.

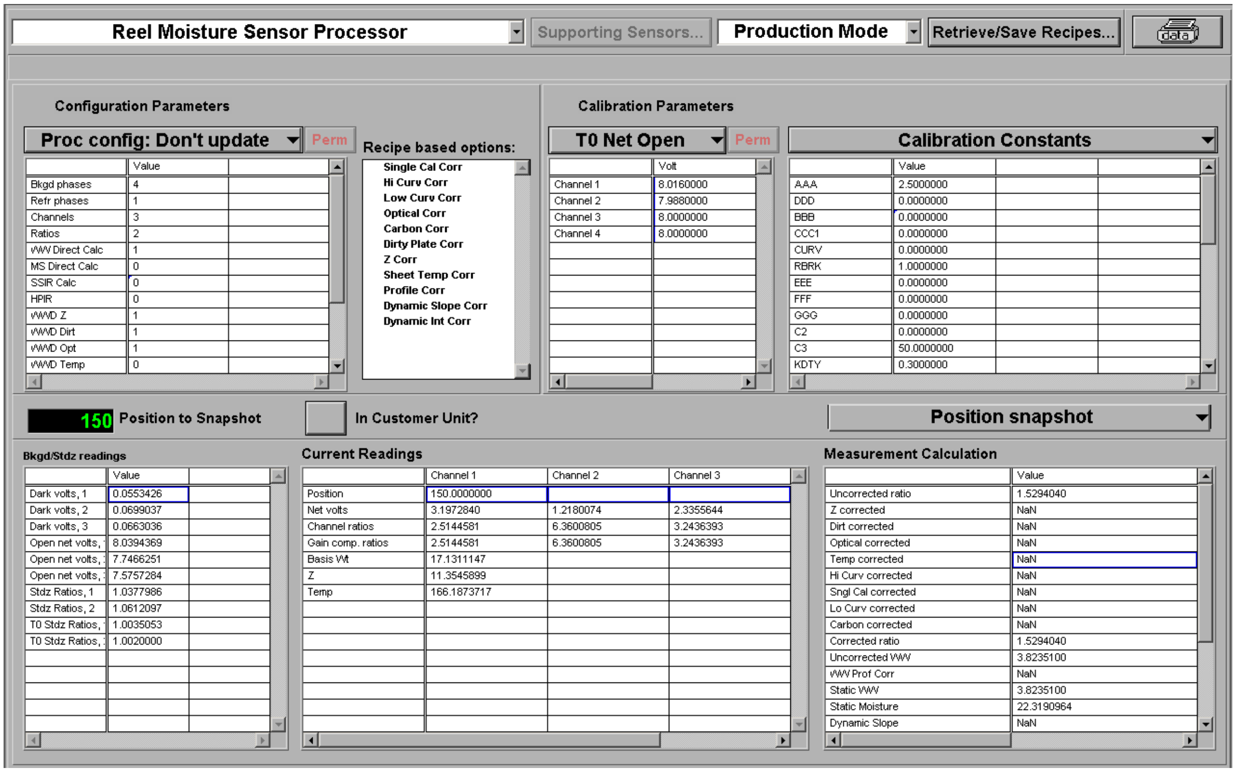
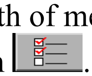


Figure 6-4 Sensor Maintenance Display for Production Mode

6.2.2. Measurement setup and profile display

Customer unit can be chosen by enabling the customer unit. Default will be set in grams/square meter (gsm), Degree C, and unit length of meters. You can change the units by pressing System Setup & Debug button . Units can be set by pressing the **Report Units** setup.

To set the filter factor on the Scanner Setup Display to 0.2:

1. Press the scanner/sensor button.
2. Press the **Measurement Setup** button.
3. In the Measurement setup display, under the select measurement option, choose **Moisture** for measurement.
4. Under the measurement arrays, set the trend filter factor to **0.2** (Figure 6-5).

To set up the profile display,

1. Choose **Home**.

2. In Home, choose the profiles button.

3. In the Profiles display, choose the desired measurement; for example, basis weight, moisture, or air gap temperature.

4. Monitor **Now** value or trend value by making an appropriate selection.

For a sample of the profile display, see Figure 6-6, which shows the profile of the basis weight, moisture, and air gap temperature.

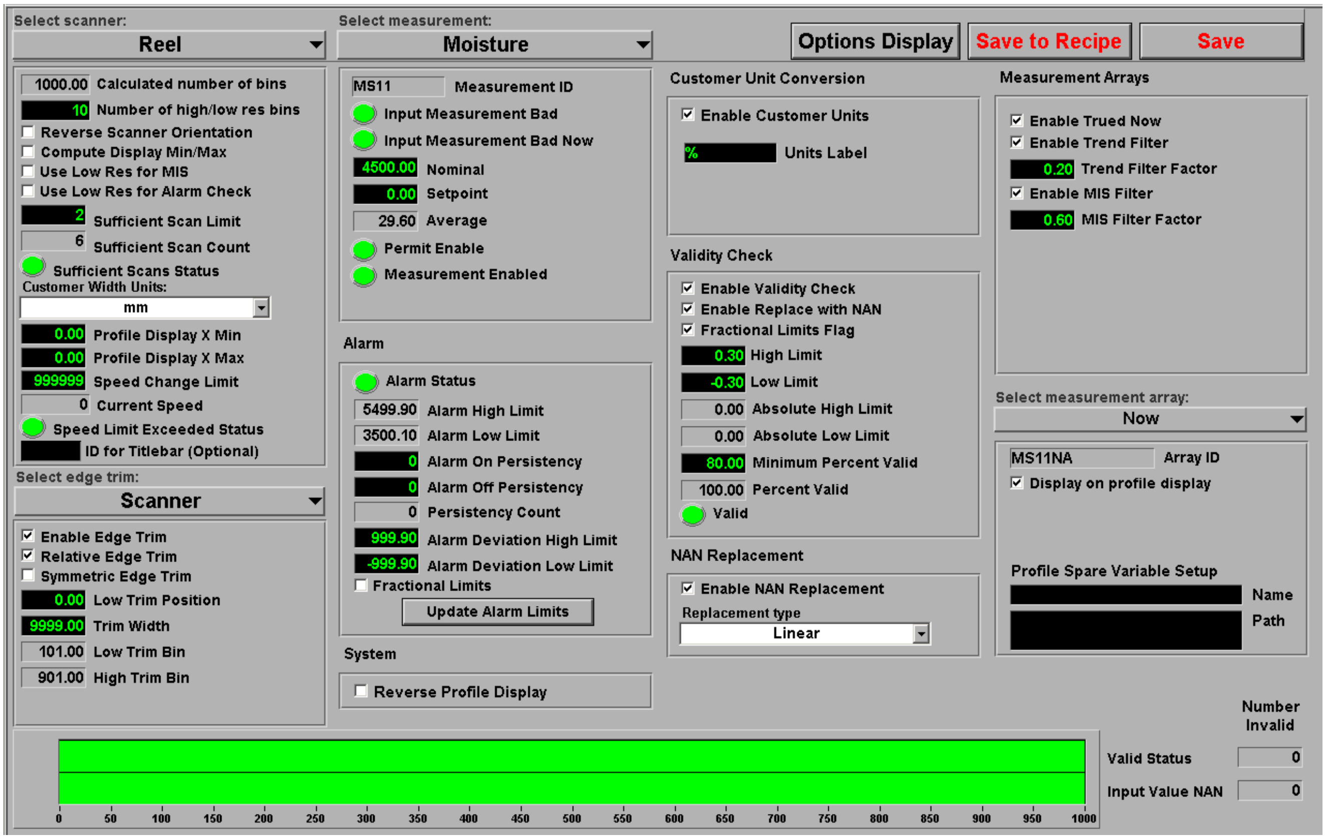


Figure 6-5 Measurement Setup Display

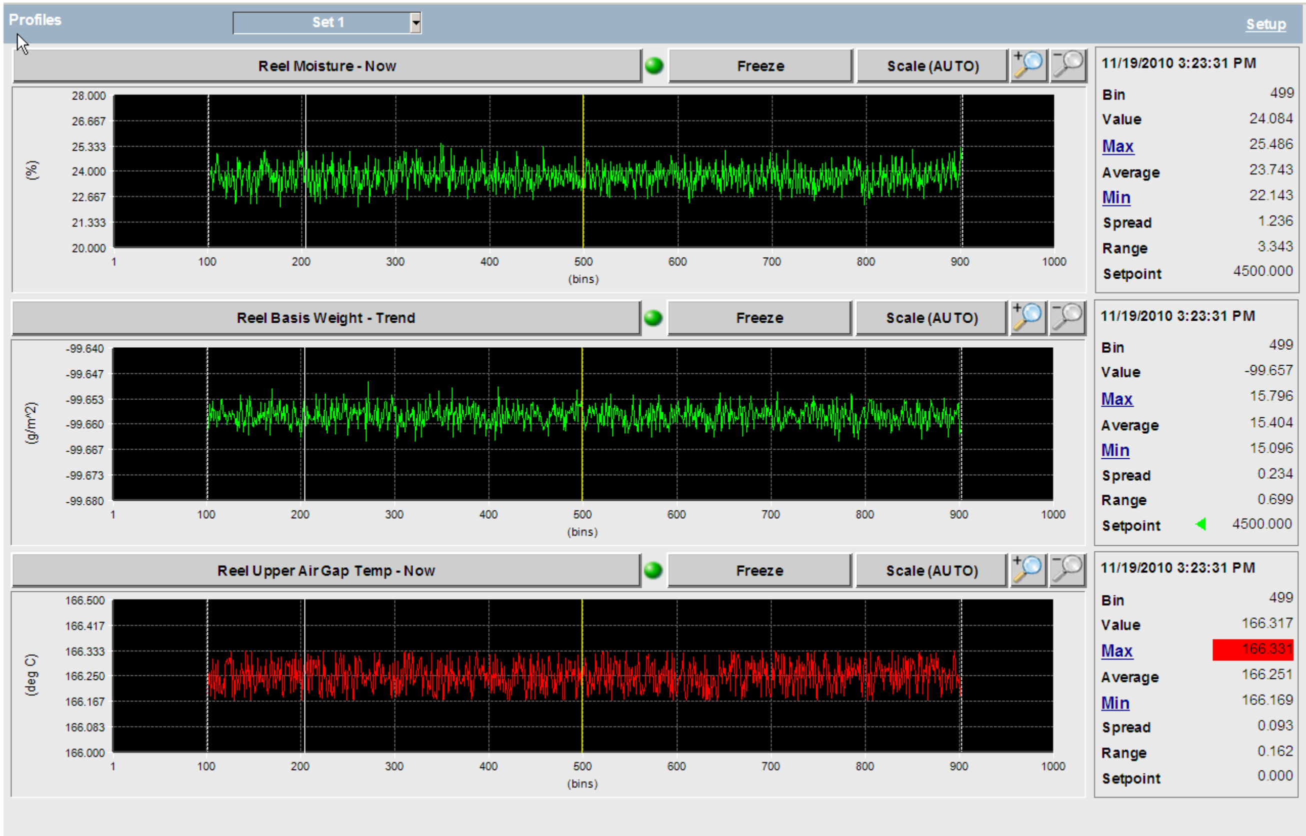


Figure 6-6 Profile Display of Moisture, Basis Weight and Air Gap Temperature

6.3. Dynamic calibration

Dynamic correction is included to correct for flashoff (evaporation from hot sheet) of moisture between the scanner and reel (Reel scanners only), any difference between static calibration readings on bagged samples and onsheet readings, and/or for any residual sheet temperature dependence in the sensor.

Dynamic calibration should only be performed after static calibrations (See Chapter 7) have been performed and verified. Dynamic verification is necessary whenever a quartz window is replaced, a filter is changed, or the static calibration is significantly changed.

It is advisable to perform dynamic verification once a week.

6.3.1. Nominal dynamic correction constants

Table 6-1 gives recommended initial values for dynamic correction for various grades at 6% moisture. They may be used before dynamic testing is possible.

These values are only approximate because the sheet temperature varies widely in different applications, and the sheet temperature strongly affects the flashoff.

A sheet temperature drop of 13°C (23°F) is normally accompanied by evaporation of 1% moisture. Flashoff may also be negative for very dry sheets. The effect from any residual sheet temperature dependence of the sensor should be less than ±0.25% and would be unpredictable, so it is not included.

The recommended dynamic correction (DMBE) values given in Table 6-1 include flashoff for Reel Scanners, but not for other scanners that cannot be dynamically verified.

These are conservative values for the correction (about 75% of the actual expected correction).

Table 6-1 Recommended Initial Values for Dynamic Correction (DMBE)

Product	Reel Scanner
Tissue	0.75%
Newsprint	0.6%
Fine Paper	0.5%
Board	0.25%

If the moisture target is significantly different from 6%, the effect should be multiplied by (0.17•Target Moisture). Both effects are truly slope rather than offset effects. If there is likely to be more than 2% range in moisture, the dynamic slope corrector DMAE should be used instead of DMBE. In this case, use DMAE = 1 - 0.17 • (Suggested DMBE) and DMBE=0.

6.3.2. Dynamic sampling

A minimum of 30 samples off 5 or more reels is needed for a verifiable dynamic calibration. Gathering and processing the samples should take place as soon as possible after startup. However, no dynamic samples should be taken before verifying sensor stability and static calibration.

1. Prior to taking samples, verify:

   - The sensor has been aligned and stability-checked (Background/reference values check - see Section 9.2. Short term stability check – see Section 9.3).
   - The static calibration has been verified (see Chapter 7).
   - The Air Gap Temperature sensors have been adjusted (see your Basis Weight Sensor manual).
   - Dynamic calibration constants have been set either to best-known values or to the appropriate default values given in Subsection 6.3.1.

2. Choose the section of the reel to be sampled.

3. Take measurements or mark the reel (see Figure 6-7) to assure that the section being sampled corresponds to the slices chosen on the profile display.

4. Cut and bag the samples very quickly to reduce conditioning effects. This usually requires two people.

For medium and heavy weight paper, see Subsection 6.3.2.2. For tissue and toweling, see Subsection 6.3.2.4.

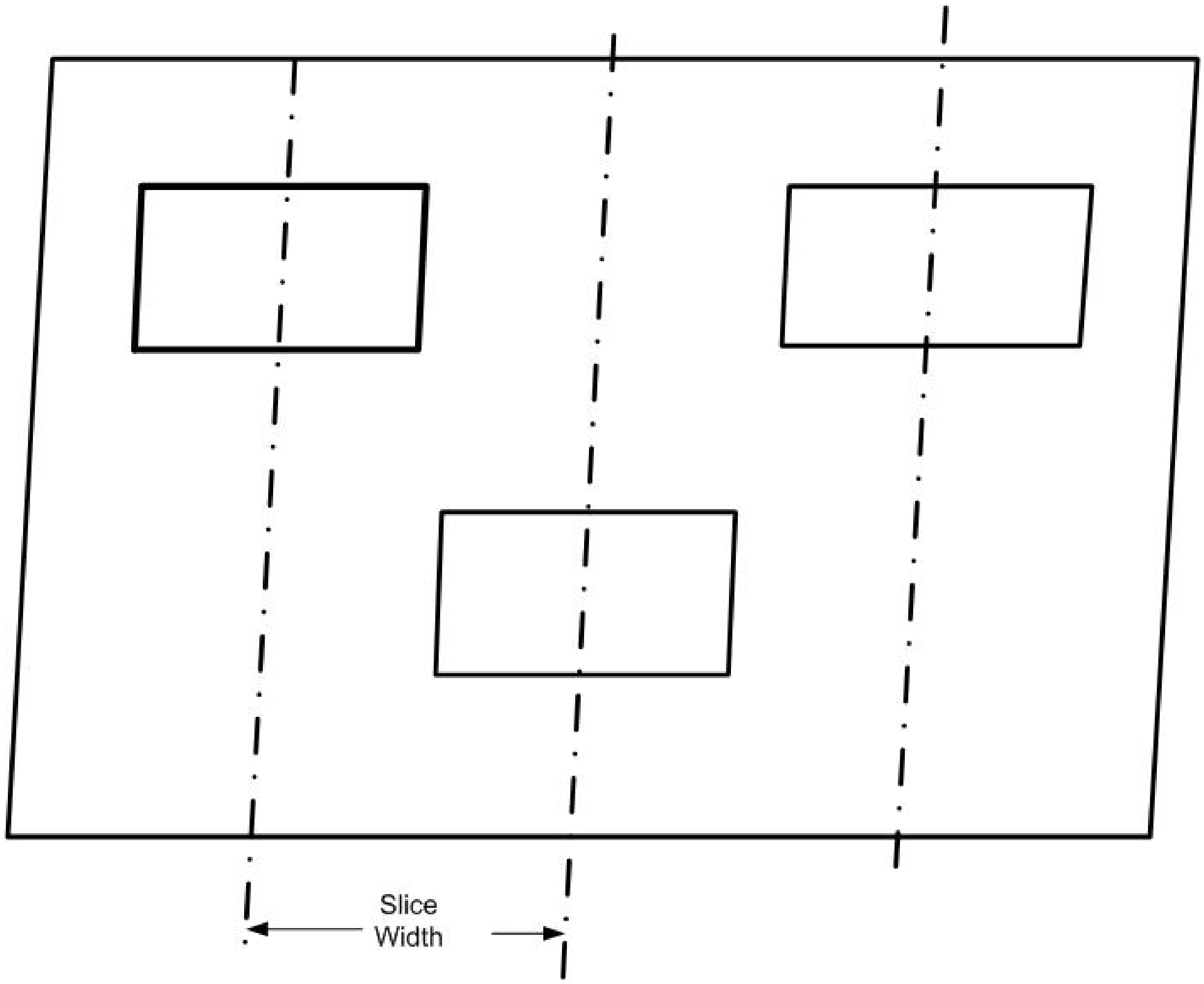


Figure 6-7 Reel Marked with Sampling Template

6.3.2.1. Sampling for medium and heavy weight grades

Equipment required

- Pre-weighed and numbered plastic bags, at least 11 by 18 inches (28 by 46 cm)
- Pre-weighed rubber bands
- Tape measure (of adequate length to measure from edge to center of sheet)
- Reel Sampling Template (see Figure 6-7)

- Sharp utility knife for cutting samples from reel
- Dynamic Sampling worksheet (p/n 42000852, page 5)
- Laboratory balance accurate to 0.05% of sample weight.

(Usually a top-loading balance accurate to .01g is acceptable.)

- Forced-draft, temperature-regulated drying oven, located in a room with constant temperature and humidity. The oven must be set for105.0 ±0.5°C (221.0 ± 0.9 °F).

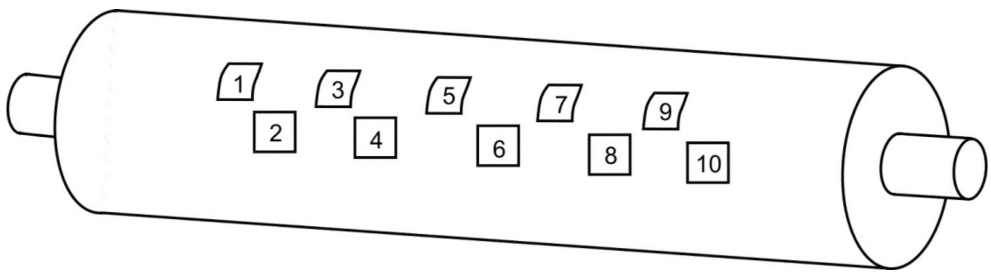


Figure 6-8 Reel Sampling Template for Medium and Heavy Grades

6.3.2.2. Sampling procedure for medium and heavy grades

Set the filter factor on the Scanner Setup display to 0.2:

1. Choose the Scanner/Sensor button.
2. Press **Measurement Setup**.
3. In the Measurement Setup display, under **Select Measurement**, choose **Moisture**.
4. Under **Measurement Arrays**, enable the trend filter and set the trend filter factor to 0.2.

For dynamic calibration, set the dynamic calibration constants (DMAE, DMBE, and KAYE) either to best-known values or to the appropriate default values given in Subsection 6.3.1.

To set the calibration constant:

1. Press Setup followed by Recipe Maintenance.
2. In the Recipe Maintenance display, press **Main Code Table** and, under that, choose the **MOIP Calibration Table.**

3. In the **MOIP Calibration Table**, enter the dynamic calibration constants and click on the Save button. After saving, you must reload the code in order to make the new calibration constants active.

   When you load the code, the correct calibration constants should be shown in the calibration constant table in the sensor maintenance display.

Choose the section to be sampled:

1. Prior to turn-up, use the **Profile Display** to locate one or more sections of six slices or more where the moisture and basis weight profiles are relatively flat.

   If more than one section is used, try to find sections with different average moisture.

2. Use the **Quality Data** display to single-point the scanner at a slice at the center of the chosen area.

3. Monitor successive moisture Now values on the **Quality Data** display.

   If the values vary by more than 1% moisture, the short-term variations are too high to produce usable calibration data. In this case, do not perform calibration; instead, either try another area or investigate the causes of such high variations.

4. Make sure that the section being sampled is the same as the slice chosen by measuring from the edge of the sheet to the centerline of the basis weight and moisture sensors. Record the distance and slice.

5. Return the sensor to Scan mode.

6. Set up the profile display to automatically produce a profile of moisture, basis weight, and air gap temperature.

7. Allow the scanner to complete 15 scans before turn-up, and monitor the average moisture on the **Quality Data** display until turn-up.

   If the average moisture differs from the trended value by more than 0.5%, do not sample the reel.

8. As soon as possible after turn-up, locate the slice at which the sensor was single-pointed and center the template over it. Mark the sections corresponding to the chosen slices (see Figure 6-8).

9. Use the knife to cut at least six wraps into the reel (more for lighter grades) at each slice using the template marks.
10. Quickly peel off the layers together and insert them into a plastic bag.
11. Peel off two layers from the top and one from the bottom, then seal the bag with a rubber band, squeezing out the excess air.
12. Mark each bag with the slice number.
13. Put the bagged samples in a large plastic bag, then take them to the lab for weighing and drying.

6.3.2.3. Weighing and drying medium and heavy grade samples

To weigh and dry medium and heavy grade samples:

1. Use the same scale for all weighing, and record all entries on a Dynamic Sampling worksheet.
2. Verify the oven setting and the oven temperature with a thermometer 105.0 ±0.5°C (221.0 ±0.9°F).
3. Record the lab temperature and humidity.
4. Weigh the bagged samples as soon as possible. Record their weights in the column **Wet Sample + Bag**. Record the bag weight in the column **Wet Bag**.
5. Remove each sample from its bag and mark it by slice number.
6. Check that the oven is empty, then place the marked samples in the oven, fanning out each one to promote drying.

   Avoid crowding; it is not necessary to dry all of the samples at once. Place a sign on the oven to prevent others from opening the door, changing the oven setting, or putting in other samples.
7. Allow the samples to dry for 4 hours at 105.0 ±0.5°C (221.0 ±0.9°F)
8. While the samples are drying, weigh a second set of bags and rubber bands (one per sample) for the dried samples. Do not re-use the **Wet Sample** bags- trapped moisture may cause errors.
9. Remove one sample at a time from the oven and quickly put it in a pre-weighed bag in the hot oven air. Keep the oven door open only long enough to get the one sample bagged.

WARNING The samples will be very hot. Be sure to wear gloves when removing them from the oven.

10. Squeeze as much air as possible out of the bag and seal it with the rubber band. Let the oven return to 105°C (221°F) before opening the door again.

11. Weigh the sample and record it in the column **Dry Sample + Bag**. Record the bag plus rubber band weight in the column **Dry Bag**.

12. For each sample, calculate the Wet Sample and Dry Sample weights, and the percent moisture:

    Wet Sample = Wet Sample+Bag - Wet Bag

    Dry Sample = Dry Sample+Bag - Dry Bag

    Lab Moi = 100 • (1 - Dry Sample/Wet Sample)

6.3.2.4. Sampling for tissue and toweling grades

Equipment required

- Large plastic sheets: 0.5 mil (20 micron) thick drop cloth about 4 by 8 ft (1.3 by 2.7m)
- Pre-weighed and numbered plastic bags, at least 12 by 18 inches (30 by 46 cm)
- Pre-weighed rubber bands
- Tape measure (of adequate length to measure from edge to center of sheet)
- Masking tape
- Sharp utility knife for cutting samples from reel
- Dynamic Sampling worksheet (p/n 42000852, page 5)
- Laboratory balance accurate to 0.05% of sample weight. Usually a top-loading balance accurate to .01g is acceptable.

- Forced-draft, temperature-regulated drying oven, located in a constant temperature and humidity room. The oven must be set for (105.0 ±0.5°C (221.0 ±0.9°F).

6.3.2.5. Tissue and toweling sampling procedure

Set the filter factor on the Scanner Setup display to 0.2:

1. Choose the Scanner/Sensor button.
2. Press **Measurement Setup**.
3. In the **Measurement Setup** display, under **Select Measurement**, choose **Moisture**.
4. Under **Measurement Arrays**, enable the trend filter and set the trend filter factor to 0.2.

For dynamic calibration, set the dynamic calibration constants (DMAE, DMBE, and KAYE) either to best-known values or to the appropriate default values given in Subsection 6.3.1.

To set the calibration constant:

1. Press the setup button followed by the Recipe Maintenance button.
2. In the **Recipe Maintenance** display, press **Main Code Table** and, under that, choose the **MOIP Calibration Table**.
3. In the **MOIP Calibration Table**, enter the dynamic calibration constants and click on the Save button. After saving, you must reload the code in order to make the new calibration constants active.

   When you load the code, the correct calibration constants should be shown in the calibration constant table in the sensor maintenance display.

Choose the section to be sampled.

1. Prior to turn-up, use the **Profile Display** to locate one or more sections of six slices or more where the moisture and basis weight profiles are relatively flat.

   If more than one section is used, try to find sections with different average moisture.

2. Use the **Quality Data** display to single-point the scanner at a slice at the center of the chosen area.

3. Monitor successive moisture Now values on the **Quality Data** display.

   If the values vary by more than 1% moisture, the short-term variations are too high to produce usable calibration data. In this case, do not perform calibration; instead, either try another area or investigate the causes of such high variations.

4. Make sure that the section being sampled is the same as the slice chosen by measuring from the edge of the sheet to the centerline of the basis weight and moisture sensors. Record the distance and slice.

5. Return the scanner to Scan mode.

6. Using the known slice width at the scanner, calculate the edges of the area to be sampled.

7. Set up the profile display to automatically produce a profile of moisture, basis weight, and air gap temperature.

8. Allow the scanner to complete 15 scans before turn-up, and monitor the average moisture on the **Quality Data** display until turn-up.

   If the average moisture differs from the trended value by more than 0.5%, do not sample the reel.

9. As soon as possible after turn-up, locate the slice at which the sensor was single-pointed and center the template over it. Mark the sections corresponding to the chosen slices (see Figure 6-8).

Sampling must be complete within 90 seconds to prevent conditioning. This requires two people.

1. Draw a line in the cross direction along the reel where the cut will be made.

2. Use the utility knife to cut along the line, cutting through 250 to 400 layers to get a representative sample. Slab this material onto the floor.

3. On top of the slabbed-down tissue, and behind a 10-inch (25 cm) width of it, lay down a piece of plastic sheet 2 feet wide and 4 to 6 feet longer than the reel width (see Figure 6-9).

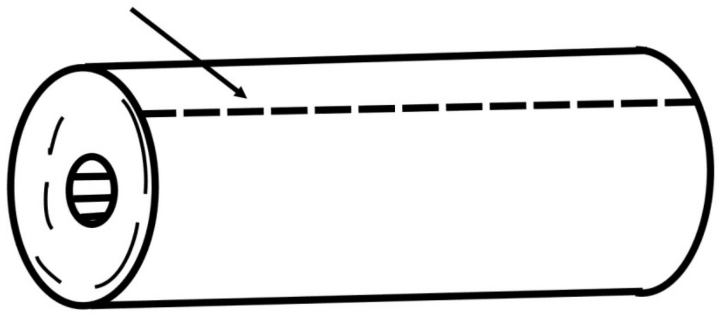
4. Cut off a 10-inch-wide sample (measuring back from the leading edge) the full length of the reel, cutting down to the floor.

5. Peel off the top 10 to 15 layers and discard them.

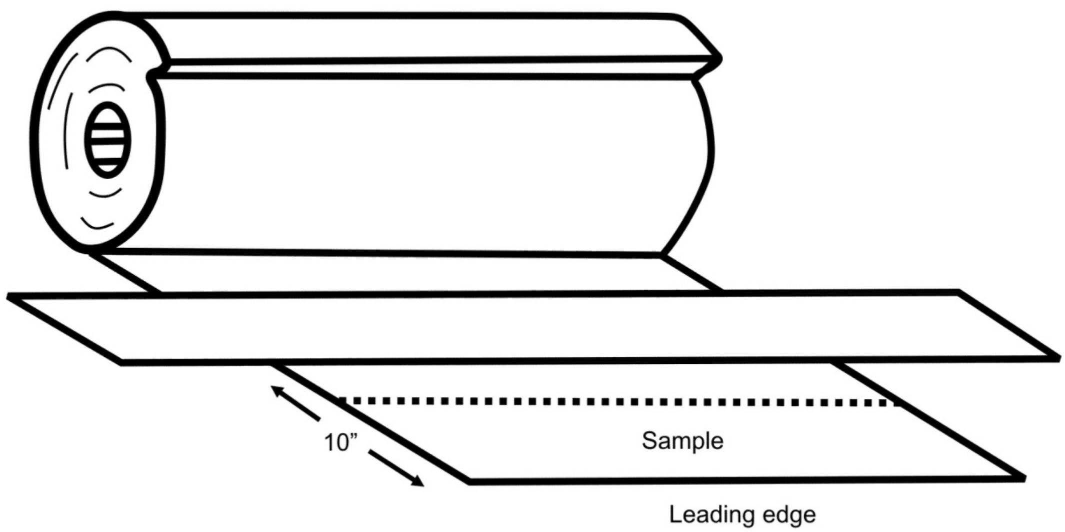
6. Quickly roll up the tissue in the plastic, forming a long sausage of tissue inside the plastic sheet. Use masking tape to bind the sheet.

7. Tie a knot in each end of the plastic sheet, or seal the ends by twisting the plastic and securing it with rubber bands. Mark the position of the high slice number on the end.

Draw line for cut.



Cut and lay down slab. Lay down plastic strip.



Cut sample and wrap in plastic.

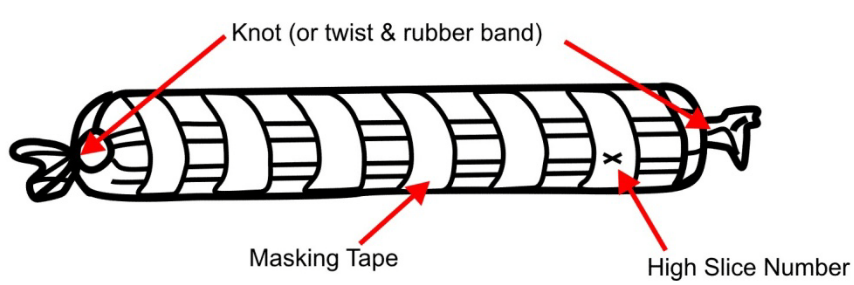


Figure 6-9 Sampling for Tissue and Toweling

6.3.2.6. Weighing and drying of toweling and tissue

To weigh and dry of toweling and tissue:

1. Verify and record the oven setting and temperature.
2. Mark the roll off in units of slice width so that each segment centers on a slice boundary (marks at 14.5 and 15.5 give a segment centered on slice 15). Place a rubber band around each segment to hold it together.
3. Working quickly, cut a segment off one end and weigh it, keeping the cut end of the roll covered with a small plastic bag while you weigh the segment. Keep the segments in order or mark each one before weighing. Record the weight in the column **Wet Sample + Bag**.
4. After all of the samples have been cut off and weighed, unwrap each one and weigh the plastic that was weighed with it. Include any rubber bands. Record this weight in the column **Wet Bag**.
5. Check that the oven does not contain any other samples. Dry only as many segments at one time as can be placed in the oven without crowding.
6. Place the segments in the oven, fanning out the layers as much as possible.
7. Hang a sign on the oven to prevent others from changing the oven setting, opening the door, or putting other samples in it.
8. Allow the samples to dry for 4 hours at 105.0 ±0.5°C (221.0 ±0.9°F).
9. While the samples are drying, mark new plastic bags and weigh them and a rubber band for each sample. Do not re-use the **Wet Sample** bags because trapped moisture may cause errors.
10. Remove one sample at a time from the oven and quickly put it in a pre-weighed bag in the hot oven air. Keep the oven door open only long enough to get the one sample bagged.

WARNING	The samples will be very hot. Be sure to wear gloves when removing them from the oven.

11. Squeeze as much air as possible out of the bag and seal it with the rubber band. Let the oven return to 105°C (221°F) before opening the door again.

12. Weigh the sample and record it in the column **Dry Sample + Bag**. Record the bag plus rubber band weight in the column **Dry Bag**.

13. For each sample, calculate the Wet Sample and Dry Sample weights, and the percent moisture:

    Wet Sample = Wet Sample+Bag - Wet Bag

    Dry Sample = Dry Sample+Bag - Dry Bag

    Lab Moi = 100 • (1 - Dry Sample/Wet Sample)

6.3.3. Dynamic correction

When taking profile samples, check for positioning errors (correspondence between slice number and sample taken) by plotting the moisture value from the lab (MLAB) and the moisture value from the sensor (MDYN) against slice position on the same graph. If they do not track, there may be a positioning error.

1. If you have only a few data points (<20), it is probably best to use only an intercept correction. If dynamic correction was turned off while collecting the data:

   DMBE = Average[MDYN - MLAB].

   If dynamic correction was turned on while collecting the data, calculate for each point the sensor value without dynamic correction, MSTAT (see Subsection 2.4.11 for definitions). In the simplest and most common case, DMAE=1 and KAYE=0; therefore, MSTAT = MDYN + DMBE. Use:

   DMBE = Average[MSTAT - MLAB].

2. When you have at least 20 data points, make a graph of lab percent moisture MLAB (vertical axis) against Sensor percent moisture (if dynamic correction was turned on while collecting the data, use MSTAT as calculated above).

   Determine if the graph looks like a ball or a line.

   If the range of moisture levels is narrow, the points may form a ball. In this case, the best you can do is to use a simple intercept correction. Use DMBE = Average [MSTAT - MLAB]. Be sure to use DMAE = 1.

If the range of values is great enough that a line can be discerned, perform a linear regression on MLAB (y) vs. Sensor (x). Use DMAE = slope and DMBE = - intercept.

Use a computer spreadsheet to keep track of dynamic test results and corrector values. To avoid making arbitrary or hasty changes in DMBE, use a running average of the [MSTAT - MLAB] column as the appropriate value for DMBE.

6.3.4. Z-Correction and dirt correction

Z-Correction and Dirty Plate Correction are onsheet correctors that may be enabled on the Moisture Status display and calibrated on site.

6.3.4.1. Z (Gap) correction

Z-Correction is used to correct for the variations in gap in a scanner that bows due to differential heating of the beams. Scanners may have gap variations of ±0.05 inches (1.27 mm). Because a narrowed gap will cause more average passes of light through the sheet, the sensitivity of the sensor will increase. There is also an effect due to the fact that the straight-through optics is not affected in the same way as the INFRAND optics. The degree of change depends on the value of the calibration constant for the Optical Correction, EEE. The following table gives some typical results for a ±0.05 inch (1.27 mm) deviation:

EEE	0	0.5	0.8
% Moi Error	0.25%	0.6%	0.8%

The need for Z-Correction may be checked by interpolating from this table.

Nominal correction

The Z-Corrector is applied to onsheet and Sample readings on the basis of the Z value relative to that at Standardize. The Z-Correction algorithm (see Subsection 2.4.2) gives a correction that is independent of EEE. The calibration constants ZCR1 and ZCR2 correct the ratio RN, while ZCR3 corrects RN2.

The standard values are shown in Table 6-2. If different values are supplied with your system, they should be used instead of those given in the table.

Table 6-2 Standard Values

ZCR1	ZCR2	ZCR3	ZCR4
0.55	0.1	-0.9	0

Check the adequacy of these values by entering them in the MOIP calibration table, putting shims under the wheels of the upper head to increase the gap over a few slices. Look at profiles with the Z-Corrector enabled and shims present vs. profiles without shims. The profiles should look the same, with no step in the profile where the shims are.

Sampling

If the nominal corrector values are not adequate calibrate using the bagged calibration samples and shims under the wheels of the upper head.

Choose a set of (typically three) grades of representative basis weight. Pick the nominal moisture level sample from each. Disable the Z-Corrector. Without shims, perform a Reference of the Z-Sensor (or a Standardize) with an empty gap and note the Z value.

Perform a Moisture sensor Reference with the paddle and rings (See Section 7.3). Perform a Sample with each of the samples. If you need to change gain, perform a Reference again before sampling.

Shim the wheels of the upper head and perform a Z-Sensor Sample, noting the Z value. Repeat the Samples without References. If you need to change gain, perform the Reference without the shims and the Sample with the shims.

Data reduction

For the easiest and best results, use the Advanced Moisture Calibration Tool in Experion MX (see Subsection 7.3.1).

For data reduction by hand, note the RN, RN2, and REFA for each Sample measurement. Calculate for each sample:

$$\mathrm{ZCF} = \frac{\dfrac{\mathrm{RN(noshims)} - 1}{\mathrm{RN(shims)} - 1} - 1}{\dfrac{\mathrm{Z}}{\mathrm{ZST}} - 1} \qquad \mathrm{ZCF2} = \frac{\dfrac{\mathrm{RN2(no\ shims)}}{\mathrm{RN2(shims)}} - 1}{\dfrac{\mathrm{Z}}{\mathrm{ZST}} - 1}$$

It is normally sufficient to assume the ZCR2 value from Table 6-2 and ZCR4=0, and calculate only ZCR1 and ZCR3 from the following formula:

ZCR1 = Avg[ZCF/(REFA+ZCR2)]   ZCR3 = Avg[ZCF2]

In some cases where there is a large basis weight range, you may find it necessary to fit both ZCR1 and ZCR2. Plot ZCF vs. REFA and perform a linear regression to obtain the slope and intercept; that is, ZCF = A • REFA+D. Then

ZCR1 = A, and ZCR2 = D/A.

Enter the values in the MOIP calibration table and check it with shims. See Nominal Correction.

6.3.4.2. Dirty plate correction

Buildup of pitch or other light-absorbing material on the sensor windows causes them to be less reflective, reducing the sensitivity of the sensor. The need for Dirty Plate Correction should be checked if the dirt buildup causes the REF volts at Standardize to decrease by more than 10%.

To determine the need for Dirty Plate Correction:

1. Choose a typical sample.
2. Clean the windows.
3. Perform a Reference with empty gap, and again with the paddle and rings in the gap.
4. Allow the sensors to scan until the plates are dirty.
5. Take the scanner offsheet, and enter the REF volts as T0 REF (T0 Channel1) in calibration parameters in the sensor maintenance display.
6. Enable Dirty Plate Corrector in the recipe-based option of the Moisture Sensor Maintenance display.
7. Perform a Reference with the paddle and rings.
8. Perform a Sample with dirty plates.
9. Repeat the Reference and Sample again after cleaning the windows.

If the sample readings differ by more than 0.25% moisture, then use Dirt Correction.

ATTENTION

> If there is enough dirt buildup on the quartz-Teflon plates to significantly reduce the volts on the offset optics channels (REF and MES), RS2 may be lowered also and go out of limits. In this case, clean the plates more often and, if necessary, increase the tolerance for the limit check on RS2. To change it, go to the MOIP limits table. The default value of this tolerance is 0.95 and 1.05.

Nominal correction

The corrector is applied onsheet and during Sample to the ratios RN and RN2 after Z-Correction. The Dirt Correction algorithm used on InfrandPLUS sensors measuring products above 100 gsm typically has grade-dependent KDTY.

The calibration constant KDTY applies to RN, and KDT2 applies to RN2.

The nominal values for these correctors are given in Table 6-3. Test them by entering the values for KDTY and KDT2 in the MOIP calibration table. Load the code and repeat the test. If different suggested values are supplied with your system, use them instead of the ones given in Table 6-3.

Table 6-3 Nominal Values

Product	**InfrandPLUS Algorithm**	
Grade	KDTY	KDT2
Tissue	0.3	-0.2
Newsprint	0.3	-0.2
Fine Paper	0.33	-0.16
Board	0.4	-0.13

Sampling

If the nominal values are not adequate, calibrate the values using this procedure (and the procedures in the following sections):

1. Choose samples representative of the full basis weight range and moisture values near nominal moisture.

2. Allow buildup of dirt on the plates for a maximum period between cleaning.

3. For each grade, enter the grade code and target basis weight.

4. Perform a Reference with the paddle and rings.

5. Perform a Sample on the sample for that grade.

6. Repeat the grade code entry, target weight entry, and Reference and Sample for each grade.

7. Clean the plates and repeat the sampling, as above.

Data reduction

Note the N0 = T0 REF = the clean window REF volts at Reference, and NS = the dirty window REF volts at Reference. Note the RN, RN2, and REFA for each Sample.

For easiest and best results, use the advanced calibration display (see Subsection 7.3.1).

For data reduction by hand, calculate for each sample:

$$CF = \frac{(RN - 1)\ \text{Clean}}{(RN - 1)\ \text{Dirty}} \qquad KGDTY = \frac{AVG\left[(CF - 1)\right]}{REFA \bullet \left[\frac{N0}{NS} - 1\right]}$$

$$CF2 = \frac{RN2\ \text{Clean}}{RN2\ \text{Dirty}} \qquad KGDT2 = \frac{AVG\left[(CF2 - 1)\right]}{(1 - REFA) \bullet \left[\frac{N0}{NS} - 1\right]}$$

Use the REF volts on a clean window Standardize as the value for T0 REF.

Enter these values in the calibration table and repeat the sampling with clean and dirty windows, as above, to verify the corrector.

Subsequent recalibration and verification on bagged samples should always be performed on clean sensor windows, either with the Dirt Corrector disabled or with the REF volts on a paddle with the rings entered as T0 REF. It will prevent erroneous correction resulting from the drop in REF volts caused by the paddle and rings. During onsheet measurement, the empty gap value of REF volts should always be used as T0 REF.

7. Static Calibration

This chapter describes all of the procedures for performing static calibration. Normal installation requires only hardware checks (see Section 9.1, Section 9.2 and Section 9.3) and verification or recalibration (see Section 7.3 and Subsection 7.4.1).

Study this chapter if there is no static calibration, or if a change in grade structure occurs requiring a complete new static calibration.

Operation of the scanner buttons and switching to maintenance mode are described in Operations (see Section 6.1).

7.1. Sample selection

7.1.1. Standard sample selection

Five moisturized samples of each grade are required for calibration (typically 2, 4, 6, 8, and 10% for reel scanners). Select five target moisture values spanning the range needed.

If it is feasible, prepare samples for each grade; if not, select a representative set of grades (see Section 7.1.2).

If Carbon Correction is required and/or for heavy paper weights, a 5.5-inch die should be used to eliminate light leaks around the samples; otherwise, use a 4.5-inch die.

7.1.2. Representative grade selection

If there are so many grades that it is impractical to moisturize samples for all of them, select a set of grades that is representative in basis weight and composition.

For dry end sensors, use the method of **Ambient Grade Grouping**:

1. For each grade, die out one sample and label it to indicate the grade.
2. Weigh each sample and calculate its basis weight:
3. Basis Weight (gsm) = Weight (grams) X (gsm Conversion Factor); using the appropriate gsm Conversion Factor for the sample size from Table 7-1.
4. Perform a Reference on the sensor with the sample paddle including the sample rings in the gap.
5. Using the sample paddle, measure each sample on the sensor.
6. Plot the sensor ratio RN-1 (vertical) vs. basis weight using symbols to identify the grades.
7. Draw a straight line through the main body of the points starting from near the origin.
8. Check to see if points lay more than 10% above and below this line. If so, draw additional lines 10% above and below the central line, as needed (that is, pick a basis weight, note the corresponding RN-1, and multiply it by 1.1 and 0.9 to determine the positions of the lines using a common origin).
9. Select the grades to be moisturized using the following criteria:
   - Include grades that cover the full basis weight range.
   - Select representative grades for each line.
   - Choose grades that represent a large percentage of the customer's production, if this is known.

7.1.3. Carbon detection

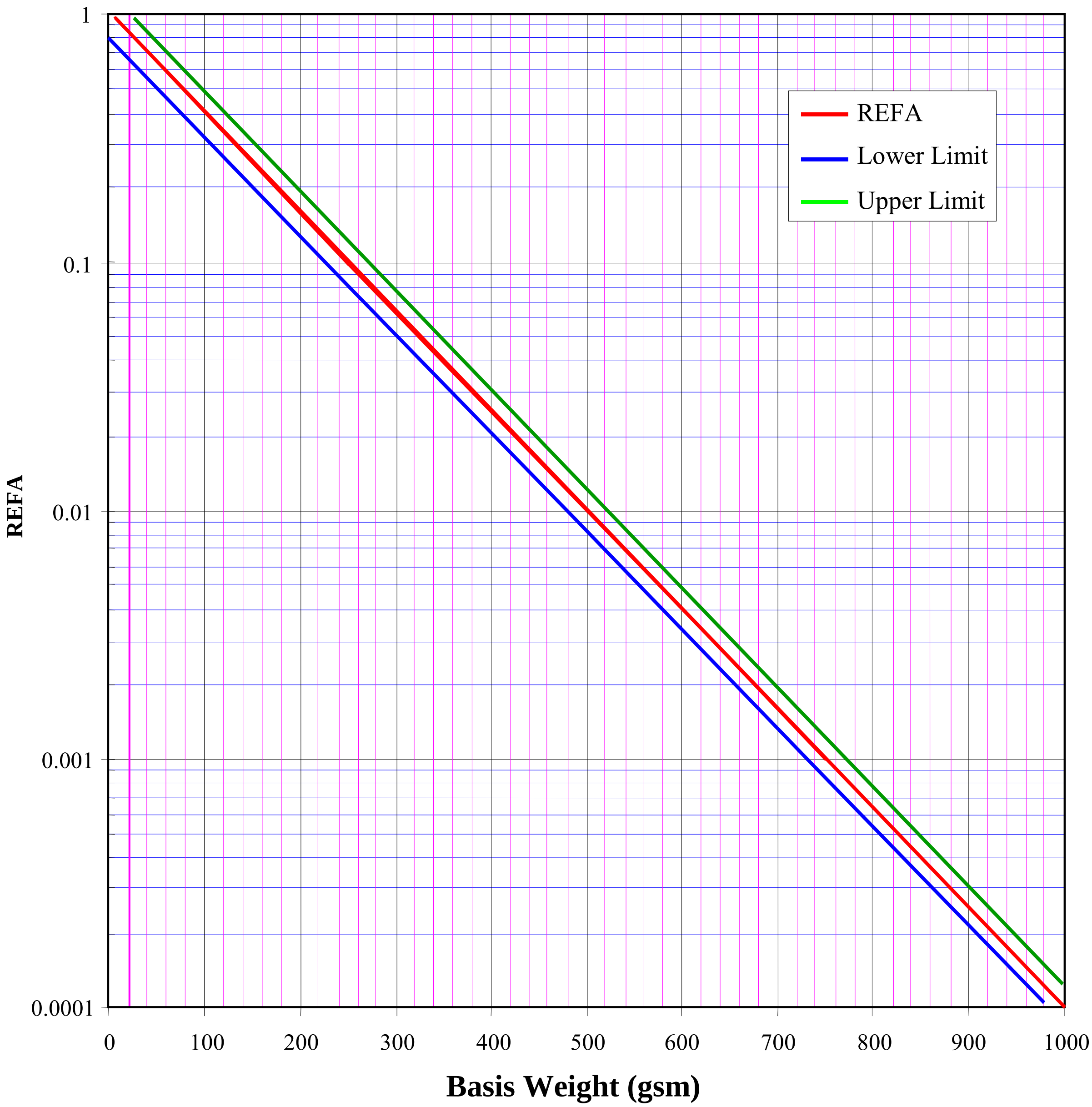
If you suspect that there is carbon, but cannot be certain, use the following procedure to determine if carbon is present:

1. Die out a sample at ambient moisture for each grade suspected, and weigh it to determine its basis weight.
2. Bag the sample without sealing it.

3. Perform a Reference with the paddle and rings in the gap.

4. Perform a Sample on the sample using the rings and paddle. If the volts in each channel are not adequate, adjust the gain settings and repeat the Reference and Sample.

5. Note the REFA on the Sample printout and plot REFA versus basis weight (see Figure 7-1). If they fall below the central band, there is probably elemental carbon or iron oxide present in the sample.



The central diagonal band is for paper with no carbon or iron oxide.
Paper with carbon or iron oxide will give REFA values below the band.

Figure 7-1 Sensor REFA vs. Paper Basis Weight in gsm for IR Moisture Measurement Sensors

7.1.4. Selection of samples with high and low carbon content

If variable levels of carbon may be present due to use of recycle, use this procedure to select samples with low and high levels of carbon for the calibration. Ideally, each grade with variable levels of carbon should be represented by moisturized samples with high and low levels of carbon. Follow these steps:

1. Collect a variety of samples (at least 8.5 by 11 inches, or 21 by 28 cm) from different days of production.
2. Check the samples visually for the grayest or darkest and the brownest or whitest ones. Select the extremes of color for trial measurement on the sensor, and arrange them by grade.
3. Perform a Reference with an empty gap.
4. Insert a sheet into the gap so that it is centered on the sensor windows, and perform a Sample. Be sure that the gain settings are correct (see Subsection 2.2.3).
5. Repeat the Sample for the other samples of that grade.

   The samples of the same basis weight with the lower REFA have the more carbon. For each grade, choose those samples with the highest and lowest REFA for sample preparation. The REFAs should differ by more than 10% to be significant.

7.2. Sample preparation

7.2.1. Materials required

These materials are required for sample preparation:

- Lab with controlled humidity and temperature (23°C or 73°F and 50% relative humidity), free from drafts and vibration
- Forced-air drying oven, controlled to 105 ± 0.5°C (221 ± 0.9°F), with drying racks and accurate thermometer
- Analytical balance, accurate to 0.1 mg
- Faraday cage balance pan

- Aclar bags (4.5-inch or 5.5-inch)
- Bag sealer
- Sample die (4.5-inch or 5.5-inch)
- Mallet for die
- Wood or hard rubber backing block for sample die
- Permanent ink pen for bags
- Rubber gloves
- Aluminum foil for sample protection
- Humidity cabinets, or beaker of boiling water (covered by screen) and tweezers
- Moisture Samples Worksheet (See Appendix B).

7.2.2. Dry weight determination

To determine dry weight:

1. Die out five samples for each grade selected.

   Do not use samples with worn or frayed edges; they will cause errors if pieces fall off.

2. Mark the sample I.D. and target moisture on each sample, near the edge.

   Be sure to use gloves and to keep bags and samples clean and dry. Accumulation of dirt and fingerprints will cause errors.

3. Dry all samples for four hours in the 105 ± 0.5°C (221 ± 0.9°F) oven.

   Make sure that no other materials are drying in the oven and that they are not disturbed.

4. Pre-weigh two Aclar bags for each sample: one bag for weighing the bone-dried sample (*dry* bag), and one bag for weighing the moisturized sample (*wet* bag).

5. Label each bag with the grade and target moisture level.

6. Record bag weights on the moisture sample worksheet.

7. Remove each bone-dry sample, quickly insert it in its dry bag and seal it, removing excess air.

8. Weigh the bone-dry samples and subtract the bag weights to get the dry sample weight.

9. Enter the dry sample weight on the worksheet.

10. Calculate a target weight for the wet samples using the following formula:

    $T = 100 \bullet Dg / (100-M)$

    where

    T = target sample weight in grams

    M = target percent moisture

    Dg = bone-dry sample weight in grams

11. Enter the wet sample target weight on the worksheet.

12. For each sample to be moisturized, remove it from its dry bag (cut the bag open carefully) and bring it up to target moisture and weight.

    For moisture up to 4%, this can be done in the balance. For higher moistures, it will be necessary to use steam or conditioning chambers. In steaming samples, do the following:

    a. Hold the samples over boiling water and steam both sides evenly.

    b. Use a screen over the water as large errors can result from uneven wetting.

    Water drops from spattered, condensed, or picked up water will cause large errors. Discard and replace any samples that pick up drops.

13. Let each sample dry to the target weight on the balance, then seal it quickly in its Aclar bag, removing excess air.

14. Weigh the bagged samples and record the weights. Calculate the following:

    Wet Sample Weight (grams) = Sealed Bag & Wet Sample (grams) – Bag (grams)

Basis Weight (gsm) = Wet Sample Weight (grams) • gsm Conversion Factor

using the appropriate gsm Conversion Factor for the sample size from Table 7-1.

15. Calculate the water weight in grams in the sample:

    Water Weight (grams) = Wet Sample Weight (grams) - Dry Sample Weight (grams)

16. Calculate the water weight per unit area in gsm.

    WW(gsm) = Water Weight(grams) X gsm Conversion Factor

17. Calculate the percent moisture:

$$\%\ \text{Moisture} = \frac{100 \bullet \text{Water Weight (grams)}}{\text{Wet Sample Weight (grams)}}$$

18. Wrap each grade of samples in aluminum foil for protection, and allow them to condition for at least 24 hours before measurement on the sensor.

19. Reweigh and recalculate the lab values before measurement on the sensor.

Table 7-1 Basis Weight Unit Conversion Factors

Basis Weight Units	4.5-Inch Sample Conversion Factor	5.5-Inch Sample Conversion Factor
gsm	97.46	65.24
lbs/3300 ft2	65.871	44.1
lbs/3000 ft2	59.883	40.09
lbs/1000 ft2	19.961	13.362

7.2.3. Hardware checks

Before shooting calibration samples make sure that the sensor is stable and up to specifications. Perform these tasks before advancing to the next section:

1. Check background/standardize values (See Section 9.2).

2. Check short term stability (See Section 9.3).

7.3. Sample measurement

7.3.1. Sample paddle setup

1. Clean the quartz-Teflon plates if they are dirty.
2. Slide the paddle into the gap and position it properly (make sure that the interlocking black rings are approximately centered over the quartz-Teflon plates).
3. Ensure the paddle handle is perpendicular to the sheet guide.

7.3.2. Reference

1. Set the Reference Integration Time to four seconds on the Sensor Maintenance display.
2. Insert the paddle and interlocking black rings without any sample.
3. Turn on the paddle's motor to start the sample rotating. Turn the Sample/Reference switch on the scanner clockwise for a Reference. The amber light in the switch turns on.
4. When the light in the switch goes out, remove the paddle from the gap.

For interlocking black rings, the REF and MES voltages should not be lower than those for the empty gap by more than 0.5V. The 3RD or Straight-through voltage should not be lower than those for the empty gap by more than 0.3V. RS should not have changed by more than 2% compared with those obtained for the empty gap. However, RS2 should be lower by approximately 1 – 4%. See Table 7-2 for a summary of allowed voltage levels.

If the channel voltages and ratios have changed more than what is specified in Table 7-2, check the paddle setup and alignment.

Table 7-2 Summary of Allowed Voltage Levels for alignment check of sample paddle

Hardware Check	Value
Allowed maximum REF and MES volts drop with paddle and black rings at Reference	0.5V
Allowed maximum 3RD volts drop with paddle and black rings at Reference	0.3V

Hardware Check	Value
Allowed maximum change for RS with paddle and black rings	2%
Drop of RS2 with paddle and black rings	1-4%

7.3.3. Sample procedure

Before proceeding to shoot all the samples for all the grades, make sure that the gain settings for the various grades are correct:

1. If the appropriate gain (Gain/Flag for Medium Power) for the grade is unknown, perform a Sample on the lowest moisture sample for the grade and make sure the REF channel gives between 1 and 8V.

2. As needed, raise or lower the gain (Gain/Flag for Medium Power) by loading a grade code that has been set up for the appropriate gain.

3. Make sure that the gauge is not saturated: Lowering the gain by one unit should lead to the expected drop in channels volts (approximately x3). If not, the gauge may be saturated.

Sample procedure:

1. Set Sample Integration Time to **4** seconds on the Sensor Maintenance display.

2. Clamp the sample into the interlocking black rings, taking care to center it well, and twist the rings to lock them.

3. Put the interlocking black rings and sample in the paddle.

4. Slide the paddle into the gap and position it properly. (Make sure that the rings are approximately centered over the quartz-Teflon plates.) Ensure the paddle handle is perpendicular to the sheet guide.

5. Turn on the paddle's motor to start the sample rotating.

6. Press on the sample button on the paddle or on the scanner. The light in the button turns on.

7. When the light in the button goes out, turn off the motor and remove the paddle from the gap.

ATTENTION	Fastcards saturate at 10V; however, with strong enough signals, the output voltage drops to as low as 7.5V. Therefore, you must raise gain only if the REF voltages are below the lower limit.

ATTENTION	For Medium Power sensors, skip Flag IN Gain 3 because Flag OUT Gain 0 covers the same range with a higher signal level.

7.3.1. Calibration tool

Sensor calibration is done by using the Advanced Moisture Calibration Tool in Experion MX (see Figure 7-2). The tool is accessed by pressing **Advanced** on the Sensor Maintenance display while in Maintenance mode and with the appropriate Moisture sensor selected.

The Advanced Moisture Calibration Display provides a convenient user interface to perform calibration and verification of the moisture gauge.

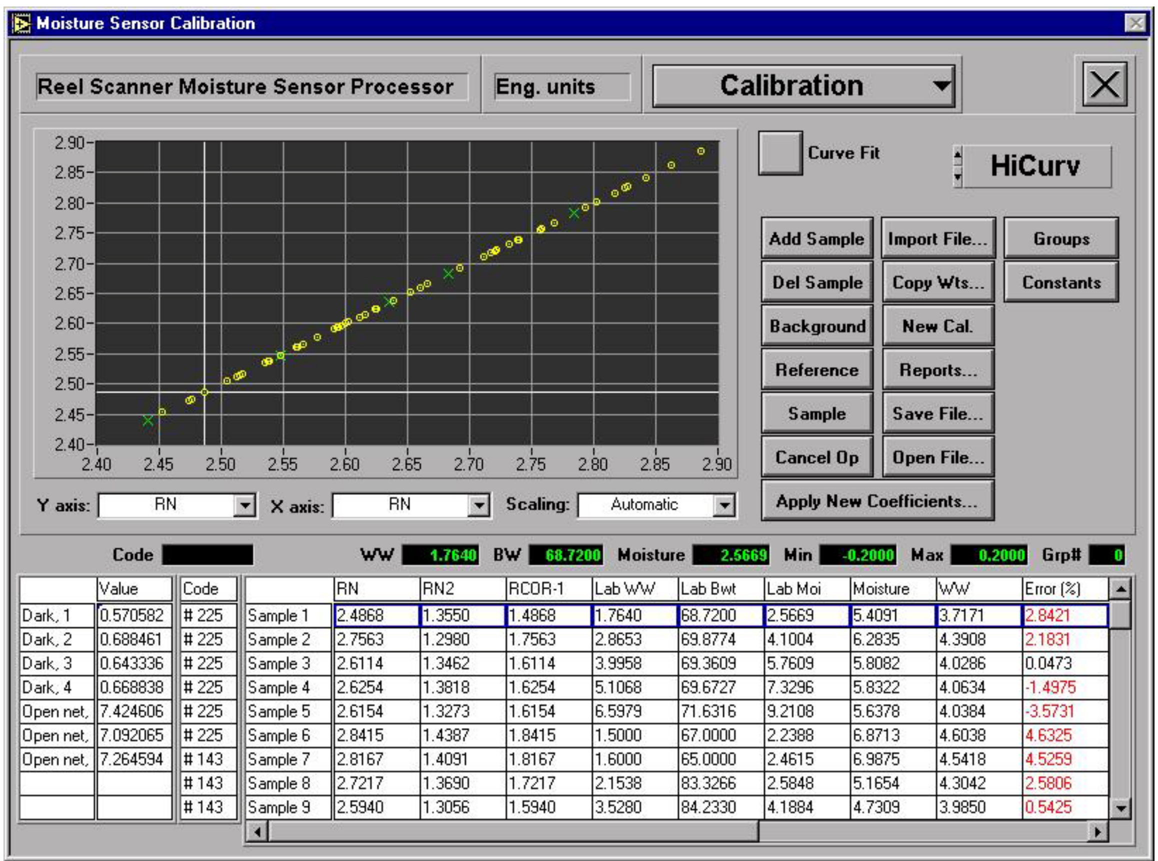


Figure 7-2 Advanced Moisture Sensor Calibration Display

7.3.1.1. Data entry

1. Select **Calibration** in the selector bar on the top right of the display.

2. Click **Import File…** to import the calibration file from the legacy calibration software MOICAL.

   Or enter the basis weight, lab water weight and grade information manually. For this, click **Add Sample** to create the number of sample entries required. Then enter the values for each sample in the green entries above the table (See Figure 7-2).

3. Perform a background.

4. Perform a reference with the rotating sample paddle and interlocking black rings in the gap (see Subsection 7.3.2 for correct reference values).

5. Select the first row (Sample 1 in Figure 7-2) by clicking any field in the first row.

6. Perform a Sample on each sample in the grade. See Sample Procedure for correct sampling procedure.

7. Change the gain (Gain/Flag for Medium Power) settings if required before proceeding to sampling the next grade.

8. If the gain (Gain/Flag for Medium Power) has changed or if more than 10 minutes has passed since the last Reference, perform a Reference (with sample paddle and interlocking black rings in the gap).

9. Perform a Sample on each sample in the next grade. All samples from a grade must be measured with the same gain (Gain/Flag for Medium Power).

10. Repeat for each grade of bagged samples prepared.

11. Save the raw data by clicking **Save File…**. Two files are created. The first is a binary file that you can reload using **Open File…**. The second is a text file with the *.txt* extension.

CAUTION

When all sampling is complete, visually inspect the gap to make sure that it is clear before scanning the heads.

7.4. Calibration fit and data reduction

For calibration fit and data reduction, follow the procedures in this section. In case of difficulty, request the assistance of Honeywell Engineering.

7.4.1. Recalibration

The static calibration from the factory should "verify" on site within accuracy specifications. After verification using the procedure in Section 7.5, dynamic calibration is required (see Section 6.3).

A recalibration may be required if the factory calibration does not verify within accuracy specifications. It may also be performed to calibrate new grades or if significant hardware components were changed (for example, Infrand plates).

In a typical recalibration only the slope and intercept are refitted. The other calibration constants such as SingleCal, HiCurve, Optical, and so on, stay as per factory settings.

Prepare the appropriate samples and measure them on the sensor, following the procedures in Section 7.1. Then recalibrate:

1. In the **Advanced Moisture Sensor Calibration** display, load the raw calibration data file. Select **Calibration** in the drop down menu.
2. Click **Constants** and the **Moisture Calibration Constants** dialog appears (Figure 7-3).
3. Enter the factory values. Do not enter the AAA and DDD values as these will be recalculated.

Figure 7-3 Moisture Calibration Constants

4. In the display, select **Cal** in the selector bar, and then click **Curve Fit**.

5. Accept the recalibration. If the recalibration is performed on the same grades as the ones used by the factory, the slope value (AAA) should not differ from the factory value by more than 10-20%.

6. Inspect the calibration data using the plot function, selecting Error (%) on the Y axis and Moisture on the X axis. Most of the errors should be equal or less than the static accuracy (usually ±0.25% - see Section 1.7).

7. If the calibration does not meet the static accuracy:

   a. Some samples may have either poor lab or sensor values and should be repeated or discarded and replaced.

   b. Another possibility is that there are too many grades in the group. Use the group function to remove a grade from the group. Once the groups have been identified, it may be convenient to save the calibration data in a separate file (that is, one calibration file per group of grades).

8. Print the calibration report by clicking **Reports…** then selecting **Calibration**. Make sure that the appropriate correctors are selected on the Sensor Maintenance display so that all the calibration parameters appear on the report.

7.4.2. Full calibration

A full calibration may be required to calibrate new grades if the accuracy specifications are not met with a recalibration. In a full calibration, the necessary correctors are identified and all the static calibration parameters are refitted.

Prepare the appropriate samples and measure them on the sensor, following the procedures in Section 7.1. Then proceed to the full calibration:

1. In the **Advanced Moisture Sensor Calibration** Display, load the raw calibration data file. Select Calibration in the selector bar drop down menu).

2. Click **Constants** and the **Moisture Calibration Constants** dialog appears (Figure 7-3).

3. Enter **0** in all the fields except in the AAA and DDD fields.

4. In the display, select **Cal** in the selector bar and then click **Curve Fit**. This will calculate a slope and an intercept. Click **Accept**.

5. Inspect the raw data using the plot function, selecting **Lab WW** on the Y axis and **RN** on the X axis. The data should spread like a hand fan. One grade is represented by a line. If the hand fan is very wide, the SingleCal corrector may need to be used. If the lines are curved, the HiCurv corrector may be required.

6. If the data set includes a number of grades and/or if the basis weight range is significant (± 10%), SingleCal may be necessary. Select **SingleCal** and click **Curve Fit** and then **Accept**.

7. If necessary, select **HiCurv**, click **Curve Fit** then **Accept**. HiCurv is typically required for wide moisture range (≥10%), high moisture samples (above ambient) and/or medium to high basis weight.

8. If carbon is present in the sheet (see Section 7.1.3), carbon correction may be required. Make sure that the C2 and C3 calibration parameters are set to their default values in the recipe calibration table (C2 = **0** and C3 = **50**). Select Carbon, click **Curve Fit** then **Accept**. For a successful Carbon calibration, it is imperative that a good sample set be used (see Section 7.1.4).

9. Optical correction may be used to increase the number of grades in a group. Make sure that the FFF calibration parameter is set to its default values in the recipe calibration table (FFF = **0**). Select **Optical**, click **Curve Fit** and then **Accept**. Do not use the optical corrector if it does

not improve the calibration accuracy significantly (10-20% improvement) and does not allow fitting more grades in a group.

10. Check the calibration parameters. They must be within the range specified in Table 7-3. If the calibration parameters are outside the specified limit then:

    a. One of the corrector used may not be needed.

    b. The data set does not support the use of one of the corrector selected (that is, there is not enough range in the sample set for percentage moisture, Basis weight and/or carbon content).

11. Select Cal in the drop down menu and click **Curve Fit**. This recalculates a slope and an intercept. Click **Accept**.

12. Inspect the calibration data using the plot function, selecting **Error (%)** on the Y axis and **Moisture** on the X axis. Most of the errors should be equal or less than the static accuracy (usually ±0.25%, see Section 1.7).

13. The calibration may not meet the static accuracy for the following reasons:

    a. Some samples may have either poor lab or sensor values and should be repeated or discarded and replaced.

    b. There are too many grades in the group. Use the group function to remove a grade from the group. Once the groups have been identified, it may be convenient to save the calibration data in separate file (that is, one calibration file per group of grades).

    c. The proper corrector(s) has (have) not been selected. Try other correctors.

14. Print the calibration report by clicking **Reports…** then selecting Calibration. Make sure that the appropriate correctors are selected on the Sensor Maintenance display so that all the calibration parameters appear on the report

CAUTION

The calibration process is iterative. It is necessary to use the Curve Fit function iteratively selecting the appropriate corrector(s) then selecting Cal, the corrector(s) again, then Cal, and so on until the calibration tool finds the optimum minima.

CAUTION

To remove a corrector, click on Constants and put a zero in the appropriate field(s) (see Table 7-3 for a list of calibration parameters and associated corrector).

CAUTION

Only use a corrector if it improves the calibration significantly. The calibration error should drop by a minimum of 10-20% when the corrector is used.

Table 7-3 Calibration parameters

Calibration parameter	Range	Description
AAA	0.5 - 20	Water weight slope
DDD	±10	Water weight intercept
BBB	±0.01	SingleCal primary corrector
CCC	±100	SingleCal secondary corrector
CURV	±0.3	HiCurv corrector
EEE	±1	Optical primary corrector
GGG	0 – 1.25	Carbon primary corrector

7.4.3. Entry of calibration constants

In the **Advanced Moisture Calibration** display, click **Apply New Coefficients…** to store calibration constants to the recipe database (see Figure 7-4). A new table can be created to link to a particular recipe. Otherwise, the data is stored in the current code's table. Check or uncheck each coefficient to store. Only checked values are written to the recipe database.

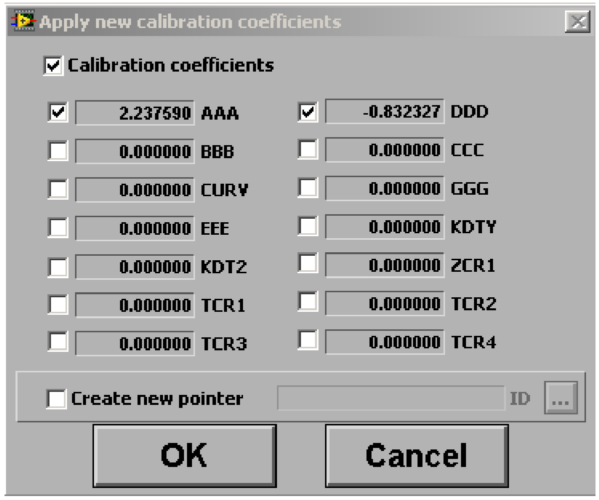


Figure 7-4 Apply new calibration coefficients

It is also possible to manually enter the calibration constants in a grade code through the Recipe Maintenance display on the **Setup** menu. In the appropriate recipe, click on the **Main Code Table** tab and select the M**oisture sensor Calibration Table**. Enter the calibration coefficients and click **Save**. The appropriate correctors also need to be enabled/disabled in the Moisture Sensor Configuration Table (see Chapter 5).

For temporary usage, the calibration constants can be entered through the Calibration Constants Table under **Calibration Constants** in the **Sensor Maintenance** display. Enable or disable Correctors through the Recipe-based options in the Sensor Maintenance display. To enable a corrector, double-click on it and a check mark shows in front to indicate that it has been enabled (to disable a corrector, double-click on it again and the check mark disappears).

7.5. Verification

Verification of the factory static calibration is required during installation. Verification can also be performed at any time to confirm the calibration parameters of current and/or new grades.

Like calibration, verification is done using the **Advanced** display. Bring up the Advanced display by clicking **Advanced…** in Maintenance mode from the **Sensor Maintenance** display. To enter verification, select **Verification** in the drop down menu. See Figure 7-5.

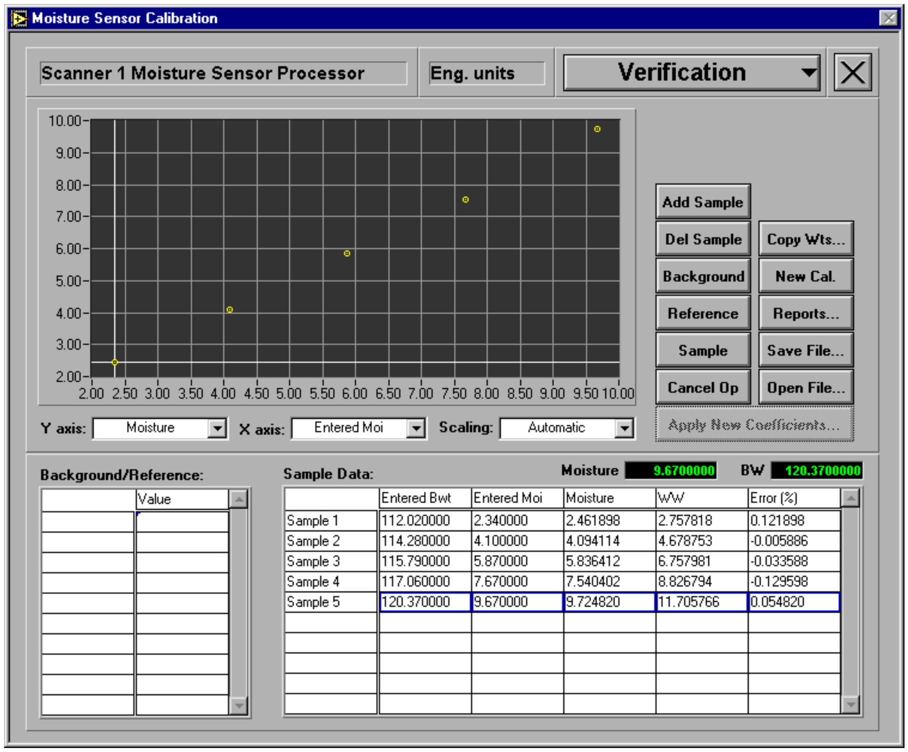


Figure 7-5 Advanced Window

While Maintenance Mode applies to an entire scanner, maintenance operations are targeted to a single sensor, therefore only one **Advanced** screen can be brought up at a time. The common interface maintains only one copy of working memory for the verification.

On top, the window shows which moisture sensor in the system is under maintenance and which units, either engineering units or customer units, are being used. These two settings are inherited from the Sensor Maintenance display and can only be changed from there.

To verify previously calibrated grades:

1. Ensure that the gauge is stable. See Section 9.3.

2. Load a grade code containing the calibration constants and correctors of the samples to be verified.

3. Ensure that the appropriate calibration constants and correctors are properly restored on the **Sensor Maintenance** display.

4. Request a printout of the calibration constants by clicking **data** on the **Sensor Maintenance** display.

5. In Maintenance mode, click **Advanced…** from the **Sensor Maintenance** display.

6. Start from a blank Sample data table.

   It is blank the first time you call up the Advanced screen; otherwise, click **New Cal.** to reset the working space to blank.

7. Load the lab values from a file if the appropriate file exists, or click **Copy Wts…** to copy the lab values from the Calibration table to the verification table.

8. If the lab values have never been entered, set up the Sample data table by clicking **Add Sample** once for every sample in a grade. For each sample, enter the lab basis weight and %moisture in the green field above the table. Save the entered data to a file before starting shooting samples.

9. With nothing in the gap, click **Background** to request a background operation.

   The result appears in the **Background/Reference** table in the lower left corner.

10. Perform a Reference with the paddle and interlocking black rings in the gap. See Subsection 7.3.2 for the Reference measurement procedure.

    The result also appears in the Background/Reference Table.

11. Place the cursor on the first row in the Sample data table, and perform a Sample using the paddle and interlocking black rings. See Subsection 7.3.3 for the proper procedure on sample measurement.

    When the operation is complete, the result is displayed in the Sample data table. The cursor (the highlighted row) automatically moves down to the next entry.

    Repeat the sample measurement until all of the samples in a grade are measured.

12. Save the data again to include the verified data.

13. Repeat the steps above from step 2 for each grade of samples prepared.

14. Select **Error (%)** on the vertical Y axis and **lab Moisture** on the horizontal X-axis to view the verification results graphically.

15. Make a note of any samples that measure with an error of greater than the 2•σ accuracy specification (see Section 1.7). If more than 20% of the samples that were not omitted during calibration fail this criterion, the verification and/or calibration should be repeated until success is achieved. If more than one sample needs to be omitted per grade, then the omitted samples for that grade should be replaced with freshly made samples.

7.5.1. Verification of sheet temperature insensitivity

This procedure is normally only performed when there is reason to suspect that the temperature compensation is not adequate.

To perform this procedure, you need:

- Glass-encased samples
- Empty glass Reference disk
- An oven set to 60°C (140°F)
- Sample paddle
- A towel, cloth, and/or hot glove (to protect the hands and to keep the samples hot on the way to the scanner)

1. Set up a grade code or codes with the appropriate gains (Gain/Flag for Medium Power), calibration constants, and correctors to be used for the glass-encased samples.
2. Load the appropriate grade, and ensure that the proper grade data is loaded on the **Sensor Maintenance** display.
3. Set up the Sample Data Table for the glass samples to be measured through **Advanced**; enter the appropriate sample calculated basis weight.

ATTENTION When there is a change in gain (Gain/Flag for Medium Power), a new Reference is required before sampling.

4. Perform a Reference with the paddle and empty glass Reference pair.

The REF and MES volts should be about 5% lower than those obtained with an empty gap, while the 3RD or Straight-Through volts should be within 2% of those obtained with an empty gap.

5. Perform a Sample with the paddle and the appropriate glass-encased sample at ambient temperature (do not use rings or the pair of glass plates used for the Reference). Repeat for the other glass-encased samples.

6. Heat the samples for five minutes in the 60°C (140°F) oven along with the Reference pair, and then carry them to the sensor in a towel.

7. Perform a Reference on the empty glass Reference pair, and repeat Steps 1 – 5 for each hot glass-encased sample.

8. Allow the sample to cool to ambient temperature for at least ten minutes (longer for heavier samples).

9. Perform a Reference with the Reference pair, and repeat Steps 1 – 5 for each cooled glass-encased sample.

   The result should be that the two ambient temperature readings would repeat within 0.10% moisture.

10. Calculate the percent moisture reading change between the averaged ambient temperature readings and the hot reading; it should be less than ± 0.30% moisture.

7.5.2. Determination of GFLAGs (Medium Power only)

For Medium Power sensors, it is necessary to determine GFLAG, GFLG2, and GFLG3. These constants correct for the attenuation of the flags that are not inserted for certain grades.

Find a glass-encased sample that gives adequate volts (all three channels give between 0.5 and 8.0V) on Flag IN Gain 2 or 3 and on Flag OUT Gain 0, and then follow the procedure:

1. Set GFLAG, GFLG2, and GFLG3 to 1.0 in the grade code through the **Recipe Maintenance** display in the **Setup** menu.

   These constants can also be entered on the **Calibration Table** in the **Sensor Maintenance** display.

2. Load a grade code that is set up for Flag IN Gain 2 or 3; verify that GFLAG, GFLG2, and GFLG3 are set to 1.0 on the **Calibration Table** in the **Sensor Maintenance** display.

3. Perform a Background.

4. Perform a Reference with the glass Reference disk in the paddle.

5. Measure the glass sample on the sensor with the paddle.

6. Load a grade code that is set up for Flag OUT and Gain 0; verify that GFLAG, GFLG2, and GFLG3 are set to 1.0 on the **Calibration Table** in the **Sensor Maintenance** display.

7. Perform a Background.

8. Perform a Reference with the glass Reference disk in the paddle.

9. Measure the glass sample on the sensor with the paddle.

10. Request a printout of the REFA values:

    a. Change over to the Sensor Reporting display.

    b. Select the Moisture Sample Report.

    c. Select the desired parameters to be printed under the Field Names by double-clicking on the field.

       A check mark shows in front of the field to indicate that it is selected. To deselect a field, double-click on it again and the check mark disappears.

    d. Press **data** to request a printout of the selected parameters.

11. Calculate:

$$\mathrm{GFLAG} = \frac{\mathrm{REFA\ (Flag\ OUT,\ Gain\ 0)}}{\mathrm{REFA\ (Flag\ IN,\ Gain\ 2\ or\ 3)}}$$

$$\mathrm{GFLG2} = \frac{\mathrm{RN\ (Flag\ IN,\ Gain\ 2\ or\ 3)}}{\mathrm{RN\ (Flag\ OUT,\ Gain\ 0)}}$$

$$\mathrm{GFLG3} = \frac{\mathrm{RN2\ (Flag\ IN,\ Gain\ 2\ or\ 3)}}{\mathrm{RN2\ (Flag\ OUT,\ Gain\ 0)}}$$

12. Enter the values calculated in the previous step into the grade codes via the Recipe Maintenance display for permanent storage. They can also be entered on the **Calibration Constants Table** in the **Sensor Maintenance** display for temporary usage.

8. Preventive Maintenance

8.1. Preventive Maintenance

Preventive maintenance procedures are minimal. The frequency of preventive maintenance procedures is often defined by the operating environment.

In Table 8-1, **X** indicates recommended maintenance intervals, and **XX** indicates adjust the interval on an as-needed basis.

Table 8-1 Preventive Maintenance Internal checklist

Procedure	Daily	Weekly	Months		Years			Procedure Details
			1	6	1	2	5	
GENERAL								
Clean sensor window	XX							Section 9.1
Check standardize/background values		X						Section 9.2
Check short term stability			X					Section 9.3
Replace IR Lamp				X				Section 9.4
Assess gauge stability using glass samples		X						Section 9.5
Dynamic verification		X						Section 6.3

9. Tasks

This chapter contains procedures for maintaining optimal IR Moisture sensor function or troubleshooting issues with the IR Moisture sensor.

ATTENTION	Activity Numbers that appear in the Task Tables are for use of the sensor diagnostics display only and do not reflect model numbers for the tasks. To determine whether the Task applies to your sensor, check **Applicable Models**. If a value in the Task Table is blank, that means it is not applicable to that task.

9.1. Clean sensor window

Inspect the Daily Sensor Report each day to check for the level of dirt and any indications of instability or failure. The RS2 Standardize ratio is particularly sensitive to the dirt level.

Activity Number:	Q4205-51-ACT-001	**Applicable Models:**	All
Type of procedure:	Inspect	**Expertise Level:**	Operator
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner Offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	1 day
Duration (time period):	5 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time

Required Tools:	Cloth or paper towels Thin stick Methanol or isopropyl alcohol

Keep the sensor windows clean. Clean with a cloth or paper towels dipped in methanol or isopropyl alcohol and wrapped on a thin stick.

CAUTION

The windows are made of thin quartz and are fragile. Broken windows must be replaced, and complete recalibration of the sensor will be required.

For recommended values for correction to moisture due to dirt build-up, see Subsection 6.3.4.2.

If the dirt build-up causes the RS2 ratio to go out of limits, clean the plates more often. It may also be necessary to increase the tolerance of the ratio limit and/or of the ratio Drift limit on the drift check to prevent Bad Standardize alarms caused by too much dirt buildup (see Section 10.1).

To increase the tolerance:

1. Press **SETUP** on the horizontal dispatcher.
2. Select **Recipe Maintenance**.
3. Under **MAIN CODE TABLE**, select the **Moisture Sensor (e.g. MOIP11) Limit Table**.
4. Increase the **Moisture Sensor ratio limit and/or ratio drift limit** value.

9.2. Check standardize/background values

Inspect the sensor Standardize and Background Reports weekly to check for indications of sensor instability.

Activity Number:	Q4205-51-ACT-002	**Applicable Models:**	All
Type of procedure:	Inspect	**Expertise Level:**	Operator
Priority Level:	Average	**Cautions:**	None
Availability Required:	None	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	1 week

Duration (time period):	5 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Realign after Replacing Parts
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:			

1. In the Sensor report display, select **Moisture Background Report** (see Figure 9-1).

2. Select the desired parameters under the field name by double-clicking on them. Use the printer button to print them out.

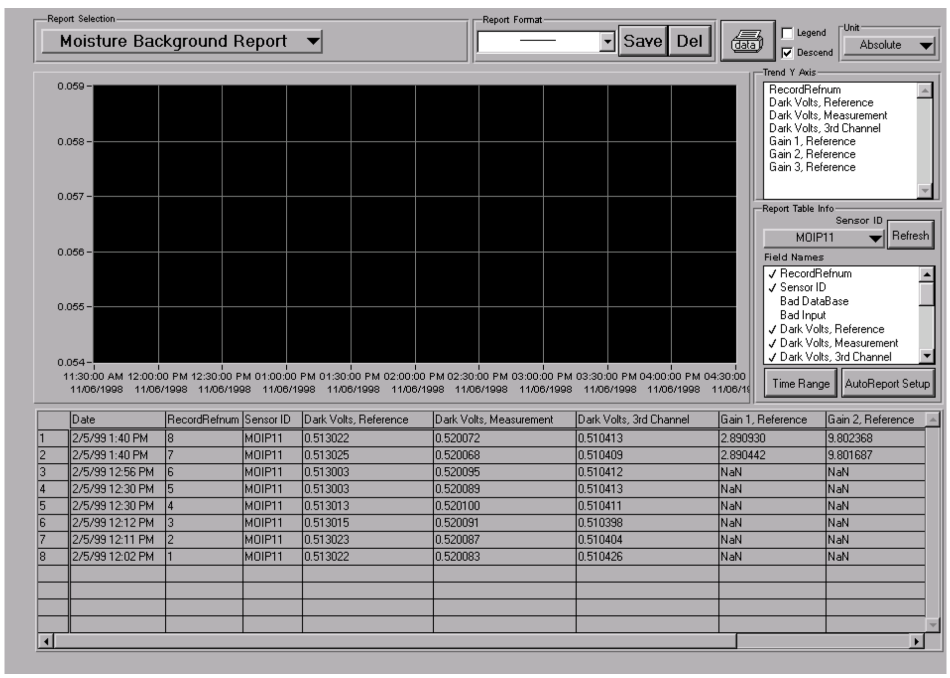


Figure 9-1 Moisture Background Report

- **Dark volts** for the three channels (Ref, Mes, 3rd) should be between 0.45 V and 0.6 V.

- **Gain 1** gain factors for the three channels should be between 2.85 and 3.05

- **Gain 2** gain factors for the three channels should be between 9.6 and 10.1

3. If a Dark Volt or a Gain factor is not within these limits, consult the troubleshooting table.

4. In the Sensor report display, select the **Moisture Standardize Report.**

   - Standardize volts should be within 0.5 V of each other

   Standardize volts are expected to move up and down with head temperature. Channel volts decrease (increase) when head temperature increases (decreases).

   Excessive common mode drift (all three channels drift in phase) may be due to the instability of the source and receiver power supplies, temperature controller card, tuning fork/chopper or lamp/lamp holder.

   Excessive uncorrelated drift of one or more channels (that is, channels drift differently from each other) maybe due to one or more bad detectors. See Section 10.2 for troubleshooting.

   In the event that the standardize volts are stable but far apart (that is, greater than 0.5 V from each other), hardware alignment is required (see Section 9.11).

ATTENTION

The maximum number of records per sensor in the Sensor Reports file is 100 for Background and Sample and 1000 for Reference operations. When the maximum number of records is reached, the newest record replaces the oldest record in the file, so it is advisable to save the sensor report regularly.

9.3. Check short term stability

Check the sensor short term stability monthly for indications of sensor noise and instability.

Activity Number:	Q4205-51-ACT-003	**Applicable Models:**	All
Type of procedure:	Maintain	**Expertise Level:**	Operator
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner Offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	1 month
Duration (time period):	20 minutes	**# of People Required:**	1

Prerequisite Procedures:		**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:			

To check Background measurements:

1. Go into maintenance mode (see Chapter 6).
2. On the **Sensor Maintenance** display (see Figure 9-2), set **Integration Time** for background (in seconds) to **4.00** for four seconds.
3. Perform two Background operations with nothing in the gap.

   The Dark volts should be repeated within 2% and be between 0.45 and 0.6 for Fastcards.

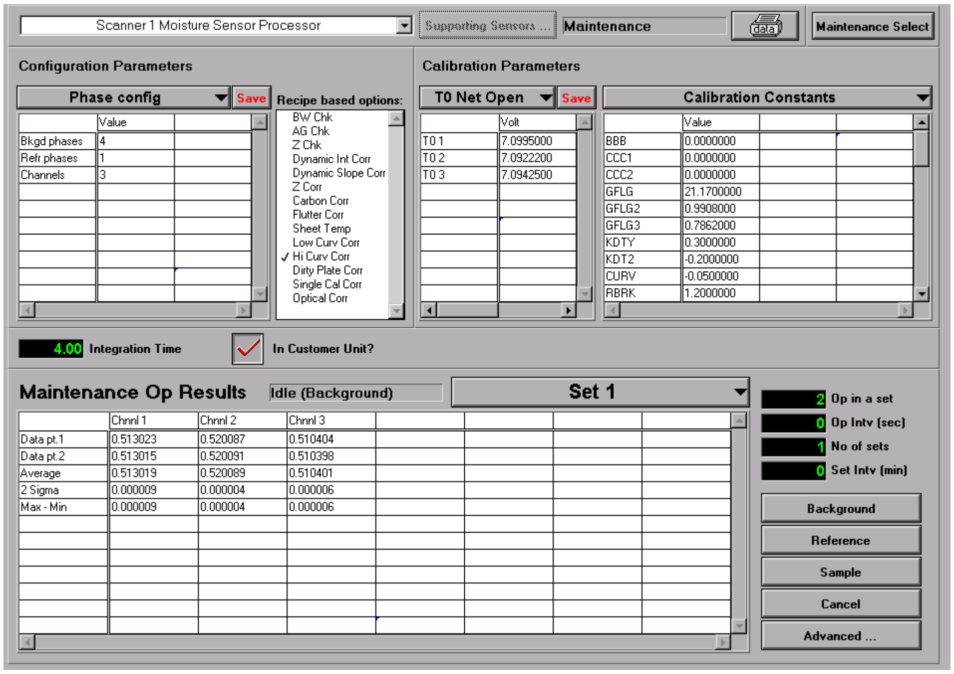


Figure 9-2 Sensor Maintenance Display

To check Standardize measurements:

1. Ensure that the head temperature is within specifications and is stable.

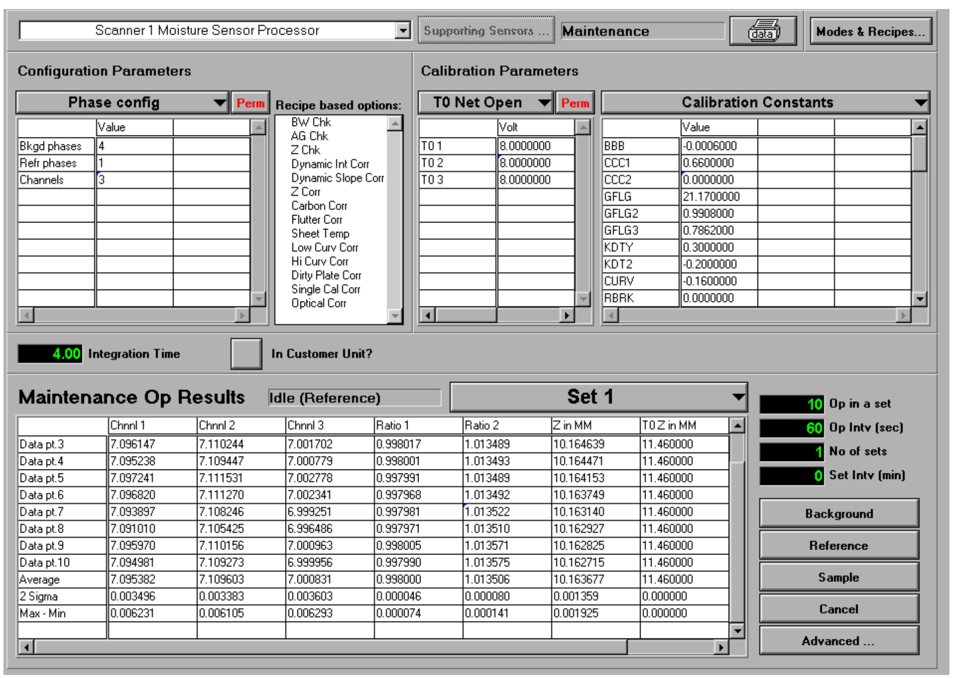
2. On the Sensor Maintenance display, set **Integration Time** for reference (in seconds) to **4.00** for four seconds.

3. Set up to request at least 2 sets of 10 reference operations in a 10 minute period with nothing in the gap (see Figure 9-3).

The results of more than one set of (10) operations usually give a reliable picture of the short-term stability of the sensor. Compare the resulting statistics against the specification (the REF, MES, and 3RD channel volts must be within 0.5V of each other). If all three of the following conditions are met, the sensor is within spec:

- 2• σ(RS)/Average(RS) < 0.0010
- 2• σ(RS2)/Average(RS2) < 0.0010
- (Max-Min) volts for each channel are no more than 12 mV

If the sensor is close to but does not meet the specifications, check that the head temperature is stable. If the head temperature is not stable, wait until it becomes stable (or fix head temperature stability issue – refer to your Scanner manual) and then redo the stability test. If the sensor still does not meet the specifications, consult the troubleshooting guide (see Section 10.2).



	Chnnl 1	Chnnl 2	Chnnl 3	Ratio 1	Ratio 2	Z in MM	T0 Z in MM
Data pt.3	7.096147	7.110244	7.001702	0.998017	1.013489	10.164639	11.460000
Data pt.4	7.095238	7.109447	7.000779	0.998001	1.013493	10.164471	11.460000
Data pt.5	7.097241	7.111531	7.002778	0.997991	1.013489	10.164153	11.460000
Data pt.6	7.096820	7.111270	7.002341	0.997968	1.013492	10.163749	11.460000
Data pt.7	7.093897	7.108246	6.999251	0.997981	1.013522	10.163140	11.460000
Data pt.8	7.091010	7.105425	6.996486	0.997971	1.013510	10.162927	11.460000
Data pt.9	7.095970	7.110156	7.000963	0.998005	1.013571	10.162825	11.460000
Data pt.10	7.094981	7.109273	6.999956	0.997990	1.013575	10.162715	11.460000
Average	7.095382	7.109603	7.000831	0.998000	1.013506	10.163677	11.460000
2 Sigma	0.003496	0.003383	0.003603	0.000046	0.000080	0.001359	0.000000
Max - Min	0.006231	0.006105	0.006293	0.000074	0.000141	0.001925	0.000000

Figure 9-3 Reference Display

9.4. Replace IR lamp

Regular replacement of the IR lamp and lamp holder ensures continuous operation of the moisture sensor and prevents unexpected failures. The IR lamp is under run at 4.4V to prolong its life. The lifetime of the lamp can vary greatly from one lamp to another and is hard to predict.

Activity Number:	Q4205-51-ACT-004	**Applicable Models:**	All
Type of procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric Shock
Availability Required:	Sensor Offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	6 month
Duration (time period):	1 hour	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:	38000201	1	In stock
	08594000	1	In stock
	Part Number	Quantity	Lead Time
Required Tools:	Cloth, screwdriver, Allen key		

Change both the lamp and the lamp holder on a regular basis (default is every six months).

1. Turn off IR source power in lower head.
2. Unscrew lamp leads from the terminal block.
3. Loosen screw securing lamp holder (using Allen key).
4. Carefully remove the lamp holder.

CAUTION

Remove lamp using a cloth, as the lamp could still be hot.

5. Inspect bulb leads. If the leads show signs of oxidation, it is imperative that both the lamp and the lamp holder be replaced.
6. Insert the new lamp in the lamp holder. Always use a cloth. Do not touch the lamp with your bare fingers.

7. Reinstall the lamp holder and reconnect the leads to the terminal block.

8. Turn the IR source power back on.

9. Before securing the lamp holder, the position of the lamp needs to be adjusted:

   a. Connect an oscilloscope to TP2 and TP1 (gnd) on one of the Fastcards in the receiver (Figure 2-10).

   b. Move the lamp up and down to maximize the signal at TP2. Secure the lamp holder by tightening the screw firmly.

      The maximum signal is usually found when the lamp is pushed down almost all the way. Do not overload any channel with too much signal. No channel (including Opacity, when present) should have more than 3V peak-to-peak with the jumper on the detector preamp set to lowest gain.

   c. Back the lamp off if any signal is too high.

10. Check and adjust gain and phase of Fastcards. See Section 9.10.

9.5. Check stability

The long term stability of the gauge can be assessed by shooting glass samples regularly. Glass samples are ambient samples encased in glass which, if stored properly, stay stable for months. A large shift in the sensor reading can be the indication of a hardware issue.

Activity Number:	Q4205-51-ACT-005	**Applicable Models:**	All
Type of procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner Offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	1 week
Duration (time period):	20 minutes	**# of People Required:**	1
Prerequisite Procedures:	Check short term stability	**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time

Required Tools:	

Verification of glass-encased samples involves the following steps:

1. Go into maintenance mode (see Chapter 6).
2. Check the sensor stability (See Section 9.3).
3. Click **Advanced…** and select **Verification** on the drop down menu.
4. Load the file containing the glass samples basis weight and lab moisture values using the **Open File…** command or enter the values manually. See Verification chapter for more details on data entry if required.
5. Perform a background.
6. Load the (first) grade for the glass sample(s) to download the calibration constants. Check that the proper calibration constants and correctors appear on the Sensor Maintenance display.
7. Perform a Reference with the paddle and reference glass disk.
8. Perform a Sample on each glass sample within a grade. With the appropriate gain settings, the voltage readings should be between 0.5 and 8V for each channel.
9. Repeat steps 6-8 for each grade.
10. Save the verification file using the **Save File…** function.
11. Seasonal shifts in the moisture readings are expected when verifying glass samples. However, a sudden shift in the readings is indicative of a problem.
    a. Ensure that the proper gain settings, calibration constants, correctors are loaded.
    b. Confirm that the glass sample seal is not damaged (that is, use more than one glass verification sample).
    c. If a hardware issue is suspected, check sensor alignment (Section 2.1) and proceed to the troubleshooting section.

9.6. Replace a board

Printed circuit boards are not to be repaired in the field. Replace defective boards and return them to Honeywell for repair.

Activity Number:	Q4205-51-ACT-006	**Applicable Models:**	All
Type of procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric Shock
Availability Required:	Sensor Offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	1 hour	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Realign after Replacing Parts
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:			

CAUTION

Wear a static electricity discharge band on your wrist and ground its wire.

1. Turn off head power before removing or inserting a board.
2. Handle boards by their edges or wear clean gloves. Do not touch edge connectors on printed circuit boards.
3. Exchange only one board at a time.
4. If a replacement board does not solve a problem, reinstall the original before proceeding.
5. Set jumpers and/or switches of new boards exactly as positioned on the replaced board and/or check jumper settings (see Section 2.1).
6. Tag the defective board (at the time you confirm that it is defective) with the suspected trouble or symptom.

9.7. Realign after replacing parts

Replacement of some parts requires realignment of other parts (See Table 9-1).

Activity Number:	Q4205-51-ACT-007	**Applicable Models:**	All
Type of procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric Shock
Availability Required:	Scanner Offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	1 hour	**# of People Required:**	1
Prerequisite Procedures:	Replace a board	**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:			

Table 9-1 Replaced Parts Requiring Realignment of Other Parts

Replaced Item	Check/Section
Source:	
Lamp	Lamp focus, gain, and phase of Fastcards See Replace IR lamp and Align Fastcard board
Tuning Fork (Standard Power)	Tuning Fork Driver Board (See Align Tuning Fork Driver Board) Gain and phase of Fastcards (See Align Fastcard board)
Tuning Fork Driver Board (Standard Power)	Align Tuning Fork Driver Board Gain and phase of Fastcards (See Align Fastcard board)
Power Supply Adapter Board	See Subsection 2.1.1.1.
Motor (Medium Power IR)	Motor frequency (See Subsection 2.1.2.3) Gain and phase of Fastcards (See Align Fastcard board)
Source Backplane (Medium Power IR)	None
Sync Gen/Lamp Mod Board (Medium Power IR)	See Subsection 2.1.2.3 Gain and phase of Fastcards (See Align Fastcard board)
Motor Controller Board (Medium Power IR)	See Subsection 2.1.2.3.
Single-Sided Detector Board (Medium Power IR)	Sync signals (See Subsection 2.1.2.3) Gain and phase of Fastcards (See Align Fastcard board)
Receiver:	

Replaced Item	Check/Section
Detector Preamp	Peltier cooler voltages (See Subsection 2.1.3.2) Gain and phase of Fastcards (See Align Fastcard board)
Fastcard	Gain and phase of Fastcards (See Align Fastcard board)
Temp Control Board	Peltier cooler voltages (See Subsection 2.1.3.2) Gain and phase of Fastcards (See Align Fastcard board) Temperature output, if needed (See Subsection 2.1.3.3)
Unigauge Backplane Board	See Subsection 2.1.3.1 Gain and phase of Fastcards (See Align Fastcard board) Edge detect, if used (See Subsection 2.1.3.5)
Quartz Plates:	
Optically Tuned Plates	Gain of Fastcards (See Align Fastcard board); Check dynamic calibration (See Section 6.3) and if required static calibration (See Chapter 7)

9.8. Check for water in Quartz-Teflon Plates

IR Moisture sensors use composite Quartz-Teflon plates to create an optical cavity around the sheet, requiring the light to make multiple passes through the sheet to reach the offset optics detectors. The quartz is breakable, and the Teflon is porous and can become filled with water. Perform this test if you suspect that moisture trapped in the plates is affecting the measurement.

Activity Number:	Q4205-51-ACT-008	**Applicable Models:**	All
Type of procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	None
Availability Required:	Sensor Offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	1 hour	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Replace Quartz-Teflon plate
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:	Blow dryer		

If water has entered a plate, the water will cause a very strong reduction in the MES volts during Standardize/Reference and may be visible upon inspection.

To check for water in the plates:

1. Perform a Reference.
2. Split the heads.
3. Heat the central area of the Quartz-Teflon plate (7.5 cm by 2.5 cm, or three inches long by one inch wide) with a blow dryer to drive the water away.

   You should observe some change in appearance.

4. Once the plate is hot, quickly put the heads back together and perform several References.

If water has entered a plate, the MES volts should increase when the plate is hot and then gradually fall as the plate cools down and the moisture redistributes itself.

9.9. Replace Quartz-Teflon Plates

IR Moisture sensors use composite Quartz-Teflon plates to create an optical cavity around the sheet, requiring the light to make multiple passes through the sheet to reach the offset optics detectors. See Figure 9-4 for a cross-section view of the Medium Power IR sensor. The quartz is breakable, and the Teflon is porous and can become filled with water. Replace any cracked or broken plates.

Activity Number:	Q4205-51-ACT-009	**Applicable Models:**	All
Type of procedure:	Repair	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	None
Availability Required:	Sensor Offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	6 hours	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Realign after replacing parts Dynamic verification
	Part Number	Quantity	Lead Time

Required Parts:	See Table 9-2		
	Part Number	Quantity	Lead Time
Required Tools:	Exact-o knife Flat head screwdriver Alcohol Tissue		

Follow the procedures in Subsections 9.9.1 and 9.9.2.

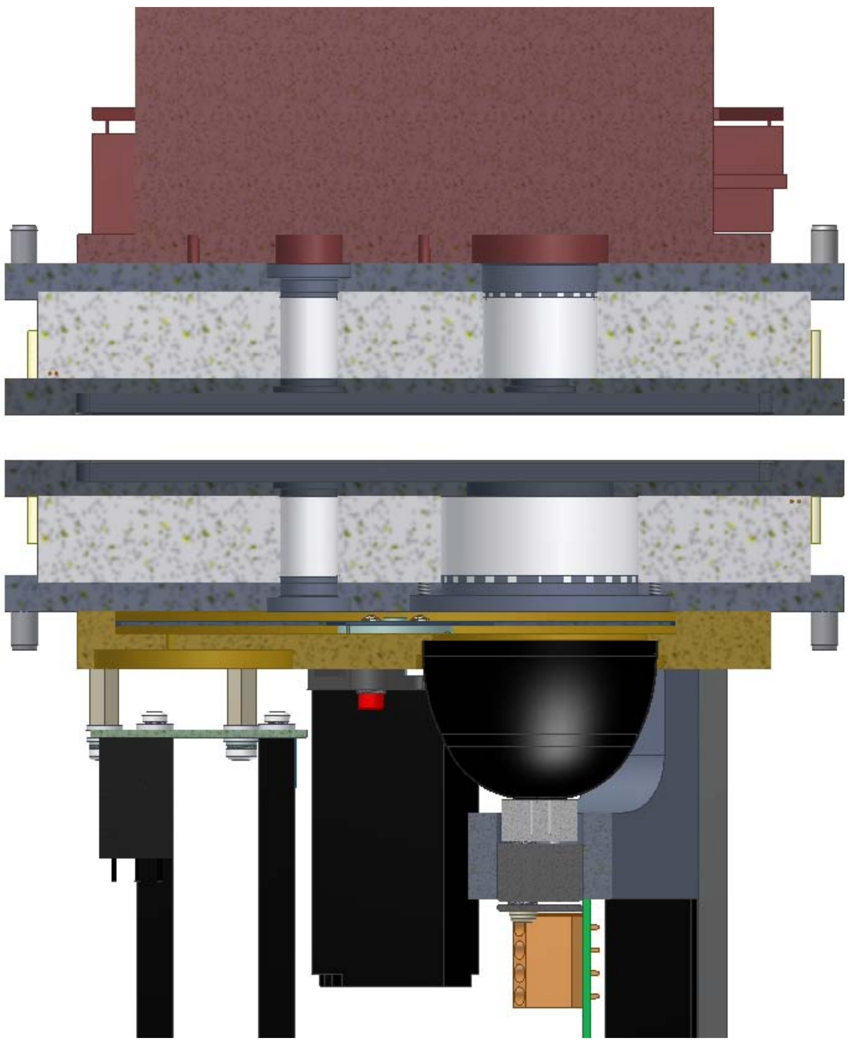


Figure 9-4 Cross-Section View of Medium Power sensor

9.9.1. Remove the Plate

1. Remove the plate (See Figure 9-5) using an Exact-o knife to cut the RTV around the edge and a screwdriver to pry it out.
2. Clean the RTV off the sheet guide using the knife and screwdriver, followed by alcohol and tissue.
3. Remove the Light Pipe, using a knife to cut away the RTV at the sheet guide and the RTV holding the Light Pipe to the head platform.
4. Push the Light Pipe in either direction to dislodge it.
5. Clean away the RTV using a knife, followed by alcohol and tissue.

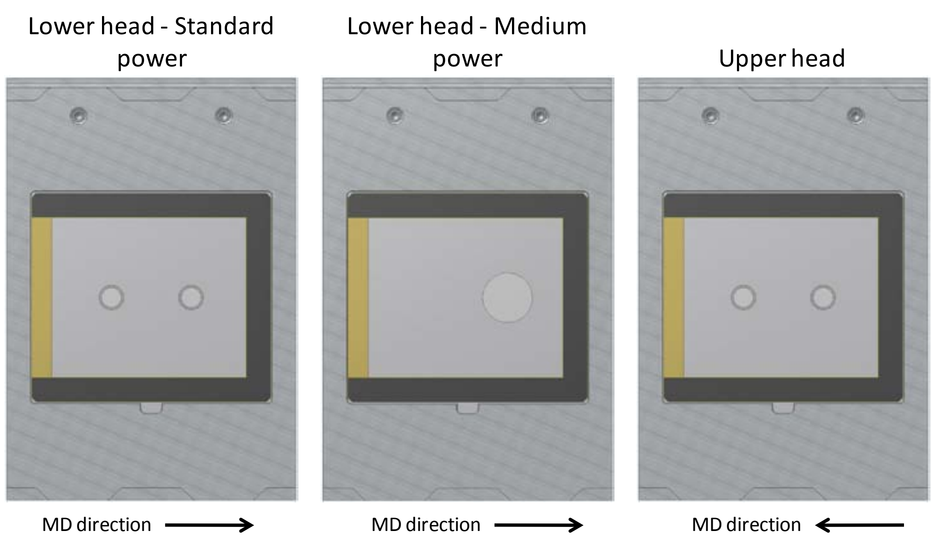


Figure 9-5 Orientation of Black-Border Quartz-Teflon Plates

9.9.2. Install the Plate

The part numbers for materials needed to install the plate are listed in Table 9-2.

Table 9-2 Plate Installation Part Numbers

Description	Upper Head		Lower Head	
	Part No.	Quantity	Part No.	Quantity
Plate	08607801	1	08607801 08632100	1 (Std Pwr) 1 (Medium Power IR)

Description	Upper Head		Lower Head	
	Part No.	Quantity	Part No.	Quantity
Light Pipe	00300000	2 (Std Pwr) 2 (Medium Power IR)	00299900	1 (Std Pwr) None (Medium Power IR)
Clear RTV	16000001	As required	16000001	As required

Optically Tuned black border plates minimize dynamic correction. Because of the consistency of manufacture of the plates, a sensor does not normally require recalibration if the plates have been replaced. Check the calibration, however.

1. Place the sheet guide on a flat surface facing up.
2. Insert the Light Pipe(s) into the hole(s) so that they project about 0.25 inch (6 mm) at the sheet guide.
3. Fill the circular cavity around the Light Pipe(s) with clear RTV.
4. Push the Light Pipe(s) back in until they only project by about 0.125 inch (3 mm).
5. Without pausing, lay down a bead of clear RTV about 0.25 inch (6 mm) wide around the inside of the rectangular recess for the plate.
6. Place the Quartz-Teflon plate into the recess, pushing against the RTV and Light Pipe(s) until the plate is flush with the sheet guide. Optically Tuned plates should be mounted with the white edges opposing:

    On the lower head, the white edge should be on the offset optics side; on the upper head, the white edge should be on the straight-through optics side (See Figure 9-5).

    Make sure that the Light Pipe(s) do not fall through. It may be helpful to gently restrain them with masking tape and a ball of paper in the head (make sure the restraint does not lift the plate).

7. Using tissue and alcohol, wipe off any excess RTV around the plate. Be sure the side cavities are filled with RTV. Allow the RTV to dry for at least four hours.

9.10. Align Tuning Fork Driver Board

The tuning fork typically does not need to be aligned unless it is being replaced. A tuning fork not properly aligned can result in the fork not vibrating at all (no signal on the detectors), chattering (high pitch noise) and low detector output.

Activity Number:	Q4205-51-ACT-010	**Applicable Models:**	Q4205-51
Type of procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	Electric Shock
Availability Required:	Scanner Offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	30 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Align Fastcard board
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:	Voltmeter Oscilloscope Small flat head screwdriver		

9.10.1. Check Alignment

1. Power up the sensor.

2. Connect a voltmeter to TP6 (+) and TP2 (-), and an oscilloscope with probes to TP5 and TP3 with ground to TP1.

   There should be a 12V peak-to-peak sine wave on TP5, and a 4 to 16V peak-to-peak sine wave on TP3. TP6 is in the range from -0.3 to +0.1 VDC.

   The Phase Reference signal appears on TP4 as a 6V peak-to-peak signal with a frequency of 570 ± 20 Hz.

3. If all of these conditions are satisfied, the tuning fork is aligned. If not, proceed to the next section.

9.10.2. Obtain Stable Oscillation

1. Power up the sensor. If the fork vibrates cleanly, proceed to the next section.

   If there is no vibration, turn R1 counterclockwise (CCW) until the fork starts vibrating.

2. If it fails to start with R1 fully CCW, turn R2 clockwise (CW) until the fork oscillates.

3. If the fork vibrates but chatters, turn R1 CCW until the chattering stops. If it still chatters, turn R2 CW until it stops.

9.10.3. Adjust Maximum Amplitude

Once the fork is vibrating at a stable rate, maximize the amplitude of vibration.

1. Connect a voltmeter to TP6 (+) and TP2 (-), and an oscilloscope with probes to TP5 and TP3 with ground to TP1. There is a 12V peak-to-peak sine wave on TP5, and a 4 to 16V peak-to-peak sine wave on TP3.

2. Turn R1 to get 12 Vpp (4.25 Vrms) ± 0.1V on oscilloscope at TP3. This translates to a maximum sine wave fork drive voltage of 24 Vpp. At this drive voltage, maximum permissible fork aperture is ensured. If the fork chatters, turn R1 CCW until the chattering stops.

3. Turn R1 CCW to reduce the signal at TP3 by 0.5 Vpp from the value obtained in step 2. Signal at TP3 now reads 11.5 Vpp (4.05 Vrms) or lower.

4. Adjust R2 until the voltmeter at TP6 reads -0.2 to 0V.

9.10.4. Test for Clean Start

1. Power down, wait a few seconds, and then power up again. Check that the fork starts up quickly and cleanly.

2. If there is any tendency to chatter, turn R1 CCW to reduce the TP6 voltage by 0.2 ± 0.1V, and then R2 to bring it back to -0.1V.

ATTENTION	As the fork heats up, the voltage on TP6 will increase about 0.2V and the fork may chatter. For this reason, it is good practice to make a final adjustment when the sensor is at temperature. If time does not permit a warm-up period, make a final adjustment on R1 to make TP6 read -0.3 ± 0.1V to allow for warm-up.

9.11. Align Fastcard board

Fastcard boards need to be aligned every time a sensor part (electronic or optical part) has been replaced. It is also necessary to align a Fastcard board when the corresponding channel voltage has drifted significantly.

Follow the procedure in this section for all three boards.

Activity Number:	Q4205-51-ACT-011	**Applicable Models:**	All
Type of procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	Electric Shock
Availability Required:	Scanner Offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	30 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:	Voltmeter Oscilloscope Small flat head screwdriver		

1. There are five jumpers on the Fastcard board. Four of the jumpers are labeled H/L, and they govern the frequency response. Check to see that these are in the L position for Standard Power sensors and in the H position for Medium Power sensors.

2. The fifth jumper is labeled A/B and it governs the phase delay. Check to see this is on A – where it is normally, but it may need to be switched to B for Medium Power IRs in order to be able to adjust the phase properly.

3. Check the output of the Detector Preamp by connecting the oscilloscope probe to TP2 (signal) and TP1 (Gnd) of the Fastcard. The signal should be a 570 Hz (Standard Power) or 170 Hz (Medium Power) sine wave of amplitude between 0.3 and 3V peak-to-peak.

4. If the signal is greater than 3V, select a lower gain on the corresponding PbS detector assembly by changing the jumper selection on the Fast Preamp board (See Figure 9-6).

   If the signal is less than 0.3V, select a higher gain by changing the jumper selection on the Fast Preamp board.

   There are three jumper-selectable gains; their exact values depend on the revision of the assembly.

   The highest gain is selected by placing a jumper in position W1, medium gain is selected by placing the jumper in position W2 and the lowest gain is selected by removing the jumper or by placing it across the W1 and W2 positions as shown in Figure 9-6.

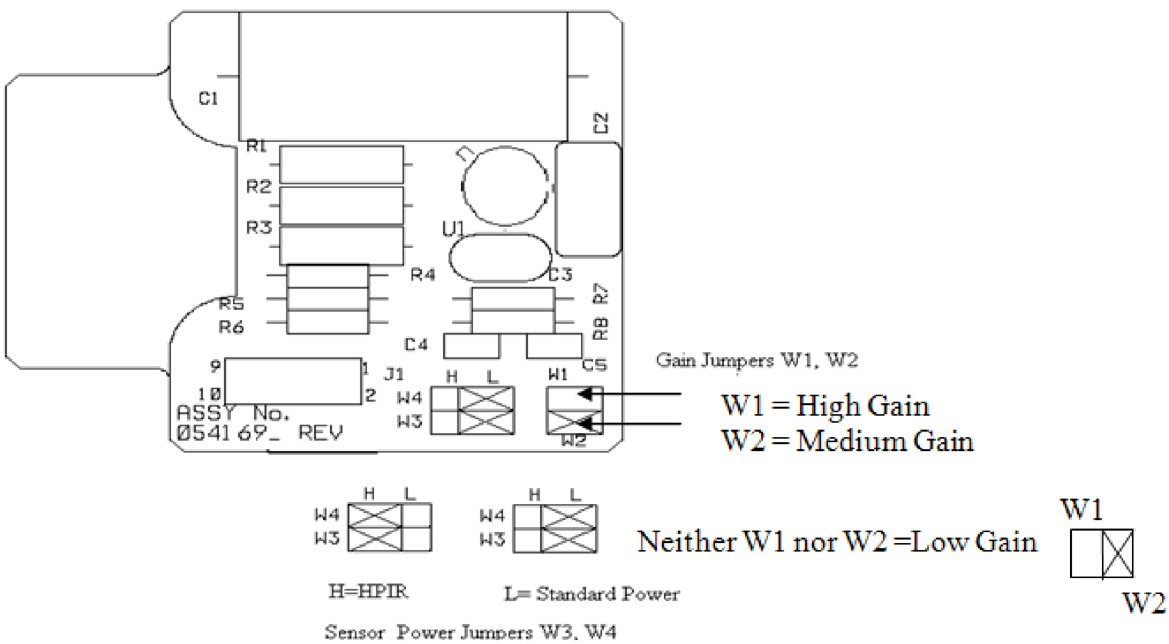


Figure 9-6 PbS Detector Assembly

5. Connect the voltmeter to TP9(+) and TP1(Gnd) and connect the oscilloscope probe to TP7A and TP1(Gnd) of the Fastcard. Adjust R1

on the Fastcard to bring the meter reading into the range from 4 to 8 VDC.

6. Adjust R2 to balance the phase (see Figure 9-7). Phasing adjustment can be done using TP7A and TP7B on the Fastcards. If phasing is impossible on Fastcard, change the selection on jumper W5/W6.

ATTENTION	Switching spikes will appear on some sensors. Disregard their position and magnitude. If the sine wave from the preamp is asymmetric, the balance could be above or below ground (B1 or B3).

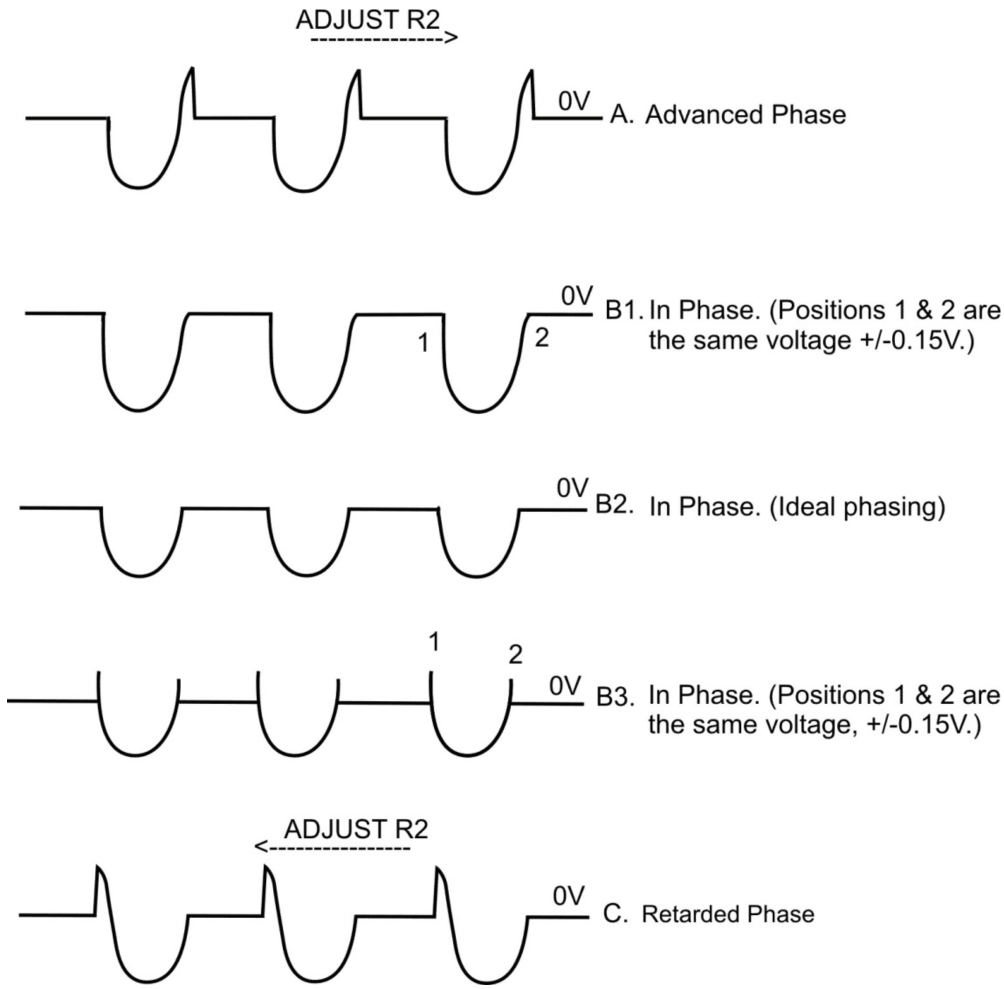


Figure 9-7 Phase Adjustment

7. Adjust R1 again to bring the meter reading to 7.5 ± 0.1 VDC. If it is not possible to bring the meter reading to this level, select a different jumper on the Fast Preamp board in the Detector Preamp Assembly.

The test points should be as shown in the summary Table 9-3 (with TP1 as ground).

Table 9-3 Test Points for the Fastcard Board

Test Point	Voltage
TP2	0.3 to 3 VAC peak-to-peak
TP3	0.6 VAC peak-to-peak
TP4	N/A
TP5	1.2 VAC peak-to-peak
TP6	N/A
TP7A, TP7B	4V trough-to-peak half-sine wave
TP8	3.5V trough-to-peak both half-sine waves
TP9	7.5 VDC

None of the AC signals should be clipped.

10. Troubleshooting

The troubleshooting section is divided in three sections:

- Alarm based troubleshooting that applies to both the Standard Power Moisture Sensor and the Medium Power Moisture Sensor\
- Non alarm based troubleshooting that applies to only the Standard Power Moisture Sensor
- Non alarm based troubleshooting that applies to only the Medium Power Moisture Sensor

10.1. Alarm based troubleshooting

Depending on your system's configuration, your Experion MX system may only display some of these alarms.

10.1.1. Bad dark volts

Symptom	Possible Cause(s)	Solution (Tasks)
Dark volts are outside limits (Alarm: Bad Dark Volts)	Dark volts are outside limits For any channel, $Volts_{Dark} \geq$ Upper Limit OR $Volt_{Dark} \leq$ Lower Limit Default values for Upper and Lower limits are 0.6 V and 0.45 V, respectively	Check standardize/background values Replace a board If dark value is outside limits for all three channels, check EDAQ contact output

10.1.2. Bad standardize ratio

Symptom	Possible Cause(s)	Solution (Tasks)
Alarm: Bad Standardize Ratio	For any of the two working ratios: $Ratio_{Standardize}$ > Upper Limit OR $Ratio_{Standardize}$ < Lower Limit where: Ratio = $NetOpenVolts_{ChannelA}$ / $NetOpenVolts_{ChannelB}$ and: NetOpenVolts = $Volts_{Standardize}$ – $Volts_{Dark}$ Default values for upper and lower limits are 1.05 and 0.95, respectively.	Align Fastcard board Clean sensor window See Non –alarm Based troubleshooting. If the issue cannot be avoided, increase the ratio limits in the Moisture Sensor Limit Table

10.1.3. Standardize Ratio drift

Symptom	Possible Cause(s)	Solution (Tasks)
Alarm: Standardize Ratio drift	For any of the two working ratios: | $Ratio_{Standardize}$ - $Ratio_{TimeZero}$ | > Ratio Drift Limit where: Ratio = $NetOpenVolts_{ChannelA}$ / $NetOpenVolts_{ChannelB}$ and: NetOpenVolts = $Volts_{Standardize}$ – $Volts_{Dark}$ Default value for the ratio drift limit is 0.1	Align Fastcard board Clean sensor window See Section Non –alarm Based troubleshooting. If the issue cannot be avoided, increase the ratio drift limit in the Moisture Sensor Limit Table or change the time zero net open volts In the Sensor Maintenance display (Maintenance mode only)

10.1.4. Bad Z reading

Symptom	Possible Cause(s)	Solution (Tasks)
Alarm: Bad Z reading	The Z correction is ON and the Z sensor standardize was flagged as bad	Check Z sensor

10.1.5. Bad Z correction

Symptom	Possible Cause(s)	Solution (Tasks)
Alarm: Bad Z correction	The Z correction is ON and the Z sensor measurement was flagged as bad	Check Z sensor

10.1.6. Bad temperature correction

Symptom	Possible Cause(s)	Solution (Tasks)
Alarm: Bad Temperature correction	The dynamic slope correction is ON, the dynamic temperature corrector is not equal to 0 and the sheet temp or air gap measurement was flagged as bad	Check the sheet temp or air gap sensor

10.2. Non –alarm Based troubleshooting

10.2.1. Standard power sensors

Table 10-1 contains troubleshooting information for standard power sensors.

Table 10-1 Troubleshooting Standard Power Sensors

Symptom	Possible Cause(s)	Check/Action
Lamp not lit.	Lamp failure 24V failure Power supply adapter board failure	Replace IR lamp Check 24V and 4.4V on Power Supply Adapter Board
Gain values not within limits. See Section 9.2 for acceptable ranges	Fastcard failure Backplane failure	If gain values are bad on one channel, swap/replace the corresponding Fastcard If gain values are bad on all channels, replace Backplane (See Replace a board)
Tuning Fork will not start or will not stop chattering.	Tuning Fork damage Tuning Fork Driver Board failure	Replace Tuning Fork. Replace Tuning Fork Driver Board. Align tuning fork (See Align Tuning Fork Driver Board)
No signal at TP2 on Fastcard.	PbS Detector failure Failure of lamp, Power Supply Adapter Board, Tuning Fork Driver Board or backplane failure	Check other channels. If issue only with one channel, swap or replace PbS detector (See Replace a board). If all the channels are affected, check lamp, tuning fork operation (Align Tuning Fork Driver Board) and backplane 250V, ±15V, 6/8V.
Fastcard cannot be adjusted into phase.	Jumper set wrong Temp Board failure	Check Fastcard jumpers. Swap Fastcard jumper A to B or vice versa (See Align Fastcard board) Check Temp Board.
Fastcard will not adjust to 7.5V at TP9.	Gain jumper on PbS Detector set too low Fastcard failure Temp Board failure	Check TP2. The signal should be between 0.3V and 3V pk-pk with nothing in the gap. Adjust PbS detector gain accordingly (See Align Fastcard board). Swap/replace Fastcard. Check/replace Temp Board (See Replace a board).
All 3 channels unstable.	Head temperature unstable Lamp contact oxidized Tuning Fork unstable	Check head temperature. Change lamp and lamp holder (See Replace IR lamp) Replace Tuning Fork (See Align Tuning Fork Driver Board).

Symptom	Possible Cause(s)	Check/Action
One channel unstable.	Fastcard may be saturated Detector unstable Fastcard unstable Temp Board failure	Check TP7A&B on Fastcard (See Align Fastcard board) Swap/replace PbS Detector. Swap/replace Fastcard. Check/replace Temp Board. (See Replace a board)
Low standardize volts and unstable channels	Temp board failure Tuning Fork Driver Board failure Tuning Fork unstable Water in the Infrand plates	Check/replace Temp Board (See Replace a board) Replace Tuning Fork Driver Board. Replace Tuning Fork See Align Tuning Fork Driver Board Check for water in Quartz-Teflon Plates

10.2.2. Medium power sensors

Table 10-2 contains troubleshooting information for Medium Power sensors.

Table 10-2 Troubleshooting Medium Power Sensors

Symptom	Possible Cause(s)	Check/Action
Lamp not lit.	Lamp failure 24V failure Power supply adapter board failure	Replace IR lamp Check 24V and 4.4V on Power Supply Adapter Board
No phase square wave at TP2 on Sync Generator/Lamp modulator board.	Single-Sided Detector Board needs adjustment Motor failure Motor Controller Board failure Sync Generator/Lamp Modulator board failure Single-Sided Detector board failure	Adjust Single-Sided Detector Board to give clean signals on Sync Gen board TP3 & TP4. Check chopper motion/replace Motor. Check chopper motion/ replace Motor Controller Board. Replace Sync Gen/Lamp Mod board. Replace Single-Sided Detector board.

Symptom	Possible Cause(s)	Check/Action
No signal at TP2 on Fastcard.	PbS Detector failure Failure of lamp, Power Supply Adapter Board, Single-Sided Detector Board, Sync Generator/Lamp Modulator Board, or High-Power, Low-Frequency Source Backplane Board Backplane failure	Check other channels. If issue only with one channel, swap or replace PbS detector (See Replace a board). If all the channels are affected, check lamp, chopper operation, sync gen board and backplane 250V, ±15V, 6/8V.
Fastcard cannot be adjusted into phase.	Jumper set wrong Temp Board failure	Check Fastcard jumpers. Swap Fastcard jumper A to B or vice versa (See Align Fastcard board) Check Temp Board.
Fastcard will not adjust to 7.5V at TP9.	Gain jumper on PbS Detector set too low Fastcard failure Temp Board failure	Check TP2. The signal should be between 0.3V and 3V pk-pk with nothing in the gap. Adjust PbS detector gain accordingly (See Align Fastcard board) Swap/replace Fastcard. Check/replace Temp Board. (See Replace a board)
All 3 channels unstable.	Head temperature unstable Lamp contact oxidized Single-Sided Detector board needs adjustment Motor problem Fastcards may be saturated.	Check head temperature. Change lamp and lamp holder (See Replace IR lamp) Adjust Single-Sided Detector board to give clean signals on Sync Gen board TP3 & TP4. Check that the motor frequency is stable on Sync Gen board TP2. Check flag in. Check Fastcards TP7 A&B (See Align Fastcard board)
One channel unstable.	Fastcard may be saturated Detector unstable Fastcard unstable Temp Board failure	Check Fastcard TP7 A&B (See Align Fastcard board) Swap/replace PbS Detector Swap/replace Fastcard. Check/Replace Temp Board (See Replace a board)
Low standardize volts and unstable channels	Temp board failure Water in the Infrand plates	Check/replace Temp Board (See Replace a board) Check for water in Quartz-Teflon Plates

11. Storage, Transportation, End of Life

11.1. Storage and transportation environment

In order to maintain integrity of sensor components, storage and transportation of all equipment must be within these parameters:

Duration of Storage	Acceptable Temperature Range	Acceptable Humidity Range
Short Term (less than one week)	-20°C to 45°C	20-90% non-condensing
Long Term	-10°C to 40°C	20-90% non-condensing

11.2. Disposal

Honeywell supports the environmentally conscious disposal of its products when they reach end of life or when components are replaced.

All equipment should be reused, recycled or disposed of in accordance with local environmental requirements or guidelines.

This product may be returned to the Honeywell manufacturing location, and it will be disposed using environmental friendly methods. Contact the factory for further details and instructions.

12. Glossary

Bin (or Measurement Bin)	The smallest measurement zone on the frame. Also called **Bucket** or **Slice**.
Bucket	See **Bin**.
CD	**Cross Direction**
	Used to refer to those properties of a process measurement or control device that are determined by its position along a line that runs across the paper machine. The Cross Direction is transverse to the MD (Machine Direction) that relates to a position along the length of the paper machine.
Distant End	The end of the scanner opposite the Cable End.
DMAE	Dynamic slope corrector.
DMBE	Dynamic offset corrector.
Drive Side (DS)	The side of the paper machine where the main motor drives are located. Cabling is routed from this end. Also called **Back Side**.
Experion MX	A Quality Control System. See **QCS**.
InfrandPLUS	Offset optics called INFRAND for INfinite RANDom scattering optics.
KAYE	Dynamic temperature corrector.
MD	**Machine Direction**
	The direction in which paper travels down the paper machine.
MDYN	Percent moisture reading of the sensor, including dynamic correction.
MLAB	Percent moisture of the sample determined in the lab.

MSTAT	Percent moisture reading of the sensor, without dynamic correction (correction calculated out).
QCS	**Quality Control System** A computer system that manages the quality of the product produced.
RAE	**Real-Time Application Environment** The system software used by QCS to manage data exchange between applications.
Recipe	A list of pulp chemicals, additives and dyes blended together to make a particular grade of paper. In Experion MX, the recipe contains all sensor and actuator configuration and calibration parameters associated with a grade.
Sensor Set	The term used in the Sensor Maintenance displays to describe a set of sensors working together on a scanner to perform one measurement.
Setpoint (SP)	Target value (desired value). Setpoints are defined process values that can be modified by entering new values through the monitor, loading grade data, and changing a supervisory target.
Slice	See **Bin.**
Standardize	An automatic periodic measurement of the primary and auxiliary sensors taken offsheet. The standardize measurements are used to adjust the primary sensors' readings to ensure accuracy.
Tending Side (TS)	The side of the paper machine where the operator has unobstructed access. Also called **Front Side**.
TEESH	Air gap temperature at slice position.
T0SH	Air gap temperature at calibration time (default 100°F).
Trend	The display of data over time.

A. Part Numbers

A.1. Part Numbers

A.1.1. Standard Power Sensors

The part numbers in Table A-1 are provided for reference purposes. Items marked with an asterisk (*) are included in Spares Kit SP09420551.

Table A-1 Part Number List for Standard Power Sensors

Part Number	Name
05298102*	Temperature Control Board
05333000*	Power Supply Adapter Board
05341600*	Tuning Fork Driver Board
05401100*	Unigauge Backplane Type II
05413200*	Fastcard Board (needed if 08631800 is used)
08607801*	Quartz-Teflon Plate Assembly
08631800* or 08578800	Fast PbS Detector Assembly Or PbS Detector Assembly
39000201*	Lamp QTH 20 Watts
51000037*	Fuse: 2 Amp, 3AG (on 05333000)
51000282*	Fuse: 1.5 Amp Pico (on 05401100)
29000152	570 Hz Tuning Fork Chopper
00299900	Light pipe, source
00300000	Light pipe, receiver
38000172	Beamsplitter
07631900	Lower Body Optics Block
07631600	Upper Body
08617400	Standard Power Receiver Assembly
05416900	Fast Preamp Board
42000025	Aclar Bags 4.5 inch

Part Number	Name
07279100	Sample die 4.5 inch
42000030	Bag Sealer
42000272	Rubber Gloves

A.1.2. Medium Power Sensors

The part numbers in Table A-2 are provided for reference purposes. Items marked with an asterisk (*) are included in Spares Kit SP09420552.

Table A-2 Part Number List for Medium Power Sensors

Part Number	Name
05298102*	Temperature Control Board
05333000*	Power Supply Adapter Board
05340900*	Single-Sided Detector Board
6581500021*	Sync Generator/Lamp Modulator Board
05341100*	High-Power, Low-Frequency Source Backplane Board
05421400*	Motor Controller Board
05401100*	Unigauge Backplane, Type II
05413200*	Fastcard Board
39000201*	Lamp QTH 20 Watts
08631800	Fast PbS Detector Assembly
08607801	Quartz-Teflon Plate Assembly (upper)
08632100	HPIR Quartz-Teflon Plate Assembly (lower)
22000041	Solenoid
35000081	Motor
00300000	Light pipe, receiver
38000172	Beamsplitter
42000806	Aclar Bags 5.5 inch
07612500	Sample die 5.5 inch
42000030	Bag Sealer
42000272	Rubber Gloves
51000037*	Fuse: 2 Amp, 3AG (on 05333000)
51000282*	Fuse: 1.5 Amp Pico (on 05401100)
08628700	Medium Power Source Assembly
08628600	Medium Power Receiver Assembly

B. Moisture Samples Worksheet

Print out the attached Microsoft® Excel worksheet for use in the Sampling procedure in Chapter 7.