Honeywell

SSIR CaCO3 Coat Weight and Moisture Measurement

System Manual

6510020385

SSIR $CaCO_3$ Coat Weight & Moisture

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Contents

List of Figures

List of Tables

Introduction

The purpose of this manual is to provide an introduction to the six-channel direct infrared (IR) coat weight sensor that measures the weight of applied coatings on paper, normally on base stock above 150 g/m^2.

The Experion MX marketing model number for all SSIR $CaCo_3$ coat weight sensors is Q4212-60.

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 12 chapters and three appendixes.

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

Chapter 2, **System Components**, describes the components for the system.

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

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

Chapter 5, **Software**, describes software configuration parameters for the system software.

Chapter 6, **Operations**, describes operation of the system

Chapter 7, **Static Calibration**, describes procedures for static calibration of the system.

Chapter 8, **Preventive Maintenance**, describes recommended ongoing preventive 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, **Storage, Transportation, and End of Life**, describes methods for storing, transporting, and disposing sensor components.

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

Appendix A, **Coat Weight Measurment Configurations**, describes examples of coater and coat weight measurement systems.

Appendix B, **Part Numbers**, lists the component part numbers for this system.

Appendix C, **MS Excel Worksheets**, gives the instructions for opening the worksheets used in Chapter 7.

Related Reading

The following documents contain related reading material.

Honeywell Part Number	Document Title / Description
46005400	Transmission IR Coat Weight Sensor User's Manual
6510020328	IR Moisture Measurement System Manual
6510020381	Experion MX MSS EDAQ Data Acquisition System Manual

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 chapter is intended to provide an overview of coat weight technology, sensor hardware, and specifications for single sided infrared (SSIR) coat weight measurement.

1.1. Paper Coating and Coat Weight

Advances in printing and packaging technologies place new requirements on the performance of the paper sheet surface. More stringent demands are placed on paper gloss, color, and printing detail. To meet these demands, many paper surfaces are coated with water-based mixtures applied to the sheet online.

There are many different formulations of the coatings, containing many different components. In general, however, there are three types of ingredients in paper coating:

- pigments, such as calcium carbonate or clay, that build a fine porous structure and create a glossy surface
- binders, such as latex, that reinforce the base sheet and bind the coating to the paper
- additives, such as plasticizers, dyes, and numerous others, that can modify the appearance and performance of the coating

Honeywell SSIR coat weight sensors allow the paper mill to measure and control the online application of pigments and binders in the coating with a high degree of accuracy. If required, each type of sensor can measure two different coating components, such as calcium carbonate and clay. The sensors also measure the moisture content, enabling the control of coating dryers without the space or expense of an additional sensor.

The SSIR coat weight sensor makes its coating and reference measurements simultaneously at the same spot on the sheet. This feature ensures that the sensor measurements are insensitive to the formation of the coating, thus helping to optimize control of the coating process.

1.1.1. Coat Weight

Because the coating mixture is known, if a measurement is made of the weight per unit area for one of the coating ingredients, the total weight of the applied coating is also obtained in the measurement.

The coat weight is obtained by dividing the weight of the measured component by the percentage of the component in the total dry coating solids. This percentage of the component in the formulation is stored in the system by grade.

Because the component being measured may be present in the base sheet, a measurement of the pre-coated base sheet is made to correct for this contribution to the component weight.

In addition, if the sheet is coated on both sides, the *other-side* coating contributes to the component measurement when the basis weight is below a grade-dependent value. Another side corrector (OSC) is determined in the calibration of the sensor to correct for this effect.

For the simplest configuration (see Figure 1-1), the calculation of the coat weight has the following form:

Coat Wt = (After Comp Wt - Before Comp Wt) / %Comp

where

Comp refers to the component of the coating being measured (calcium carbonate or clay), and %Comp is the percentage of component in the coating.

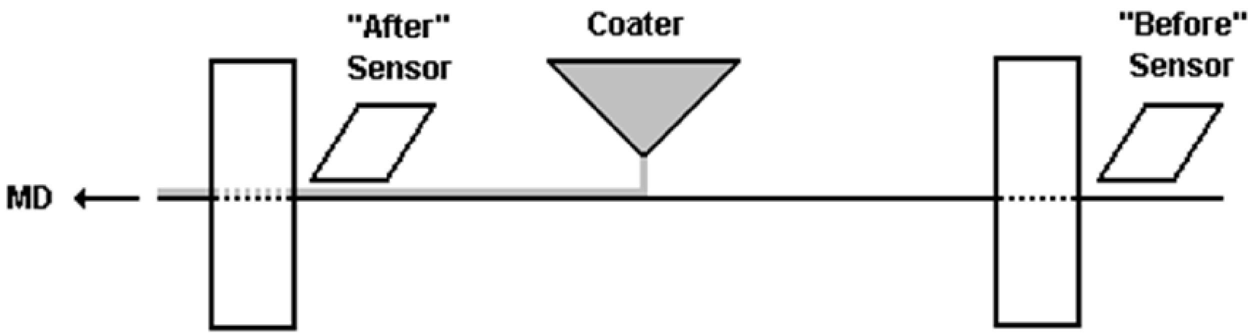


Figure 1-1 Basic Coating Configuration

For the case of two-sided coatings on lighter basis weights:

Coat Wt = (After Comp Wt - Before Comp Wt - “OtherSide Comp”) / %Comp

where

OtherSide Comp refers to the correction for the presence of the component on the other-side of a sheet coated on both sides.

The fraction of the component (%Comp) in the total dry weight of the solids is typically 50–90% for the major solid, either calcium carbonate or clay.

In some circumstances, it may be necessary to correct for changes in the moisture content in the coating (for example, when a flashoff of moisture occurs between the sensor and the reel). The same moisture measurement capability of the sensor used to control the dryers can also be used along with the sensor calibration procedures to correct for variations in moisture in the coating.

1.2. SSIR Measurement Principle

1.2.1. Physical Basis of the IR Measurement

The SSIR coat weight sensors illuminate an area of the moving sheet with broad band IR light. Each component of the coating has its own characteristic absorption of a narrow band of the incident IR light. This narrow band of light is not absorbed by the other coating components, or by other compounds in the base sheet. The component absorbs a significant fraction of the absorption band, and the coating and sheet scatter, reflecting the remaining light.

The sensor collects a portion of this reflected light, passing it through two pairs of filters and detectors for each component being measured. One filter and detector pair corresponds to the narrow-band absorption spectrum for the coating component being measured. The other filter and detector pair provides the reference for the measurement. This pair is set to a section of the IR spectrum that is close to the absorption band but not absorbed by the coating. This scheme allows the reference and measurement to be made simultaneously on the coating.

Figure 1-2 shows the physical basis of the SSIR measurement sensors.

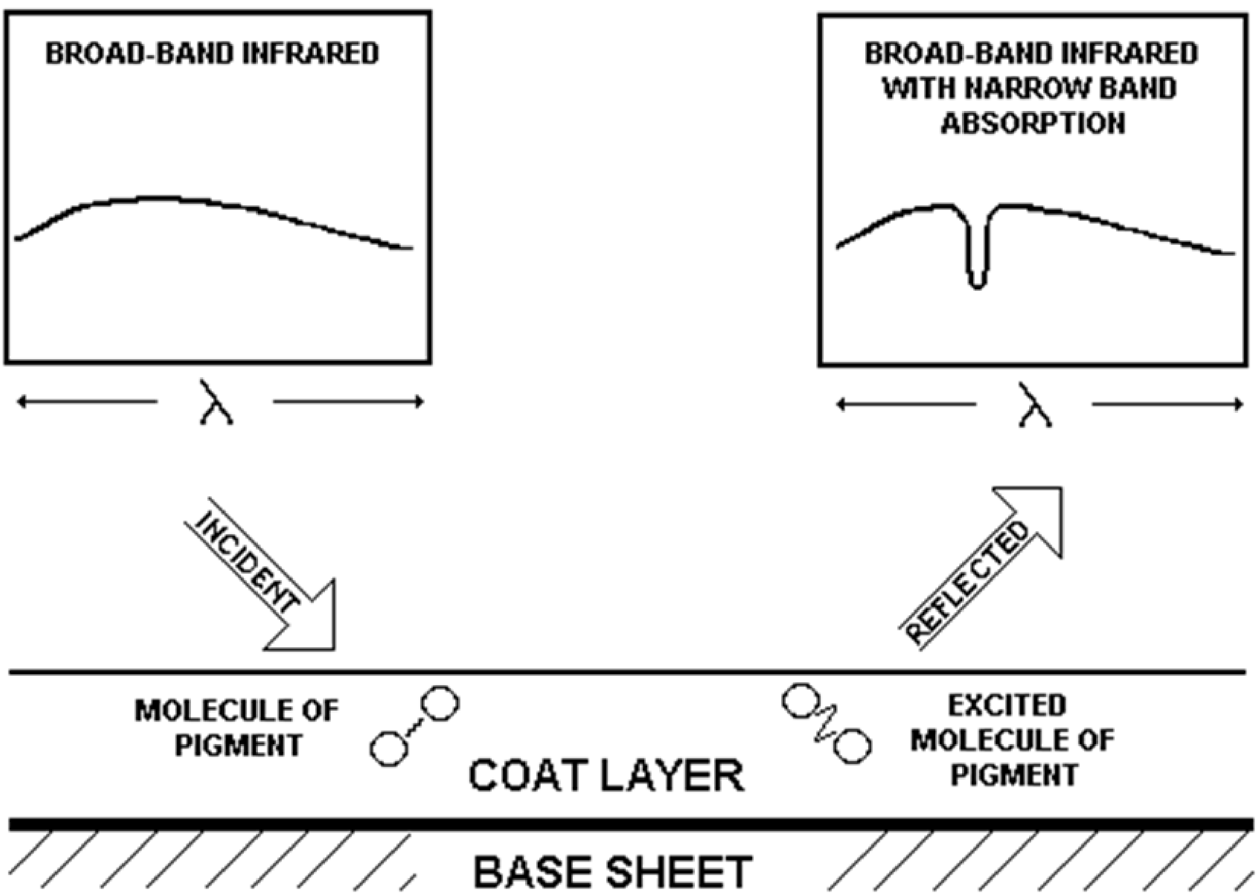


Figure 1-2 Physical Basis of the SSIR Measurement Sensors

1.2.2. Correlation with Other Measurements

One of the significant advantages of the Honeywell IR sensors is their accuracy compared to other online methods. Cumulative errors in the subtractive dry weight method, for example, can approach the actual coat weight being measured.

In particular, this can occur with the heavier base sheets in the presence of large basis weight fluctuations.

The measurement accuracy of the SSIR sensors is independent of fluctuations in basis weight.

1.2.3. SSIR Design Principle

The SSIR coat weight sensor is a four- or six-channel SSIR reflection sensor (or, more accurately, a backscatter sensor). In the recommended version of this sensor there are six channels providing three measurements:

- calcium carbonate
- clay
- moisture

Each measurement has a reference channel and a measurement channel, as described in Subsection 1.2.1. The source and receiver hardware are contained in one sensor head.

The sensor illuminates the sheet with broadband IR light. The light is modulated to discriminate signal from ambient light, and to allow for improved signal amplification.

Figure 1-3 shows the SSIR design principle.

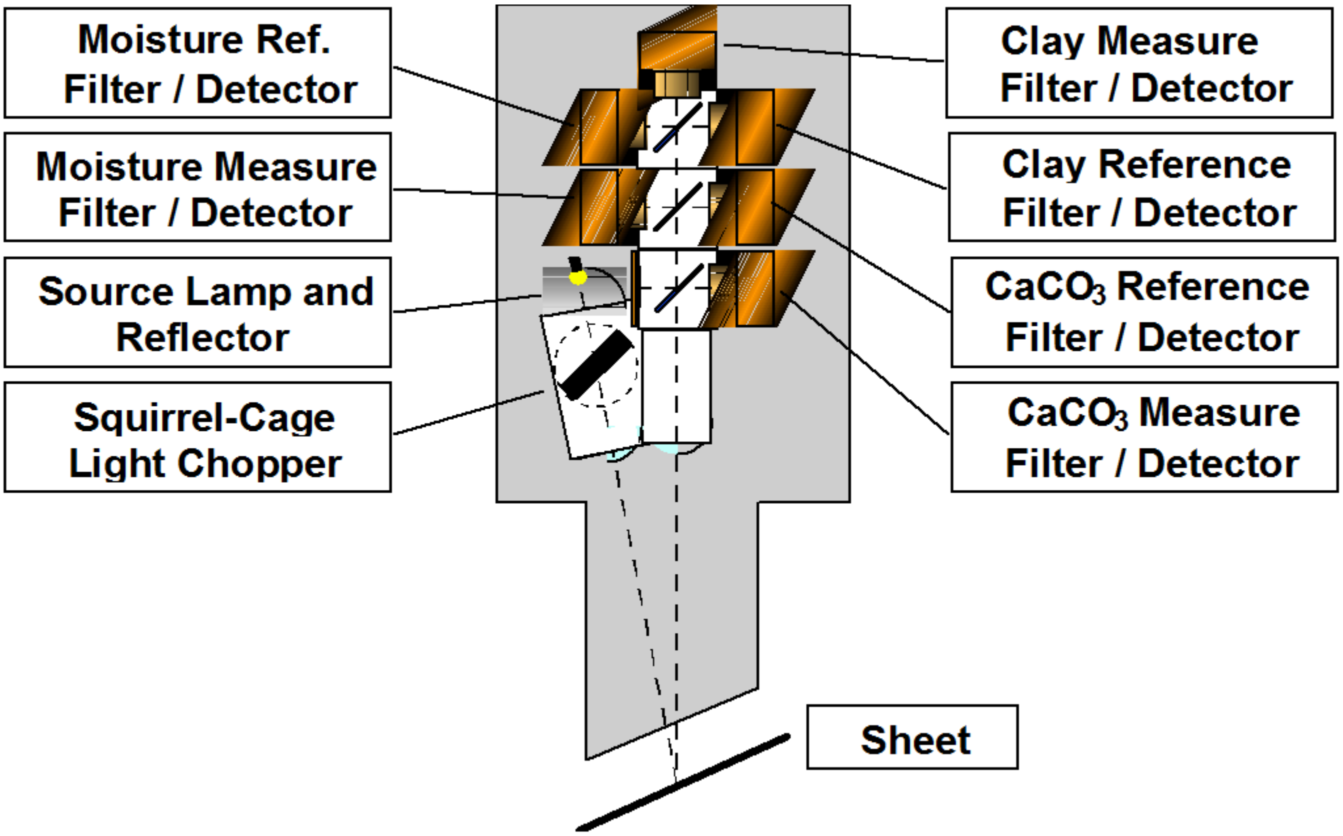


Figure 1-3 SSIR Design Principle

1.3. Requirements for Measurement

The choice and configuration for the types and number of sensors is determined by the following:

- A measurement should be made before and after each coater on the side(s) coated.
- The base sheet must be measured to correct for variations in the paper chemistry and optical properties. For example:
  - If clay or $CaCO_3$ (from broke) is in the base sheet and clay or $CaCO_3$ absorption is used in the coat weight measurement, subtraction of the base sheet component is necessary.
  - If coatings are to be measured on both sides of the sheet, measurements of both sides of the base sheet are necessary.

- If the base sheet has a flat profile (that is, unvarying amounts of coating across the sheet) and a base-sheet scanner is not otherwise wanted, the measurement can be made in a fixed point.

- If the base sheet basis weight is less than 100 gsm and if both sides of the sheet are coated, measurement of the other-side coating may be required for correction of the effect of transmission through the sheet and reflection off the coating from the other side. The correction is required for scanners where both near side and other-side coatings have been applied since the last measurement.

The applicability of the Coat Weight sensor is based on the following requirements:

- The coatings must contain materials that absorb in the near IR. These materials are: calcium carbonate and clay. Calcined or anhydrous clay cannot be measured.

- The sensor responds differently to *ground* calcium carbonate (“GCC”) and *precipitated* calcium carbonate (“PCC”), with the sensor having less sensitivity to the latter. There must be more than 40% PCC, or more than 50% GCC present in the coating.

- The coating formulation must be maintained constant with good accuracy. Typically, we measure the clay and calculate the coat weight using the ratio of solids to clay in the dry coating. In a similar manner, we measure the $CaCO_3$ and calculate the coat weight using the ratio of solids to $CaCO_3$ in the dry coating. If the clay or $CaCO_3$ fractions fluctuate, the sensor reading fluctuates in proportion. For best accuracy, each of the clay and/or $CaCO_3$ components should be held constant with an accuracy of better than 1 percent of their weight. More commonly, this accuracy is 3 percent that will lead to an accuracy of no better than 0.3 gsm on a 10 gsm coat weight.

- The standard sensor measures clay and calcium carbonate. It can, however, be configured to measure latex rather than clay. Measurement of latex requires a latex content in the coating of 10% or more. Implementation of a latex measurement is a hardware and software special.

1.3.1. SSIR Coat Weight System Configurations

The actual determination of the coat weight is an Intergauge measurement; the weight of the component is determined by comparing the measurements between a pair or group of sensors. The system configuration (number and location of the sensors) depends on the specifics of how many layers are applied to which sides of the sheet. See Subsection 1.4.3 and Appendix A for examples of system configuration.

The standard configuration of scanners and sensors is determined from the following criteria:

- Make a measurement before and after each coater on the sides coated.
- Measure the base sheet to correct for variations in the paper chemistry and optical properties. For example, if clay (from broke) is in the base sheet, and clay absorption is used in the coat weight measurement, subtraction of the base sheet clay is necessary.
- If coatings are measured on both sides of the sheet, SSIR measurements of both sides of the base sheet are necessary.
- If the base sheet has a flat profile (varying amounts of coating that are across the sheet), and a base-sheet scanner is not otherwise wanted, the SSIR measurement may be made in a fixed point.
- If the base sheet basis weight is less than 100 g/m^2 and if both sides of the sheet are coated, measurement of the other-side coating may be required for correction of the effect of transmission through the sheet and reflection off the coating from the other side. The correction is required for scanners where both near side and other-side coatings have been applied since the last measurement.

1.4. Measurements

Each SSIR coat weight sensor can provide three kinds of measurements:

- calcium carbonate
- clay
- moisture

The calcium carbonate and clay measurements can require inputs from up to three scanners/sensors:

- Raw clay and calcium carbonate: These measurements are provided by the sensor after the coating station. The various corrections to this value are made in Intergauge calculations involving measurements from an earlier scanner or from another SSIR coat weight sensor on the same scanner measuring the other side of the sheet.

- Pre-coat or base sheet clay/calcium carbonate correction: This measurement is provided by the sensor before the coating station and on the same side of the sheet as the coating to be applied. Its value is subtracted from the raw coat weight of the sensor after the coating station in the Intergauge calculations.

- Other-side correction: This measurement is provided by the sensor measuring the clay or calcium carbonate on the other side of the sheet. Its value is subtracted with the appropriate coefficient from the raw clay or calcium carbonate.

- Moisture: This measurement can be provided by the sensor, which can be used to measure surface moisture for display and control of dryers. The sensor measures moisture approximately 30 g/m^2 deep into the base sheet paper. Moisture measurement is a local measurement that requires no Intergauge calculations.

1.4.1. Measurement Channels

Six-channel sensors are standard. Some applications require only four-channel sensors (channel 1 to channel 4). Table 1-1 shows the standard six-channel assignment.

Table 1-1 Standard Six-Channel Assignment

Name	Function
CH1	Moisture reference
CH2	Moisture measure
CH3	Calcium carbonate reference
CH4	Calcium carbonate measure
CH5	Clay measure
CH6	Clay reference

1.4.2. Local Versus Global Measurements

Only the fully Intergauge-corrected coat weights are available as coat weights on operator displays.

The raw clay and calcium carbonate weight, pre-coat correction, and other-side correction measurements are local or internal measurements only. The measurements are provided only as input to the Intergauge calculations and are not available as coat weights for display on operator displays. They may be available as local scanner measurements (that is, as clay or calcium carbonate content, not complete coat weight) on some displays under **Reel Scanner Maintenance**.

The moisture measurements, although considered local measurements, are available for process display and control, and for use on operator displays.

1.4.3. System Configuration

Figure 1-4 and Table 1-2 provide an example of a common configuration of coaters, and a corresponding coat weight measurement system. The configuration illustrated in this example has two coating stations applying coatings to opposite sides of the sheet. Four sensors are required.

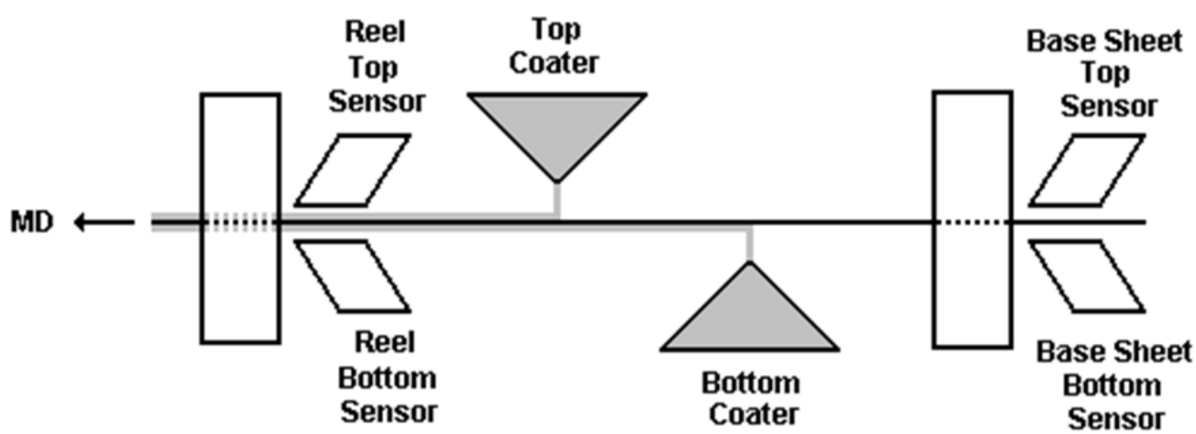


Figure 1-4 Two-Sided, One Coat Each Side Application with 2 Scanners

Table 1-2 Two-Sided, One Coat Each Side Application with 2 Scanners

Scanner/SSIR	Possible Measurements	
	Name	**Description**
2/ Base Sheet Top	$CaCO_3$ (B/S T)	Top base sheet $CaCO_3$ correction
	Moi (B/S T)	Top base sheet surface moisture
2/ Base Sheet Bot.	$CaCO_3$ (B/S B)	Bottom base sheet $CaCO_3$ correction
	Moi (B/S B)	Bottom base sheet surface moisture
1/ Reel Top SSIR	$CaCO_3$ (Reel T)	Top raw $CaCO_3$ weight
	Moi (Reel T)	Top reel surface moisture
1/ Reel Bot. SSIR	$CaCO_3$ (Reel B)	Bottom raw $CaCO_3$ weight
	Moi (Reel B)	Bottom reel surface moisture

ATTENTION

In Table 1-2, only calcium carbonate is shown. Clay can be used instead.

In the configuration shown in Figure 1-4, only two scanners are used. Use of two scanners may necessitate the use of the OSC for thin sheets. If three scanners are used, the OSC is not required. For further details of this and other examples of system configurations, see Appendix A.

In some applications, it is possible to omit the sensor for the base sheet bottom measurements, and use the readings from the base sheet top sensor in the calculations in Table 1-3.

Table 1-3 Intergauge Calculations

Intergauge Calculations	
Top Coat Wt (from $CaCO_3$)	$\frac{CaCO_3\text{ (Reel T) - }CaCO_3\text{ (B/S T) - OSC} \bullet CaCO_3\text{ (Reel B)}}{\%\text{Comp}}$
Bottom Coat Wt (from $CaCO_3$)	$\frac{CaCO_3\text{ (Reel B) - }CaCO_3\text{ (R/S B) - OSC} \bullet CaCO_3\text{ (Reel T)}}{\%\text{Comp}}$
Total Coat Wt	= Top Coat Weight + Bottom Coat Weight

1.5. Hardware Overview

The SSIR sensor has the source (lamp) and detectors in a single housing. There are four or six measurement channels. The SSIR coat weight sensor head with the cover removed is illustrated in the two views of Figure 1-5.

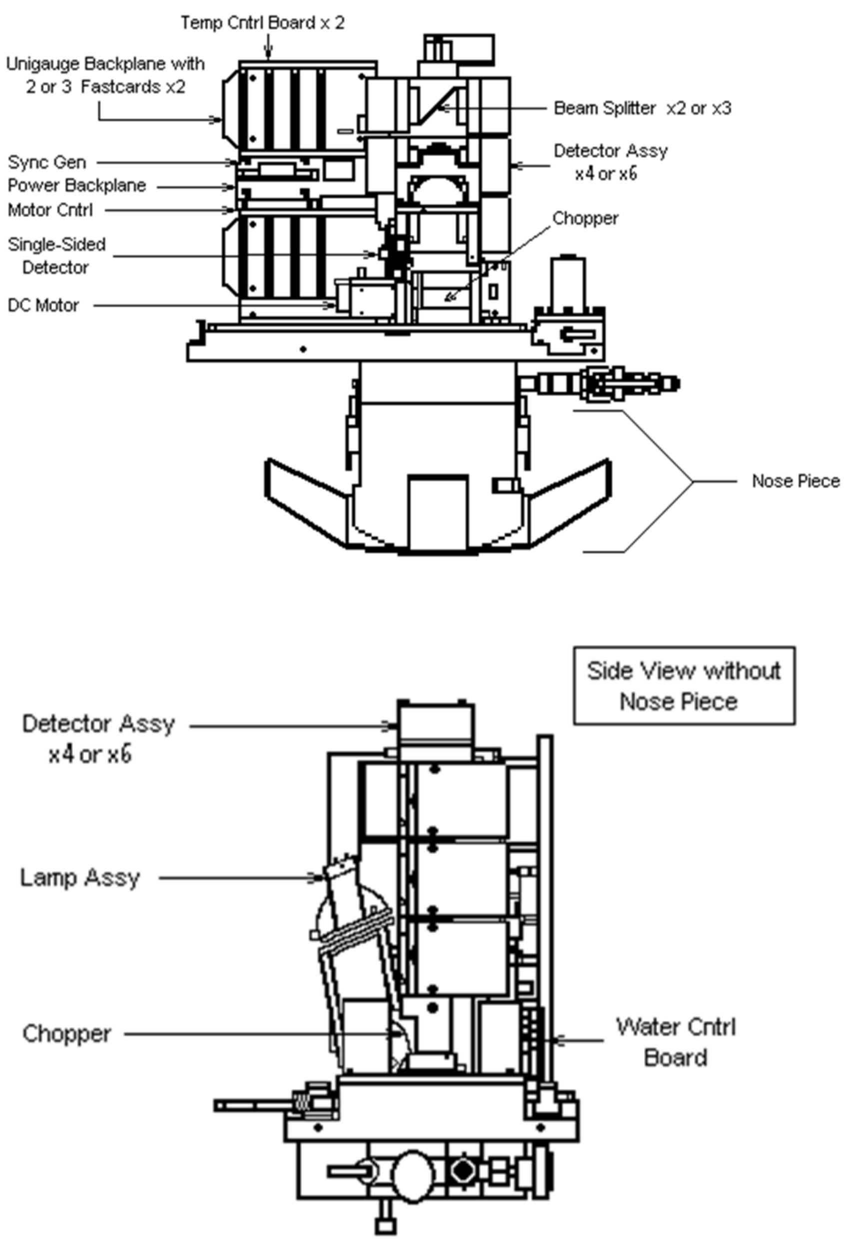


Figure 1-5 SSIR Coat Weight Sensor Head

1.5.1. IR Source and SSIR Optics

The broadband IR source employs a long-life halogen 20 W, 6 V lamp that is powered at slightly more than 4 V to prolong bulb life. A parabolic reflector directs the 25 mm diameter infrared beam onto the *squirrel cage chopper*. The rotating chopper intercepts the full diameter of the beam, providing deep modulation of the light at 170 Hz.

The light is focused by a parabolic reflector and collimated by a lens. It is then set incident to the sheet at an angle of 10° from normal. The light scattered from the sheet and collected by the receiver lens is at an angle of 20° from normal. The angle prevents any specularly reflected light from a smooth coating surface from getting back to the receiver.

The received light is collected by a lens, then sent as a collimated beam to the beam splitters. They reflect and transmit the light to be shared by the filters and detectors for the various channels.

A ceramic tile provides an internal optical standard that is inserted during standardization. It is activated by a solenoid (1 A at 24 V), and located inside the cylindrical housing between the sheet guide and the sensor body. A beam-blocking flag located in the receiver optics inside the sensor head is used during the second phase of standardization.

Significant reduction of sensor accuracy may result if the sensor lenses are allowed to accumulate water, dust, or other materials. The cylindrical housing holding the exposed optics is purged with air to prevent materials from reaching the lenses.

1.5.2. Receiver Electronics

A driver circuit for the motor controls the chopper that rotates at a constant 85 Hz, resulting in a 170 Hz modulation of the beam. A second circuit sends a 170 Hz timing signal through the backplane to the fastcard amplifier boards. There, it is used in the demodulation of the received signal to make the sensor insensitive to ambient light.

The IR light for each channel is detected by either a lead sulfide (PbS) or a lead selenide (PbSe) photoconductive detector, then amplified. The signal is demodulated using the phase signal from the same timing circuit that drives the chopper. The resulting 0–8 V DC signal is read by a voltage-to-frequency converter (VFC) in the system.

A photoconductive detector assembly contains a thermistor and Peltier cooler that maintain the temperature of the assembly at a few degrees above freezing. This low temperature increases signal sensitivity, reduces noise, and decreases sensitivity of the detector to temperature fluctuations. The accurate temperature control ± 0.005 °C /(°F) ensures uniform sensitivity to the IR signal.

All of these elements are supported by the unigauge backplanes. These pass the various signals and voltages to the other components, and house the DC–DC converters used to power the electronics. There are two identical backplanes, each supporting either two or three channels of fastcard amplifiers.

1.6. Specifications

Table 1-4 General System Specifications

Item	Specification
Basis weight range	The coat weight sensor measures the coating regardless of the basis weight of the substrate
Coat weight range	The sensor can measure from 0–20 g/m^2 of coating
Coat weight measurement repeatability	On the internal optical standard, the repeatability is 0.15 g/m^2 (2σ). On static samples the repeatability is 0.25 g/m^2 (2σ)
Coat weight measurement static accuracy	The accuracy varies from 0.25–1.0 g/m^2 (2σ) depending on the application, and the accuracy of the lab coat weight verification technique. This specification includes sensor, calibration, sampling, and lab errors that may occur with proper sampling and laboratory techniques, and calibration, well-maintained equipment.
Coat weight measurement dynamic accuracy	Depending on the application and the precision of the verification technique, the dynamic correlation ranges from 0.25–1.0 g/m^2. Measurement of the base sheet is required to meet the specified dynamic accuracy.
Moisture range	The standard range is 0–20% moisture
Moisture measurement repeatability	On the internal optical standard the repeatability is 0.05% moisture (2σ). On Aclar-bagged samples the repeatability is 0.1% moisture (2σ).
Moisture measurement static accuracy	Accuracy is 0.25% moisture (2σ) on Aclar-bagged calibration samples
Moisture measurement dynamic correlation	Using proper dynamic testing procedures, the sensor correlates to the lab within 0.25% moisture (2σ)
Nominal distance to sheet	The sensor may be mounted 5 mm (0.20 in) or 25mm (1.0 in) from the sheet surface, depending on the scanner used
Flutter sensitivity	For a passline variation of 25 mm (1.0 in), expect 0.15% moisture and 0.15 g/m^2 component weight errors. For best accuracy, the sheet should be as stable as possible.
Moisture and basis weight sensitivity	The errors in calcium carbonate and clay measurements resulting from moisture variations are negligible. Basis weight sensitivity is normally removed in calibration.
Streak sensitivity	70% of response is from a 20 mm (0.8 in) circle
Frequency response	60 Hz at -3dB
Maximum ambient temperature	The sensor is not meant to operate beyond 120 °C (250 °F)

Item	Specification
Sensor temperature sensitivity	Less than 0.2% moisture per °C (10 °F); less than 0.25 g/m^2 coat weight per °C (10 °F)
Power requirements	24.V DC, dissipating about 100 W

2. System Components

The SSIR coat weight sensor is supplied for use only in an Experion MX or Da Vinci system. The sensor may be mounted on a variety of scanners. References in this chapter are to a typical installation on an Experion MX Q4000-80 series scanner.

This chapter describes the various hardware components of the sensor. Each component is aligned to optimize its function at the factory, but if parts are replaced, some re-optimization may be required. The more common repairs and routine checks are described in Chapter 9, and the less common procedures are described in this chapter.

The basic components of the SSIR coat weight sensor are shown the block diagram shown in Figure 2-1.

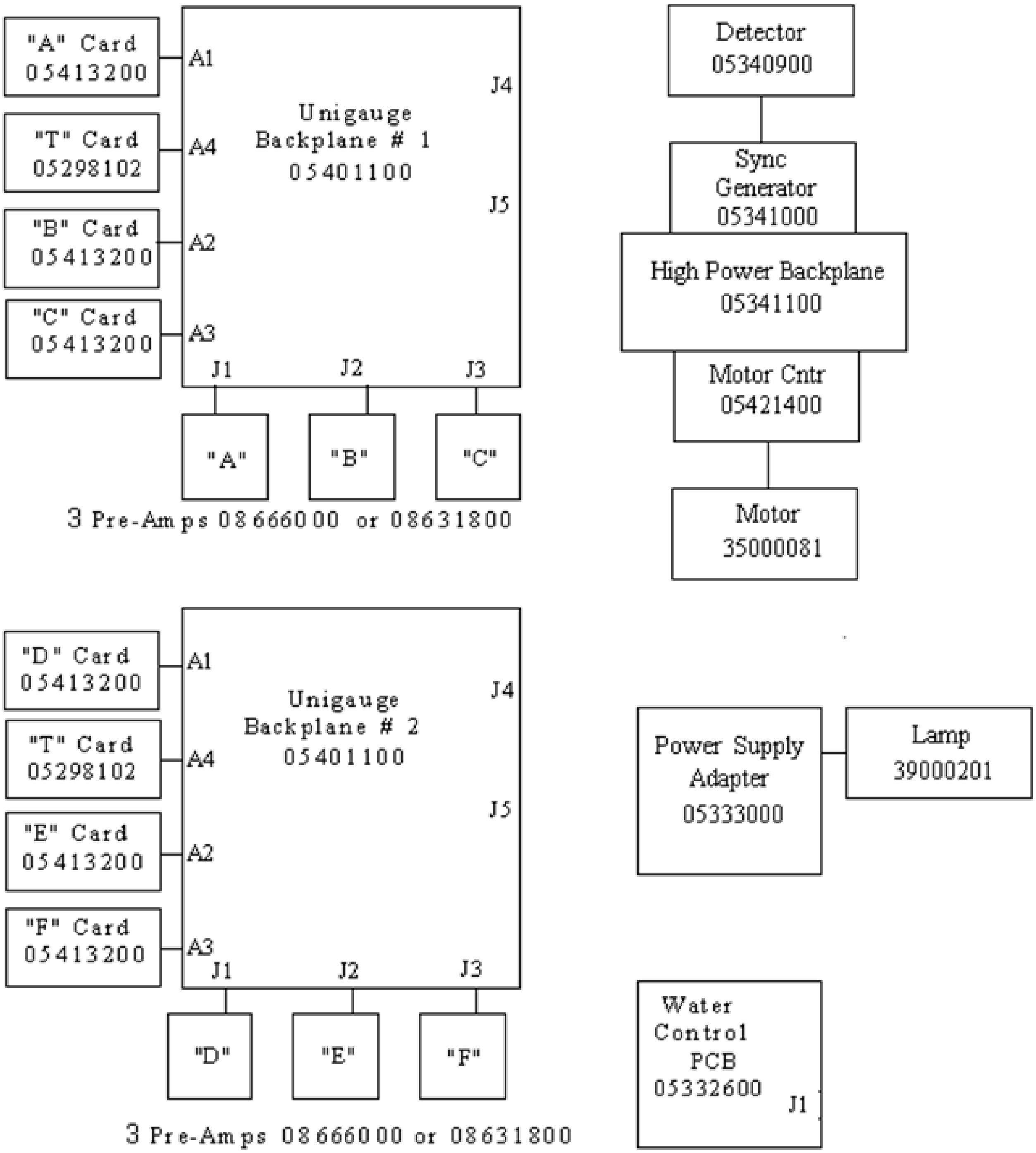


Figure 2-1 Component Diagram

To do a hardware alignment, you need:

- a digital voltmeter with two clip leads
- an oscilloscope with two probes
- a small flathead screwdriver to adjust pots

2.1. Hardware Overview

Figure 2-2 shows the relative locations of the preamps, filters, backplanes, fastcards, and temperature control boards referred to in this section.

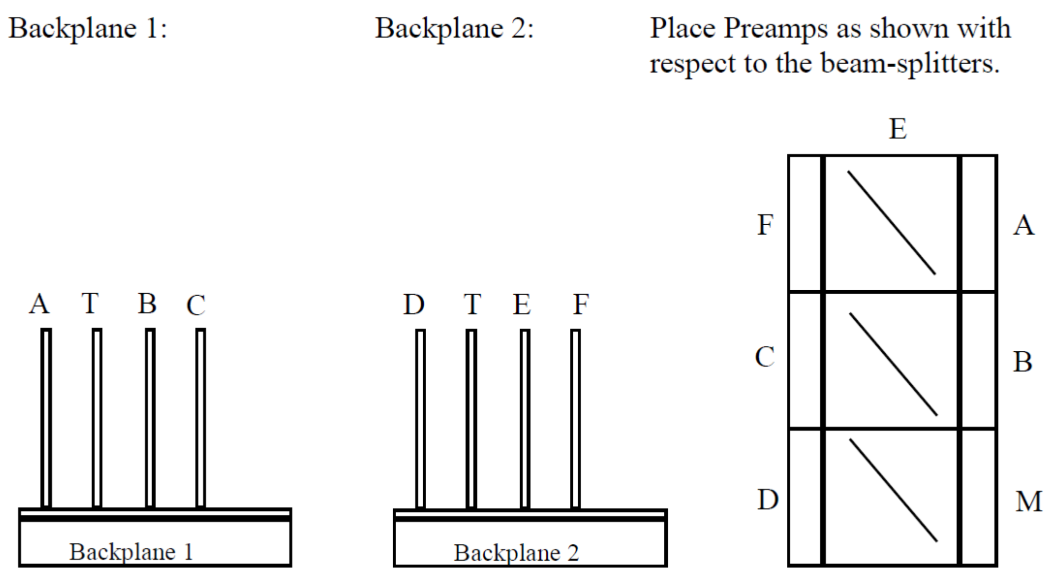


Figure 2-2 Six-channel Sensor: Standard Preamp and Filter Placement

Cards A, B, C, D, E, and F, are fastcards.

T-cards are temperature control boards. T-cards for the six-channel sensor do not have E3–E4 jumpers.

Detector preamp assemblies:

- A, B, C plug into backplane 1
- D, E, F plug into backplane 2

Table 2-1 Standard 6-Channel Configuration

SW Channel	Channel	Filter Part Number	Name
CH1	A	38000099	Moi Ref
CH2	B	00299474	Moi Meas
CH3	C	38000331	$CaCO_3$Ref
CH4	D	38000332	$CaCO_3$Meas
CH5	E	38000310	Clay Meas
CH6	F	38000307	Clay Ref

2.1.1. Water Controller Board

The water controller board controls the flow of cooling water to the sensor, and is normally set to maintain a head temperature of 37.8 °C (100 °F). The LED DS1 is on when there is 24 V to the solenoid, and off when there is no voltage to the solenoid. The head can be set to run cooler by triggering on a higher thermistor resistance. For example, if the trigger point is set for a thermistor resistance of 71 kΩ, the head is maintained at 32.2 °C (90 °F).

The head operates best at the lowest temperature that does not yield condensation inside the head. The factory settings of the water controller board are satisfactory for most environments.

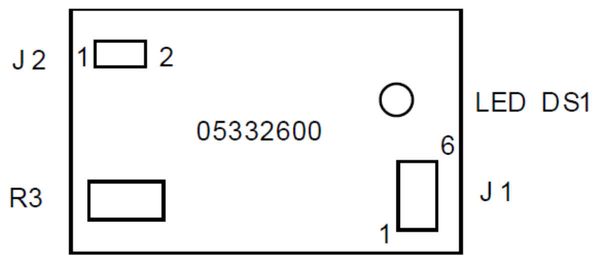
CAUTION

Condensation is a very serious problem for the sensor and must be avoided.

If the water controller board is replaced, realignment will be required.

2.1.1.1. Water Controller Board Alignment

Check the 24 V solenoid power to the board by disconnecting J1. J1 should have + 24 V on pin 4 and 24 V RTN on pin 2 (see Figure 2-3).



J1-1 and J1-6: Solenoid
J1-2 and J1-5: 24 V rtn
J1-3 and J1-4: + 24V
J2-1 and J2-2: To Thermistor Assembly (next to TB2)

Figure 2-3 Water Controller Board

Head temperature adjustments:

- To adjust the head temperature, first display the temperature on the **Scanner Status** display from the **Scanner Setup** display. Adjust pot R3 until the LED is just triggered.
- To lower the head temperature, increase R3 until the LED stays on. Wait for the head temperature displayed on the **Scanner Status** display to stabilize, and further adjust R3 as necessary.
- To raise the head temperature, decrease R3 and wait for the temperature to stabilize.

The head operates best at the lowest temperature that does not yield condensation inside the head.

2.1.2. Lamp and Chopping System

The SSIR uses a 20 W tungsten-halogen lamp in a reflector assembly. Replace the lamp periodically (see Section 9.4).

The light from the lamp is modulated by a chopper with two blades. The chopper is driven by a motor and motor controller board.

The chopped light is sensed by a small detector, which generates a sync pulse through the sync generator board. This sync pulse is used to drive the rest of the sensor detection system, to remove stray light from the environment, and to boost signal-to-noise.

The chopper system is quite robust and it is rare that replacement is required (see Chapter 9).

2.1.3. Backplane Assemblies

Figure 2-4 shows the backplane board for the standard six-channel sensor. There are two backplanes, each bearing three fastcard boards for three detectors as well as a single temperature controller board.

Table 2-2 Backplane Configuration

Sensor	Backplane 1	Backplane 2
Six-channel	Channels A, B, and C	Channels D, E, and F

The standard three-channel backplane has jumpers W4, W5, and W7, and no RP1.

Each backplane has several connectors, and the mating cables can easily be mismatched to these connectors. Ensure that all cables are connected properly before loading the boards into the backplanes.

It is rare to have to replace a backplane.

Subsections 2.1.3.1 to 2.1.3.3 describe checking for proper functioning of the backplane, as well as setting up edge detection using the SSIR sensor.

2.1.3.1. Backplane Voltages

Figure 2-4 shows a schematic of the unigauge backplane. Three voltages are supplied by the DC–DC converters, attached below the backplanes. Table 2-3 summarizes the various components, testpoints, and jumpers for the backplane.

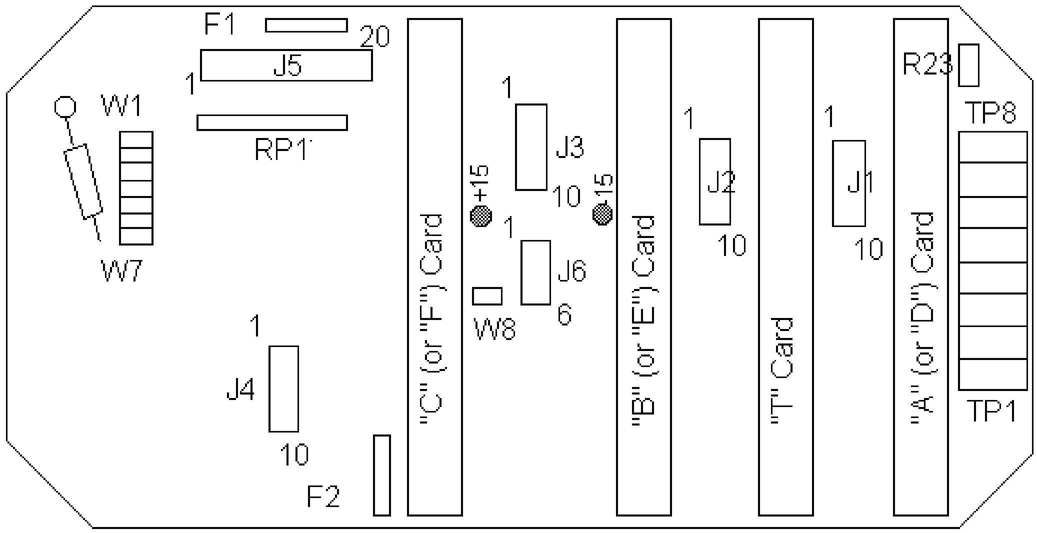


Figure 2-4 Unigauge Backplane

Table 2-3 Backplane Testpoint Summary

Connectors	**Description**
J1, J2, J3	Feeds detector preamp signal A to board A, B to board B, C to board C
J4	Provides phase, gain to backplane from harness
J5	Provides 24 V from harness and signals to harness
J6	Not used
Test Points	
TP1	Electrical ground
TP2	Phase signal, 0 to + 5 V, 170 Hz
TP3	Phase signal, 0 to + 5 V, 180° out of phase with TP2
TP4	Gain 1 indicator (+ 14 V when on)
TP5	Gain 2 indicator (+ 14 V when on)
TP6	Edge level: adjust R23 (05401100) or R7 (052991XX) to approximately 5 V
TP7	Edge signal: 0 V onsheet, + 14 V offsheet
TP8	+ 250 V DC
Jumpers	**Configuration**
W1, W2, W3	Never have more than 1 in at same time to use A, B, or C signal for edge detect. Normally use W1 to select A signal.

Connectors	Description
W4, W5	Both jumpers are in at all times.
W6	Jumper is out at all times.
W7	Jumper-in reduces Peltier cooler supply voltage to 6 V. This is not recommended for a 6 channel sensor. The default Peltier cooler supply voltage is set to 8 V.
W8	Jumper is out at all times; if in, it will cross-connect B and C signals.
RP1	Resistor pack is not used for SSIR
DC–DC converters	Three units with voltage readings as follows: lower left: + 6 to + 8 V;lower center:± 15 V; lower right: + 250V
Fuses	F1 and F2 are both 1.5 A on 24 V in line.

If malfunction is suspected, check each set of voltages:

1. Remove the temperature control board and the first two fastcards.
2. Use TP1 as ground. Check the ± 15 V, identified as black circles in Figure 2-4. The values should be + 15 ± 0.2 V DC and -15 ± 0.2 V DC.
3. Return the boards to their appropriate slots.
4. Check the 250 ± 5 V between TP8 and TP1 at the front of the backplane.
5. Replace the backplane if the voltages are out of range.

See Subsection 2.1.5 to check the Peltier supply voltage, 8.0 V.

2.1.3.2. Phase Reference

Check that the phase reference signal is present at TP2 and TP3, relative to TP1 (Gnd). Each signal should be a square wave, 0–5 V, at approximately 170 Hz. Signals at TP2 and TP3 are 180 degrees out of phase with each other.

2.1.3.3. Edge Detection

The SSIR sensor can be used for detecting the edge of the sheet during a scan. Normally the CH1 (A) channel of backplane 1 is used. This is because there is a large difference between the onsheet signal and the offsheet signal, and the software accommodates this large ratio best using CH1 (A). Install jumper W1, but not jumpers W2 or W3 (see Figure 2-4).

See Subsection 2.1.6 before setting up the edge detection.

Activate the tile solenoid and set the output voltage of fastcard A to 8 V (TP9 of the fastcard to TP1).

To adjust the edge detection, set the comparison voltage at TP6 on the backplane to a value half way between the onsheet reading (as seen on TP9 of the fastcard) and the offsheet reading (zero volts). This value is usually around 3 V for the sensor because the paper typically produces a somewhat lower signal than the standardization tile.

To check that edge detection is working, bring a sheet of the paper parallel to the extended nose piece and about 2.5 cm (1 in) from the nose piece sheetguide. Connect a voltmeter between TP7 (+) and TP1 (Gnd) of the backplane.

TP7 is low (0–1 V) when the sheet is in the beam and is high (13–15 V) when the sheet passes the middle of the beam.

Adjust the edge threshold adjustment pot R23 as required. Ideally, the edge detector should trigger when exactly half of the beam from the sensor is on the sheet.

2.1.4. PbS and PbSe Detector Assemblies

The SSIR coat weight sensor has four PbS detector assemblies (one in each of channels 1, 2, 5, and 6), and two PbSe detector assemblies (in channels 3 and 4). These detectors may become unstable over time and may need replacing. See Chapter 9 for preventative maintenance and replacement of these parts.

2.1.5. Temperature Control Board

The temperature control boards control the temperatures of the detector preamps and are shown as cards *T* in Figure 2-2 and in Figure 2-5.

The cables connecting the detector preamps to the backplane must be plugged into their proper places for the temperature control to work.

Check for the Peltier cooler supply voltage by reading between TP3 on the temperature control board and TP1 (Gnd) on the backplane. This supply voltage should read 8.0 ± 0.5 V DC.

Check the Peltier cooler voltages as follows (they should be between 0.5 and 0.8 V DC):

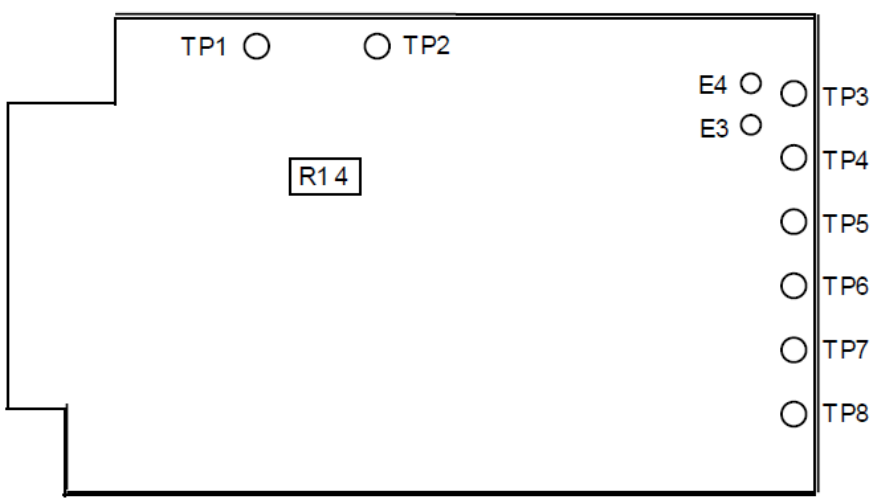
- A (or D) channel, TP3 (+) to TP4

- B (or E) channel, TP7 (+) to TP8
- C (or F) channel, TP5 (+) to TP6

Also check the control voltages. They should all be greater than 0.8 V DC:

- A (or D) channel, TP4 (+) to TP5
- B (or E) channel, TP8 (+) to GND (TP1 of backplane)
- C (or F) channel, TP6 (+) to TP7

The temperature control board has a circuit to read a thermistor and convert its resistance to a temperature. Ensure that there is a 10 kΩ termination resistor across the ADC or VFC input where the temperature is being read. Remove the first fastcard and adjust R14 until the voltage between TP1 and TP2 agrees with the temperature-to-voltage chart shown in Figure 2-5.



Temp °F	Temp° °C	Volts
59	15.0	2.24
62	16.7	2.08
65	18.3	1.94
68	20.0	1.8
71	21.7	1.68
74	23.3	1.57
77	25.0	1.46
80	26.7	1.36
83	28.3	1.27
86	30.0	1.18
89	31.7	1.10
92	33.3	1.03
95	35.0	0.96
98	36.7	0.90
101	38.3	0.84
104	40.0	0.78
107	41.7	0.73

TP1 to TP2: For temp output, see table, above right
TP3 to TP4: Peltier cooler voltage for A signal
TP5 to TP6: Peltier cooler voltage for C signal if 3 channels
TP7 to TP8: Peltier cooler voltage for B signal
E3 - E4: If jumper in, then TP5 to TP6 shorted

Figure 2-5 Temperature Control Board

2.1.6. Fastcard Board

Fastcards amplify AC signals from detector preamps, convert the signals to DC, and send the DC signals to the head. Fastcard boards may need periodic alignment if the corresponding channel voltage has drifted significantly. See Chapter 9 for preventative maintenance, parts replacement, and realignment.

2.2. Software Description

This section describes sensor inputs and outputs, and details the calculations performed in making the coat weight measurement.

2.2.1. Sensor Outputs

2.2.1.1. Measurement Channels

There are six analog inputs to the system, corresponding to the channels CH1 to CH6. Table 2-4 lists the inputs that are read by the system software.

Table 2-4 Sensor Inputs

Variable	Description
CH1	Moisture reference
CH2	Moisture measure
CH3	Calcium carbonate reference
CH4	Calcium carbonate measure
CH5	Clay measure
CH6	Clay reference

2.2.1.2. ADC Input

There is a single ADC input to the system from the SSIR coat weight sensor. TEMPH provides the voltage corresponding to the temperature of the electronics in the sensor head.

2.2.1.3. Contact Inputs

The single contact input from the sensor to the system is the EDGE contact that allows for sheet edge detection.

2.2.2. Sensor Inputs

Table 2-5 lists the contact outputs that are sent to the sensor by the system. Note that although the system provides six contact outputs, only two of them are used by this sensor.

Table 2-5 Contact Outputs

Contact Output	Description
TILE	Activates tile solenoid that inserts tile into the beam. Provides an optical standard during reference, standardize, and background.
DARK	Sets signals from detectors to zero. Used to record offset due to electronics. Offset is subtracted from subsequent measurements.
GAIN 1	Boosts onsheet detector output by about 2.85. Used by TRIR for dark grades of paper. Not used by this sensor.
GAIN 2	Boosts onsheet detector output by about 9.8. Used by TRIR for dark grades of paper. Not used by this sensor.
GAIN ATTENUATE	Used during background operation. Reduces signals from the detectors by a factor of 10 to 20. Not used by this sensor.
FLAG	Used during Phase 2 of standardize and reference. Not used by this sensor.

The contact outputs GAIN 1, GAIN 2, GAIN ATTENUATE, and FLAG, although set or unset in sensor operations, are not used by the SSIR coat weight sensor. This software is shared by all of the IR sensors, and includes elements applicable only to specific versions of the sensor.

Table 2-6 lists the settings of the six contact outputs for the different SSIR coat weight sensor operations.

Table 2-6 Contact Outputs to the SSIR Coat Weight Sensor

Operation	Contact Output					
	TILE	DARK	GAIN1	GAIN2	GAIN ATTEN.	FLAG
Background: phase 1	On	On	Off	Off	On	Off
Background: phase 2	On	Off	Off	Off	On	Off
Background: phase 3	On	Off	On	Off	On	Off
Background: phase 4	On	Off	Off	On	On	Off
Standardize: phase 1	On	Off	Off	Off	Off	Off
Standardize: phase 2	On	Off	Off	Off	Off	On
Sample	Off	Off	Off	Off	Off	Off
Onsheet mode	Off	Off	Off	Off	Off	Off

2.2.3. Background Operation

Background is scheduled typically every 8 or 24 hours to measure the dark (electronic) offsets.

The background operation for the SSIR coat weight sensor has four phases. The first phase is used for measuring the dark counts for a subsequent correction of readings. The remaining phases are for evaluating the gain factors produced by the contacts GAIN 1 and GAIN 2 (that are not used by this version of the sensor). Table 2-7 lists system actions during background phases.

Table 2-7 Phases of Background Operation

Background	Read and Store	TILE	DARK	GAIN ATTEN.	GAIN 1	GAIN 2	CHi (i = 1 - 6) Counts Labeled
Phase 1	Dark offsets	ü	ü	ü			MOCi (i = 1-6)
Phase 2	GAIN 0	ü		ü			GA0i (i = 1-6)
Phase 3	GAIN 1	ü		ü	ü		GA1i (i = 1-6)
Phase 4	GAIN 2	ü		ü		ü	GA2i (i = 1-6)

Since GAIN 1 and GAIN 2 are not used by the sensor, the values GA0i, GA1i, and GA2i, (as well as quantities subsequently calculated from these values by the system) are also not used.

2.2.4. Limit Checks During Background Operation

The database contains drift limit values and time-zero values for the measurements of dark volts obtained during background. The values of dark volts taken during the time-zero calibrations are subtracted from the current background dark volts for each of the channels. These differences (if any) are then checked against the appropriate drift limits stored in the database. If any of the limits is exceeded, a *Bad Dark Volts* alarm results.

A *Bad Dark Volts* alarm typically results in a *Bad Stdz Ratio* alarm as well.

The system attempts to perform the background operation a number of times (the number is configurable). After repeated failure, the sensor is taken offsheet.

2.2.5. Reference/Standardize Operation

The readings taken during the first phase of standardize are used to correct measurements for electronic drift, changes in lamp brightness, dirt on the optics, and so on.

A two-phase standardize/reference is used by the SSIR coat weight sensor. Standardize and reference are almost identical, the difference being that a reference is manually requested while in maintenance mode, while a standardize is scheduled periodically during scanning. This system manual usually refers to these operations as just the standardize operation.

In the second phase of standardize, all channels are read with a flag inserted in the receiver assembly. This enables the system to check on sensor repeatability.

Chapter 10 describes possible alarms and the actions required to address them.

2.2.5.1. Phase 1

In the first phase of standardize, counts are read in each channel from measurements of the optical standard TILE (contact output set). These counts are corrected with the dark offsets obtained during background. This gives the phase 1 standardize counts for each channel:

$$CCH_i = CH_i - MOC_i \qquad \text{for } i = 1 \ to \ 6$$

2.2.5.2. Phase 2

With TILE still set, the readings are taken again and corrected for dark offsets.

$$C2CH_i = CH_i - MOC_i \qquad \text{for } i = 1 \ to \ 6$$

The FLAG contact is set, but the sensor does not respond to the FLAG signal.

2.2.5.3. Standardize/Reference Calculations

The channel standardize counts and the ratios to time-zero (calibration time) counts are calculated:

$$TCH_i = \frac{CCH_i}{MCC_i} \qquad \text{for } i = 1 \ to \ 6$$

Five standardize ratios are calculated from the dark count corrected phase 1 counts. *RSB* and *RSE* (and the calculations that use these values) are not used by this sensor.

$$RSA = \frac{CCH_1}{CCH_2} \qquad \text{Moisture reference/Moisture measurement}$$

$$RSB = \frac{CCH_1}{CCH_3} \qquad \text{not used by this sensor}$$

$$RSC = \frac{CCH_3}{CCH_4} \qquad \text{CaCO3 reference/CaCO3 measurement}$$

$$RSD = \frac{CCH_6}{CCH_5} \qquad \text{Clay reference/Clay measurement}$$

$$RSE = \frac{CCH_4}{CCH_5} \qquad \text{not used by this sensor}$$

The phase 2 ratios are calculated and divided by the phase 1 ratios:

$$RFSA = \frac{C2CH_1}{C2CH_2} \times \frac{1}{RSA} \qquad RFSB = \frac{C2CH_1}{C2CH_3} \times \frac{1}{RSB}$$

$$RFSC = \frac{C2CH_3}{C2CH_4} \times \frac{1}{RSC} \qquad RFSD = \frac{C2CH_6}{C2CH_5} \times \frac{1}{RSD}$$

$$RFSE = \frac{C2CH_4}{C2CH_6} \times \frac{1}{RSE}$$

2.2.6. Limit Checks During Standardize

The database contains drift limit values for the raw signal, net volts (dark-subtracted signal), channel ratios, and standardize ratios obtained during standardize, compared to the values taken at time-zero. If *any* of these limits are exceeded, an alarm results.

If the sensor is scanning, another standardize operation is forced. If the system is offsheet (as for sampling), the bad standardize should not prevent subsequent sampling. On a bad standardize, the system disables the sensor during the next forward-and-back scan, then forces another standardize. The system will attempt repeated standardize operations (the number of repeats is configurable; it is three by default). If all fail, the sensor is immediately disabled until the next time the scanner is taken offsheet (until it is taken offsheet, the scanner operates without the SSIR coat weight sensor).

Chapter 10 lists possible alarms and the actions required to address them.

2.2.7. Sample Operation (local measurements)

Each sensor is capable of making up to four measurements; some can be correctors used in other calculations.

2.2.7.1. Ratios

The channels are read and the dark counts are subtracted:

$$SCCH_i = CH_i - MOC_i \qquad \text{for } i = 1 \text{ to } 6$$

The channel ratios are the ratios of the STDZ counts to the sample/onsheet counts and indicate the degree of IR absorption on that channel:

$$RCH_i = \frac{REFG_i}{SCH_i} \qquad \text{for } i = 1 \text{ to } 6$$

Up to five inter-channel ratios are calculated. These can be configured at the time the software is built. The default ratios are:

$$RA(raw) = \frac{RCH_2}{RCH_1} - 1 \quad RB(raw) = \frac{RCH_3}{RCH_1} - 1 \quad RC(raw) = \frac{RCH_4}{RCH_3} - 1$$

$$RD(raw) = \frac{RCH_5}{RCH_6} - 1 \quad RE(raw) = \frac{RCH_6}{RCH_4} - 1$$

for moisture, spare, calcium carbonate, clay, and spare, respectively.

2.2.7.2. Individual Scanner (local component) Calculations

A local measurement is made by first obtaining a combined ratio from the combination of five available ratios (RA...RE). The ratios are selected by coefficients *ACm1...ACm8*, where *m* is 1, 2, 3, or 4. This yields four combination ratios of R $(\text{combined})_m$. The algorithm is:

$$R(combined)_m = \frac{AC_{m1} \times RA}{1 + AC_{m8} \times RA} + AC_{m2} \times RB + AC_{m3} \times RC + AC_{m4} \times RD + AC_{m5} \times RE + \frac{AC_{m6} \times RA}{RB + AC_{m7} \times RA}$$

$$COMP_m = AAA_m \times R(combined)_m + DDD_m$$

Standard assignments for the index *m* are shown in Table 2-8. The first measurement (m = 1) is usually the clay measurement, the second is calcium carbonate, and the third is moisture. Often the moisture measurement is done with an independent sensor, so the moisture shown with $m = 3$ is for informational purposes only.

An example of a local component calculation is shown next. A calibration using the clay measurement from channels 5 and 6 as the first measurement ($m = 1$) has $AC_{14} = 1$. The 4 of AC_{14} is used to select the fourth ratio from *RA, RB, RC, RD, RE*, which is *RD*. The previous equations then become:

$$R(combined)_1 = \frac{0 \times RA}{1 + 0 \times RA} + 0 \times RB + 0 \times RC + 1 \times RD + 0 \times RE + \frac{0 \times RA}{RB + 0 \times RA}$$

$$COMP_1 = AAA_1 \times RD + DDD_1$$

Table 2-8 Standard AC Coefficient Assignments

Index M	Measurement	AC Coefficients	Slopes & Intercepts
1	Clay (alternative measurement)	$AC_{14} = 1$, the rest of AC_{1n} are all zeros	AAA_1 and DDD_1 used for clay
2	Calcium carbonate (primary measurement)	$AC_{23} = 1$, the rest of AC_{2n} are all zeros	AAA_2 and DDD_2 used for $CaCO_3$
3	Moisture (water weight)	$AC_{31} = 1$, the rest of AC_{3n} are all zeros	AAA_3 and DDD_3 used for water weight

2.3. Scanning Operation – Limit Checks

The database contains limit values for the raw signal and net volts (dark-subtracted signal) from the detectors. If *any* of these limits are exceeded during scanning, an alarm results. The alarms are detailed in Chapter 10.

The system also periodically (typically, every 60 seconds) checks the head temperatures.

2.4. Intergauge Calculations (global measurements)

Often more than one coating is applied to a sheet, usually in the form of coatings on both sides of the paper. Accurate measurement of each coating requires Intergauge sensor calculations–calculations involving several sensors–to correct for effects of base sheet variations, earlier coat weight variations and, for lighter-weight sheets, the effects of the coating on the other side of the sheet.

Measurements from two scanners are combined to determine the coating applied between the scanners. The procedure is first to make measurements at each scanner (local measurements), then to subtract these measurements to find the coating applied between the scanners.

The Intergauge-corrected values of coating components are referred to in the software with variable names. $ICOMP_m$ *(i-gauge)*, for example, has been corrected for measurements of the sheet taken before the current coater, and has used the other-side corrector (OSC). The subscript *m* refers to a specific component. Only a single component is chosen for use. For this coat weight sensor, by default, it is the $CaCO_3$ component (set in the Intergauge configuration table for the recipe).

The total coat weight is obtained from the component weight by dividing by the percentage of the component in the total coating:

$$ICOAT_m = 100 \times \frac{ICOMP_m}{\%COMP_m}$$

for the coat weight derived from component *m*, where $ICOAT_m$ is the total (net) coating applied between the scanners, and $\%COMP_m$ is the percentage of the component. Typical values for *%COMP* for calcium carbonate and clay are between 50 and 90.

A dynamic corrector can be applied to the coat weight $ICOAT_m$. The dynamic corrector uses a slope and intercept with default values 1 and 0, respectively. With the corrector included, the Intergauge dynamic coat value is:

$IDYCOAT_m = Slope_m \times ICOAT_m + Intercept_m$ for i=1,4

%COMP, $Slope_m$ and $Intercept_m$ are all part of the Intergauge calibration table for the recipe.

3. EDAQ

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

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

The board is based on an ARM CPU running the Linux™ operating system and a Field-Programmable Gate Array (FPGA) that controls real-time data acquisition.

The EDAQ contains software licensed under third party licenses including the Gnu Public License (GPL)[1]. 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 board contains a large number of input/output (I/O) systems, including:

- analog inputs (16 inputs of 12 bits @ 4 kHz and 8 inputs of 10 bits @ 1 Hz)
- analog outputs (2 @ 12 bits)
- digital inputs (16 @ 24 V logic)
- digital output (16 @ 24 V logic)
- frequency input (400 Hz to 500 kHz)

[1] This product may contain or be derived from materials, including software, of third parties. The third party materials may be subject to licenses, notices, restrictions and obligations imposed by the licensor. The licenses, notices, restrictions and obligations, if any, may be found in the materials accompanying the product, in the documents or files accompanying such third party materials, in a file named third_party_licenses on the media containing the product, or at http://www.honeywell.com/ps/thirdpartylicenses.

- Three serial ports
- USB (presently unused)
- 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 Measurement Sub System (MSS) by Ethernet.

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

This chapter gives a brief overview of the EDAQ board and some of the diagnostic information. More detail is provided in *Experion MX MSS EDAQ data Acquisition System Manual (p/n 6510020381)*.

3.1. Physical Layout

Figure 3-1 and Figure 3-2 show the EDAQ PCBA 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 (FC) expansion board.

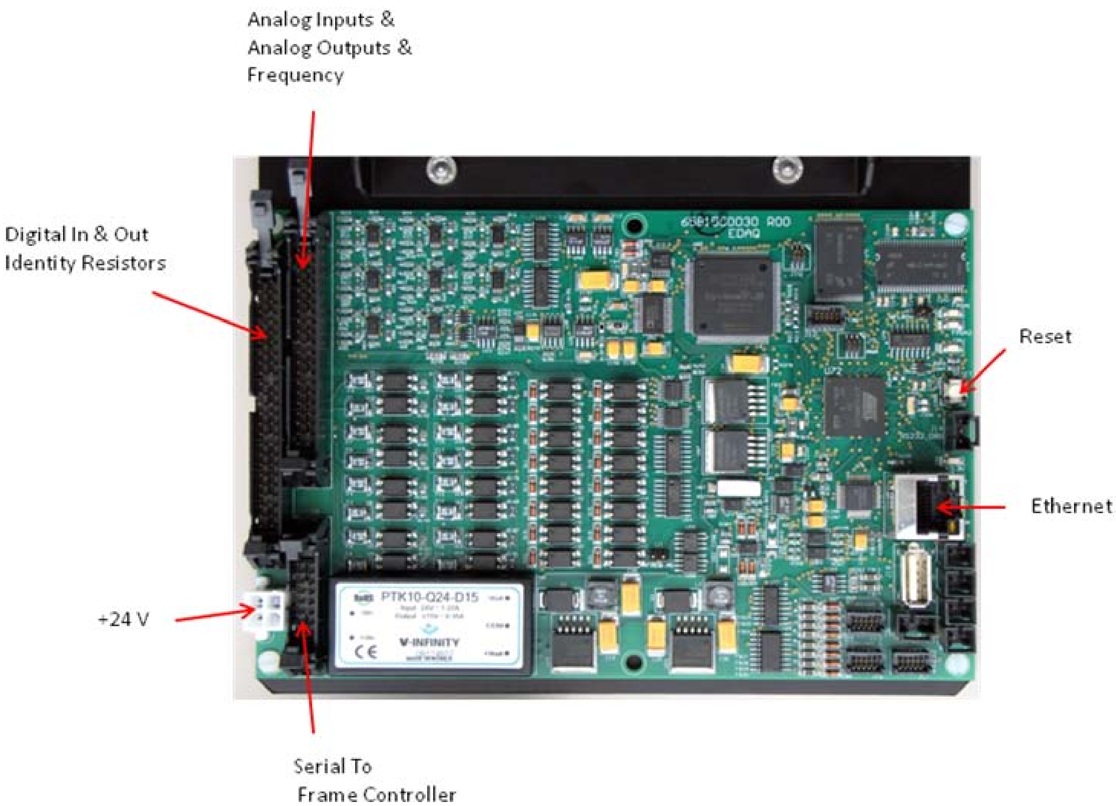


Figure 3-1 EDAQ Board

J1 is the large 50-pin connector on the far left. J2 is the smaller 40-pin connector. J8 on the lower left is used for the FC only.

To the right are the Ethernet port, 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 kb/s, 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.

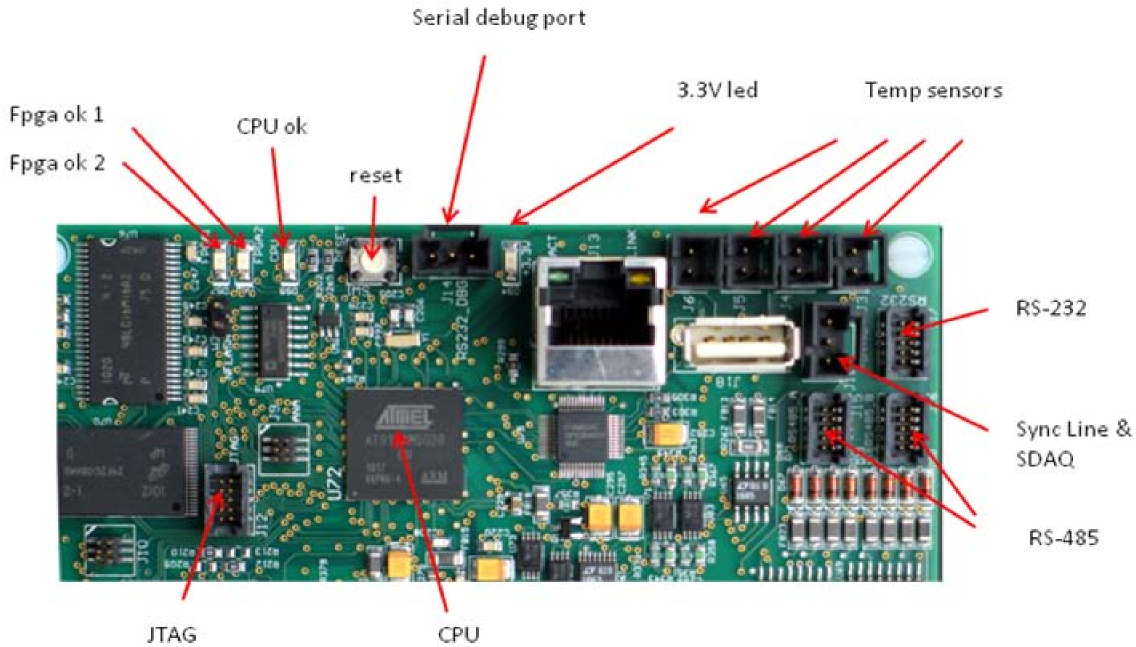


Figure 3-2 EDAQ Board: Ports and Diagnostic LEDs

3.2. Hardware Status Information

There are four diagnostic LEDs on the EDAQ (see Figure 3-2).

- The *3.3 V LED*. When lit, this indicates that all power supplies on the 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 + 24 V input.

- The *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.

- The *Fpga ok 1* (not used at present).

- The *Fpga ok 2*. This LED will blink if the FPGA is loaded and running code.

In addition, the Ethernet connector contains two LEDs: amber indicates a good link to the switch, and green indicates 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 real-time application environment (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

Assuming the firmware (flash code) is the same, all EDAQs are identical. EDAQs can be freely interchanged between sensors and the scanner endbell.

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 your scanner manual to troubleshoot if the EDAQ does not identify itself properly (or 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 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 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. Obtain Status Information

3.5.1. Experion MX Platform

An overall status page is available from a RAE station under the **MSS Setup Diagnostics** tab. Select 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).

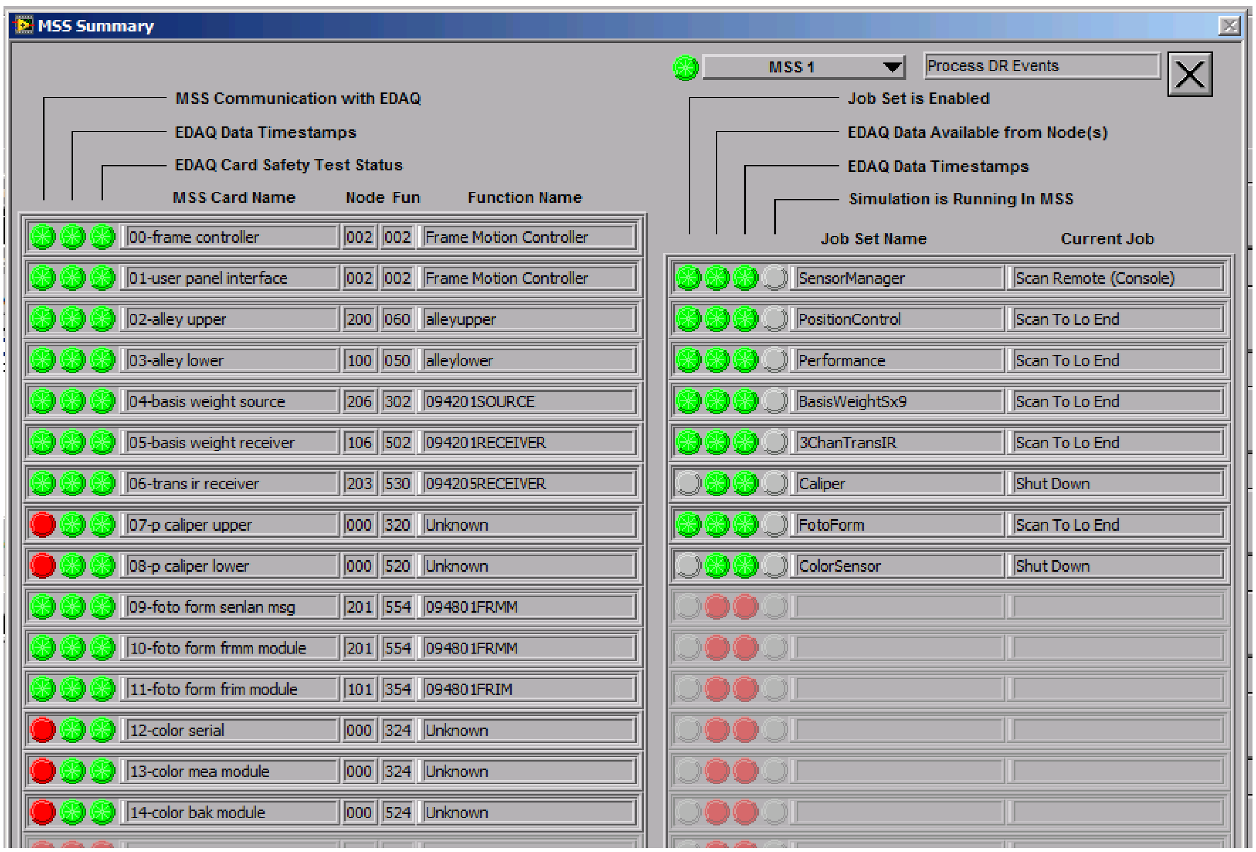


Figure 3-3 MSS Summary

Table 3-1 MSS Summary Display Status Indicators and Descriptions

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 Test 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, for example, *07-caliper upper* in Figure 3-3.

3.6. MSS and EDAQ Web Pages

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 first MSS on the system)

Figure 3-4 shows the main MSS Web page (**PHP MSS Page**).

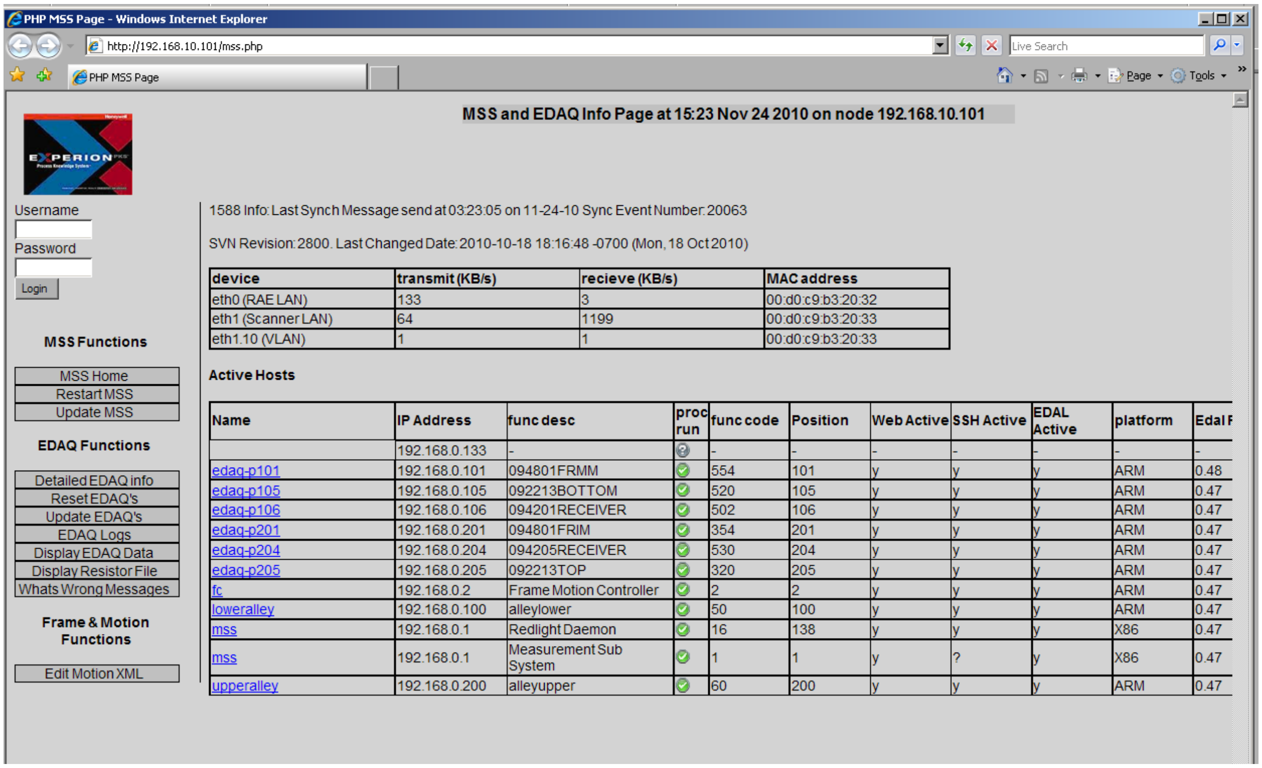


Figure 3-4 PHP MSS Page

The left panel shows a column of options divided into:

- **MSS Functions**
- **EDAQ Functions**
- **Frame and Motion Functions**

Enter the username (**`admin`**) and password (`hmxresult`) 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 the one required in the RAE setup.

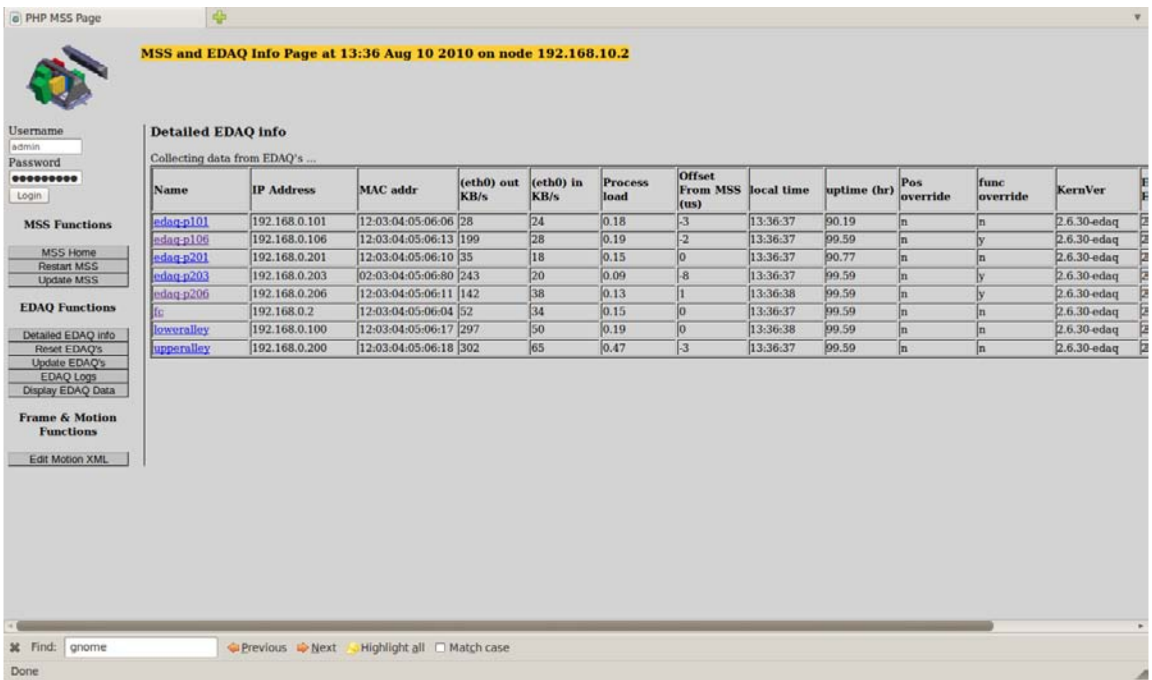
The second table lists all EDAQs discovered on the scanner LAN, their IP numbers, a brief description (related to model number), a program status column, the associated function code and position code, and whether the communication protocols are running (http, ssh and Edal, the proprietary sensor data 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 calls 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 than 0.5), **local time** (matches MSS time clock shown at top) and **Offset From MSS (µs)** (less than 50 µS 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 Detailed EDAQ Information: Partial Display

4. Installation

The SSIR coat weight sensor is supplied for use only in an Experion MX or Da Vinci system. The sensor may be mounted on a variety of scanners. References in this chapter are to a typical installation on a Q4000-80 scanner.

Before installing a SSIR coat weight sensor, read about the components and operation of the sensor in Chapters 1 and 2.

4.1. Preparation

Install the SSIR coat weight sensor head on the scanner at least one week before system installation to allow time for system and sensor checkout. To retrofit the SSIR coat weight sensor to an existing system, allow 8 to 12 hours of downtime to complete the retrofit installation.

The SSIR coat weight sensor is mounted to the sheet guides of the head in the machine direction. The SSIR coat weight sensor adds approximately 41 cm (16.2 in) to the length of the head footprint in the machine direction dimension. It can be mounted either on the upstream side or the downstream side of the head, and can face upwards or downwards.

There are two different sheetguide assemblies used to mount the sensor, one for mounting the sensor on box-beam type scanners, the other for mounting on U-beam scanners. The assemblies are the same for mounting the sensor upstream, downstream, and so on. The same installation kit is used with each assembly.

The SSIR coat weight sensor electrical requires + 24 V DC at about 4 A from the head. Electrical connections to the sensor heads are made through hermetically sealed, military style connectors that are mated into the head wiring harnesses.

The SSIR coat weight sensor requires cooling water (or coolant) at less than 2 L/min (0.5 gal/min) and at a maximum temperature of 25 °C (77 °F). This water should be filtered to remove fiber. The water can be supplied with a T-connection from the head water input. Specifications for water quality, such as cleanliness and pH, are the same as for the heads.

Installation requires the following tools:

- two open-end 0.5-inch wrenches
- crescent wrench
- miscellaneous screwdrivers
- tweaker screwdriver
- diagonal cutter
- wire stripper
- pliers
- miscellaneous Allen wrenches and drivers (U.S., not metric)
- electrical tape
- crimper for spade lugs
- digital voltmeter
- oscilloscope

4.2. Installation (Retrofit)

4.2.1. Head Mounting

ATTENTION

All bolts should be lightly coated with a copper-based anti-seize compound.

Installation kit components are listed in Table 4-1.

Table 4-1 Installation Kit

Part number	Description	Quantity
16000006	Pipe compound	1
41000001	Hose, air 0.25 in	100 feet

Part number	Description	Quantity
61000002	Coupling, pushlock 0.25 in barb	3
61000041	Coupling, hose mender	2
61000091	Bushing	2
61000056	Flow meter	1
61000150	Bushing	2
61000286	Filter assembly	1

For head mounting to box-beam type scanners, see Figure 4-1.

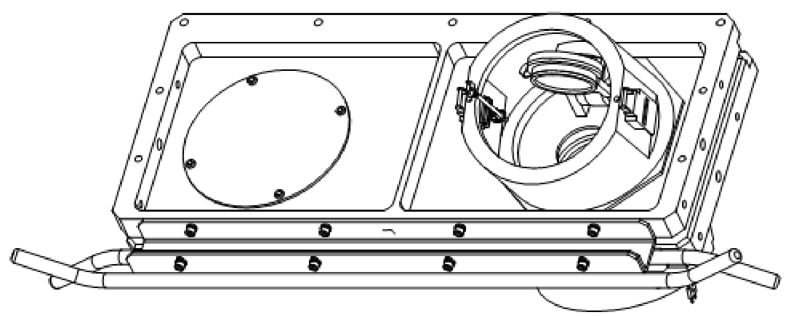


Figure 4-1 Sheet Guide Assembly for Box-Beam Type Scanners

For head mounting to U-beam scanners, see Figure 4-2.

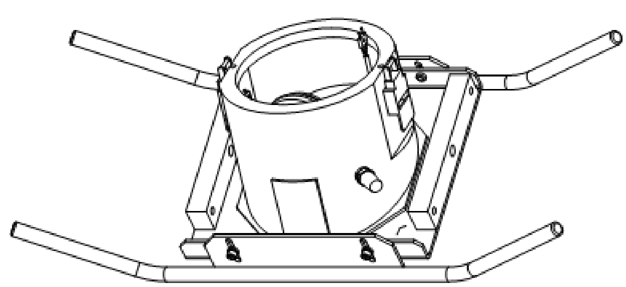


Figure 4-2 Sheet Guide Assembly for U-Beam Type Scanners

Perform the procedures indicated on drawings numbered 09842800 or 09842700 (Sheet Guide Assembly for SSIR), respectively.

4.2.2. Plumbing

To establish plumbing connections (for a description of the SSIR coat weight sensor water requirements, see Section 4.1):

1. Connect the water supply and return lines for the SSIR coat weight sensor head by using T-connections and the in-line solenoid assembly (see Figure 4-3).

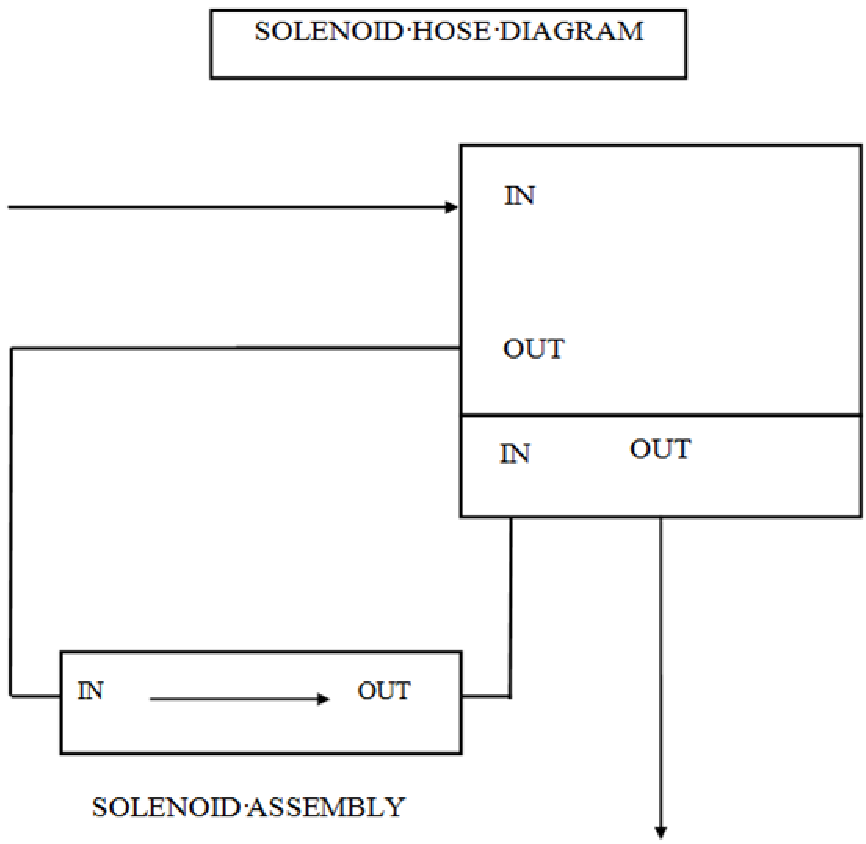


Figure 4-3 Solenoid Hose Diagram

2. Insulate the hoses to prevent condensation from dripping on the sheet or heads.

4.2.3. Sample Paddle

The sample paddle shown in Figure 4-4 is used on both of the sheetguide assemblies used to mount the sensor.

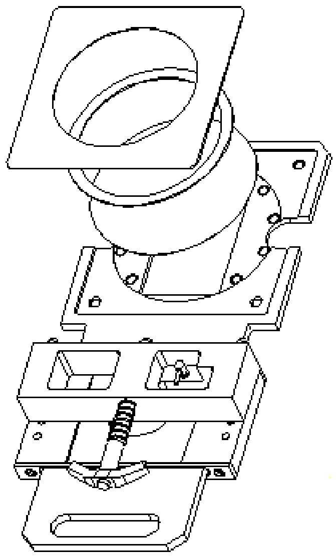


Figure 4-4 Sample Paddle

4.3. Sensor Commissioning Task List

To commission the SSIR sensor:

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 sensor alignment (see Section 2.1).
3. Verify the static calibration samples (see Section 7.3).
4. Recalibrate as needed (see Chapter 7).
5. Enter nominal dynamic correction calibration constants (see Section 6.3).
6. Perform dynamic calibration (see Section 6.3).

5. Software Configuration Parameters

This chapter describes how to set up grade recipes (codes) and calibration tables in the Experion MX software.

Setting up how the system will behave in terms of calibrations, alarms, and checks is done through the **Setup** display. The **Recipe Maintenance** tab calls up the basic page from where all the tables are accessed. Each recipe consists of a hierarchical tree of linked tables, with each table describing some configuration parameters of the system. Tables can be shared between recipes if required.

Each recipe is configured from the bottom of the hierarchy to the top. The complete list of recipes can be found in the **Main Code table** page. Each recipe has its own main table. The main code table is at the top of the hierarchy. It references the **IRCP Configuration Table** and the **IRCP Calibration Table**, which will be set up first.

5.1. IRCP Configuration Table

The **IRCP Configuration Table** (see Figure 5-1) is at the bottom of the recipe hierarchy.

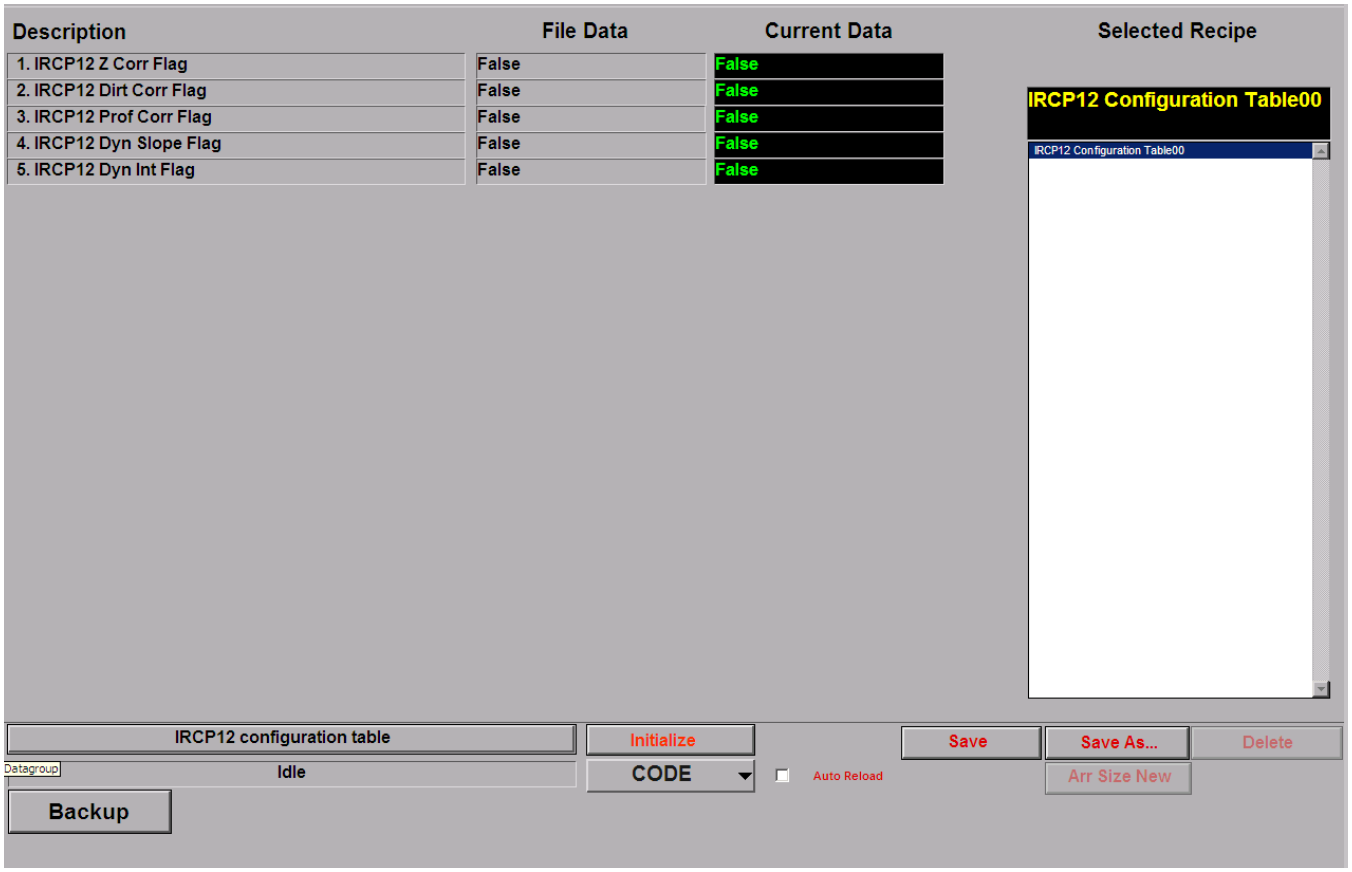


Figure 5-1 IRCP12 Configuration Table00

This table controls which correctors will be used. There are five flags that can be set:

- IRCP12 Z Corr Flag (Z-correction)
- IRCP12 Dirt Corr Flag (dirt correction)
- IRCP12 Prof Corr Flag (profile correction)
- IRCP12 Dyn Slope Flag (dynamic slope correction)
- IRCP12 Dyn Int Flag (dynamic intercept correction)

The dynamic slope and intercept correctors should be set to **True**. Profile, dirt and Z corrections are not recommended and the flags should be set to **False**. These correctors can also be set in the **Sensor Maintenance** display (see Section 9.3).

Create an **ICRP Configuration Table** for each calibration group. For each table, set the value to **True** if the corresponding corrector is used; for example, the dynamic intercept. Then, click **Save As…** to save a new table with a new name. To remove a table, select it and click **Delete**.

5.2. IRCP Calibration Table

Create an **IRCP Calibration Table** for each calibration group, for example, **IRCP12 calibration table00** (see Figure 5-2).

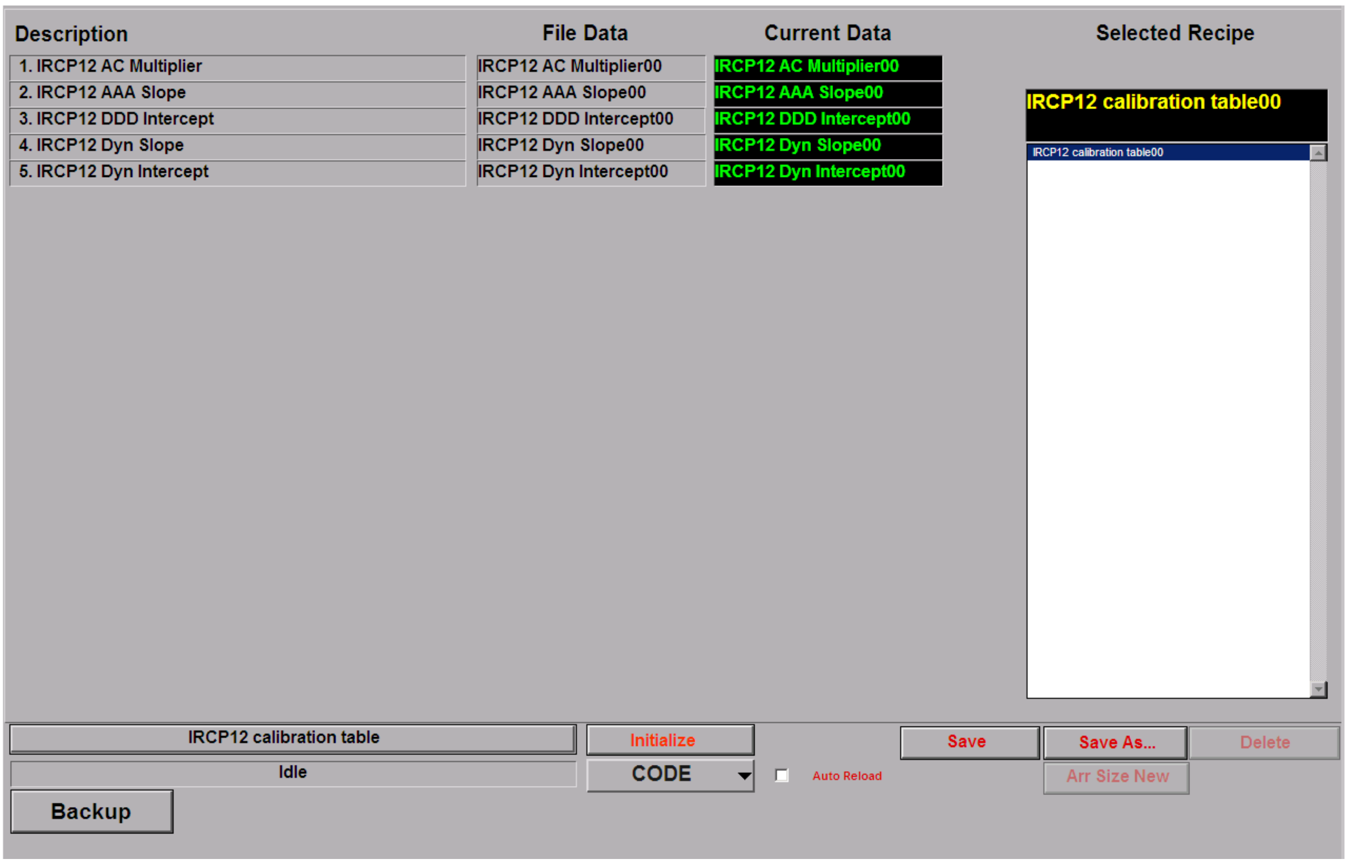


Figure 5-2 IRCP12 calibration table00

To create another table, select an existing table and **Save As…** with a new name. This table specifies the proper calibration constants, each in its own table, which will be used for this recipe. If you need to change the table names (pointers) referred to in this table, type the new names in, and then click **Save As…** to save a new version.

These pointers and the values in them are set during calibration time (see Chapter 6).

You can check them by calling each of them up in the **IRCP AC Multiplier**, **IRCP12 AAA Slope00** (see Figure 5-3), **IRCP DDD Intercept**, **IRCP Dyn Slope**, and **IRCP Dyn Intercept** tables.

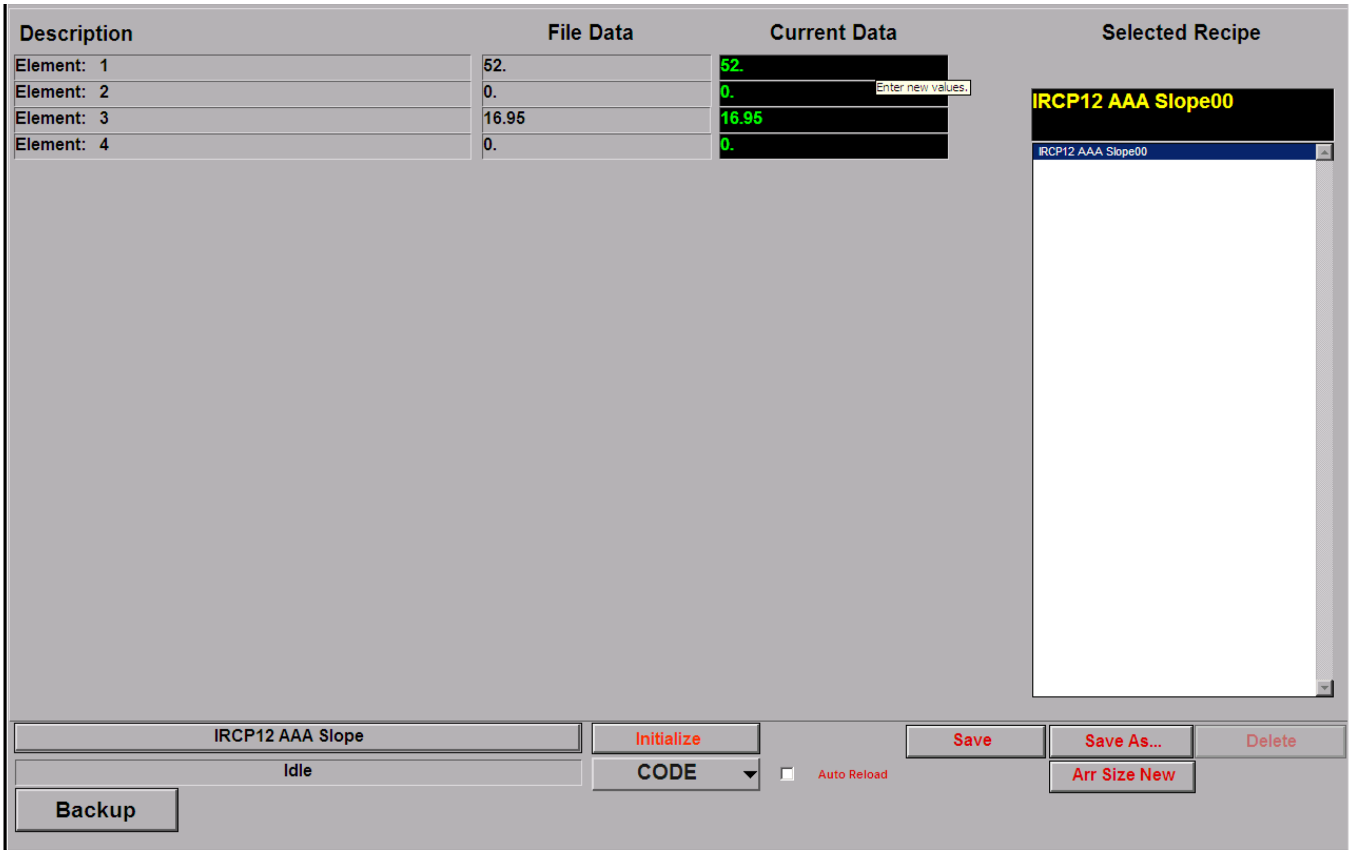


Figure 5-3 IRCP12 AAA Slope00

The slope and intercept tables will each contain four elements, one for each of the four coat weight measurements as described in Subsection 2.2.7.2 and Section 2.4. The **IRCP AC Multiplier** table is a 4 x 8 array of constants (typically 1 or 0) that determine the functional form of the calibration equation. These are detailed in Subsection 2.2.7.2. The dynamic correctors (elements 4 and 5 in Figure 5-2) for each component are not used and should not be changed.

You can browse the sub-tables by double-clicking on them. Elements can be changed by overwriting them and clicking **Save**.

5.3. Intergauge Configuration Table

To calculate coat weight in the case where more than one sensor is involved (for example, base sheet and coating station scanner), an **Intergauge Configuration** table (see Figure 5-4), will be available (one for each pair of sensors).

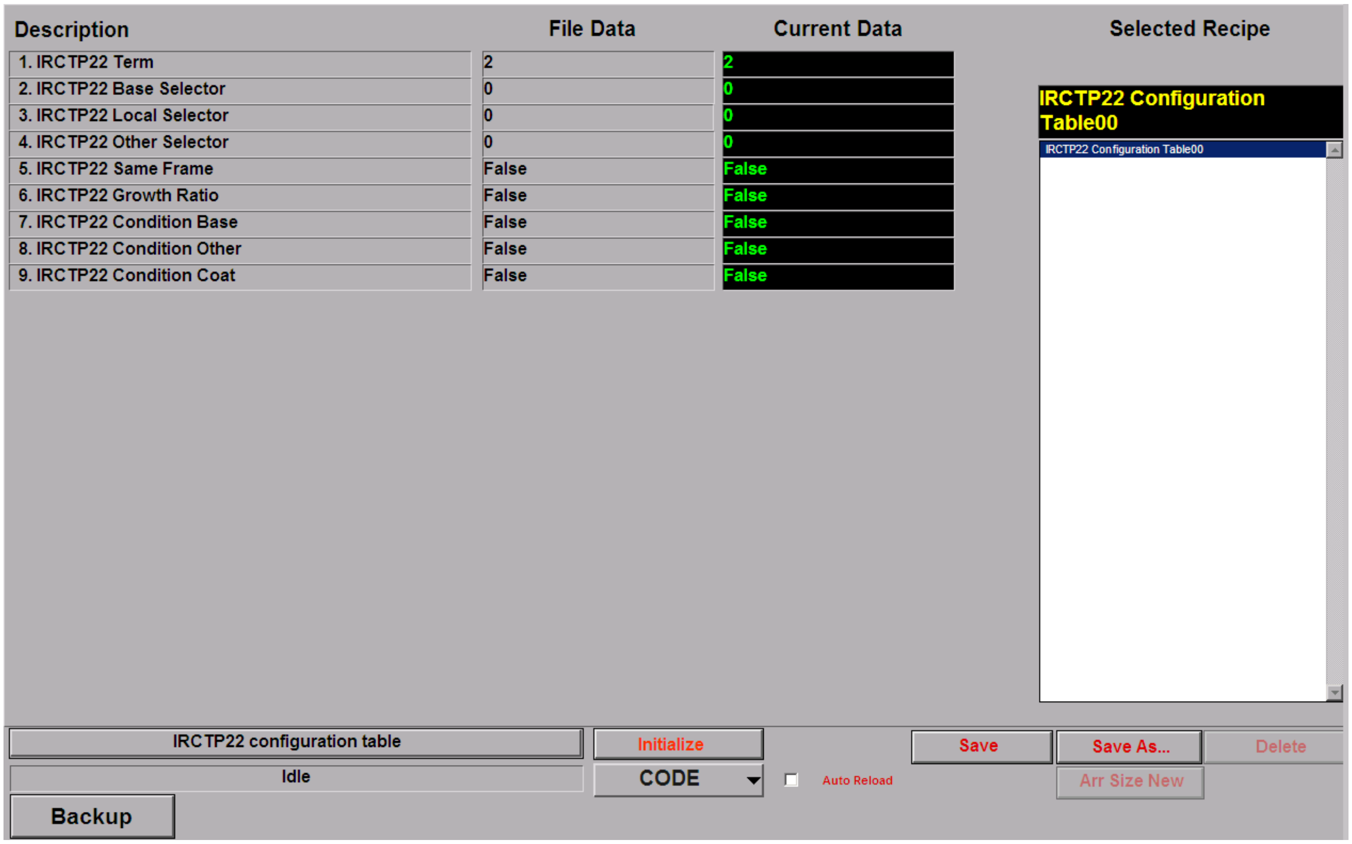


Figure 5-4 IRCTP22 Configuration Table00

The elements should be set up by the factory and should not be changed. The most important element in the table is the **Term** (element 1 under **Description** in Figure 5-4), which determines which component will be used to measure the coat weight. By default, this will be the $CaCO_3$ component (the second component).

5.4. Intergauge Calibration Table

To calculate coat weight in the case where more than one sensor is involved (for example, base sheet and coating station scanner), the **Intergauge Calibration** table (see Figure 5-5), will be available.

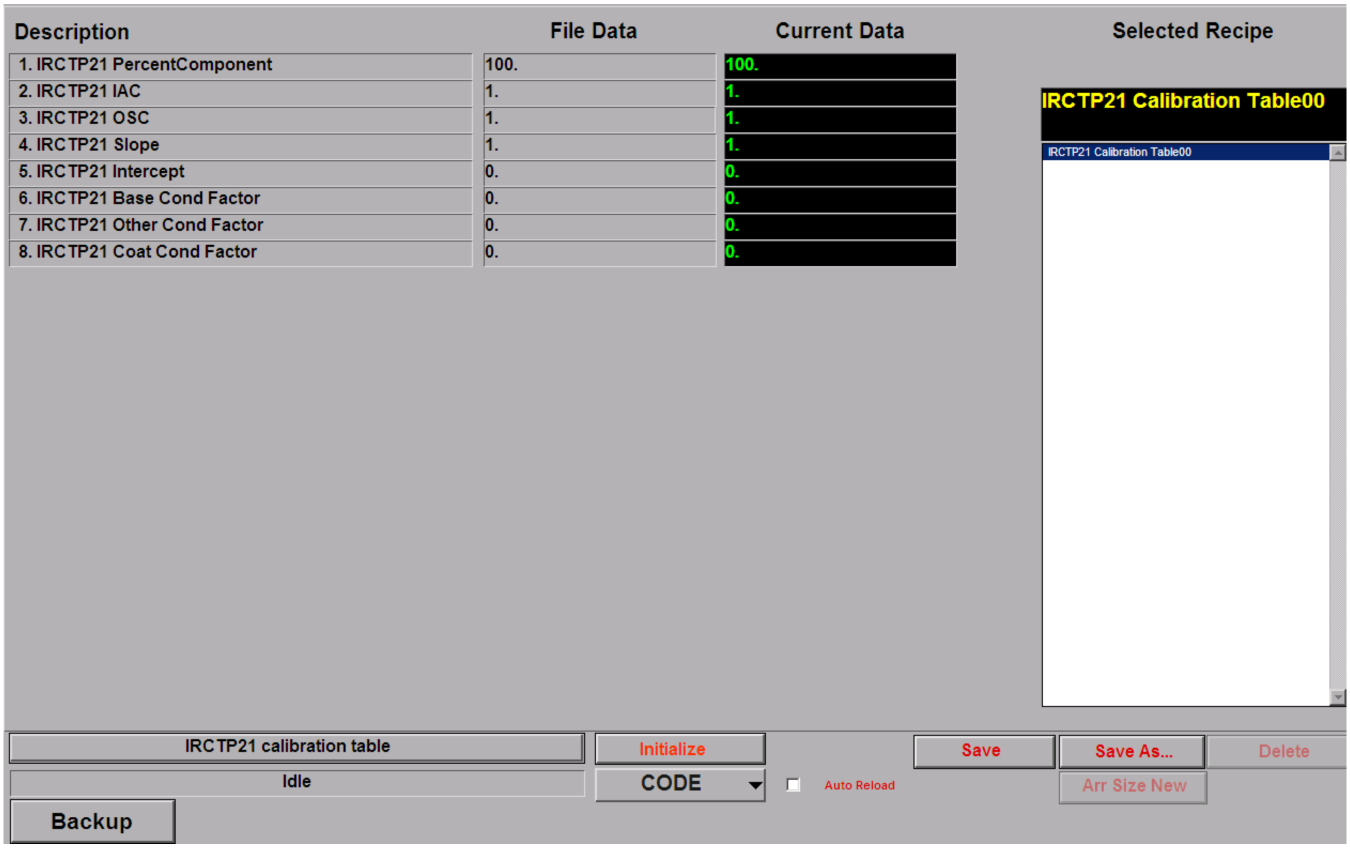


Figure 5-5 IRCTP21 Calibration Table00

This table contains coating formulation information (the percent of the coating that is the component being measured–by default, $CaCO_3$), the other-side corrector (OSC), and the dynamic slope and intercept for the final measurement.

There will be one of these tables per pair of sensors. The pairs are duplicated for each calibration group.

5.5. Main Code Table

The **Main Code** table gathers together all the other tables for each grade recipe required (see Figure 5-6).

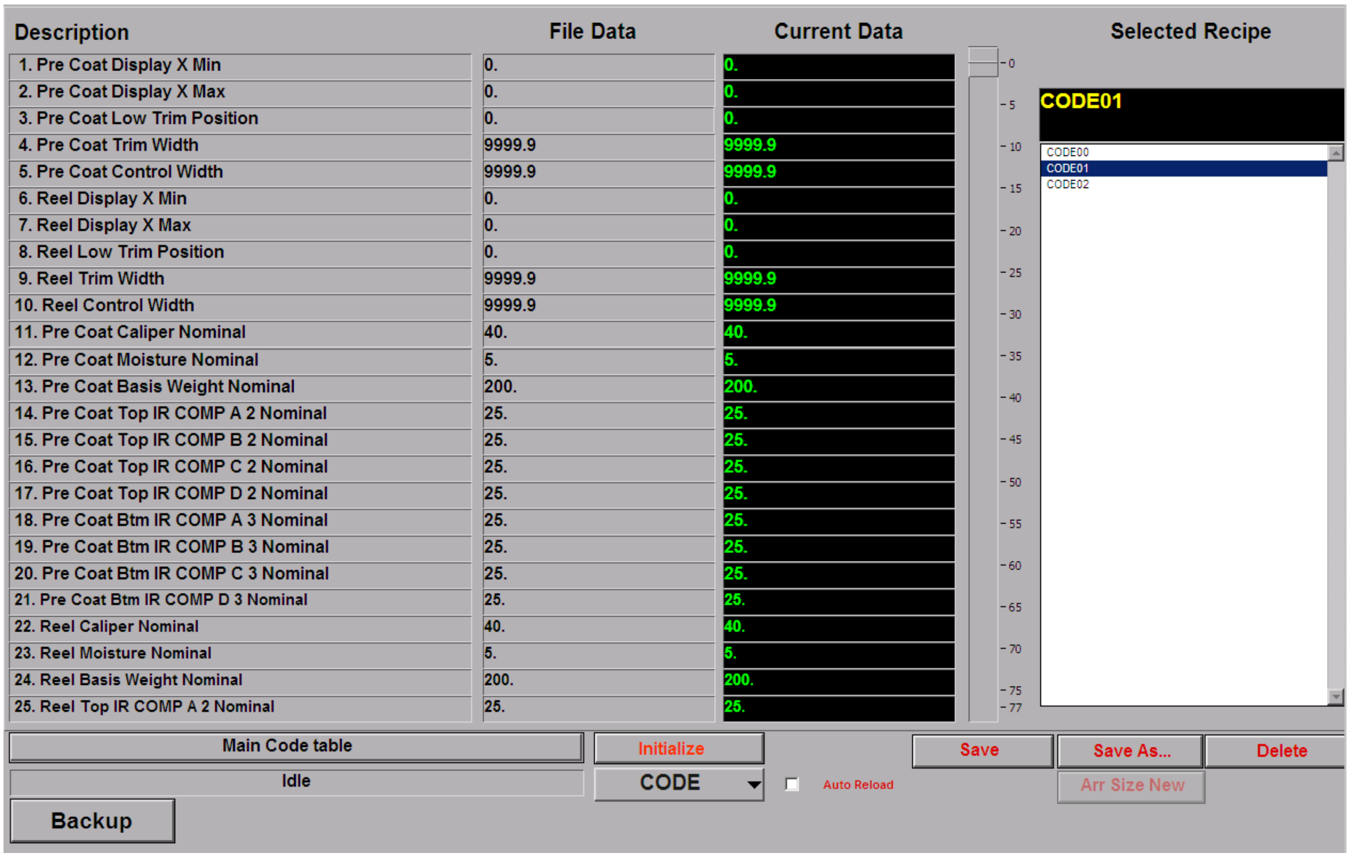


Figure 5-6 Main Code Table

Create a grade recipe for each grade as required, for example, Code00 to Code02.

For each recipe, ensure that the associated **Main Code** table contains the appropriate sub-tables that you created for the **IRCP Configuration Table**, **IRCP Calibration Table**, **IRCTP Configuration Table**, and **IRCTP Calibration Table**.

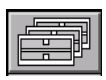
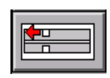
6. Operations

6.1. Maintenance Mode Setup

The system must be put into maintenance mode in order to access sensor activities such as calibration, repeatability, or reference operations.

To set up maintenance mode, the scanner heads must be brought offsheet, and the maintenance recipe (code) must be loaded.

To load a maintenance grade code:

1. Press  to bring up the **Scanner control** display.
2. Select the appropriate scanner and press  on the **Scanner control** display to take the selected head offsheet.
3. Select **Maintenance Mode** from the drop-down menu on the **Sensor Maintenance** display.

4. Press **Retrieve/Save Recipes…** on the **Sensor Maintenance** display to call up the **Scanner Modes & Maintenance Recipes** display (see Figure 6-1). The dialog box indicates the currently selected mode (**Maintenance** in Figure 6-1).

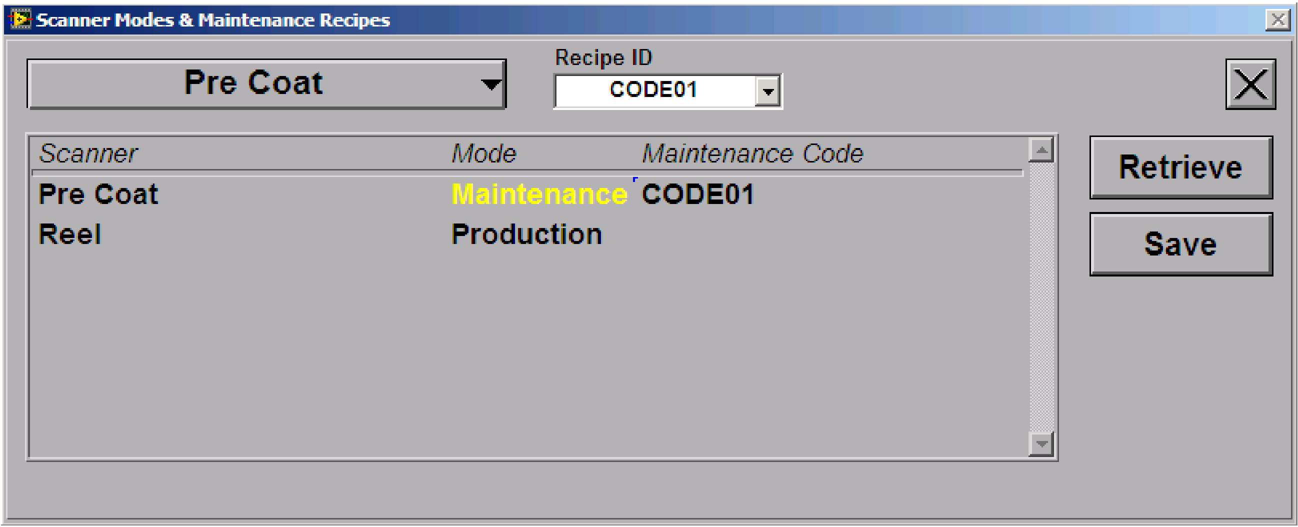


Figure 6-1 Scanner Modes & Maintenance Recipes Display

5. Select the appropriate scanner using the drop-down menu button on the left (**Pre Coat** in Figure 6-1).

6. Under **Recipe ID**, select the appropriate code.

7. Press **Retrieve**.

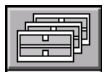
8. Close the **Scanner Modes & Maintenance Recipes** display.

9. To return to production mode, repeat steps 1-8, selecting **Production Mode** in the dropdown menu.

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  on the top horizontal dispatcher to bring up the **Scanner control** display (see Figure 6-2).

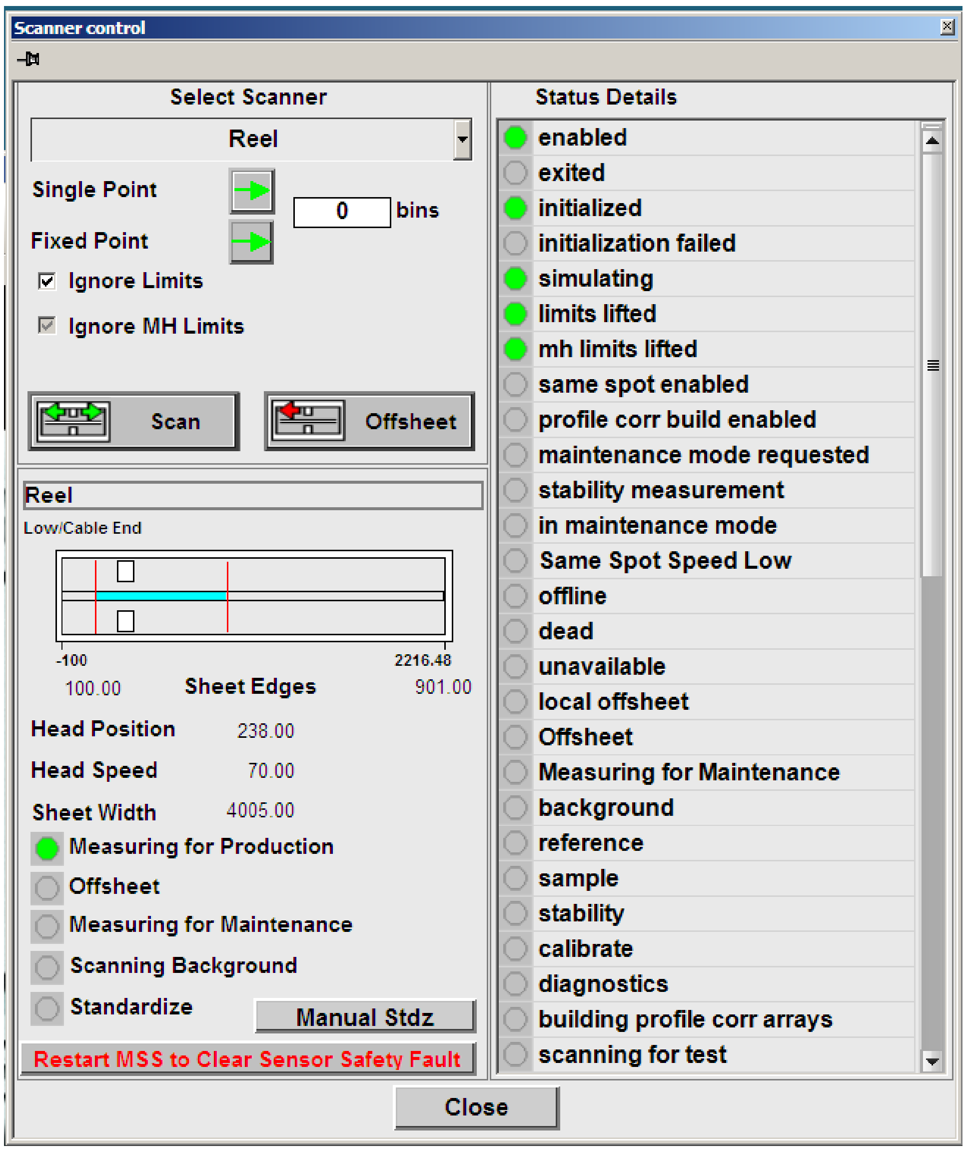
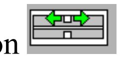


Figure 6-2 Scanner control Display

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

6.2.1. Types of Scan and Sensor Data Snapshot

While scanning, you can choose **Position snapshot**, **Partial Scan snapshot**, or **Single point** by selecting the appropriate button in the **Sensor Maintenance** display (see Figure 6-3).

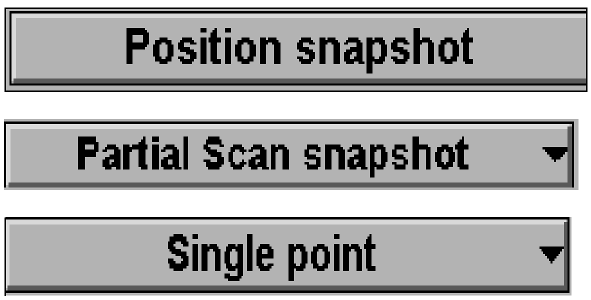


Figure 6-3 Snapshot Options

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

To send the head offsheet:

1. Enter the single point position (in terms of bins) in the **Scanner control** display

2. Press the **Single point** button (see Figure 6-2).

For the position snapshot and the 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.

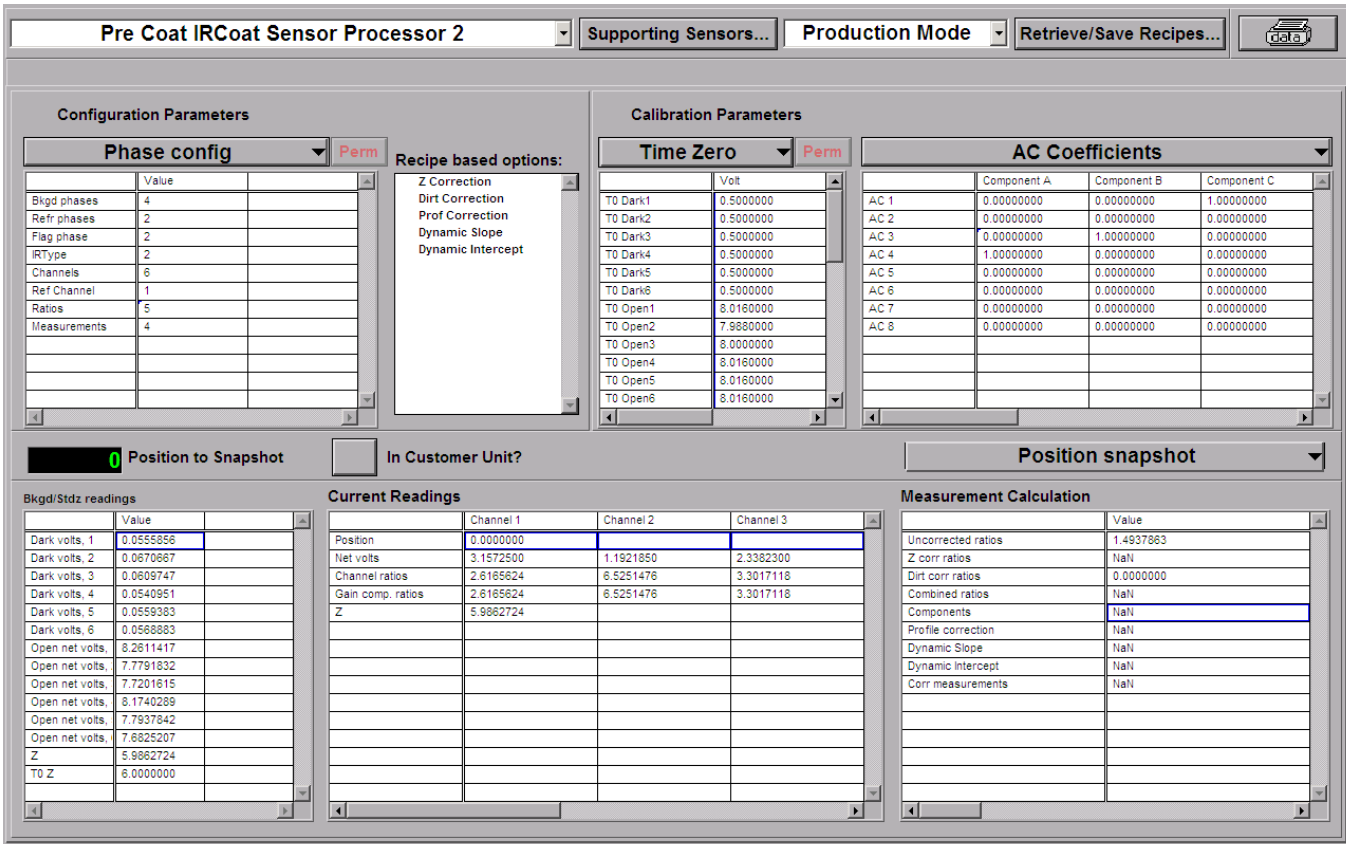
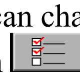


Figure 6-4 Sensor Maintenance Display for Production Mode

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

6.2.2. Measurement Setup, and Profile Display

Customer units can be chosen by enabling the customer unit checkbox. The defaults are grams per meter squared (g/m^2), degrees Celsius, and a unit length of meters. You can change the customer units by pressing the **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 which measurement to set up. You may choose any of the coat weight component measurements, or the coat weight itself.

4. Under **Measurement Arrays**, set **Trend Filter Factor** to 0.2 (Figure 6-5).

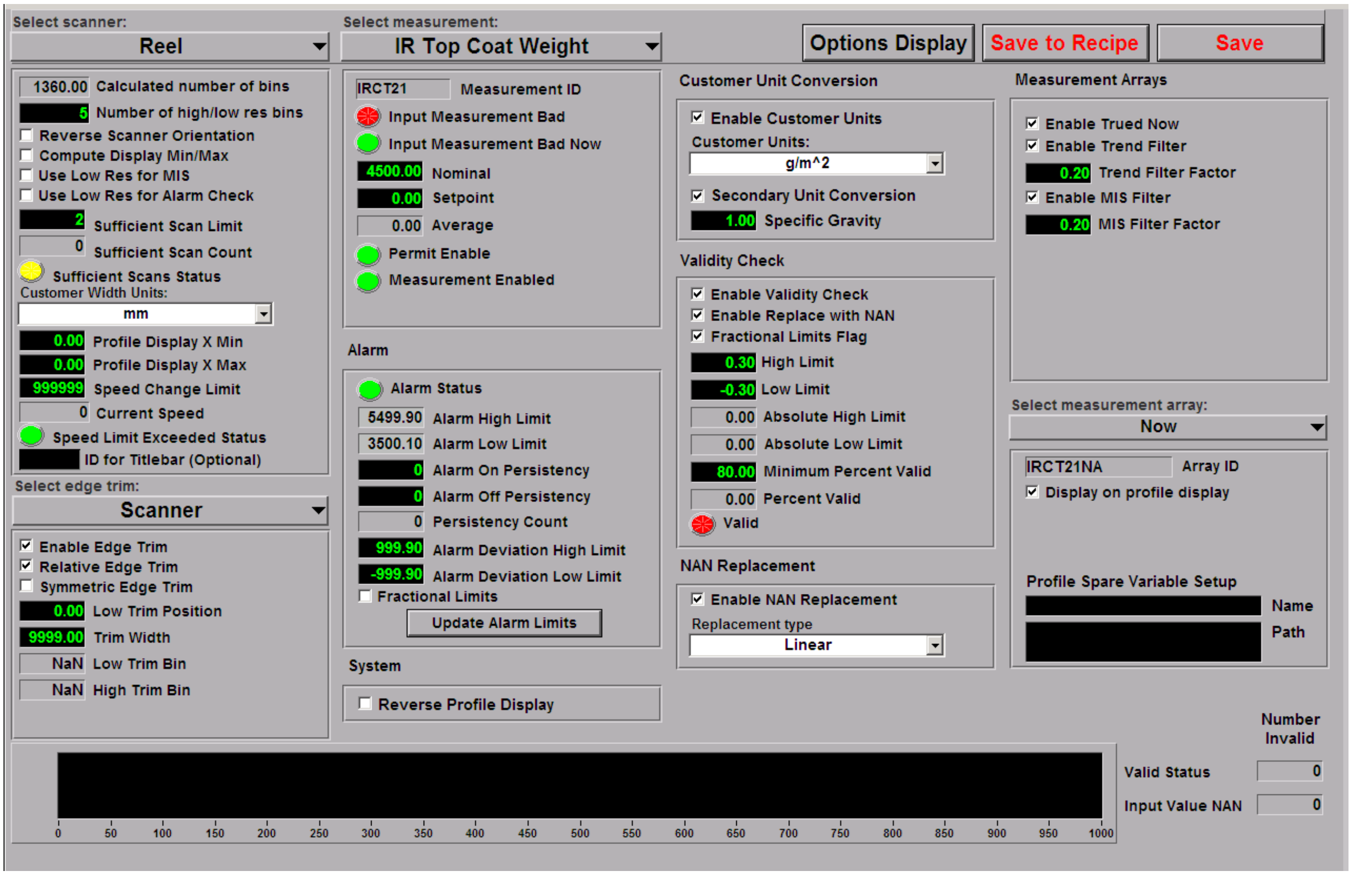


Figure 6-5 Measurement Setup Display

To set up the profile display:

1. Choose **Home**.

2. In **Home**, choose the **Profiles** tab.

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.

Figure 6-6 shows the **Profile** display.

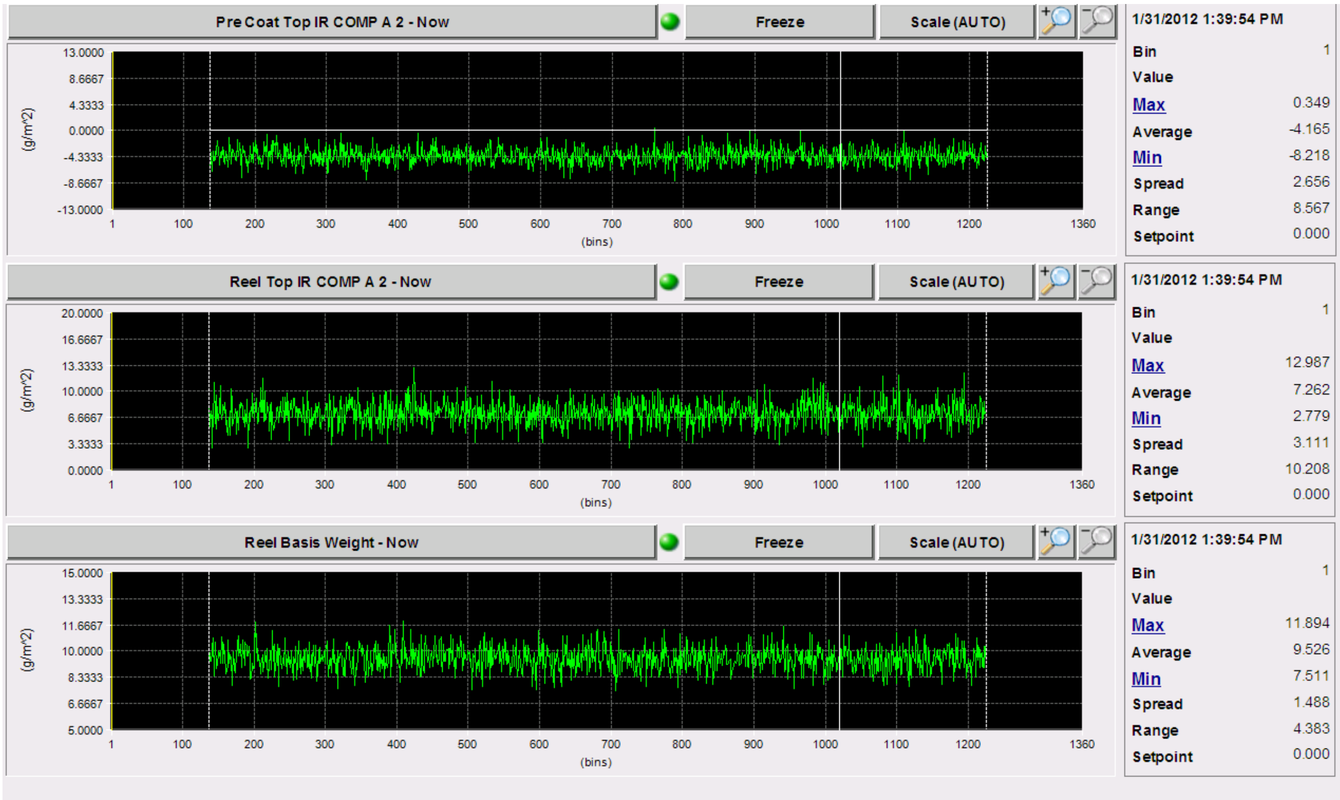


Figure 6-6 Profile Display

6.3. Dynamic Calibration

Dynamic calibration consists of *verifying* and *correcting* (if necessary) the online measurements of the sensor. The dynamic calibration for coat weight is performed in *coat weight*, not *component weight*. The dynamic calibration of coat weight and moisture is required to ensure accurate online measurement. Verification and correction should begin at startup and continue until the credibility of the measurement is established. Verification should be repeated at least weekly.

ATTENTION

Static calibration should always be done before dynamic calibration. The fundamental rule of static calibration is that the same sample set should give *exactly* the same readings for each sensor in the same system. If different sensors do not agree on their readings of a given sample set, dynamic verification should not be attempted.

Dynamic correction of a coat weight measurement can be included to correct for any differences between calibration samples and the final machine-coated product. For example, if the sensor is calibrated with lab-coated samples, there can be significant differences in the optical properties of the calibration lab-coated samples and the machine-coated product. This would necessitate dynamic correction.

6.4. Dynamic Moisture Correction

Dynamic correction of a moisture measurement can be included to correct for flashoff. It should only be performed after static calibrations are performed and verified. More detailed discussions are available from the various documents relating specifically to moisture.

ATTENTION

> The moisture measured by the sensor is a surface moisture, not a bulk moisture, and so it may be difficult to get absolute correlation between sensor and lab measurements. Be cautious in making large dynamic corrections if it is likely that there is moisture stratification in the sheet.

Dynamic calibration of moisture requires samples to be taken from the reel, quickly bagged, and analyzed in the lab. The lab moisture measurements are then compared to the sensor readings taken during the last few minutes of reel building. The *IR Moisture Measurement System Manual* (p/n 6510020328) contains details of how to collect proper moisture samples. If sensor readings and the lab results for the samples taken from the reel are consistently different, proceed with determination of the dynamic moisture correction.

ATTENTION

> Because moisture measurement is always a local measurement, each sensor/scanner should be treated independently.

Determine the dynamic correction using:

MOI = Honeywell-Measurex moisture reading from the coat weight sensor for the slice in question, over the last few scans on the reel

MLAB = Percent moisture of the sample determined in the lab

Write the following simple intercept correction:

$$\text{MLAB} = A_1 \bullet \text{MOI} + B_1$$

Check for positioning errors (correspondence between slice number and sample taken) by plotting *MLAB* and *MOI* against the slice position on the same graph. If they do not track, there may be a positioning error.

If there are fewer than 10 data points, or if the data covers only a narrow moisture range, it is probably best to use an intercept correction. In this case, calculate the new offset as follows:

dynamic intercept (new) = dynamic intercept (old) + Avg{MLAB - MOI}

When there are 20 or more data points, make a graph of lab percent moisture *MLAB* (vertical axis) against sensor percent moisture *MOI*.

Determine if the graph looks like a ball or a line. This determination is gained through experience at each individual installation. If the range of moisture is narrow, the points may form a ball. In this case, the best that you can do is to use a simple intercept correction.

If the range of values is great enough that a line can be discerned, perform a linear regression on the lab value (Y) versus the sensor value (X) to determine slope A_1 and intercept B_1. If the *Coat Wt Processor* is used, calculate:

dynamic slope (new) = $A_1 \bullet$ dynamic slope (old)

dynamic intercept (new) = $A_1 \bullet$ dynamic intercept (old) + B_1

The dynamic slope and intercept correctors for moisture are stored in the **IRCP Calibration** table, as described in Section 5.2.

6.5. Dynamic Coat Weight Verification

Again, it is critical that a static verification be performed before any dynamic verification is attempted. A number of techniques for dynamic verification are described in this section. Experience and the specifics of the installation determine which technique or techniques to use. It is not implied that they all should be used at one installation.

6.5.1. Verification by Delta Dry Weight

Many systems have basis weight sensors as well as coat weight sensors before and after each coating station. One of the best methods to do coat weight verification is to compare dry weight subtraction, as done by the basis weight and moisture sensor combination versus the coat weight sensor subtraction. However, the coat weight sensor is often more accurate in the short-term than the dry weight subtraction, especially if there is considerable machine direction variability. If the coating operation is running smoothly, a general rule is that the well-filtered dry weight profiles can be used as a long term standard to judge how well the IR coat weight measurement is performing.

6.5.1.1. Preparation

Prepare for the data collection by setting up the relevant sensor parameters for print-out at turn-up, both numerically and as profiles. Most systems can allow the choice of trended averages or reel averages. For coat weight comparison, trended averages are preferred. The relevant sensor parameters for IR coat weight are dry weight for each scanner, clay (or calcium carbonate) weight for each scanner, and coat weight applied between scanners. Although some extra work is required in the data analysis if clay is used, and not the coat weight applied between scanners, the coat weight applied can be calculated from the clay data.

6.5.1.2. Data Collection and Analysis

To collect data:

1. Choose a time when the machine is running steadily.

2. Record the individual sensor (local) readings and the Intergauge (global) calculations, as well as the dry weights for each scanner.

3. Collect several data sets to ensure that corrections to the coat weight calibration are required. Before making any corrections to the coat weight calibration, shoot at least an uncoated and a coated sample in the sensor before and after the coating head where the correction is to be made. Verify that both samples read the same on both sensors. If they do, it is probable that a slope correction is required. If they do not, make the necessary intercept correction and repeat the data collection process to determine the slope correction required.

4. Transfer the data to a software spreadsheet for analysis.

To analyze data:

1. Make a graph of the coat weight determined by the nuclear and moisture gauges on the Y axis, and the coat weight as determined by the single sided infrared (SSIR) sensors on the X axis.

2. Determine if the graph resembles a ball, or a line. If the range of coat weights is narrow, the points may form a ball. In this case, the best that can be done is to use a simple intercept correction:

   dynamic intercept (new) = dynamic intercept (old) + average(nuclear differential coat weight – SSIR coat weight)

3. If, on the other hand, a line can be discerned, perform a linear regression on the data (for example, include a linear trend line in MS Excel) to determine the slope A and intercept B. These values are then the new dynamic slope and dynamic intercept, respectively.

6.5.2. Verification by Lifting Coating Heads

The following procedure is outlined for the most complicated coating operation, which is putting a pre-coat and a finish-coat on both the top and bottom of heavy paper. This method should be simplified as appropriate for use on coaters with less complexity. The coating operation described here coats the bottom pre-coat first, then the bottom finish-coat, then the top pre-coat, and finally the top finish-coat. The reel scanner/sensor is designated as number 1, down to the raw-stock scanner/sensor as number 6. The bottom pre-coat is applied between scanner/sensor 6 and 5, the bottom-finish coat between 5 and 4, the top pre-coat between 3 and 2, and the top finish-coat between 2 and 1.

For less complicated coaters (machines with fewer than the four coaters described here), use the appropriate portions of the following procedures.

6.5.2.1. Preparation

To prepare:

1. Choose a time when the machine is running steadily and wait until just before turn-up for the end of a reel.

2. Record all the relevant sensor parameters for IR coat weight, basis weight, and moisture. If possible, record the individual sensor (local) readings and the Intergauge (global) calculations. Using the datalogger, save all the profiles for both IR coat weight and differential dry weight.

3. Station personnel at each scanner, each with a spray bottle with different colored inks.

6.5.2.2. Sample Collection

For sample collection:

1. Starting nearest the reel, lift the coaters, one by one. The person at that scanner marks the sheet with ink for approximately 10 meters (enough for a wrap or two).

2. After approximately 5–10 seconds, the second coater should be lifted. The person at this scanner marks the sheet at this time for approximately 10 meters.

3. Repeat Steps 1 and 2 for each of the other two coaters, until the last coater, the bottom pre-coat coater, is lifted.

4. Complete reel turn-up.

5. Draw a liter or so of coating from each coater and label the containers. There should be four containers for this example.

6. Cut cross direction strips out of the reel with the coats listed:

All coats:	Top finish-	Top pre-	Bottom finish-	Bottom pre-
3 coats		Top pre-	Bottom finish-	Bottom pre-
2 coats:			Bottom finish-	Bottom pre-
1 coat				Bottom pre-
Uncoated: Base sheet only				

7. If hand-coated samples are made, cut 8 to 10 strips of each type 0.5 m (20 in) wide by the cross direction width. Otherwise, one sheet plus one or two spare strips are sufficient. Mark each with the front and back side, and the coating composition.

8. Allow one strip from each of the five coatings to reach equilibrium in a conditioned room.

9. Lay the strips on top of each other so that the machine direction locations line up.

10. Die out 11.4-cm (4.5-in) samples through all five sheets, and be careful to mark them. Figure 6-7 shows how to align and die-cut the samples.

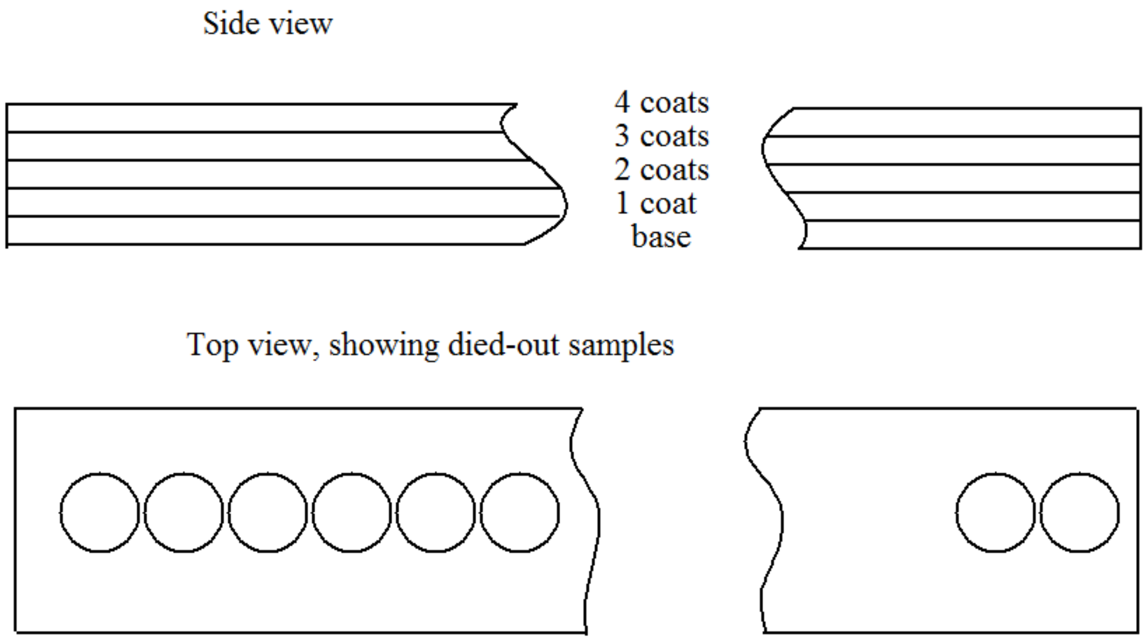


Figure 6-7 Aligning and Die-cutting Samples

6.5.2.3. Sample Analysis

For a sample analysis:

1. Weigh each sample from each sheet.
2. Determine the ambient-conditioned coat weights for each coating, slice by slice, by subtraction.
3. Plot the cross direction profiles for each coating.
4. If slightly more accuracy is wanted, the samples can be TAPPI dried, and the dry coat weights can be determined.
5. Compare the coat weights, as determined in step 4 with the data from the datalogger just before the samples were made.
6. If corrections are required for the calibrations, see Subsection 6.5.1.2.

6.5.2.4. Hand-Made Samples versus Machine-Made Samples

The samples collected according to the procedure outlined in Subsection 6.5.2.2 can be used to verify that the original hand-made sample set had produced an accurate calibration. To do this, select an area where the basis weight and coat weight are both fairly flat.

To verify that the pre-coat calibration is accurate:

1. Take seven sheets of base paper, and one sheet that contains the bottom pre-coat, and lay them out on a flat surface marking the machine direction and the cross direction on each sheet.

2. Using the coating rod set, coat five of the samples with the pre-coat mix obtained from the pre-coat coating head. To prepare samples, see Section 7.3.

3. After the hand-made coating samples have dried, calculate the coat weights of each.

4. Read the hand-made samples, and the single machine-made sample that has only the bottom pre-coat applied in both sensor 6 and sensor 5. Each sample should read the same on both sensors. The machine-made sample should also lie on the same calibration line as the hand-made samples.

5. Verify that the bottom finish-coat calibration is accurate by using seven sheets of pre-coated paper and one sheet of finish-coated paper. Repeat Steps 1–4. Each sample should read the same on both sensor 5 and sensor 4. The machine-made sample should also lie on the same calibration line as the hand-made samples.

6. Verify the next coating (top pre-coat) in the same way, using seven sheets of bottom pre-coated and finish-coated paper (for hand-made samples), and one sheet of top pre-coated paper. Each sample should read the same on both sensor 3 and sensor 2. The machine-made sample should also lie on the same calibration line as the hand-made samples.

7. Verify the last coating (top finish-coat) in the same way, using seven sheets of top pre-coated paper (for hand-made samples) and one sheet of top finish-coated paper. Each sample should read the same on both sensor 2 and sensor 1. The machine-made sample should also lie on the same calibration line as the hand-made samples.

6.5.3. Verification by Comparing Turn-up Versus Stub Roll

This method takes advantage of the fact that the uncoated paper left on the stub roll is directly adjacent (in the machine direction) to the last wrap of the reel at turn-up. This method can be used to verify total coat weight, but cannot separate out the individual coats.

ATTENTION

This method is only useful for off-machine coaters, not on-machine coaters.

6.5.3.1. Preparation and Sample Collection

To prepare for and collect a sample:

1. Choose a time when the machine is running steadily just before turn-up for the end of a reel.

2. Record all the relevant sensor parameters for IR coat weight, basis weight, and moisture. If possible, record the individual sensor (local) readings and the Intergauge (global) calculations. Dump out all the profiles for both IR coat weight and differential dry weight. If possible, dump out numerical values as well as profiles for all previous measurements.

3. Collect a few of the top wraps at the reel and a few wraps from the stub roll. Ensure that they are labeled and cover the entire cross direction width of the paper.

4. To align and die out samples, see Figure 6-7. Note that with this technique there will be only the fully coated sheets and the uncoated sheets.

6.5.3.2. Sample Analysis

To analyze a sample:

1. Weigh each sample from each sheet.

2. Determine the ambient-conditioned coat weights for each coating, slice by slice, by subtraction.

3. Plot the cross direction profiles for each coating.

4. If slightly more accuracy is wanted, the samples can be TAPPI dried and the dry coat weights can be determined.

5. Compare the coat weights, as determined in step 2, with the values collected by the datalogger just before the samples were made.

6. If corrections are required for the calibrations, see Subsection 6.5.1.2.

6.5.4. Verification by Masking the Coating

Some paper mills allow the verification of the coat weight sensor by masking off a small portion of the coating. This is done by taking a small piece of paper approximately 21.5 cm by 28 cm (8.5 in by 11 in), applying double-sticky tape along one edge, and attaching it to the sheet just before the coater to be tested. The sheet then has the normal coating before and after the attached mask paper, and no coating beneath it.

CAUTION

Do not try this unless the mill is totally aware of the test. There is a chance that a sheet break can occur or that the coater can be jammed.

To verify by masking the coating:

1. If possible, single-point the sensor near the edge of the sheet and monitor readings by using the **Status** software screen. If the readings are stable, proceed.

2. Wait until just before turn-up and attach as many mask pieces as practical.

3. Remove the mask pieces (that now have a coat layer), and remove approximately 30 cm (12 in) of paper both up-stream and down-stream around the mask pieces.

4. Die out samples in sets of three: one just before each mask piece; one under each mask piece; one just after each mask piece.

5. Average the weight of the first and third samples, and subtract the weight of the middle sample from the average.

6. If corrections are required for the calibrations, see Subsection 6.5.1.2.

7. Static Calibration

This chapter describes procedures for performing static calibration. Normal installation requires only hardware checks (see Chapter 2) and dynamic verification (see Chapter 6).

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 Section 6.1.

7.1. Static Calibration

The initial installation of the direct IR coat weight sensor normally requires only hardware checks (see Section 7.5), and verification or recalibration (see Section 7.10 and Section 7.11).

The same sample set must be measured by all coat weight sensors, so that a proper subtraction of the coating is obtained by measurement after the coater and measurement before the coater. See Section 7.2 for important details on calibration sample requirements.

If there is no static calibration, or if a change in grade structure occurs that requires a new static calibration, follow Sections 7.1 through 7.8.

See Appendix C for MS Excel® worksheets *SSIR cal worksheet.xls* and *Moisture_samples.xlsx* to be used in conjunction with the procedures in this chapter.

A brief overview of the calibration procedure:

- Proper product samples must be collected for calibration.
- Samples used for calibration are prepared in the laboratory and bagged in Aclar® bags. The same sample set is used for both the moisture and coat weight calibrations.
- The sensor must be verified to be stable and in good operating condition prior to shooting samples.
- The laboratory coat weights and moisture levels are entered into the system software.
- The samples are shot in the sensor using the single sided infrared (SSIR) sample paddle and the data collected in the system software.
- The system calibration screens are used for data reduction and fitting.
- The calibration results must pass accuracy specifications.
- When the calibration passes specification, the sensor is verified.
- The verification must pass accuracy specification.
- The results of the calibration and verification are recorded and kept with the system.

7.2. Definition of Measurements and Sample Selection

The first step in calibration is to specify the coater and system configurations, and the measurements required for each sensor. It is then necessary to define what samples are required to calibrate these measurements. Normally, calibrations are done for moisture, clay, and calcium carbonate. Sometimes either calcium carbonate or clay is omitted.

The goal of sample selection is to base the calibration on a set of samples that uses all the required local and Intergauge measurements. These samples must be representative of all grades and coating levels. The samples must allow for the correction of effects due to base sheet variations, expected moisture variations, and for any coating on the opposite side of the sheet.

Each sensor is normally calibrated with some of the following types of samples:

- lab-coated samples
- machine-coated samples
- other-side correction samples
- samples for calibrating moisture
- select samples that have coatings appropriate to the sensor in question
- select samples that have accurately known coat weights (at ambient moisture) of the products made on the machine

Samples should include as wide a range of coat weights as are found in normal production (and are practical to obtain). Sample selections should always include base sheet (for example, uncoated) samples. Where possible in multiple-coat systems, samples should represent each stage in the coating process.

The following information must accompany any coat weight system to be calibrated by the Honeywell factory (this information is entered into the *SSIR cal worksheet.xls* and is required for calibration):

- details of the composition of each coating formula
- list of the percentage of natural clay
- names of types of clay and the percentage if more than one type is used
- list of the percentage of calcium carbonate
- list of the other components by name and percentage
- simple process drawing showing paper flow, coating stations, and sensor positions, indicating which side of the sheet is coated at each station (this is essential)
- a matrix relating a specific coating sample to a specific paper sample and finished product grade ID and target coat weights for each

7.2.1. Lab-Coated Samples

Coat weight samples used for gauge calibration should be of accurately known coat weights (at ambient moisture), similar to the product expected at the scanner in question. These may be produced by the customer or by Honeywell factory personnel. Ideally, there should be a set of samples below the target coat weight, at the target coat weight, and above the target coat weight. In addition, this sample set should normally include uncoated samples to be measured on the sensor. That means a base sheet for the first coat sensor, paper with only the first coat for the second coat sensor, and so on.

ATTENTION

> IR coat weight sensors require that samples used for calibration be hand coated by Honeywell factory personnel just before calibration of the sensor. The special sample collection requirements for this process are described next. These samples are in addition to those required by other sensors in a given system.

To calibrate a coat weight system, the following are required:

1. Raw stock (base/uncoated) samples:

   minimum size of 300 x 300 mm (12 in)–prefer machine direction longer–samples smaller than 300 x 300 mm (12 in) are not acceptable

   minimum quantity of 20 sheets per grade

   label with grade identification

   mark which is the top side and which is the machine direction

2. liquid coating samples of each coating formula:

   minimum amount of one liter (0.26 gals) per formula

   label with formula identification

3. Package paper samples either flat or rolled so that creases or wrinkles are not created. Paper samples should be packaged such that they are not damaged in the event of a coating liquid leak.

4. Package liquid coating samples carefully to prevent leakage or damage. Some types of coating formulas degrade or spoil if not kept cool. It is recommended that jars of coating liquid be packaged in six-pack style coolers and shipped overnight to the attention of the Honeywell factory. Phone or fax the Honeywell factory that coating samples are in transit.

If there are any questions regarding these instructions, contact the Honeywell factory.

7.2.2. Machine-coated Samples

It is advisable to include some machine-coated samples in the calibration. This is because machine-coated and lab-coated samples of the same coating on the same base paper may measure differently on the sensor due to the different surface properties of the coatings.

7.2.3. Other-side Correction Samples

These samples are required for any grade that has less than a 150 g/m^2 base sheet. They may be either machine-coated or lab-coated, depending upon the makeup of the bulk of the calibration samples. These samples should have coatings of the target weight for the side of the sheet that the sensor measures. For the coatings on the other side, two coating levels are required:

- an uncoated other-side sample
- a target weight other-side sample

7.2.4. Samples for Calibrating Moisture

The samples can be either machine-coated (preferred), or lab-coated. They should have the appropriate target coating levels. Normally, five moisture samples with target moistures at 2, 4, 6, 8, and 10% moisture are used. Enough paper must be included to die out five samples with 11.43-cm (4.5-in) diameters. In addition, a few large sheets of paper that can be stretched in place across the coat weight sensor are recommended. These sheets can be used to calculate moisture correction coefficients.

7.2.5. Lab Coatings for Multiple-grade Coating Machines

Some coating machines are essentially single-grade machines. These machines make basically one coating on only one paper weight.

Other machines may make a number of coatings on several weights of paper. For these machines it is usually not necessary to provide lab samples for each grade. Use these sample selection guidelines:

- Select a medium-weight paper and one near the heavy end.
- Select as many weights as possible for base sheet weights below 150 g/m^2, so the other-side corrector (OSC) can be evaluated for them.

- If recycled paper that contains carbon black is used, select the dirtiest grade of paper.
- Select each of the liquid samples.
- Match the liquid samples to the appropriate paper samples.

7.3. Static Coat Weight Sample Preparation

Static calibration samples are prepared as follows:

- ash content of the base sheet is determined (or given)
- hand-coated samples are prepared using the coatings and base sheets provided for each grade and for each coated side

7.3.1. Materials Required

In addition to the base paper and coating provided by the customer, the following materials are required:

- lab with controlled temperature of 23 °C (73 °F) and a relative humidity of 50%, 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
- muffle furnace with temperature control to 900 °C (1652 °F), for ashing samples
- several oven-proof crucibles for holding the samples to be ashed
- analytical balance accurate to 0.1 mg
- Faraday cage balance pan to hold samples upright
- Aclar bags 12.07 cm x 12.7 cm (4.75 in x 5.0 in) (part number 42000025)
- bag sealer
- sample die 11.43-cm (4.5-in) diameter (part number 07279100); mallet for die; and wood or hard rubber backing block

- permanent ink pen for marking bags
- rubber gloves
- tweezers
- graduated cylinder for measuring out the exact amount of coating and water
- stirring rods
- large plastic syringe without needle or tip; 100–200 ml (3.38–6.76 fl oz).
- sufficient quantity of base sheets for grades to be calibrated
- a good supply of scrap base sheets similar to the customer samples
- very flat surface large enough to hold base sheets, for example, a 30.48 x 30.48-cm (12 x 12-in) granite table as used in machine shops
- aluminum foil or plastic bag for sample protection
- copies of the *SSIR cal worksheet.xls* (see Appendix C)
- set of five 2.54 cm (1-in) diameter precision coating rods with different gaps (part number 09832400)
- masking tape, 2.54 cm (1-in) wide, to hold samples on flat table and to hang samples up while drying

Before making any samples, familiarize yourself with the *SSIR cal worksheet.xls*. The calculations performed are straightforward and correspond to those outlined in the procedures in the next sections of this chapter.

You will need to modify the *SSIR cal worksheet.xls* by copying and pasting more lines in each tab to accommodate the number of samples you will be using. Ensure that you understand what you are copying so that the internal functioning of the worksheet is not damaged and the connections between the tabs remains correct.

7.3.2. Determining Ash Fraction In the Base Sheet

When samples have been collected, the first step is to determine the amount of ash in the base sheet. Ash, if present in the base sheet, will be seen by the coat weight sensor and must be taken into account in the calibration.

ATTENTION

Because the sensor *sees* the coating and base sheet best near the surface, only a fraction of the coat weight in the base sheet is counted for thick base sheets.

Use the **ash in base sheet** tab in *SSIR cal worksheet.xls* for data entry and calculations. Instructions are included in the worksheet.

To determine the ash fraction in each type of base sheet:

1. Obtain an uncoated sample of the base sheet and die out an 11.43-cm (4.5-in) sample, taking care that the edge is not torn or frayed.
2. Mark it and place it in the oven in a drying rack. The oven should be set for 105 ± 0.5 °C (221 ± 0.9 °F), and there should be no other material in it.
3. Dry the samples for at least four hours at 105 °C (221 °F) without disturbing the oven.
4. Mark and weigh an Aclar bag (*BAGB*).
5. After the samples have dried for four hours, quickly open the oven door, insert one sample in the Aclar bag, and remove it from the oven, keeping the door open only long enough to bag the sample. Quickly squeeze out all the excess air, and immediately seal the bag.
6. Allow the sample and bag to cool to room temperature, weigh it, and record the weight (*BGBD*).
7. Weigh a crucible (*CRUB*).
8. Cut open a bag, remove the dry base sheet, place it in the crucible, then place it in the 900 °C (1652 °F) furnace for four hours.
9. Remove the crucible and ash from the furnace, allowing it to reach room temperature. Weigh it to determine the weight of the crucible plus ash (*CRBA*).

10. The worksheet will calculate the fraction (*FAB*) and percentage (*PAB*) of ash in the base sheet:

$$FAB = \frac{CRBA - CRUB}{BGBD - BAGB} \qquad PAB = 100 \times FAB$$

11. Ash several samples per grade for best results. The average ash percentage is used in the subsequent coat weight calibration worksheets. Ensure that subsequent worksheet tabs refer to the correct ash number.

7.3.3. Coating Procedure

To make hand-coated samples:

1. Ensure that the first coating has not segregated or settled in its container. Stir if necessary. Pour approximately 100 ml (3.38 fl oz) of the coating into the syringe–the coating mix may appear too thick, but do not add water. Experience has shown that adding water to dilute the coating mix may result in non-uniform coatings.

2. Tape a piece of the paper to be coated to the flat working surface. Ensure that the machine direction points up/down. Select the first rod from the coating rods (this rod does not have an indentation). Place the rod across the width of the sheet, 12.7–15.24 cm (5–6 in) down from the top of the sheet. Ensure that there is enough room to die out an 11.43-cm (4.5-in) sample from above the rod (uncoated portion), and from below the rod (where the coating is applied).

3. Squeeze out an even bead of the coating from the syringe along the rod. Press down firmly on the rod and draw it down the length of the sheet by dragging it while maintaining very firm pressure. Work as quickly as possible after the coating is on the paper.

ATTENTION

> If there is an insufficient amount of coating in front of the rod, the sheet will not be coated evenly. If this happens, discard the sheet and repeat the procedure on a fresh sheet.

4. When properly coated, the sheet should have an uncoated area and a coated area, each large enough to die out 11.43-cm (4.5-in) samples.

5. Allow the evenly coated piece of paper to air dry by taping it to a flat surface. Tape all four corners so that the coated paper dries with

minimal curl. Label each sample with the rod number and the grade number, as well as the coating machine direction.

6. Repeat the coating procedure with the next four rods.

7.3.4. Obtaining the Static Coat Weight

The accurate determination of the coat weight is critical to calibration. Extreme care in technique is necessary to ensure the accurate and repeatable coat weight determination.

Use the **ct wt sample prep** tab in the *SSIR cal worksheet.xls* for data entry and calculations. Follow the instructions therein, entering the relevant data into the blue cells.

To obtain the static coat weight:

1. After air drying for several hours or overnight, die out an 11.43-cm (4.5-in) disk from the coated section and another 11.43-cm (4.5-in) disk from the uncoated section, exactly in line (in the machine direction) with each other.

2. Obtain bone-dry weights for both coated and uncoated samples by placing them in a 105 °C (221 °F) oven for 20 to 30 minutes.

3. Put the samples in an Aclar bag, squeeze all excess air out, and quickly weigh each sample in turn, using the same bag each time (this way the bag weight can be ignored, because it cancels out).

4. Enter these weights into the **Sample Weight** column on the **ct wt sample prep** tab in the *SSIR cal worksheet.xls*. The samples should be entered in pairs, with the uncoated base sample weight entered on the line above its coated counterpart.

5. The worksheet will calculate the total coat weight applied to each sample in g/m^2 as well as the basis weight of $CaCO_3$, clay, and latex that are now on the sample. It does these calculations by using the coating formulation information on the first tab of the worksheet. Ensure that the formulation specifications are correctly picked up.

When the process is completed, there should be 10 samples for each grade: five coated with rods 1 through 5, and five uncoated samples (each matched with its coated counterpart).

It is likely that the three, or even four thicker coatings will have higher coating weights than the target weight. This is usually not a problem because the calibration is normally linear over a wide range.

Samples should be protected in aluminum foil or a plastic bag when not in use. They should be allowed to condition for 24 hours before use.

7.4. Preparing Static Moisture Samples

To calibrate the sensor for moisture, machine-coated product is preferred. It is best if the samples resemble as closely as possible the product that will be measured by the gauge, for example, if only a topcoat is present when moisture is measured, then the calibration samples should be top-coated only.

ATTENTION

The two moisture channels of the six-channel coat weight sensor are physically located within the sensor hardware. If there is no transmission moisture sensor on the same scanner, the moisture software can deal with these two inputs. If there is a transmission moisture sensor on the same scanner, the coat weight software can be used to give a surface moisture measurement (or two, if there are both top and bottom coat weight sensors).

7.4.1. Required Materials

Required materials:

- The materials listed in Subsection 7.3.1.
- For moisture samples, machine-coated samples are preferred. The samples used for calibration should resemble as closely as possible the real product that the sensor will see.
- Copies of the *Moisture_sample.xlsx* worksheet.

7.4.2. Determining Dry Weight

For determining dry weight, use the **target moisture** tab in *Moisture_sample.xlsx* to enter the data and perform the calculations. You may need to copy parts of the worksheet to accommodate more grades.

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). Mark the sample ID and target moisture on each sample near the edge. Ensure that you use gloves, and keep bags and samples clean and dry because an accumulation of dirt and fingerprints causes errors.

2. Bone-dry all samples for four hours in the 105 °C (221 °F) oven. Ensure that no other materials are drying in the oven and that no one will disturb them.

3. Weigh two Aclar bags for each sample: one dry bag for weighing the bone-dried sample, and one wet bag for the moisturized sample. Label each bag with the grade and target moisture level. Record dry and wet bag weights on the moisture sample worksheet.

4. Remove each bone-dry sample, quickly insert it into a dry bag, and seal it. Weigh the bagged, bone-dry samples, and enter the weights on the worksheet. The worksheet will calculate the dry weight of the sample.

5. The worksheet will calculate a target weight for the wet samples using the following formula:

   $$T = 100 \times \frac{D_g}{(100 - M)}$$

   Where

   T = target sample weight in grams

   M = target percent moisture

   D_g = bone-dry sample weight in grams

7.4.3. Calculating Percent Moisture

When calculating percent moisture, data should be entered into the **actual moisture** tab of the *Moisture_sample.xlsx* worksheet. Ensure that you select the proper conversion factor for your sample size and desired units in the upper right hand corner (**BW UCF**, and **WW UCF**).

To calculate percent moisture:

1. For each sample to be moisturized, remove it from its dry bag, and bring it up to target moisture and weight. For moisture up to 4%, this can be done in the balance; the sample will moisturize within minutes.

2. For moistures greater than 4%, it will be necessary to use steam or conditioning chambers. In steaming samples, hold them over boiling water and steam both sides evenly, and use a screen over the water– large errors can result from uneven wetting, and water drops from spattered, condensed, or picked up water, will also cause large errors; discard and replace any samples that pick up drops.

3. Let each sample dry to the target weight on the balance. Seal it quickly in an Aclar wet bag, removing excess air.

4. Weigh the bagged samples and record the weights on the **actual moisture** tab in the worksheet. The worksheet will calculate:

   Wet Sample Weight = Sealed Bag & Wet Sample - Bag

   Water Weight = Wet Sample Weight - Dry Sample Weight

   $$\%\,Moisture = 100 \times \frac{water\ weight\ (g)}{wet\ sample\ weight\ (g)}$$

5. Wrap each grade of sample in aluminum foil for protection. Allow them to condition at least 24 hours before measurement on the sensor.

6. Reweigh and recalculate the lab values before measurement on the sensor by copying the **actual moisture** tab and re-entering the weights.

7.5. Hardware Checks/Sensor Stability

Confirm that the sensor is stable prior to shooting any samples.

Set the sampling time in the system computer to a value between three and five seconds. Call up the **Coat Weight Sensor Verify** display for the appropriate sensor and scanner. Perform two backgrounds. The dark counts should repeat within 2%.

Set up a cycle of 30 references over a 10 minute period. The counts of all channels should be within 5% of each other. The standard deviations of the standardization ratios RS_i should be within the following limits for each channel standardize ratio:

$2\sigma[RSi/Avg(RSi)] < 0.0006$

ATTENTION

This requirement is nearly twice as stringent as the specifications for the moisture sensor (0.0006 versus 0.0010).

Table 7-1 lists the voltages expected for a stable, well-tuned sensor.

Table 7-1 Voltages for Well-Tuned Sensor

Counts/Volt	Voltage
Allowable dark counts for Fastcard	0.45 to 0.6 V
Allowable Difference between Channels	0.5 V
Allowable Full Spread for a Channel on 10 References	0.012 V

7.6. Data Entry

The lab values of moisture and coat weight must be entered into the system prior to performing any calibration.

The **IRCoat Sensor Calibration** display (see Figure 7-1) is accessed by pressing **Advanced** on the **Sensor Maintenance** display, while in maintenance mode, and with the appropriate sensor processor selected (correct sensor and scanner).

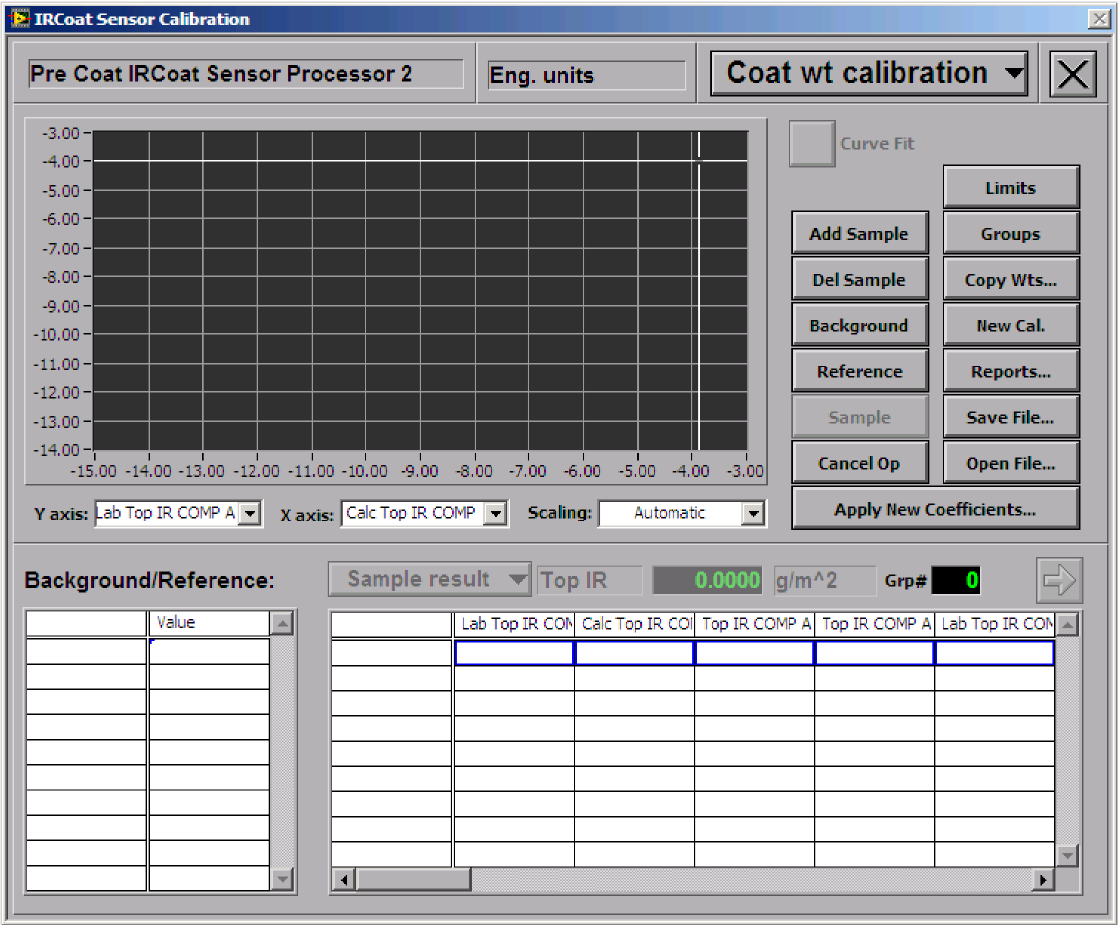


Figure 7-1 IRCoat Sensor Calibration Display

To use this display, select **Coat wt calibration** from the drop-down button on the top right of the display.

1. Click **Open File…** to import a calibration file previously saved using **Save File...** from this display.

2. If you do not have previously entered data, click **Add Sample** to create the number of sample entries required.

3. Enter the coat weight component values for each sample in the green entries above the table, using the appropriate (yellow) column(s) from the **ct wt sample prep** tab in the *SSIR cal worksheet.xls*. As indicated in the worksheet, note that for the $CaCO_3$ sensor (model number 4212), component A is by default clay, and component B is $CaCO_3$. component C is by default the moisture measurement, and component D is not usually used.

4. Press **ENTER** to enter the data into the table, and to advance to the next sample. Toggle between component coat weight values by clicking on

the arrow to the right of the green numbers. Confirm that the data is correct by scrolling through the data table.

5. When the data for all samples has been entered, save the raw data by clicking **Save File…**. This creates a binary file that you can reload using **Open File…** from this display. The binary file is saved in the directory *C:\Honeywell\Database\Calibration data\IR Coat*.

6. Select the first row by clicking any field in the first row. You are now ready to start shooting samples.

7.7. Measuring Samples

7.7.1. Sample Setup

1. Go to the **Sensor Maintenance** display and select the appropriate sensor and scanner from the drop-down menu at the top left.

2. Perform a background, then a reference, and then a sample. The background readings should be around 0.5 V. The reference readings are done on the internal standard (tile) and should display approximately 7.5 V. The sample is performed on empty air, and will read very low–close to the background voltage.

3. At the scanner, press the **Offsheet** button to take the heads offsheet.

4. Engage the **Crash** switch so that the head cannot be inadvertently sent back onsheet.

5. Position the Sample Fixture into the mounting plate on the head.

7.7.2. Reference Procedure

Push the **Reference** button on the scanner. The standardize tile should rotate into position, and the green light in the **Reference** button will light, then go out when the reference is finished.

7.7.3. Sample Procedure

1. At the scanner, press the **OffSheet** button to take the heads offsheet. Engage the **Crash** switch so that the head cannot be inadvertently sent back onsheet.
2. Verify that you can properly mount the sample paddle and that the light from the sensor correctly hits the sample area.
3. Load the bagged samples into the sample paddle fixture, making sure that the magnet plate holds the sample flat, and that the samples are properly oriented in the machine direction.
4. Snap the paddle onto the sheetguide and engage the sample button on the endbell. The sample should remain motionless for the duration of the sampling.
5. When the light goes out, remove the fixture and load another sample.
6. Repeat steps 3-5 until all samples have been shot in the sensor. If different backing materials have been provided, shoot all the samples over each different backing in turn.
7. Remove the sample paddle and disengage the **Crash** switch when finished.
8. On the **IRCoat Sensor Calibration** display, save the raw data by clicking **Save File…**.

7.8. Data Reduction by Regression Analysis

Data reduction is done separately for coat weight and moisture.

Data for a new calibration of coat weight can be sent to the calibration department for data reduction and determination of the calibration constants. Data for each sample set should include the appropriate interchannel ratios (RA to RE), coat weights, and base sheet weights. Alternatively, data reduction can be accomplished using the Experion MX software.

7.8.1. Coat Weight Fit

To enable fitting, click on the **Curve Fit** button (see Figure 7-2).

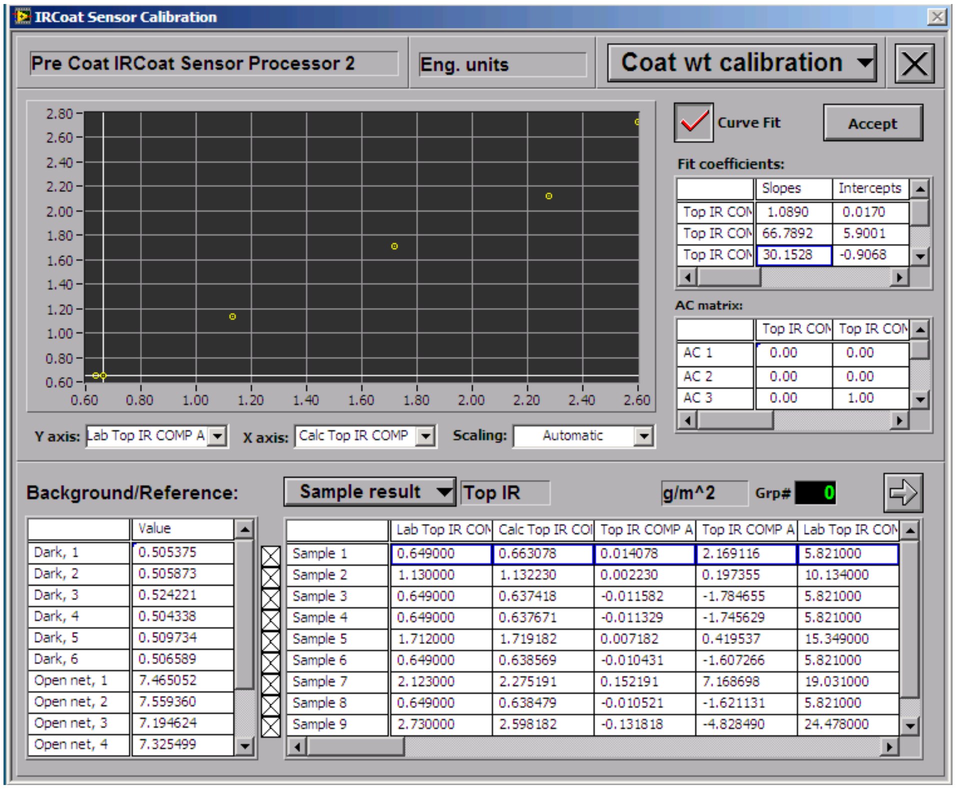


Figure 7-2 IRCoat Sensor Calibration Display

The top right of the **IRCoat Sensor Calibration** display will change to show each component (A–D), as well as their fit coefficients. The fit begins with component A (clay), and by clicking on the arrow to the right of **Grp #**, you advance to the other components. The standard assignments for the fits are:

- component A = clay
- component B = $CaCO_3$
- component C = moisture

The graph updates with each component fit.

The AC table is also shown (see Table 2–8 for more details); these values control which sensor ratios are included in the fit. Do not modify these.

Verify that the values in the **Background/Reference** table are reasonable (the dark voltages should all be approximately 0.5 V and the **Open** net voltages should be approximately 7.5–8.0 V).

For a proper fit, the points should describe a line, as indicated in Figure 7-2. To exclude points from the fit, delete the sample from the list (do not use the check boxes).

When you are satisfied with the result, click on **Accept** to advance to the next component, and repeat. Save your work by clicking on **Save File…**. The results can then be loaded and refit at any future time. To apply the calibration results and to save the parameter values in the system for use during production, click on **Apply New Coefficients…**. A new screen appears (see Figure 7-3) that allows you to optionally apply the most recent calibration coefficients. To apply the parameter values, select the appropriate check box.

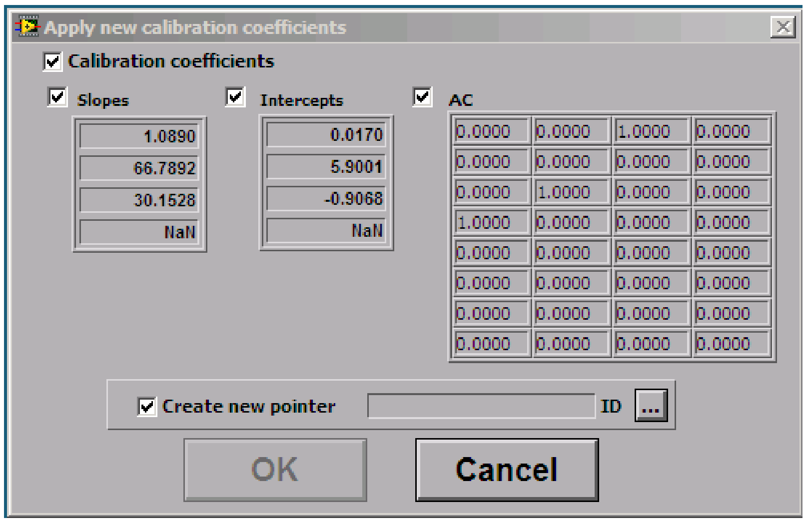


Figure 7-3 Apply new calibration coefficients Display

Select the **Create new pointer** check box, then click on the **ID** button (**...**). This will call up the **Select ID and groups to apply** display, which will show the database table where the calibration coefficients will reside (**IRCP12 calibration table00** in Figure 7-4).

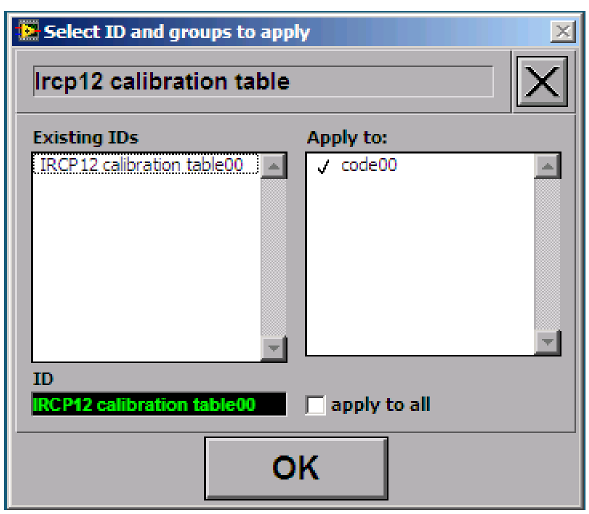


Figure 7-4 Select ID and groups to apply Display

Select the code for which the parameters are valid by double clicking on the code name, or select the **apply to all** check box to associate the new parameters with all codes. A check mark will appear beside the code names, under **Apply to:**, that will be associated with the new calibration parameter values.

Double click on the desired calibration table ID in which to store the parameter values. This name will then appear below the data tables in the previous dialog box. Click **OK** to complete.

You will note that the calibration is done in *component weight*, not in *coat weight*. The coat weight is determined by multiplying the component weight by the component fraction, as described in Section 2.4.

7.8.2. Moisture Fit

The moisture fit proceeds in the same matter as coat weight fit in Subsection 7.8.1. The slope and intercept for the moisture fit will be those of component C. In contrast to the transmission sensor, there are no correctors possible.

7.9. Evaluation of the Other-side Corrector

The OSC is required when the paper is quite thin (below approximately 70 g/m^2) and the component measured is $CaCO_3$ (clay and moisture measurements do not use this corrector).

For thin paper, the IR light used in the coat weight sensor penetrates into the paper and can see not only the coating adjacent to it, but also the coating on the other side of the paper.

It is usually possible to install a sensor before and after a coater. Even if the two sensors see the other-side coating, they both see it equally. After the Intergauge subtraction, the errors due to the other-side coating cancel out. No OSC correction is required in this case.

Some coaters coat both sides of the paper at the same time. If the sheet is thin, the OSC must be used. The normal coat weight calibration should be performed first, as in Subsection 7.8.1. Then, to evaluate the OSC:

1. Select **Coat wt osc** from the drop-down button on the **IRCoat Sensor Calibration** screen, as per Figure 7-5.

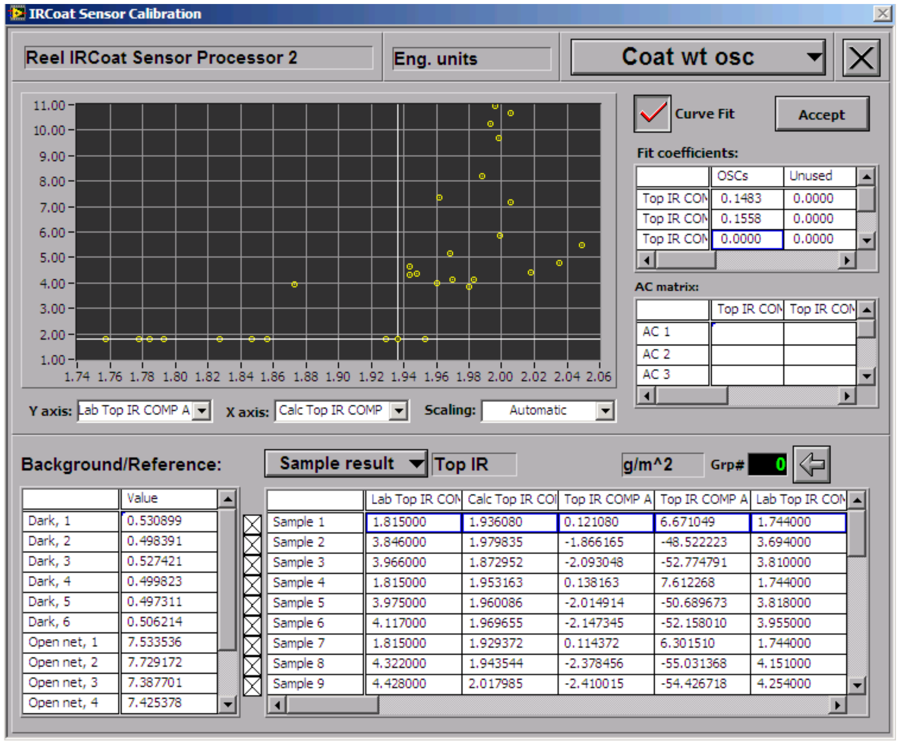


Figure 7-5 IRCoat Sensor Calibration Display

2. To enter the lab weights for the samples, click on **Copy Wts…** and make sure the same lab weights for each sample are correctly copied.

3. Now shoot all the samples used for calibration again, but flip them over and shoot them from the backside.

4. Click on the **Curve Fit** button to enable the fitting. The OSC values will show up in the **Fit coefficients...** data table, as shown in Figure 7-5. If the data looks like a cloud, as in Figure 7-5, the OSC is probably not required. If the corrector is well-determined, the graph will show a clear line.

5. Store and save the OSC values in the appropriate **Intergauge Calibration Table** (see Section 5.4).

7.10. 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.

To verify previously calibrated grades:

1. Ensure that the gauge is stable (see Section 7.5).
2. Load a grade code containing the calibration constants of the samples to be verified.
3. Ensure that the correct calibration constants are restored on the **Sensor Maintenance** display (the table on the upper right).

Verification is performed using the **IRCoat Sensor Calibration** display (Figure 7-1). The display is accessed by pressing **Advanced** on the **Sensor Maintenance** display, while in maintenance mode, and with the appropriate sensor processor selected. To access the verification mode, select **Verification** from the drop-down menu in the top right.

If you have just completed a calibration, and will be using these samples for verification, you can transfer all the sample weights and moisture values by pressing the **Copy Wts…** button. If you will be verifying on new samples, you must enter the data for each sample, as detailed in Section 7.6.

Then shoot the samples you intend to verify, proceeding as per Section 7.7. Once all samples have been shot, save the data to include the verification results.

Note any samples that measure with an error greater than the static accuracy appropriate for the sensor (usually 0.25% for moisture, and 0.25–1 g/m^2 for coat weights). If more than 20% of the samples fail this criterion, the verification and/or calibration/recalibration should be repeated.

7.11. Recalibration

If, during installation, the factory calibration does not verify within accuracy specification, or a new grade is added, or the formulation of a coating changes, a complete recalibration may be required. This involves making samples, shooting them, and establishing new calibration constants for each component.

8. 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 that the you should adjust the interval on an as-needed basis.

Table 8-1 Preventive Maintenance Internal checklist

Procedure	Daily	Weekly	Months		Years			Task Details
			1	6	1	2	5	
General								
Basic daily inspection	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 long-term gauge stability			X					Section 9.5
Dynamic verification		X						Section 6.3

9. Tasks

This chapter contains procedures for maintaining optimal sensor function, as well as how to perform basic troubleshooting tasks on the sensor.

ATTENTION

Activity numbers that appear in the task tables are for use of the sensor diagnostics display only. To determine whether a task applies to your sensor, check the **Applicable Models** field in the task table.

If a value in the task table is blank, that means it is not applicable to that task.

9.1. Basic Daily Inspection

Inspect the sensor standardize report daily to check for changes in the ratio-to-time-zero for channel 4 or channel 5 and for head temperature instability. These reports are updated every time the sensor standardizes during normal operation. If standardize values have dropped markedly, blow out the nosecone. If the temperature varies outside the limits, check the cooling water supply.

Activity Number:	Q4212-60-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:	Compressed clean air		

To print out the *Standardize Report*:

1. In the **Sensor Reporting** display, select **IRCoat Standardize Report** (see Figure 9-1).

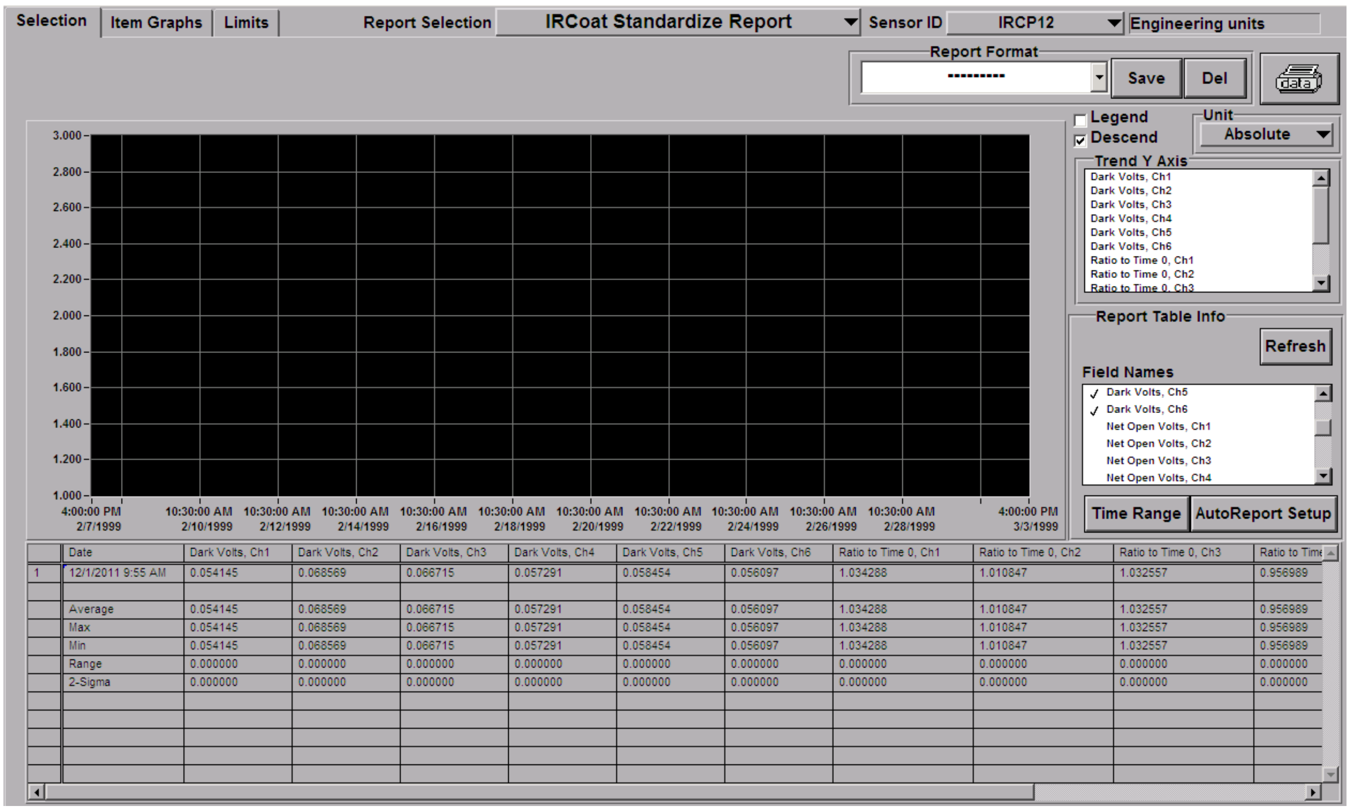


Figure 9-1 IRCoat Standardize Report

2. Select the desired ratios under **Field Names** by double-clicking on them. They will be added to the hard copy report. Use the printer button (top right) to print the report.

Ensure that you select **Ratio to Time 0, Ch4**, or **Ratio to Time 0, Ch5** which are the most sensitive to dirt. These numbers represent the ratio of the voltage at standardize at the time of the measurement, to the voltage at standardize at time-zero.

If the dirt build up causes the ratio to drop dramatically, clean the nosecone more often.

To print out the *Head Temperature Report*:

1. In the **Sensor Reporting** display, select **TMP Standardize Report** from the first pulldown menu. Select the appropriate head to monitor on the second pulldown. See Figure 9-2 for details.

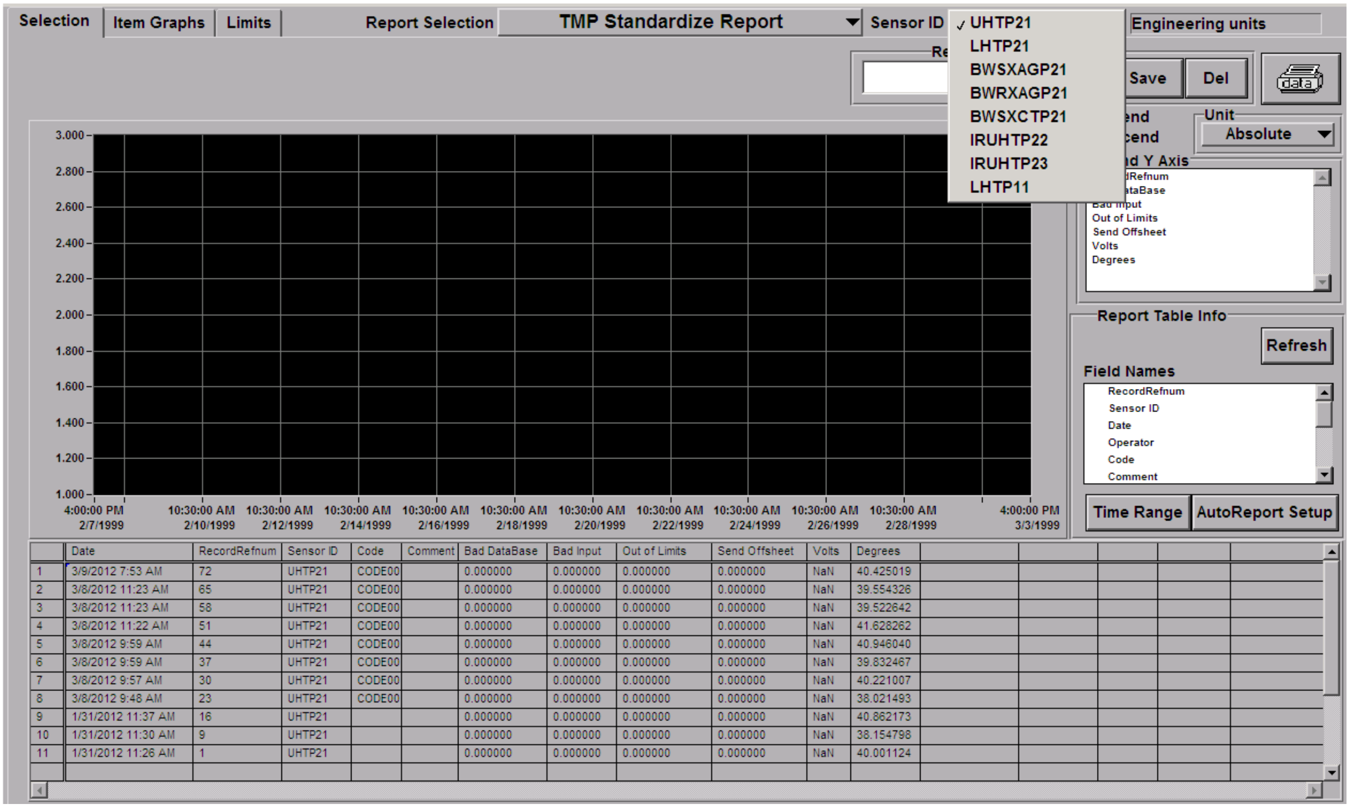


Figure 9-2 Head Temperature Standardize Report

2. Select the desired ratios under **Field Names** by double-clicking on them. They will be added to the hard copy report. Use the printer button (top right) to print the report.

Ensure that you select **Degrees**, which gives the temperature of the head. Repeated temperature excursions above 45C will damage the PbS/PbSe detectors and are to be avoided.

9.2. Check Standardize and Background Values

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

Activity Number:	Q4212-60-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:**	Realigning After Replacing Parts
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:			

Section 9.1 details how to print out the *IRCoat Standardize Report*. Ensure that you select the net volts for all channels. The readings on all six channels should be within 0.5 V of each other.

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

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

Excessive *uncorrelated* drift of one or more channels (that is, channels drift differently from each other) may be due to one or more bad detectors. See Chapter 10 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 9.8).

The *IRCoat Background Report* should also be printed out. It is available from the **Sensor Reporting** display. On this report, the dark volts for the three channels should be between 0.45 and 0.6 V.

If a dark volt is not within these limits, see Section 10.1.8.

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

Short-term instability refers to changes in sensor readings that happen between standardizes (ie. over a 20-minute timescale or less). The short-term stability should be monitored monthly.

Activity Number:	Q4212-60-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 9-3), set **Bkgd. Integr. Time** for background (in seconds) to 4.00.

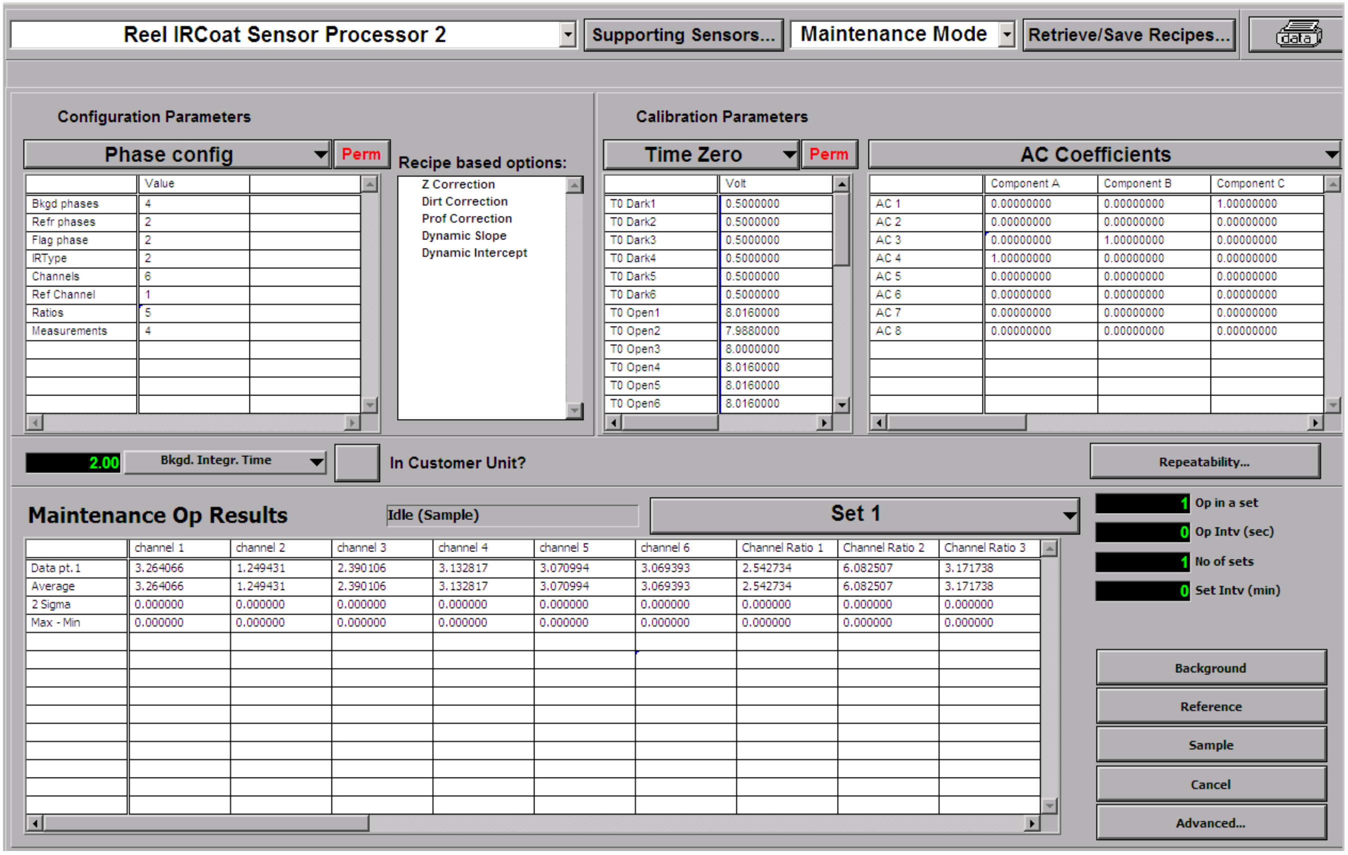


Figure 9-3 Sensor Maintenance Display

3. Set **Op in a set** to 2. Press **Background**. This performs two backgrounds, with nothing in the gap. The resulting dark volts should be repeatable within 2%, and be between 0.45 and 0.6 V.

To check standardize measurements:

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

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

3. Set **Op in a set** to 30, **No of sets** to 1, and **Op Intv (sec)** to 20 (seconds). Press **Reference**. This performs 30 references over approximately 10 minutes, with nothing in the gap (see Figure 9-4).

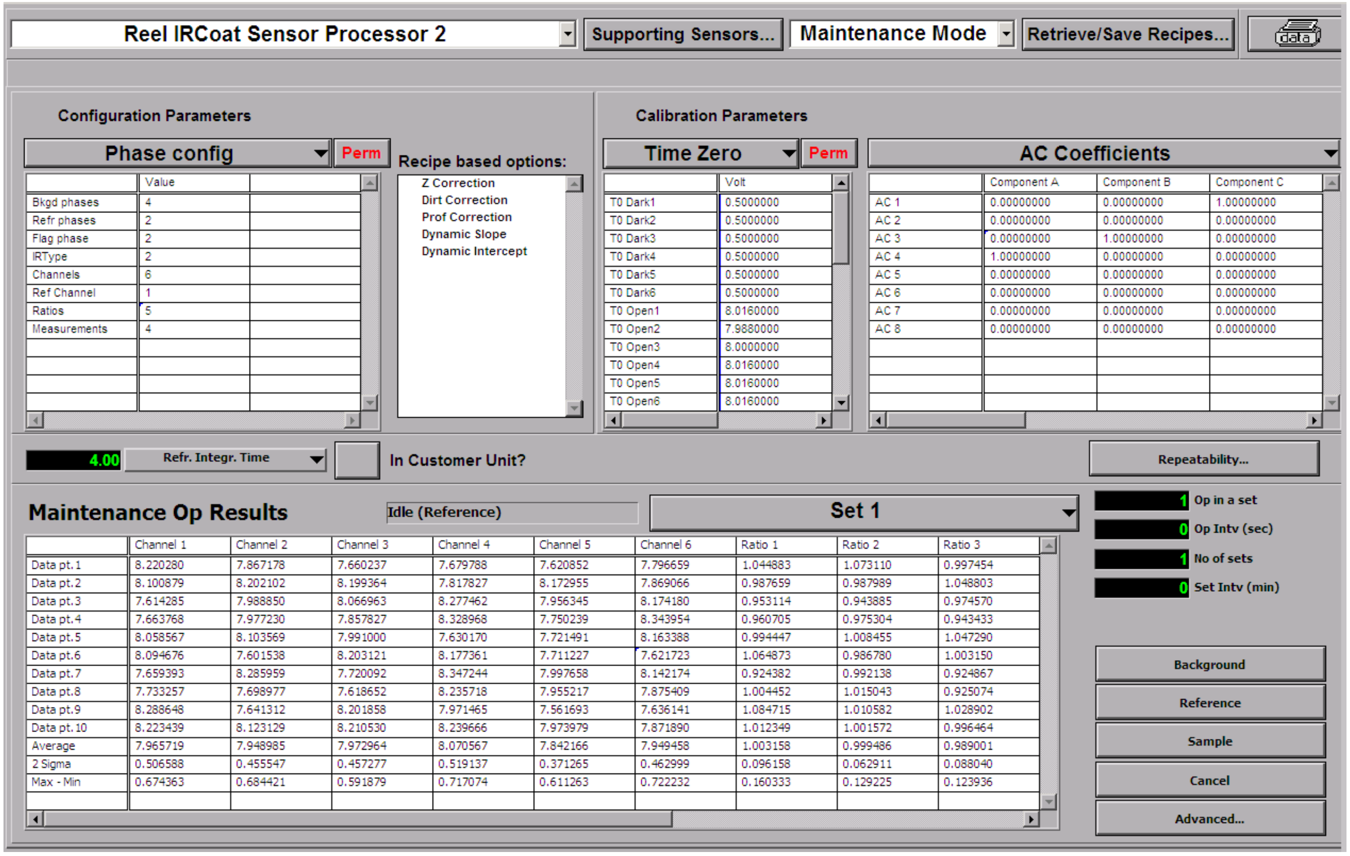


Figure 9-4 Reference Display

The results of more than one set of 10 operations usually give a reliable picture of the short-term stability of the sensor. The three channel volts must be within 0.5 V of each other. Further, if both of the following conditions are met, the sensor is within spec:

- 2• σ(RSi)/Average(RSi) < 0.0010 for i=1 to 6.
- (Max-Min) volts for each channel are no more than 12 mV (0.012V).

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 the head temperature stability issue–refer to your scanner manual) and then redo the stability test.

9.4. Replace Infrared 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 run at 4.4 V to prolong its life. The lifetime of the lamp is difficult to predict because it can vary greatly from one lamp to another.

Activity Number:	Q4212-60-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 the IR source power by unplugging the sensor.
2. Unscrew the lamp leads from the terminal block.
3. Loosen the screw securing lamp holder (using Allen key).
4. Carefully remove the lamp holder.

CAUTION

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

5. Inspect the 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, and 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, adjust the lamp position:

   Connect an oscilloscope to TP2 and TP1 (Gnd) on one of the fastcards in the receiver (Figure 9-10).

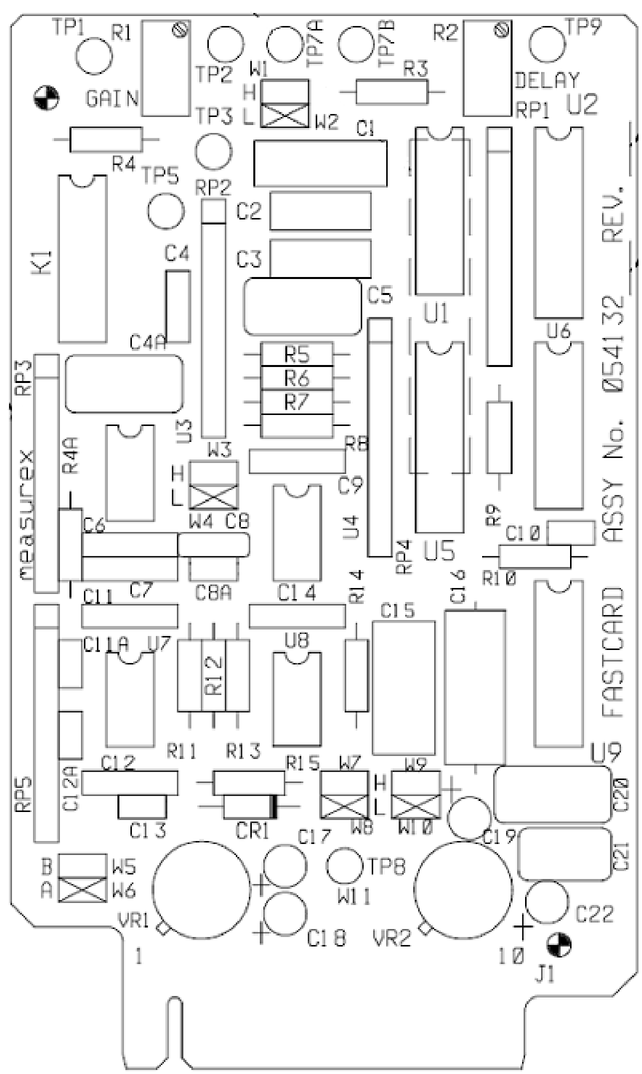


Figure 9-5 Fastcard Assembly

Move the lamp up and down to maximize the signal at TP2, and 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 should have more than 3 V peak-to-peak with the jumper on the detector preamp set to lowest gain.

Back the lamp off if any signal is too high.

10. Check and adjust the gain and phase of the fastcards. See Section 9.8.

9.5. Check Long-term Stability

The sensor should give stable readings over months, if properly functioning. The long-term stability of the gauge can be assessed by shooting a machine-coated sample regularly, recording the values obtained, and monitoring this. Machine coated samples are ambient samples 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:	Q4212-60-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 month
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:			

To verify machine-coated samples:

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 sample component weight using the **Open File…** button, or enter the values manually. See Section 7.2 for more details on data entry if required.

5. Perform a background.

6. Load the first grade for the sample 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 8 V for each channel.

9. Repeat steps 6–8 for each grade.

10. Save the verification file using the **Save File…** button.

Seasonal shifts in the moisture readings are expected when verifying glass samples. However, a sudden shift in the readings indicates a problem:

1. Ensure that the proper gain settings, calibration constants, and correctors are loaded.

2. Confirm that the glass sample seal is not damaged (that is, use more than one glass verification sample).

3. If a hardware issue is suspected, check sensor alignment (Table 9-1) or proceed to the troubleshooting outlined in Chapter 10.

9.6. Replace a Board

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

Activity Number:	Q4212-60-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:**	Realigning 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.

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

9.7. Realign Sensor

Replacement of some parts requires realignment/readjustment of other parts (see Table 9-1).

Activity Number:	Q4212-60-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**
Lamp	Lamp focus, gain, and phase of fastcards (see Replace Infrared Lamp and Aligning a Fastcard Board).
Single-sided detector	Align sync generator Gain and phase of fastcards (see Align Sync Generator)
Sync generator/lamp modulator board	Align sync generator Gain and phase of fastcards (see Align Sync Generator)
Power supply adapter board	See Subsection 2.1.1.1.
Detector preamp	Peltier cooler voltages (see Subsection 2.1.3.2) Gain and phase of fastcards (see Aligning a Fastcard Board)
Fastcard	Gain and phase of fastcards (see Aligning a Fastcard Board)
Temp control board	Peltier cooler voltages (see Subsection 2.1.3.2) Gain and phase of fastcards (see Aligning a 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 Aligning a Fastcard Board) Edge detect, if used (see Subsection 2.1.3.3)

9.8. Align Sync Generator

Activity Number:	Q4212-60-ACT-008	**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):	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		

To confirm proper operation of the light chopping system:

1. Check that the lamp is on and that the chopper is spinning.
2. On the backplane (see Figure 2-4), check for

   24 ± 0.5 V at TB1-1 (+ 24 V) and TB1-2 (RTN)
3. On the power supply adapter board shown in Figure 9-6 check for:

   24 ± 0.5 V at TB1-2 (+ 24 V) and TB1-1 (RTN).

   4.4 ± 0.2 V at TB1-4 (+ 24 V) and TB1-3 (RTN).

   Testpoints are numbered 1 to 4 from the top.

Figure 9-6 Power Supply Adaptor Board

4. Connect oscilloscope probes to TP2, TP3 and TP4 of the sync generator/lamp modulator board shown in Figure 9-7, using TP5 as ground:

   TP3 should produce a clean square wave, indicating clear detection of the chopper wheel position.

   TP4 should produce narrow clock pulses with an amplitude of approximately 9 V.

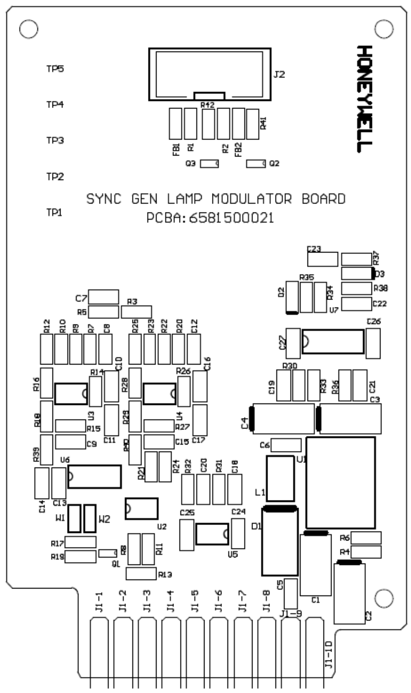


Figure 9-7 Sync Generator/Lamp Modulator Board

These pulses are generated by small holes in the chopper. If the signals are not clean or their amplitude is too small, adjust the three spring-loaded mounting screws of the single-sided detector to correct the signals. The detector is located on the side of the chopper cage (see Figure 9-8).

Figure 9-8 Single-sided Detector (connector removed for clarity)

TP2 should produce a clean square wave with a 10 V amplitude. The frequency should be 160–170 Hz. If not, adjust the pot R2 on top of the motor controller board (see Figure 9-9).

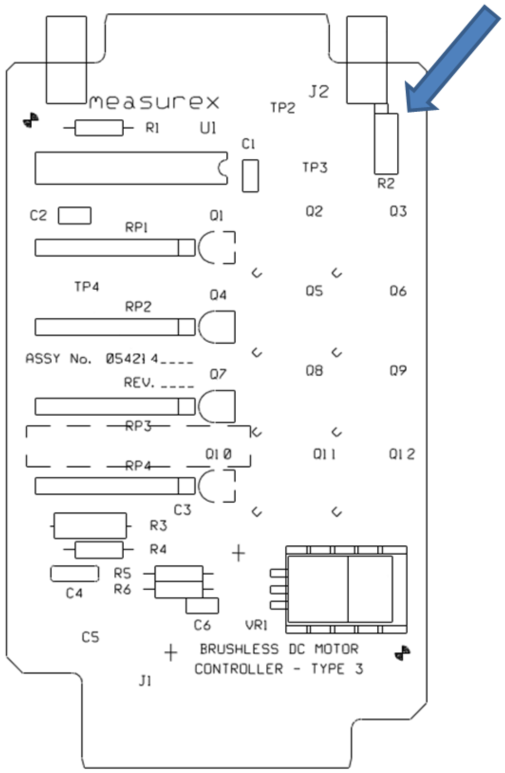


Figure 9-9 Motor Controller Board

9.9. Align Fastcard Board

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

Activity Number:	Q4212-60-ACT-009	**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		

Follow the procedure in this section for all three boards. Figure 9-10 shows the layout of the fastcard board.

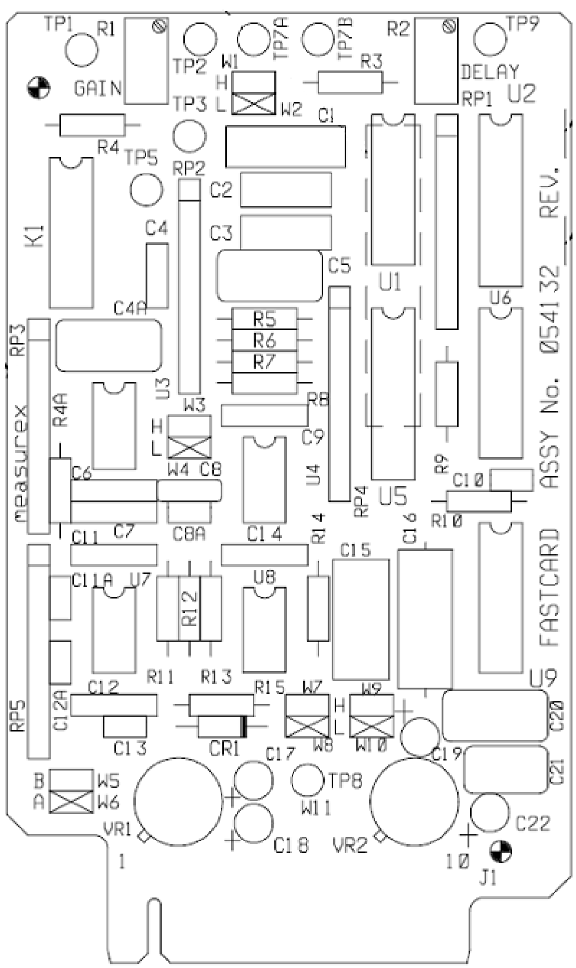


Figure 9-10 Fastcard Board

1. There are five jumpers on the fastcard board (three near the bottom, one in the middle, and one near the top). Four of the jumpers are labeled **H/L**; they govern the frequency response. Check to see that these are in the **L** position.

2. The fifth jumper is labeled **A/B** and it governs the phase delay. Check to see this is on **A**.

3. The testpoints are along the top of the board. 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 sine wave of amplitude between 0.3 and 3 V peak-to-peak.

4. You are now going to check that the gain on the PbS or PbSe detector assembly preamp board is set correctly (see Figure 9-11). There are three jumper-selectable gains. The exact values of the gains they produce 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 9-11.

    a. If the signal in step 3 above is greater than 3 V, select a lower gain on the corresponding PbS or PbSe detector assembly by changing the jumper selection on the fast preamp board

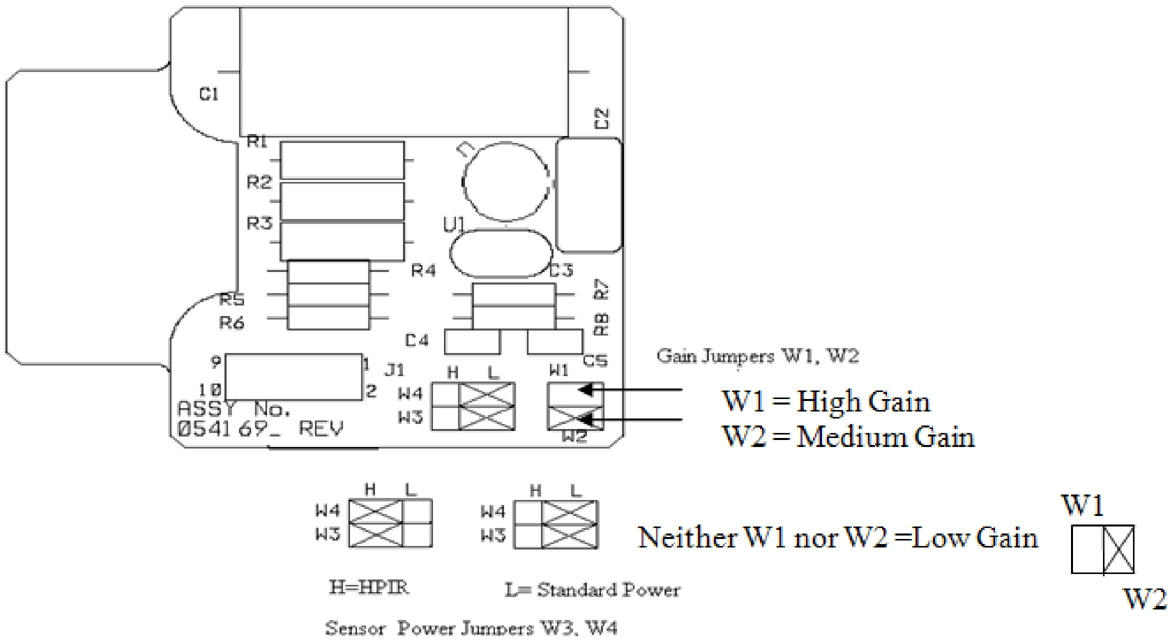


Figure 9-11 PbS Detector Assembly

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

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 4–8 V DC.

6. Adjust R2 to balance the phase (see Figure 9-12). Phasing adjustment can be done using TP7A and TP7B on the fastcards. If balancing the phase is impossible on the fastcard, change the selection on jumper W5/W6.

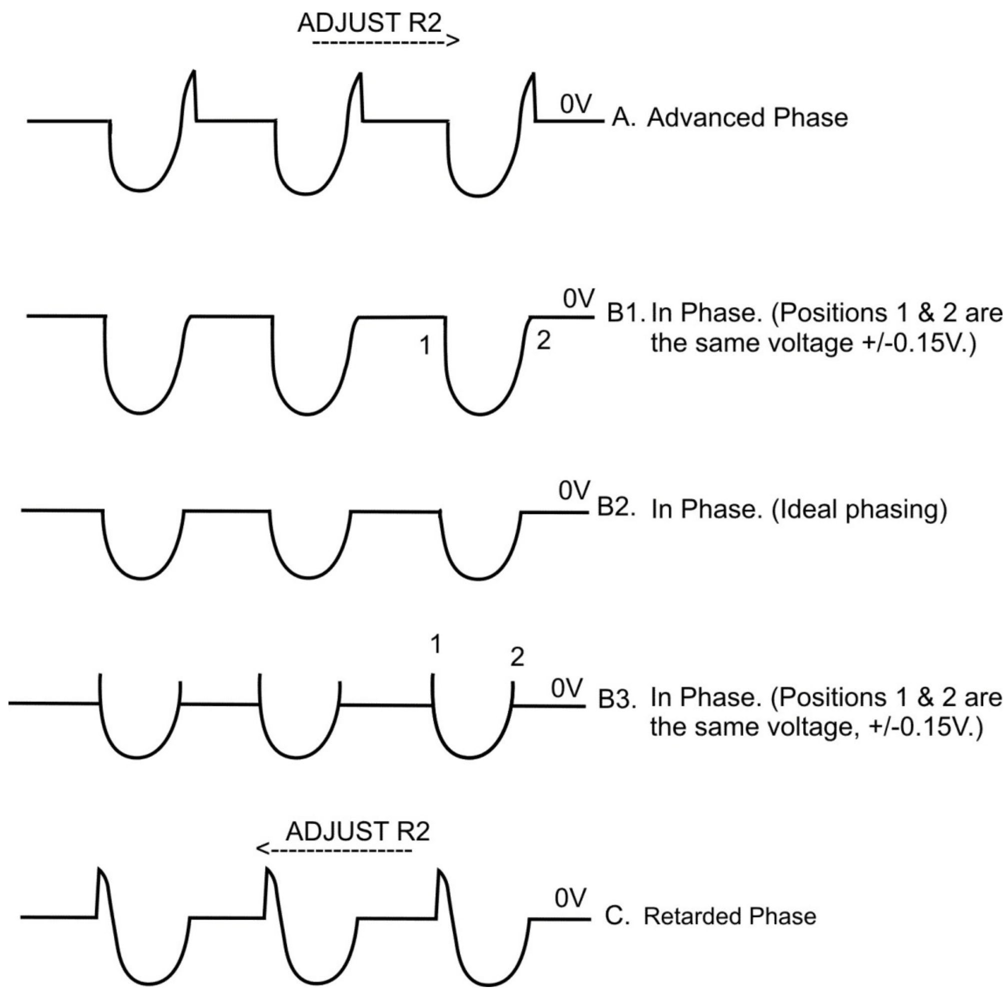


Figure 9-12 Phase Adjustment

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).

7. Adjust R1 again to bring the meter reading to 7.5 ± 0.1 V DC. 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.

A summary of the proper value of all test points is shown in Table 9-2 (with TP1 as ground). None of the AC signals should be clipped.

Table 9-2 Test Points for the Fastcard Board

Test Point	Voltage
TP2	0.3 to 3 V AC peak-to-peak
TP3	0.6 V AC peak-to-peak
TP4	n/a
TP5	1.2 V AC peak-to-peak
TP6	n/a
TP7A, TP7B	4 V trough-to-peak half-sine wave
TP8	3.5 V trough-to-peak both half-sine waves
TP9	7.5 V DC

10. Troubleshooting

The troubleshooting chapter is divided in two sections:

- Alarm Based Troubleshooting: Troubleshooting steps to be taken in response to a specific alarm generated in the Experion MX system.
- Non-alarm Based Troubleshooting: Troubleshooting steps that may not be related to a specific alarm in the Experion MX system.

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

10.1. Alarm Based Troubleshooting

10.1.1. Bad Temperature Input

Symptom	Cause	Solution (Tasks)
Bad Input alarm. The raw voltage output from the sensor required for the temperature processor is outside the specified range.	Sensor thermistor failure	Must be replaced. Call TAC.
	Signal path broken	Cabling or EDAQ issue; verify EDAQ connections. If this doesn't help, call TAC.

10.1.2. Temperature Below Limit

Symptom	Cause	Solution (Tasks)
Temperature Below Limit alarm. Temperature processor computes a temperature value which is below the minimum limit.	Water solenoid failure	Check head temperature (Basic Daily Inspection) to confirm consistent reading; then, if confirmed, confirm proper operation of Water Controller Board (see Section 2.1.1).
	Water temperature controller board failure	Check head temperature (Basic Daily Inspection) to confirm consistent reading; then, if confirmed, confirm proper operation of Water Controller Board (see Section 2.1.1).

10.1.3. Temperature Above Limit

Symptom	Cause	Solution (Tasks)
Temperature Above Limit alarm. Temperature processor computes a temperature value which is above the maximum limit.	Water solenoid failure	Check head temperature (Basic Daily Inspection) to confirm consistent reading; then, if confirmed, confirm proper operation of Water Controller Board (see Section 2.1.1).
	Water temperature controller board failure	Check head temperature (Basic Daily Inspection) to confirm consistent reading; then, if confirmed, confirm proper operation of Water Controller Board (see Section 2.1.1).

10.1.4. Temperature Drifting

Symptom	Cause	Solution (Tasks)
Temperature Drifting alarm. Temperature Processor computes a temperature value which has drifted too far from the last standardize value.	Water solenoid failure	Check head temperature (Basic Daily Inspection) to confirm consistent reading; then, if confirmed, confirm proper operation of Water Controller Board (see Section 2.1.1).
	Water temperature controller board failure	Check head temperature (Basic Daily Inspection) to confirm consistent reading; then, if confirmed, confirm proper operation of Water Controller Board (see Section 2.1.1).

10.1.5. Bad IRCoat Voltage Input

Symptom	Cause	Solution (Tasks)
Bad Input alarm from one or two channels.The raw voltage from one or two on the sensor is outside its defined range.	Detector failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to eliminate Fastcard issue; finally swap or replace PbS/PbSe detector (Replacing a Board, Aligning a Fastcard Board).
	Fastcard failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to confirm Fastcard issue; finally swap or replace Fastcard (Replacing a Board, Aligning a Fastcard Board).

Bad Input alarm on 3, but not all channels. The raw voltage from three, but not all, channels on the sensor are outside their defined ranges.	Temperature board failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to eliminate Fastcard issue; finally swap or replace temperature board (Replacing a Board, Realigning After Replacing Parts).
Bad Input alarm on all channels. The raw voltage from all channels on the sensor are outside the defined range.	Lamp failure	Replace Infrared Lamp
	24V failure	Check 24V and 4.4V on power supply adapter board (Align Sync Generator)
	Power supply adapter board failure	Check 24V and 4.4V on power supply adapter board (Align Sync Generator)
	Light chopping system failure	Align Sync Generator
	Backplane failure	Section 2.1.3.1, Replacing a Board Realigning After Replacing Parts

10.1.6. Bad Net Volts

Symptom	Cause	Solution (Tasks)
Bad Net Volts alarm from one or two channels. The net voltage from any one or two channels, either during standardize or while on sheet, are not above the background (dark) level.	Detector failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to eliminate Fastcard issue; finally swap or replace PbS/PbSe detector (Replacing a Board, Aligning a Fastcard Board)
	Fastcard failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to confirm Fastcard issue; finally swap or replace Fastcard (Replacing a Board, Aligning a Fastcard Board)

Bad Net Volts alarm on 3, but not all channels. The net voltage from three channels, either during standardize or while on sheet, are not above the background (dark) level.	Temperature board failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to eliminate Fastcard issue; finally swap or replace temperature board. (Replacing a Board, Realigning After Replacing Parts)
Bad Net Volts alarm on all channels. The net voltage from all channels, either during standardize or while on sheet, are not above the background (dark) level.	Lamp failure	check and Replace Infrared Lamp if required
	Light chopping system failure	Check sync signal present at receiver. Replace and/or align single-sided detector board (Align Sync Generator).
	Backplane failure	check backplane 250 V, ± 15 V, 6/8 V (Section 2.1.3.1, Replacing a Board, Realigning After Replacing Parts)

10.1.7. Bad Dark Volts

Symptom	Cause	Solution (Tasks)
Bad Dark Volts alarm on one or two channels. The raw dark voltage on any one or two channels has drifted too far since time “zero”.	Fastcard failure	In maintenance mode, Check Standardize and Background Values to confirm; swap fastcard. (Replacing a Board, Aligning a Fastcard Board). If no change, contact TAC.
Bad Dark Volts alarm on three channels. The raw dark voltage on three channels has drifted too far since time “zero”.	Temperature board failure	In maintenance mode, Check Standardize and Background Values to confirm; swap/replace temperature board (Replacing a Board, Realigning After Replacing Parts). If no change, contact TAC.

Symptom	Cause	Solution (Tasks)
Bad Dark Volts alarm on all channels. The raw dark voltage on all channels has drifted too far since time zero.	Backplane failure	In maintenance mode, Check Standardize and Background Values to confirm; Check head temperature to confirm not an environmental issue; check backplane 250 V, ± 15 V, 6/8 V and replace backplane if required. (Section 2.1.3.1, Replacing a Board, Realigning After Replacing Parts) If no change, contact TAC.

10.1.8. Bad Channel Ratio

Symptom	Cause	Solution (Tasks)
Bad Channel Ratio alarm on one or two channels. The channel ratio for one or two channels has drifted too far from the time zero value.	PbS/PbSe detector failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to eliminate Fastcard issue; finally swap or replace PbS/PbSe detector (Replacing a Board, Aligning a Fastcard Board).
	Fastcard failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to confirm Fastcard issue; finally swap or replace Fastcard (Replacing a Board, Aligning a Fastcard Board).
Bad Channel Ratio alarm on three channels. The channel ratio for three channels has drifted too far from the time zero value.	Temperature board failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to confirm Fastcard issue; finally swap or replace temperature board (Replacing a Board, Realigning After Replacing Parts).
Bad Channel Ratio alarm on all channels. The channel ratio for one or more channels has drifted too far from the time zero	Lamp failure	In maintenance mode, Check Standardize and Background Values to confirm; check and Replace Infrared Lamp if required

Symptom	Cause	Solution (Tasks)
value.	Light chopping system failure	Check sync signal present at receiver. Replace and/or align single-sided detector board (Align Sync Generator).

10.1.9. Bad Standardize Ratio

Symptom	Cause	Solution (Tasks)
Bad Stdz Ratio alarm. The standardize ratio for one or more working ratios has drifted too far from the time zero value.	PbS/PbSe detector failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to eliminate Fastcard issue; finally swap or replace PbS/PbSe detector (Replacing a Board, Aligning a Fastcard Board).
	Fastcard failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to confirm Fastcard issue; finally swap or replace Fastcard. (Replacing a Board, Aligning a Fastcard Board).
	Temperature board failure	In maintenance mode, Check Standardize and Background Values to confirm; then check TP7A&B on fastcard (Aligning a Fastcard Board) to confirm Fastcard issue; finally swap or replace temperature board (Replacing a Board, Realigning After Replacing Parts).
	Lamp failure	In maintenance mode, Check Standardize and Background Values to confirm Replace Infrared Lamp
	Light chopping system failure	Check sync signal present at receiver. Replace and/or align single-sided detector board (Align Sync Generator).

10.2. Non–alarm Based Troubleshooting

Table 10-1 contains troubleshooting information for the SSIR Coatweight sensor.

Table 10-1 Troubleshooting the SSIR Coatweight Sensor

Symptom	Possible Cause(s)	Solutions
Lamp not lit	Lamp failure	Replace Infrared Lamp
	24V failure	Check 24 V and 4.4 V on power supply adapter board
	Power supply adapter board failure	Check 24 V and 4.4 V on power supply adapter board
Sensor reads 0.5V always	No sync signal from source	Check sync signal present at receiver
	Single-sided detector board not aligned or broken	Replace and/or align single-sided detector board. Replace and/or align sync generator board (Align Sync Generator).
No signal at TP2 on Fastcard	PbS/PbSe detector failure	Check other channels. If issue only with one channel, swap or replace PbS/PbSe detector (Replacing a Board).
	Failure of lamp, power supply adapter board, single-sided detector board not aligned or broken or backplane failure	If all the channels are affected, check lamp, light chopping operation (Align Sync Generator) and backplane 250 V, ± 15 V, 6/8 V.
Fastcard cannot be adjusted into phase	Jumper set wrong	Check fastcard jumpers. Swap fastcard jumper A to B or vice versa (Aligning a Fastcard Board).
	Temp board failure	Check temp board
Fastcard will not adjust to 7.5 V at TP9	Gain jumper on PbS/PbSe detector set too low	Check TP2. The signal should be between 0.3 V and 3 V peak-to-peak with nothing in the gap. Adjust PbS/PbSe detector gain accordingly (Aligning a Fastcard Board).
	Fastcard failure	Swap or replace fastcard
	Temp board failure	Check or replace temp board (Replacing a Board)
All channels unstable	Head temperature unstable	Check head temperature
	Lamp contact oxidized	Change lamp and lamp holder (Replace Infrared Lamp)
	No sync signal from source	Check sync signal present at receiver

Symptom	Possible Cause(s)	Solutions
	Single-sided detector board not aligned or broken	Replace and/or align single-sided detector board (Align Sync Generator)
One channel unstable	Fastcard may be saturated	Check TP7 A and B on fastcard (Aligning a Fastcard Board)
	Detector unstable	Swap or replace PbS detector
	Fastcard unstable	Swap or replace fastcard
	Temp board failure	Check and/or replace temp board (Replacing a Board)
Low standardize volts and unstable channels	Temp board failure	Check and/or replace temp board (Replacing a Board)

11. Storage, Transportation, and 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

Cable End	Location of the electronics and/or the entry point for communications and power on the scanner.
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 machine direction that relates to a position along the length of the paper machine.
C-frame	The C-shaped metal support for the sensor head.
Code or Code Name	See Recipe. Alternately, another name for alloy.
Distant End	The end of the scanner opposite the cable end.
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.
Data Storage and Retrieval (DSR)	A mechanism provided in real-time application environment (RAE) for storing recipe- or grade-dependent data, such as tuning, calibration, and setup values, and retrieving them when a recipe is loaded. The recipe- or grade-dependent data are saved to a database known as the *Recipes* database.
Error Profile	A profile in cross direction bin resolution that is the difference between the target profile and the current profile of a measurement, both in cross direction bin resolution.
HMI/UPI	Human/machine interface. Interface at endbell for controlling sensors and scanner movement.
Machine direction	The direction in which paper travels down the paper machine.
Measurement Sub System (MSS)	CPU responsible for binning data before sending to the RAE server.
Motor End	Location of the motor on the scanner.
Quality Control System (QCS)	A computer system that manages the quality of the product produced.
Real-Time Application Environment (RAE)	The system software used by Experion MX to manage data exchange between applications.
Recipe	A list of pulp chemicals, additives, and dyes blended together to make a particular grade of paper. Also called codes.

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.

Tending Side (TS) The side of the paper machine where the operator has unobstructed access. Also called front side.

Trend The display of data over time.

A. Coat Weight Measurement Configurations

Some examples follow of coaters and coat weight measurement systems.

A.1. One-Sided, One Coat

Figure A-1 and Table A-1 show the one-sided, one-coat configuration.

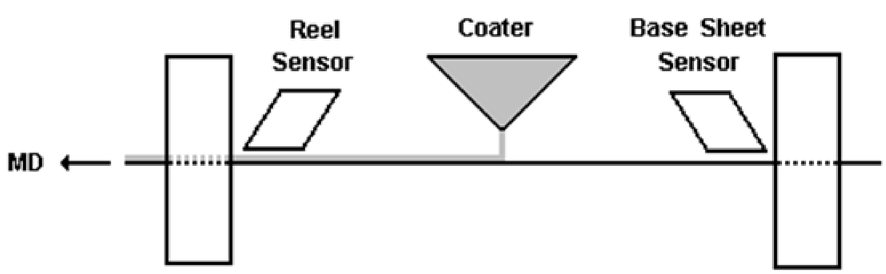


Figure B-1 One-Sided, One-Coat Configuration

Table A-1. One-Sided, One-Coat Configuration

Scanner/SSIR	Name	Description
2. Base Sheet	Clay (R/S)	Base Sheet Clay Correction
or Raw Stock - "R/S"	$CaCO_3$(R/S)	Base Sheet $CaCO_3$ Correction
	Moi (R/S)	Base Sheet Surface Moisture
1. Reel	Clay (Reel)	Raw Clay Weight
	$CaCO_3$(R/S)	Raw $CaCO_3$ Weight
	Moi (Reel)	Reel Surface Moisture
Intergauge Calculations:		
Coat Weight (from Clay)		$= \dfrac{\text{(Clay (Reel) - Clay (R/S))}}{\text{\% Comp of Clay}}$
Coat Weight (from $CaCO_3$)		$= \dfrac{(CaCO_3\text{(Reel)} - CaCO_3\text{(R/S)})}{\text{\% Comp of } CaCO_3}$

A.2. Two-Sided, One Coat Each Side

If there are two coating stations applying coatings to opposite sides of the sheet, four sensors are required. See Section 2.4 for an example given for a two scanner system requiring use of the Other-Side Corrector (OSC). If three scanners are available, Figure A-2 and Table A-2 show the preferred system.

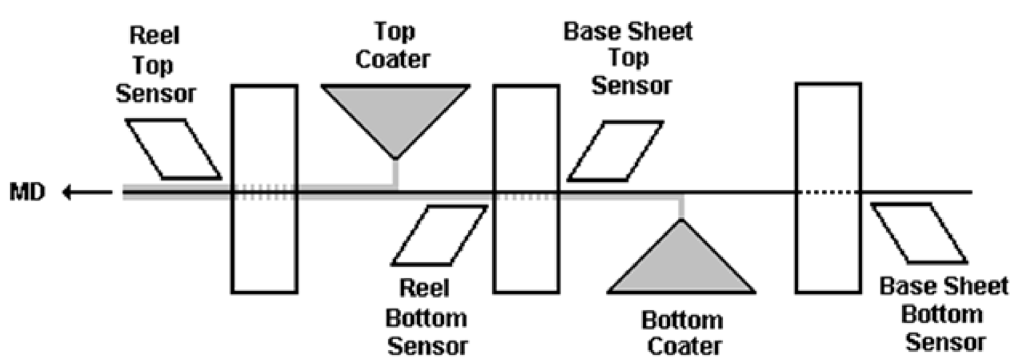


Figure B-2 Two-Sided, One Coat Each Side Application with Three Scanners

Table B-1 Two-Sided, One Coat Each Side Application with Three Scanners

	Possible Measurements Note: Only calcium carbonate is shown. Clay can be used instead.	
Scanner/SSIR	**Name**	**Description**
2. Base Sheet Top	$CaCO_3$ (B/S T)	Top Base Sheet $CaCO_3$ Correction
	Moi (B/S T)	Top Base Sheet Surface Moisture
2. Base Sheet Bot.	$CaCO_3$ (B/S B)	Bottom Base Sheet $CaCO_3$ Correction
	Moi (B/S B)	Bottom Base Sheet Surface Moisture
1. Reel Top SSIR	$CaCO_3$ (Reel T)	Top Raw $CaCO_3$ Weight
	Moi (Reel T)	Top Reel Surface Moisture
1. Reel Bot. SSIR	$CaCO_3$ (Reel B)	Bottom Raw $CaCO_3$ Weight
	Moi (Reel B)	Bottom Reel Surface Moisture
Intergauge Calculations		
Top Coat Wt (from $CaCO_3$)	$\frac{CaCO_3 \text{ (Reel T) - } CaCO_3 \text{ (B/S T)}}{\text{\% Comp}}$	
Bottom Coat Wt (from $CaCO_3$)	$\frac{CaCO_3 \text{ (Reel B) - } CaCO_3 \text{ (R/S B)}}{\text{\% Comp}}$	
Total Coat Wt	= Top Coat Weight + Bottom Coat Weight	

A.2.1. One-Sided, Two Coats

If there are two coating stations applying coatings to the same side of the sheet, threesensors are normally required: a sensor between the two coaters, the base sheet sensor preceding the coaters, and the reel sensor following the coaters.

Table A-3 shows the $CaCO_3$ measurement only. However, clay could be used instead of or in addition to $CaCO_3$ on all 3 scanners.

Table B-2 One-Sided, Two-Coats Configuration

	Possible Measurements Note: Only $CaCO_3$ is shown.	
Scanner/SSIR	**Name**	**Description**
3. Base Sheet	$CaCO_3$(R/S)	Base Sheet $CaCO_3$ Correction
	Moi (R/S)	Base Sheet Surface Moisture
2. Pre-Coat	Pre-Coat $CaCO_3$	$CaCO_3$ Measurement (Pre-Coat)
	Pre-Coat Moi	Surface Moisture (after Pre-Coat Station)
1. Reel	$CaCO_3$(Reel)	Finish Coat $CaCO_3$ Measurement
	Moi (Reel)	Reel Surface Moisture
Intergauge Calculations		
Pre-Coat Weight (from $CaCO_3$)		$\frac{CaCO_3(\text{Pre-Coat}) - CaCO_3(\text{R/S})}{\%\ \text{Comp}}$
Finish Coat Weight (from $CaCO_3$)		$\frac{CaCO_3(\text{Reel}) - CaCO_3(\text{Pre-Coat})}{\%\ \text{Comp}}$
Total Coat Weight		Pre-Coat Weight + Finish Coat Weight

A.3. Factors Affecting Coat Sheet Properties

The structure of the final dry coating is not a continuous smooth sheet, but a porous structure of pigment particles with many voids. The pigment particles are held to one another and to the sheet by the binder. The size and distribution of the voids are important in the scattering of light from the coated surface.

Coating does not compensate for poor raw stock. In fact, requirements for a coated base sheet are usually more stringent than for an uncoated sheet. The factors affecting coat sheet properties are:

- Properties and surface of a base sheet
- Coating formulation
- Coating method
- Drying method
- Supercalendering

A.4. Dynamic Moisture Loss

Flashoff (evaporation with accompanying heat loss) may occur between the scanner and dynamic sampling if the sheet is hot and at or above equilibrium moisture. If the product is very dry, it may gain moisture before dynamic sampling can occur. These effects must be taken into account when using the sensor as a predictor of moisture level or basis weight at any point after the scanner.

B. Part Numbers

Table B-1 lists part numbers and descriptions for the SSIR $CaCO_3$ coat weight and moisture measurement system.

Table B-1 Part Numbers

Part Number	Description
05298100	Temperature control card
05298102	Temperature control board
05332600	Water controller board
05333000	Power supply adapter board
05401100	Three-channel backplane
05413200	Fastcard board
05421400	Motor controller board
08631800	Detector pre-amp
086654XX	In-line solenoid assembly
08666000	Detector pre-amp
09223809	Six-channel sensor
09829400	Sample fixture
09832400	2.54-cm (1-in) diameter precision rods with different gaps
09832400	Sample making set
09840300	Sample paddle
16000006	Pipe compound
16000212	Copper-based anti-seize compound
41000001	Hose, air, 0.25 in
61000002	Coupling, pushlock, 0.64-cm (0.25-in) barb
61000041	Coupling, hose mender
61000056	Flow meter
61000091	Bushing
61000150	Bushing
61000286	Filter assy
6581500021	Sync generator/lamp modulator board
6581500030	EDAQ PCBA

Part Number	Description
6581500032	Frame controller expansion board
IK09223803	Installation kit

C. MS Excel Worksheets

Print out the *SSIR cal worksheet.xls* worksheet attached to this PDF file for use with Chapter 7.

Print out the *Moisture_sample.xlsx* worksheet attached to this PDF file for use with Chapter 7.