# TRIR Fiber Weight and Moisture Measurement

**System Manual**

6510020375

# TRIR Fiber Weight & Moisture Measurement

December, 2011

## Confidentiality Statement

This manual is a product of Honeywell. It is intended for use only by Honeywell and customer personnel in connection with Honeywell products. It is strictly prohibited to copy this manual or any part thereof or to transfer this manual or any part thereof to any non-Honeywell person or entity, except customer personnel for use in connection with Honeywell products. Persons employed by a third-party service company shall not have access to this manual.

## Notice

All information and specifications contained in this manual have been carefully researched and prepared according to the best efforts of Honeywell, and are believed to be true and correct as of the time of this printing. However, due to continued efforts in product improvement, we reserve the right to make changes at any time without notice.

## Trademarks



## Copyright

# Contents

# List of Figures

# List of Tables

# Introduction

The purpose of this manual is to provide an introduction to the Experion MX TRIR Fiber Weight and Moisture Measurement.

## 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 twelve chapters and three appendixes.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Appendix C, **Basis Weight Dynamic Verification Tool Worksheet**, contains versions of the worksheet.

# 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:<br>**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,<br>**[CONTROL]**, or **[CTL]**. |
| **[KEY-1]-KEY-2** | Connected keys indicate that you must press the keys simultaneously; for example, **[CTRL]-C**. |
| Click | Click means to position the mouse pointer on an item, then quickly depress and release the mouse button. This action highlights or “selects,” the item clicked. |
| Double-click | Double-click means to position the mouse pointer on an item, and then click the item twice in rapid succession. This action selects the item “double-clicked.” |
| Drag X | Drag X means to move the mouse pointer to X, then press the mouse button and hold it down, while keeping the button down, move the mouse pointer. |
| Press X | Press X means to move the mouse pointer to the X button, then press the mouse button and hold it down. |
| ATTENTION | The attention icon appears beside a note box containing information that is important. |
| CAUTION | The caution icon appears beside a note box containing information that cautions you about potential equipment or material damage. |
| WARNING | The warning icon appears beside a note box containing information that warns you about potential bodily harm or catastrophic equipment damage. |

# 1. System Overview

This manual covers the IR Fiber Weight and Moisture Measurement Transmission Sensor (TRIR). Table 1-1 lists model numbers.

**Table 1-1 Fiber Weight and Moisture Transmission Sensor Model Numbers**

| | |
|---|---|
| **Marketing Model Number** | Q4204-50 |
| **Hardware Model Number** | 094204-50 |

The IR Fiber Weight and Moisture Measurement Transmission Sensor uses the specific infrared radiation (IR) absorption properties of water and cellulose at a wavelength of 1.9 microns and 2.1 microns respectively, to provide a measurement of percentage of moisture and fiber weight in tissue or other materials. The typical application for this sensor is the basis weight and percent moisture measurement of towel and tissue grades which contain a low and/or constant ash levels.

The sensor is a three-channel transmission sensor. Source and receiver hardware are mounted on 17.78cm by 25.4cm (seven-inch by ten-inch) baseplates for assembly into Experion MX heads.

## 1.1. Source

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

# 1.2. Infinite Random Scattering Optics

The sensor uses two flat quartz-Teflon® diffusing reflector plates with a receiver aperture offset two inches in the machine direction from the source aperture.

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

The increased sensitivity of light weight sheets compensates for the strong scattering of light from fibers that increase the path length inside heavy weight sheets and thus increases sensitivity in heavy weight sheets. This offset optics is called infinite random scattering optics (INFRAND).

# 1.3. Receiver Optics

The light that reaches the aperture in the receiver window passes through a quartz light pipe. The light is collected by a lens mounted in the lower body optics block and collimated.

The beam splitter, which is mounted in the upper body, transmits approximately 60% of the light to the REF channel filter and detector, reflecting approximately 30% to the MES channel filter and detector. The light rejected by the REF channel filter reflects a second time on the beam splitter before reaching the CEL channel filter.

# 1.4. Receiver Electronics

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

The PbS detector contains a thermistor and a Peltier cooler that, along with the Temperature Control PCBA, maintain the detector temperature at a few degrees above freezing. The extremely stable operating temperature increases sensitivity to moisture and fiber, reduces noise, and decreases sensitivity to ambient temperature shifts.

All of the preceding elements are supported by the Unigauge Backplane, Type II, that passes signals and voltages to the other components and houses the DC–DC converters (±15V, 8V, and 250V) used for powering the electronics.

# 1.5. Filter Selection

The three IR band-pass filters for the three channels are listed in Table 1-2.

**Table 1-2 Wavelengths and Functions**

| Channel | Wavelength | Function |
|---|---|---|
| REF | 1.8µ | Correction for effect of basis weight, dirt, drift, and so on |
| MES | 1.9µ | Measurement of absorption by water |
| CEL | 2.1µ | Measurement of absorption by cellulose |

Sheet temperature influences all IR moisture sensors because the absorption spectrum of water shifts with temperature due to water molecules grouping together. The number of molecules in a group influences the molecular absorption spectrum. At higher temperatures, fewer molecules group together and the absorption shifts to lower wavelengths. The sheet temperature effect is minimized in the IR sensor by carefully balancing the REF and MES filters.

# 1.6. Specifications

| | |
|---|---|
| **Basis Weight Range** | The basis weight range is up to 150g/m$^2$ with low and constant ash levels and no, or negligible, amount of elemental carbon or iron oxide present. |
| **Moisture Range** | The standard range for moisture level is 0%–10%. Higher ranges are special and will further restrict the basis weight range and degrade accuracy. A moisture range of 10% up to a maximum of 30% is possible. |
| **Repeatability** | Larger of 0.4% or 0.15g/m$^2$ fiber weight and 0.10% moisture (2•Sigma) on stirred bagged samples (if heated, moisture in a sample may redistribute and degrade repeatability). |
| **Ash Range** | The sensor will give reliable readings only if the ash level is low and stable. |
| **Carbon Sensitivity** | Carbon affects the sensitivity of the sensor, but the gauge accuracy is not dramatically compromised as long as the carbon content is stable and low. |
| **Static Accuracy** | Larger of 0.5% or 0.20g/m$^2$ fiber weight and 0.25% moisture (2•Sigma) for well made bagged calibration samples with a moisture content range of 0–10%. Above 10% moisture content, accuracy is degraded to 2•Sigma = ±0.025•sheet moisture. Accuracy is not only affected by sensor error, but also by calibration, sampling, and lab errors. |

| | |
|---|---|
| **Flutter Sensitivity** | Over the full range of the gap, the sensor deviation will be less than 0.25% moisture (≤ ±0.125%) as long as the sheet is not touching the quartz window. When the sheet touches the quartz window, the sensor deviation may reach ±0.15%. |
| **Streak Sensitivity** | The full-width at half-maximum of the spot is 1cm (0.39 inches) in the cross direction. |
| **Frequency Response** | The cutoff frequency is 200Hz. |
| **Sheet Temperature Sensitivity** | Sheet temperature dependence is less than ±0.003% moisture per degree Celsius. |
| **Dynamic Moisture Loss** | The flashoff (evaporation with accompanying heat loss) between the reel scanner and take-up reel is normally corrected in the software with dynamic correction. A temperature loss of 12.8°C (23°F) is typically accompanied by a moisture loss of 1% due to flashoff. |
| **Sensor Temperature Sensitivity** | The error induced by changes in sensor temperature is <0.1% moisture per 12.22°C (10°F). |

# 1.7. Power Requirements

Top and bottom heads require 24VDC. The source and the receiver each dissipate approximately 20 watts.

# 2. Sensor Components

## 2.1. Hardware Description and Alignment

Section 2.1 describes the hardware components of the sensor.

Figure 2-1 shows a generalized schematic of the sensor. It consists of a source, with a lamp (the lamp's light is chopped by a tuning fork), and a receiver, which uses three solid-state lead-sulfide detectors to measure the light transmitted through the paper at three different wavelengths in the infrared (IR) region of the spectrum.

Each component is aligned to optimize its function at the factory. If parts are replaced, some re-optimization may be required (see Chapter 9).

This chapter describes some of the basic checks that can be performed on the rare occasion that basic functionality of sensor parts require verification. These tasks are not usually required as part of routine sensor maintenance.

The following equipment is required to check the correct function of the gauge:

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

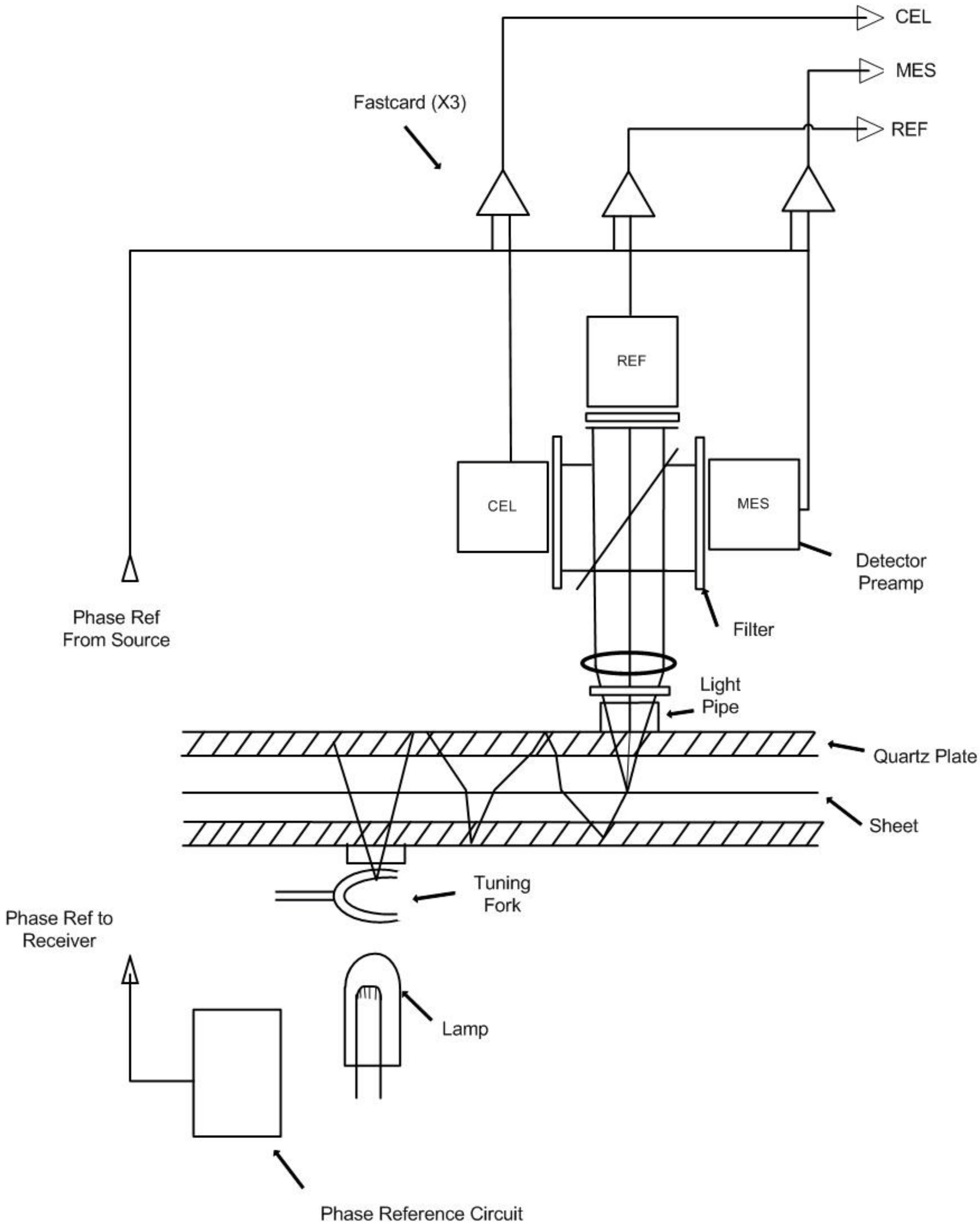



**Figure 2-1 Sensor Configuration**

## 2.1.1. Source Assembly

Figure 2-2 shows the schematic for the source assembly.

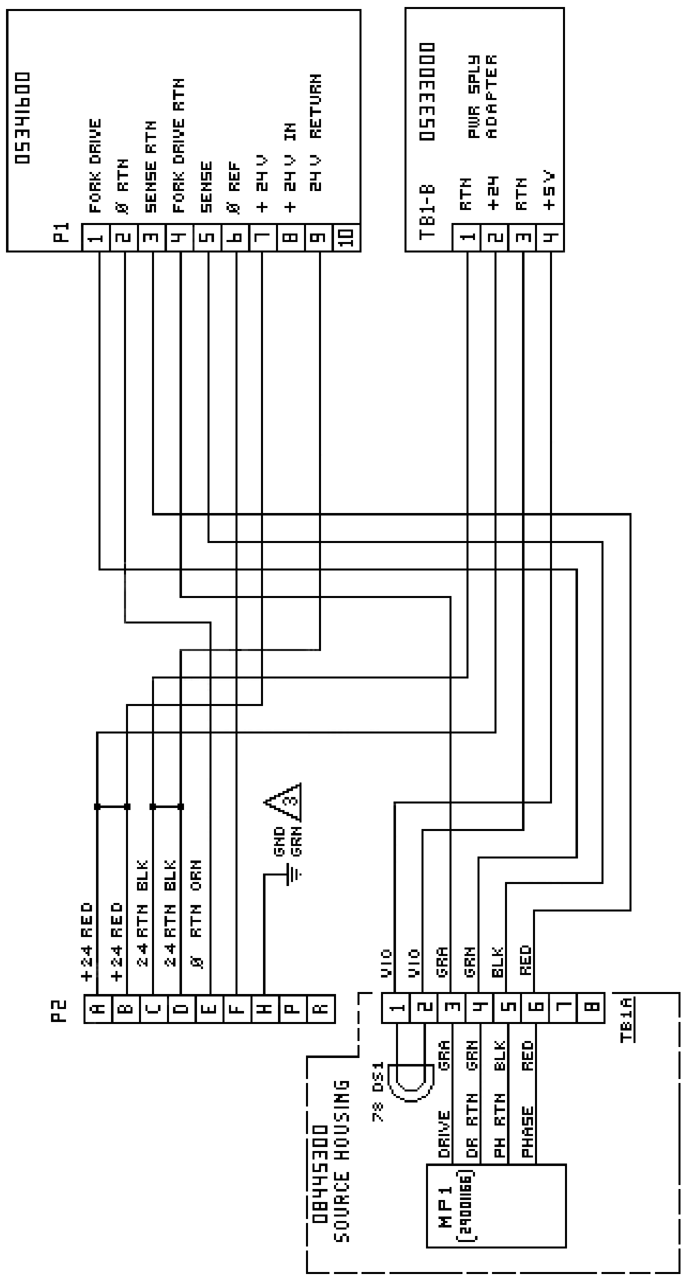


**Figure 2-2 Source Assembly Schematic**

The source assembly consists of the following tunable components:

- power supply adapter printed circuit board (PCB)
- tuning fork driver board

Basic checks of these two components are described in Subsection 2.1.1.1.

#### 2.1.1.1. Power Supply Verification

The power supply adapter circuit board layout is shown in Figure 2-3.

To check for basic functionality:

1. Check that the input voltage is 24±0.5VDC at TB1-2 (+24V) and TB1-1 (GND).
2. Check that the lamp power is 4.4±0.2VDC at TB1-4 (+) and TB1-3 (RTN).

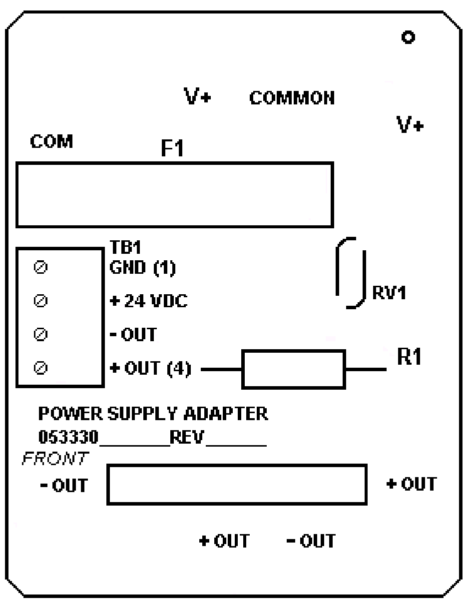



**Figure 2-3 Power Supply Adapter Circuit Board**

### 2.1.1.2. Tuning Fork Driver Alignment

The tuning fork driver board layout and block schematic are shown in Figure 2-4.

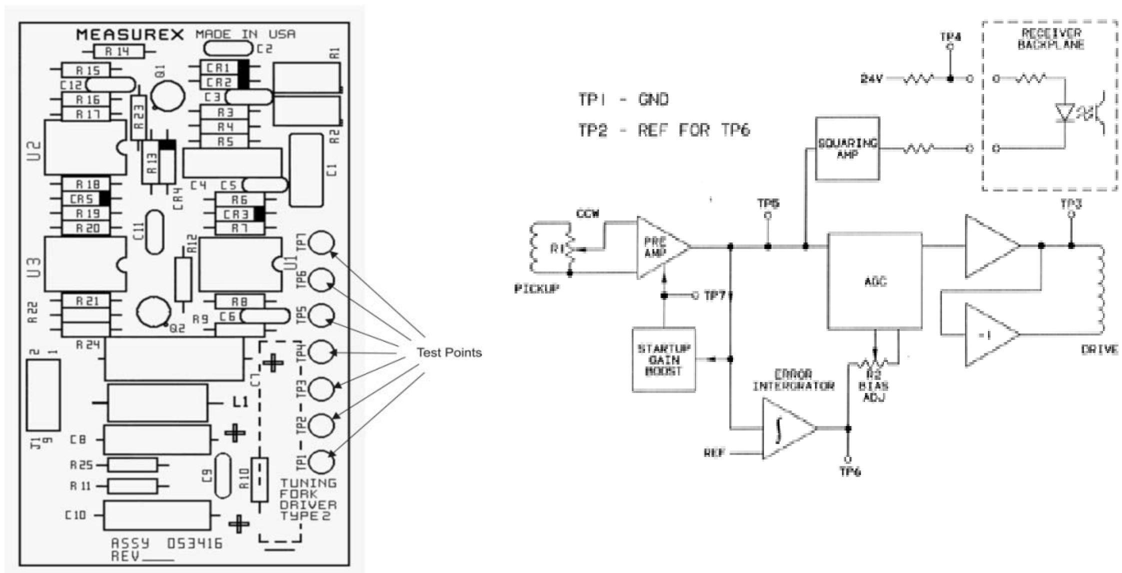



**Figure 2-4 Tuning Fork Driver Board and Block Schematic**

The R1 gain pot attenuates the input signal from the tuning fork, which is then pre-amplified and appears at TP5. This signal is then attenuated by an automatic gain control circuit which holds the amplitude at TP5 constant. The result is amplified and fed to the drive coil of the fork. The TP5 signal is also used to generate a square wave for the phase signal sent to the receiver assembly. R2 adjusts the bias of the AGC circuit. An auxiliary circuit boosts the gain of the pre-amp when the fork is not vibrating.

The tuning fork driver may need (re)alignment if the tuning fork starts to chatter or whine. Instructions on (re)alignment can be found in Subsection 9.10.1.

## 2.1.2. Receiver Assembly

The receiver consists of an optical stack containing the lead-sulfide (PbS) solid state detector assemblies, each with an associated filter and lens, and a backplane which carries three fastcards and a single temperature controller board.

See Figure 2-5 for the standard locations of the PbS detector assemblies for the three channels.

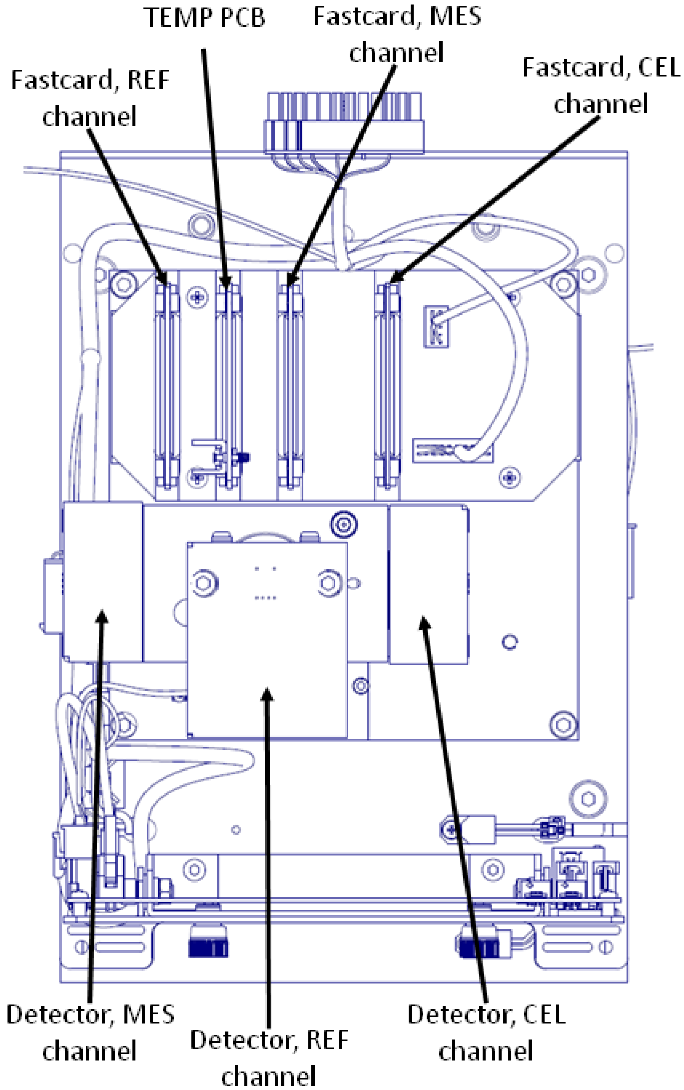



**Figure 2-5 Receiver Detector Locations**

The backplane contains jumpers which control the ability of the IR sensor to be used as a sheet edge detector. Other than this, the board rarely needs adjustment.

The fastcard boards may need periodic adjustment, especially if detectors are replaced.

The temperature control board controls the Peltier coolers for the detectors and rarely needs adjustment.

Figure 2-6 shows the assembly schematic for the sensor's receiver, including part numbers for the detectors, backplane, fastcards, and temperature controller board.

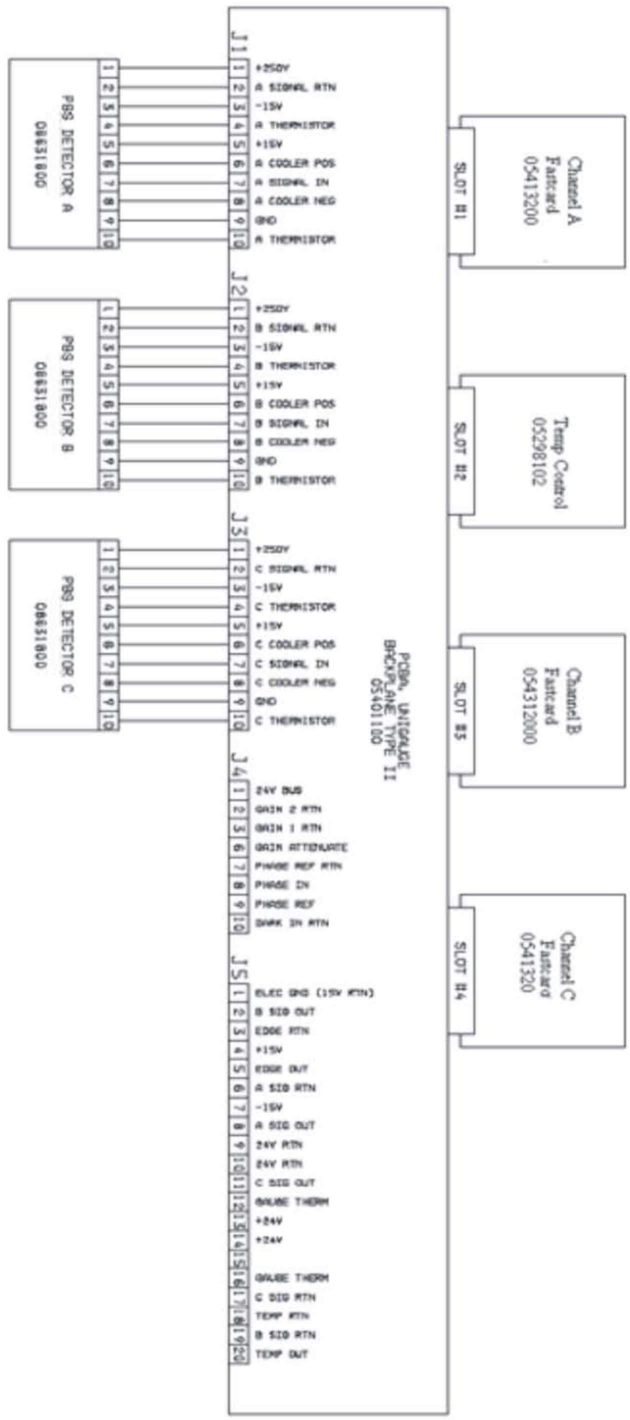



**Figure 2-6 Infrared Radiation Receiver Assembly Schematics**

# 2.1.3. Backplane Assembly: Setting Up Edge Detection

Figure 2-7 shows the Unigauge Backplane Board Type II Assembly.

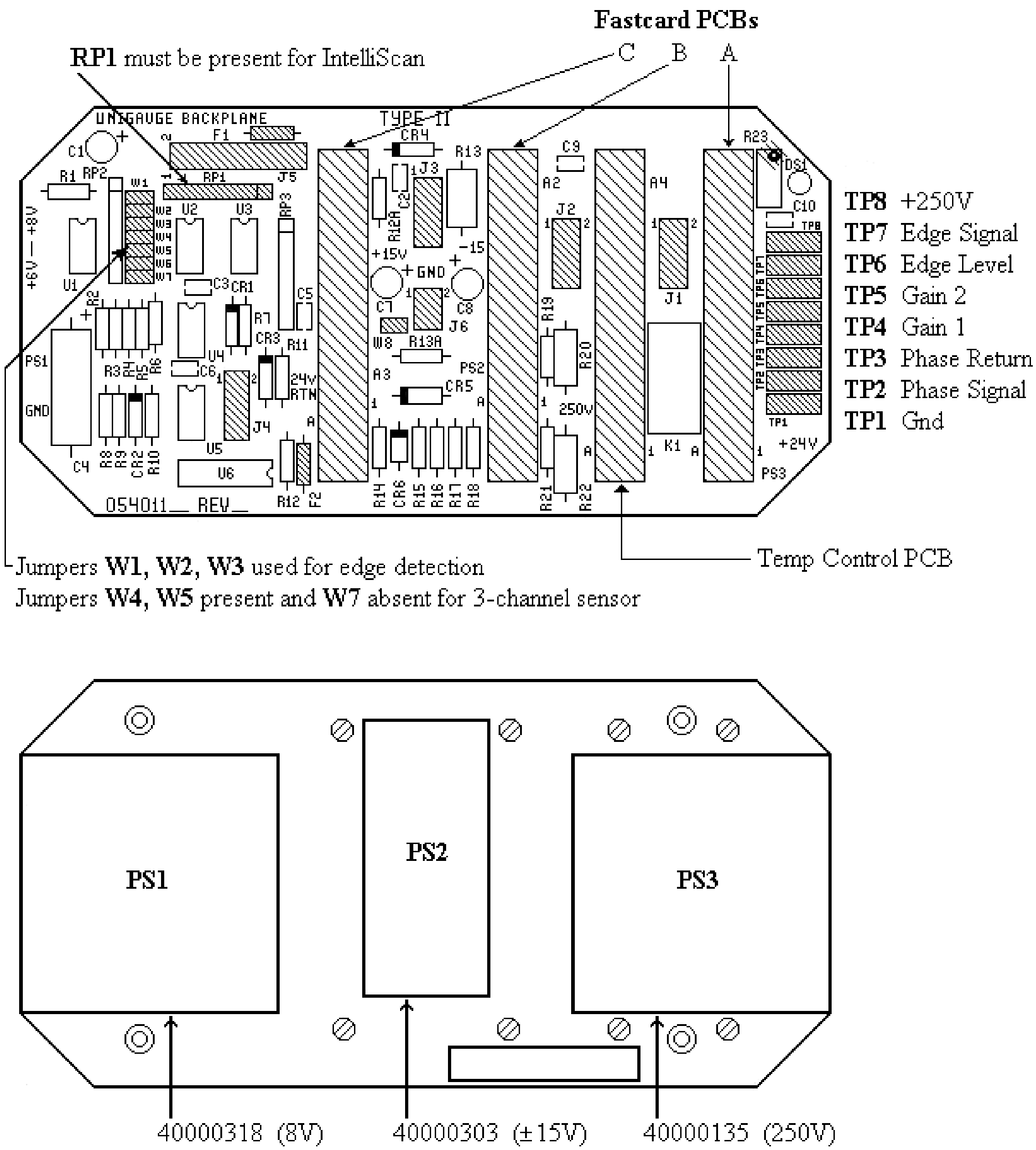



**Figure 2-7 Unigauge Backplane Board, Type II**

To verify normal operation:

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

2. Check the voltage between TP3 on the temperature control board and ground TP1 on the backplane. It should read 8.0VDC±0.5VDC.

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

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

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

To adjust the edge detection:

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

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

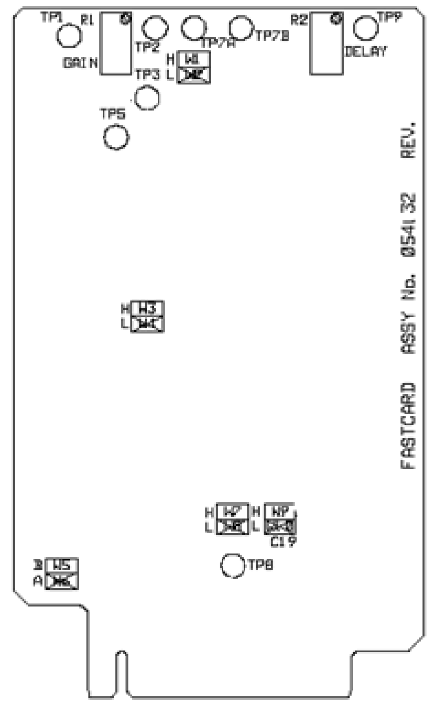
3. Adjust R23 so that TP7 is high (13–15VDC) when the sheet is out of the beam, and goes low (0–1VDC) when the sheet passes the middle of the beam.

### 2.1.3.1. Fastcard Boards

The layout of the fastcard boards is shown in Figure 2-8. The sensor uses three lead-sulfide (PbS) solid-state detector assemblies and an associated fastcard for each channel. Section 9.11 describes the tuning of a fastcard board.

**Fastcard Board**

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




**Temperature Control Board**

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

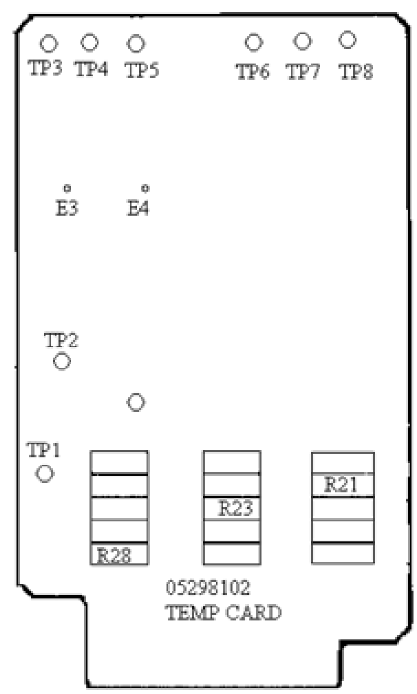



**Figure 2-8 Fastcard and Temperature Control Boards**

### 2.1.3.2. Temperature Control Board

The temperature control board controls the Peltier coolers to all the detectors. With electronics plugged in, check the voltages supplied to the three Peltier coolers. The test points are on the temperature control board (see Figure 2-8).

The following should be between 0.4VDC and 0.8VDC:

- cooler A (REF) channel, TP3(+) to TP4
- cooler B (MES) channel, TP7(+) to TP8
- cooler C (CEL) channel, TP5(+) to TP6

The cooling circuits should be adjusted to keep the detectors operating near the head temperature. To adjust the cooling circuits:

1. Remove the first fastcard board and read the voltage between TP1 and TP2 on the temperature control board.
2. Adjust R14 on the temperature control board until the voltage reading corresponds to the head temperature ±2.7ºC (±5ºF) using Figure 2-1.
3. Return the first fastcard to its slot.

**Table 2-1 Temperature Sensor Voltage Output and Temperature**

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

# 2.2. Software Description

The IR moisture measurement sensor uses real-time application environment (RAE) software on an Experion MX system.

## 2.2.1. Inputs and Outputs

There are three analog voltage outputs corresponding to the three channels

- REF
- MES
- CEL

The upper head also provides one temperature output (**TEMP**).

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

**DARK** zeroes the inputs from the three detectors to allow the software to read the offset due to the electronics for subtraction from all subsequent readings.

The **GAIN1**, **GAIN2**, and **GAIN ATTENUATE** inputs are not used.

### 2.2.2. Background

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

**Table 2-2 Background Phases**

| Phase | | Contact Output Set | REF (volts) | MES (volts) | CEL (volts) |
|---|---|---|---|---|---|
| 1 | Read, Store dark offsets | DARK GAIN | Dark volt | Dark volt | Dark volt |
| 2 | Read Gain0 Phase | GAIN ATTEN | $Gain0_{REF}$ | $Gain0_{MES}$ | $Gain0_{CEL}$ |
| 3 | Read Gain1 Phase | GAIN ATTEN GAIN1 | $Gain1_{REF}$ | $Gain1_{MES}$ | $Gain1_{CEL}$ |
| 4 | Read Gain2 Phase | GAIN ATTEN GAIN2 | $Gain2_{REF}$ | $Gain2_{MES}$ | $Gain2_{CEL}$ |

The results from phases 2, 3, and 4 are combined to calculate the analog gains for **GAIN0**, **GAIN1**, **GAIN2**, and **GAIN3**, respectively. These **GAIN** factors are typically not used with this gauge.

## 2.3. Standardize or Reference Operations

A reference or standardize are identical operations. The term *reference* is used when it is manually requested in maintenance mode. A *standardize* is scheduled periodically during sensor scanning in production mode. These functions consist of: taking a reading on an empty gap to correct sample and onsheet readings for dirt buildup on the sensor windows, electronic drift, lamp brightness changes, and so on.

The reference (or standardize) measurement gives the net open volts (dark volt subtracted measurements) for the three channels. The net open volts are stored and used in determining the channel ratios of REF, MES, and CEL, which are explained in Section 2.4.

The channel ratios at standardize are compared with their values at calibration time (time-zero). Alarms can be set to check that these values maintain their integrity. If the values drift more than a value set by the user, or go out of bounds (minimum and maximum set by the user), an alarm is generated.

By default, no checks are performed. To enable checking of these values, set the **Enable Stdz Limit Ch** value to 1 on the **Sensor Maintenance** display. This value can be found at the bottom of the **Phase Config** table. Type in a new value and click **Perm** to write it into the permanent database; refresh the screen to enable the change to take place.

Enabling standardize limit checking will cause the software to compare the values obtained at regular standardizes to the values obtained at time-zero. The limits for setting off the alarm are set in the **T0 Net Open** drop-down menu. Select one of **Stdz Ratio Drift Limits, Stdz Ratio Min Limits,** or **Stdz Ratio Max Limits**, and enter your desired limits (the default limits are so loose as to effectively prevent alarms) for the three ratios. Click on **Perm** to register in the permanent database.

# 2.4. Sample/Onsheet Measurement

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

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

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

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

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

The raw RN and *working ratios* are defined as:

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

$$WR_1 = RN - 1$$

$$RN2 = \frac{\text{Channel Ratio CEL}}{\text{Channel Ratio REF}}$$

$$WR_2 = RN2 - 1$$

$$RN3 = \frac{\text{Channel Ratio MES}}{\text{Channel Ratio CEL}}$$

$$WR_3 = RN3 - 1$$

These ratios appear in various locations in the software displays.

### 2.4.1. Static Percent Moisture

The static percent moisture is calculated as:

$$MS = A_0 + A_{10} \cdot WR_1 + A_{11} \cdot WR_1^2 + A_{20} \cdot WR_2 + A_{21} \cdot WR_{21}^2 + A_{30} \cdot WR_3 + A_{31} \cdot WR_3^2$$

$A_{xx}$ are the calibration constants and $WR_x$ the sensor ratios. MS is the percent moisture value reported in the Sample mode.

## 2.4.2. Static Fiber Weight

The static fiber weight is calculated as:

$$DW = B_0 + B_{10} \cdot WR_1 + B_{11} \cdot WR_1^2 + B_{20} \cdot WR_2 + B_{21} \cdot WR_{21}^2 + B_{30} \cdot WR_3 + B_{31} \cdot WR_3^2$$

$B_{xx}$ are the calibration constants and $WR_x$ the sensor ratios. DW is the fiber weight value reported in the Sample mode.

## 2.4.3. Dynamic Percent Moisture

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

$M_{dyn} = MS \times (MS\ dynamic\ slope) + (MS\ dynamic\ intercept)$

The dynamic slope and intercept are accessible in the **Sensor Maintenance** screen and are loaded as part of the recipe, as **MS dynamic slope** *and* **MS dynamic intercept.**

## 2.4.4. Dynamic Basis Weight

The fiber weight also has a dynamic corrector:

$DW_{dyn} = DW \times (DW\ dynamic\ slope) + (DW\ dynamic\ intercept)$

The dynamic slope and intercept are accessible in the **Sensor Maintenance** screen and are loaded as part of the recipe, as **DW dynamic slope** *and* **DW dynamic intercept.**

# 2.5. Calibration Constants

## 2.5.1. Time-Zero (Calibration Time) Constants

Table 2-3 shows the time-zero moisture calibration constants determined in the factory from an empty-gap standardize, or reference, operation. These are typical values for the standardize measurements.

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

**Table 2-3 Time-Zero Moisture Calibration Constants**

| Name | Typical Value | Description |
|---|---|---|
| T0 channel 1 | 7.0V–8.0V | REF net volts at time-zero |
| T0 channel 2 | 7.0V–8.0V | MES net volts at time-zero |
| T0 channel 3 | 7.0V–8.0V | CEL net volts at time-zero |
| Ratio 1 | 1.00±0.07 | Standardize ratio of REF/MES at time-zero |
| Ratio 2 | 1.00±0.07 | Standardize ratio of REF/CEL at time-zero |
| Ratio 3 | 1.00±0.07 | Standardize ratio of CEL/MES at time-zero |

### 2.5.2. Correctors Determined On site

Table 2-4 shows the calibration constants normally determined or entered on-site.

**Table 2-4 Calibration Constants Entered On site**

| Default | Name |
|---|---|
| 0 | Dynamic intercept corrector, moisture |
| 1 | Dynamic slope corrector, moisture |
| 0 | Dynamic intercept corrector, fiber weight |
| 1 | Dynamic slope corrector, fiber weight |

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

If there is enough dirt buildup on the quartz plates to significantly reduce the signal volts, clean the plates more often and, if necessary, increase the tolerances for the limit checks (see Section 2.3).

# 3. EDAQ

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

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

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

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

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

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

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

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

# 3.1. Physical Layout

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

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

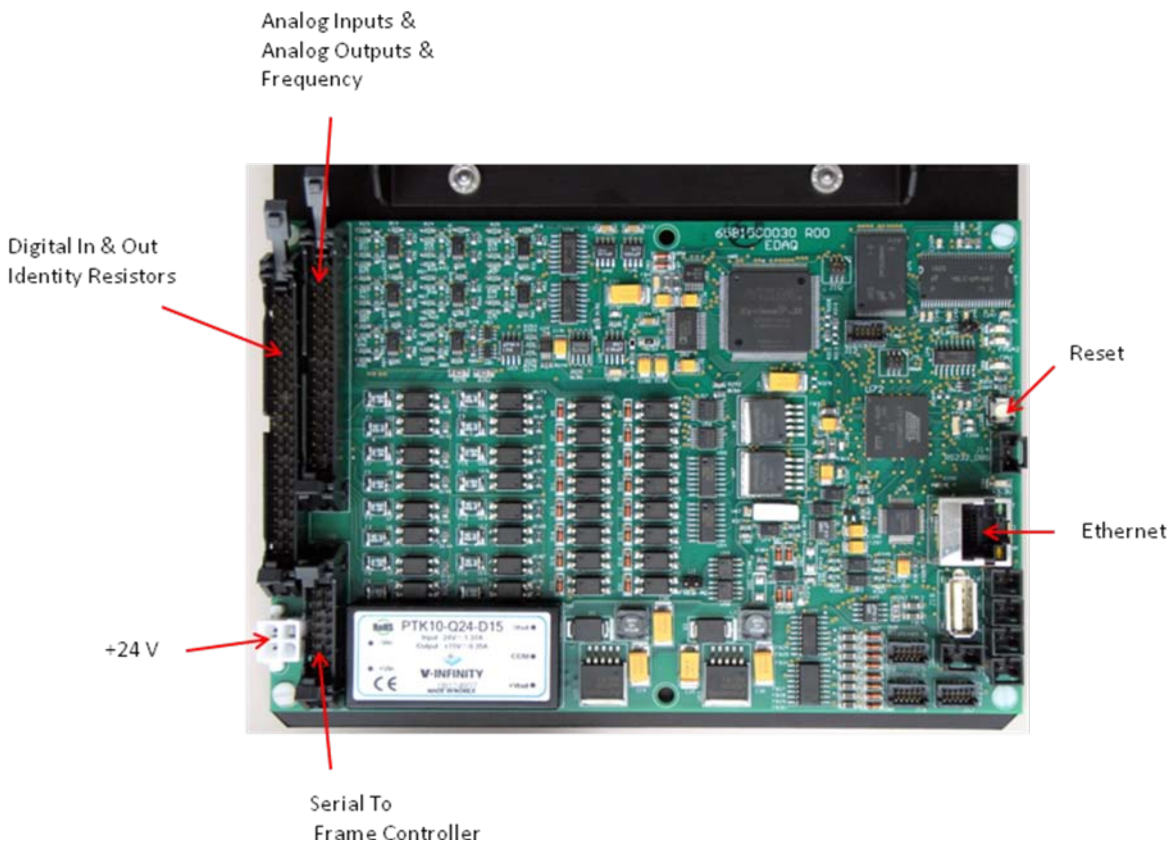



**Figure 3-1 Top view of EDAQ board**

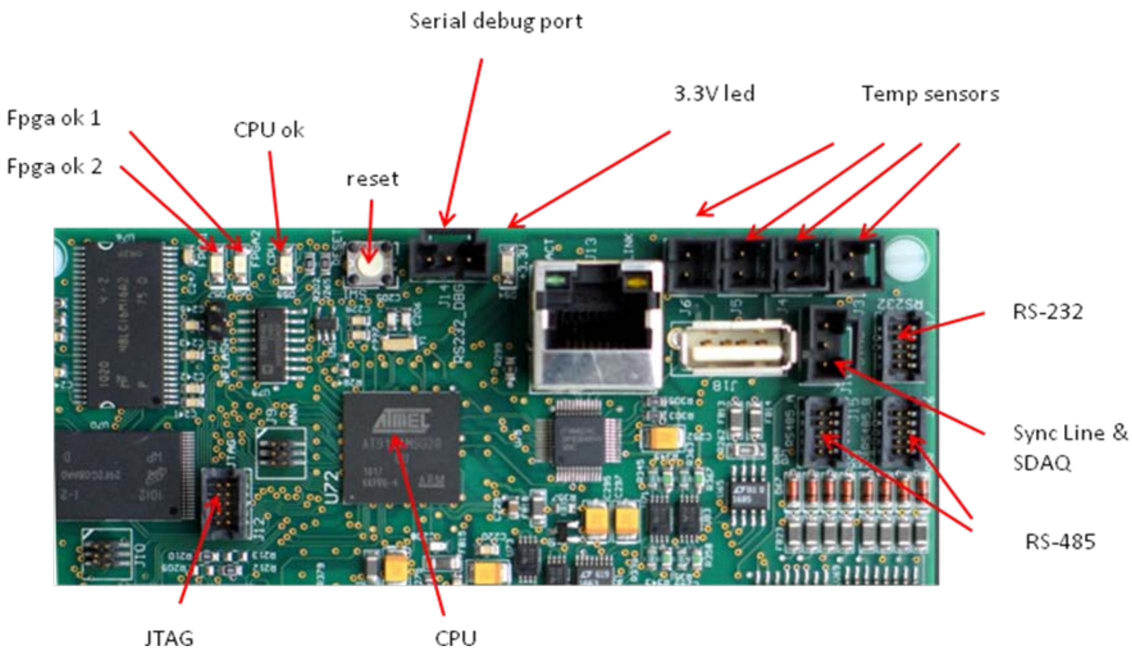



**Figure 3-2 Enlarged view of the top right corner of the EDAQ to show LEDs and I/O connectors**

# 3.2. Hardware Status Information

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

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

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

# 3.3. EDAQ reset

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

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

# 3.4. EDAQ Sensor Identification and IP addressing

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

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

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

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

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

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

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

# 3.5. Obtaining Status Information

## 3.5.1. Experion MX Platform

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

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

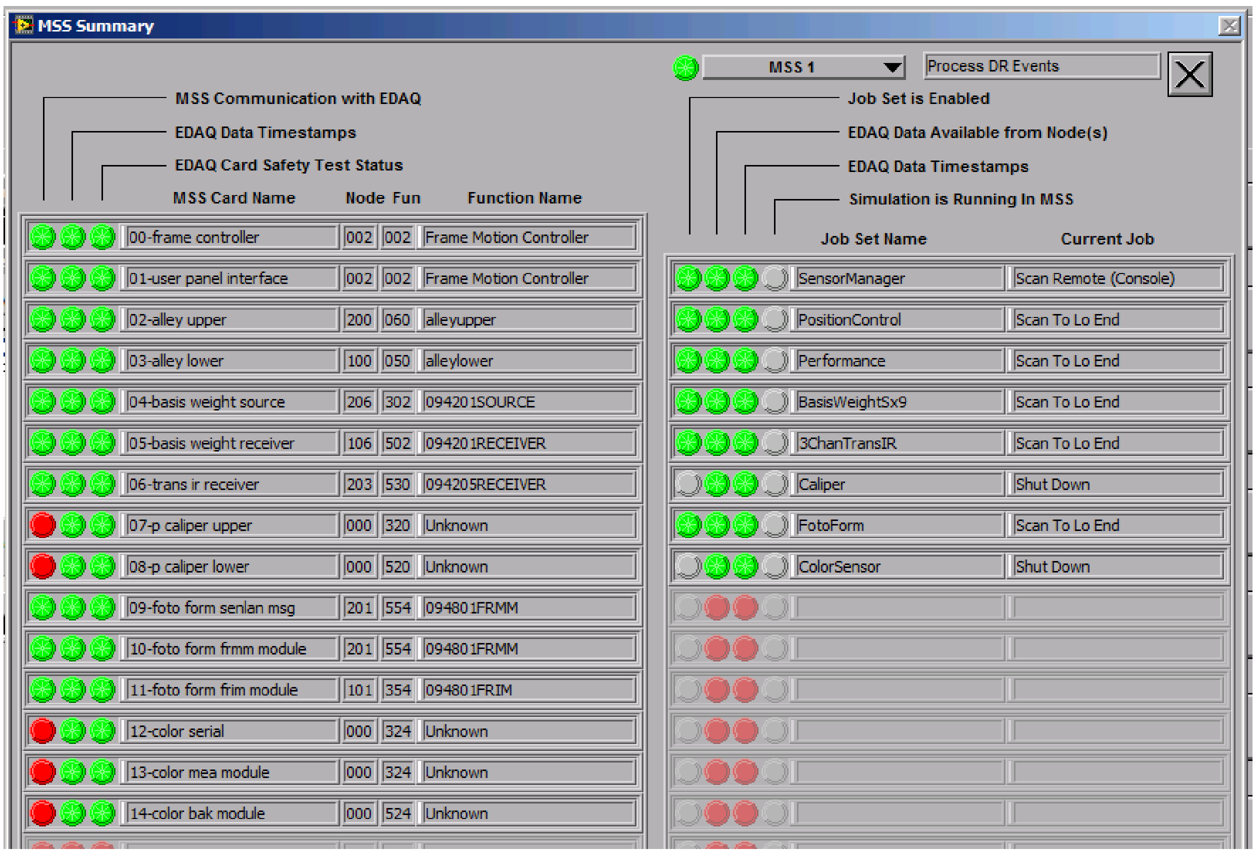



**Figure 3-3 MSS Diagnostic page displaying EDAQ status**

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

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

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

# 3.6. MSS and EDAQ Web Pages

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

- From RAE by going to the MSS Diagnostic tab, clicking on MSS Monitor, choosing the appropriate MSS and clicking on MSS web page

- By opening a browser on any computer connected to the Experion MX level network and using the address *http://192.168.10.101/mss.php* (the first MSS on the LAN) or the address set up for the MSS in the Experion MX system

- By opening a browser on any computer connected to the scanner LAN switch and using the address *http://192.168.0.1/mss.php* or *http://192.168.10.101* (for the 1st MSS on the system)

Figure 3-4 is the main MSS web page.

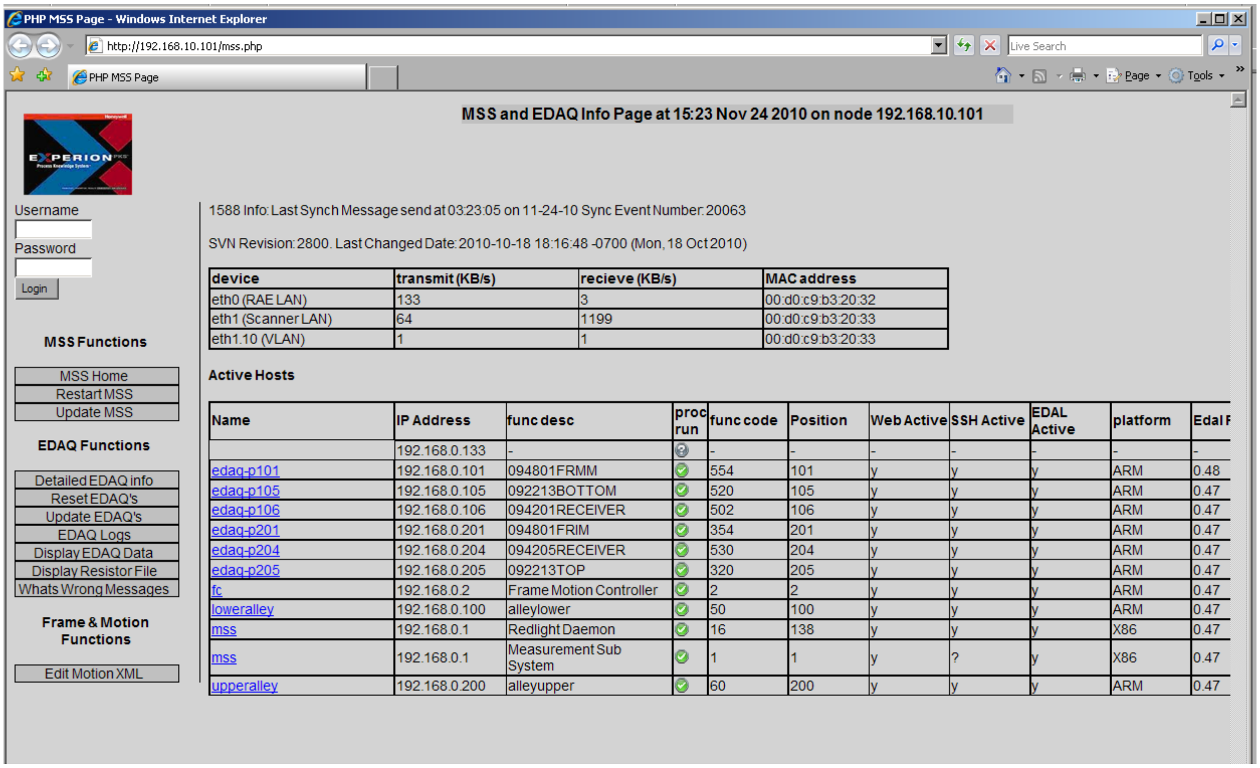



**Figure 3-4 Main MSS web page**

The left panel shows a column of options divided into:

- MSS functions
- EDAQ functions
- Frame and Motion Functions

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

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

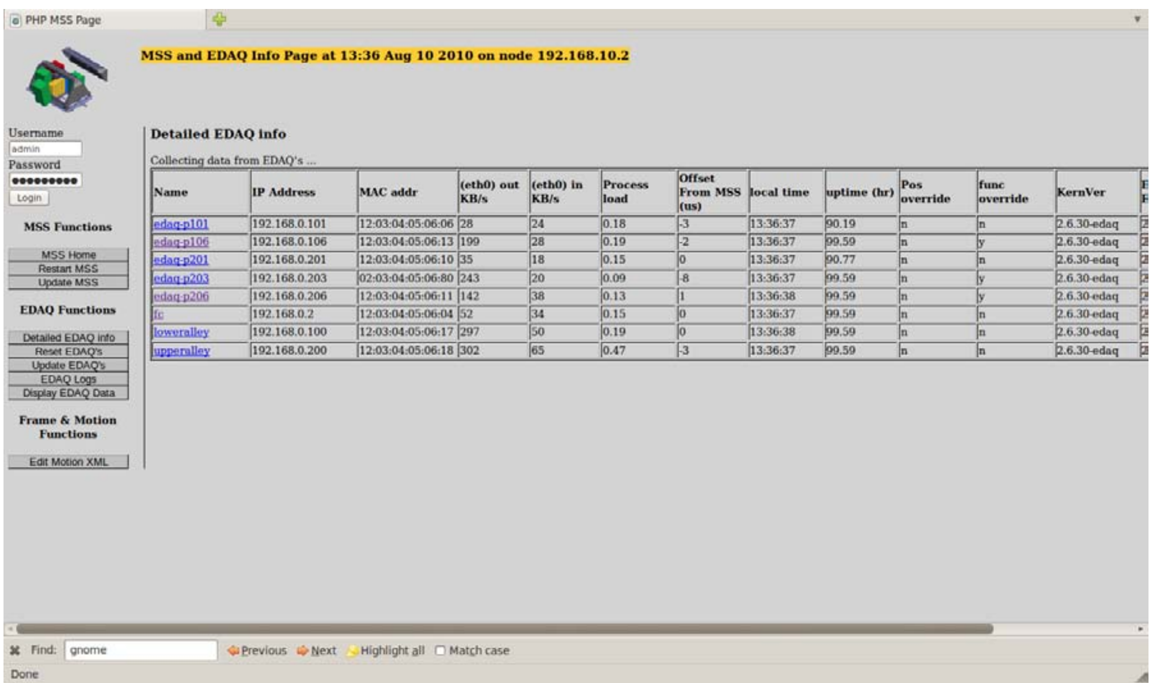
The second table lists all EDAQs discovered on the Scanner LAN, their IP numbers, a brief description (related to model number), a program status column, the associated Function Code, Position Code and whether the communication protocols are running (http, ssh and Edal, the proprietary sensor data transmission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

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

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

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

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




| 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 |

**Figure 3-5 Partial display of EDAQ detailed information**

# 4. Installation

Before installing an Infrared (IR) Fiber Weight and Moisture Measurement sensor, see Chapter 1 and Chapter 2 for information on the components and operation of sensors.

## 4.1. Mounting and Electrical Connections

Install the receiver and source part of the IR sensor by sliding the sensor part and sheet guide combination into the appropriate location. See your Scanner System Manual for details on head design.

The IR sensor source is typically installed in the bottom head, and the receiver is installed in the top head. Ensure that the INFRAND plates are properly oriented. Ensure that the borders around the plates look as shown in Figure 4-1.

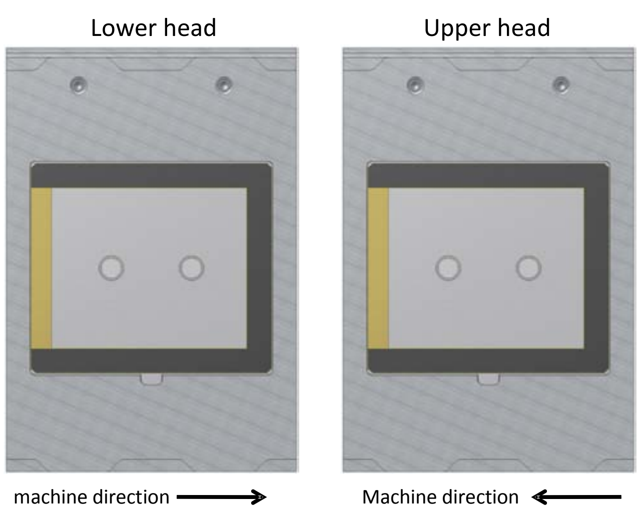



**Figure 4-1 INFRAND Plate Orientation**

Only the sensor receiver uses an EDAQ. Connections to the EDAQ are shown in Figure 4-2. There is an Ethernet connection on the left, and three connectors on the right. The connectors are keyed and can only be inserted in a single orientation.

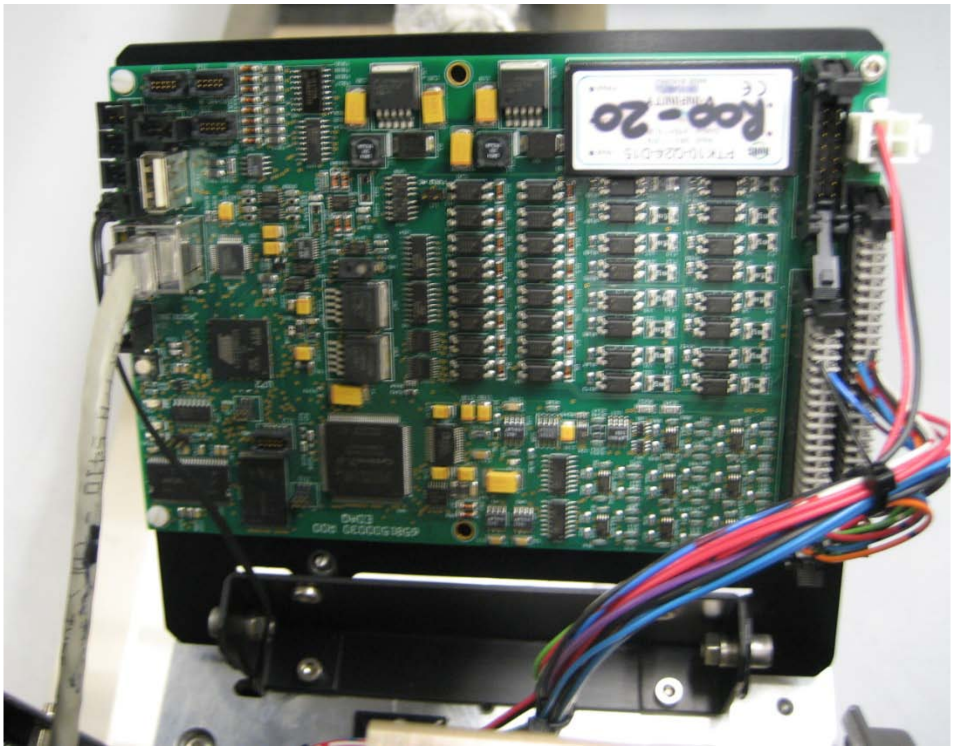


**Figure 4-2 EDAQ Connections in the Moisture Receiver**

# 4.2. Task List for Sensor Commissioning

1. Check that the calibration constants in maintenance mode or production mode, for a given code, match the ones in the calibration data sheets provided with the system.
2. Check the source alignment (see Section 2.1).
3. Check the receiver alignment (see Section 2.1).
4. Verify the static calibration samples (see Subsection 7.2.10).
5. Recalibrate as needed (see Chapter 7).

6. Enter nominal dynamic correction calibration constants (see Subsection 6.4.1).

7. Perform dynamic verification (see Section 6.4).

# 5. Software Configuration Parameters

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

Setting up system behavior in terms of calibrations, alarms, and checks is done through the **Setup** page. The **Recipe Maintenance** tab is the basic page from where all the tables are accessed. Each recipe or code consists of a hierarchical tree of linked tables. Each table describes 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 on the **Main Code Table** page; each recipe has its own main code table. The main code table is at the top of the hierarchy and references the **IRP Configuration Table** and the **IRP Calibration Table**, which will be set up first.

# 5.1. IRP Configuration Table

Figure 5-1 shows the **IRP Configuration Table**, which is at the bottom of the recipe hierarchy. This table controls which correctors will be used.

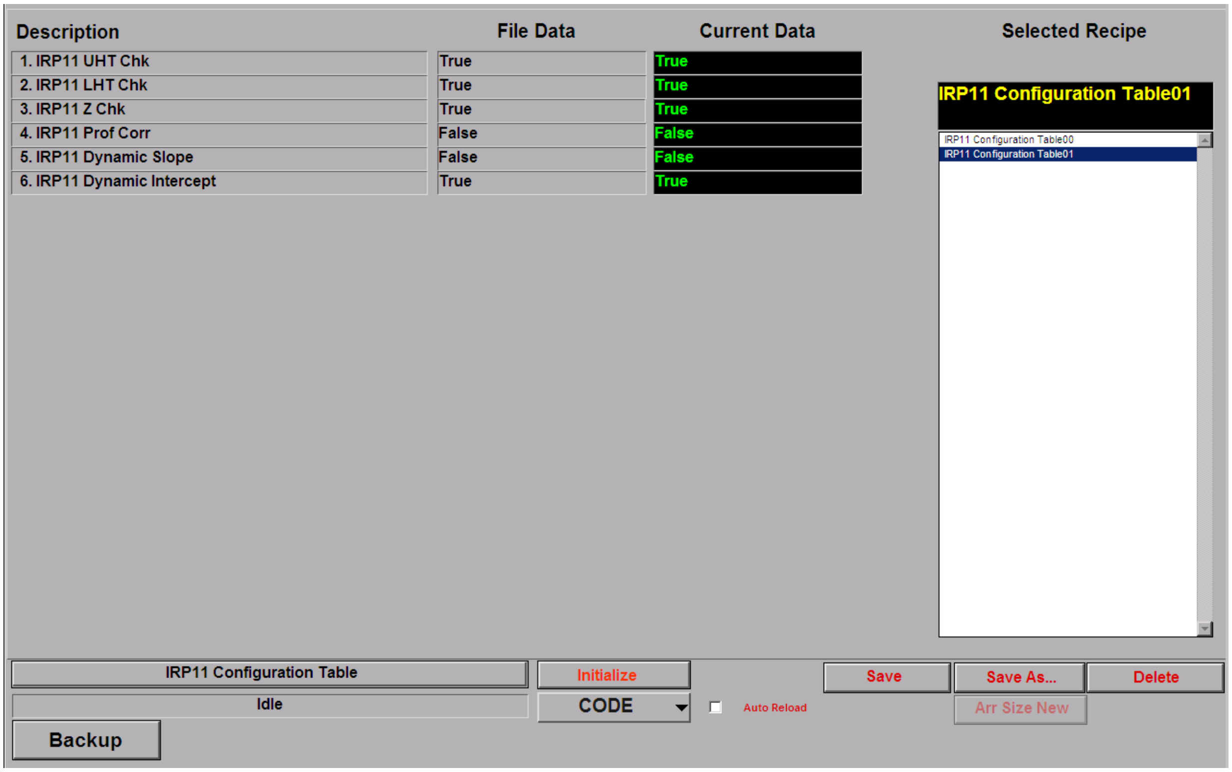



**Figure 5-1 IRP Configuration Table**

The UHT, LHT, and Z checks are used only for snapshot data. These checks do not set alarms for valid temperature/Z readings, they check if the arrays were actually computed (and not if the values are physical). This check is not performed if the corresponding sensors are disabled or not present.

Create an IRP Cconfiguration 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. IRP Calibration Table

Now create an IRP Calibration Table for each calibration group. For example, **IRP11 Calibration Table00** and **IRP Calibration Table01** (see Figure 5-2).

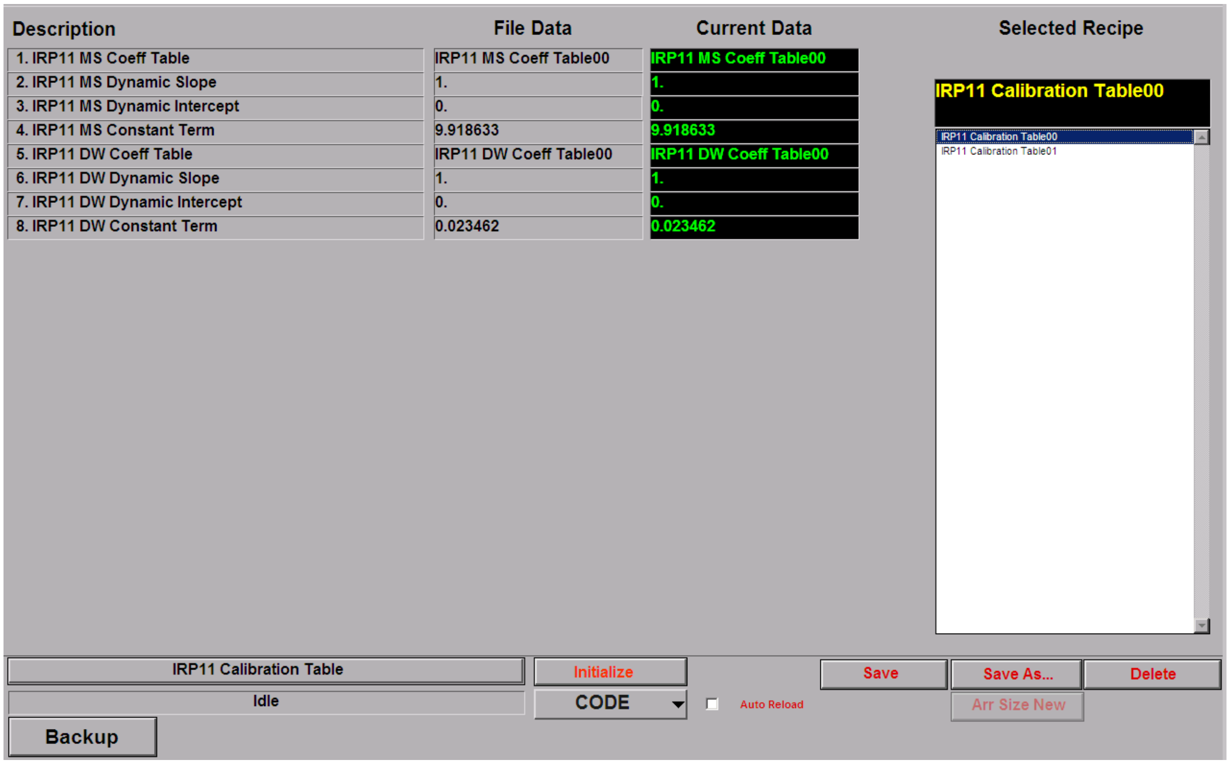



**Figure 5-2 IRP Calibration Table**

The calibration table specifies the proper calibration constants that will be used for this recipe. The calibration constants in this table are generated during calibration time, when you select or create the appropriate table to store the numbers (see Chapter 6). If you need to change the values, type them in, then click **Save As...** to save a new version. The dynamic slope for both fiber weight and moisture should be set to 1 by default.

This table contains a link to the rest of the calibration numbers–in this example, **IRP11 MS Coeff Table00** and **IRP11 DW Coeff Table00**. These pointers and the values in them are set during calibration time (see Chapter 6). Check them by bringing up the **IRP MS Coeff table**(s). Each table will contain 3 sub-tables, called **IRP11 MS RNx coefficients**, one for each of the three working ratios that the sensor generates, as shown in Figure 5-3.

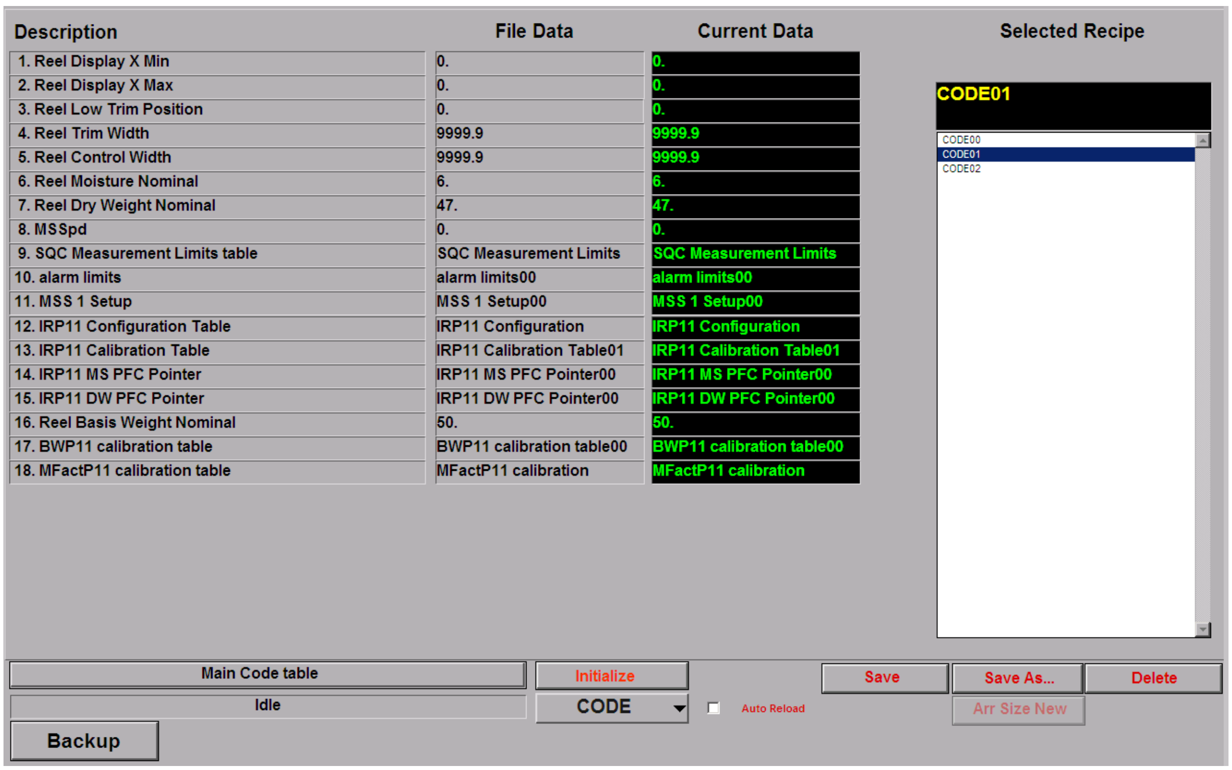

**Figure 5-3 IRP11 MS Coeff Table**

The values entered here will appear in the **Sensor Maintenance Page** in the **Calibration Constants** table. There are as many elements in each sub-table as there are orders to the calibration fit (that is, one element for a linear fit, two elements for a quadratic, and so on). You can browse the sub-tables by double-clicking on them. Elements can be changed by overwriting them and clicking **Save**.

# 5.3. Main Code Table

The Main Code table gathers together all the other tables for each grade code (or recipe) required. Create a grade code (recipe) for each grade as required, for example, Code00 to Code03.

For each recipe, ensure that the associated main code table contains the appropriate sub-tables that you created for the IRP Configuration Table and the IRP Calibration Table (see Figure 5-4).



| Description | File Data | Current Data |
|---|---|---|
| 1. Reel Display X Min | 0. | 0. |
| 2. Reel Display X Max | 0. | 0. |
| 3. Reel Low Trim Position | 0. | 0. |
| 4. Reel Trim Width | 9999.9 | 9999.9 |
| 5. Reel Control Width | 9999.9 | 9999.9 |
| 6. Reel Moisture Nominal | 6. | 6. |
| 7. Reel Dry Weight Nominal | 47. | 47. |
| 8. MSSpd | 0. | 0. |
| 9. SQC Measurement Limits table | SQC Measurement Limits | SQC Measurement Limits |
| 10. alarm limits | alarm limits00 | alarm limits00 |
| 11. MSS 1 Setup | MSS 1 Setup00 | MSS 1 Setup00 |
| 12. IRP11 Configuration Table | IRP11 Configuration | IRP11 Configuration |
| 13. IRP11 Calibration Table | IRP11 Calibration Table01 | IRP11 Calibration Table01 |
| 14. IRP11 MS PFC Pointer | IRP11 MS PFC Pointer00 | IRP11 MS PFC Pointer00 |
| 15. IRP11 DW PFC Pointer | IRP11 DW PFC Pointer00 | IRP11 DW PFC Pointer00 |
| 16. Reel Basis Weight Nominal | 50. | 50. |
| 17. BWP11 calibration table | BWP11 calibration table00 | BWP11 calibration table00 |
| 18. MFactP11 calibration table | MFactP11 calibration | MFactP11 calibration |



**Figure 5-4 Main Code table**

# 6. Operations

There are two main operating modes for the scanning system: Maintenance Mode and Production Mode.

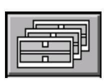
Maintenance Mode must be engaged when performing calibrations, verifications, or repeatability operations. It is a test mode.

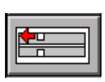
Production mode is used in daily operations.

## 6.1. Engaging Maintenance Mode

The system must be in maintenance mode 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 must be loaded:

Click  to bring up the scanner control dialog box.

Click  on the scanner control dialog box and select the appropriate scanner(s) to take the selected head(s) offsheet.

To load a maintenance grade code:

1. Select **Maintenance Mode** from the dropdown list on the **Sensor Maintenance** tab.

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

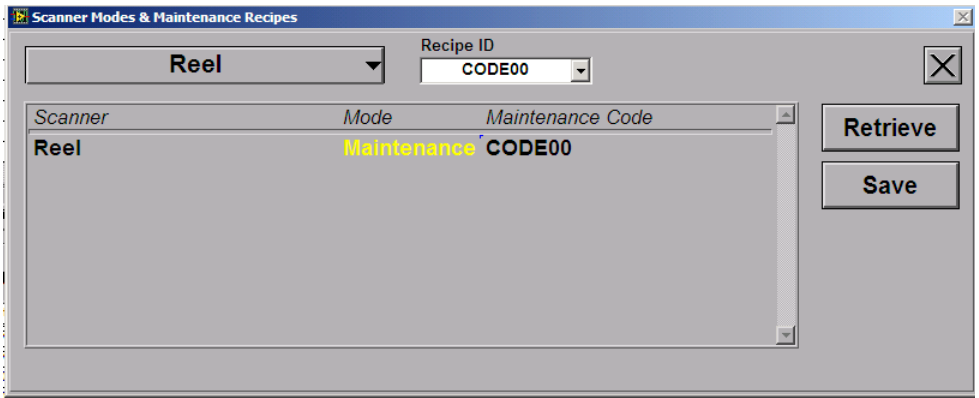



**Figure 6-1 Scanner Modes & Maintenance Recipes**

3. Click the dropdown arrow on the left to select the appropriate scanner (**Reel** in Figure 6-1).

4. Click the dropdown list on the right, under **Recipe ID**, to select the appropriate recipe/code.

5. Click **Retrieve**.

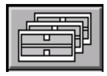
6. Close the **Scanner Modes & Maintenance Recipes** dialog box.

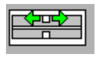
7. To return to production mode, select **Production Mode** from the dropdown list on the **Sensor Maintenance** tab.

# 6.2. Engaging Production Mode

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

To start scanning:

1. Click  on the top horizontal dispatcher to display the Scanner control display (see Figure 6-2).

2. Click  in the Scanner control display to scan the head. Before the sensor starts scanning, it takes the background and reference reading from all of the sensors (basis weight, moisture, and so on) and stores it.

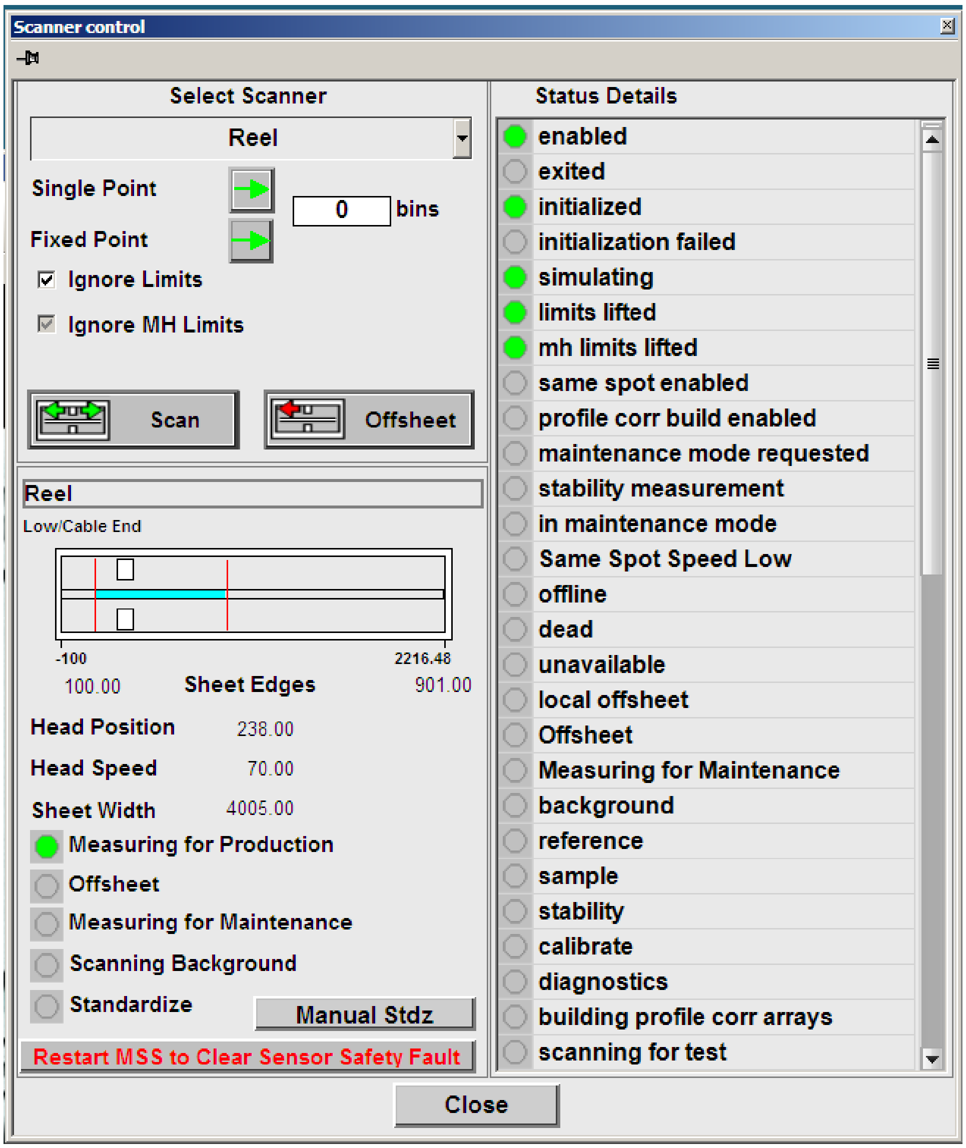



**Figure 6-2 Scanner Control Display**

# 6.3. Dynamic Calibration for Moisture

Dynamic calibration for moisture is included to correct for:

- flashoff (evaporation from hot sheet) of moisture between the scanner and reel (reel scanners only)
- any difference between static calibration readings on bagged samples and on-sheet readings
- any residual sheet temperature dependence in the sensor

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

Perform dynamic verification once a week.

## 6.3.1. Nominal Dynamic Correction Constants

The recommended initial value for dynamic moisture correction for tissue at 6% moisture is 0.75%. This value may be used before dynamic testing is possible.

This value is only approximate because the sheet temperature varies widely in different applications, and the sheet temperature strongly affects the flashoff.

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

The recommended dynamic correction (DMBE) value of 0.75% includes flashoff for Reel Scanners, but not for other scanners that cannot be dynamically verified.

This is a conservative value for the correction (about 75% of the actual expected correction).

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

# 6.3.2. Dynamic Calibration and Verification Procedure

In order to perform dynamic checks, the system must be in a stable operating mode, with machine-direction moisture stable to 1% or better, and the profile stable to better than 0.5%. Once the system is stable, data is collected over some 15 scans before reel turn up, with the average moisture in one or more selected *slices,* or regions in the cross direction, noted. Once the reel is turned up, samples are cut from the reel, bagged, and taken to the lab for measurement of their moisture. These samples are from the *same slice* as was being monitored by the sensor.

A minimum of 30 samples of five or more reels is needed for a verifiable dynamic calibration. Gather and process the samples as soon as possible after startup.

Read this procedure prior to collecting any samples, to be sure that you understand what is required.

Two people are required to perform sample collection, and samples must be collected within 90 seconds of reel turn up to prevent conditioning.

## 6.3.2.1. Equipment Required for Sample Collection

- Large plastic sheets: 0.5 mil (20 micron) thick drop cloth about 1.3 by 2.7m (four by eight feet).
- pre-weighed and numbered plastic bags, at least 30 by 46 cm (12 by 18 inches)
- pre-weighed rubber bands
- tape measure of adequate length to measure from edge to center of sheet
- masking tape
- sharp utility knife for cutting samples from reel
- *IR Moisture Sensor worksheet* (p/n 42000852, page 5)
- laboratory balance accurate to 0.05% of sample weight–usually a top-loading balance accurate to .01g is acceptable
- Forced-draft, temperature-regulated drying oven, located in a constant temperature and humidity room. The oven must be set for 105.0 ±0.5°C (221.0 ±0.9°F)

### 6.3.2.2. Ensuring system stability

Prior to taking any samples, verify:

1. The sensor has been aligned and stability-checked (background/reference values check–see Section 9.2. Short term stability check–see Section 9.3).
2. The static calibration has been verified–see Chapter 7.
3. Dynamic calibration constants have been set either to best-known values or to the appropriate default values given in Subsection 6.4.1.

### 6.3.2.3. Sampling Procedure

Physically cutting samples from the reel requires two people. Sample collection must be done within 90 seconds of reel turn up to prevent conditioning.

Appropriate sampling locations must be established, and the sensor moisture recorded over several scans prior to reel turn up. Only after the reel is turned up are samples collected.

1. Prepare for monitoring stability by setting the filter factor on the Scanner Setup display to **0.2** as outlined in Section 6.3.
2. For dynamic calibration, set the dynamic calibration constants (DMAE, DMBE, and KAYE) either to best-known values or to the appropriate default values given in Subsection 6.4.1.To set the calibration constants:
   a. Press the setup button followed by the Recipe Maintenance button.
   b. In the **Recipe Maintenance** display, press **Main Code Table** and, under that, choose the **MOIP Calibration Table**.
   c. In the **MOIP Calibration Table**, enter the dynamic calibration constants and click on the Save button. After saving, you must reload the code in order to make the new calibration constants active.
   d. When you load the code, the correct calibration constants should be shown in the calibration constant table in the sensor maintenance display.
3. Choose the section of the reel to be sampled: prior to turn-up, use the **Profile Display** to locate one or more sections at least 30cm (12in) wide where the moisture and basis weight profiles are relatively flat. If more than one section is used, try to find sections with *different* average moisture. You need to find the actual physical location of these regions on the reel; use the bin number, the

known sheet width, and a measuring tape to find them relative to the sheet edge.

4. Monitor that the sheet has stable moisture at your chosen location(s). The moisture should not vary by more than 1% (minimum to maximum value). Monitoring can be done in a number of ways:

   - Use the **Quality Data** display to *single-point* the scanner at a slice at the center of the chosen area and collect data over a few minutes

   - Use the **colormap** display to assess stability

   - Use either the **position snapshot** or **partial scan snapshot** to collect data over several scans

5. Once you are satisfied that the system is stable, set up the profile display to automatically produce a profile of moisture, basis weight, and air gap temperature.

6. Allow the scanner to complete 15 scans before turn up, and monitor the average moisture until turn up. If the *average* moisture differs from the *trended* value by more than 0.5%, do not sample the reel.

7. Record the average moisture value in the slice regions you will physically sample.

8. As soon as possible after turn up, go to the reel. Draw a line in the cross direction along the reel where the cut will be made.

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

10. On top of the slabbed-down tissue, and behind a 25 cm (10 inch) width of it, lay down a piece of plastic sheet two feet wide and four to six feet longer than the reel width (see Figure 6-8).

11. Cut off a 10 inch-wide sample (measuring back from the leading edge) the full length of the reel, cutting down to the floor. Flip this material onto the plastic sheet, with the inside material face-down on the plastic and the outer layers on top.

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

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

14. Tie a knot in each end of the plastic sheet, or seal the ends by twisting the plastic and securing it with rubber bands. Mark the position of the high slice number on the end, so that you can accurately locate your monitored position(s) once the samples are unrolled in the lab.

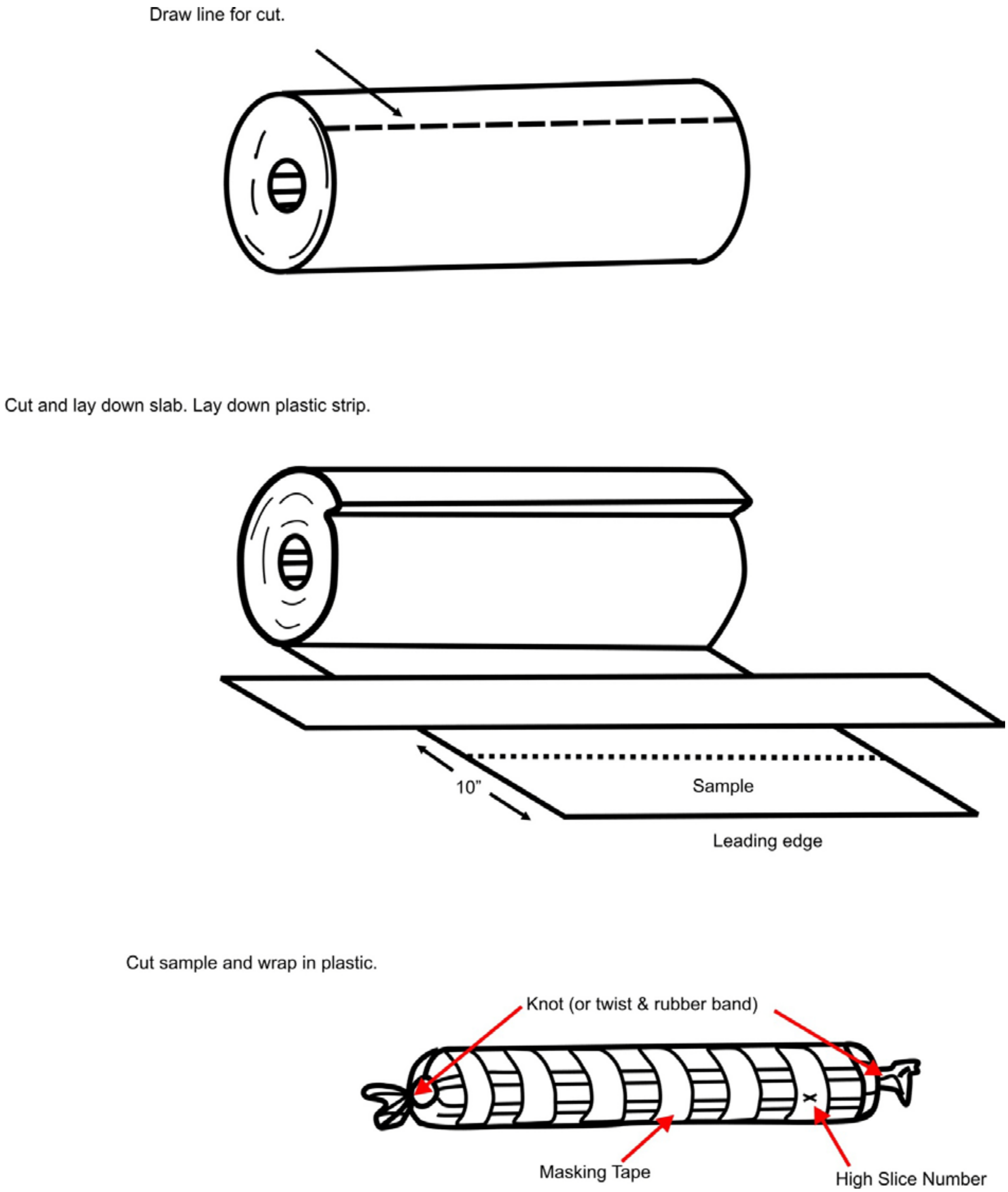



**Figure 6-3 Sampling for Tissue and Toweling**

## 6.3.3. Weighing and Drying of Tissue

To weigh and dry the samples:

1. Verify and record the oven setting and temperature.

2. Mark the roll off in units of slice width so that each segment centers on a slice boundary (marks at 14.5 and 15.5 give a segment centered on slice 15). Place a rubber band around each segment to hold it together. You should be able to identify the particular location on the reel that you were monitoring.

3. Working quickly, cut your desired segment(s) off and weigh it, keeping the cut ends of the roll covered with small plastic bags while you weigh the segment(s). Keep the segments in order or mark each one before weighing. Record the weight in the column **Wet Sample + Bag**.

4. After all of the samples have been cut off and weighed, unwrap each one and weigh the plastic that was weighed with it. Include any rubber bands. Record this weight in the column **Wet Bag**.

5. Check that the oven does not contain any other samples. Dry only as many segments at one time as can be placed in the oven without crowding.

6. Place the segments in the oven, fanning out the layers as much as possible.

7. Hang a sign on the oven to prevent others from changing the oven setting, opening the door, or putting other samples in it.

8. Allow the samples to dry for 4 hours at 105.0 ±0.5°C (221.0 ±0.9°F).

9. While the samples are drying, mark new plastic bags and weigh them and a rubber band for each sample. Do not re-use the **Wet Sample** bags because trapped moisture may cause errors.

10. Remove one sample at a time from the oven and quickly put it in a pre-weighed bag in the hot oven air. Keep the oven door open only long enough to get the one sample bagged.

WARNING

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

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

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

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

    *Wet Sample = Wet Sample+Bag - Wet Bag*

    *Dry Sample = Dry Sample+Bag - Dry Bag*

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

## 6.3.4. Calculating the Dynamic Correction

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

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

*MS dynamic intercept = Average[MS - MLAB]*.

If dynamic correction was turned **on** while collecting the data, calculate *MS* for each point the sensor value without dynamic correction (see Subsection 2.4 for definitions). In the simplest and most common case, *MS dynamic slope* =1; therefore, *MS = MS + MS dynamic intercept*. Use:

*MS dynamic intercept = Average[MS - MLAB]*.

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

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

If the range of moisture levels is narrow, the points may form a ball. In this case, the best you can do is to use a simple intercept correction. Use:

*MS dynamic intercept = Average[MS - MLAB]*

*MS dynamic slope = 1.*

If the range of values is great enough that a line can be discerned, perform a linear regression on *MLAB* (y) vs. *MS* (x) to obtain a slope and intercept. Calculate:

*MS dynamic slope* = slope, and

*MS dynamic intercept* = - intercept.

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

# 6.4. Dynamic Calibration for Fiber Weight

There are several approaches to evaluating the accuracy of the online basis weight measurement by comparing its measurements to basis weight that has been determined from careful measurements of weight and area of paper that the sensor has measured.

Three verification procedures are detailed:

- Reel Check Method
- Roll Check Method
- Lab Sample Method

Further description of each of these methods is provided in Sections 6.4.1- 6.4.3. Associated spreadsheets can be found in the appendices.

## 6.4.1. Reel Check Method

In the reel check method, the weight of the entire reel is obtained, and the weight of the spool is subtracted, leaving the weight of the paper in the reel. The total area of paper in the reel is calculated from reel length and trim. Dividing weight of paper in the reel by its area yields average basis weight for all of the paper in the reel. This value is then compared to the reel-average basis weight obtained from the Quality Control System's (QCS) reel report.

This approach assumes that the scanning measurement has measured enough of the last reel to produce a reel average value that accurately represents all of the paper in the reel. Of course, the sensor has not measured 100% of the paper – it has measured only a small percentage of all of the paper in the reel. This sample is assumed to be a statistically valid representation of all of the paper in the reel.

Advantages of this approach include:

- The sample is very large – an entire reel of paper – so there is little opportunity for sampling error to compromise the accuracy of the results.
- There is no laboratory testing, so there is no potential for lab testing error. However, errors in weighing the reel, as well as errors in determining reel length (from sheet speed and time) and paper width can contribute to error in this verification method.
- This procedure requires a means to obtain the weight of the entire reel:
    - A crane with an integral load-cell weighing system, or
    - A floor scale at the reel, or
    - An integral scale in the reel

If one of these is not available, either the Roll Weight or Lab Sample Method must be used.

#### 6.4.1.1. Reel Check Procedure

1. For all reel spools that will be used for this procedure, obtain the weight of each spool, and either record the spool weight in a visible location on each spool or mark each spool with a unique reference number (1, 2, 3, …..). Enter the spool weight next to its associated reference number in cells B32 to B41 in the *Basis Weight Dynamic Verification Tool* spreadsheet, *Reel Weight Method* tab (see Appendix C).
2. Ensure that the scale that will be used to read reel weight has been verified accurate to ±00.1%, for example, ± 0.01 ton in 10 tons).
3. Before proceeding:

   Talk with operators and examine the trend display on the QCS to ensure that the paper machine is operating in a stable manner, and that there have been no sheet breaks or upsets in basis weight or moisture during the production of the reel.

   Ensure that profile displays of basis weight and moisture are stable and do not change significantly from scan to scan.

Ensure that the correct paper grade is entered in the QCS. Selecting the correct paper grade number in the QCS ensures that the correct calibration constants are applied to the basis weight sensor signal to yield accurate basis weight measurement for that paper grade.

Print the Sensor Maintenance display for basis weight, which lists calibration values and correctors enabled, and retain it with the dynamic verification results for future reference.

4. Verify the accuracy of the reel speed in the QCS. If possible, check the speed of the reel using a hand-held tachometer, and confirm that the QCS displays the reel speed value to within ±0.1% of the tachometer value or better, for example, ± 3fpm or less in 3000fpm).

5. Using a tape measure, measure the sheet width at the reel, and confirm that the QCS displays the measured reel width value to within ± 0.1%, for example: ± 8mm or less in 7620mm or ± 0.3" or less in 300".

6. At the end of the reel, observe the turn-up process to ensure that the reel turn-up contact input to the QCS is well synchronized with the reel turn-up, to within ± 0.1% of the reel length in minutes (for example, ± 2.4 seconds in a 40 minute (2400 second) reel).

7. If the reel is weighed before any paper is slabbed off:

    - record the weight of the reel
    - record spool number and/or spool weight
    - note the reel length and reel average basis weight from the QCS reel report
    - record the trim as measured manually in step 5.

    Enter this and other reel information into the appropriate locations in the *Basis Weight Dynamic Verification Tool* spreadsheet, sheet 1, *Reel Weight Method*. The spreadsheet calculates and reports the error in the online basis weight measurement for this test. If paper is slabbed off the reel before it is weighed, valid verification results demand accurate determination of the area of paper that has been slabbed off.

8. Measure and record the reel diameter to ± 0.1%.

9. Measure and record the trim of the slabbed-off paper to ± 0.1% (only necessary if a trim change occurred at the top of the reel, and has been slabbed off).

10. Count the number of sheets that have been slabbed off.

11. Record these three values into the appropriate locations in the *Basis Weight Dynamic Verification Tool* spreadsheet, sheet 1, *Reel Weight Method*.

12. After the reel has been weighed, record the weight of the reel.

13. Record spool number and/or spool weight.

14. Note the reel length and reel average basis weight from the QCS reel report.

15. Record the trim as measured manually in step 5.

Enter this and other reel information into the appropriate locations in the *Basis Weight Dynamic Verification Tool* spreadsheet, sheet 1, *Reel Weight Method*. The spreadsheet calculates and reports the error in the online basis weight measurement for this test.

Before making any changes to the basis weight sensor calibration or dynamic offset, perform this procedure for least six reels of production on the paper grade.

## 6.4.2. Roll Check Method

The roll check method is recommended for basis weight verification if a scale is not available to weigh the entire reel. In this method, the roll weight, paper length, and width of each roll off the winder are used to estimate the average basis weight of all paper in the reel. The only paper not included in this analysis is reel slab-off and winder edge-trim, which are assumed to be close to the average basis weight of the reel. This value is compared to the reel average basis weight from the QCS reel report.

This approach assumes that the scanning measurement has measured enough paper from the last reel to produce a reel average value that accurately represents all of the paper in the reel. Of course, the sensor will not have measured 100% of the paper – it will have measured only a small percentage of all of the paper in the reel. This sample should be a statistically valid representation of all of the paper in the reel.

Advantages of this approach include:

- The sample is very large – nearly the entire reel of paper – so there is little opportunity for sampling error to compromise the accuracy of the verification results.

- There is no laboratory testing, so there is no potential for lab testing error. However, errors in weighing rolls and cores, measuring sheet length, and width can contribute to error in this verification method.

### 6.4.2.1. Roll Check Procedure

1. Ensure that the scale that will be used to read roll weights has been verified accurate to ±0.1%, for example, ± 1kg or less in 1000kg, or ± 1.0 lb. or less in 1000 lb.

2. Before proceeding:

   Talk with operators and examine trend displays on the QCS to ensure that the paper machine is operating in a stable manner, and that there have been no sheet breaks or upsets in basis weight or moisture during the production of the reel.

   Ensure that profile displays of basis weight and moisture are stable and do not change significantly from scan to scan.

   Ensure that the correct paper grade is entered in the QCS. Selecting the correct paper grade number in the QCS ensures that the correct calibration constants are applied to the basis weight sensor signal to yield accurate basis weight measurement for that paper grade.

   Print the Sensor Maintenance display for basis weight, which lists calibration values and correctors enabled, and retain it with the dynamic verification results for future reference.

3. After selecting a reel for verification, and in advance of the reel turn-up, weigh all of the roll cores with as much precision as possible, ideally ± 1%. Enter the core weights into the spreadsheet *Basis Weight Dynamic Verification Tool*, sheet 2, *Roll Weight Method* (see Appendix C).

4. After the selected reel has been turned up, obtain and record the reel average basis weight from the QCS reel report, and enter it into the *Basis Weight Dynamic Verification Tool*, sheet 2, *Roll Weight Method.* Print a hard copy of the reel report and retain it with the dynamic verification results for future reference.

5. Verify the accuracy of the paper speed on the winder, so as to be confident that the winder linear footage measurement is accurate. If possible, check the speed of the sheet using a hand-held tachometer, and confirm that the winder control displays the sheet speed value to within ± 0.1% of the hand tachometer value or better. If a sheet length

value is not available on the winder, or if the measurement is not accurate, mount a sheet-length counter at a location that will contact the sheet, or on a paper-carrying roll where there will be no sheet slippage.

6. If an external sheet-length counter is used, have the operator slow the winder at the end of every set (especially the end of the reel) to allow the length measurement to be accurately captured. Enter the roll lengths for each set into the *Basis Weight Dynamic Verification Tool*, sheet 2, *Roll Weight Method.* Entering the sheet length for Roll 1 in each set will copy that value to all other rolls in that set.

7. After the rolls are removed from the winder, use a tape measure to measure the width of each roll to ± 0.1%, if possible. Record roll width in inches, with any fractions converted to decimal equivalent. Enter roll widths into the spreadsheet.

8. Weigh each roll to ± 0.1% of the roll weight, for example, ± 1.0 lb. or less in 1000 lb. Record each roll weight into the spreadsheet.

9. Following entry of all necessary data into the spreadsheet, the average basis weight value from the tested reel is calculated, and compared to the QCS reel average basis weight.

10. Before making any changes to the basis weight sensor calibration or dynamic offset, perform this procedure for least six reels of production on the paper grade.

### 6.4.3. Lab Sample Method

This method compares basis weight value for a selected zone from the trend or filtered profile to basis weight of paper samples cut from that zone on the top of a reel of production. The basis weight of the paper samples is determined in the laboratory, and the results are compared to the basis weight sensor measurement for the sampled zone on the trend or filtered profile.

Advantages of this method:

If carefully performed, it can reveal the scanning basis weight measurement accuracy, building confidence in the measurement or providing valuable information on calibration changes that may be necessary.

Disadvantages of this approach include:

- It requires a good deal of preparation and sample handling, so it is very time consuming.

- Because of the amount of sample handling involved, there is the potential that the results could be compromised by sample conditioning, that is, moisture gain or loss. There is also a danger that laboratory error may occur in cutting, counting or weighing the samples.

- Because the total size of the lab sample is very small compared to the total area represented in a single low-resolution trend or filtered profile zone, there is a danger of sampling error compromising the results.

### 6.4.3.1. Equipment Required

- Tape measure (of adequate length to measure the full sheet width).

- Felt-tip marker or crayon to mark the paper on the reel or slab from which the coarse samples will be cut.

- Razor- sharp knife to cut the coarse samples from the reel or slab.

- Template of stiff paper or board to mark the position on the reel or slab where coarse samples will be cut. To ensure that the samples are large enough to accommodate the precision sample size, make the coarse-cut template about one inch larger on each side than the precision sample size. To simplify cutting the coarse samples, make this template square or rectangular, even if the precision sample shape is circular.

- Two plastic bags, large enough to accommodate the coarse samples without bending or folding. Label these bags *Coarse A* and *Coarse B*. Provide a means to seal the bags; use rubber bands, or use self-sealing (Ziploc®) bags.

- Two plastic bags, large enough to accommodate precision-cut samples without bending or folding. Label these bags *Precision A* and *Precision B*. Provide a means to seal the bags; use rubber bands, or use self-sealing (Ziploc) bags.

- Laboratory or work area controlled to TAPPI laboratory temperature and relative humidity specifications: 23.0 ± 1.0°C (73.4 ± 1.8°F) and 50.0 ± 2.0% RH.

- Latex or similar gloves for sample handling.

- Precision sample punch (recommended), precision sample cutter, or template and razor knife, for cutting samples of precise and repeatable dimension(s).

- Laboratory balance accurate to 0.05% of sample weight. A top-loading balance accurate to 0.01g or better is recommended.
- Forced-draft, temperature-regulated drying oven, set to 105.0° ± 0.5°C (221.0° ± 0.9°F), located in a room with constant temperature and humidity.
- *Basis Weight Dynamic Verification Tool.xls* spreadsheet. See Appendix C.

### 6.4.3.2. Lab Sample Procedure

Before proceeding, check for a mark on the sensor head indicating the centerline of the basis weight sensor. If no mark exists, take the sensor head offsheet and use masking tape and a pen or marker to make a temporary sensor centerline mark on the edge of the sheet guide on whichever head is accessible for head-position measurement under normal operating conditions (usually the lower sensor head).

1. Weigh sample bags labeled *Precision A* and *Precision B* (include rubber bands, if used), and record the weight of each bag separately in the *Basis Weight Dynamic Verification Tool.xls* spreadsheet, sheet 3, *Lab Sample Method*.

2. Before proceeding:

   Ensure that the basis weight sensor meets stability and static verification specifications.

   Ensure that Air Gap Temperature and Dynamic Z-axis sensors are operating properly.

   Ensure that the correct QCS grade number is entered for the grade being produced. Selecting the correct paper grade number in the QCS ensures that the correct calibration constants are applied to the basis weight sensor signal to yield accurate basis weight measurement for that paper grade.

   Ensure that all necessary correctors, including dynamic correctors, are both appropriate and enabled for the basis weight sensor.

   Print the Sensor Maintenance display for basis weight, which lists calibration values and correctors enabled, and retain it with the dynamic verification results for future reference.

3. Select the profile location to be sampled. Enter a filter factor of 0.2 for the basis weight low-resolution profile, or, if **UltraTrue** or **Truing** is

enabled, enter a filter factor of 0.33. Under these conditions, 90% of each zone's trend profile value is based on the last 11 scans, where a scan is one trip across the sheet. Use the Reel Scanner low-resolution trend profile display of basis weight (do not use the high-resolution profile or the CD Control display) to select an 18"- to 24"-wide section of the basis weight profile that is relatively flat, and that the shape of the profile does not change visibly from scan to scan.

4. Single-point the scanner at the slice, bin or measurement zone near the center of the profile section selected in step 2. Using the Quality Data display, monitor successive basis weight Now values. If the values vary by more than ± 1% from the average basis weight, the short-term variations are too high to perform a useful dynamic verification. If this occurs, check to see if another area of the profile is more stable. If a more stable area cannot be found, wait to proceed until the machine is operating in a more stable manner.

5. If the single-point basis weight measurement in step 3 is found to be satisfactorily stable, use a tape measure to measure from the edge of the sheet to the centerline of the sensor head.

WARNING

Exercise extreme caution when working near the scanner on an operating process. Unprotected open nips, rotating equipment, the dry-end pulper, and potentially hot machine components pose serious safety threats.

WARNING

Steam from the sheet or the dry-end pulper can obstruct vision in this extremely hazardous location.

6. Repeat step 5 on the reel or slab roughly halfway around the reel from the first sample. Place this sample in the bag labeled *Coarse B*. Close and seal the bag immediately.

7. In a temperature- and relative-humidity-controlled environment, using latex gloves, open the bag labeled *Coarse A*, remove and discard the top two or three sheets, then, working as quickly as possible, remove one sheet, close the bag, use the precision sample cutter or punch to cut a precision sample from the coarse sample, place the precision sample in the bag labeled *Precision A*, and close the bag, to minimize sample conditioning.

   Perform this step with the rest of the samples in the *Coarse A* bag, except for the last two or three sheets, which should be discarded. After cutting all of the samples, seal the *Precision A* bag, weigh the sample stack and bag to ± 0.01 g. and record the weight in the *Basis Weight Dynamic Verification Tool.xls* spreadsheet, sheet 3, *Lab Sample Method*. The number of individual samples in the bag should be sufficient to yield a total sample stack weight of 25 to 50 grams, not including the weight of the bag.

8. Repeat step 8 for the bag labeled *Coarse B*, using the bag labeled *Precision B* for the precision-cut samples.

9. After weighing the sample stacks in their bags, count and record the number of sheets in each bag, and record in the *Basis Weight Dynamic Verification Tool.xls* spreadsheet, sheet 3, *Lab Sample Method*.

10. After entering the above results, the spreadsheet calculates the basis weight of the Precision A and B samples, and calculates the average basis weight of both samples. This value is compared to the basis weight trend profile zone measurement, and the error of the online measurement is calculated.

Before making any changes to the basis weight sensor calibration or dynamic offset, perform this procedure for least six reels of production on the paper grade, using different profile zones for each test, if possible.

# 7. Static Calibration

This chapter describes all of the 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. Calibration Overview

A brief overview of the calibration procedure is:

- proper product samples must be collected for calibration
- samples used for calibration are prepared in the laboratory and bagged in Aclar® bags, and the same sample set is used for both the moisture and fiber weight calibrations
- the sensor must be verified to be stable and in good operating condition prior to shooting samples
- the laboratory weights and moisture levels are entered into the system software
- the samples are shot in the sensor using the proper 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

- once 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. Sample Selection

## 7.2.1. Standard Sample Selection

If feasible, prepare calibration samples for each grade. Otherwise, select a subset of grades that are representative of the lowest and highest basis weight, and that vary as much as possible in composition. Choose grades that represent a large percentage of the customer’s production, if known. Samples must be taken from where the sensor measurement is to be made.

Five moisturized samples of each grade are required for calibration (typically two, four, six, eight, and ten percent for reel scanners). Select five target moisture values spanning the range needed.

For the fiber weight calibration, a minimum of three weights spanning a basis weight range of $15g/m^2$ is required. If the grades provided do not span a large enough range, double-ply samples will have to be prepared. To do this, take the lowest weight product and stack two sheets together, making a double ply sheet, with double the basis weight of the original single ply. If this still does not result in enough basis weight range, make double ply samples from the next lightest grade, until a span of $15g/m^2$ is created. Double ply samples are to be handled with the plies held together as one in all following steps.

# 7.2.2. Sample Preparation

## 7.2.2.1. Materials Required

In addition to product and any backing samples provided by the customer, the following materials are required for sample preparation:

- 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°C±0.5°C (221°F±0.9°F), with drying racks and accurate thermometer
- analytical balance, accurate to 0.1 mg (0.0001g)
- Faraday cage balance pan
- Aclar bags 12.07cm by 12.7cm (4.75 inches by 5.0 inches)
- bag sealer
- sample die 11.43cm (4.5-inch) diameter mallet for die, and wood or hard rubber backing block for sample die
- permanent ink pen for marking bags
- KimWipes® or equivalent lint-free tissue
- isopropyl alcohol in a dispenser (for cleaning bags)
- aluminum foil for sample protection
- humidity cabinets, or beaker of boiling water (covered by fine-meshed screen), or a cold-water humidifier, and tweezers
- worksheet *Moisture_samples.xls* (see Appendix B)
- rubber gloves and safety glasses

# 7.2.3. Preparing Samples (Fiber Weight and Moisture)

Die out five samples for each grade selected, handling any double-ply samples as though they were a single layer. All calculations are done in grams per square meter ($g/m^2$).

CAUTION

Wear safety glasses when die-cutting samples.

ATTENTION

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

ATTENTION

Use gloves and keep the samples and the Aclar bags clean and dry. Fingerprints and especially dust will cause errors.

ATTENTION

Do not mark samples. Mark only bags. Ink on the samples will cause measurement errors.

Follow these steps to make a single set of samples (the same series of steps is used for both the moisture and the fiber weight calibration):

1. Place all samples in the 105°C±0.5°C (221°F±0.9°F) oven.
2. Make sure that no other materials are drying in the oven and that no one will disturb them. Be careful to keep any double-ply samples together.
3. Keep the samples in the oven for a minimum of four hours to ensure they are bone-dry.
4. While the samples are drying in the oven, prepare two Aclar bags for each sample:
   - one bag for weighing the bone-dry sample (the dry bag)
   - one bag for containing the moisturized sample (the wet bag)
5. Label each bag with the sample ID, grade, and target moisture level.
6. Clean each bag, using an alcohol-soaked lint-free cloth (be careful not to wipe off the label), and weigh it.
7. Record bag weights on the moisture sample worksheet, and store cleaned bags in a clean plastic bag until the moment of use.

8. When the samples are dry, remove each bone-dry sample, quickly insert it in its dry bag and seal it, removing excess air. Be careful to keep any double-ply samples together.

9. Weigh the bone-dry samples and subtract the bag weights to determine the dry sample weight.

10. Enter the dry sample weight on the worksheet.

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

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

    where

    T = target sample weight in grams

    M = target percent moisture

    Dg = bone-dry sample weight in grams

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

13. For each sample to be moisturized, remove it from its dry bag (cut the bag open carefully) and bring it up to target moisture and weight. Keep double-ply samples together. For moisture up to four percent, this can be done in the balance under ambient conditions. For higher moistures, it will be necessary to use steam or conditioning chambers. To steam samples:

    Hold the samples over boiling water or cold-water humidifier and steam both sides evenly.

    Use a fine-mesh screen over any boiling water as large errors can result from uneven wetting.

    Be careful to keep any double-ply samples together.

**ATTENTION**

Drops from spattered water or condensed steam will cause large errors. Discard and replace any samples that collect water drops.

14. Let each sample dry to the target weight on the balance, then seal it quickly in its new wet bag, removing excess air, and being careful not to fold or wrinkle the samples.

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

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

    Basis Weight (g/m$^2$) = Wet Sample Weight (g) • 97.46

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

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

    Calculate the water weight per unit area in g/m$^2$.

    WW(g/m$^2$) = Water Weight(g) • 97.46

17. Calculate the percent moisture:

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

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

19. When it is time to measure the samples in the sensor, clean each sample bag with an alcohol-soaked lint-free cloth being careful not to wipe off the label. Reweigh and recalculate the lab values before measurement on the sensor.

## 7.2.4. Hardware Checks

Before shooting calibration samples, ensure that the sensor is stable and up to specifications. Perform the following tasks before proceding:

- In the **Sensor Maintenance** display, set the **Background Integration** time to four seconds. Perform two Backgrounds. The background readings should repeat to within two percent.

- In the **Sensor Maintenance** display, set the **Standardize Integration** time to four seconds. Set up a cycle of 30 references over a 10 minute period. The resulting channel ratios should be within five percent of each other. The standard deviations of the standardization ratios $Rs_i$ should be within the following limits:

$$2\sigma[RS_i / Avg(RS_i)] < 0.001$$

for each channel standardize ratio

## 7.2.5. Data Entry

Sensor calibration is performed using the **Infrared Sensor Calibration** display in Experion MX (Figure 7-1). The display is accessed by clicking **Advanced** on the **Sensor Maintenance** display while in maintenance mode and with the appropriate sensor processor selected (typically the Reel IR Sensor Processor).

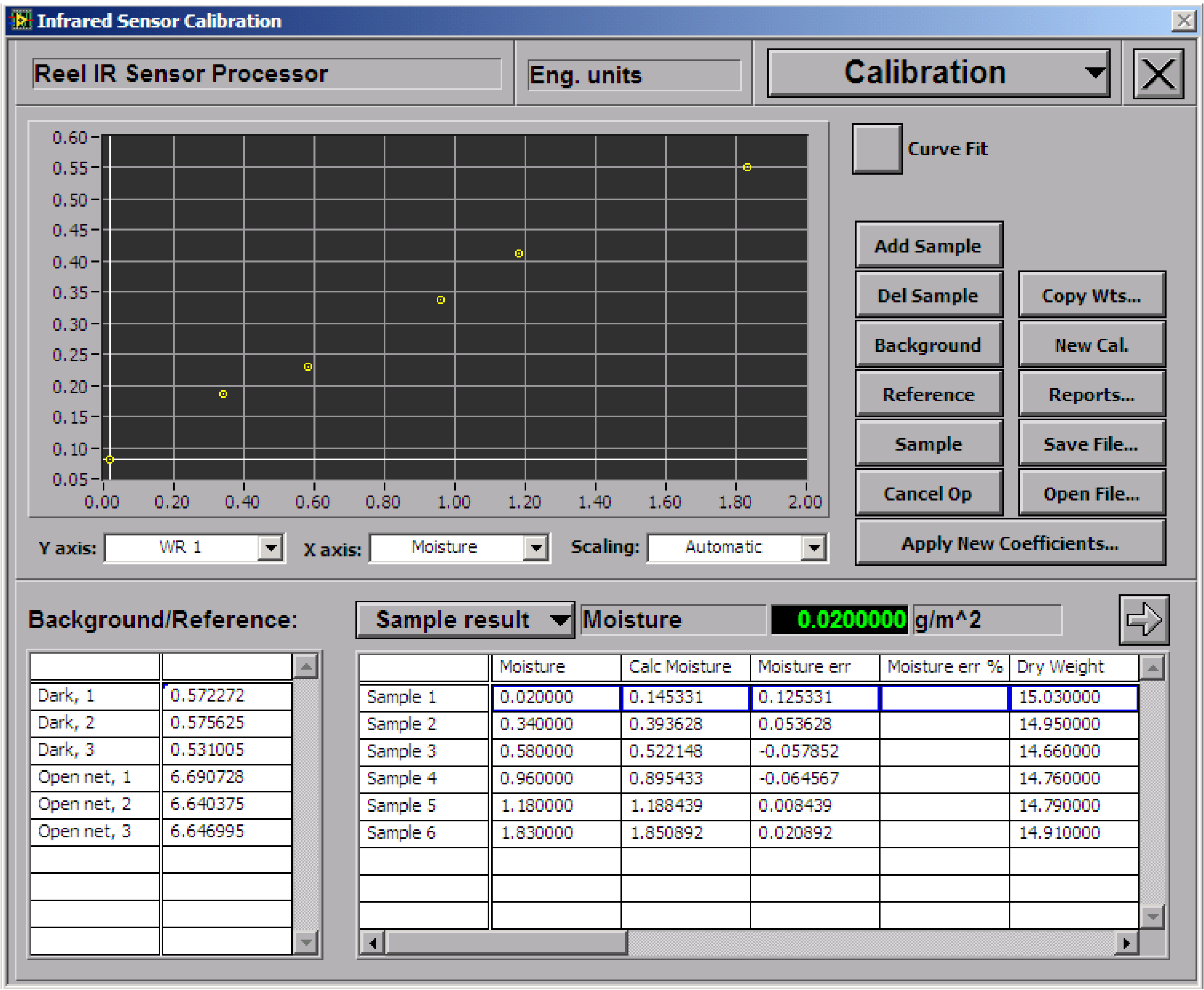



**Figure 7-1 Infrared Sensor Calibration Display**

To use the **Infrared Sensor Calibration** display:

1. Click the upper-right drop-down arrow and select **Calibration** to call up the calibration display (see Figure 7-1).

2. Click **Open File…** to import a calibration file previously saved using **Save File...** from the **Infrared Sensor Calibration** display.

3. If you do not have previously entered data, click **Add Sample** to create the number of sample entries required. Then enter the dry weight and moisture values for each sample in the green numbers text box above the table. Press **ENTER** to advance to the next sample.

4. Click the right-pointing arrow button, to the right of the green numbers text box, to toggle between moisture and dry weight values.

5. When the data for all samples have been entered, click **Save File…** to save the raw data. Doing so creates a binary file that you can reload using **Open File…** from the **Infrared Sensor Calibration** display. The binary file is usually saved in the directory *C:\Program Data\Honeywell\Experion MX\Database\Calibration data\Infrared.*

**6.** Click any field in the first row. You are now ready to start shooting samples.

## 7.2.6. Sample Measurement

1. At the scanner, click the **Offsheet** button to take the heads offsheet. Engage the **Crash** switch so that the head cannot be inadvertently sent back onsheet.

2. Split the heads and clean the quartz-Teflon® plates if they are dirty.

3. Bring the heads back together.

## 7.2.7. Reference Procedure

1. Set the **Reference Integration Time** to four seconds on the **Sensor Maintenance** display.

2. Slide the paddle into the gap and position it properly (ensure that the interlocking black rings are approximately centered over the quartz-Teflon plates). The initial reference will be done without any sample present.

3. Ensure the paddle handle is perpendicular to the sheet guide.

4. Turn on the paddle motor to start the sample rotating. Either click the **Reference** button on the scanner (displays green light), or flick the switch on the sample paddle to **Ref** (displays small amber LED). A reference will be taken.

5. When the indicator light (either on paddle or on scanner frame) goes out, remove the paddle from the gap.

6. For interlocking black rings, the voltages should not be lower than those for the empty gap by more than 0.5V. If the channel voltages and ratios have changed more than this, check the paddle setup and alignment, as the light may be partially blocked.

## 7.2.8. Sample Procedure

The sampling procedure is identical to the reference procedure, but with a sample on the paddle:

1. Set the **Reference Integration Time** to four seconds on the **Sensor Maintenance** display.

2. Load a sample (in an Aclar bag) between the black locking rings, sliding them to lock the rings.

3. Place the sample with the ring onto the paddle fixture.

4. Slide the paddle into the gap and position it properly (ensure that the interlocking black rings are approximately centered over the quartz-Teflon plates).

5. Ensure the paddle handle is perpendicular to the sheet guide.

6. Turn on the paddle motor by flicking the left-most switch on the handle to start the sample rotating. Either press the **Sample** button on the scanner (displays green light), or flick the switch on the sample paddle to **Sam** (displays small amber LED). A reading will be taken.

7. When the indicator light (either on paddle or on scanner frame) goes out, remove the paddle from the gap.

8. Repeat until all samples have been shot in the sensor.

9. Remove the sample paddle and disengage the **Crash** switch when finished.

10. On the **Infrared Sensor Calibration** display, save the raw data by clicking **Save File…**.

# 7.2.9. Data Reduction and Fitting

Once all samples have been shot in the sensor, the data is fit for both moisture and dry weight. Toggle between the two fits by using the arrow above the data table.

## 7.2.9.1. Moisture Fit

To enable fitting, click the **Curve Fit** button. The top right of the **Infrared Sensor Calibration** display (see Figure 7-2) will change to show the working ratios that are included in the fit, as well as the fit coefficients. Ensure that the **Moisture** fit is selected (to the right of the **Sample result** drop-down arrow). Verify that the values in the **Background/Reference** table are reasonable (the dark voltages should all be approximately 0.5V and the open net voltages should be approximately 6.5V–8.0V).

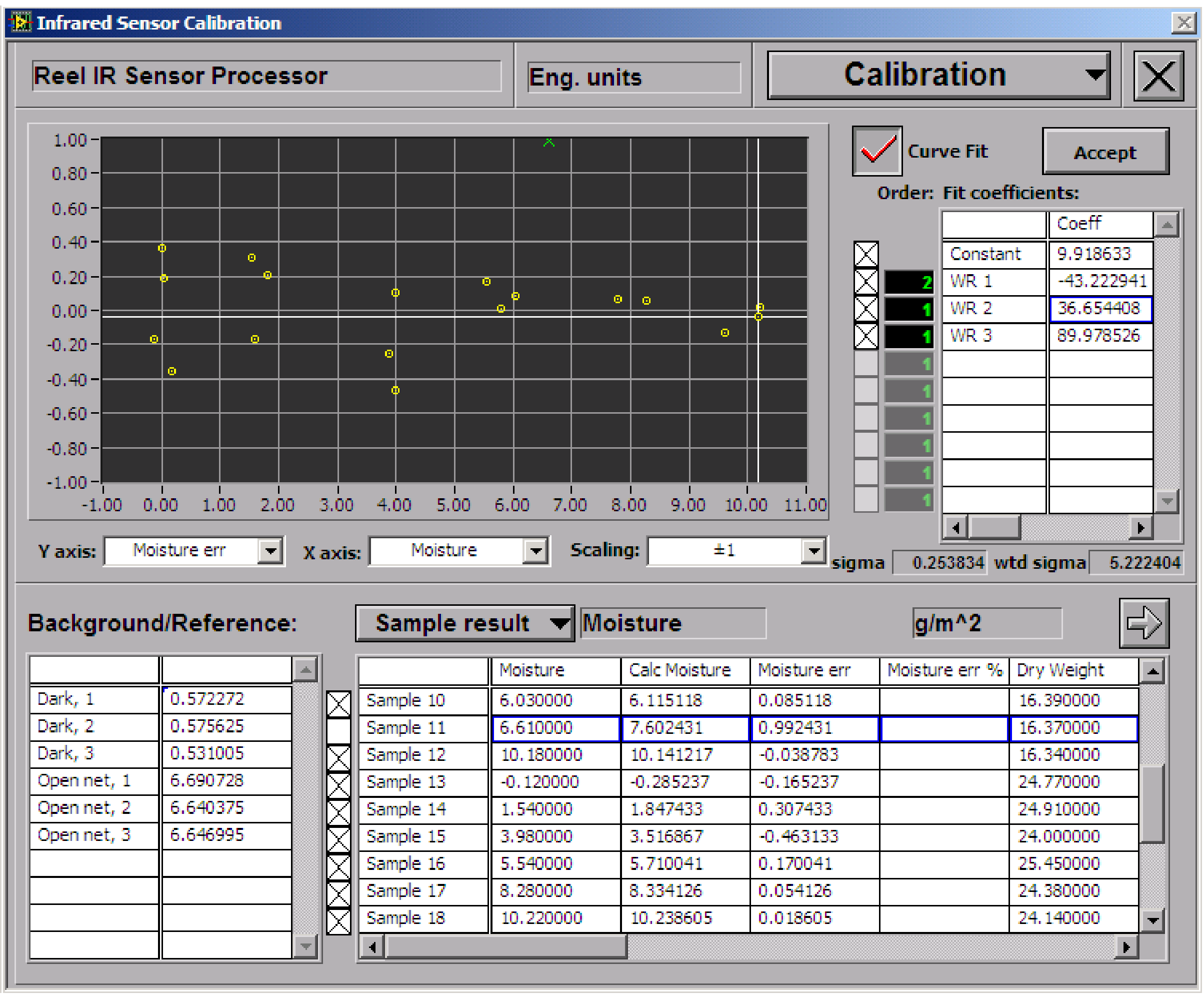



**Figure 7-2 Infrared Sensor Calibration Display (fitting for coefficients: percent moisture)**

To include a working ratio (WR) in the fit, select the X-box next to the applicable field under **Order: Fit coefficients** to mark it with a cross. For the moisture fit, select **WR1** and **WR3**. Depending on the weight range, **WR2** may also be required as shown in Figure 7-2. Type the order of the fit polynomial (1 for a linear fit, 2 for a quadratic) in the green numbers text box next to it. For applications with moisture between 0%–10%, a linear fit is typically selected (the **Order** should be 1). For higher moisture contents, a quadratic fit may be required (the **Order** should be 2 for **WR1**).

The program will generate the best fit to the data and display the values of the fit parameters immediately in the **Fit coefficients** table in the upper-right corner. It will also show the calculated moisture and the error associated with each point, if the **Sample result** is chosen from the drop-down menu above the data table.

Change the display to plot **Moisture err** (*not* **moisture error %**!) on the **Y axis, Moisture** on the **X axis**, and change the scaling to **Automatic** as shown in Figure 7-2. The values on the Y axis are in percent, so that a value of 0.5 means an error of 0.5% in moisture. You may exclude outliers from the fit by moving the crosshairs on the graph and snapping them to a point. The corresponding line in the data table will be highlighted (you may need to scroll to find it) and you can then deselect the point by clicking on the **X** beside it. Points marked by an X in the table are included in the fit. Points excluded from the fit show up as green crosses on the graph. In general, the calculated moisture of all the points should be within 0.25% of the lab value. It is very unusual to remove more than a single outlier from a grade.

For tissue applications, do not subdivide the samples into grades. A single group containing all grades should be sufficient.

The best fit is the one that has the fewest parameters, with the smallest possible parameter values, and still achieves acceptable accuracy. Remove each parameter in turn and observe the effect on the fit. Remove any parameter that does not improve the fit quality by more than 10%, or, in other words, that does not decrease the **sigma** value by less than 10%. The number of fit parameters (including the constant) should be less than half the number of samples included in the fit (for example, for six data points or samples there should be *at most* two fit parameters).

Once you are satisfied with the moisture fit, click **Accept** and advance to the dry weight fit.

There are no correctors to the moisture fit.

### 7.2.9.2. Dry Weight Fit

Proceed in the same way as for the moisture fit. Set up the plot to show **Dry Weight err** (not in percent) on the **Y axis** and **Dry Weight** on the **X axis**, as shown in Figure 7-3.

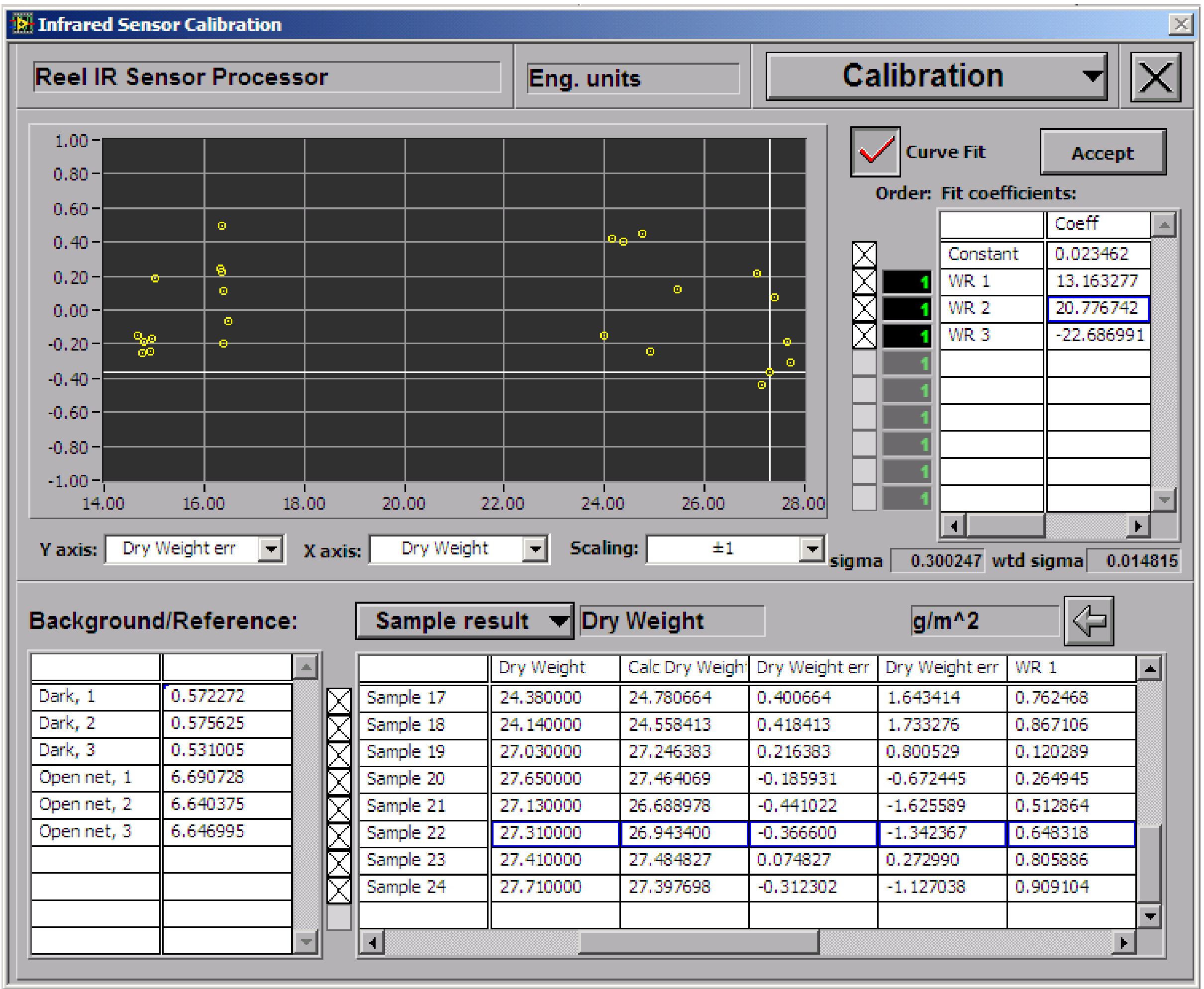



**Figure 7-3 Infrared Sensor Calibration Display (fitting for coefficients: fiber weight)**

For the dry weight fit, all ratios should initially be included. If the weight range is higher than 15g/m$^2$, a quadratic in **WR2** and/or **WR3** may be required.

Remove each parameter in turn and observe the effect on the fit. Lower any quadratic term to linear and observe the effect on the fit. Remove or lower any parameter that does not improve the fit quality by more than 10%. In general, the calculated dry weights should be within 1.0g/m$^2$ of the lab values, for grades with similar furnish.

Parameter values over 400 are to be avoided as they cause large increases in errors from other sources (passline, temperature, and so on).

For tissue applications, do not subdivide the samples into grades. A single group containing all grades should be sufficient.

Once you are satisfied with the dry weight fit, click **Accept** to return to the **Infrared Sensor Calibration** display.

There are no correctors to the dry weight fit.

### 7.2.9.3. Saving Fit Results

Click **Save File…** to save the results of your work. The results can then be loaded and refit at any time.

Click on **Apply New Coefficients…** to apply the calibration results and to save the parameter values in the system for use during production. The **Apply new calibration coeffieicnts** display will appear (see Figure 7-4) enabling you to optionally apply the most recent reference voltages and the calibration coefficients for dry weight and moisture. Click the right-pointing arrow button to the right of the data table text box to toggle between the two fit results. Select the appropriate check box to apply the parameter values.

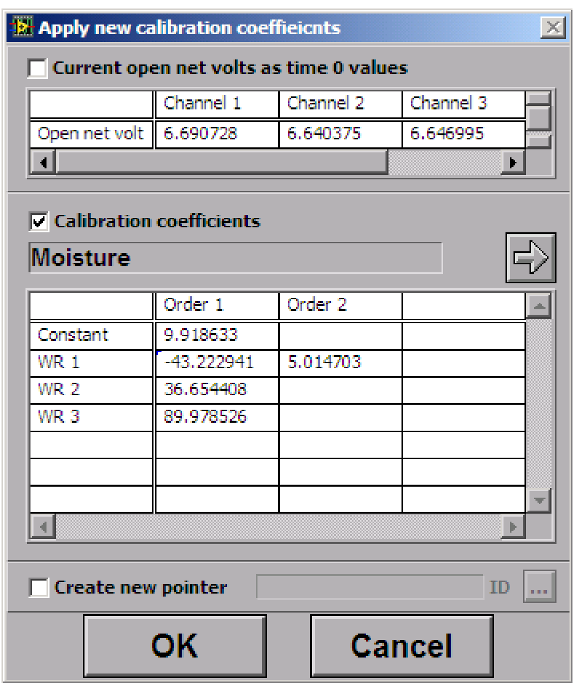



**Figure 7-4 Apply new calibration coeffieicnts Display**

Select the **Create new pointer** check box, then click the **...** button (to the right of the **ID** text box). This will call up the **Select ID and groups to apply** display as shown in Figure 7-5 showing the database table where the calibration coefficients will appear (**Irp21 calibration table** in Figure 7-5). Select the code (grade) 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 (grades). A check mark appears beside the code name(s) associated with the new calibration parameter values.

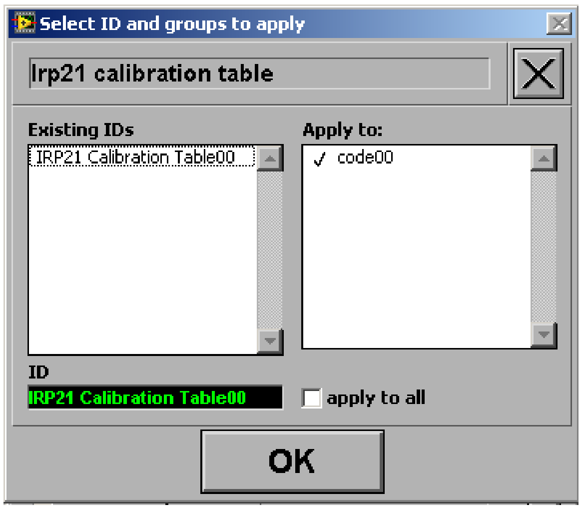



**Figure 7-5 Select ID and groups to apply Display**

Double click on the desired calibration table ID in which to store the parameter values. The name will appear in green text in the **ID** text box below the data tables.

Click **OK** to complete, then click **OK** again in the **Apply new calibration coeffieicnts** display.

## 7.2.10. 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 Subsection 7.2.4).
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 **Infrared Sensor Calibration** display in Experion MX (see 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 to 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 clicking **Copy Wts…**. If you will be verifying on new samples, you must enter the data for each sample, as described in Subsection 7.2.5. Then, shoot the samples you intend to verify, proceeding as described in Subsection 7.2.6 and making sure to clean the samples before shooting them. Once all samples have been shot, save the data to include the verification results.

### 7.2.10.1. Moisture Verification

Change the display to plot **Moisture err** (not **moisture error %!**) on the **Y axis, Meas Moisture** on the **X axis**, and change the scaling to **Automatic** as shown in Figure 7-6. The values on the Y axis are in percent, so that a value of 0.5 means an error of 0.5% in moisture. In general, the calculated moisture of all the points should be within 0.25% of the lab value. Make a note of any samples that measure with an error of greater than 0.25%. If more than 20% of the samples that were not omitted during calibration fail this criterion, the verification and/or calibration should be repeated until success is achieved. If more than one sample needs to be omitted per grade, then the omitted samples for that grade should be replaced with freshly made samples.

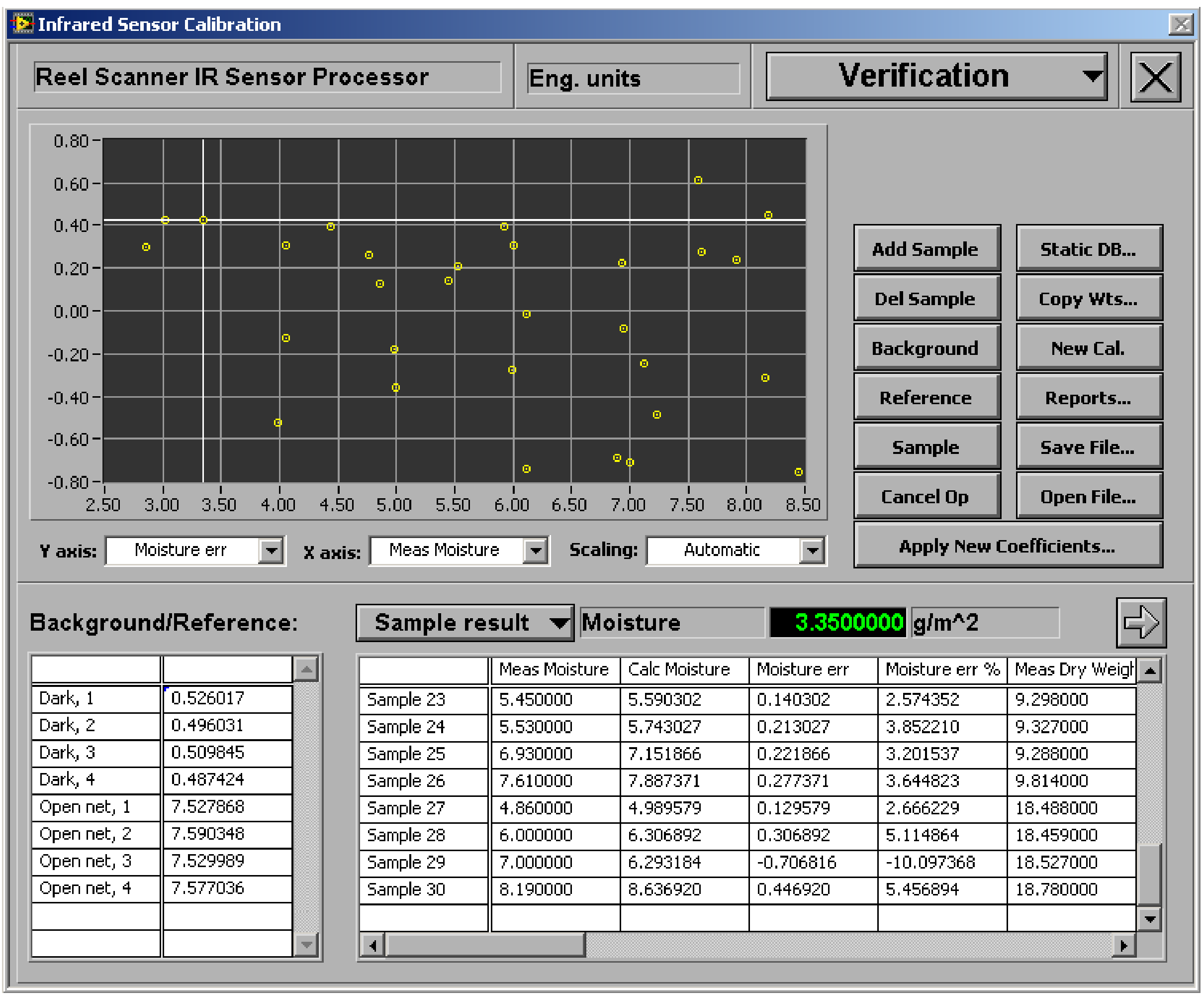



**Figure 7-6 Infrared Sensor Calibration Display (moisture calibration verification)**

## 7.2.10.2. Dry Weight Verification

Change the display to plot **Dry Weight err** on the **Y axis**, and **Meas Dry Weight** on the **X axis**, and change the scaling to **Automatic** as shown in Figure 7-7 (the figure shows **Dry Weight err%**; this is not recommended). In general, the calculated moisture of all the points should be within 1.0g/m$^2$ of the lab value. Make a note of any samples that measure with an error of greater than 1.0g/m$^2$. If more than 20% of the samples that were not omitted during calibration fail this criterion, the verification and/or calibration should be repeated until success is achieved. If more than one sample needs to be omitted per grade, then the omitted samples for that grade should be replaced with freshly made samples.

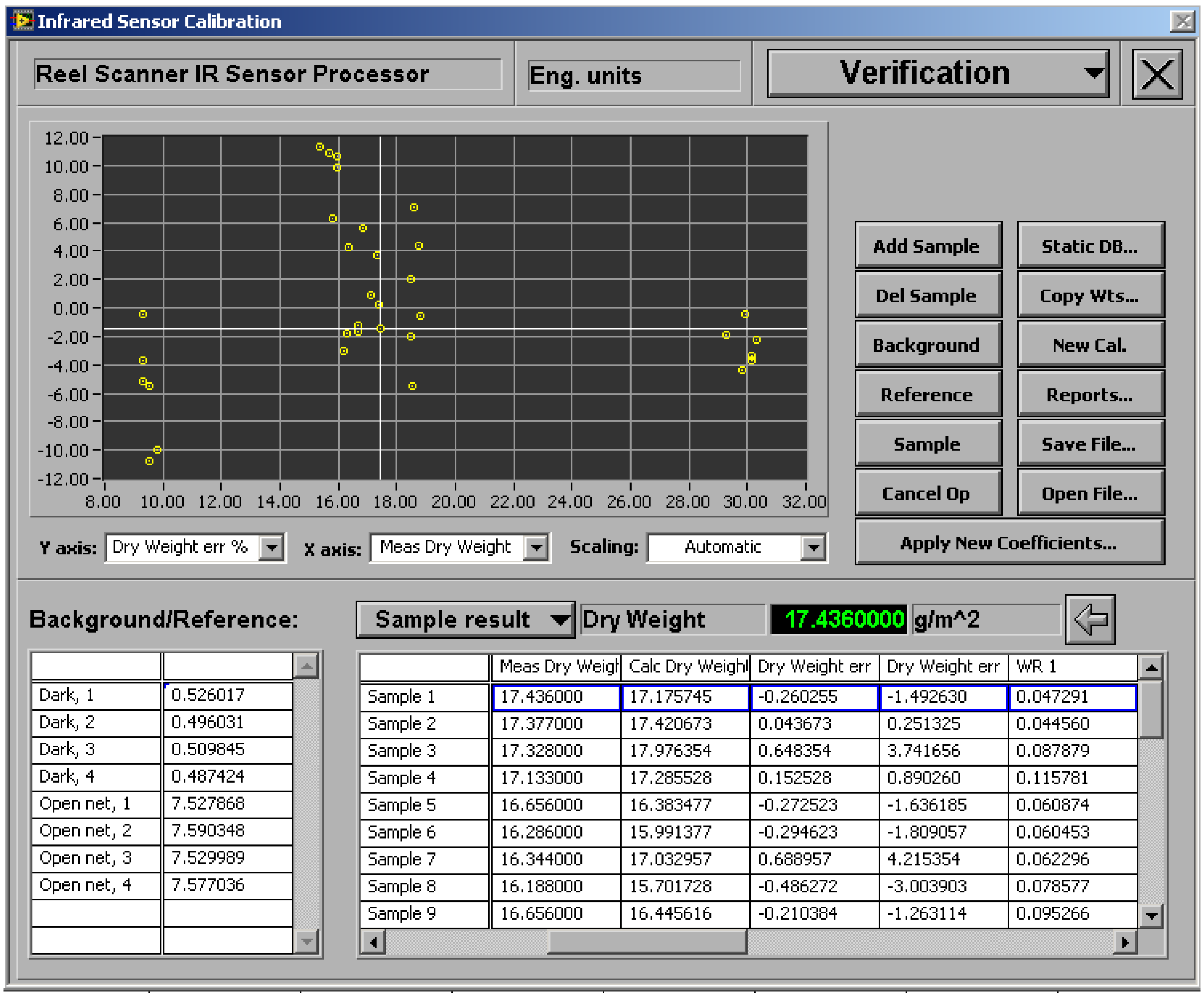



**Figure 7-7 Infrared Sensor Calibration Display (dry weight verification)**

### 7.2.10.3. Saving the Results

Click **Save File…** and save the binary file in a safe location. Click **Reports…** to produce hard-copy printouts of the results. When selecting the report, do not plot the error in percent; errors should be plotted in **customer units** (GSM) for the basis weight and **percent moisture** for the moisture measurement.

# 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 user should adjust the interval on an as-needed basis.

**Table 8-1 Preventive Maintenance Internal Checklist**

| **Procedure** | **Daily** | **Weekly** | **Monthly** | | **Yearly** | | | **Procedure Details** |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | > | 1 | 2 | 5+ | |
| **Clean Sensor Window** | XX | | | | | | | Section 9.1 |
| **Check Standardize and Background Values** | | X | | | | | | Section 9.2 |
| **Check Short-term Stability** | | | X | | | | | Section 9.3 |
| **Replace Infrared Lamp** | | | | 6 m | | | | Section 9.4 |
| **Assess gauge stability using glass samples** | | X | | | | | | Section 9.5 |
| **Dynamic Verification** | | X | | | | | | Section 6.3 |

# 9. Tasks

This chapter describes procedures for maintaining optimal infrared (IR) moisture sensor function, and procedures for performing 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. Clean Sensor Window

Inspect the sensor's *Standardize Report* daily to check for changes in the **Ratio to Time 0** for **Channel 3**. This report is updated every time the sensor standardizes during normal operation. This ratio is particularly sensitive to the dirt level. If the level has dropped markedly, clean the window.

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-ACT-001 | **Applicable Models:** | All |
| **Type of Procedure:** | Inspect | **Expertise Level:** | Operator |
| **Priority Level:** | Average | **Cautions:** | None |
| **Availability Required:** | Scanner Offsheet | **Reminder Lead Time:** | |
| **Overdue Grace Period:** | | **Frequency (time period):** | 1 day |
| **Duration (time period):** | 5 minutes | **# of People Required:** | 1 |
| **Prerequisite Procedures:** | | **Post Procedures:** | |
| | Part Number | Quantity | Lead Time |
| **Required Parts:** | | | |

| | Part Number | Quantity | Lead Time |
|---|---|---|---|
| **Required Tools:** | Cloth or paper towels<br>Thin stick<br>Methanol or isopropyl alcohol | | |

Print out the *Standardize Report*:

1. In the **Sensor Reporting** display, click the drop-down arrow at the top-center of the page and select **IRP Standardize Report** (see Figure 9-1).

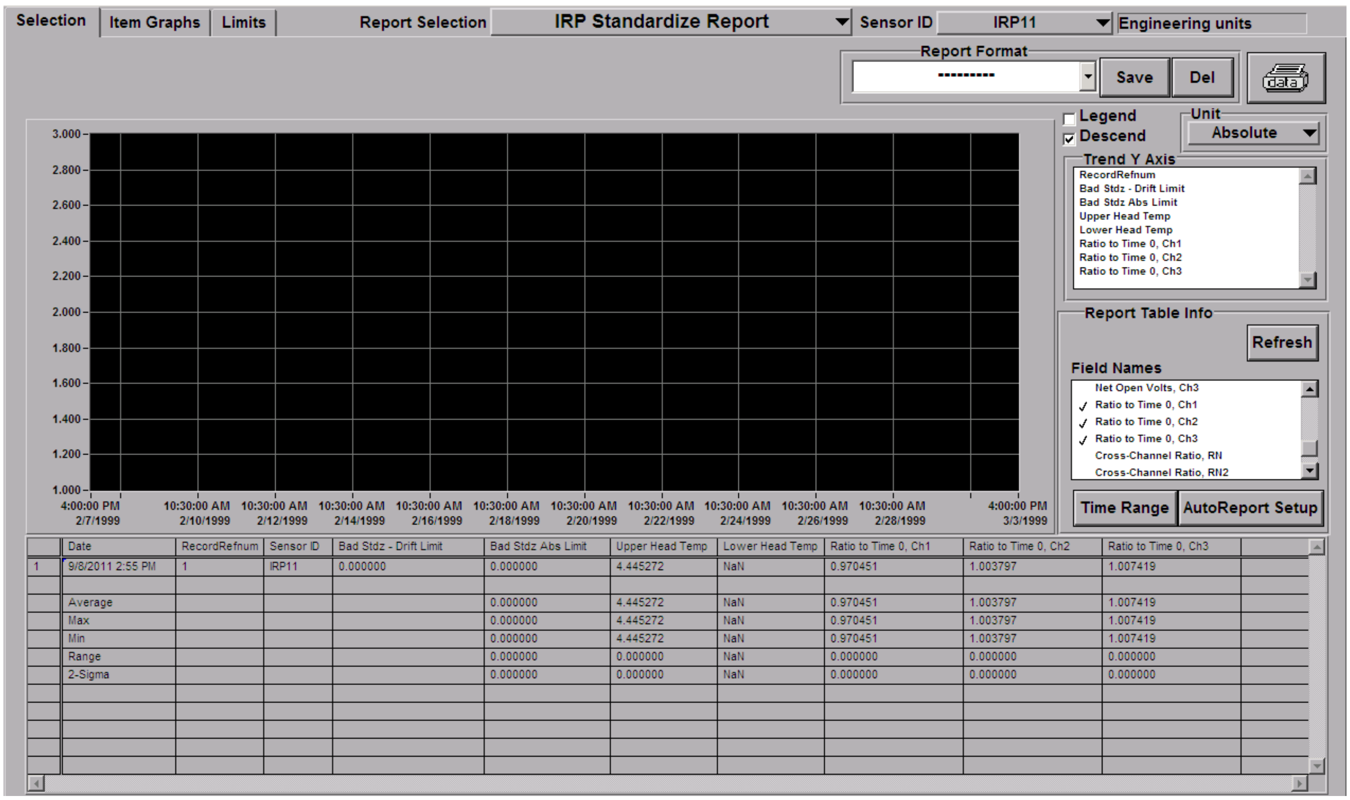



**Figure 9-1 IRP Standardize Report**

2. Select the desired ratios in the **Field Names** text box by double-clicking on them. They will be added to the hard copy report. Click the printer button at top-right of the display to print the report.

3. If the dirt build-up causes the ratio to drop dramatically, clean the plates more often. Dirt and/or dust accumulation will be most evident in the fiber weight measurement and will cause discrepancies between the sensor readings and any samples taken from the process.

4. Gently wipe the sensor windows with a cloth or paper towel wrapped around a thin stick and dipped in methanol or isopropyl alcohol.

CAUTION

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

# 9.2. Check Standardize and Background Values

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

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-ACT-002 | **Applicable Models:** | All |
| **Type of Procedure:** | Inspect | **Expertise Level:** | Operator |
| **Priority Level:** | Average | **Cautions:** | None |
| **Availability Required:** | None | **Reminder Lead Time:** | |
| **Overdue Grace Period:** | | **Frequency (time period):** | 1 week |
| **Duration (time period):** | 5 minutes | **# of People Required:** | 1 |
| **Prerequisite Procedures:** | | **Post Procedures:** | Realign After Replacing Parts |
| | Part Number | Quantity | Lead Time |
| **Required Parts:** | | | |
| | Part Number | Quantity | Lead Time |
| **Required Tools:** | | | |

Section 9.1 describes how to print out the *IRP Standardize Report*. The standardize volts of all three channels should be within 0.5V of each other.

Standardize volts are expected to move up and down as the head temperature changes. Channel volts decrease (increase) when head temperature increases (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, tuning fork and/or chopper, or lamp and/or lamp holder.

Excessive uncorrelated drift of one or more channels (channels that drift differently from each other) may be due to one or more bad detectors (see Section 10.2).

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

The **IRP Background Report** should also be printed out. It is also available from the **Sensor Reporting** display. On this report, the dark volts for the three channels should be between 0.45V and 0.6V. If a dark volt is not within these limits, consult the troubleshooting table.

ATTENTION

The maximum number of records per sensor in the sensor reports file is 100 for background and sample, and 1000 for reference operations. When the maximum number of records is reached, the newest record replaces the oldest record in the file, so it is advisable to save the sensor report regularly.

# 9.3. Check Short-term Stability

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

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-ACT-003 | **Applicable Models:** | All |
| **Type of Procedure:** | Maintain | **Expertise Level:** | Operator |
| **Priority Level:** | Average | **Cautions:** | None |
| **Availability Required:** | Scanner Offsheet | **Reminder Lead Time:** | |
| **Overdue Grace Period:** | | **Frequency (time period):** | 1 month |
| **Duration (time period):** | 20 minutes | **# of People Required:** | 1 |
| **Prerequisite Procedures:** | | **Post Procedures:** | |
| | Part Number | Quantity | Lead Time |
| **Required Parts:** | | | |
| | Part Number | Quantity | Lead Time |
| **Required Tools:** | | | |

To check background measurements:

1. Go into maintenance mode (see Chapter 6).
2. On the **Sensor Maintenance** display (see Figure 9-2), set **Bkgd. Integr. Time** for background (in seconds) to **4.00**.

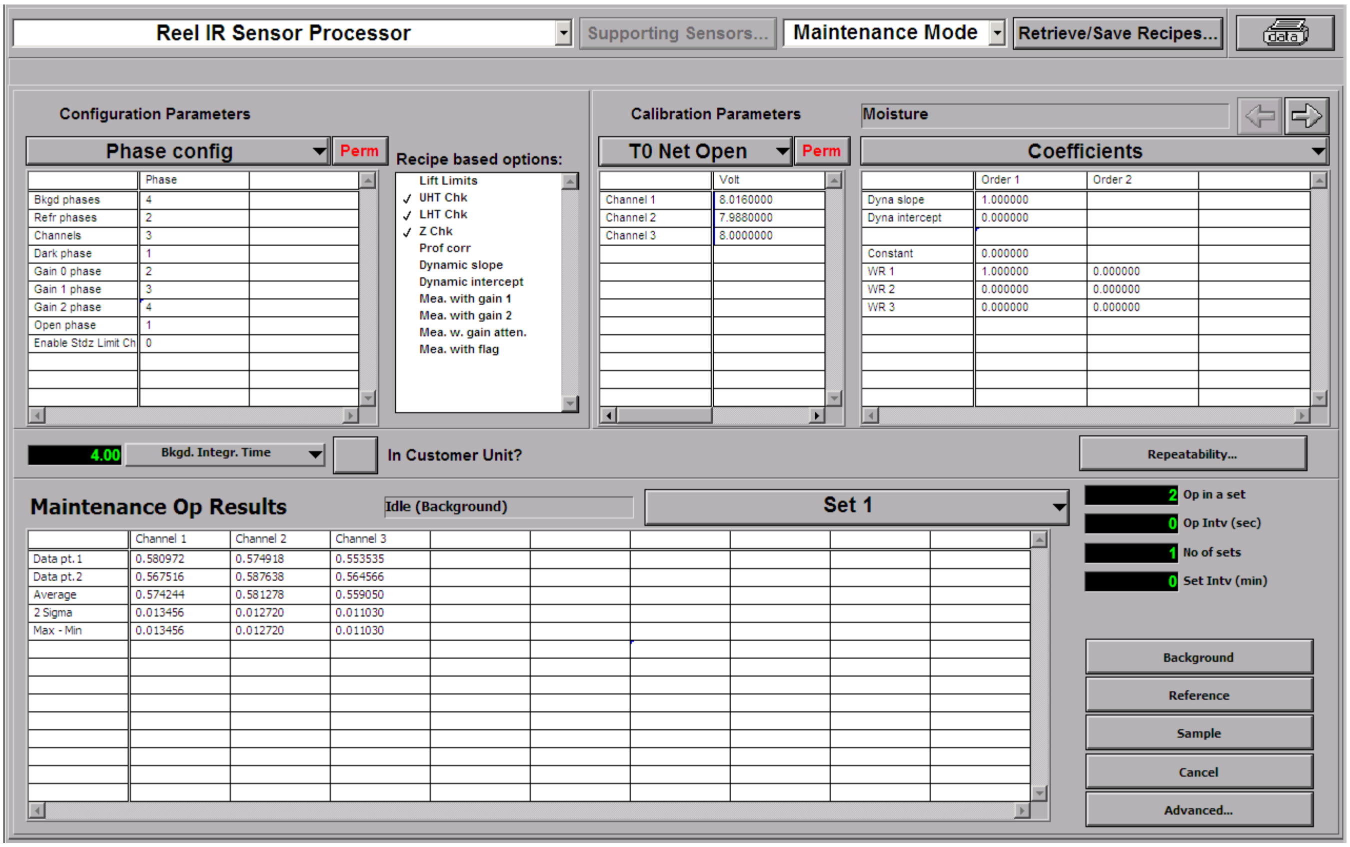



**Figure 9-2 Sensor Maintenance Display**

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

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). Click **Reference** to perform 30 references over approximately 10 minutes with nothing in the gap (see Figure 9-3).

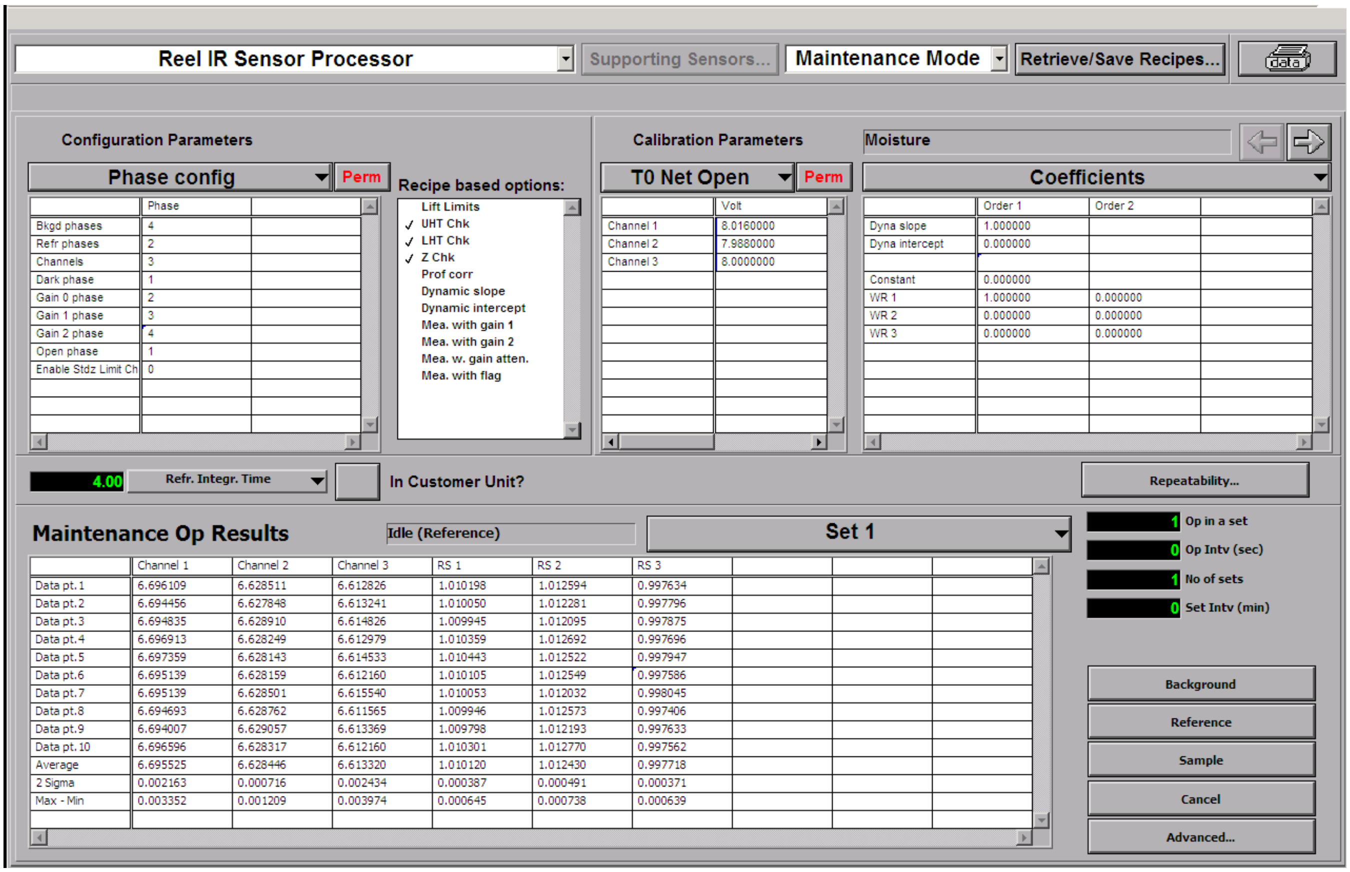



**Figure 9-3 Reference Display**

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 0.5V of each other. If all three of the following conditions are met, the sensor is within specifications:

- 2• $\sigma(RS_i)$/Average($RS_i$) < 0.0010 for $i$=1,2,3
- (Max-Min) volts for each channel are no more than 12mV (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. If the sensor still does not meet the specifications, consult the troubleshooting guide (see Section 10.2).

# 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 4.4V to prolong its life. The lifetime of the lamp can vary greatly from one lamp to another and is difficult to predict.

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-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<br>Screwdriver<br>Allen key | | |

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

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

4. Carefully remove the lamp holder.

CAUTION

| |
|---|
| Remove lamp using a cloth; the lamp might be hot. |

5. Inspect bulb leads. If the leads show signs of oxidation, it is imperative that both the lamp and the lamp holder be replaced.

6. Insert the new lamp in the lamp holder. Always use a cloth, 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, the position of the lamp needs to be adjusted:

   Connect an oscilloscope to TP2 and TP1(gnd) on one of the Fastcards in the receiver (Figure 9-6).

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

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

   Back the lamp off if any signal is too high.

10. Check and adjust gain and phase of Fastcards (see Section 9.11).

# 9.5. Check Stability

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

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-ACT-005 | **Applicable Models:** | All |
| **Type of Procedure:** | Maintain | **Expertise Level:** | Technician |
| **Priority Level:** | Average | **Cautions:** | None |
| **Availability Required:** | Scanner Offsheet | **Reminder Lead Time:** | |
| **Overdue Grace Period:** | | **Frequency (time period):** | 1 week |
| **Duration (time period):** | 20 minutes | **# of People Required:** | 1 |
| **Prerequisite Procedures:** | Check Short-term Stability | **Post Procedures:** | |
| | Part Number | Quantity | Lead Time |
| **Required Parts:** | | | |
| | Part Number | Quantity | Lead Time |
| **Required Tools:** | | | |

Verify glass-encased 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 glass samples basis weight and lab moisture values using the **`Open File…`** button or enter the values manually. See Chapter 7 for more details on data entry if required.
5. Perform a background reading.
6. Load the first grade for the glass sample(s) to download the calibration constants. Check that the proper calibration constants and correctors appear on the **Sensor Maintenance** display.

7. Perform a reference reading 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 0.5V and 8V for each channel.
9. Repeat Steps 6–8 for each grade.
10. Save the verification file using the **Save File…** button.
11. Seasonal shifts in the moisture readings are expected when verifying glass samples. However, a sudden shift in the readings is indicative of a problem.
12. Ensure that the proper gain settings, calibration constants, and correctors are loaded.
13. Confirm that the glass sample seal is not damaged (that is, use more than one glass verification sample).
14. If a hardware issue is suspected, check sensor alignment (see Subsection 9.10.1) and proceed to 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:** | Q4204-50-ACT-006 | **Applicable Models:** | All |
| **Type of Procedure:** | Replace | **Expertise Level:** | Technician |
| **Priority Level:** | High | **Cautions:** | Electric Shock |
| **Availability Required:** | Sensor Offline | **Reminder Lead Time:** | |
| **Overdue Grace Period:** | | **Frequency (time period):** | |
| **Duration (time period):** | 1 hour | **# of People Required:** | 1 |
| **Prerequisite Procedures:** | | **Post Procedures:** | Realign After Replacing Parts |
| | Part Number | Quantity | Lead Time |
| **Required Parts:** | | | |
| | Part Number | Quantity | Lead Time |
| **Required Tools:** | | | |

CAUTION

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

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

# 9.7. Realign After Replacing Parts

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-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:** | | | |

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

**Table 9-1 Replaced Parts Requiring Realignment of Other Parts**

| **Replaced Item** | **Check/Section** |
|---|---|
| **Source:** | |
| Lamp | Lamp focus (see Replace Infrared Lamp)<br>Gain, and phase of Fastcards (see Align Fastcard Board) |
| Tuning Fork | Tuning Fork Driver Board (see Align Tuning Fork Driver Board)<br>Gain and phase of Fastcards (see Align Fastcard Board) |
| Tuning Fork Driver Board | Align Tuning Fork Driver Board<br>Gain and phase of Fastcards (see Align Fastcard Board) |
| Power Supply Adapter Board | See Subsection 2.1.1.1 |
| **Receiver:** | |
| Detector Preamp | Peltier cooler voltages (see Subsection 2.1.3.2)<br>Gain and phase of Fastcards (see Align Fastcard Board) |
| Fastcard | Gain and phase of Fastcards (see Align Fastcard Board) |
| Temp Control Board | Peltier cooler voltages (see Subsection 2.1.3.2)<br>Gain and phase of Fastcards (see Align Fastcard Board)<br>Temperature output, if needed (see Subsection 2.1.3.2) |
| Unigauge Backplane Board | See Subsection 2.1.3.1<br>Gain and phase of Fastcards (see Align Fastcard Board)<br>Edge detect, if used (see Subsection 2.1.3) |

| Replaced Item | Check/Section |
|---|---|
| **Quartz Plates:** | |
| Optically Tuned Plates | Gain of Fastcards (see Align Fastcard Board);<br>Check dynamic calibration (see Section 6.3) and if required static calibration (see Chapter 7) |

# 9.8. Check for Water In Quartz-Teflon Plates

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

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-ACT-008 | **Applicable Models:** | All |
| **Type of Procedure:** | Inspect | **Expertise Level:** | Technician |
| **Priority Level:** | High | **Cautions:** | None |
| **Availability Required:** | Sensor Offline | **Reminder Lead Time:** | |
| **Overdue Grace Period:** | | **Frequency (time period):** | |
| **Duration (time period):** | 1 hour | **# of People Required:** | 1 |
| **Prerequisite Procedures:** | | **Post Procedures:** | Replace Quartz-Teflon Plates |
| | Part Number | Quantity | Lead Time |
| **Required Parts:** | | | |
| | Part Number | Quantity | Lead Time |
| **Required Tools:** | Blow dryer | | |

If water has entered a plate, the water will cause a very strong reduction in the channel 2V during standardize and/or reference and may be visible upon inspection.

Check for water in the plates:

1. Perform a reference reading.
2. Split the heads.

3. Heat the central area of the quartz-Teflon plate (7.5cm by 2.5cm; 2.95 inches by 0.98 inches) with a blow dryer to drive the water away.
4. You should see some change in appearance.
5. Once the plate is hot, quickly put the heads back together and perform several references.
6. If water has entered a plate, the channel 2 volts should increase when the plate is hot and then gradually fall as the plate cools down and the moisture redistributes itself. If water has entered a plate, it should be replaced as described in Section 9.9.

# 9.9. Replace Quartz-Teflon Plates

The IR sensor uses a pair of composite quartz-Teflon plates to create an optical cavity around the sheet, requiring the light to make multiple passes through the sheet to reach the offset optics detectors. The quartz is breakable. Replace any damaged or water-infiltrated plates.

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-ACT-009 | **Applicable Models:** | All |
| **Type of Procedure:** | Repair | **Expertise Level:** | Technician |
| **Priority Level:** | High | **Cautions:** | None |
| **Availability Required:** | Sensor Offline | **Reminder Lead Time:** | |
| **Overdue Grace Period:** | | **Frequency (time period):** | |
| **Duration (time period):** | 6 hours | **# of People Required:** | 1 |
| **Prerequisite Procedures:** | | **Post Procedures:** | Realign After Replacing Parts<br>Dynamic verification |
| | Part Number | Quantity | Lead Time |
| **Required Parts:** | See Table 9-2 | | |
| | Part Number | Quantity | Lead Time |
| **Required Tools:** | Exact-o knife<br>Flat head screwdriver<br>Alcohol<br>Tissue | | |

## 9.9.1. Remove the Plate

Remove the plate (see Figure 9-4) using an Exacto knife to cut the RTV around the edge and a screwdriver to pry it out.

Clean the RTV off the sheet guide using the knife and screwdriver, followed by alcohol and tissue.

It is not usually necessary to remove the light pipe, unless it is damaged. If the light pipe is visibly damaged, replace it as well as described in Subsection 9.9.3.

## 9.9.2. Install the Plate

The part numbers for materials needed to install the plate are listed in Table 9-2. Unless visibly damaged, the light pipe will not require replacement or removal.

**Table 9-2 Plate Installation Part Numbers**

| Description | Upper Head Part Number | Quantity | Lower Head Part Number | Quantity |
|---|---|---|---|---|
| Plate | 08607801 | 1 | 08607801 | 1 |
| Light Pipe | 00300000 | 1 | 00299900 | 1 |
| Clear RTV | 16000001 | As required | 16000001 | As required |

Optically tuned black border plates minimize dynamic correction. Because of the consistency of manufacture of the plates, a sensor does not normally require recalibration if the plates have been replaced. Verify the calibration (see Chapter 7).

1. Remove the sheet guide from the scanner head.
2. Place the sheet guide on a flat surface facing up.
3. Lay down a bead of clear RTV approximately 6mm (0.24 inches) wide around the inside of the rectangular recess for the plate.

4. Place the quartz-Teflon plate into its recess on the sheet guide, pushing against the RTV and light pipe until the plate is flush with the sheet guide. Optically tuned plates should be mounted with the white edges opposing:

   - on the lower head, the white edge should be upstream
   - on the upper head, the white edge should be downstream (see Figure 9-4)

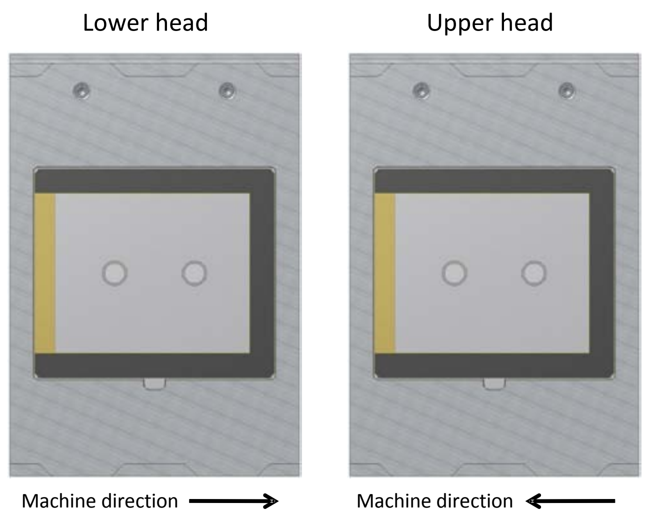



**Figure 9-4 Orientation of Black-Border Teflon Plates**

5. Using tissue and alcohol, wipe off any excess RTV around the plate. Ensure that the side cavities are filled with RTV.

6. Allow the RTV to dry for at least four hours.

7. Replace the sheet guide.

## 9.9.3. Replacing Light Pipes

In the unlikely event that a light pipe is visibly damaged, you will need to replace it. Table 9-2 lists the part numbers of the appropriate pipes. Removal of the light pipe is done once the quartz plate has been removed, as described in Subsection 9.9.1.

To remove a light pipe:

1. Remove the light pipe using a knife to cut away the RTV at the sheet guide and the RTV holding the light pipe to the head platform.

2. Push the light pipe in either direction to dislodge it.

3. Clean away the RTV using a knife, followed by alcohol and tissue.

To replace a light pipe:

1. Remove the sheet guide and place it on a flat surface facing up.

2. Insert the light pipe into the hole so that it projects approximately 6mm (0.24 inches) at the sheet guide.

3. Fill the circular cavity around the light pipe with clear RTV.

4. Push the light pipe back in until it only projects by approximately 3mm (0.125 inches).

5. Place the quartz-Teflon plate into its recess on the sheet guide, pushing against the RTV and light pipe until the plate is flush with the sheet guide. Optically tuned plates should be mounted with the white edges opposing:

   - on the lower head, the white edge should be upstream

   - on the upper head, the white edge should be downstream (See Figure 9-4)

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

# 9.10. Align Tuning Fork Driver Board

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

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-ACT-010 | **Applicable Models:** | Q4205-51 |
| **Type of Procedure:** | Maintain | **Expertise Level:** | Technician |
| **Priority Level:** | Average | **Cautions:** | Electric Shock |
| **Availability Required:** | Scanner Offsheet | **Reminder Lead Time:** | |
| **Overdue Grace Period:** | | **Frequency (time period):** | |
| **Duration (time period):** | 30 minutes | **# of People Required:** | 1 |
| **Prerequisite Procedures:** | | **Post Procedures:** | Align Fastcard Board |
| | Part Number | Quantity | Lead Time |
| **Required Parts:** | | | |
| | Part Number | Quantity | Lead Time |
| **Required Tools:** | Voltmeter<br>Oscilloscope<br>Small flat head screwdriver | | |

# 9.10.1. Check Alignment

The tuning fork driver board assembly, is shown in Figure 9-5.

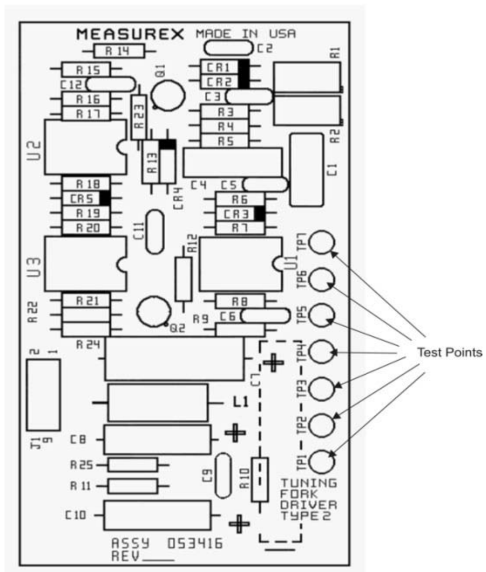



**Figure 9-5 Tuning Fork Driver Board Assembly**

To check alignment:

1. Power up the sensor.
2. Connect a voltmeter to TP6 (+) and TP2 (-), and an oscilloscope with probes to TP5 and TP3 with ground to TP1.
3. There should be a 12V peak-to-peak sine wave on TP5, and a 4V–16V peak-to-peak sine wave on TP3. TP6 is in the range from -0.3VDC–+0.1VDC.

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

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

#### 9.10.1.1. Obtain Stable Oscillation

See Figure 9-5.

1. Power up the sensor. If the fork vibrates cleanly, proceed to Subsection 9.10.1.2.

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

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

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

#### 9.10.1.2. Adjust Maximum Amplitude

Once the fork is vibrating at a stable rate, maximize the amplitude of vibration (see Figure 9-5).

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

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

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

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

### 9.10.1.3. Test for Clean Start

See Figure 9-5.

1. Power down, wait a few seconds, and then power up again. Check that the fork starts up quickly and cleanly.
2. If there is any tendency to chatter, turn R1 CCW to reduce the TP6 voltage by 0.2V±0.1V, and then R2 to bring it back to -0.1V.

ATTENTION

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

# 9.11. Align Fastcard Board

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

Follow the procedure in this section for all three boards. Figure 9-6 shows the layout of the Fastcard board assembly.

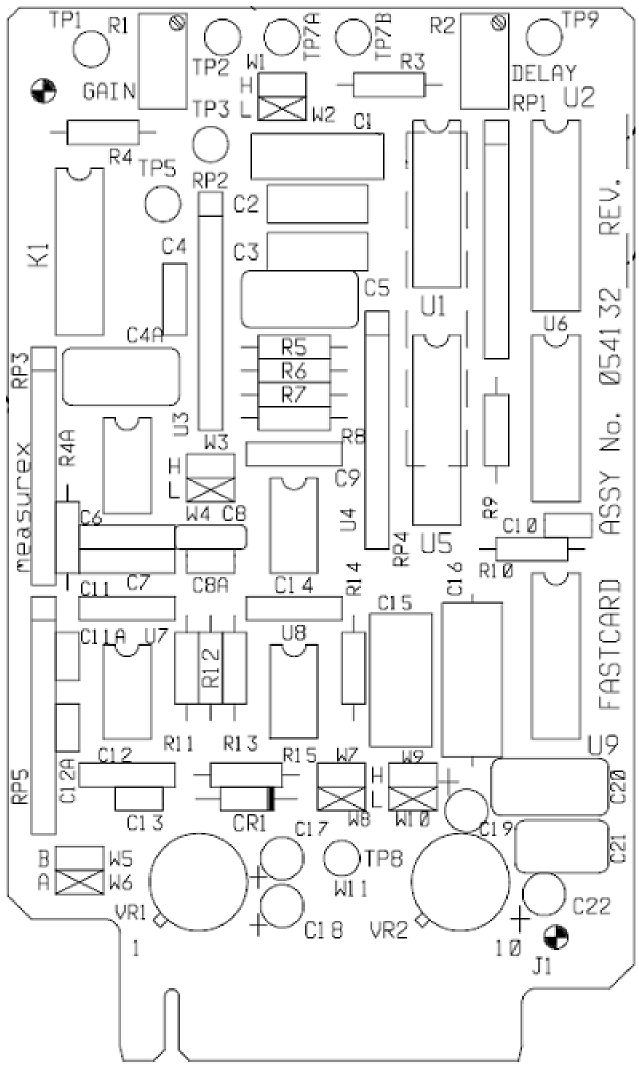


**Figure 9-6 Fastcard Board Assembly**

| | | | |
|---|---|---|---|
| **Activity Number:** | Q4204-50-ACT-011 | **Applicable Models:** | All |
| **Type of Procedure:** | Maintain | **Expertise Level:** | Technician |
| **Priority Level:** | Average | **Cautions:** | Electric Shock |
| **Availability Required:** | Scanner Offsheet | **Reminder Lead Time:** | |
| **Overdue Grace Period:** | | **Frequency (time period):** | |
| **Duration (time period):** | 30 minutes | **# of People Required:** | 1 |
| **Prerequisite Procedures:** | | **Post Procedures:** | |

| | Part Number | Quantity | Lead Time |
|---|---|---|---|
| **Required Parts:** | | | |
| | Part Number | Quantity | Lead Time |
| **Required Tools:** | Voltmeter<br>Oscilloscope<br>Small flat head screwdriver | | |

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, and they govern the frequency response. Check to see that these are in the L position.

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

The test points 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 0.3V and 3V peak-to-peak.

If the signal is greater than 3V, select a lower gain on the corresponding PbS Detector Assembly by changing the jumper selection on the fast preamp board (see Figure 9-7).

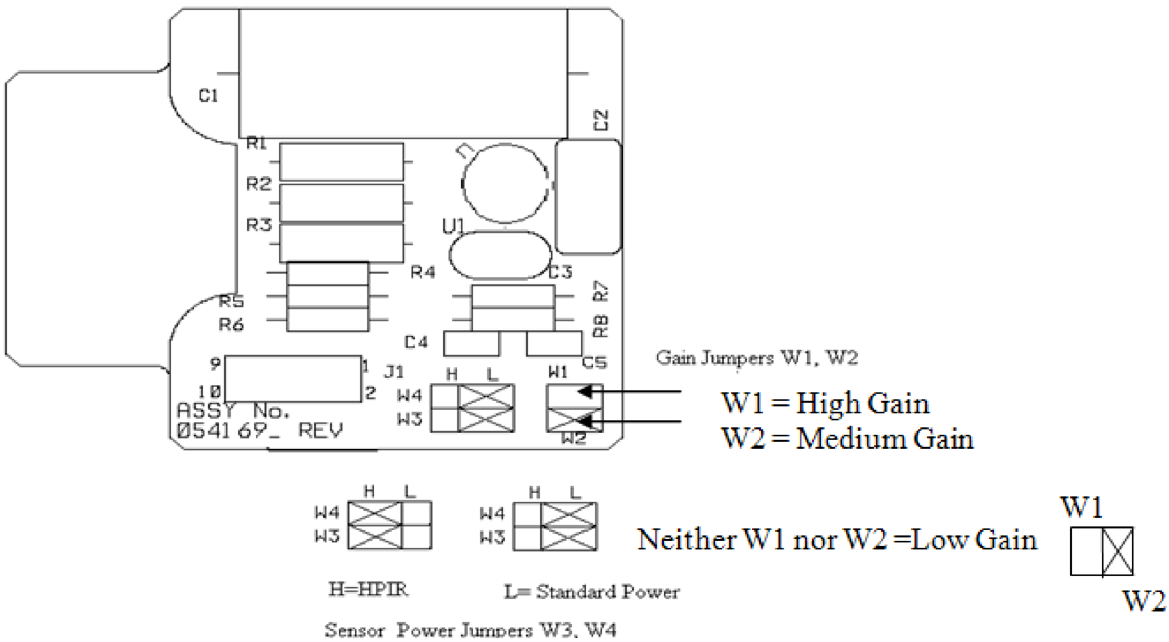



**Figure 9-7 PbS Detector Assembly**

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

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

The highest gain is selected by placing a jumper in position W1, medium gain is selected by placing a jumper in position W2 and the lowest gain is selected by removing the jumper from W1 and W2 as shown in Figure 9-7, or by placing a jumper across the W1 and W2 positions.

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 4VDC–8VDC.

Adjust R2 to balance the phase (see Figure 9-8). Phasing adjustment can be done using TP7A and TP7B on the Fastcards. If phasing is impossible on Fastcard, change the selection on jumpers W5/W6.

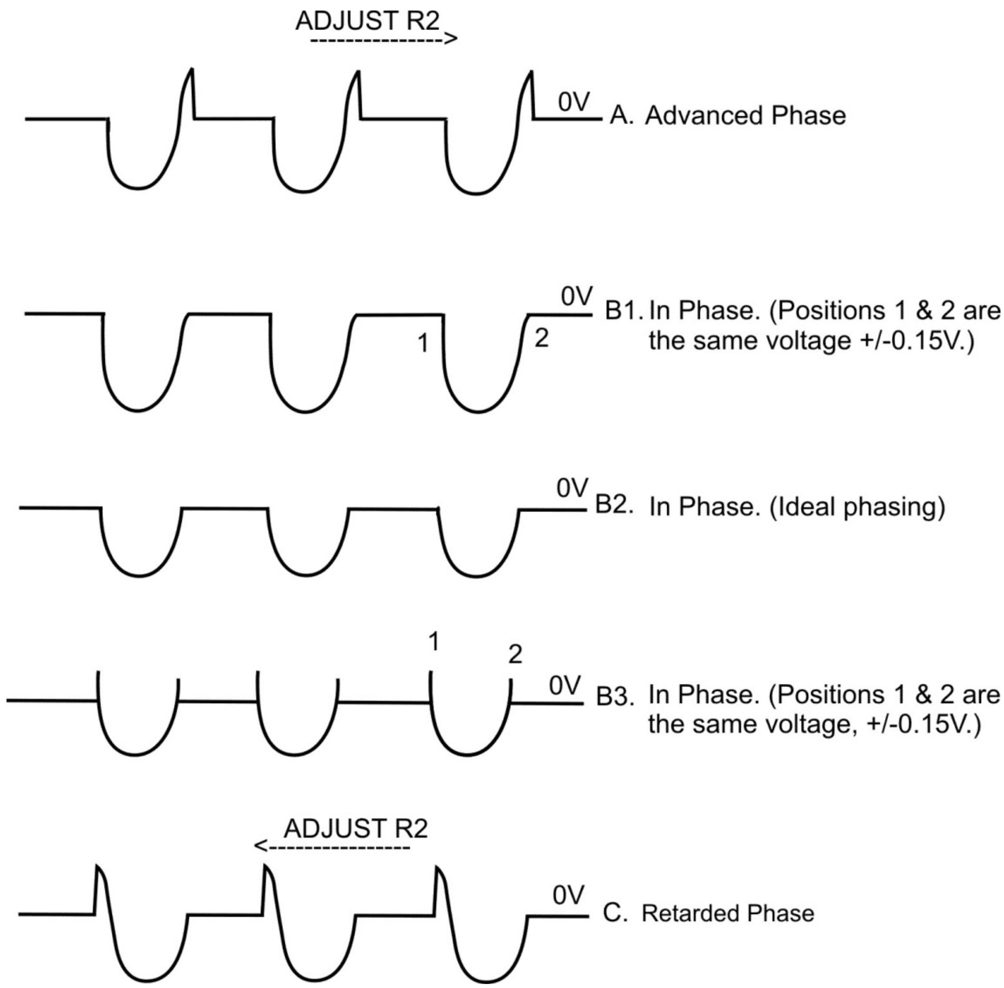



**Figure 9-8 Phase Adjustment**

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). |

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

The test points should be as shown in the summary (Table 9-3), with TP1 as ground. None of the AC signals should be clipped.

**Table 9-3 Test Points For the Fastcard Board**

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

# 10. Troubleshooting

Troubleshooting is divided into two sections:

- Section 10.1 Alarm Based Troubleshooting
- Section 10.2 Non-alarm Based Troubleshooting

## 10.1. Alarm Based Troubleshooting

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

### 10.1.1. Bad Dark Volts

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

# 10.1.2. Bad Standardize Ratio

| Symptom | Possible Cause(s) | Solution (Tasks) |
|---|---|---|
| **Alarm: Bad Standardize Ratio** | For any of the two working ratios:<br>$Ratio_{Standardize}$ > Upper Limit OR<br>$Ratio_{Standardize}$ < Lower Limit<br>where:<br>Ratio = $NetOpenVolts_{ChannelA}$ / $NetOpenVolts_{ChannelB}$<br>and:<br>NetOpenVolts = $Volts_{Standardize}$ – $Volts_{Dark}$<br>Default values for upper and lower limits are 0 and 9999, respectively. | Align Fastcard Board |
| | | Clean Sensor Window |
| | | See Non-alarm Based Troubleshooting |
| | | If the issue cannot be avoided, increase the ratio limits in the Sensor Maintenance Page (Maintenance mode only) |

# 10.1.3. Standardize Ratio Drift

| Symptom | Possible Cause(s) | Solution (Tasks) |
|---|---|---|
| **Alarm: Standardize Ratio drift** | For any of the two working ratios:<br>\| $Ratio_{Standardize}$ - $Ratio_{TimeZero}$ \| > Ratio Drift Limit<br>where:<br>Ratio = $NetOpenVolts_{ChannelA}$ / $NetOpenVolts_{ChannelB}$<br>and:<br>NetOpenVolts = $Volts_{Standardize}$ – $Volts_{Dark}$<br><br>Default value for the ratio drift limit is 9999 | Align Fastcard Board |
| | | Clean Sensor Window |
| | | See Section Non-alarm Based Troubleshooting |
| | | If the issue cannot be avoided, increase the ratio drift limit in the Sensor Maintenance display (Maintenance mode only) |

# 10.2. Non-alarm Based Troubleshooting

This section contains troubleshooting information for the transmission IR fiber weight and moisture sensor.

| Symptom | Possible Cause(s) | Check/Action |
|---|---|---|
| **Lamp not lit** | Lamp failure | Replace Infrared Lamp |
| | 24V failure | Check 24V and 4.4V on Power Supply Adapter Board |
| | Power supply adapter board failure | Check 24V and 4.4V on Power Supply Adapter Board |
| **Tuning Fork will not start or will not stop chattering** | Tuning Fork damage | Replace Tuning Fork |
| | | Align tuning fork (see Align Tuning Fork Driver Board) |
| | Tuning Fork Driver Board failure | Replace Tuning Fork Driver Board |
| **No signal at TP2 on Fastcard** | PbS Detector failure | Check other channels. If issue only with one channel, swap or replace PbS detector (see Replace a Board) |
| | Failure of lamp, Power Supply Adapter Board, Tuning Fork Driver Board or backplane failure | If all the channels are affected, check lamp, tuning fork operation (Align Tuning Fork Driver Board) and backplane 250V, ±15V, 6/8V |
| **Fastcard cannot be adjusted into phase** | Jumper set wrong | Check Fastcard jumpers |
| | | Swap Fastcard jumper A to B or vice versa (see Align Fastcard Board) |
| | Temp Board failure | Check Temp Board |
| **Fastcard will not adjust to 7.5V at TP9** | Gain jumper on PbS Detector set too low | Check TP2. The signal should be between 0.3V and 3V peak-to-peak with nothing in the gap. Adjust PbS detector gain accordingly (See Align Fastcard Board) |
| | Fastcard failure | Swap/replace Fastcard |
| | Temp Board failure | Check/replace Temp Board (See Replace a Board) |
| **All 3 channels unstable** | Head temperature unstable | Check head temperature |
| | Lamp contact oxidized | Change lamp and lamp holder (see Replace Infrared Lamp) |
| | Tuning Fork unstable | Replace Tuning Fork (see Align Tuning Fork Driver Board) |
| **One channel unstable** | Fastcard may be saturated | Check TP7A&B on Fastcard (see Align Fastcard Board) |
| | Detector unstable | Swap/replace PbS Detector. |
| | Fastcard unstable | Swap/replace Fastcard. |

| | | |
|---|---|---|
| | Temp Board failure | Check/replace Temp Board (see Replace a Board) |
| **Low standardize volts and unstable channels** | Temp board failure | Check/replace Temp Board (see Replace a Board) |
| | Tuning Fork Driver Board failure | Replace Tuning Fork Driver Board. |
| | Tuning Fork unstable | Replace Tuning Fork (see Align Tuning Fork Driver Board) |
| | Water in the INFRAND plates | Check For Water In Quartz-Teflon Plates |

# 11. Storage, Transportation, End of Life

## 11.1. Storage and Transportation Environment

In order to maintain integrity of sensor components, storage and transportation of all equipment must be within the parameters displayed in Table 11-1.

**Table 11-1 Storage and Transportation Parameters**

| Duration of Storage | Acceptable Temperature Range | Acceptable Humidity Range |
|---|---|---|
| Short-term (less than one week) | -20°C–45°C | 20–90% non-condensing |
| Long-term | -10°C–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 of using environmentally friendly methods. Contact the factory for further details and instructions.

# 12. Glossary

| | |
|---|---|
| **Bin (or Measurement Bin)** | The smallest measurement zone on the frame. Also called **Bucket** or **Slice**. |
| **Bucket** | See **Bin**. |
| **CD** | **Cross Direction**<br>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 (MD) that relates to a position along the length of the paper machine. |
| **Distant End** | The end of the scanner opposite the Cable End. |
| **DMAE** | Dynamic slope corrector. |
| **DMBE** | Dynamic offset corrector. |
| **Drive Side (DS)** | The side of the paper machine where the main motor drives are located. Cabling is routed from this end. Also called **Back Side**. |
| **Experion MX** | A Quality Control System. See **QCS**. |
| **InfrandPLUS** | Offset optics called INFRAND for infinite random scattering optics. |
| **KAYE** | Dynamic temperature corrector. |
| **MD** | **Machine Direction**<br>The direction in which paper travels down the paper machine. |
| **MDYN** | Percent moisture reading of the sensor, including dynamic correction. |
| **MLAB** | Percent moisture of the sample determined in the lab. |
| **MSTAT** | Percent moisture reading of the sensor, without dynamic correction (correction calculated out). |
| **QCS** | **Quality Control System**<br>A computer system that manages the quality of the product produced. |
| **RAE** | **Real-time Application Environment**<br>The system software used by QCS to manage data exchange between applications. |
| **Recipe** | A list of pulp chemicals, additives and dyes blended together to make a particular grade of paper. In Experion MX, the recipe contains all sensor and actuator configuration and calibration parameters associated with a grade. |

| | |
|---|---|
| **Sensor Set** | The term used in the Sensor Maintenance displays to describe a set of sensors working together on a scanner to perform one measurement. |
| **Setpoint (SP)** | Target value (desired value). Setpoints are defined process values that can be modified by entering new values through the monitor, loading grade data, and changing a supervisory target. |
| **Slice** | See **Bin.** |
| **Standardize** | An automatic periodic measurement of the primary and auxiliary sensors taken offsheet. The standardize measurements are used to adjust the primary sensors' readings to ensure accuracy. |
| **Tending Side (TS)** | The side of the paper machine where the operator has unobstructed access. Also called **Front Side**. |
| **TEESH** | Air gap temperature at slice position. |
| **T0SH** | Air gap temperature at calibration time (default 100ºF). |
| **Trend** | The display of data over time. |

# A. Part Numbers

## A.1. Sensor Parts List

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

**Table A-1 Part Number List for Standard Power Sensors**

| Part Number | Name |
|---|---|
| 05298102* | Temperature Control Board |
| 05333000* | Power Supply Adapter Board |
| 05341600* | Tuning Fork Driver Board |
| 05401100* | Unigauge Backplane Type II |
| 05413200* | Fastcard Board |
| 08607801* | Quartz-Teflon Plate Assembly |
| 08631800* | Fast PbS Detector Assembly |
| 39000201* | Lamp QTH 20 Watts |
| 51000037* | Fuse: 2 Amp, 3AG (on 05333000) |
| 51000282* | Fuse: 1.5 Amp Pico (on 05401100) |
| 29000152 | 570 Hz Tuning Fork Chopper |
| 00299900 | Light pipe, source |
| 00300000 | Light pipe, receiver |
| 38000172 | Beamsplitter |
| 07631900 | Lower Body Optics Block |
| 07631600 | Upper Body |
| 08347704 | 3-Channel Receiver Assembly |
| 05416900 | Fast Preamp Board |
| 42000025 | Aclar Bags 4.5 inch |
| 07279100 | Sample die 4.5 inch |
| 42000030 | Bag Sealer |
| 42000272 | Rubber Gloves |

# B. Moisture Samples Worksheet

Print out the attached *Moisture_samples.xls* worksheet for use in the sampling procedure in Chapter 7.

# C. Basis Weight Dynamic Verification Tool Worksheet

Print out the attached *Basis Weight Dynamic Verification Tool, Metric, 2009-07-17.xls* metric worksheet for use in Section 6.4.

Print out the attached *Basis Weight Dynamic Verification Tool, US, rev 1.xls* US worksheet for use in Section 6.4.