Opacity Measurement

System Manual

6510020435

Opacity Measurement

October, 2012

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Introduction

The purpose of this manual is to provide an introduction to Opacity Measurement, and to enable Honeywell personnel to install, calibrate, and maintain the Opacity Sensor.

This manual is intended for use with the model Q4240-52 Opacity Sensor for Experion MX, which has common components with the model Q4205-51 Moisture Sensor, and is packaged in the Experion MX head.

No additional field documentation is normally required with this manual.

ATTENTION

The term *Opacity Measurement* refers to the *Opacity Sensor*. These terms may be used interchangeably in this manual.

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 11 chapters and one appendix.

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

Chapter 2, **Sensor Components**, describes Opacity Sensor components.

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

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

Chapter 5, **Operations**, describes operation of the system.

Chapter 6, **Static Calibration**, describes procedures for static calibration of the system.

Chapter 7, **Preventive Maintenance**, describes recommended ongoing preventive maintenance tasks.

Chapter 8, **Tasks**, describes procedures for maintenance, diagnostic, and troubleshooting tasks.

Chapter 9, **Troubleshooting**, describes symptoms, alarms, possible causes, and links to associated diagnostic or troubleshooting tasks.

Chapter 10, **Storage, Transportation, and End of Life**, describes methods for storing, transporting, and disposing sensor components.

Chapter 11, **Glossary**, describes the terms and acronyms used in this manual.

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

Related Reading

The following documents contain related reading material.

Honeywell Part Number	Document Title / Description
6510020328	IR Moisture Measurement System Manual

Conventions

The following conventions are used in this manual:

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

`Boldface`	Boldface characters in this special type indicate your input.
`Special Type`	Characters in this special type that are not boldfaced indicate system prompts, responses, messages, or characters that appear on displays, keypads, or as menu selections.
Italics	In a command line or error message, words and numbers shown in italics represent filenames, words, or numbers that can vary; for example, filename represents any filename. In text, words shown in italics are manual titles, key terms, notes, cautions, or warnings.
Boldface	Boldface characters in this special type indicate button names, button menus, fields on a display, parameters, or commands that must be entered exactly as they appear.
lowercase	In an error message, words in lowercase are filenames or words that can vary. In a command line, words in lowercase indicate variable input.
Type	Type means to type the text on a keypad or keyboard.
Press	Press means to press a key or a button.
[ENTER] or **[RETURN]**	**[ENTER]** is the key you press to enter characters or commands into the system, or to accept a default option. In a command line, square brackets are included; for example: **SXDEF 1 [ENTER]**
[CTRL]	**[CTRL]** is the key you press simultaneously with another key. This key is called different names on different systems; for example, **[CONTROL]**, or **[CTL]**.
[KEY-1]-KEY-2	Connected keys indicate that you must press the keys simultaneously; for example, **[CTRL]-C**.
Click	Click means to position the mouse pointer on an item, then quickly depress and release the mouse button. This action highlights or “selects,” the item clicked.
Double-click	Double-click means to position the mouse pointer on an item, and then click the item twice in rapid succession. This action selects the item “double-clicked.”
Drag X	Drag X means to move the mouse pointer to X, then press the mouse button and hold it down, while keeping the button down, move the mouse pointer.
Press X	Press X means to move the mouse pointer to the X button, then press the mouse button and hold it down.
ATTENTION	The attention icon appears beside a note box containing information that is important.
CAUTION	The caution icon appears beside a note box containing information that cautions you about potential equipment or material damage.
WARNING	The warning icon appears beside a note box containing information that warns you about potential bodily harm or catastrophic equipment damage.

1. System Overview

1.1. Opacity Measurement

The Opacity Sensor uses the light transmitted through a sheet on a single straight-through pass, and correlates that to TAPPI opacity.

1.1.1. TAPPI Standard

The *TAPPI standard T 425* defines opacity as the contrast ratio called $C_{0.89}$. It is the ratio of the paper reflectance when backed by a black body, to the reflectance when backed by a white body, with absolute reflectance of 0.89.

$$C_{0.89} = \frac{100 \bullet R_0}{R_{0.89}}$$

Several manufacturers provide opacimeters that measure according to this standard. They measure a small spot on the paper, thereby requiring averaging of several spots to obtain a good measurement.

1.1.2. Honeywell Opacity Sensor

The Honeywell Opacity Sensor measures the light transmitted through the sheet, and converts this to TAPPI opacity by means of a simple algorithm.

The source provides chopped visible light from a halogen incandescent lamp operating at the color temperature specified by TAPPI T 425. The receiver employs a silicon detector with a filter chosen to approximate the spectral response of the human eye.

The transmittance measured by the sensor is related to the reflectance and the absorption by the following equation:

$$T + R + A = 1$$

Using this relationship, you can rewrite the above definition of opacity as follows:

$$\text{Opacity} = \frac{100 \bullet R}{R + r \bullet T^2} = \frac{100}{1 + \frac{r \bullet T^2}{R}}$$

where: R is the reflectance when backed by a black body;

r is the reflectance of the white body backing the sheet (r = 0.89);

T is the transmittance of the sheet.

In the approximation as $T^2 << 1$, or $r \bullet T^2 << R$, you have:

$$\text{Opacity} = 100 \bullet \left(1 - \frac{r \bullet T^2}{R}\right)$$

In the further approximation that $A << T$, you have $R = 1-T$ and:

$$\text{Opacity} = 100 \bullet \left(1 - r \bullet T^2\right) = 100 - 89 \bullet T^2$$

Periodic offsheet standardization and optional Z-correction and dirt correction maintain sensor accuracy.

1.2. Hardware Description

The source assembly is located in the lower head, and is the same source used for the standard power IR Moisture Sensor. The receiver assembly is located in the upper head, and shares some optical and electronic components with the IR Moisture Sensor.

1.2.1. Source

The Opacity Sensor source employs a long-life halogen 20 W 6 V lamp underrun (at 4.4 V) from the power supply adapter PCBA. An elliptical mirror focuses the light at the 570 Hz tuning fork chopper. A tuning fork driver circuit drives the fork and sends its timing signal, via the backplane, to the fastcard boards. From that point, it is used in the demodulation of the received signal to make the sensor insensitive to ambient light.

1.2.2. Opacity Sensor Optics

The Opacity Sensor employs two flat quartz-Teflon® plates. The Opacity Sensor uses the lower plate source aperture and the upper plate straight-through optics aperture directly above the source aperture. The sensor measures the light transmitted directly through the sheet. The quartz-Teflon plates have been specially designed to minimize passline or flutter dependence of the measurement and to be very uniform in quality.

1.2.3. Receiver Optics

The light that reaches the straight-through aperture of the receiver window passes to a light pipe, is collected by a lens and neutral density attenuating filter mounted in the lower body optics block, and is then collimated into a parallel beam. The beam splitter mounted in the upper body reflects about 30 percent of the IR to the 3RD channel IR detector of the IR Moisture Sensor, but transmits nearly all of the visible light up to the opacity detector. First, however, it passes to a green filter that transmits the green light specified by the TAPPI opacity test method.

1.2.4. Receiver Electronics

The light is focused by a lens in the opacity detector on a silicon detector. The resulting electrical signal is pre-amplified in the detector and sent via the opacity extension backplane PCBA to the fastcard PCBA. This circuit further amplifies and then demodulates the signal using the phase timing signal from the tuning fork driver in the source. The resulting output is a 0–10 V DC signal that is fed into the Ethernet Data Acquisition (EDAQ) board. The fastcard PCBA employs a five-pole active filter to eliminate the 570 Hz component, retain frequency components below 200 Hz, and provide fast response to changes (2 ms response time). The opacity extension backplane is supported by, and has power provided through, the Unigauge Backplane Type II PCBA.

1.3. Opacity Sensor Specifications

- model number: Q4240-52
- opacity range: 70 to 100 TAPPI opacity units

- repeatability: 2 Sigma = 0.1 opacity units on stirred samples
- static accuracy: 2 Sigma = 0.5 opacity units for opacity in the range of 80 to 100; 2 Sigma = 0.8 opacity units for opacity in the range of 70 to 80

ATTENTION

> This accuracy includes not only sensor error, but also calibration, sampling, and lab errors. Grades with high formation (large opacity variations) may require more lab measurements to achieve this accuracy.

- flutter sensitivity: typically less than 0.5 opacity units for sheet anywhere in the gap, but not touching a quartz-Teflon window
- streak sensitivity: the full width at half maximum of the sensitivity profile is 1 cm (0.4 in.).
- response time: 2 ms with a cutoff frequency of 200 Hz
- gap (Z) sensitivity: the sensor software contains a provision for correcting the effect of variations in the gap between the two Z-sensor heads.
- dirt sensitivity: The sensor software contains provisions for correcting the effect of dirt buildup on the quartz-Teflon plates

1.4. Power Requirements

Both heads require 24 V DC. The source dissipates approximately 20 W. The receiver also dissipates approximately 20 W.

2. Sensor Components

This chapter describes the various components of the Opacity Sensor.

2.1. Hardware

Figure 2-1 shows a diagram of the Opacity Sensor.

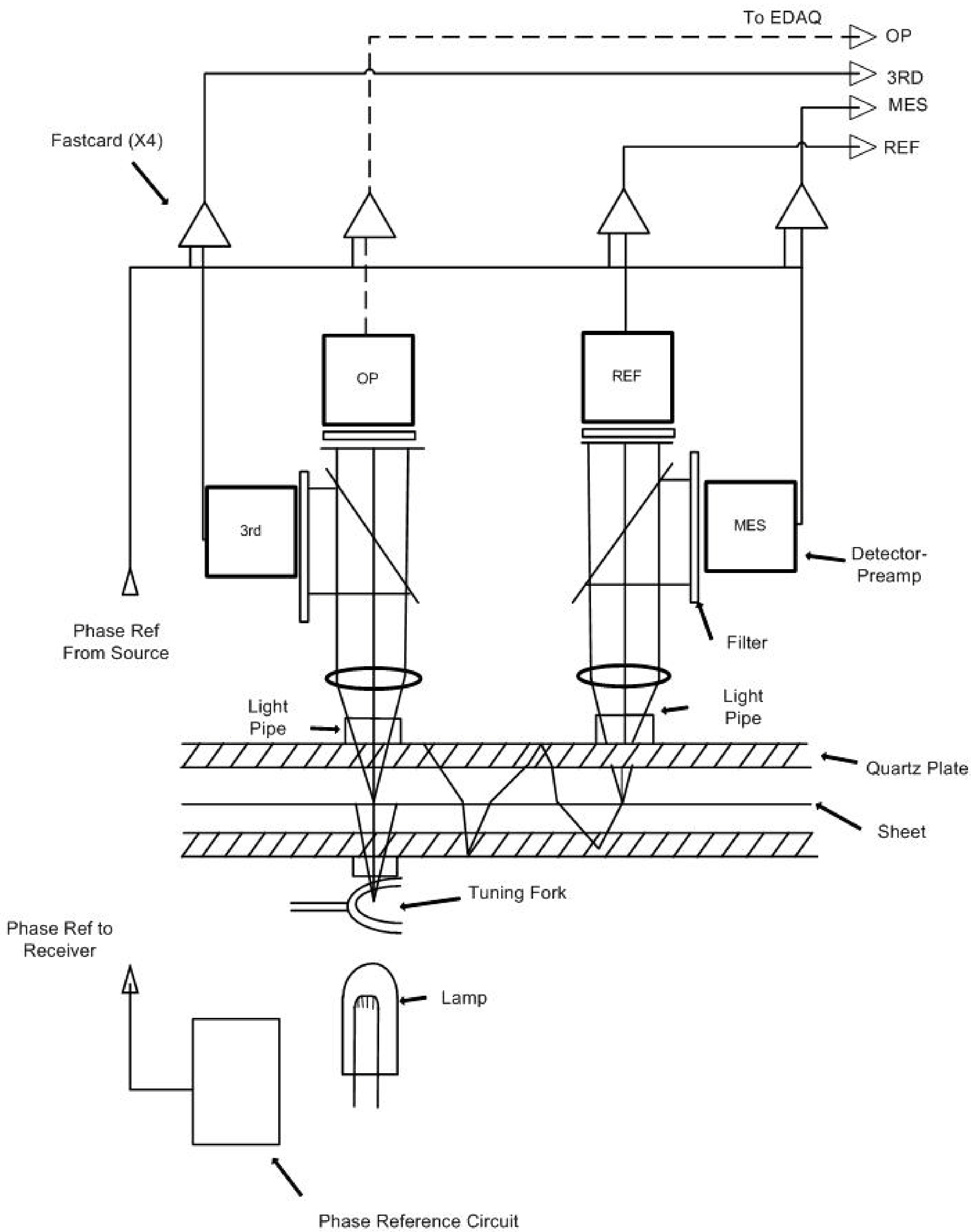


Figure 2-1 Opacity Sensor

2.1.1. Source Assembly

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

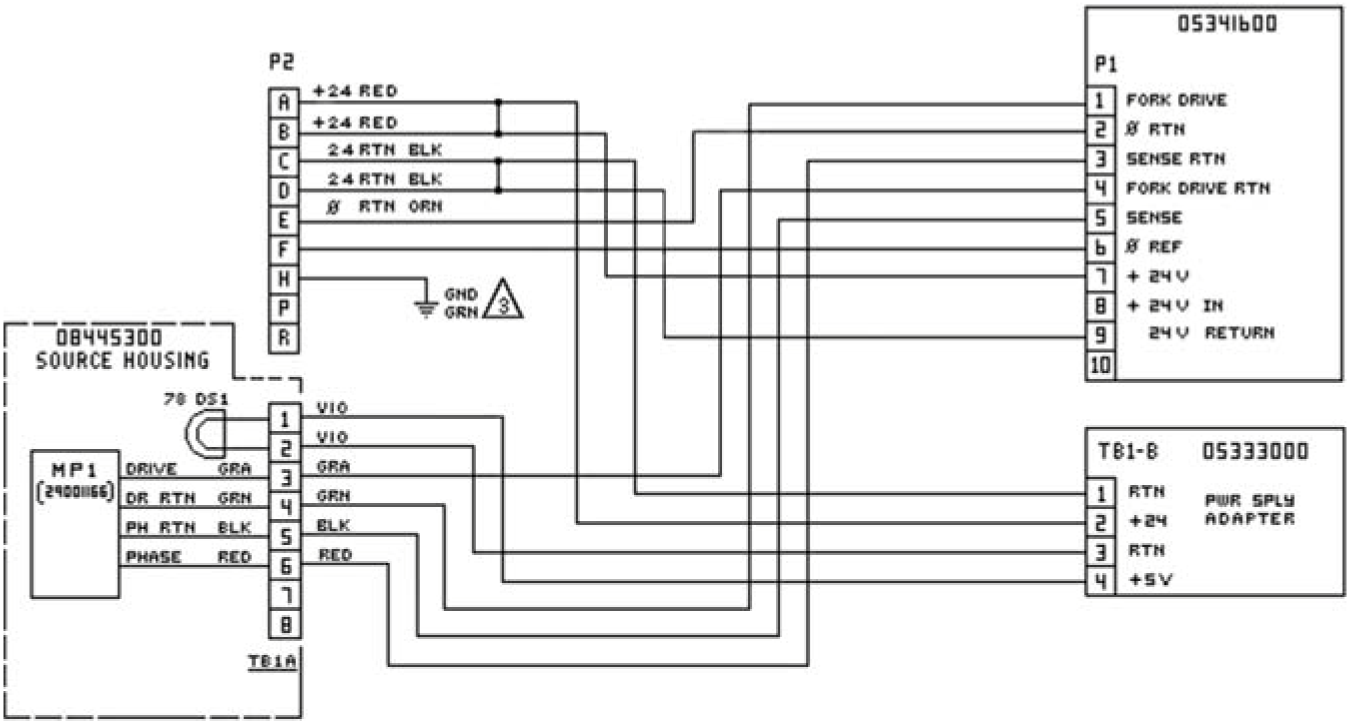


Figure 2-2 Source Assembly Schematic

2.1.2. Power Supply Adaptor Board

The power supply adapter board provides power to the lamp. Figure 2-3 shows the layout of the power supply adaptor board.

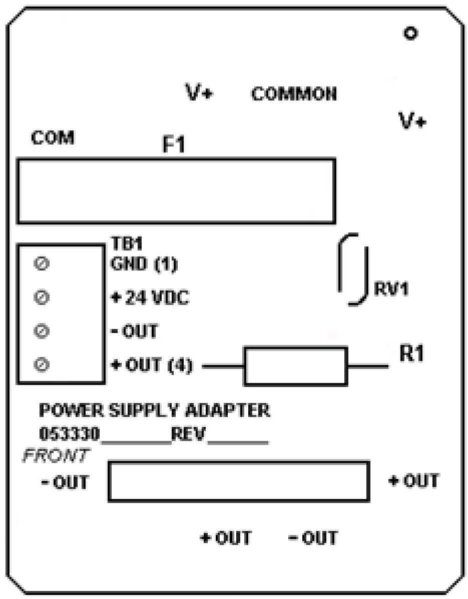


Figure 2-3 Power Supply Adaptor Board

- input voltage is 24 ± 0.5 V DC at TB1-2 (+24 V) and TB1-1 (Gnd)
- lamp power is 4.4 ± 0.2 V DC at TB1-4 (+) and TB1-3 (RTN)

2.1.3. Tuning Fork Driver Board

The tuning fork driver board controls the operation of the tuning fork, which modulates the light generated by the lamp. Figure 2-4 shows the layout and a block schematic of the tuning fork driver board. The R1 gain pot attenuates the input signal from the tuning fork, which is then pre-amplified and appears at TP5.

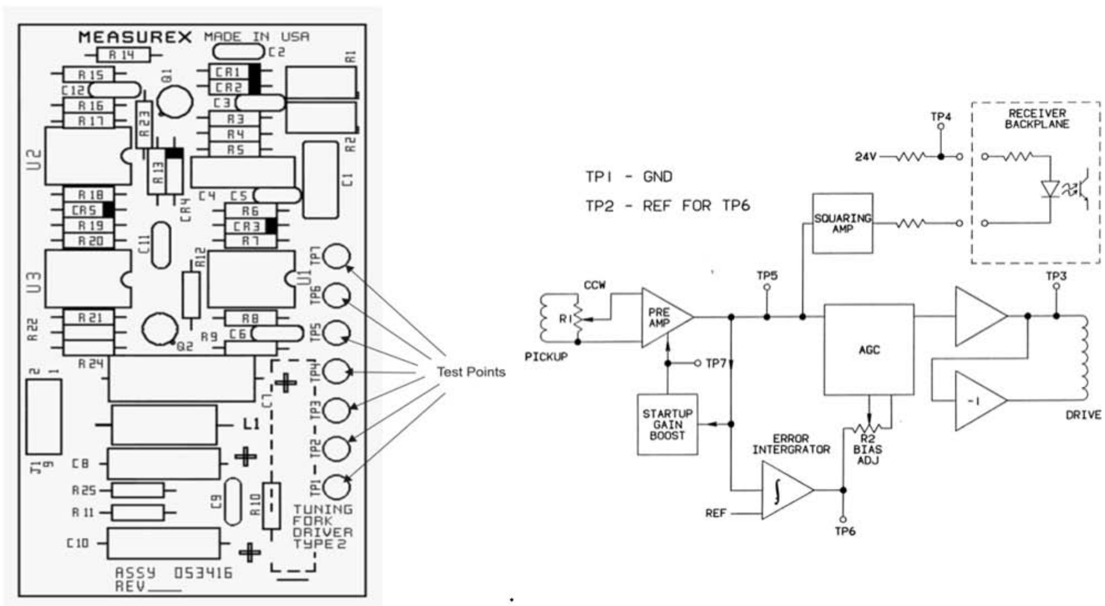


Figure 2-4 Tuning Fork Driver Board and Block Schematic

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

The TP5 signal is also used to generate a square wave for the phase signal sent to the receiver assembly. R2 adjusts the bias of the AGC circuit. An auxiliary circuit boosts the gain of the pre-amp when the fork is not vibrating. To align the tuning fork driver board, see Section 8.12.

2.1.4. Receiver Assembly

2.1.4.1. Unigauge Backplane Type II

The backplane provides the various voltages necessary for the operation of the receiver, and passes signals to and from the EDAQ. Figure 2-5 shows a diagram of the backplane.

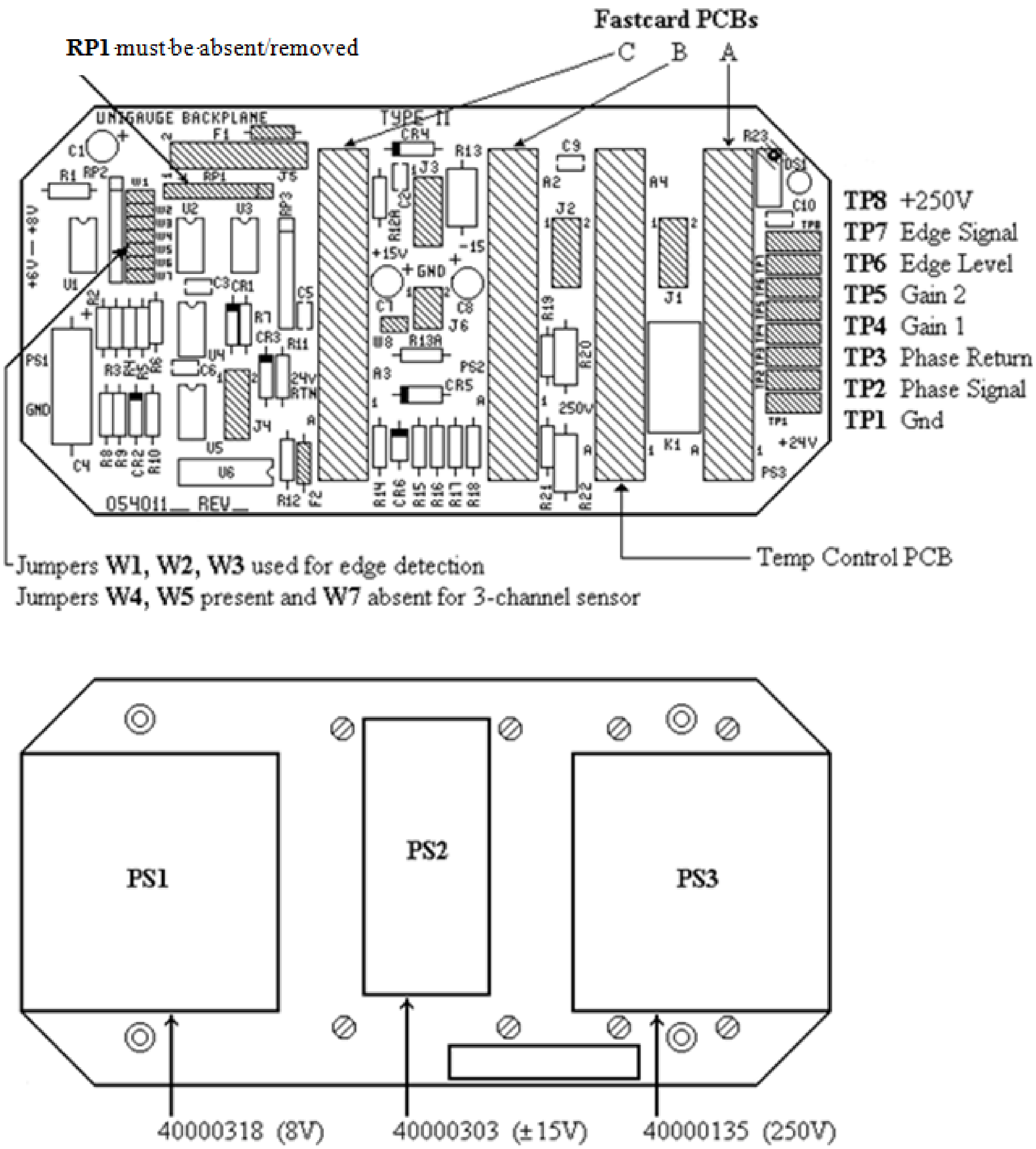


Figure 2-5 Unigauge Backplane Type II

The input voltage at the two pins of the DC–DC converter at the front of the backplane should read 24 ± 0.5 V DC.

The voltage used by the Peltier coolers on the IR detectors is selectable on the backplane. It is read between TP3 on the temperature control board and ground TP1 on the backplane. It should be 8.0 ± 0.5 V DC when three IR detectors are present. Note that the opacity detector does not use a Peltier cooler.

A bias of 250 ± 5 V DC is used by the IR detectors. It can be measured on the backplane between TP8 (the protected red test point) and TP1.

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

2.1.4.2. Opacity Extension Backplane PCBA

The Expansion Opacity B. P. Type II (see Figure 2-6) plugs into the Unigauge Backplane Type II, holds the fastcard PCBA for the opacity channel, conveys the signal from the detector pre-amp, and provides the connection point for the signals and voltages to the other elements of the system outside of the backplane.

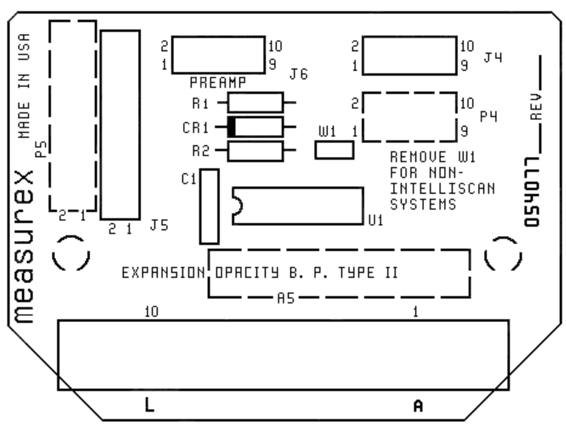


Figure 2-6 Expansion Opacity B. P. Type II (no test points)

Remove jumper W1 when used in Experion Mx systems.

When in-place, jumper W1 places a 20 kΩ resistor in parallel with the 20 kΩ load present when used with obsolete IntelliSCAN systems. There are no test points or adjustments on the board.

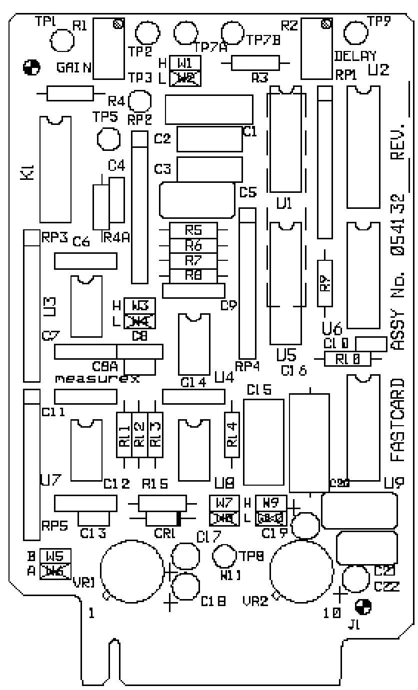
2.1.4.3. Fastcard PCBA

The fastcard demodulates the signal from the detector pre-amp and returns an analog DC signal to the backplane. Of the five jumpers present on the fastcard, four are labeled H/L, indicating the sensor power: high (HPIR), or low (standard power). These jumpers govern the frequency response of the circuit. Because the opacity sensors are standard power 570 Hz sensors, these four jumpers should be in the L position.

The other jumper is labeled A/B, indicating the phase delay. This jumper should normally be in the A position. To align the fastcard board, see Section 8.13.

Table 2-1 shows a diagram of the fastcard, and lists and describes test points and settings.

Table 2-1 Fastcard PCBA Test Points

Fastcard PCBA	**Test Points**	**Settings**
	TP1	Gnd
	TP2	Preamp signal
	TP3	Amplified signal
	TP5	Amplified signal
	TP7A TP7B	Phase signals
	TP8	Added phase signals
	TP9	Output
	W1/W2 W3/W4 W7/W8 W9/W10	Set to L (low = standard power)
	W5/W6	Phase A/B: set to A

2.1.4.4. Detector Placement

In the Q4240-52 Opacity Sensor, the opacity detector and its associated green filter are mounted in the top position on the straight-through optics block in the moisture receiver assembly (see Figure 2-7). They must not be in the offset optics block.

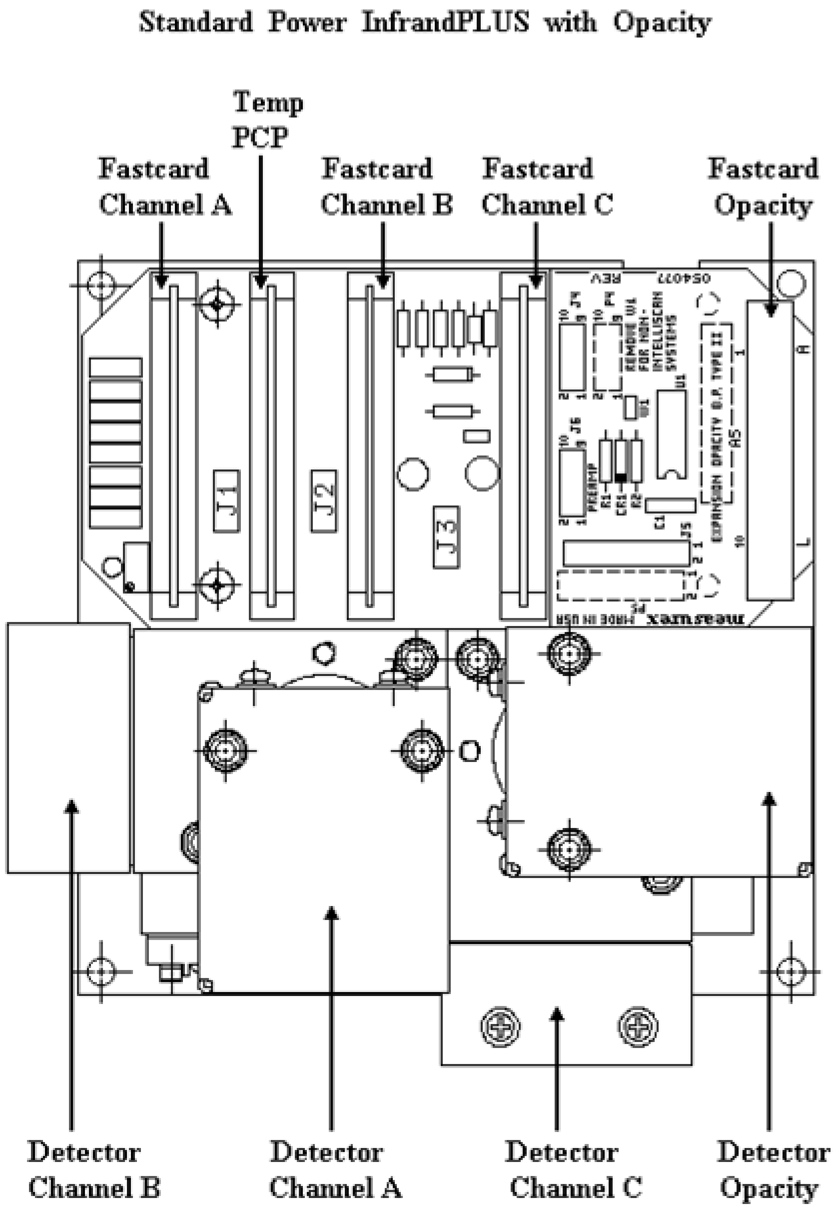


Figure 2-7 Detector Location

2.2. Software

The Opacity Sensor uses real-time application environment (RAE) software on an Experion MX System.

2.2.1. Inputs and Outputs

The Opacity Sensor provides one input signal that is fed into the EDAQ. It also has one contact output from the EDAQ, which sets the dark relay, nulling the input signal from the detector. This is used to read the offset corresponding to zero light. This contact output is shared with the IR Moisture Sensor.

2.2.2. Background

During a background, the dark volts contact output is set and, after a brief delay to allow the relay to settle, the dark volts VISD are read and saved.

2.2.3. Reference and Standardize

A reference is manually requested, while a standardize is scheduled periodically during sensor scanning. These functions are identical in every other way. During the reference and standardize functions, the empty gap volts (VISSU) are read and corrected for dark volts (VISD) to give VISST:

$$\mathrm{VISST} = \mathrm{VISSU} - \mathrm{VISD}$$

If Z-correction is not enabled, then:

$$\mathrm{VISSZ} = \mathrm{VISST}$$

If Z-correction is enabled, then the standardize volts are corrected for Z:

$$\mathrm{VISSZ} = \mathrm{VISST} \bullet \left[1 + \mathrm{ZSTDCOR} \bullet \left(\frac{\mathrm{ZSTZ} - \mathrm{ZT0}}{\mathrm{ZT0}}\right)\right]$$

where: ZSTZ is the Z in mm at the last standardize.

ZT0 is the Z in mm at calibration time.

ZSTDCOR is a Z-correction calibration constant.

The drift and dirt indicator, DRFT, and the opacity standard are calculated:

$$\mathrm{DRFT} = \frac{\mathrm{VISSZ}}{\mathrm{VISS0}}$$

$$\mathrm{OSTD} = 100 - 10 \bullet \mathrm{DRFT}^2$$

where VISS0 is the time-zero net open voltage. Standardize drift is checked. If ABS(DRFT-1) > Drift Limit (see Subsection 9.1.4), the scanner is forced to re-standardize. If three standardizes in a row fail, the sensor is disabled.

2.2.4. Sample

During the sample function, the now volts, VISN, on the sample are read and corrected for dark volts (VISD):

$$\mathrm{VISC} = \mathrm{VISN} - \mathrm{VISD}$$

If Z-correction is not enabled for the sample mode, then:

$$\mathrm{TRZC} = \mathrm{TRAN} = \frac{\mathrm{VISC}}{\mathrm{VISST}}$$

where: TRAN is the transmittance ratio (fraction of light transmitted through the sheet).

If Z-correction is enabled for the sample mode, then:

$$\mathrm{TRZC} = \frac{\mathrm{VISC} \bullet \left[1 + \mathrm{ZNOWCOR} \bullet \left(\frac{\mathrm{ZSTZ} - \mathrm{ZT0}}{\mathrm{ZT0}}\right)\right]}{\mathrm{VISSZ}}$$

where: ZNOWCOR is another Z-correction calibration constant.

If dirt correction is not enabled, then:

$$\mathrm{TRDC} = \mathrm{TRZC}$$

If dirt correction is enabled, then:

$$\mathrm{TRDC} = \mathrm{TRZC} \bullet \left[1 + \left(\mathrm{OPD1} + \mathrm{OPD2} \bullet \mathrm{TRZC}\right) \bullet \left(\mathrm{DRFT} - 1\right)\right]$$

where: OPD1 and OPD2 are the calibration constants for the dirt corrector.

The transmittance squared is calculated for calibration:

$$\mathrm{TRSQ} = \mathrm{TRDC}^2$$

Finally, the opacity is calculated:

$$\mathrm{OPAC} = \mathrm{O100} + \mathrm{OCAL} \bullet \mathrm{TRSQ}$$

where: O100 and OCAL are static calibration constants.

2.2.5. Onsheet

In onsheet and single point modes, the Z-correction uses ZNOW, the Z in mm for the bin. Dirt correction is used, and profile correction is also included.

The corrected now volts, VISC, are calculated as for the sample function:

$$\mathrm{VISC} = \mathrm{VISN} - \mathrm{VISD}$$

If Z-correction is not enabled, then:

$$\mathrm{TRZC} = \mathrm{TRAN} = \frac{\mathrm{VISC}}{\mathrm{VISST}}$$

If Z-correction is enabled, then:

$$\mathrm{TRZC} = \frac{\mathrm{VISC} \bullet \left[1 + \mathrm{ZNOWCOR} \bullet \left(\frac{\mathrm{ZNOW} - \mathrm{ZT0}}{\mathrm{ZT0}}\right)\right]}{\mathrm{VISSZ}}$$

If dirt correction is not enabled, then:

$$\mathrm{TRDC} = \mathrm{TRZC}$$

If dirt correction is enabled, then:

$$\mathrm{TRDC} = \mathrm{TRZC} \bullet \left[1 + \left(\mathrm{OPD1} + \mathrm{OPD2} \bullet \mathrm{TRZC}\right) \bullet \left(\mathrm{DRFT} - 1\right)\right]$$

The transmittance squared and opacity are calculated:

$$\mathrm{TRSQ} = \mathrm{TRDC}^2$$

$$\mathrm{OPAC} = \mathrm{OP100} + \mathrm{OPCAL} \bullet \mathrm{OPCOR} \bullet \mathrm{TRSQ}$$

where: OPCOR is the bin value of the profile correction array.

2.2.6. Profile Correction

The profile correction is designed to minimize residual errors in measurement due to X and Y misalignment of the heads. Because the Opacity Sensor uses absolute signal intensity, it is very susceptible to such errors. Also, the algorithm uses the square of the transmission, so the corrector must also use the square of the transmission in building the corrector array. Therefore, the corrector array is built up on the following values from a scan on empty gap:

$$\mathrm{OPCOR} = \frac{1.0}{\mathrm{TRSQ}(\mathrm{bin})}$$

where: TRSQ = (TRDC)2 = (VISC/VISST)2

Here, VISST is the dark-corrected standardize volts measured before performing the array-building scan, and VISC(bin) is the volts obtained during scanning on air.

The profile correction is built by scanning with an empty gap, and is initiated from the **Profile Correction** display under **Scanner/Sensor**.

2.2.7. Calibration Constants

The time-zero constants, calibration constants, and correctors are listed in Table 2-2, Table 2-3, and Table 2-4.

Table 2-2 Time-zero Constants

Constant	Default	Description
VISS0	7.5 Volts	Time-zero standardize Volts
ZT0	10.16 mm	Time-zero Z in mm

Table 2-3 Calibration Constants

Constant	Default	Description
O100	100	Intercept
OCAL	-89	Slope
ZNOWCOR	1.3	Z-corrector for onsheet
ZSTDCOR	1.3	Z-corrector for standardize
OPD1	0.14	Dirt corrector
OPD2	0.00	Grade-dependence for dirt

Table 2-4 Correctors

Correctors	Default
Z-Correction	Off
Profile Correction	Off
Dirt Correction	Off

3. EDAQ

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

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

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

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

The EDAQ board contains a large number of input/output (I/O) systems, including:

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

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

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

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

3.1. Physical Layout

Figure 3-1 and Figure 3-2 show the EDAQ PCBA as it is mounted next to a sensor. To the left are the digital and analog I/Os, 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 FC expansion board.

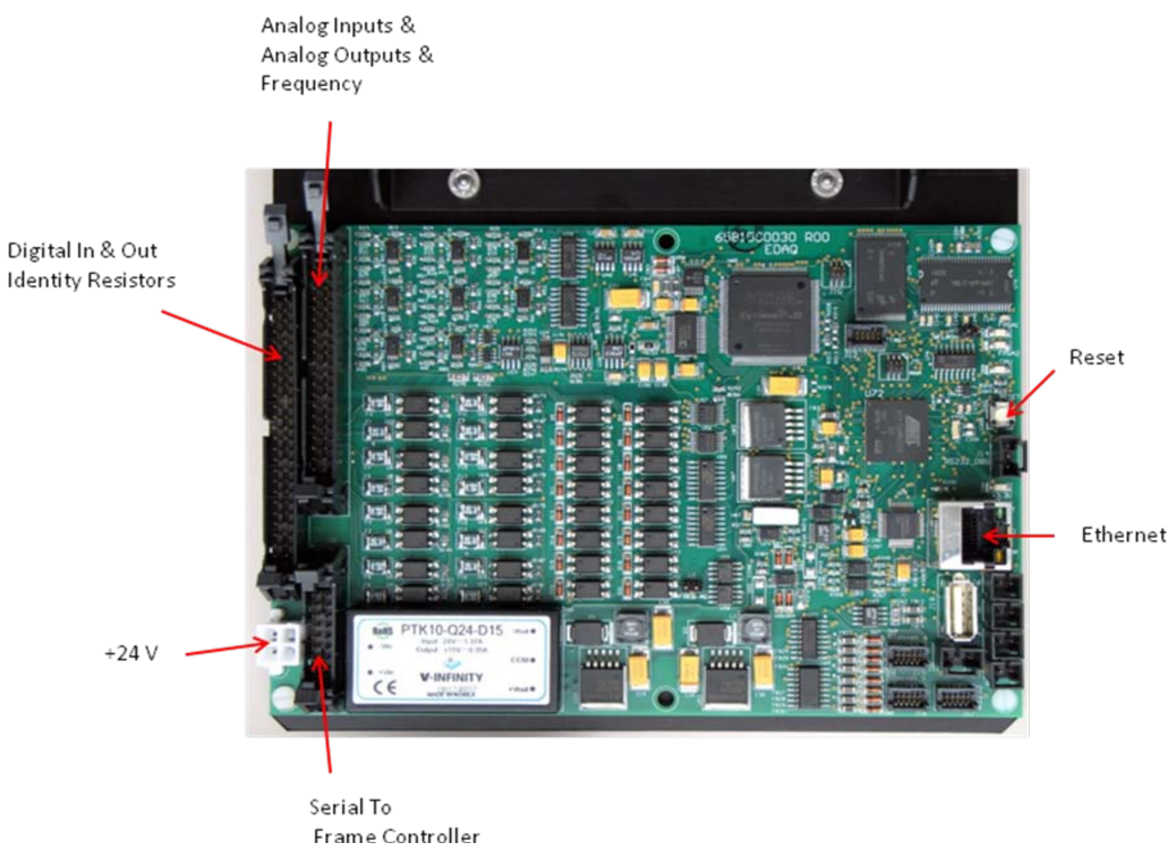


Figure 3-1 EDAQ Board

As shown in Figure 3-2, J1 is the large 50-pin connector on the far left. J2 is the smaller 40-pin connector. J8 on the lower left is used for the FC only. To the right are the Ethernet port, some diagnostic LEDs, serial connections, and temperature inputs. There are no test points for use in the field. A serial debug port is available (115200 kb/s, no flow control, 8N1) that may be connected to any PC running a serial terminal program. For diagnostic purposes, service personal may be asked to connect a serial cable between the debug port and the RS-232 of any neighboring EDAQ.

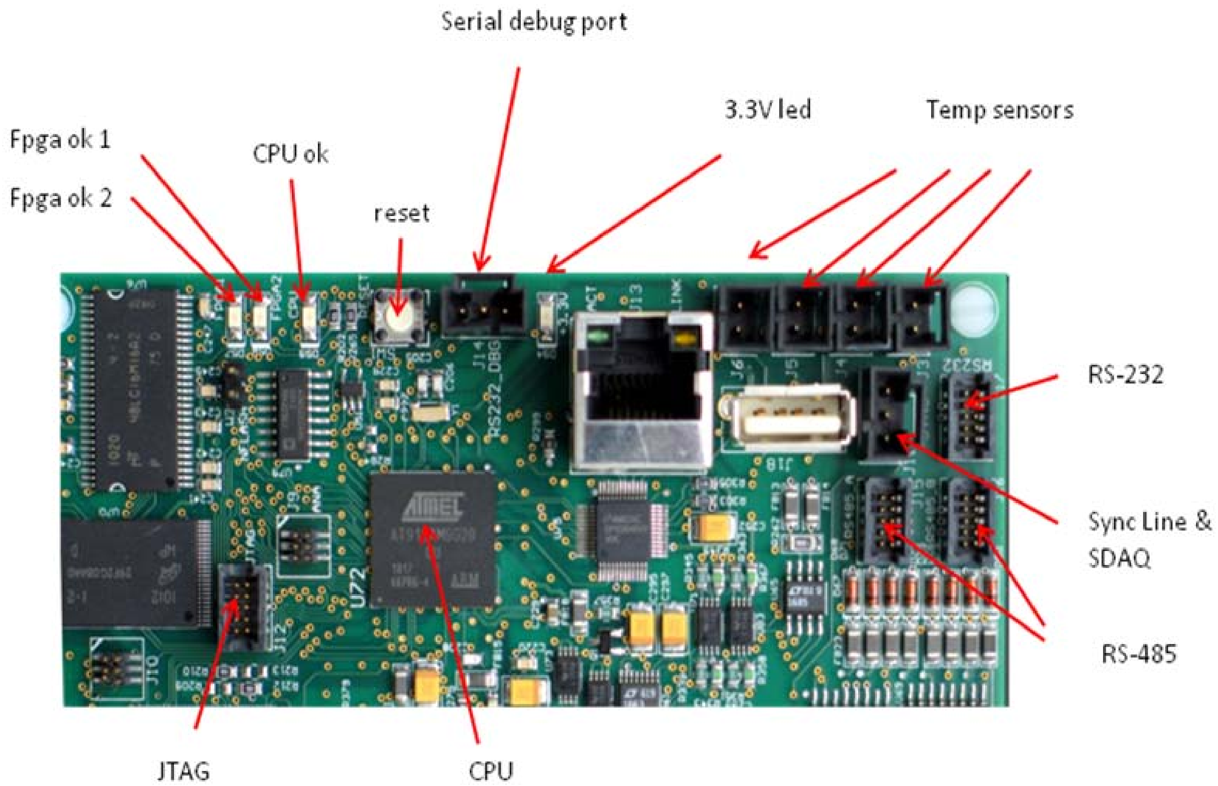


Figure 3-2 EDAQ Board: Ports and Diagnostic LEDs

3.2. Hardware Status Information

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

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

The Ethernet connector contains two LEDs:

- amber indicating a 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 QCS operator station.

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

3.4. EDAQ Sensor Identification and IP Addressing

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

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

For sensor-connected EDAQs, there is a sensor model resistor embedded in the cable harness connecting the sensor to the EDAQ. This resistor determines the function code. Function codes are unique for each sensor model to the extent that the EDAQ needs to differentiate the models. For example, all Source 9 basis weight measurement sensors presently have the same function code, regardless of radioactive isotope.

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

Refer to your scanner system manual to troubleshoot the EDAQ if it does not identify itself properly (or to find the correct resistor values).

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

3.5. Obtain Status Information

An overall status page is available from a QCS operator station under the **MSS Setup Diagnostics** tab (select the **MSS Summary** display).

On the left side of the **MSS Summary** display, as shown in Figure 3-3, is the list of expected EDAQs with three types of status indicators (from left to right).

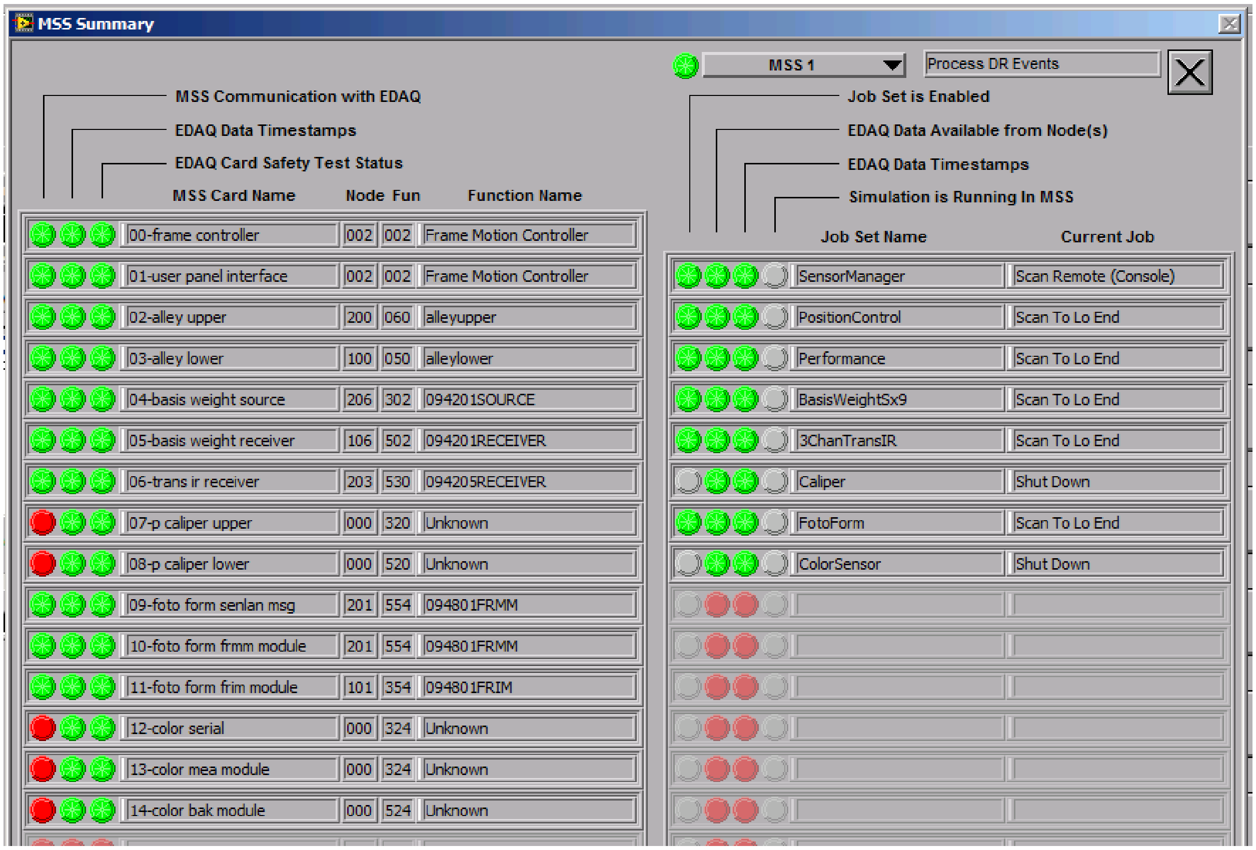


Figure 3-3 MSS Summary

Table 3-1 MSS Summary Display Status Indicators and Descriptions

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

Sensors that are part of the RAE database, but are not enabled on the scanner, appear in the left column indicators in red, for example, *07-caliper upper* in Figure 3-3.

3.6. MSS and EDAQ Web Pages

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

- go to the **MSS Diagnostic** tab, click on **MSS Monitor**, choose the appropriate MSS, and click on **MSS Web** page
- open a browser on any computer connected to the Experion MX level network, and use 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
- open a browser on any computer connected to the scanner LAN switch, and use the address *http://192.168.0.1/mss.php* or *http://192.168.10.101* (for the first MSS on the system)

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

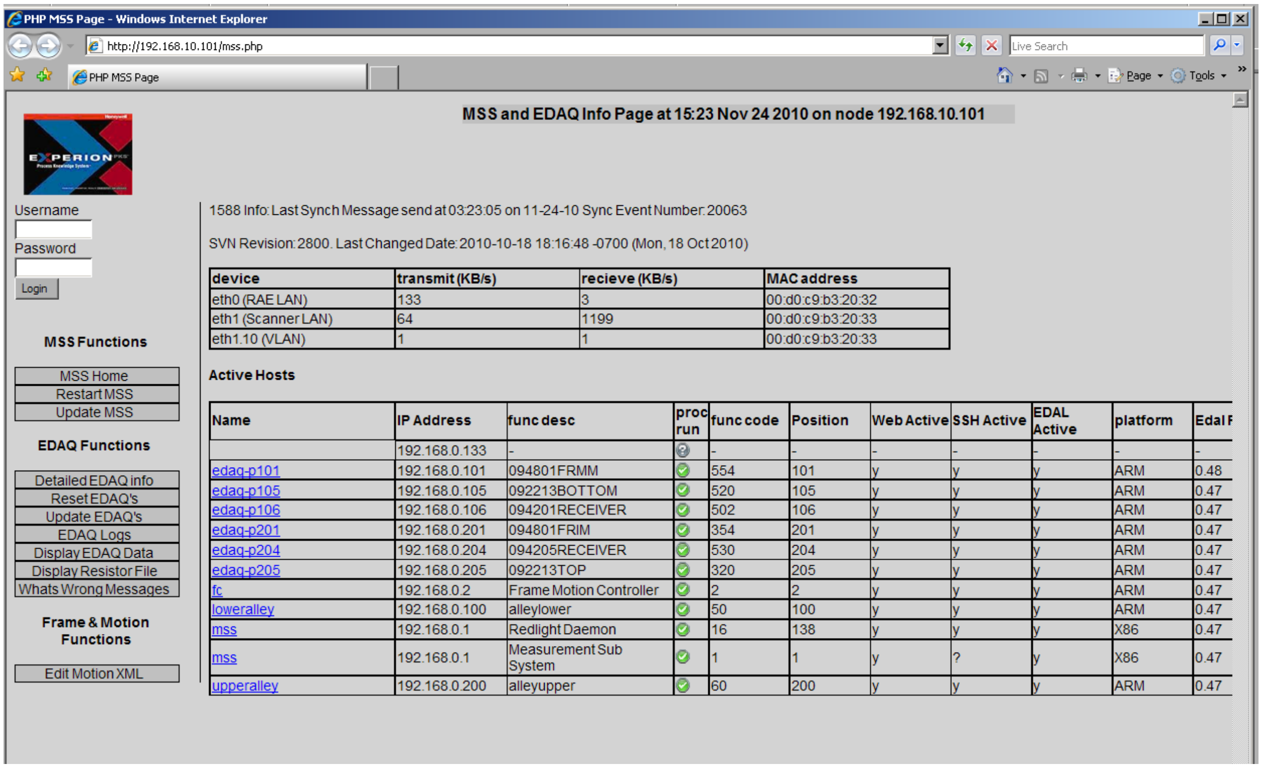


Figure 3-4 PHP MSS Page

The left panel shows a column of options divided into:

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

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

The main area 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 (RAELAN)** address is the one required in the setup.

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

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

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

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

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

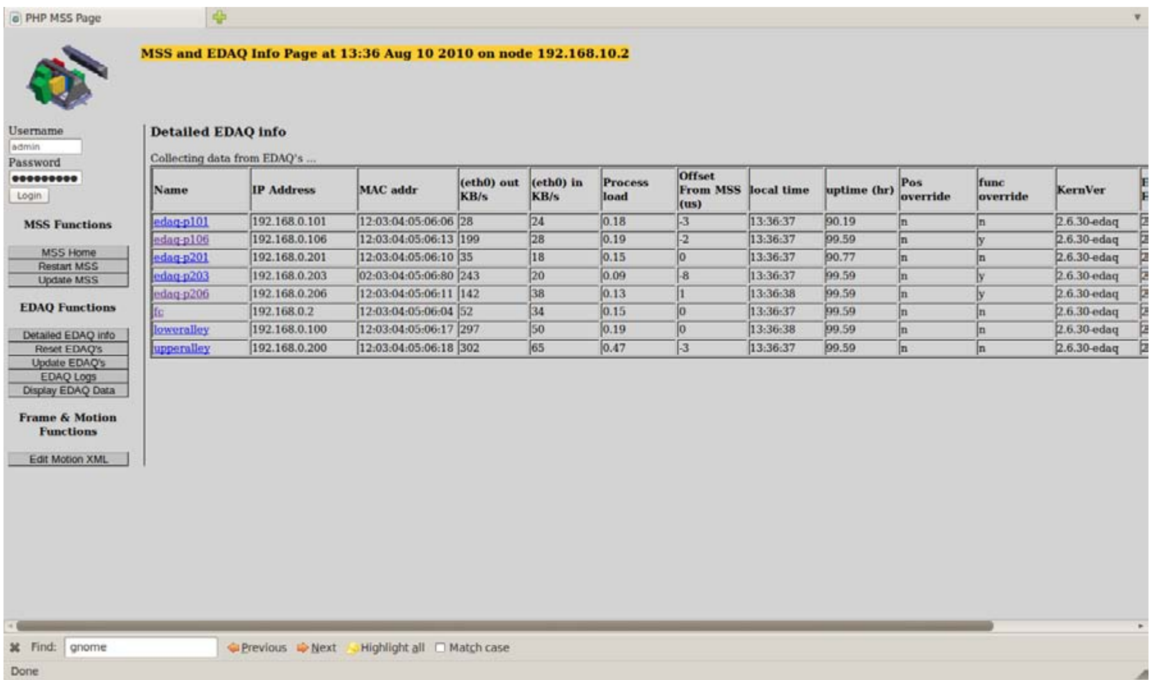


Figure 3-5 Detailed EDAQ Information: Partial Display

4. Installation

Before installing an Opacity Sensor, read Chapter 1 and Chapter 2.

4.1. Mounting and Electrical Connections

The receiver and source part of the Opacity Sensor can be installed by sliding the sensor part and sheetguide combination into the appropriate location. See your scanner manual for details on head design.

The sensor source is typically installed in the bottom head while the receiver is installed in the top head. Ensure that the quartz-Teflon plates are properly oriented, and that the black borders around the plates appear as shown in Figure 4-1.

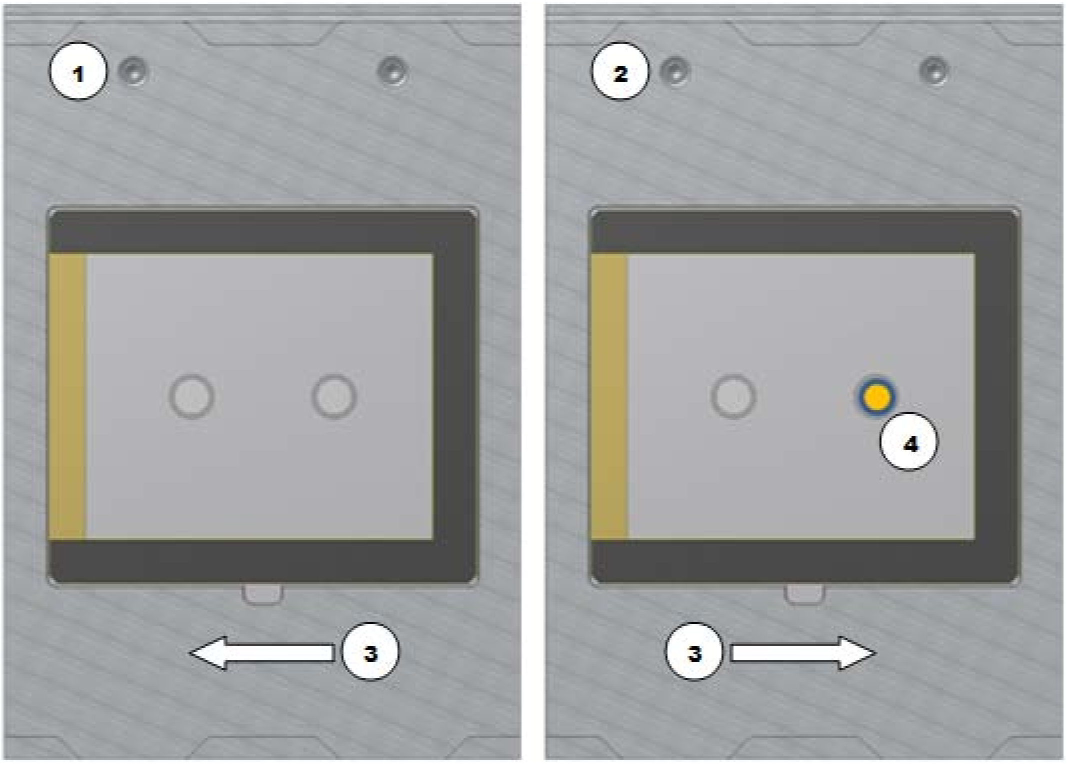


Figure 4-1 Correct Orientation of the quartz-Teflon plates

Table 4-1 lists the items labeled in Figure 4-1.

Table 4-1 Quartz-Teflon plates

Item	Description
1	Upper head
2	Lower head
3	Machine direction
4	Light source

Only the sensor receiver uses an EDAQ. Figure 4-2 shows the EDAQ connections. Only one EDAQ is present in the sensor receiver, opacity and moisture measurements share the EDAQ.

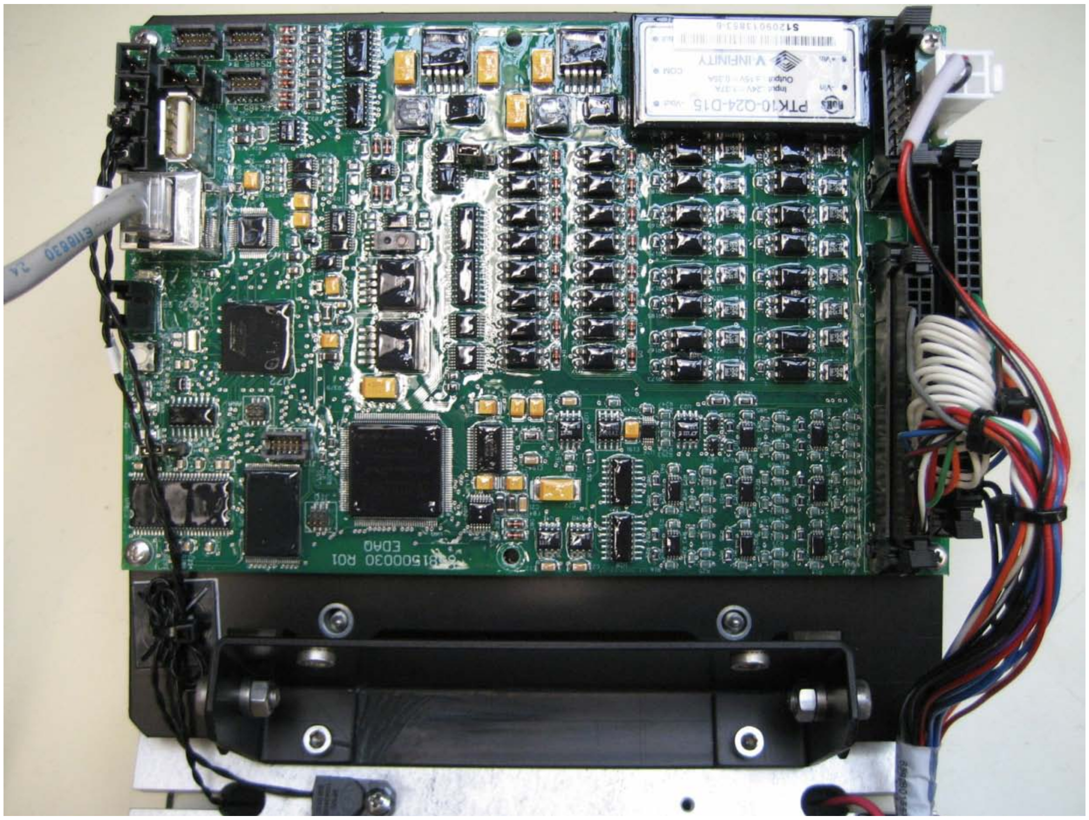


Figure 4-2 EDAQ Electrical Connections

4.2. Sensor Commissioning Task List

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

2. Check the source (see Subsection 2.1.1).

3. Check the receiver (see Subsection 2.1.4.1, Subsection 2.1.4.2, and Subsection 2.1.4.4).

4. Verify static calibration, and recalibrate if needed (see Chapter 6).

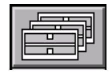
5. Determine the onsheet correctors: for Z-correction, see Section 8.6; for dirt correction, see Section 8.7.

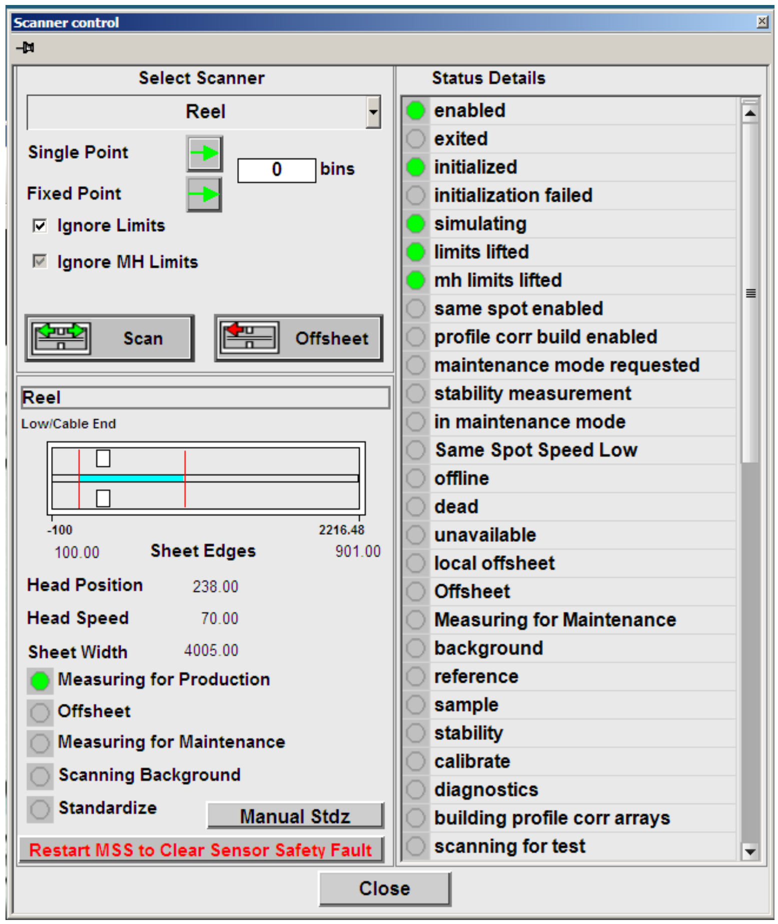
5. Operations

This chapter describes Opacity Sensor operations.

5.1. Maintenance Mode Setup

To set up maintenance mode:

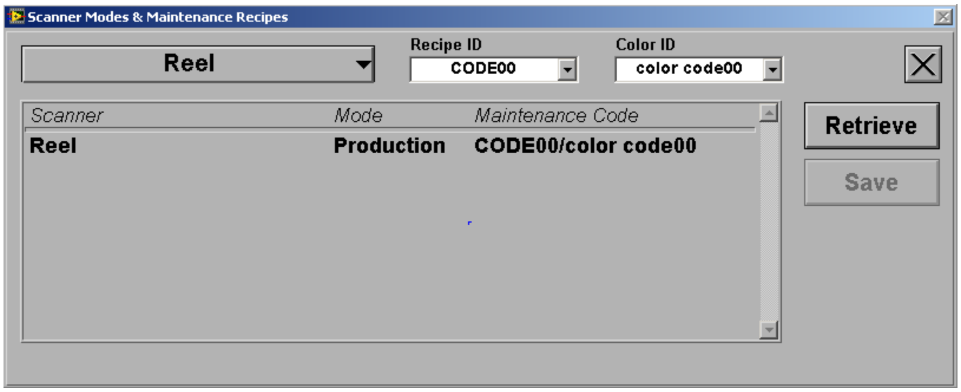
1. Bring the heads offsheet by clicking  to call up the **Scanner control** display.



2. Select the appropriate scanner and click 

on the **Scanner control** display to take the selected scanner heads offsheet.

3. Press **Retrieve/Save Recipes…** on the **Sensor Maintenance** display to call up the **Scanner Modes & Maintenance Recipes** dialog.



4. Select the appropriate scanner from the drop-down arrow.

5. Under **Recipe ID**, select the code.

6. Under **Color ID**, select a color code.

7. Click **Retrieve**.

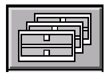
8. Close the **Scanner Modes & Maintenance Recipes** dialog.

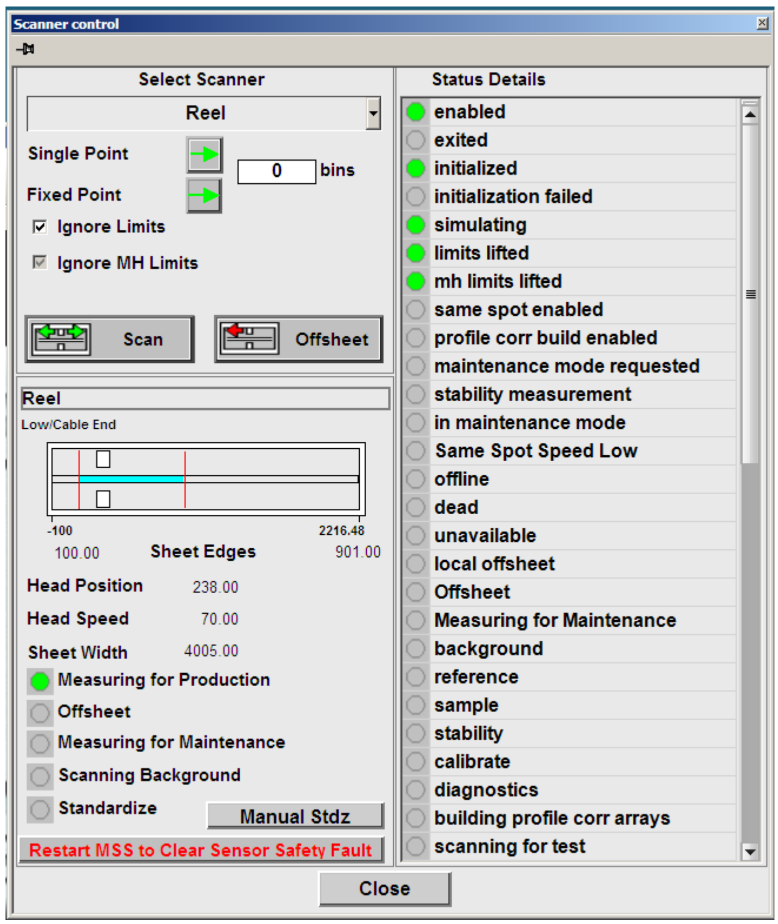
9. Select **Maintenance Mode** in the drop-down selector on the **Sensor Maintenance** display. Use the same selector to return to production mode.

5.2. Scanning in Production Mode

Before scanning, ensure that the proper recipe codes have been retrieved and that proper correctors have been enabled in the recipe-based options.

To start scanning:

1. Click  on the top horizontal dispatcher to call up the **Scanner control** display.



2. 

to scan the head. Before the head starts scanning, the system takes background and standardize readings from all sensors (basis weight, moisture, and so on), and stores them.

5.2.1. Types of Scan and Sensor Data Snapshot

While scanning, you can choose the position snapshot, the partial scan snapshot, or the single point by making the appropriate selection from the drop-down arrow (see Figure 5-1) in the **Sensor Maintenance** display.

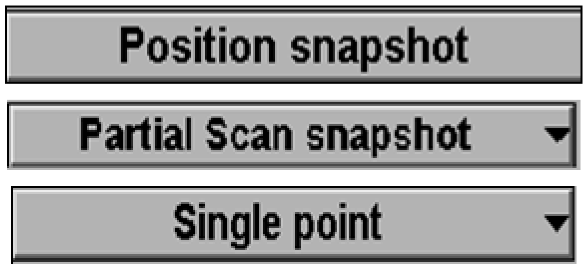


Figure 5-1 Snapshot Options

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

1. Send the head offsheet.
2. Enter the single point position (in terms of bins) in the **Scanner control** display.
3. Click **Single point** (see Figure 5-1).

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

For the position snapshot, you can set the position on the **Sensor Maintenance** display (in production mode), and the measurement readings can be monitored on the display as shown in Figure 5-2.

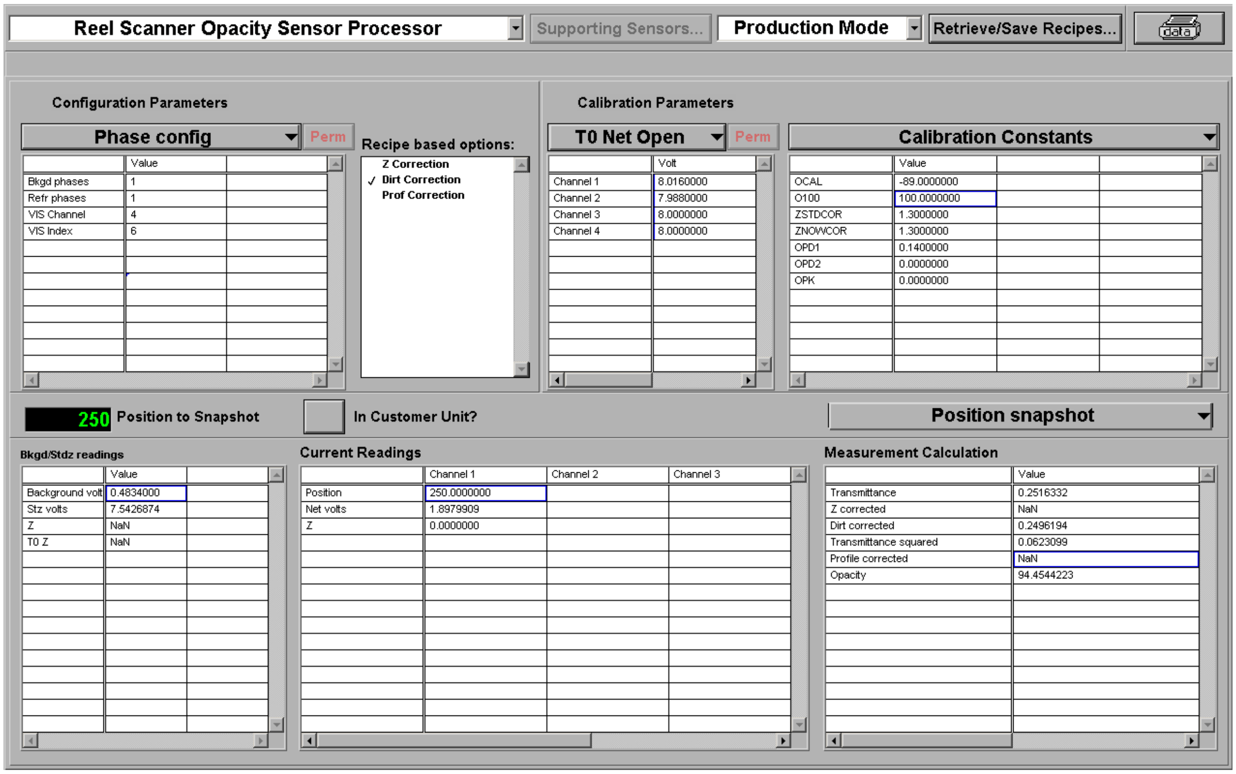


Figure 5-2 Sensor Maintenance Display (production mode)

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

5.2.2. Measurement Setup and Profile Display

To set the measurement alarm limits and the filter factor, go to the **Measurement Setup** display (see Figure 5-3).

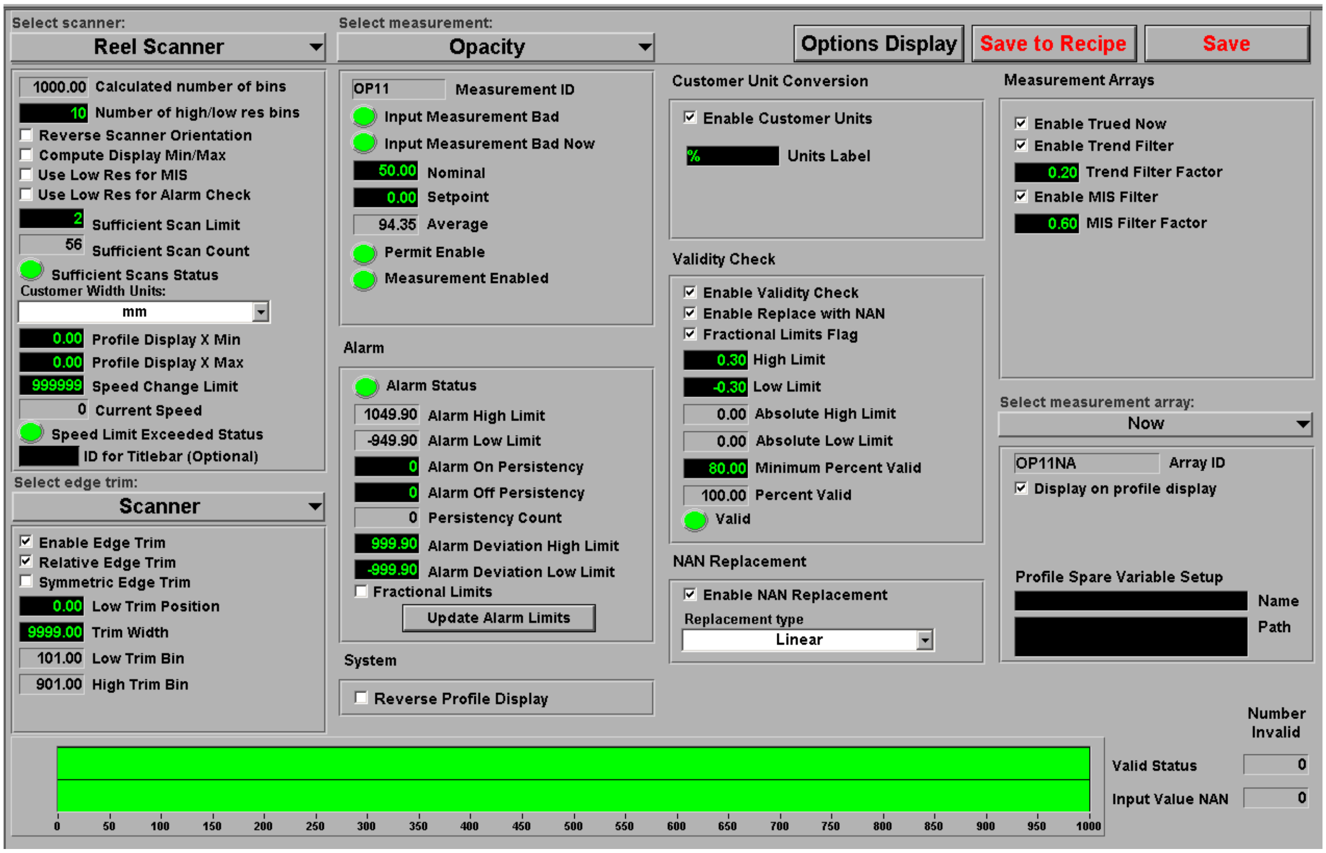


Figure 5-3 Measurement Setup Display

To go to the **Measurement Setup** display:

1. Select **Scanner/Sensor** in the horizontal dispatcher.
2. Click **Measurement Setup**.

To set up the **Profiles** display:

1. Select **Home** in the horizontal dispatcher.
2. In **Home**, click **Profiles**.
3. In the **Profiles** display (see Figure 5-4), choose the desired measurements, for example, opacity, moisture, and basis weight.

Monitor **Now** value or **Trend** value by making an appropriate selection.

Figure 5-4 shows the **Profiles** display with profiles for **Reel Opacity - Now**, **Reel Moisture - Now**, and **Reel Basis Weight - Now**.

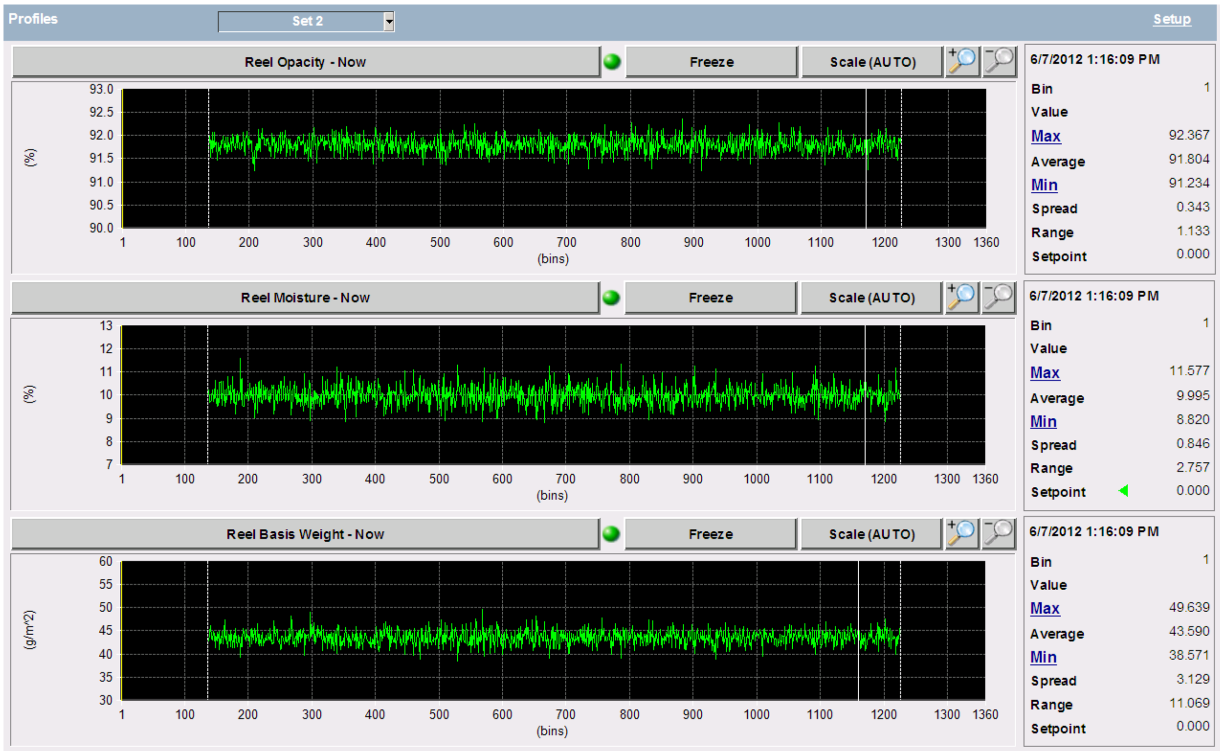


Figure 5-4 Profiles Display

6. Static Calibration

This chapter describes procedures for static calibration. Normal installation requires only hardware checks (see Section 6.4) and verification (see Section 6.7).

If there is no static calibration, or if a change in grade structure occurs requiring a complete new static calibration, see Section 6.6.

Operation of the scanner buttons and switching to maintenance mode are described in Chapter 5.

6.1. Sample Requirements

Obtain samples of all grades, or at least a set of grades that is representative in terms of opacity, basis weight, composition, and color. It is useful to also have a list of grade names and opacity targets. An 11.4-cm (4.5-in.) diameter sample will be needed for each grade.

6.2. Sample Preparation

1. Die out one 11.4-cm (4.5-in.) diameter sample for each grade to be calibrated.
2. Handle the samples by their edges only. Do not touch the test area with your fingers, and keep this area clean and free from folds and wrinkles.
3. Label each sample near the edge at the top (felt) side, with the system number, scanner name, and grade number.
4. Condition the samples under TAPPI conditions, protected from light and dirt.

6.3. Lab Sample Readings

6.3.1. Check Opacimeter

Verify the lab opacimeter using the appropriate standard samples, and make any necessary adjustments to its calibration.

6.3.2. Lab Readings

Read each sample with the opacimeter in five different positions around a 2.5-cm (1-in.) radius from the center of each sample. Take all readings with the top (felt) side toward the opacimeter unless the customer has indicated otherwise. Refer to the opacimeter documentation for the correct method of use. On some opacimeters it is necessary to take two readings, one with a white backing and one with a black backing. In this case, the opacity is obtained from the ratio of these (see Subsection 1.1.1).

For each sample, record the five opacity readings, and take the average. Also, calculate the total spread (highest minus lowest) for the five readings.

6.4. Hardware Checks

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

1. Bring heads offsheet.
2. Clean the quartz-Teflon plates if they are dirty.
3. Check that the upper and lower heads are aligned (refer to your scanner manual).
4. Check background/standardize values (see Section 8.2).
5. Check short term stability (see Section 8.3).

6.5. Sample Measurement

6.5.1. Reference

1. Set the reference integration time to four seconds on the **Sensor Maintenance** display.
2. Slide the paddle with no sample into the gap, and position it properly (the interlocking black rings should be centered over the quartz-Teflon plates).
3. Turn on the paddle motor to start the rotation.
4. Turn the reference switch on.
5. When the light in the switch goes out, turn the motor off and remove the paddle from the gap.

The opacity voltage with the empty interlocking black rings should not be lower than that for an empty gap by more than 0.3 V. If the channel voltage has changed more than by 0.3 V, check the paddle setup and alignment.

6.5.2. Sample

1. Set sample integration time to four seconds on the **Sensor Maintenance** display.
2. Clamp the sample into the interlocking black rings, taking care to center it well, and twist the rings to lock them.
3. Put the interlocking black rings and sample in the paddle.
4. Slide the paddle into the gap and position it properly (the rings should be centered over the quartz-Teflon plates).
5. Turn on the paddle motor to start the rotation.
6. Press on the sample button on the paddle.
7. When the light in the switch goes out, turn off the motor and remove the paddle from the gap.

6.6. Calibration

Sensor calibration is done by using the opacity calibration tool in Experion MX. The tool is accessed by clicking **Advanced** on the **Sensor Maintenance** display while in maintenance mode with the appropriate sensor selected.

The **Opacity Sensor Calibration** display (see Figure 6-1) provides a convenient user interface to perform calibration and verification of the opacity gauge.

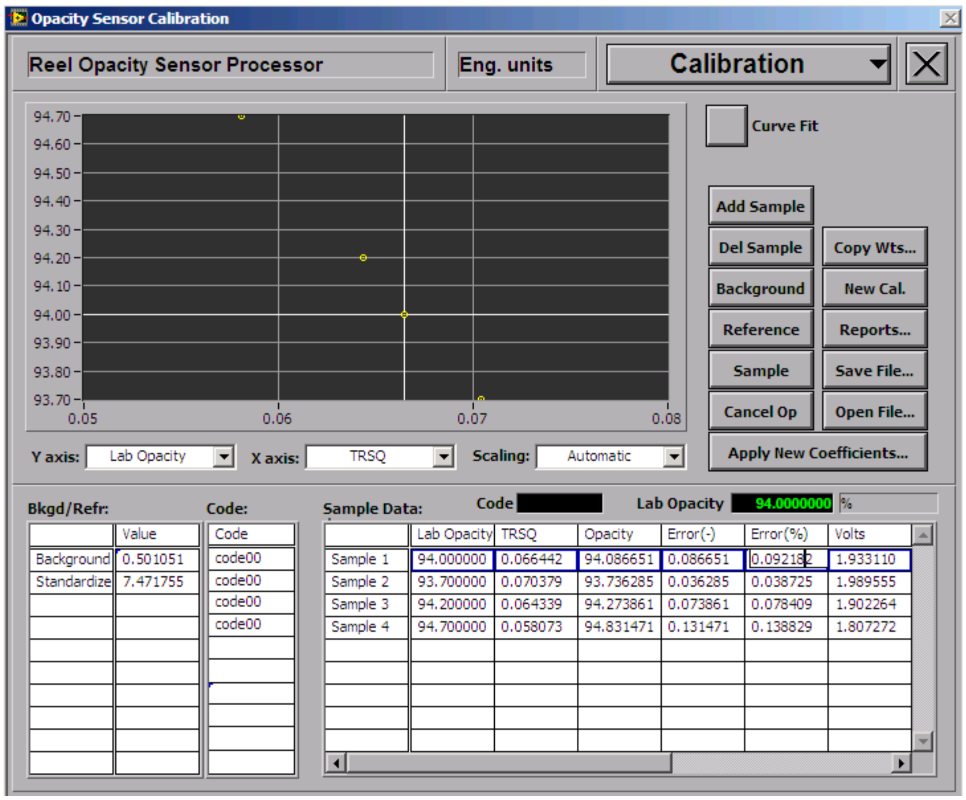


Figure 6-1 Opacity Sensor Calibration Display

The static calibration from the factory should verify on-site within accuracy specifications (see Section 6.7).

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

To calibrate the sensor, prepare the appropriate samples as per above procedures, and follow the procedures in Subsection 6.6.1, Subsection 6.6.2, and Subsection 6.6.3.

6.6.1. Data Entry

1. In the **Sensor Maintenance** display, ensure that the Z- and/or dirt correctors are selected, if required, and that the default values for the Z-corrector (ZNOWCOR and ZSTDCOR) as well as the dirt corrector (OPD1 and OPD2) have been entered–unless on-site tests have determined better values (see Sections 8.6 and 8.7).

2. In maintenance mode, click **Advanced…** on the **Sensor Maintenance** display, and select **Calibration** from the drop-down arrow on the top right of the display.

3. Enter the lab opacity and grade information manually: click **Add Sample** to create the number of sample entries required, and then enter the values for each sample in the green entries above the table (see Figure 6-1).

4. Perform a background.

5. Perform a reference with the rotating sample paddle and interlocking black rings in the gap (see Subsection 6.5.1).

6. Select the first row (Sample 1 in Figure 6-1) by clicking any field in the first row.

7. Perform a sample on each sample (see Subsection 6.5.2).

8. Perform a reference approximately every 10 samples to minimize the effect of detector drift during calibration.

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

CAUTION

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

6.6.2. Calibration Fit

For calibration fit, follow the procedure in this section. In case of difficulty, request the assistance of Honeywell Engineering.

1. In the **Opacity Sensor Calibration** display, load the raw calibration data file, and select **Calibration** from the drop-down menu.

2. Click **Curve Fit**. If the calibration is performed on the same grades as the ones used by the factory, the slope should not differ from the factory value by more than 10%.

3. Accept the calibration.

4. Inspect the calibration data using the plot function, selecting **Error (-)** on the Y axis and **Lab Opacity** on the X axis. Most of the errors should be equal to or less than the static accuracy: usually 2σ of ± 0. 5 or ± 0. 8 opacity unit (see Section 1.3), or the 2σ spread in the lab reading, whichever is greater.

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

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

   Another possibility is that some samples may need to belong to a different group with a different slope and intercept. Decide on grade groups based on the opacity error. Separate the grades in different files and try calibrating again.

6. Print the calibration report by clicking **Reports…**, then selecting **Calibration**.

6.6.3. Entry of Calibration Constants

In the **Advanced Moisture Calibration** display, click **Apply New Coefficients…** to call up the **Apply new calibration coefficients** dialog (see Figure 6-2), and store calibration constants to the recipe database.

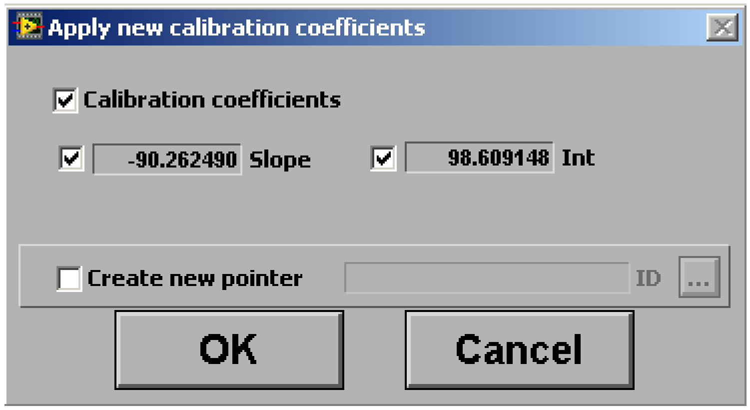


Figure 6-2 Apply new calibration coefficients Dialog

A new table can be created to link to a particular recipe. Otherwise, the data is stored in the table for the current code. Check or uncheck each coefficient to store. Only checked values are written to the recipe database.

It is also possible to manually enter the calibration constants in a grade code using the **Recipe Maintenance** display from the **Setup** menu. In the appropriate recipe, click on the **Main Code Table** tab, and select the **Opacity Sensor Calibration Table**. Enter the calibration coefficients and click **Save**.

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

6.7. 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 or new grades.

Like calibration, verification is done using the **Opacity Sensor Calibration** display. Call up the **Opacity Sensor Calibration** display by clicking **Advanced…** in the **Sensor Maintenance** display while in maintenance mode. To enter verification, select **Verification** from the drop-down arrow (see Figure 6-3).

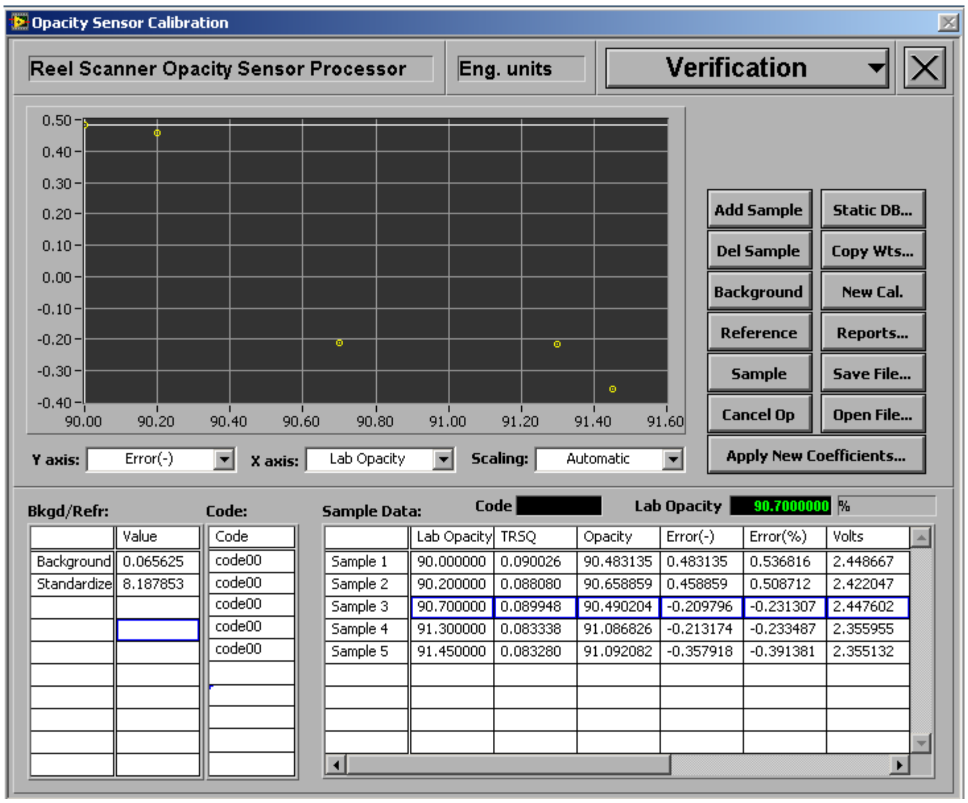


Figure 6-3 Opacity Sensor Calibration Display

Maintenance mode applies to an entire scanner; however, maintenance operations are targeted to a single sensor, therefore, only one **Opacity Sensor Calibration** display can be called up at a time. The common interface maintains only one copy of working memory for the verification.

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

To verify previously calibrated grades:

1. Perform a hardware check (see Section 6.4).
2. Load a grade code containing the calibration constants of the samples to be verified.
3. Ensure that the appropriate calibration constants and correctors (Z- and dirt) are properly restored on the **Sensor Maintenance** display.
4. In maintenance mode, click **Advanced…** on the **Sensor Maintenance** display and select **Verification**.
5. The **Sample Data** table is blank the first time you call up the **Opacity Sensor Calibration** display; otherwise, click **New Cal.** to reset the working space to blank.
6. Load the lab values from a file if the appropriate file exists, or click **Copy Wts…** to copy the lab values from the calibration table to the verification table.
7. If the lab values have never been entered, set up the **Sample Data** table by clicking **Add Sample** once for every sample. For each sample, enter the lab opacity in the green field above the table. Save the entered data to a file before starting shooting samples.
8. Click **Background** to request a background operation. The result appears in the **Bkgd/Refr** table in the lower left corner.
9. Perform a reference with the paddle and interlocking black rings in the gap (see Subsection 6.5.1). The result also appears in the **Bkgd/Refr** table.
10. Place the cursor on the first row in the **Sample Data** table, and perform a sample using the paddle and interlocking black rings (see Subsection 6.5.2).
11. When the operation is complete, the result is displayed in the **Sample Data** table. The cursor (the highlighted row) automatically moves down to the next entry.
12. Repeat the sample measurement until all of the samples are measured.
13. Save the data again to include the sensor data.

14. Select **Error (-)** on the vertical Y axis, and **Lab Opacity** on the horizontal X-axis, to view the verification results graphically.

15. Make a note of any samples that measure with an error of greater than the 2•σ accuracy specification (see Section 1.3) or the 2•σ spread in the lab reading, whichever is greater. 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.

7. Preventive Maintenance

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

In Table 7-1, *X* indicates recommended maintenance intervals.

Table 7-1 Preventive Maintenance Internal Checklist

Procedure	Daily	Weekly	Months		Years			Task Details
			1	6	1	2	5	
Clean Sensor Window	X							Section 8.1
Check Standardize/background Values	X							Section 8.2
Check Short Term Stability			X					Section 8.3
Replace IR Lamp				X				Section 8.4
Check Stability	X							Section 8.5
Check Z-correction					X			Section 8.6
Check Dirt Correction					X			Section 8.7

8. Tasks

This chapter contains procedures for maintaining optimal Opacity Sensor function, and for troubleshooting issues with the Opacity Sensor.

ATTENTION

Activity numbers that appear in the task tables are for use of the sensor diagnostics displays only and do not reflect model numbers for the tasks. To determine whether the task applies to your sensor, check *Applicable Models*.

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

8.1. Clean Sensor Window

Clean the sensor window and/or inspect the daily sensor report each day to check for the level of dirt and any indications of instability or failure.

Activity Number:	Q4240-52-ACT-001	**Applicable Models:**	Q4240-52
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:**	Check Dirt Correction
Required Parts:	Part Number	Quantity	Lead Time

Required Tools:	Part Number	Quantity	Lead Time
	• cloth or paper towels • thin stick • methanol or isopropyl alcohol		

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

CAUTION

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

Dirt correction may be necessary if the standardize voltage of the opacity (*vis*) channel with dirty plates fall by 10 percent or more in one day, and the cleaning frequency cannot be increased.

8.2. Check Background and Standardize Values

Inspect the sensor background and standardize reports weekly to check for indications of sensor instability.

Activity Number:	Q4240-52-ACT-002	**Applicable Models:**	Q4240-52
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
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

1. In the **Sensor Report** display, select **Opacity Background Report** (see Figure 8-1).

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

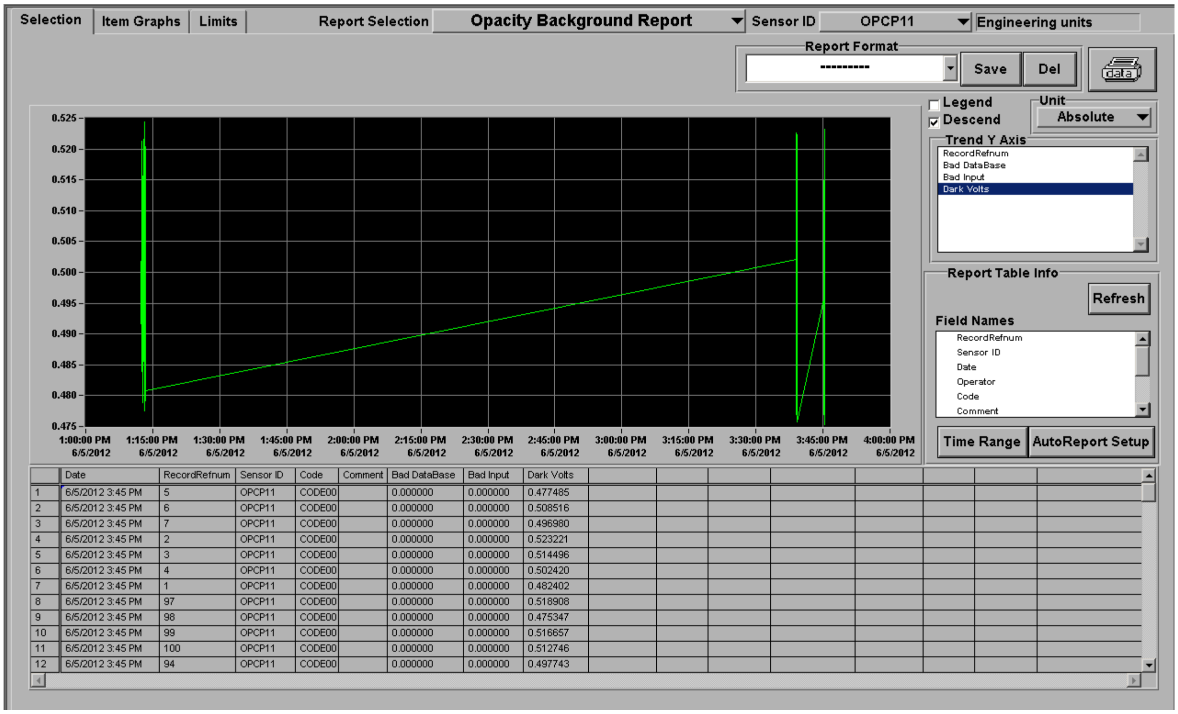


Figure 8-1 Opacity Background Report

3. Dark volts should be between 0.45 V and 0.6 V. If dark volts are not within these limits, consult the troubleshooting table.

4. In the **Sensor Report** display, select the **Opacity Standardize Report**. Standardize volts should be 7.5 V ± 0.5 V. Standardize volts are expected to move up and down with head temperature. Channel voltage decreases (increases) when head temperature increases (decreases).

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 archive the sensor report regularly.

8.3. Check Short Term Stability

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

Activity Number:	Q4240-52-ACT-003	**Applicable Models:**	Q4240-52
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:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

8.3.1. Background Measurements

To check background measurements:

1. Go into maintenance mode (see Chapter 5).
2. On the **Sensor Maintenance** display, set **Bkgd. Integr. Time** for background to 4.00 for four seconds (see Figure 8-2).
3. Perform two background operations.
4. The dark volts should be within 2% of each other and be between 0.45 V and 0.6 V.

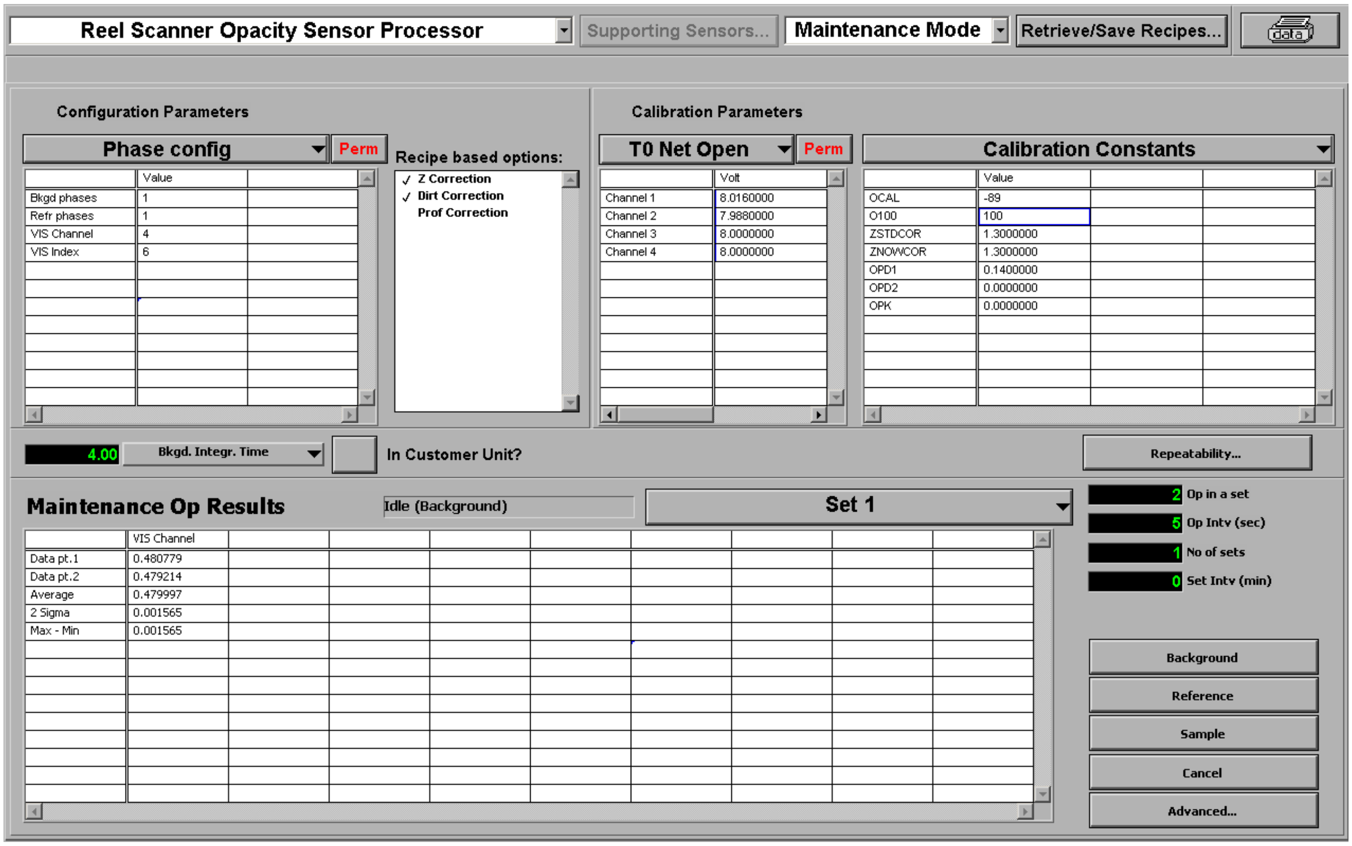


Figure 8-2 Sensor Maintenance Display: Set 1

8.3.2. Reference Measurements

To check reference measurements:

1. Ensure that the head temperature is within specifications and is stable (refer to your scanner manual).
2. On the **Sensor Maintenance** display, set **Bkgd. Integr. Time** for background to 4.00 for four seconds.
3. Set up to request at least two sets of 10 reference operations in a 10 minute period with nothing in the gap as per Figure 8-3.

The results of more than one set of 10 operations usually give a reliable picture of the short-term stability of the sensor. The sensor is within spec if:

$$\frac{2 \bullet \text{Sigma of Net Open Volts}}{\text{Average Net Open Volts}} < 0.0025$$

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 9.2).

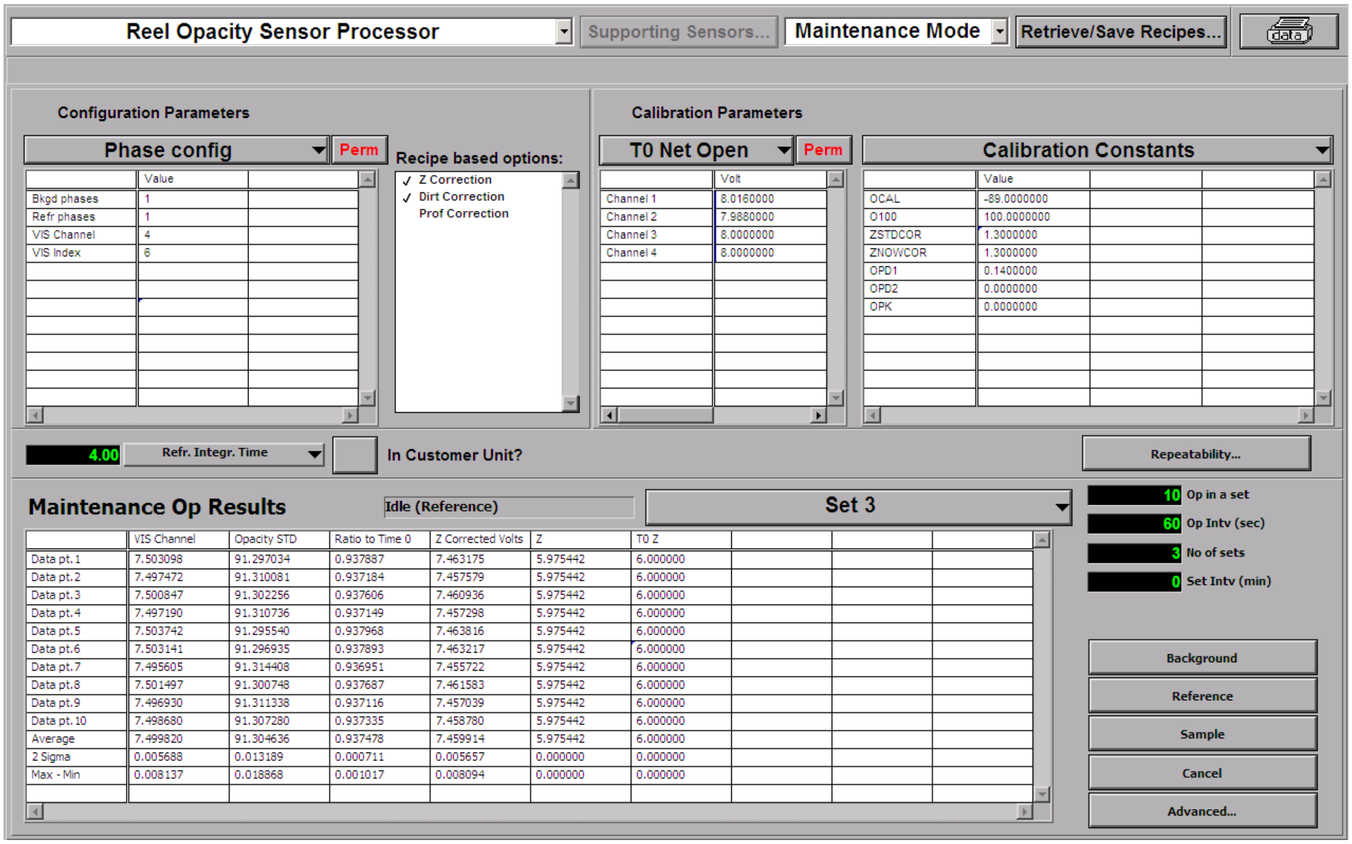


Figure 8-3 Sensor Maintenance Display: Set 3

8.4. Replace IR Lamp

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

Activity Number:	Q4240-52-ACT-004	**Applicable Models:**	Q4240-52
Type of procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock, high temperature
Availability Required:	Sensor offline	**Reminder Lead Time:**	

Overdue Grace Period:		**Frequency (time period):**	6 months
Duration (time period):	1 hour	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
	38000201: one, in stock 08594000: one, in stock		
Required Tools:	Part Number	Quantity	Lead Time
	• cloth • flat-head screwdriver • Allen key (5/32)		

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

1. Turn off the IR source power in lower head by unplugging the source connector.
2. Unscrew the lamp leads from the terminal block.
3. Loosen the screw securing the lamp holder (using a 5/32 Allen key).
4. Carefully remove the lamp holder.

CAUTION Remove the lamp using a cloth; the lamp could still be hot.

5. Inspect bulb leads. If the leads show signs of oxidation, it is imperative that both the lamp and the lamp holder be replaced.
6. Insert the new lamp into 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 (see Table 2-1).

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, should have more than 3 V peak-to-peak with the jumper on the detector preamp set to lowest gain.

Back the lamp off if any signal is too high.

10. Check and adjust the gain and the phase of the fastcards (see Section 8.9).

8.5. Check Stability

The long term stability of the gauge can be assessed by shooting customer samples regularly. A large shift in the sensor reading can be an indication of a hardware issue.

Activity Number:	Q4240-52-ACT-005	**Applicable Models:**	Q4240-52
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:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

To verify customer samples:

1. Go into maintenance mode (see Chapter 5).
2. Check the sensor stability (See Section 8.3).

3. In the **Sensor Maintenance** display, click **Advanced…** and select **Verification** from the drop-down arrow.

4. Load the file containing the samples opacity value using the **Open File…** command, or enter the values manually. See Chapter 6 for more details on data entry.

5. Perform a background.

6. Load the grade for the opacity samples to download the calibration constants. Check that the proper calibration constants and correctors appear on the **Sensor Maintenance** display.

7. Perform a reference with the paddle and interlocking black rings (see Subsection 6.5.1).

8. Perform a sample (see Subsection 6.5.2).

9. Repeat Steps 6–8 for each sample.

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

11. A significant shift in the readings compared to previous readings may be indicative of a problem.

12. Ensure that the proper calibration constants and correctors are loaded.

13. If a hardware issue is suspected, see Chapter 9.

8.6. Check Z-correction

Check Z-correction, if used, every year to confirm the accuracy of the corrector constants.

Activity Number:	Q4240-52-ACT-006	**Applicable Models:**	Q4240-52
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 year
Duration (time period):	1.5 hours	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	

Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time
	• Shims (approx. 1” x 2” x 0.01”) • opacity samples (1–3)		

Z-Correction may be necessary if the scanner deflection is 0.25 mm (0.01 inch) or more. The Z-correction algorithm is shown in Section 2.2.

8.6.1. Standard Z-correction

It is normally adequate to use the standard values for the Z-corrector calibration constants (ZNOWCOR and ZSTDCOR) shown in Subsection 2.2.7.

8.6.2. Z-correction Calibration

If the default values prove inadequate, use the following procedure to obtain the correct values:

1. Obtain shims for the upper head scanner wheels. The shims must be of equal thickness; ideally, the same thickness as the maximum scanner deflection relative to calibration time value ZT0. Select one to three samples, 11.4-cm (4.5-in.) diameter, of representative opacity.

2. With no shims in place, perform a standardize to obtain the Z reading. Record it as Z0.

3. Perform a reference with the sample paddle and interlocking black rings. Record the volts as VISST0.

4. Measure the three samples, and record their volts as VISC1, VISC2, and VISC3.

5. Install the shims and perform a standardize to obtain the new Z reading. Record it as ZZ.

6. Measure the three samples, and record their volts as VISZ1, VISZ2, and VISZ3.

7. Perform a reference with the sample paddle and rings. Record the volts as VISSTZ.

8. Calculate the corrector for the standardize/reference:

$$\mathrm{ZSTDCOR} = \frac{\left(\frac{\mathrm{VISSTZ}}{\mathrm{VISST0}} - 1\right) Z0}{(\mathrm{ZZ} - \mathrm{Z0})}$$

9. For each sample, calculate the corrector for sample/onsheet modes:

$$\mathrm{ZNOWCOR} = \frac{\left(\frac{\mathrm{VISZ1}}{\mathrm{VISC1}} - 1\right) Z0}{(\mathrm{ZZ} - \mathrm{Z0})}$$

10. Average the ZNOWCOR values obtained with the different samples.

8.6.3. Verification of Z-correction

1. Enter the ZNOWCOR and ZSTDCOR values in the **Sensor Maintenance** display.
2. Enable Z-correction in the **Sensor Maintenance** display.
3. Repeat Z-correction calibration (see Subsection 8.6.2).
4. The opacity readings for the two different gap values should agree.
5. Enter the ZNOWCOR and ZSTDCOR values in the recipe via the **Recipe Setup** display.

8.7. Check/calibrate Dirt Correction

Check dirt correction, if used, every year to confirm the accuracy of the corrector constants.

Activity Number:	Q4240-52-ACT-007	**Applicable Models:**	Q4240-52
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 year
Duration (time period):	1 hour	**# of People Required:**	1

Prerequisite Procedures:		Post Procedures:	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time
	• Rotating sample paddle (6580801704) • Black interlocking rings (07612600 and 07612700)		

Dirt correction may be necessary if the standardize voltage of the opacity (*vis*) channel with dirty plates falls by 10 percent or more in one day, and the cleaning frequency cannot be increased. The algorithm for dirt correction is given in Section 2.2.

It is normally adequate to use the default values for the dirt corrector calibration constants (OPD1 and OPD2) shown in Subsection 2.2.7.

8.7.1. Calibration of Dirt Correction

If the default values prove inadequate, use the following procedure to obtain the correct values:

1. Allow dirt to build up on the quartz-Teflon windows for as long as it normally would between cleaning (after a weekend, for example).
2. Select a set of samples, 11.4-cm (4.5-in.) diameter, of representative opacity, basis weight, and color.
3. Set the constants OPD1 and OPD2 to zero via the **Recipe Setup** display or the **Sensor Maintenance** display.
4. Perform a background.
5. Using the sample paddle and interlocking black rings, perform a reference.
6. Record the volts as VISSdirty.
7. Measure the samples on the sensor using the paddle and rings.
8. Record the transmission value, T, for each sample as Tdirty.
9. Clean the plates.

10. Perform a reference with an empty gap, and record the volts as VISST0.

11. Perform a reference with the sample paddle and rings, and record the volts as VISSclean.

12. Measure the samples on the sensor using the paddle and rings.

13. Record the transmission value, T, for each sample as Tclean.

14. Calculate the dirt indicator:

$$\mathrm{DRFT} = \frac{\mathrm{VISS_{dirty}}}{\mathrm{VISS_{clean}}}$$

15. For each sample, calculate the optimal corrector:

$$\mathrm{OPDR} = \frac{\left(\frac{\mathrm{T_{clean}}}{\mathrm{T_{dirty}}} - 1\right)}{(\mathrm{DRFT} - 1)}$$

16. Graph this value vs. T for all the samples.

    If the OPDR values fall within a narrow range, or do not correlate with T, use OPD1 = OPDR and OPD2 = 0.

    If OPDR correlates with T, determine the slope and intercept of the best fit straight line.

    Let OPD1 equal the intercept, and let OPD2 equal the slope of this line.

8.7.2. Verification of Dirt Correction

Enter OPD1, OPD2 via the **Recipe Setup** display, and reload the grade code. If no value for VISS0 has been entered, enter the empty gap reference value (VISST0) from above. Verify the calibration with the samples on dirty plates when possible.

8.8. Replace a Board

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

Activity Number:	Q4240-52-ACT-008	**Applicable Models:**	Q4240-52
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
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

CAUTION

Remove the lamp using a cloth; the lamp could still be hot.

1. Turn off the head power before removing or inserting a board.
2. Handle the boards by their edges or wear clean gloves. Do not touch the 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.

8.9. Realign After Replacing Parts

Replacement of some parts requires realignment of other parts (see Table 8-1).

Activity Number:	Q4240-52-ACT-009	**Applicable Models:**	Q4240-52
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:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

Table 8-1 lists and describes replaced parts and related tasks.

Table 8-1 Replaced Parts Requiring Realignment of Other Parts

Replaced Item	Task
Source	
Lamp	Lamp focus, gain, and phase of fastcards (see Section 8.4, and Section 8.13)
Tuning fork	Tuning fork driver board (see Section 8.12)
	Gain and phase of fastcards (see Section 8.13)
Tuning fork driver board	See Section 8.12
	Gain and phase of fastcards (see Section 8.13)
Power supply adapter board	See Subsection 2.1.2
Receiver	
Detector preamp	Gain and phase of fastcards (see Section 8.13)
Fastcard	Gain and phase of fastcards (see Section 8.13)
Unigauge backplane board	See Subsection 2.1.4.1
	Gain and phase of fastcards (see Section 8.13)
Opacity extension backplane	Remove jumper W1
	Gain and phase of fastcard (see Section 8.13)

Quartz Panels	
Optically tuned plates	Gain of fastcards (see Section 8.13)
	Check static calibration (See Chapter 6)

8.10. Check for Water in Quartz-Teflon Plates

The Opacity Sensor uses 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 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:	Q4240-52-ACT-010	**Applicable Models:**	Q4240-52
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
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time
	• blow dryer		

If water has entered a plate, the water will cause a very strong reduction in the moisture MES volts at standardize/reference.

To check for water in the plates:

1. Perform a reference.
2. Split the heads.
3. Heat the central area of the quartz-Teflon plate, 7.5 cm by 2.5 cm (3 in. by 1 in.), with a blow dryer to drive the water away. You should observe some change in appearance.

4. When the plate is hot, quickly put the heads back together and perform several references.

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

8.11. Replace Quartz-Teflon Plates

The Opacity Sensor uses 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 cracked or broken plates.

Activity Number:	Q4240-52-ACT-011	**Applicable Models:**	Q4240-52
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
Required Parts:	Part Number	Quantity	Lead Time
	See Table 8-3 and Table 8-4		
Required Tools:	Part Number	Quantity	Lead Time
	• X-Acto knife • flat head screwdriver • alcohol • tissue		

8.11.1. Remove the Plate

1. Remove the plate using an X-Acto knife to cut the RTV sealant around the edge, and a screwdriver to pry it out.

2. Clean the RTV off the sheetguide using the knife and screwdriver, followed by alcohol and tissue.

3. Remove the light pipe, using a knife to cut away the RTV at the sheetguide, and the RTV holding the light pipe to the head platform.

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

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

Figure 8-4 shows the correct orientation of the plates.

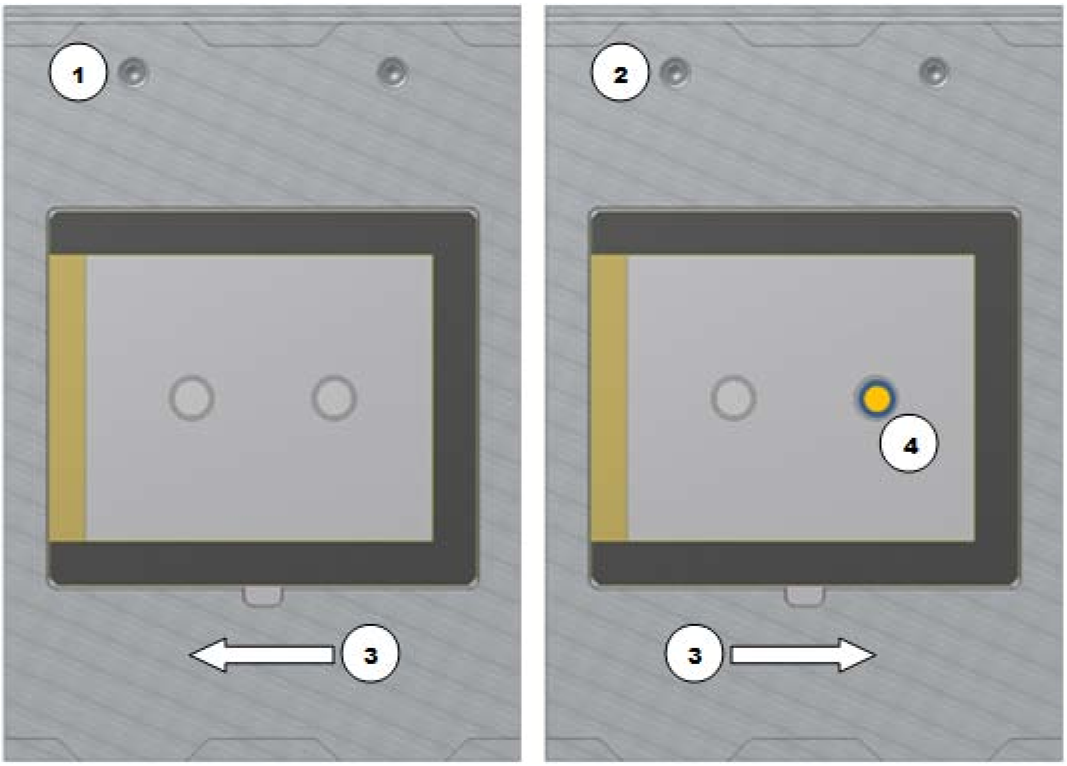


Figure 8-4 Correct Orientation of INFRAND Plates

Table 8-2 lists the items labeled in Figure 8-4.

Table 8-2 INFRAND Plates

Item	Description
1	Upper head
2	Lower head
3	Machine direction
4	Light source

8.11.2. Install the Plates

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; however, you should check the calibration.

1. Place the sheetguide on a flat surface facing up.

2. Insert the light pipes into the holes so that they project about 6 mm (0.25 in.) at the sheetguide.

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

4. Push the light pipes back in until they project by about 3 mm (0.125 in.).

5. Without pausing, lay down a bead of clear RTV about 6 mm (0.25 in.) wide around the inside of the rectangular recess for the plate.

6. Place the quartz-Teflon plate into the recess, pushing against the RTV and light pipes until the plate is flush with the sheetguide. Optically tuned plates should be mounted with the white edges opposing:

   On the lower head, the white edge should be on the offset optics side; on the upper head, the white edge should be on the straight-through optics side (See Figure 8-4).

   Ensure that the light pipes 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).

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

The part numbers for materials needed to install the plates are listed in Table 8-3 and Table 8-4.

Table 8-3 Upper Head

Item	Part Number	Quantity
Plate	08607801	1
Light Pipe	00300000	2
Clear RTV	16000001	As required

Table 8-4 Lower Head

Item	Part Number	Quantity
Plate	08607801	1
Light Pipe	00299900	1
Clear RTV	16000001	As required

8.12. Align Tuning Fork Driver Board

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

Activity Number:	Q4240-52-ACT-012	**Applicable Models:**	Q4240-52
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
Required Parts:	Part Number	Quantity	Lead Time

Required Tools:	Part Number	Quantity	Lead Time
	• voltmeter • oscilloscope • small flat head screwdriver		

8.12.1. Check Alignment

1. Power up the sensor.
2. On the tuning fork driver board, connect a voltmeter to TP6 (+) and TP2 (-), and an oscilloscope with probes to TP5 and TP3 with ground to TP1.

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

   The phase reference signal appears on TP4 as a 6 V peak-to-peak signal with a frequency of 570 ± 20 Hz.
3. If all of these conditions are satisfied, the tuning fork is aligned. If not, proceed to the Subsection 8.12.2.

8.12.2. Obtain Stable Oscillation

1. Power up the sensor. If the fork vibrates cleanly, proceed to Subsection 8.12.3.
2. If there is no vibration, turn R1 counterclockwise (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.

8.12.3. Adjust Maximum Amplitude

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

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

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

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

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

8.12.4. Test for Clean Start

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

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

ATTENTION

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

8.13. 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 four boards.

Activity Number:	Q4240-52-ACT-013	**Applicable Models:**	Q4240-52
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:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time
	• voltmeter • oscilloscope • small flat head screwdriver		

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

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

3. Check the output of the detector preamp by connecting the oscilloscope probe to TP2 (signal) and TP1 (Gnd) of the fastcard. The signal should be a 570 Hz sine wave of amplitude between 0.3 and 3 V peak-to-peak.

4. If the signal is greater than 3 V, select a lower gain on the corresponding PbS/Si detector assembly by changing the jumper selection on the fast preamp board (See Figure 8-5).

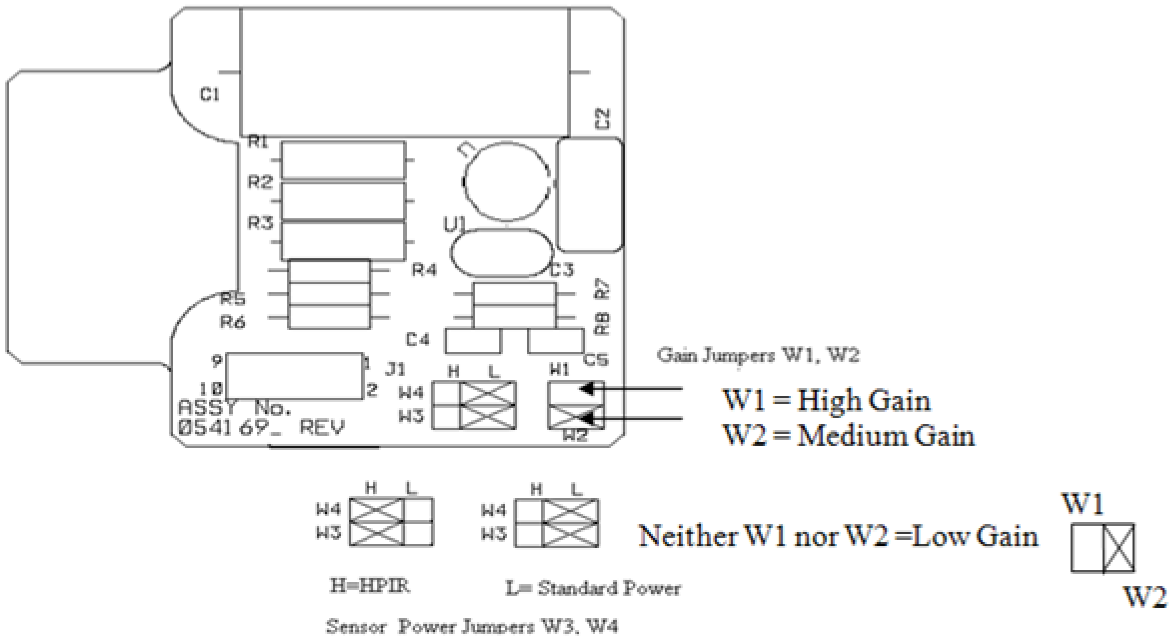


Figure 8-5 PbS Detector Assembly

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

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

7. The highest gain is selected by placing a jumper in position W1, medium gain is selected by placing the jumper in position W2, and the lowest gain is selected by removing the jumper or by placing it across the W1 and W2 positions as shown in Figure 8-5.

8. Connect the voltmeter to TP9(+) and TP1(Gnd) and connect the oscilloscope probe to TP7A and TP1(Gnd) of the fastcard. Adjust R1 on the Fastcard to bring the meter reading into the range from 4–8 V DC.

9. Adjust R2 to balance the phase (see Figure 8-6). Phasing adjustment can be done using TP7A and TP7B on the fastcards. If phasing is impossible on a fastcard, change the selection on jumper W5/W6.

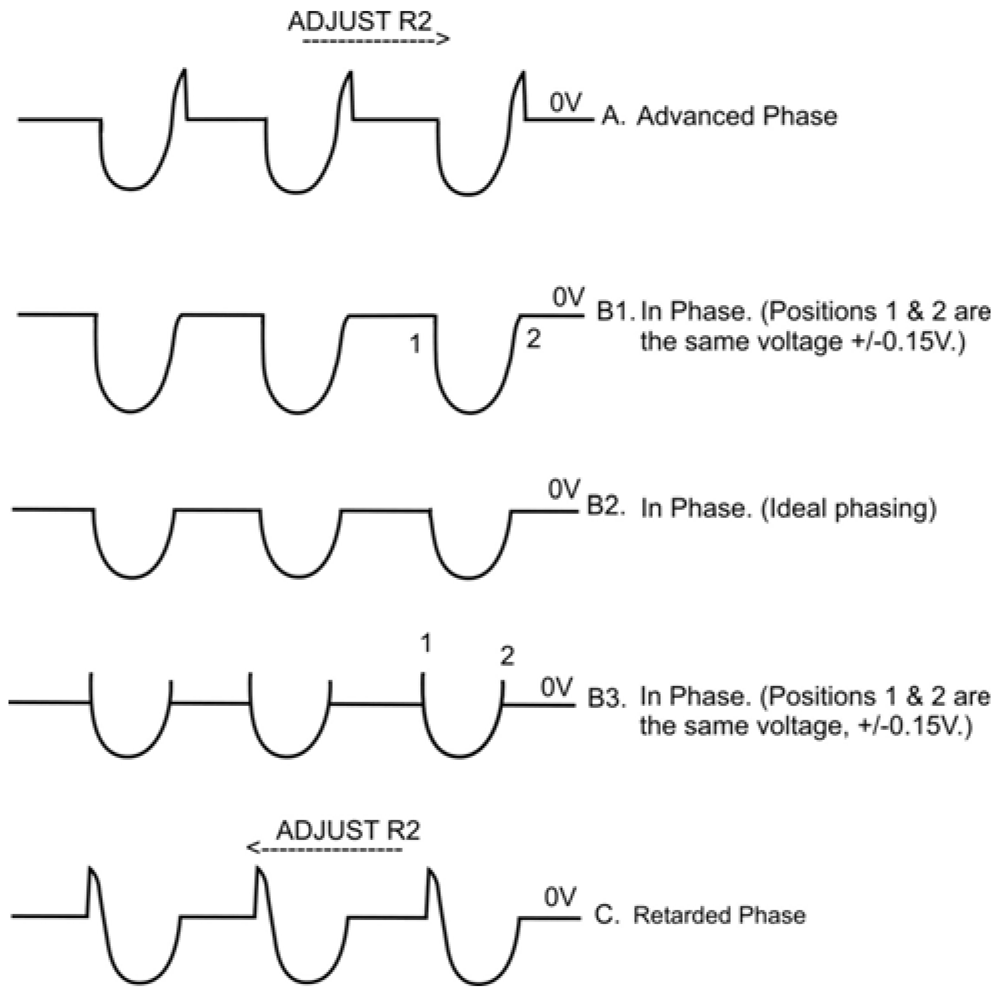


Figure 8-6 Phase Adjustment

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).

10. Adjust R1 again to bring the meter reading to 7.5 ± 0.1 V DC. If it is not possible to bring the meter reading to this level, select a different jumper on the fast preamp board in the detector preamp assembly.

The test points should be as listed in Table 8-5 (with TP1 as ground).

Table 8-5 Fastcard Test Points

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

None of the AC signals should be clipped.

9. Troubleshooting

In this chapter, possible issues with the Opacity Sensor are divided into two sections:

- Section 9.1 Alarm Based Troubleshooting: Troubleshooting steps to be taken in response to a specific alarm generated in the Experion MX system.
- Section 9.2 Non-alarm Based Troubleshooting: Troubleshooting steps that may not be related to a specific alarm in the Experion MX system.

9.1. Alarm Based Troubleshooting

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

9.1.1. Bad Input

Raw voltages for the opacity channel are outside limits (*Volts* > *Upper Limit*, or *Volts* < *Lower Limit*).

Symptom	Possible Causes	Solution (tasks)
Raw volts are outside limits	Sensor harness is faulty or disconnected	Check sensor harness connections
	Fastcard for opacity is faulty	Replace a Board

9.1.2. Bad Z Measurement

Symptom	Possible Causes	Solution (tasks)
Measurement required for Z-correction was flagged as invalid during standardize operation	Z-sensor is not plugged in or is not functioning properly	Check Z-sensor

9.1.3. Bad Z Correction

Symptom	Possible Causes	Solution (tasks)
The Z-correction applied to the net open voltage during standardization resulted in a negative value	Z-sensor is not functioning properly	Check Z-sensor
	Z-correction parameters are not correct	Check Z-correction

9.1.4. Net Open Volt Drift from Time 0

Symptom	Possible Causes	Solution (tasks)
The Z corrected Net Open voltage has drifted too far from the time zero Net Open voltage. $\lvert CorrNetOpen_{Stdz} / NetOpen_{TimeZero} - 1 \rvert$ > Ratio Drift Limit. Default value for the Ratio Drift Limit is 0.2.	INFRAND plates are dirty	Clean Sensor Window
	Head temperatures have drifted	Stabilize head temperatures (refer to your scanner manual)
	Detector pre-amp is faulty	Replace detector pre-amp (see Replace a Board)
	Fastcard is faulty	Replace fastcard (see Replace a Board)

9.1.5. Opacity Std Drift From Previous

Symptom	Possible Causes	Solution (tasks)
The opacity standard calculated during standardization has drifted too far from the value recorded for the previous standardization. $\lvert OpacityStd_{Stdz} / OpacityStd_{LastStdz} \rvert$ > Opacity Shift Limit. Default value for the Opacity Shift Limit is 5.	INFRAND plates are dirty	Clean Sensor Window
	Head temperatures have drifted	Stabilize head temperatures (refer to your scanner manual)
	Detector pre-amp is faulty	Replace detector pre-amp (see Replace a Board)
	Fastcard is faulty	Replace fastcard (see Replace a Board)

9.2. Non-alarm Based Troubleshooting

Symptom	Possible Causes	Solution (tasks)
Lamp not lit	Lamp failure	Replace IR Lamp
	24 V failure or power supply adapter board failure	Check 24 V and 4.4 V on power supply adapter board (see Subsection 2.1.2)
Tuning fork will not start or will not stop chattering	Tuning fork damaged	Replace tuning fork, and see Align Tuning Fork Driver Board
	Tuning fork driver board failure	Replace tuning fork driver board (see Align Tuning Fork Driver Board)
No signal at TP2 on fastcard	Detector failure	Check other channels. If the issue is only with one channel, replace the detector (see Replace a Board).
	Failure of lamp, power supply adapter board, tuning fork driver board, or backplane	If all the channels are affected, check lamp, tuning fork operation (see Align Tuning Fork Driver Board), and backplane 250 V, ± 15 V, 6/8 V (see Subsection 2.1.2)
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).
Fastcard will not adjust to 7.5 V at TP9	Gain jumper on detector set too low	Check TP2. The signal should be between 0.3 V and 3 V peak-to-peak with nothing in the gap. Adjust detector gain accordingly (see Align Fastcard Board).
	Fastcard failure	Swap/replace fastcard (see Replace a Board)
Opacity channel unstable	Fastcard may be saturated	Check TP7 A and B on the fastcard (see Align Fastcard Board)
	Detector unstable	Replace detector (see Replace a Board)
	Fastcard unstable	Swap/replace fastcard (see Replace a Board)
Low standardize volts and unstable channels	Tuning fork driver board failure	Replace tuning fork driver board (see Align Tuning Fork Driver Board)
	Tuning fork unstable	Replace tuning fork, and Align Tuning Fork Driver Board
	Water present in the INFRAND plates	Check for Water in Quartz-Teflon Plates

10. Storage, Transportation, and End of Life

This chapter summarizes Honeywell policy regarding the storage and disposal of the Opacity Sensor.

10.1. Storage and Transportation Environment

In order to maintain the integrity of system components, the storage and transportation of all equipment must be within the parameters shown in Table 10-1.

Table 10-1 Storage and Transportation Parameters

Duration of Storage	Acceptable Temperature Range	Acceptable Humidity Range
Short term (less than one week)	-20–45 °C (-4–113 °F)	20–90% non-condensing
Long term	-10–40 °C (14–104 °F)	20–90% non-condensing

10.2. 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.

11. Glossary

Bin (or measurement Bin)	The smallest measurement zone on the frame. Also called Bucket or Slice.
Bucket	See Bin.
Cross Direction (CD)	Used to refer to those properties of a process measurement or control device that are determined by its position along a line that runs across the paper machine. The cross direction is transverse to the machine direction that relates to a position along the length of the paper machine.
Distant End	The end of the scanner opposite the cable end.
Drive Side (DS)	The side of the paper machine where the main motor drives are located. Cabling is routed from this end. Also called Back Side.
Experion MX	A quality control system (see QCS).
INFRAND	Offset optics (INfinite RANDom scattering optics).
Machine Direction (MD)	The direction in which paper travels down the paper machine.
O100	Opacity calibration intercept.
OCAL	Opacity calibration slope.
OPD1	Primary dirt corrector.
OPD2	Grade-dependent corrector for dirt.
OSTD	Opacity standard: calculated value at standardize, which is affected by sensor drift, and dirt on the sensor windows.
Quality Control System (QCS)	A computer system that manages the quality of the product.
Real-Time Application Environment (RAE)	The system software used by the 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 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 sensor readings to ensure accuracy.
Tending Side (TS)	The side of the paper machine where the operator has unobstructed access. Also called Front Side.
Trend	The display of data over time.
VISS0	Time-zero net open voltage.
ZNOWCOR	Z-corrector for onsheet voltages.
ZSTDCOR	Z-corrector for standardize voltages.
ZT0	Time-zero Z in mm.

A. Part Numbers

The Opacity Sensor component part numbers listed in Table A-1 are provided for reference purposes.

Table A-1 Opacity Sensor Part Numbers

Part Number	Name
00299900	Light pipe, source
00300000	Light pipe, receiver
05298102	Temperature Control Board
05333000	Power Supply Adapter Board
05341600	Tuning Fork Driver Board
05401100	Unigauge Backplane Type II
05407700	Opacity Extension Backplane PCBA
05413200	Fastcard Board
07279100	Sample die 4.5 in.
07631600	Upper Body Optics Block
07631900	Lower Body Optics Block
08376900	Opacity Detector Assembly
08607801	Quartz-Teflon Plate Assembly
08617400	Standard Power Receiver Assembly
08631800	Fast PbS Detector Assembly
29000152	570 Hz Tuning Fork Chopper
38000172	Beamsplitter
39000201	Lamp QTH 20 Watts
51000037	Fuse: 2 Amp, 3AG (on 05333000)
51000282	Fuse: 1.5 Amp Pico (on 05401100)