Q4405-xx IR Polymer Measurement

System Manual

6510020557 Rev 00

IR Polymer Measurement

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Introduction

This manual covers The MXIR Polymer Measurement sensor, model 4405-xx.

Audience

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

About this manual

This manual contains 12 chapters.

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

Chapter 2, **Components**, describes system components.

Chapter 3, **EDAQ**, describes the EDAQ board functionality.

Chapter 4, **Installation**, describes the installation of an MXIR scanner.

Chapter 5, **Software Configuration Parameters**, describes setting up the grade codes and calibration tables in the software.

Chapter 6, **Operations**, describes the two operating modes for the scanning system.

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

Chapter 8, **Preventive Maintenance**, describes recommended ongoing preventive maintenance tasks.

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

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

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

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

Related reading

The following documents contain related reading material:

Honeywell Part Number	Document Title / Description
6510020381	Experion MX MSS & EDAQ Data Aquisition

Conventions

The following conventions are used in this manual:

ATTENTION

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

Boldface	Style: User Command. Boldface characters in this special type indicate user input.
Special Type	Style: System Response. 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	Style: Filename. 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	Style: Button and Menus. 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]** Style: Key Command. This is the key the user presses 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 the user presses 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 the user 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 the user about potential equipment or material damage.
WARNING	The WARNING icon appears beside a Note box containing information that warns the user about potential bodily harm or catastrophic equipment damage.

1. System Overview

This manual covers The MXIR Polymer Measurement sensor, model 4405-80.

The MXIR Polymer Measurement sensor uses the strong and very specific absorption by polymers of infrared radiation at a wavelength of 2.3 microns to provide a measurement of the amount of polymer in a product.

The MXIR Polymer Measurement is a two-channel transmission sensor that measures the polymer weight. The source and receiver hardware are mounted inside the chassis of a ZipLine Q3090 Measurement Device head.

1.1. Components

The source employs a long-life halogen 50W lamp powered by the Source board. The power to the lamp is controlled by the EDAQ and can be changed from 0% to approximately 85%. The default lamp power used by the sensor is 50%.

An elliptical reflector focuses the light at the chopper blade. The blade chops the light at a frequency of 1200Hz. The chopper frequency is controlled by the EDAQ via the motor controller and can be changed from 300Hz to 3kHz. The default frequency of 1200Hz is a compromise between motor lifetime, sensor response time and sensor signal to noise (S/N). It is not recommended to change it.

The motor is equipped with hall sensors that sense the rotation of the motor shaft. The hall sensors signal is used by the motor controller and by the EDAQ for control and diagnostics purposes, respectively.

CAUTION

At power levels above approximately 50%, product left in the gap for a long time can melt or deform. Do not leave anything in the gap when the source is operational.

When shooting samples for calibration, always ensure that the samples are rotating at all times when in the gap.

1.2. INFRAND optics

The sensor uses two flat quartz-PTFE diffusing reflector plates with a single-source aperture, and two receiver apertures offset 50mm (1.96in) in the machine direction (MD) (see Figure 1-1).

Figure 1-1 Quartz-PTFE Diffusing Reflector Plate

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

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

This increased sensitivity to light sheets compensates for the scattering of light by the product that increases the path length inside heavy sheets, and therefore increases sensitivity in heavy sheets. This offset optics is called INFRAND (*inf*inite *rand*om scattering optics).

The straight-through optics can be further used to compensate for scattering effects and to give even greater independence of sheet composition. It is also used to measure the sheet opacity.

The quartz-PTFE diffusing reflector plates are specially constructed for high signal transmission and independence of sheet pass line and flutter.

1.3. Receiver optics

The light that reaches the offset aperture in the receiver window passes through a light pipe, is collected by a lens mounted in the lower body optics block, and is collimated into a parallel beam. The beamsplitter mounted in the upper body delivers the light to the reference and measure channels.

Gains are set automatically by the EDAQ via the Interface board, based on the detector signal strength; no manual adjustment is required.

1.4. Receiver electronics

The IR for each channel is detected by an extended InGaAs photovoltaic detector, amplified and demodulated in the Detector board. For the Q3090 ZipLine Measuring Device, the signal is demodulated using the signal from channel 1.

The extended InGaAs detector contains a thermistor and a Peltier cooler which, along with the TEC driver board, maintain the detector temperature constant. Lower temperature increases S/N; accurate temperature control eliminates the sensor sensitivity to external temperature fluctuations.

All of these elements are supported by the Interface board, which passes the various signals and voltages to the other components, sets the gains for the detector boards, and houses the DC–DC converters (± 15V, 5V, and 3.3V) used to power the electronics.

1.5. Filter selection

The IR and visible bandpass filters for all channels are listed in Table 1-1.

Table 1-1 Wavelengths and Functions

Channel	Wavelength	Function
REF (grey housing)	2.0 µm	Correction for effect of basis weight, dirt, drift, and so on
MES (pink housing)	2.3 µm	Measurement of absorption by polymers (PP, PE, PET)

1.6. Specifications

Polymer Types and Weight Range

The sensor can measure PP, PE (LDPE, HDPE) and PET from 15-2000g/m^2. Weights higher than 2000g/m^2 may be measured if the material is transparent and the gauge is moved to the direct configuration (upon confirmation by Honeywell Engineering).

Repeatability

2•Sigma = 0.003% of basis weight or 15 nanometers at 50ms integration time, whichever is greater.

Static Accuracy

2•Sigma = 0.5% of total basis weight.

Streak Sensitivity

The IR sensor aperture is 6mm (0.23in).

Frequency Response

The response time is 1ms (cut-off frequency is 1kHz).

Sensor Temperature Sensitivity

Negligible.

1.7. Power Requirements

Both heads require 24VDC. The source dissipates about 35W at 50% lamp power; the receiver dissipates approximately 20W.

2. Components

This chapter describes various components of the system.

2.1. 4405 model family: hardware description

The MXIR sensors share a common hardware platform; all are infrared transmission sensors using identical parts. The difference between the Q4405-30/40/50/60 and Q4405-80 models lies in the number of channels, the scanner-specific baseplates for assembly into the heads, and in the different software algorithms used to allow measurement of water weight, fiber weight, percent moisture or polymer weight.

Subsection 2.1.1 provides details on the hardware and any tuning and/or alignment required.

2.1.1. Source assembly

Figure 2-1 shows the MXIR Source assembly mounted in the ZipLine mounting bracket. For clarity, the EDAQ card and the connection cables are not shown.

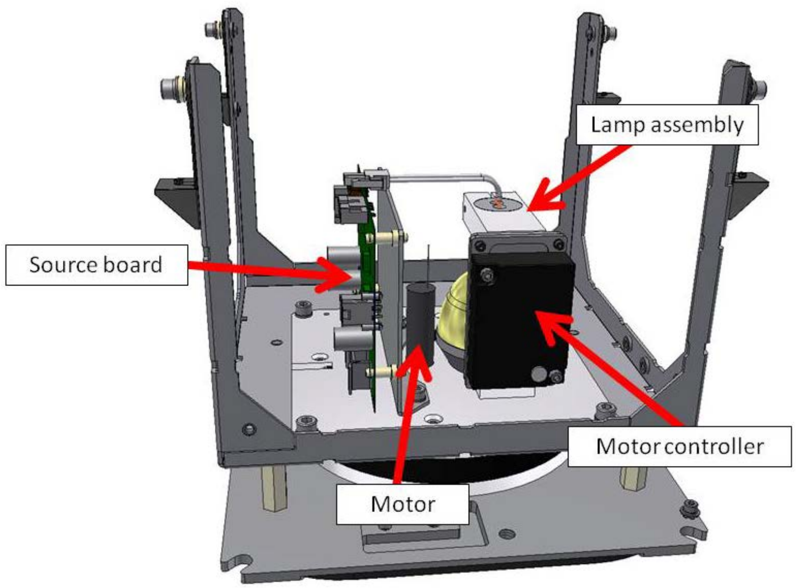


Figure 2-1 MXIR Source Assembly

The main components of the Source assembly are:

- Source board
- lamp assembly
- motor
- motor controller

2.1.1.1. Source board

Figure 2-2 shows the Source Board with connector functions pointed out.

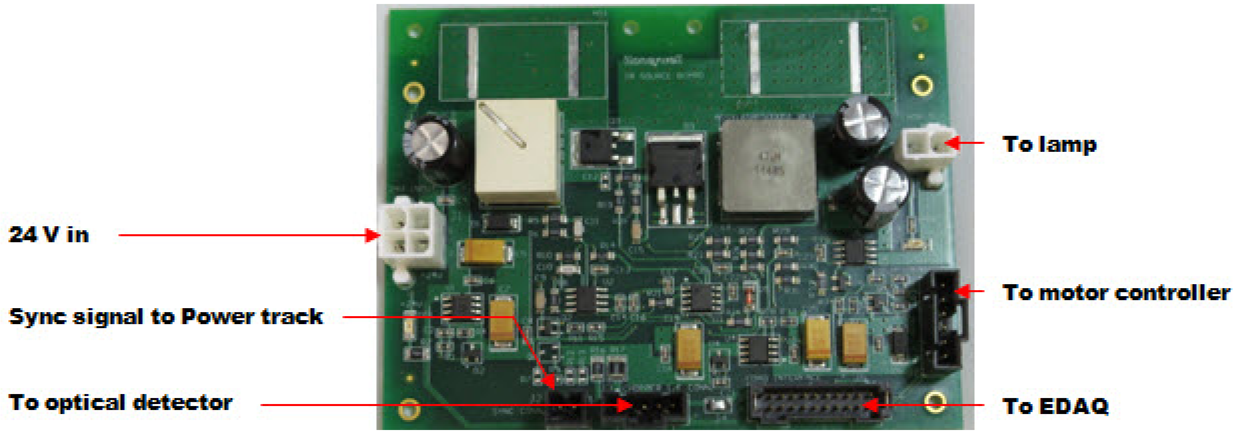


Figure 2-2 Source Board

The Source Board:

- provides pulse-width modulation (PWM) power to the lamp, measures the voltage across the lamp and the current flowing through the lamp
- provides power to the motor and motor controller, and conditions the signal generated by the motor hall sensors
- powers and conditions the signal from the optical chopper detector
- interfaces with the EDAQ

The Source Board does not have any jumpers or potentiometers to set or adjust.

2.1.1.2. Lamp assembly

The Source assembly uses a long-life quartz-tungsten halogen (QTH) 50W lamp powered by the Source board. The power to the lamp is controlled by the EDAQ, and can be changed from 0% to approximately 85%. The default lamp power used by the sensor is 50%.

Change the lamp regularly to avoid sudden failure. The default replacement frequency is six months. Also change the complete lamp assembly regularly because oxidation of the connector pins may occur, over time, leading to lamp instability.

2.1.1.3. Motor and motor controller

Figure 2-3 shows the motor and the motor controller.

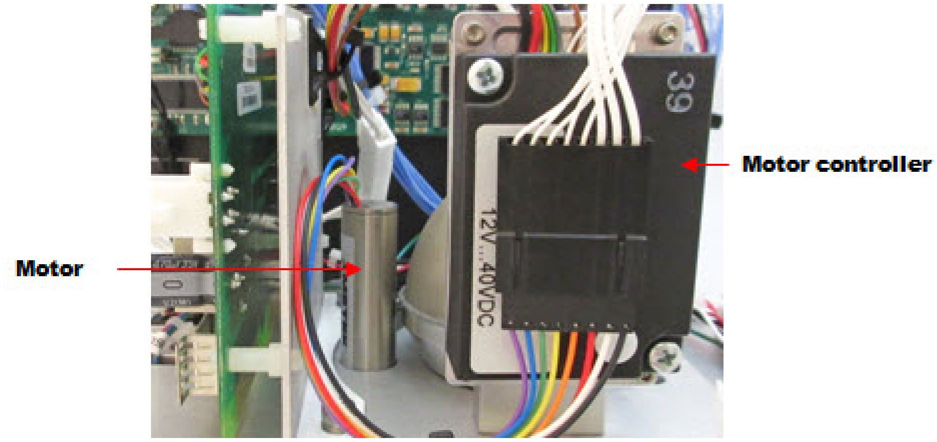


Figure 2-3 Motor and Motor Controller

The light from the lamp is modulated using a chopper blade. The chopper is mounted on a high speed motor which is controlled and powered by the motor controller. The motor is capable of running at up to 60000r/min. It is significantly under-run to increase its lifetime.

The EDAQ commands the chopper frequency, which can be set anywhere between 300Hz and 3kHz. The default frequency of 1200Hz is a compromise between motor lifetime, sensor response time, and sensor signal to noise ratio (S/N). It is not recommended to change it. The motor is equipped with hall sensors that sense the rotation of the motor shaft. The hall sensor signal is used by the motor controller and by the EDAQ for control and diagnostics purposes.

2.1.2. Receiver assembly

Figure 2-4 shows the MXIR receiver assembly mounted in the Zipline mounting bracket. For clarity the EDAQ card and connection cables are not shown.

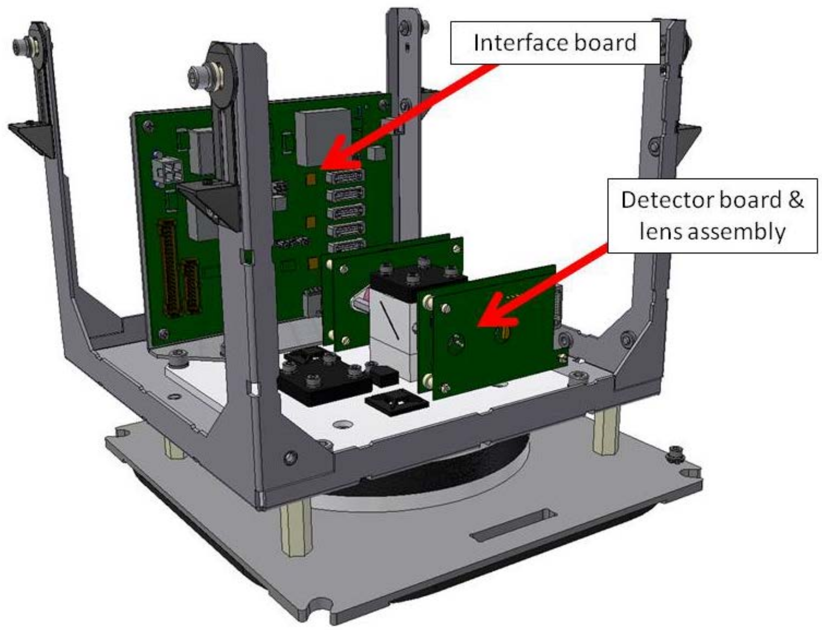


Figure 2-4 MXIR Receiver Assembly

The main components of the receiver assembly are:

- Interface board
- two detector and lens assemblies

2.1.2.1. Interface board

Figure 2-5 shows the Interface board with connections and test points highlighted.

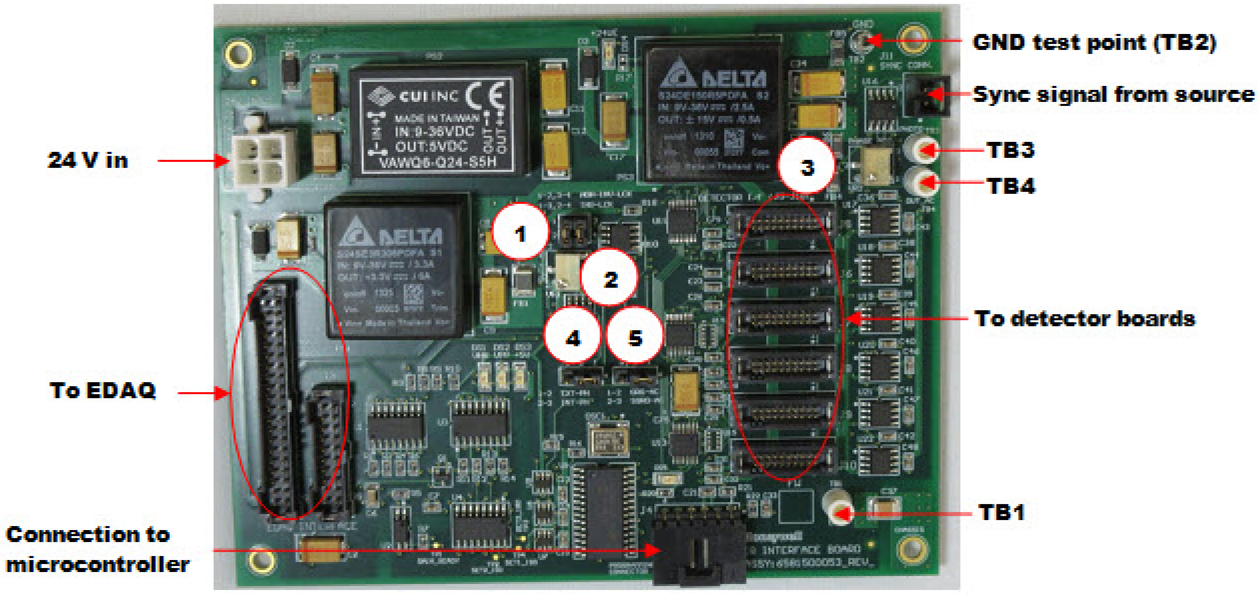


Figure 2-5 Interface Board

Table 2-1 lists and describes the numbered items in Figure 2-5.

Table 2-1 Interface Board Items

Item	Description
1	Jumper W1: used to invert the sync signal. Factory default is non inverted (1-2 and 3-4 jumpered).
2	Potentiometer VR1: used to tune the duty cycle of the sync signal (factory set)
3	Potentiometer VR2: used to tune the delay of the sync signal (factory set)
4	Jumper W2: set the source for the sync signal to internal or external (see Table 2-2).
5	Jumper W3: set the channel 1 AC signal to be squared or not. Factory default is not squared (1-2 jumpered)

The Interface board:

- Provides ± 15V power to the detector boards, and 3.3V to the temperature controller boards
- Conditions the sync signal from the source, and sends it to each detector to be used for detector signal demodulation

- Routes the detector DC outputs and detector temperature signals to the EDAQ
- Controls the detector signal gains and the detector temperatures

The interface board has four jumpers to be set for the scanner in which the sensor is installed as listed in Table 2-2.

Table 2-2 Interface Board Jumpers

Scanner Type	Q4000	Q3090 (this sensor version)
W1	1-2 and 3-4	1-2 and 3-4
W2	1-2	2-3
W3	1-2	1-2

Jumper W2 selects the source for the sync signal. When 1-2 is selected, the sync signal comes from the chopper photodetector (external). When 2-3 is selected, the sync signal is the AC signal generated by the channel 1 detector assembly (internal).

When using ZipLine (Q3090), the sync signal must be set to internal. The signal from channel 1 which is used for demodulation can be observed at the Interface board using an oscilloscope. Connect the probe ground to TB2.

Observe the following:

- TB1 and TB4: Sine wave coming from Channel 1 detector board; it is a few volts in amplitude at the chopper modulation frequency.

2.1.3. Detector and lens assembly

Figure 2-6 shows the detector and lens assemblies. For clarity, the platform and the connection cables are not shown.

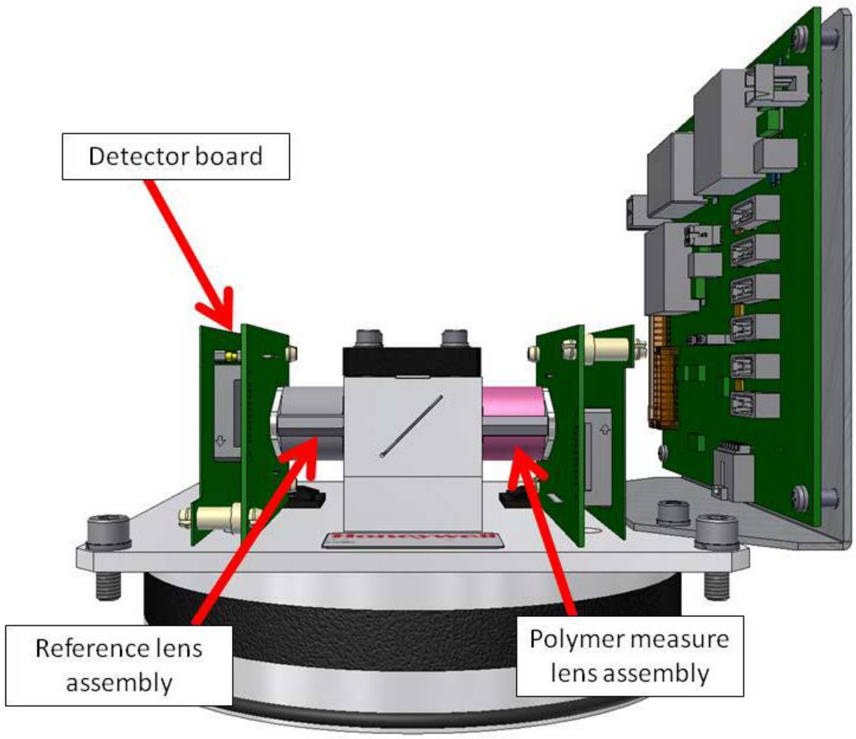


Figure 2-6 Detector and Lens Assemblies

The detector assembly is composed of an extended InGaAs detector and a detector board sandwiched with a Temperature Controller board.

The lens assembly is composed of a lens and an interference filter. The lens assembly is color coded as listed in Table 2-3.

The extended InGaAs detector is mounted on a dual-stage thermoelectric (or Peltier) cooler and packaged in a TO-66 can.

Table 2-3 Lens Assembly Color Coding

Channel	Lens Assembly Color
Reference	Grey
Polymer measure	Pink

2.1.3.1. Detector board

Figure 2-7 show the Detector board.

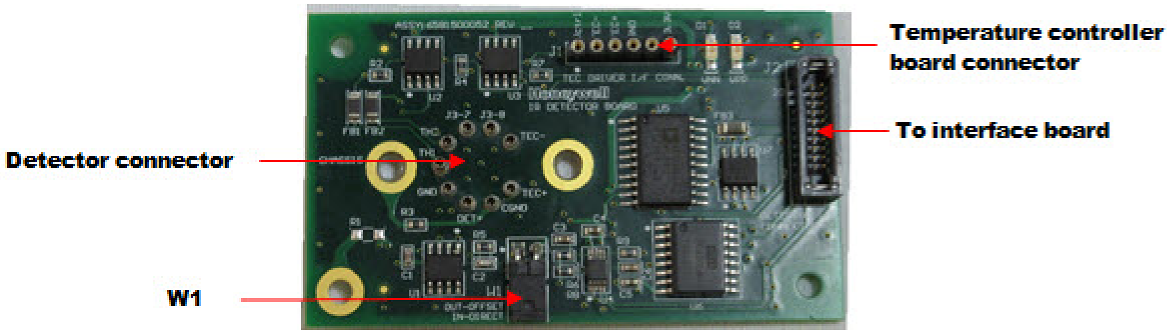


Figure 2-7 Detector Board

The Detector board conditions the signal from the extended InGaAs detector, and provides it to the Interface board. It also serves as an interface between the detector and the Temperature Controller board.

The Detector board uses one jumper (W1). The jumper should be OUT when the detector assembly is mounted in the offset optical tower (offset from the light source). The jumper should be IN when the detector assembly is mounted in the direct optical tower (opposite the light source). The green LEDs D1 and D2 are ON when the + 15V and − 15V are present on the board, respectively.

In the 4405-80 both detectors are offset by default: Jumper W1 should be OUT.

2.1.3.2. Temperature controller board

Figure 2-8 shows the Temperature Controller board (also known as the TEC driver board).

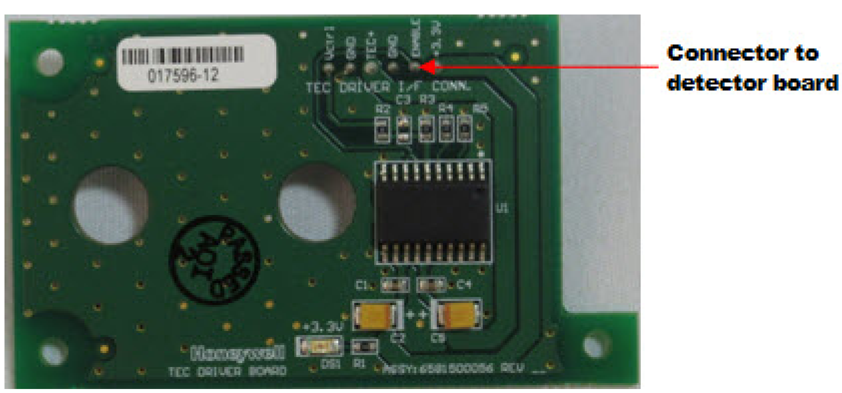


Figure 2-8 Temperature Controller Board

The board provides power to the dual-stage Peltier cooler inside the detector can. The green LED is ON when the + 3.3V is present on the board.

2.2. 4240-60 Opacity Kit

The Opacity Kit (see Figure 2-9) consists of an extra beamsplitter cube, a lens, and a detector assembly that can be added to any of the 4405 sensors. It must be mounted on the direct optical block.

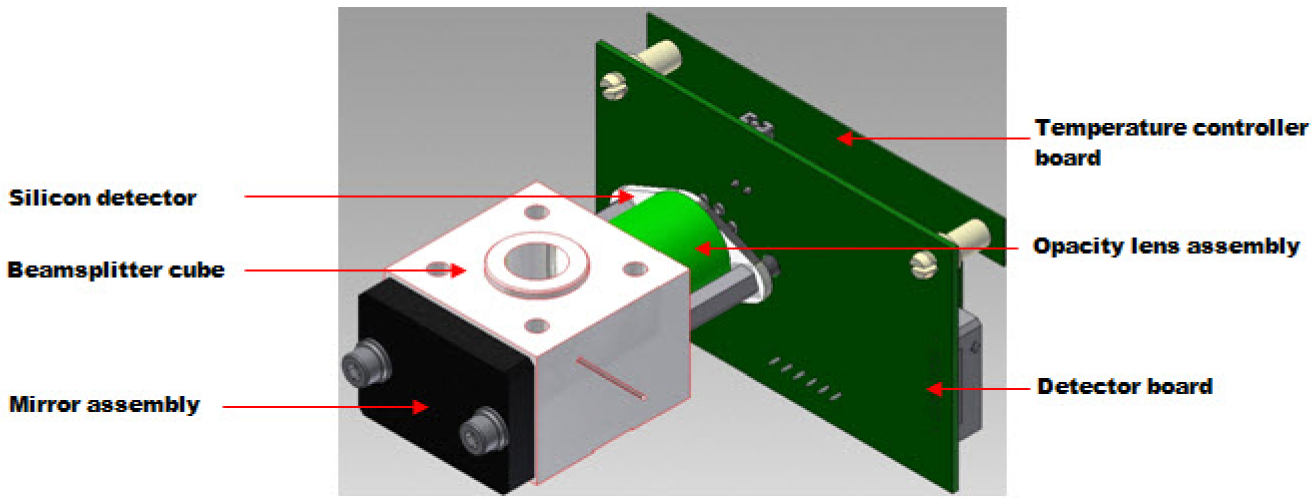


Figure 2-9 Opacity Kit

The lens assembly color is green, as listed in Table 2-3. The detector assembly consists of a Silicon detector and a detector board sandwiched with a Temperature Controller board. The Silicon detector is mounted on a single-stage thermoelectric (Peltier) cooler and packaged in a TO-66 can. The single-stage Peltier cooler does not allow the detector to reach the lowest temperatures that can be reached with the extended InGaAs detectors. ; however, due to the very high S/N ratio of the Silicon detector, this is not a concern. Excellent performance is already achieved with the opacity detector when operated at room temperature.

2.3. Software algorithm description

The 4405-80 uses a software algorithm which is referred to as the IR sensor processor.

The Opacity sensor uses its own processor, the Opacity Processor.

All processors are embedded in the real-time application environment (RAE) software on an Experion MX or MXProLine System.

2.3.1. IR sensor processor

The IR Sensor Processor uses the signals detected by the two channels and calibration parameters to provide polymer weight.

2.3.1.1. Inputs and outputs

Inputs to the processor are the signals from two channels, typically channel 1, and 2 known as the Reference, and Measure channels.

Others signals produced by the sensor, such as the detectors temperature, the chopper frequency, and the lamp voltage and current are not used by the processor, but are used for diagnostics by the EDAQ. These values are accessible in the MSS diagnostics displays, and can be trended using the **Trend** plot.

The Source temperature and the Receiver temperature are inputs to the temperature processor which is accessible on the **Sensor Maintenance** display under **Supporting Sensors**.

The processor does not set any gains, and the sensor does not use any flags.

The processor outputs polymer weight.

2.3.1.2. Background

Background is scheduled periodically (typically every 12–24 hours) to measure the dark offsets for subsequent correction of the readings.

Background has only one phase. It consists of turning off the light source completely and measuring the dark offsets for each channel individually.

The processor can perform limit checks on the background values as described in Subsection 2.3.1.3. Background should be in the range of 3–5.5.

2.3.1.3. Reference/Standardize

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

The Reference (or Standardize) measurement gives the net open volts (Dark volt subtracted measurements) for the two channels. These net open volts are stored and used in determining the channel ratios, which are explained in Subsection 2.3.1.4. The net open volts are in the range of 0–80000.

For the two channels, a ratio to time-zero is also calculated. The ratio to time-zero is the ratio of the channel net open volts at Standardize to the channel net open volts at time-zero. Time-zero ratios are typically a measure of the amount of dirt that has accumulated on the sensor window.

Alarms can be set to check that these values maintain their integrity. If the values drift more than a value set by the user, or go out of bounds (minimum and maximum set by the user), an alarm is generated.

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

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

2.3.1.4. Sample

A sample operation request displays the measurement of the sensor channels in net volts. Note that all voltages reported by the processor, V_n^{Stdz} and V_n^{Now}, represent gain- and dark-adjusted voltages. The EDAQ takes care of adjusting the voltage for the exact gain applied, and subtracts the dark voltage, before passing the result to the processor. The resulting signals are therefore not physical volts anymore, however, they are still refered to as voltages.

In this instance, V1 (net volts for channel 1) is referred to as REF, V2 as MES.

The channel ratios of REF and MES are defined as:

$$CR_{REF} = \frac{REF_{stdz}}{REF_{sample}}$$

$$CR_{MES} = \frac{MES_{stdz}}{MES_{sample}}$$

Equation 2-1

The raw working ratios is defined as:

$$WR_1 = \frac{CR_{MES}}{CR_{REF}} - 1$$

Equation 2-2

This ratio appears in various locations in the software displays.

2.3.1.5. Static polymer weight

Onsheet during normal operation, the static polymer weight is calculated as:

$$\mathrm{PW} = \mathrm{A}_0 + \mathrm{A}_1 \cdot \mathrm{WR}_1 + \mathrm{A}_2 \cdot \mathrm{WR}_1^2 + \mathrm{A}_3 \cdot \mathrm{WR}_2^3 + \cdots$$

Equation 2-3

Ax represent the calibration constants, and WR_1 represents the sensor ratio. PW is the weight value reported in the Sample mode.

2.3.1.6. Dynamic weight

If desired, a Dynamic Correction may be applied during onsheet measurement. Dynamic correction accounts for differences between the static calibration and the verified onsheet measurement. Verification of the onsheet measurement is described in Section 6.3. Dynamic correction is applied as follows:

$$PW_{dyn} = PW \times (\text{dynamic slope}) + (\text{dynamic intercept})$$

Equation 2-4

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

2.3.2. Opacity processor (4240-60)

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

2.3.2.1. TAPPI standard

In the paper industry, manufacturers use opacimeters that measure according to the TAPPI standard. In the plastic industry, manufacturers often only require a transmittance value.

The TAPPI standard T 425 defines opacity as the contrast ratio called C0.89. 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.

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

Equation 2-5

2.3.2.2. 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 sensor can also provide a customer defined opacity value.

The Source assembly provides chopped visible light from a QTH lamp. 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:

$$T + R + A = 1$$

Equation 2-6

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

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

Equation 2-7

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.

The approximation as $T^2 << 1$, or $r \bullet T^2 << R$, obtains:

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

Equation 2-8

The further approximation that A << T, obtains R = 1-T and:

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

Equation 2-9

2.3.2.3. Inputs and outputs

Input to the processor is the signal from one channel, typically channel 5, known as VIS or Opacity (on the **MSS Setup Diagnostics** display).

The processor outputs TAPPI Opacity or other user defined Opacity value.

2.3.2.4. Reference/Standardize

Reference and Standardize are identical operations. The term Reference is used when it is manually requested in Maintenance mode, while a Standardize is scheduled periodically during sensor scanning in Production mode. During the reference and standardize functions, the empty gap net volts (VISST) are read.

If Z-Correction is not enabled, then:

$$\text{VISSZ} = \text{VISST}$$

Equation 2-10

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

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

Equation 2-11

Where ZSTZ is the Z in millimeters at the last Standardize

ZT0 is the Z in millimeters at calibration.

ZSTDCOR is a Z-Correction calibration constant.

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

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

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

Equation 2-12

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

2.3.2.5. Sample

During the sample function, the now net volts (VISC) on the sample are read.

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

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

Equation 2-13

Where TRAN is the transmittance ratio (fraction of light transmitted through the sheet)

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

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

Equation 2-14

Where ZNOWCOR is another Z-Correction calibration constant

If dirt correction is not enabled, then:

$$TRDC = TRZC$$

Equation 2-15

If Dirt Correction is enabled, then:

$$TRDC = TRZC \bullet [1 + (OPD1 + OPD2 \bullet TRZC) \bullet (DRFT - 1)]$$

Equation 2-16

Where OPD1 and OPD2 are the calibration constants for the dirt corrector

The transmittance squared is calculated:

$$TRSQ = TRDC^2$$

Equation 2-17

Finally, the opacity is calculated:

$$OPAC = O100 + OCAL \bullet TRSQ$$

Equation 2-18

Where O100 and OCAL are static calibration constants

2.3.2.6. Onsheet measurement

In onsheet and single point modes, the Z-Correction uses ZNOW, the Z in millimeters for the bin. Dirt Correction and profile correction can be included.

The now net volts (VISC) are read as for the sample function.

If Z-Correction is not enabled, then:

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

Equation 2-19

If Z-Correction is enabled, then:

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

Equation 2-20

If Dirt Correction is not enabled, then:

$$TRDC = TRZC$$

Equation 2-21

If Dirt Correction is enabled, then:

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

Equation 2-22

The transmittance squared and opacity are calculated:

$$TRSQ = TRDC^2$$

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

Equation 2-23

Where OPCOR is the bin value of the profile correction array

2.3.2.7. Profile correction

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:

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

Equation 2-24

Where

$$\mathrm{TRSQ(bin)} = \left(\frac{\mathrm{VISC(bin)}}{\mathrm{VISST}}\right)^2$$

Equation 2-25

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

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

2.3.2.8. Summary of opacity calibration constants

Table 2-4 and Table 2-5 list and describe the default time-zero constants, calibration constants, and correctors.

Table 2-4 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 2-5 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 @ 4kHz and 8 inputs of 10 bits @ 1Hz)
- analog outputs (2 @ 12 bits)
- digital inputs (16 @ 24V logic)
- digital output (16 @ 24V logic)
- frequency input (400Hz to 500kHz)
- 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.

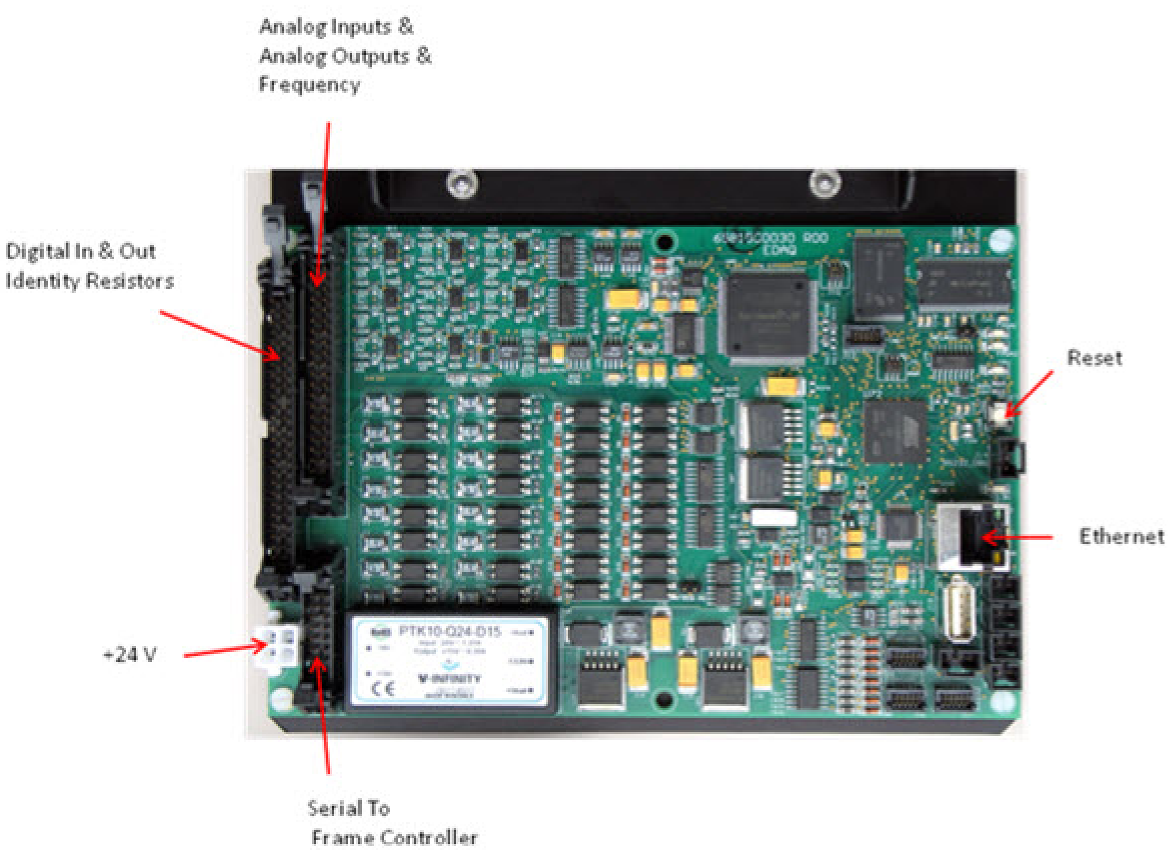


Figure 3-1 EDAQ Board

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 (115200kb/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.

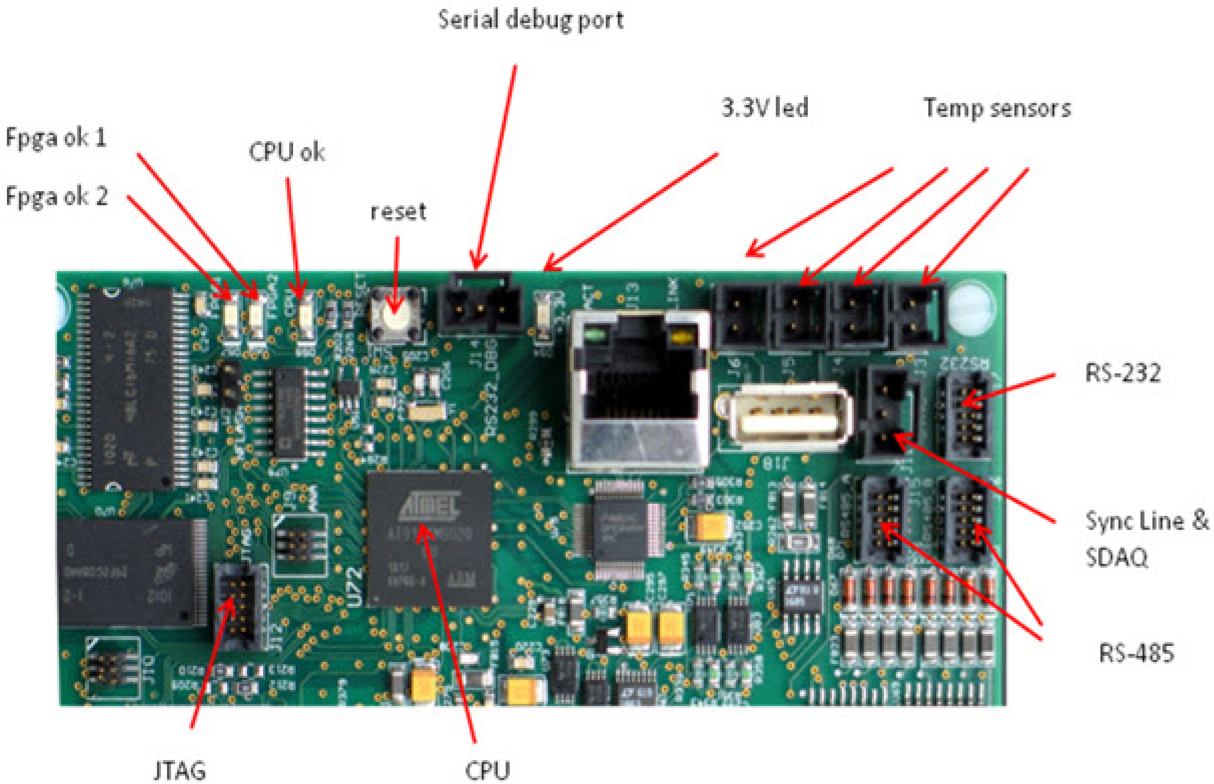


Figure 3-2 EDAQ Board: Ports and Diagnostic LEDs

3.2. Hardware status information

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

- The *3.3V LED*. When lit, this indicates that all power supplies on the board are functional. The signal is derived from the 3.3V power supply, which in turn is derived from the 15V power supply, which is derived from the + 24V 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 Quality Control System (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.

Table 3-1 shows the function codes for all the MxIR sensors covered by this manual.

Table 3-1 Function Codes For MxIR Sensors

Sensor EDAQ	Function Codes
MxIR source EDAQ	336
MxIR receiver EDAQ	536

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

Refer to the scanner system manual to troubleshoot the EDAQ if it does not identify itself correctly (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 the 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).

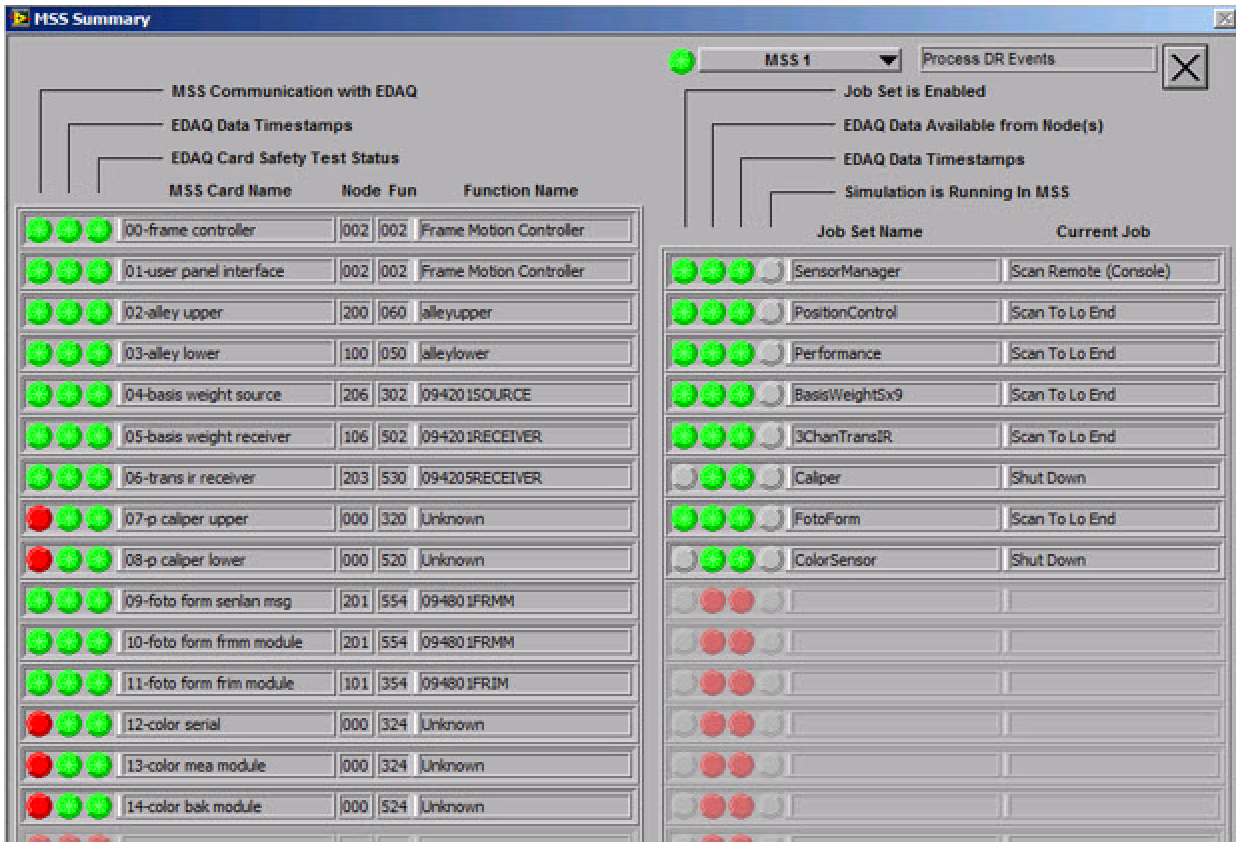


Figure 3-3 MSS Summary

Table 3-2 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 QCS 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 **MSS Monitor**, select 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).

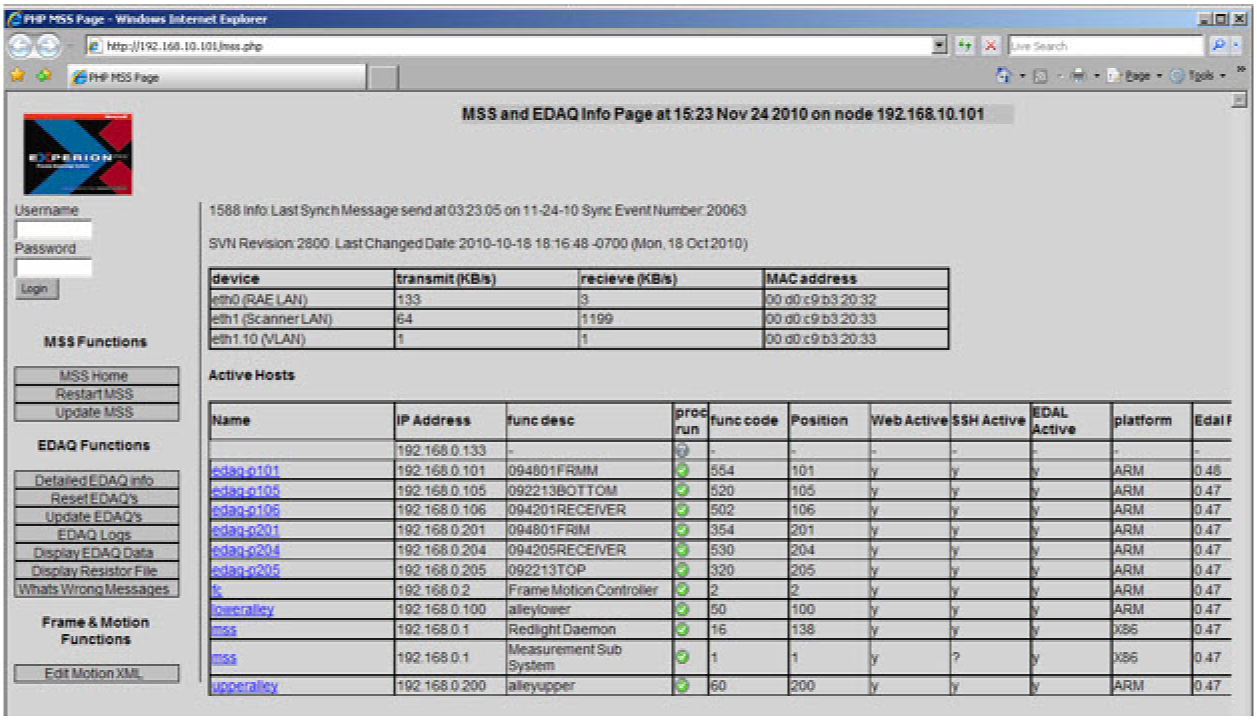


Figure 3-4 PHP MSS Page

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 50µs a few minutes after start up).

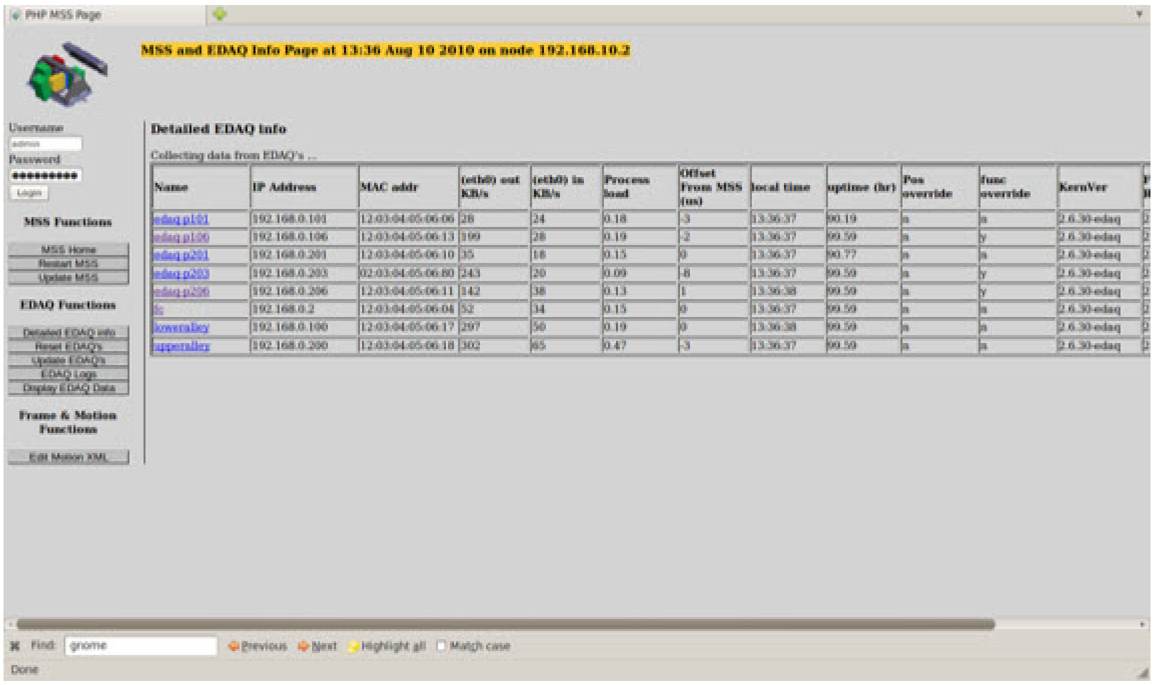


Figure 3-5 Detailed EDAQ Information: Partial Display

Clicking on the name of a particular EDAQ in the main MSS page, calls up an EDAQ-specific web page. Selecting **Edit Def File** for the MxIR source and receiver EDAQs calls up the data shown in Figure 3-6 and Figure 3-7.

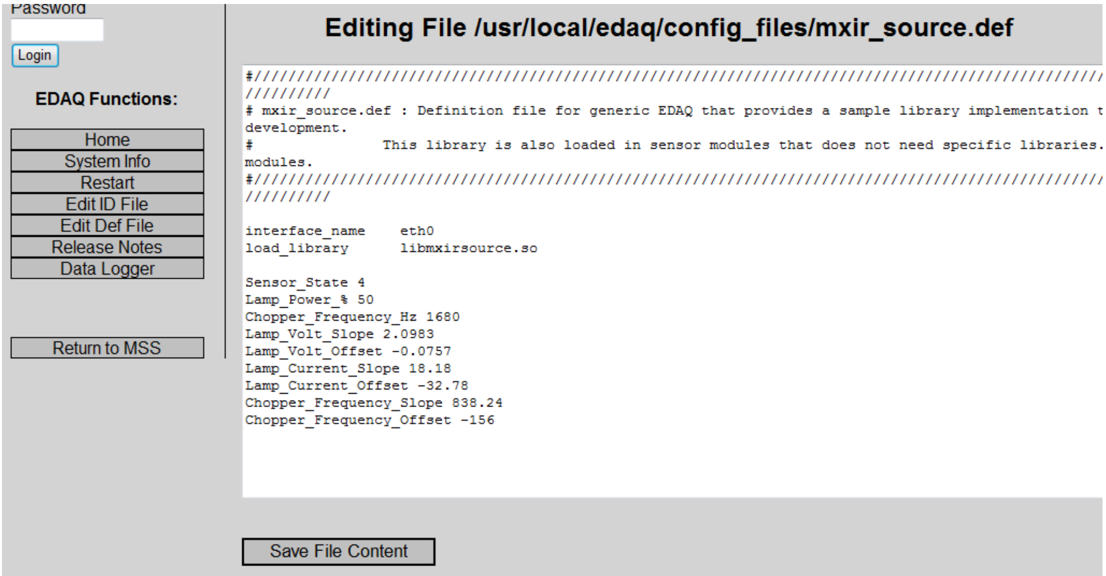


Figure 3-6 MxIR Source EDAQ Def File

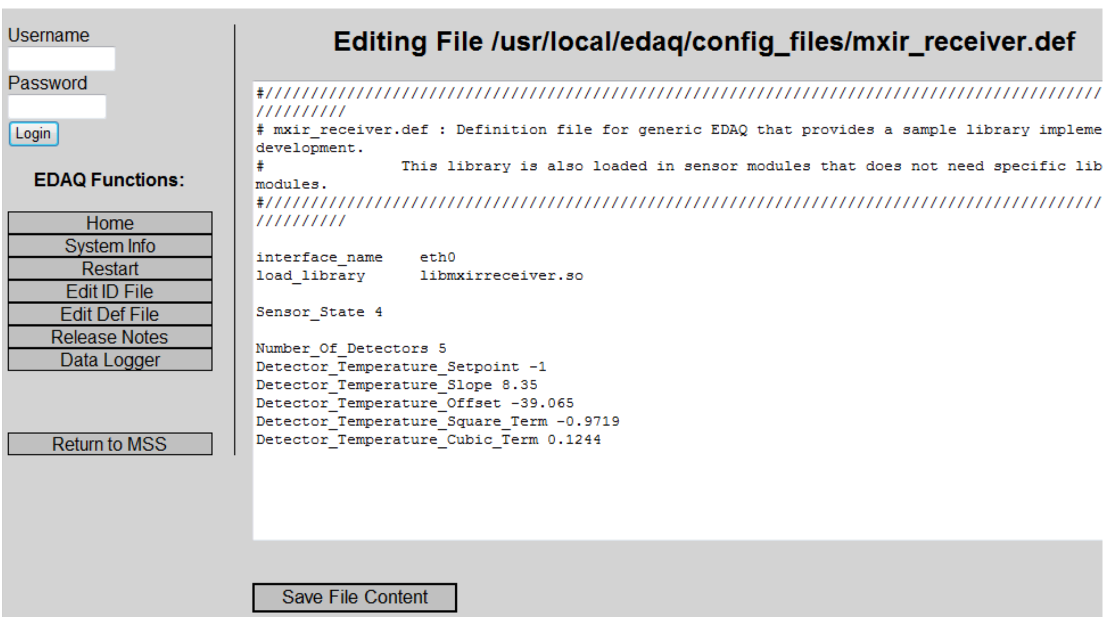


Figure 3-7 MxIR Receiver EDAQ Def File

The *Def Files* contain configuration parameters that are required for the proper operation of the sensor. Some of the values in the *Def Files* like the sensor state, lamp power, chopper frequency and detector temperature are overwritten by the QCS operator station however they are used by the sensor as starting values on power-up.

4. Installation

This chapter describes installation of an MXIR sensor.

Before installing an MXIR sensor, read about the components and operation of the sensor as described in Chapter 1 and Chapter 2. It might also be necessary to refer to the ZipLine manual for details on head design and/or scanner operation.

4.1. Installation in a Q3090 ZipLine Measurement Device

The MXIR sensor is installed by inserting the source and receiver part in their respective heads, and by securing the sensor mounting bracket with 4 screws (Figure 4-1). The sensor bracket uses alignment tabs to ensure that the gap between the top and bottom heads is constant and the the sensor windows are parallel. An aluminum bar of the correct thickness (e.g. 10mm) can be used to confirm that the gap is correct and that the sensor windows are parallel. It it is not the case, it might be necessary to adjust the position of the alignment tabs.

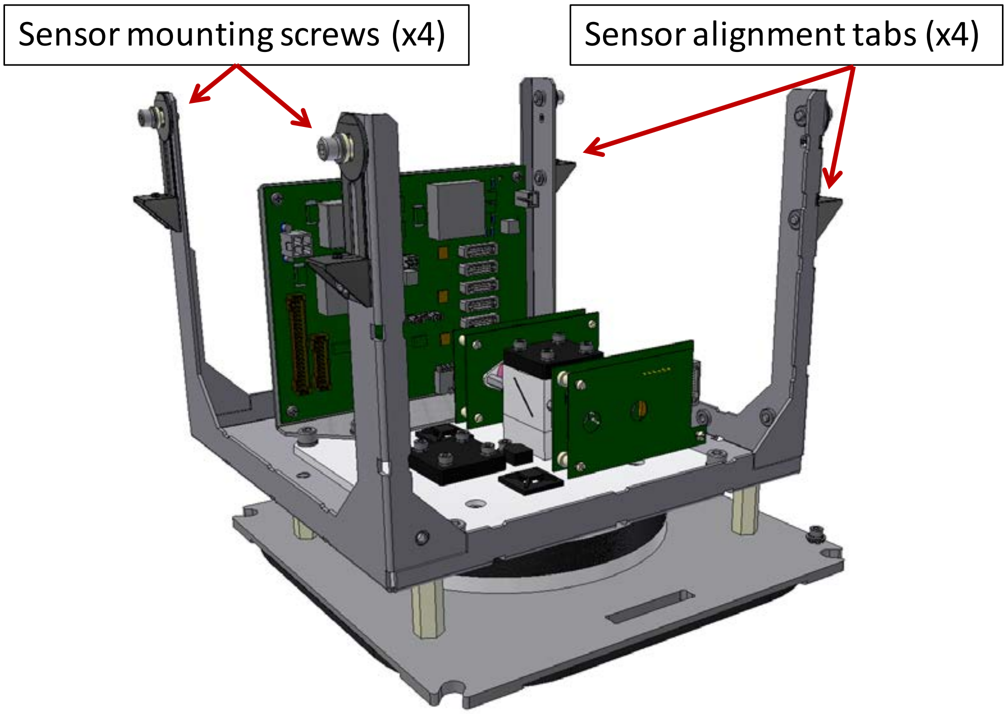


Figure 4-1 Mounting hardware in MXIR Receiver Assembly

The moisture sensor source is typically installed in the bottom head, and the receiver is installed in the top head.

Ensure that power to the scanner is down before proceeding.

For both the Source and Receiver, connect each harness as per below:

1. Connect P9, P10, and P17 (power) to the power distribution board.
2. Connect P7 (power) to the EDAQ.
3. Secure the drain cable lug on the power distribution board.

ATTENTION

Note that the ZipLine Measurement Device does not accommodate loopbacks (connections from top to bottom head).

The MXIR uses the self-demodulation mode when installed in the ZipLine Measurement Device. Ensure that the jumper connections on the IR Interface board are set for self-demodulation (see Subsection 2.1.2.1).

4.2. Sensor commissioning task list

1. Power the scanner up. Ensure that the MXIR EDAQs read the position and function codes properly (see Chapter 3, and/or refer to the MSS-EDAQ manual).

2. Check hardware stability (see Section 9.2).

3. Check short term stability (see Section 9.3).

4. Check that the calibration constants on the **Sensor Maintenance** display, and in the various recipes, match the ones in the calibration package provided with the system.

5. Verify the static calibration samples (see Section 7.2).

6. Tune the calibration as needed (see Section 7).

7. Enter nominal Dynamic Correction calibration constants (see Section 6.3.1).

8. Perform dynamic calibration when possible (see Section 6.3).

9. Enable Z-Correction (for opacity only) if required, and enter the appropriate Z-Correction calibration constants (see Section 9.5).

5. Software Configuration Parameters

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

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

Each Recipe is configured from the “bottom” of the hierarchy to the “top”. The complete list of Recipes can be found on in the Main Code table page; each Recipe has its own Main Code table. The Main Code table is at the “top” of the hierarchy. It references the IRP Configuration Table and the IRP Calibration Table, which will be set up first.

The MXIR Polymer sensor ships with some of the following factory default calibration coefficients, depending on what was specified at purchase time:

- 10-100µm PE
- 10-100µm PP
- 10-100µm PET
- 100-250µm PE
- 100-250µm PP
- 100-250µm PET
- 250-1000µm PE
- 250-1000µm PP

- 250-1000µm PET

These coefficients will be in particular factory-default Recipes that should be neither used nor modified – they should be copied and then customized for particular customer grades.

5.1. IRP Configuration Table

The IRP Configuration Table is at the bottom of the Recipe hierarchy. This table controls which correctors will be used.

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

Create an IRP Configuration Table for each calibration group. Do this by selecting an existing table to bring up its values. For each entry in the table, set the value to **True** if the corresponding corrector is used; for example, the dynamic slope and intercept. Then, click **Save As…**to save a new table with a new name. To remove a table, select it and click **Delete. Do not remove the factory default tables.**

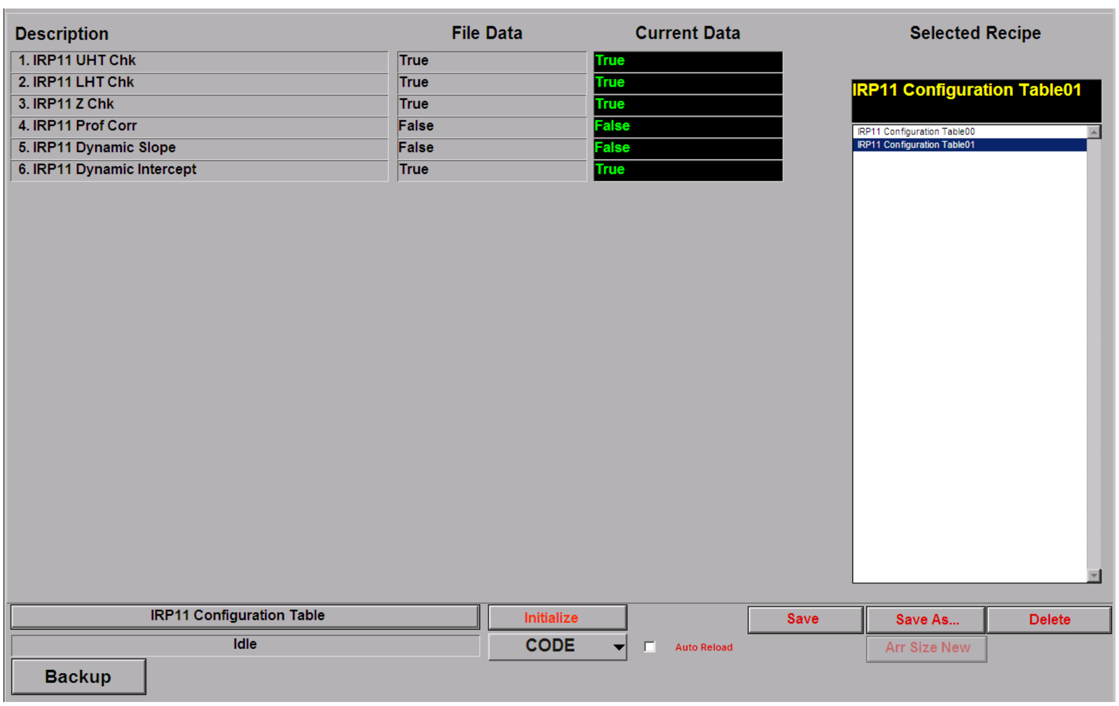


Figure 5-1 IRP Configuration Table

5.2. IRP Calibration Table

Now create an IRP Calibration Table for each calibration group; for example, IRP11 Calibration Table00 (see Figure 5-2). This table specifies the proper calibration constants that will be used for this Recipe. With the exception of Dynamic Slope and Dynamic Intercept, the calibration constants in this table are generated during calibration time, when you select/create the appropriate table to store the numbers (see Chapter 6). If you need to change the values, enter them, then click **Save As...** to save a new version.

Figure 5-2 IRP Calibration Table

Note that this table contains a link to the rest of the calibration numbers – in this example, **IRP11 IRW Coeff Table00.** This pointer and the values in them are set during calibration time, see Chapter 6. You can check them by bringing up the IRP IRW Coeff table(s). Each table will contain up to 3 elements, as per Figure 5-3. The values entered here will appear in the **Sensor Maintenance Page** in the **Calibration Constants** table. There are as many elements as there are orders to the calibration fit (ie. a single element for a linear fit, two elements for a quadratic, etc.). Elements can be changed by overwriting them and hitting **Save**.

Figure 5-3 IRP11 IRW Coeff Table

5.3. Main Code Table

The main code table gathers together all the other tables for each grade code (or Recipe) required. Create a grade code (Recipe) for each grade as required; for example, 10_100um_PP, by using the **Save As…**function.

For each Recipe, make sure the associated Main Code Table contains the appropriate sub-tables that you created for the IRP Configuration Table and IRP Calibration Table (see Figure 5-4).

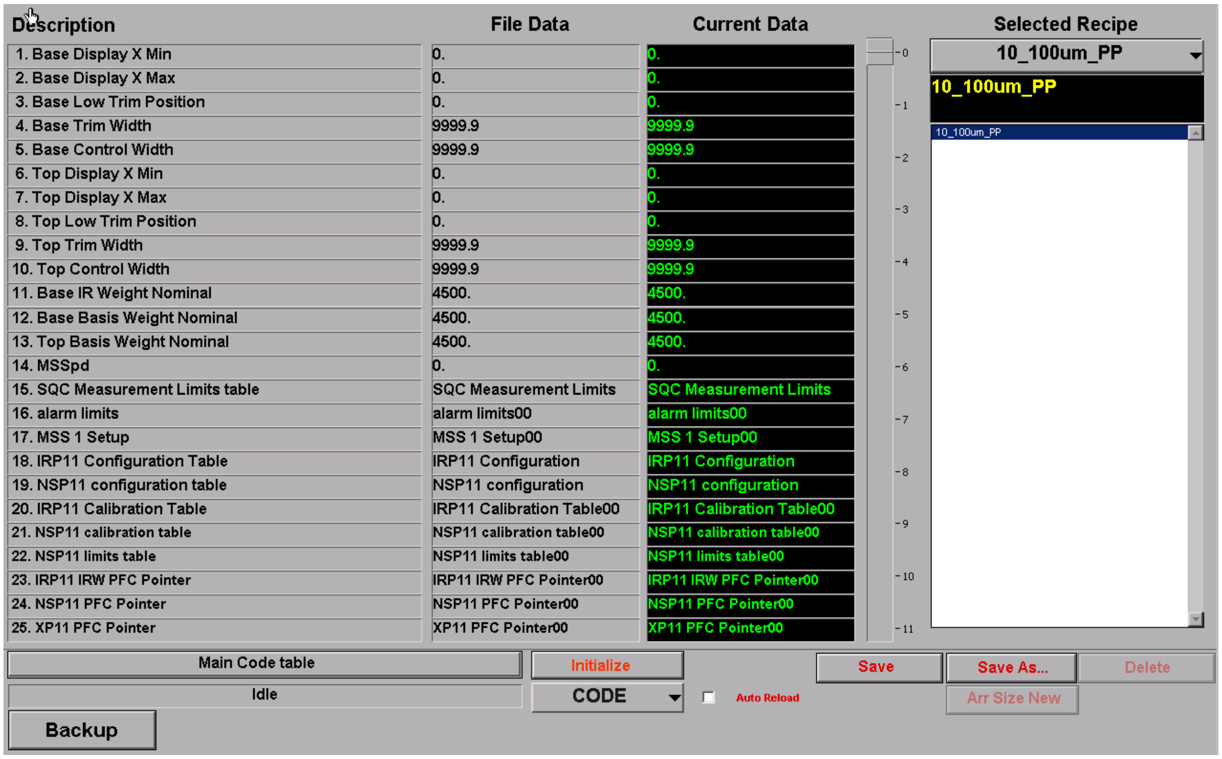


Figure 5-4 Main Code Table

6. Operations

There are two main operating modes for the scanning system:

- **Maintenance mode:** a test mode used when performing calibrations, verifications, or repeatability operations
- **Production mode:** used in daily operations

6.1. Maintenance mode

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

To set up maintenance mode, the scanner heads must be brought offsheet and the maintenance recipe must be loaded:

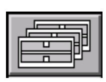
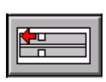
1. Click  to open the **Scanner control** display (see Figure 6-1).
2. On the **Scanner control** display, select the appropriate scanner from the drop-down menu.
3. Click  to take the selected head offsheet.

Figure 6-1 shows the **Scanner control** display.

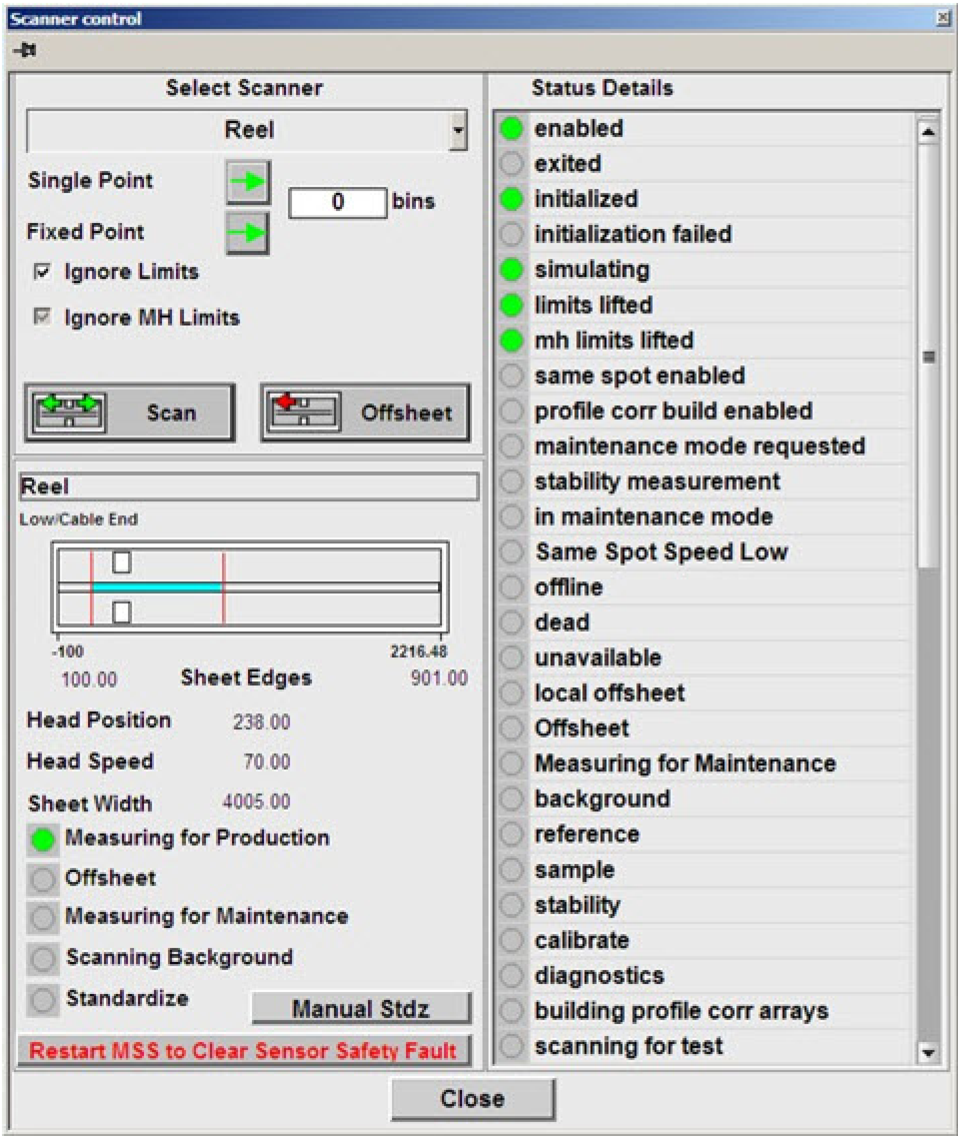


Figure 6-1 Scanner control Display

To load a maintenance grade code:

1. In the **Scanner/Sensor** menu, select **Sensor Maintenance**.
2. Select **Maintenance Mode** from the drop-down menu on the **Sensor Maintenance** display.
3. Click **Retrieve/Save Recipes…** on the **Sensor Maintenance** display to call up the **Scanner Modes & Maintenance Recipes** dialog (see Figure 6-2). The dialog box indicates the currently selected mode.

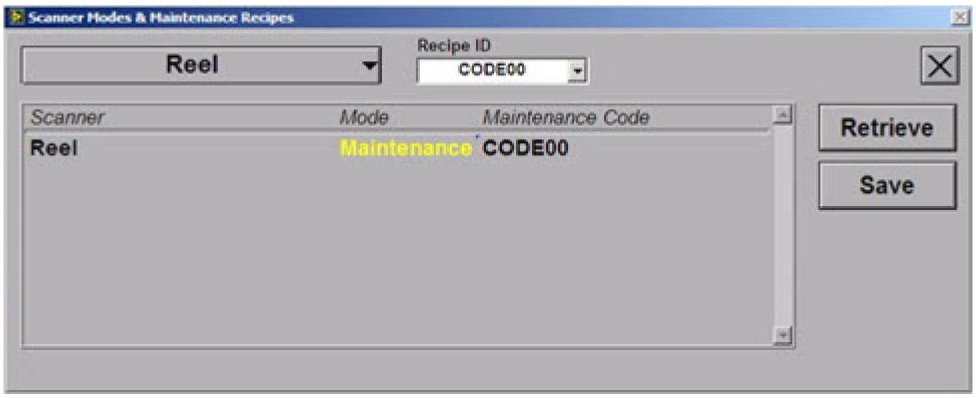


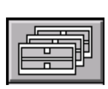
Figure 6-2 Scanner Modes and Maintenance Recipes Dialog

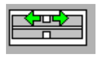
4. Click the drop-down menu on the left, and select the appropriate scanner (**Reel** in Figure 6-2).
5. Click the drop-down menu under **Recipe ID**, and select the appropriate recipe/code.
6. Click **Retrieve**.
7. Close the **Scanner Modes & Maintenance Recipes** dialog.
8. To return to production mode, select **Production Mode** from the drop-down menu under the **Sensor Maintenance** display.

6.2. Production mode

Before scanning, ensure that proper recipe codes have been retrieved.

To start scanning:

1. Click  to open the **Scanner control** display (see Figure 6-1).

2. Click  in the **Scanner control** display to scan the head.

   Before the sensor starts scanning, it takes the background and reference reading from the sensor(s) and stores the data.

6.3. Dynamic calibration for polymer weight

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

Three verification procedures are detailed in:

- Reel check method (see Subsection 6.3.1)
- Roll check method (see Subsection 6.3.2)
- Lab sample method (see Subsection 6.3.3)

For associated spreadsheets, see Appendix A.

6.3.1. Reel check method

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

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

The advantages of this approach include:

- The sample is very large (an entire reel of product), so there is little opportunity for sampling error to compromise the accuracy of the results.

- There is no laboratory testing, so there is no potential for lab testing errors. However, errors in weighing the reel, as well as errors in determining reel length (from sheet speed and time) and product width can contribute to errors in this verification method.
- This procedure requires one of the following means to obtain the weight of the entire reel:
  - a crane with an integral load-cell weighing system
  - a floor scale at the reel
  - an integral scale in the reel

If one of these is not available, either the roll check method (see Subsection 6.3.2), or the lab sample method (see Subsection 6.3.3) must be used.

6.3.1.1. Reel check procedure

1. Obtain the weight of each spool used for this procedure, and either record the spool weight in a visible location on each spool, or mark each spool with a unique reference number. Enter the spool weight next to its associated reference number in cells B32 to B41 in the *Basis Weight Dynamic Verification Tool* spreadsheet, **Reel Weight Method** tab (see Appendix A).

2. Ensure that the scale that will be used to read reel weight has been verified accurate to ± 0.1%, for example, ± 0.01 ton in 10 tons.

3. Before proceeding:

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

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

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

   Print the **Sensor Maintenance** display for the IR Sensor Processor, which lists calibration values and retain it with the dynamic verification results for future reference.

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

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

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

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

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

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

8. Measure and record the reel diameter to ± 0.1%.
9. Measure and record the trim of the slabbed-off product to ± 0.1% (only necessary if a trim change occurred at the top of the reel, and has been slabbed off).
10. Count the number of sheets that have been slabbed off.
11. Record these three values into the appropriate locations in the Basis Weight Dynamic Verification Tool spreadsheet, sheet 1, Reel Weight Method.
12. After the reel has been weighed, record the weight of the reel.
13. Record spool number and/or spool weight.
14. Note the reel length and reel average basis weight from the QCS reel report.
15. Record the trim as measured manually in Step 5.

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

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

6.3.2. Roll check method

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

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

The advantages of this approach include:

- The sample is very large (nearly the entire reel of product), so there is little opportunity for sampling error to compromise the accuracy of the verification results.
- There is no laboratory testing, so there is no potential for lab testing error. However, errors in weighing rolls and cores, measuring sheet length, and width can contribute to error in this verification method.

6.3.2.1. Roll check procedure

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

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

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

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

Print the **Sensor Maintenance** display for IR Sensor Processor, which lists calibration values and retain it with the dynamic verification results for future reference.

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

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

5. Verify the accuracy of the speed on the winder, so as to be confident that the winder linear footage measurement is accurate. If possible, check the speed of the sheet using a hand-held tachometer, and confirm that the winder control displays the sheet speed value to within ± 0.1% of the hand tachometer value or better. If a sheet length value is not available on the winder, or if the measurement is not accurate, mount a sheet-length counter at a location that will contact the sheet, or on a product -carrying roll where there will be no sheet slippage.

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

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

8. Weigh each roll to ± 0.1% of the roll weight, for example, for example, ± 1 kg or less in 1000kg (± 1.0lb or less in 1000lb). Record each roll weight into the spreadsheet.

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

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

6.3.3. Lab sample method

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

Advantages of this method:

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

Disadvantages of this approach include:

- It requires a good deal of preparation and sample handling, so it is time consuming.
- Because of the amount of sample handling involved, there is a danger that laboratory error may occur in cutting, counting, or weighing the samples.
- Because the total size of the lab sample is very small compared to the total area represented in a single low-resolution trend or filtered profile zone, there is a danger of sampling error compromising the results.

6.3.3.1. Equipment

The following equipment is required:

- Tape measure (of adequate length to measure the full sheet width)
- Felt-tip marker or crayon to mark the product on the reel or slab from which the coarse samples are cut

- A razor-sharp knife to cut the coarse samples from the reel or slab
- A template of stiff paper or board to mark the position on the reel or slab where the coarse samples are cut. To ensure that the samples are large enough to accommodate the precision sample size, make the coarse-cut template approximately 2.54 cm (1 in) larger on each side than the precision sample size. To simplify cutting the coarse samples, make the template square or rectangular, even if the precision sample shape is circular.
- Latex or similar gloves for sample handling
- Precision sample punch (recommended), precision sample cutter, or template and razor knife, for cutting samples of precise and repeatable dimensions
- laboratory balance accurate to 0.05% of sample weight; a top-loading balance accurate to 0.1 mg is recommended
- *Basis Weight Dynamic Verification Tool* spreadsheet (see Appendix A)

6.3.3.2. Lab sample procedure

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

1. Before proceeding:
   - Ensure that the sensor meets stability and static verification specifications.
   - Ensure that the correct grade number is entered for the grade being produced.
   - Ensure that all necessary correctors, including dynamic correctors, are both appropriate and enabled.
   - Print the **Sensor Maintenance** display for IR Sensor Processor, which lists calibration values and correctors enabled, and retain it with the dynamic verification results for future reference.
2. Select the profile location to be sampled. Enter a filter factor of 0.2 for the IR weight low-resolution profile, or, if UltraTrue or Truing is

enabled, enter a filter factor of 0.33. Under these conditions, 90% of the trend profile value of each zone is based on the last 11 scans, where a scan is one trip across the sheet. Use the **Reel Scanner low-resolution trend profile** display of IR weight (do not use the high-resolution profile or the **CD Control** display) to select a 45.72–60.96cm-wide (18–24in) section of the basis weight profile that is relatively flat, and that the shape of the profile does not change visibly from scan to scan.

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

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

WARNING

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

Record the distance from the sheet edge to the IR weight sensor centerline, and the slice, bin or measurement zone, in the “Basis Weight Dynamic Verification Tool.xls” spreadsheet, sheet 3, “Lab Sample Method.”

5. At reel turn-up, print the low-resolution IR weight trend profile table of values. Also, print the profile display that includes the IR weight low-res trend profile. Record the IR weight trend profile value for the selected zone in the “Basis Weight Dynamic Verification Tool.xls” spreadsheet, in sheet 3, “Lab Sample Method.”

6. After turn-up, on the reel or on a slab cut from the reel that is at least ½” thick, measure from the sheet edge to the sensor centerline, as measured in step 4, and make an MD mark. Center the template over the mark, mark its perimeter on the product, and, using a sharp razor knife, cut to a depth of ¼” or more. Remove the sample stack from the reel.

WARNING

Exercise caution in using the razor knife to cut samples. Wear gloves to protect your hands from sharp edges of the cut samples. Wear safety glasses. Work the knife from side to side, or away from your body; never toward your body. Keep all body parts out of the path of the blade in the event that the knife slips out of the cut.

7. Repeat step 6 on the reel or slab roughly halfway around the reel from the first sample.

8. In a temperature- and relative-humidity-controlled environment, using latex gloves, remove and discard the top 2 or 3 sheets from the stack, then, remove one sheet, use the precision sample cutter or punch to cut a precision sample from the coarse sample.

9. Perform this step with the rest of the samples in the stack. After cutting all of the samples, weigh the sample stack to ± 0.01g and record the weight in the “Basis Weight Dynamic Verification Tool.xls” spreadsheet, sheet 3, “Lab Sample Method.” The number of individual samples in the bag should be sufficient to yield a total sample stack weight of 25 to 50 grams.

10. Repeat Step 8 for the second sample stack.

11. After weighing the sample stacks, count and record the number of sheets in each stack, and record in the *Basis Weight Dynamic Verification Tool* spreadsheet, sheet 3, Lab Sample Method.

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

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

7. Static Calibration

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

Study this chapter if there is no static calibration, or if a change in grade structure occurs requiring a complete new static calibration. New optical components (INFRAND plates, filters) may also require a new static calibration.

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

7.1. Overview

The 2-channel MXIR poly sensor is calibrated in the factory on standard samples for one or more of the following polymers: PET, PP, LDPE, and over one or more of the following approximate thickness ranges: 10-100µm, 100-250µm, 250-1000µm. The calibrations appropriate to the customer's product will have been loaded onto the system for use. The samples used to create these calibrations are not provided with the gauge.

These "generic" calibrations must be tuned for specific customer product(s). This section describes the following tuning procedures:

1. Establishing a dynamic slope and offset to accommodate a wide range of customer grades,

2. Fine-tuning individual grades, and

3. Creating a totally custom calibration from the ground up (only done if options 1 and 2 are not satisfactory).

The recommended procedure is to attempt tuning the factory calibrations and to examine the results before deciding if it is necessary to create a custom calibration.

Procedures involved in calibration include:

- Proper product samples must be collected for calibration
- The sensor must be verified to be stable and in good operating condition prior to shooting samples
- The laboratory weights are entered into the system software
- The samples are shot in the sensor using the proper sample paddle and the data collected in the system software
- For calibration tuning, a spreadsheet application is required to do the calculations involved
- The system calibration screens are used for data reduction and fitting if a new custom calibration is required

7.2. Sample selection

If feasible, prepare calibration samples for each grade. If the total number of customer grades is prohibitively large, select a subset of grades that are representative of the lowest and highest basis weight, and that vary as much as possible in composition. Choose grades that represent a large percentage of the customer production, if known.

Samples must be taken from where the sensor measurement is to be made.

A minimum of 4 samples per grade should be prepared if one is tuning established calibrations. A minimum of 10 samples per grade is required if creating a new calibration.

7.3. Sample preparation

7.3.1. Materials

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

- Analytical balance, accurate to 0.1mg
- Faraday cage balance pan
- Sample die: 4.5” or 7” diameter, mallet for die, and wood or hard rubber backing block for sample die
- Permanent ink pen for marking samples
- Rubber gloves and safety glasses
- A spreadsheet tool such as Excel

7.3.2. Preparing samples

Die-cut samples for each grade selected. If tuning an existing calibration, 4 samples per grade are required. If creating a new calibration, 10 samples per grade are required.

CAUTION

Wear safety glasses when die-cutting samples.

ATTENTION

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

Use gloves and keep the samples clean and dry. Fingerprints and dirt will cause errors (especially in lightweight applications).

Mark the samples on the extreme outer edge, in very small letters. Do not mark the central portion of the samples, as measurement errors result from the ink.

To make a single set of samples:

1. Mark each die-cut sample with a unique identifier.
2. Weigh each sample and enter the sample’s ID and weight on the worksheet. Calculate each sample’s basis weight using the appropriate conversion factor.

ATTENTION

Conversion factors:

- For 4.5” diameter samples *basis weight in g/m*^{2} *= weight in g × 97.45804*
- For 7” diameter samples *basis weight in g/m*^{2} *= weight in g × 40.27603*

7.3.3. Hardware checks

Sensor calibration can only be performed when the system is in maintenance mode. Ensure that this is done, and ensure that a reasonable factory calibration is loaded. Select a factory calibration that best matches the polymer and weight range of the samples.

Install the sample paddle and plug the power cord into the side of the HMI panel (the power plug is under the screw cap on the side). Insert the interlocking black rings into the sample paddle, if using 4.5” diameter samples.

Set up the standardize location. From the **MSS Scanner Calibration** dialog box (from the **MSS Setup Diagnostics** page) set the Reference Positions 1-4 to be outside of the offsheet position (the sample paddle should fit between the offsheet position and the scanner frame). Reference Positions 1-4 should be identical; see **Figure 7-1**. Enter best-guess estimates based on measurements using a tape measure, then perform a background. While the head is at the reference position, move the top head to confirm fine adjustments. The sensor windows (Infrand plates) should be precisely centered with respect to the sample paddle.

ATTENTION

It might be necessary to temporarily change the offsheet position as it will be convenient for the head to completely clear the paddle after a reference and/or sample is shot. This will allow easy access to the paddle to change sample.

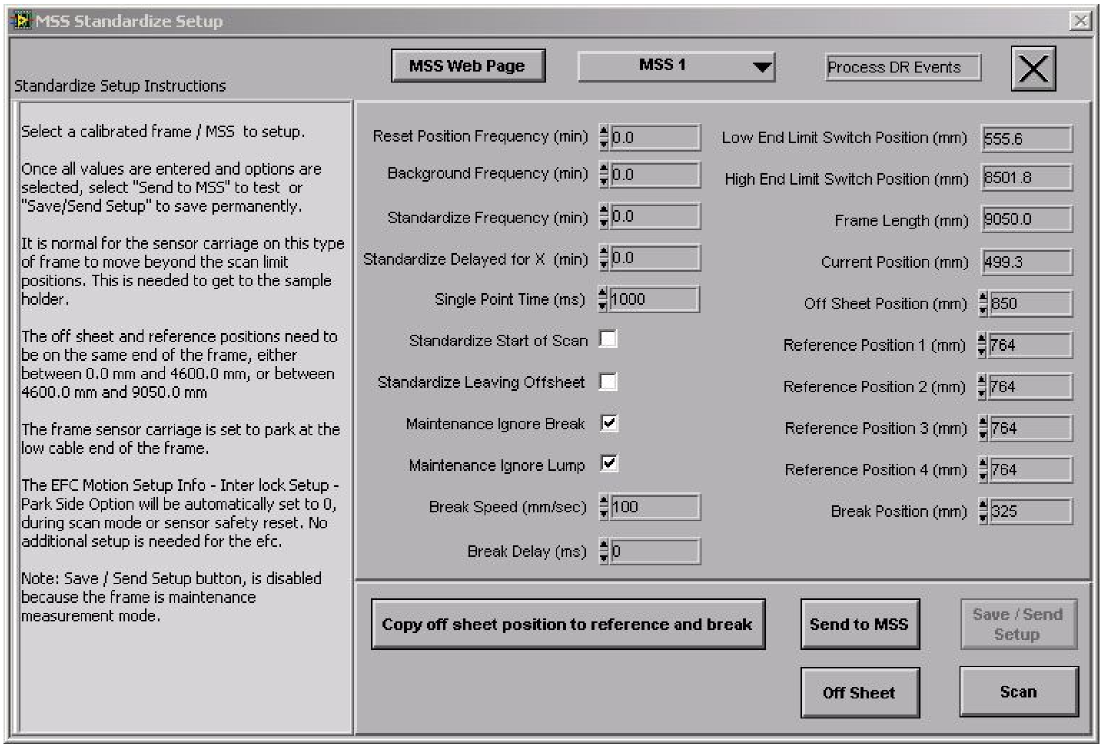


Figure 7-1 MSS Standardize Setup screen

Enable sampling movement on the **Sensor Maintenance** page for the IR sensor. The **Enabled** flag should be set to 1, and the **Sampling Radius** set to 0 for 4.5” diameter samples and 12 for 7” diameter samples. Click **Perm** to save these values (see **Figure 7-2**).

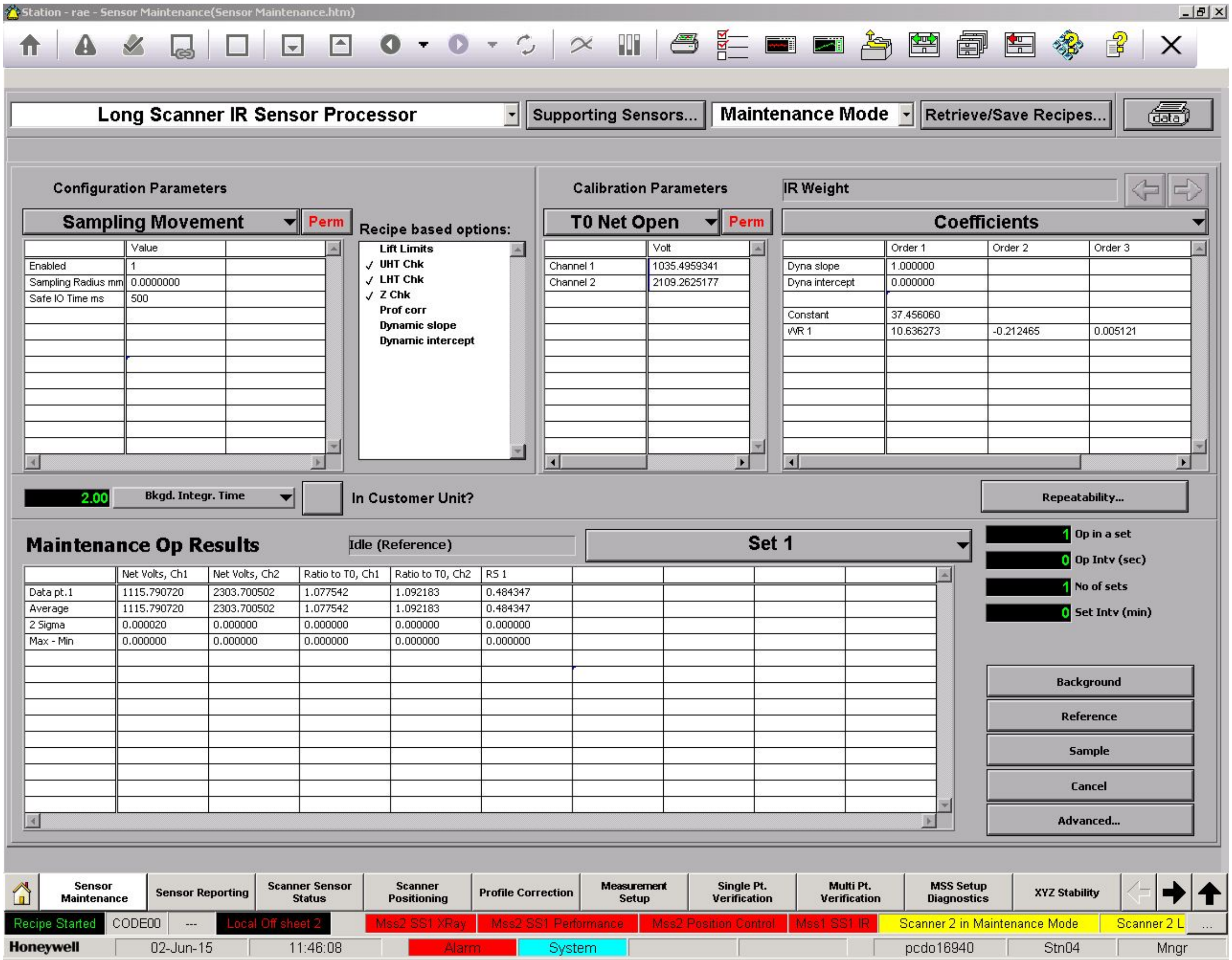


Figure 7-2 Sensor Maintenance page

Before shooting any calibration samples ensure that the sensor is stable and up to specifications. Perform the following tasks before proceeding (See Section 9.2 and 9.3):

1. Set the **Background Integration** time to two seconds. Perform two Backgrounds. The background readings should be in the range of 3–6, and repeat to within 2%.

2. Set the **Standardize Integration** time to two seconds. Set up a cycle of 10 or more references over a 10 minute period. The resulting ratio to time-zero for each channel should be within the following limits:

   $2\sigma[\text{Ratio to T0, Ch}_i] < 0.005$

7.3.4. Data entry

Sensor calibration can only be performed when the system is in maintenance mode. Ensure that this is done. Create a new recipe based on a reasonable factory calibration, and load it. Choose a factory calibration that best matches the polymer and weight range of your samples. You will be changing the default values, so *do not overwrite the factory calibration* – make a new working copy. Chapter 5 describes how to do this.

The calibration screen is accessed from the **Sensor Maintenance** display by clicking **Advanced**. This brings up the **Infrared Sensor Calibration** display in Experion MX (see Figure 7-3).

The lab data must be entered into the data table in order to perform any calibration or tuning. To enter the lab data in the **Infrared Sensor Calibration** display:

1. Click the upper-right drop-down menu and select **Verification** (see **Figure 7-3**).

2. Click **Open File…** to import a previously saved calibration file, if available.

   If there is no previously saved data, click **Add Sample** to create the number of sample entries required. Highlight the the first sample in the table, and enter the IR Weight in the black/green textbox. Press **`[ENTER]`** to advance to the next sample. You will need to click on the textbox again to be able to enter the next weight. Continue until all sample weights have been entered.

ATTENTION

If establishing a new calibration and if the samples available do not cover enough basis weight range, enter the *combined basis weights* of the samples, not the individual sample weights. Samples can be stacked on top of each other to provide a greater basis weight range.

3. When the data for all samples is entered, click **Save File…** to save the raw data. Doing so creates a binary file that can be reloaded by clicking **Open File…** on the **Infrared Sensor Calibration** display. The binary file is usually saved in the directory *C:\Program Data\Honeywell\Experion MX\Database\Calibration data\Infrared*.

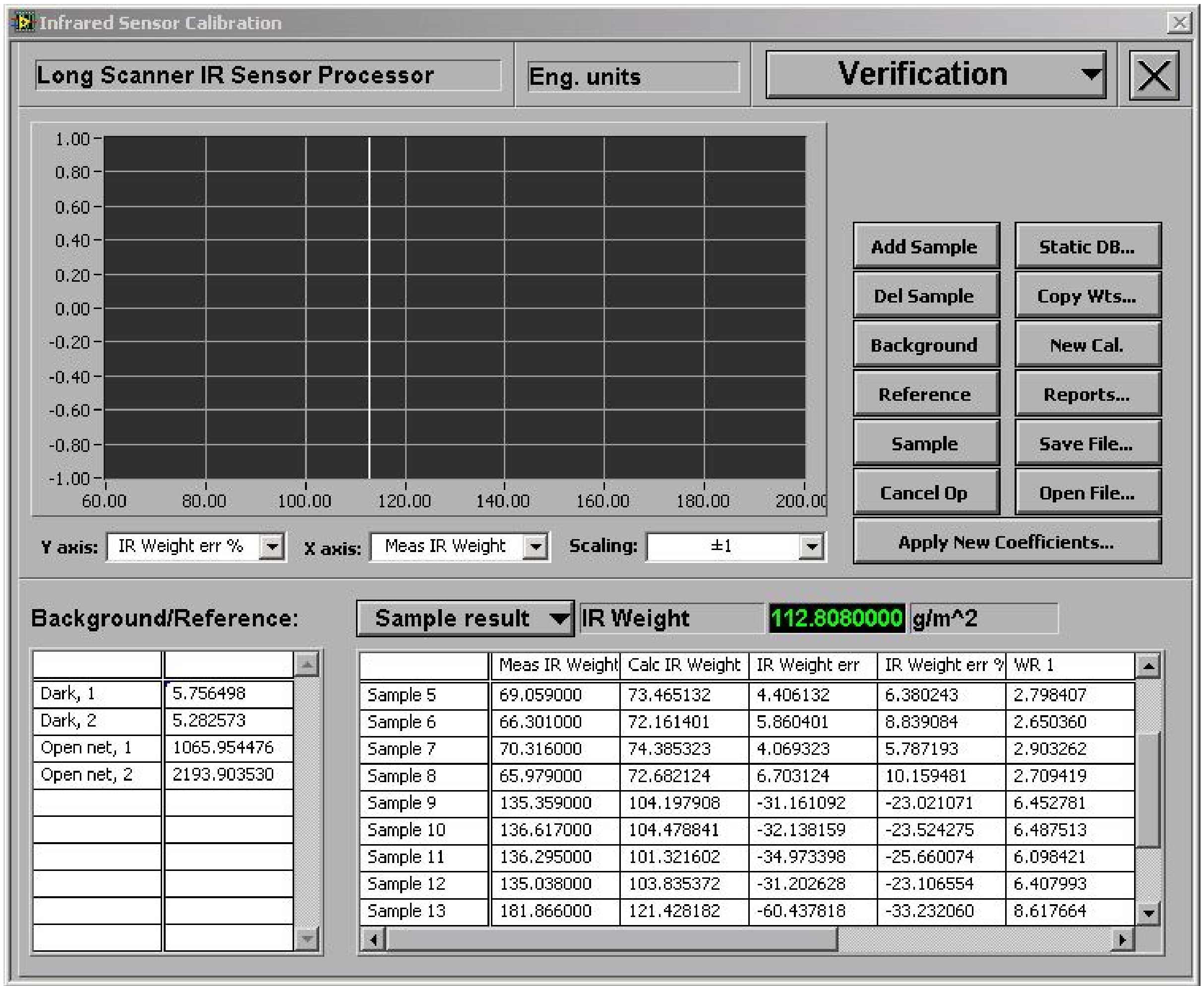


Figure 7-3 Infrared Sensor Calibration Display, Verification Mode

7.3.5. Background and Reference procedure

A Background and Reference is required prior to taking any sample data:

1. Set the **Backgroud Integration Time** and the **Reference Integration Time** to four seconds on the **Sensor Maintenance** display, see **Figure 7-2**.

2. Slide the interlocking black rings without sample into the paddle. Interlocking black rings are used with 4.5” samples only.

3. Click the **Background** button on the **Infrared Sensor Calibration** page. The **Dark** values will appear in the table to the right of the sample weights. They should be between 3-6.

4. Click the **Reference** button on the **Infrared Sensor Calibration** page. The **Open net** values should appear in the table. These are in engineering units (not volts) and should be close to the T0 (time zero) values.

7.3.6. Sample Procedure

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

1. Set the **Sample Integration Time** to four seconds on the **Sensor Maintenance** display. Ensure that Sample 1 is highlighted in the data table.

2. Load a sample between the black interlocking rings, sliding them to lock the rings.

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

4. Turn on the paddle motor to start the sample rotation. Either press the **Sample** button on the HMI at the endbell scanner or press the sample button on the **Infrared Sensor Calibration** page. A reading will be taken.

5. The heads will move away from the sample paddle when the reading has been taken, allowing a new sample to be inserted into the paddle.

6. Repeat until all samples have been shot in the sensor. Samples are shot one by one, *unless* you are establishing a new calibration. In this case, *stack the samples one on top of the other*.

7. Remove the sample paddle when finished shooting all samples.

8. On the appropriate calibration display, save the raw data by clicking **Save File…**.

7.3.7. Data reduction and fitting

When all samples have been shot in the sensor, the data can be fit to determine the calibration constants.

7.3.7.1. Establish a Slope and Offset correction for a Group of Grades

A single slope and intercept correction may be all that is required to tune the factory calibration to read all customer grades correctly. A spreadsheet tool is required for this procedure.

Open a new spreadsheet and enter each sample's ID, lab weight, and calculated IR weight as read by the sensor (copy the values from the **Infrared Sensor Calibration** page, see **Figure 7-3**). The table below gives an example, using 12 samples divided into 4 grades of product.

sample	lab wt	sensor wt	diference
1	97.808	92.26	5.548
2	98.071	90.94	7.131
3	98.383	91.75	6.633
4	97.593	91.27	6.323
5	69.059	73.46	Av =6.4
6	66.301	72.16	
7	70.316	74.39	
8	65.979	72.68	
9	135.359	104.2	
10	136.617	104.48	
11	136.295	101.32	
12	135.038	103.84	
13	181.8664	121.43	
14	179.3714	122.7	
15	183.6986	125.21	
16	178.5723	121.53	

Table 7-1 example calibration tuning

Make a plot, with the *sensor weight* on the X-axis and the *lab weight* on the Y-axis. If *3 or more groups of points* (product grades) lie on a line, you can define a calibration group consisting of these grades. Fit a line to these points (use Excel's "trendline" option, for example). The slope of the fitted line is the **slope correction** and the intercept is the **offset correction** for this group**. Figure 7-4** shows the example data of Table 7-1, with three grades defining a calibration group, and one grade not fitting into this group. In this example, the slope correction is *2.271* and the offset correction is *-98.4* for the three "blue" grades.

In **Recipe Maintenance**, adjust the calibration parameters of the new calibration group you used to shoot these grades as follows (see Chapter 5 for detailled description of the recipe maintenance):

- Multiply every element (typically 3) in the **IRW Coeff Table** by the slope correction value.
- Multiply the IRW Constant Term in the IRP Calibration Table by the slope correction value then add the offset correction value

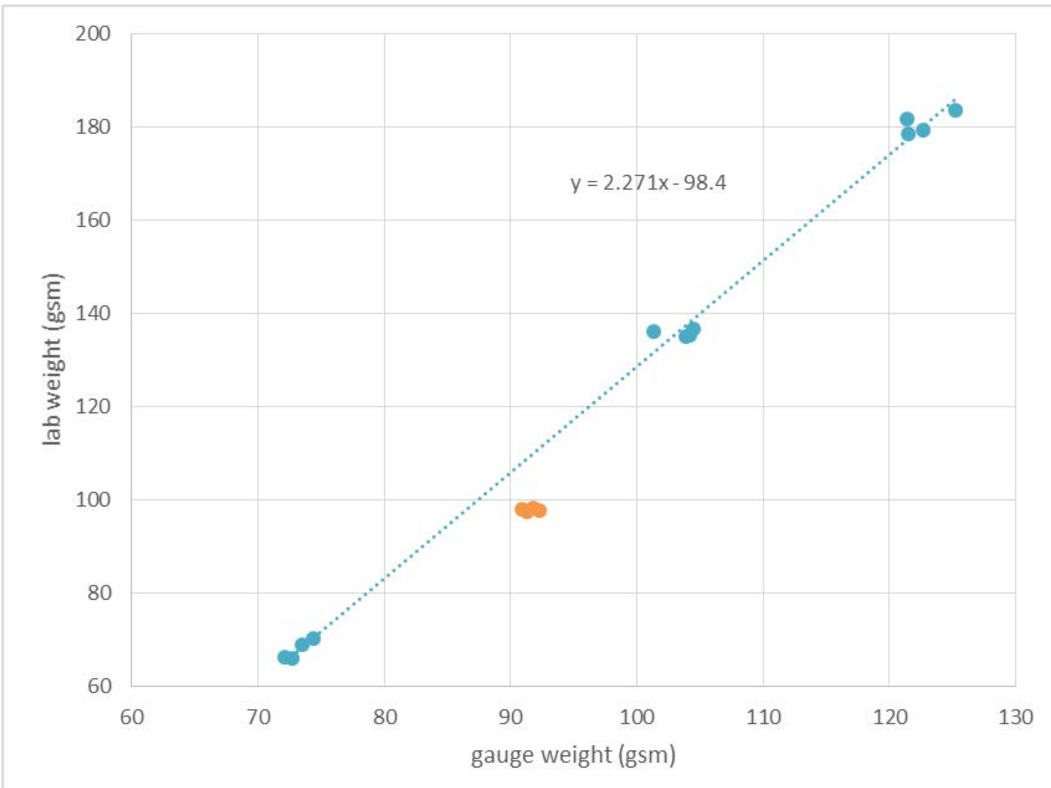


Figure 7-4 Example calibration tuning, using data from table above

7.3.7.2. Establish an Offset correction for Single Grades

If you have grades that cannot be grouped, then these grades must be given their own calibration. In the example above, the "orange" grade does not fit into the “blue” calibration group. The “orange” grade is represented by the first 4 samples in the table.

For single grades that require adjustment, a single **offset correction** is recommended. Calculate the difference between the lab weight and what the gauge reads using the factory calibration for each of the samples in the grade, and then take the average of these differences. In the example above, this average difference is *6.4*g/m^2, with the gauge reading consistenly low. This average difference is the offset corrrection for this grade.

In **Recipe Maintenance**, adjust the calibration parameter as follows:

- Add the offset correction value to the IRW Constant Term in the IRP Calibration Table

7.3.8. Creating a Custom Calibration

If tuning the factory calibration does not result in the desired accuracy, a custom calibration can be created using customer samples. A minimum of 10 circular samples (either 4.5” or 7”) is required per grade. Follow the instructions in section **7.3.2** for making the samples.

Samples should be chosen so that they cover the entire basis weight production range. If it is not possible to obtain such samples, samples can be stacked on top of each other to increase the available basis weight range.

ATTENTION

> When establishing a new calibration, it is preferable not to use stacked samples however this is only possible if the samples available cover the entire basis weight production range.

When the samples have been weighed and their basis weights recorded in the spreadsheet, calculate the combined basis weight of the samples if stacked and record that as well. The combined basis weight is the basis weight of a stack of samples (i.e. samples 1+2, sample 1+2+3,…).

Complete the hardware checks as outlined in **7.3.3**. In this case, it doesn’t matter if a factory calibration has been loaded, as you will be creating a new one.

Enter the data as described in section **7.3.4**, but rather than being in ***verification*** mode, select ***calibration*** mode instead. Enter the basis weight of the samples and/or the *combined* basis weight of the stack of samples.

Perform a background and reference as per section **7.3.5**.

When shooting samples, refer to section **7.3.6**, shoot individual samples and stack of samples in the same order as basis weight values were entered in the calibration display.

7.3.8.1. Fitting the Data

Once the final samples has been shot, you can start fitting the data to generate the calibration curve. Press **Curve Fit** on the **Infrared Sensor Calibration** screen, see **Figure 7-5** below. The table on the upper right hand side of the screen lists the working ratios used in the fit. There should be only one. You can specify the order of the polynomial fit to be used by typing into the green text box to the left of the table. In the example below, 3 orders are used in the fit, plus a constant, for a total of 4 fit parameters. Use the slider bar underneath the table to view the values of the fit parameters.

A rule of thumb when deciding how many orders to use for the fit, is that *less is better*. Use no more than *(N-1)/2*, where *N* is the number of data points that you are including in the fit. In the example shown, *N = 11*, so the number of parameters in this fit is acceptable ($4 \leq \frac{(11-1)}{2} = 5$).

Samples can be removed from the fit by dragging the graph's cursors to the offending point, which highlights it in the data table, from where you can click on it's "x" and remove it from the fit.

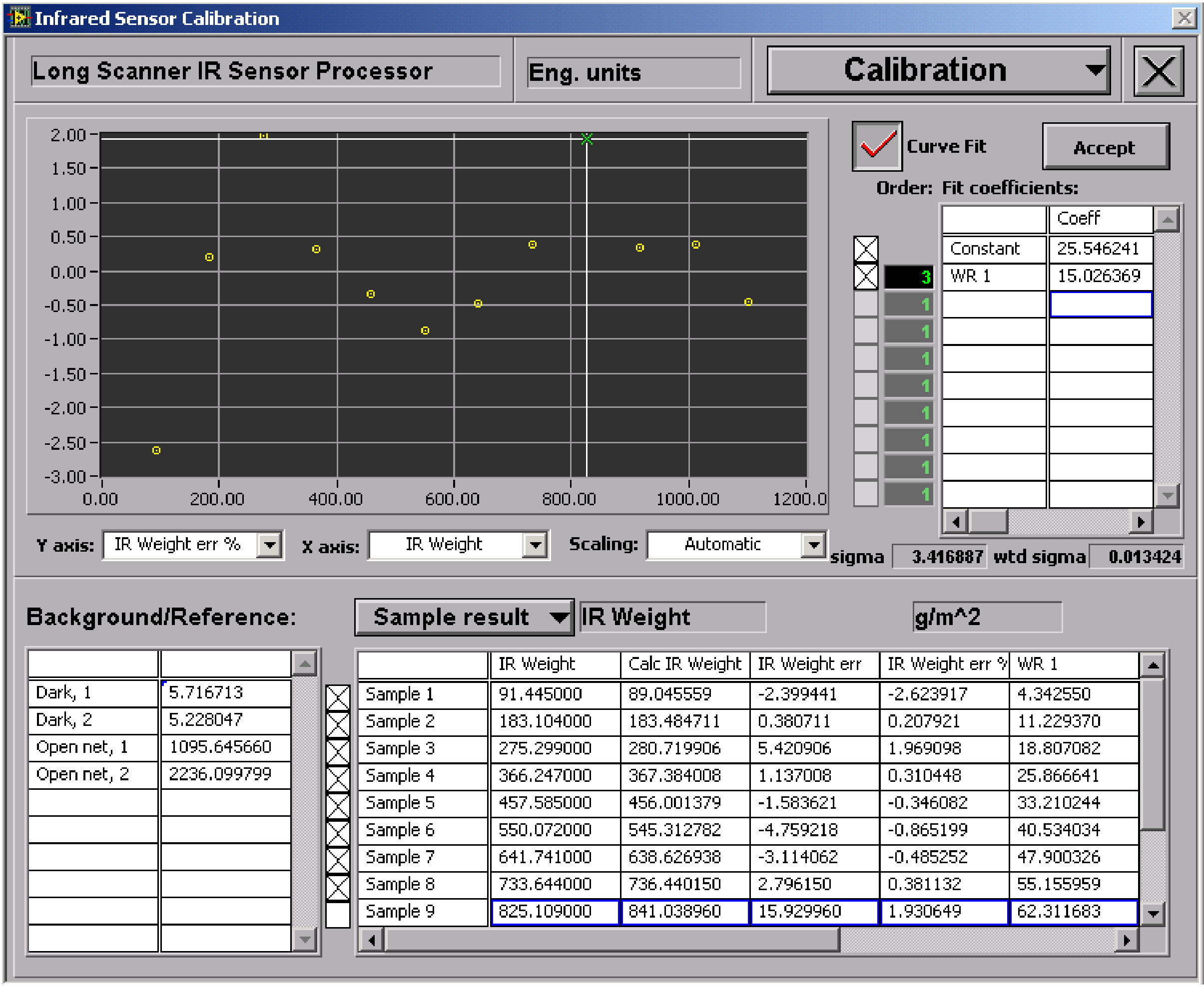


Figure 7-5 calibration results

When you have minimized the **sigma** value of the fit and are satisfied with the results, save the calibration. Click **Accept**, then **apply new coefficients…** and confirm that the correct coefficients are displayed, see **Figure 7-6**. Click on the appropriate checkboxes to enable saving them. It is typically better not to apply the open net volts as T0 at this time as these values were obtained with the paddle and interlocking black rings in place.

Create new pointer by clicking the **ID** button. This will open a new dialog box (**select ID and groups to apply**), see Figure 7-7. Double-click on an existing ID to overwrite it (note: to create a new ID, you have to create an empty recipe first, then you can fill it by overwriting it), and click **apply to all** to make this calibration apply to all your grade groups, where required.

The correct calibration constants should appear in the coefficients table of the **Sensor Maintenance** page. When you enter production mode, the recipe will need to be reloaded to ensure the correct constants are used.

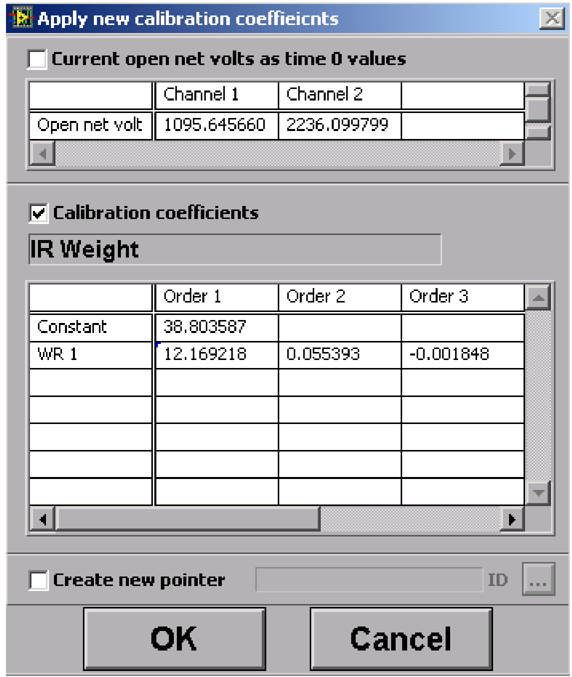


Figure 7-6 Apply New Calibration Coefficients

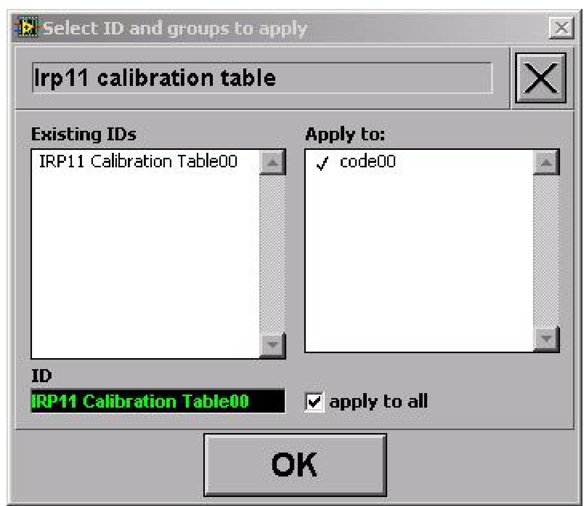


Figure 7-7 Select ID and Groups to Apply

8. Preventive Maintenance

Preventive maintenance, when performed on a periodic basis, can prevent many failures, and catch minor problems before they become major ones. The frequency of preventive maintenance procedures might need to be adjusted depending on the operating environment.

8.1. Preventive maintenance schedule

Table 8-1 provides a preventive maintenance checklist.

Table 8-1 Preventive Maintenance Checklist

Procedure	Daily	Weekly	Months		Years			Task Details
			1	6	1	3	5	
Dynamic verification		X						Section 9.1
Check hardware stability		X						Section 9.2
Check short term stability		X						Section 9.3
Check sensor stability		X						Section 9.4
Check Z-Correction								Section 9.5
Check EDAQ jumper settings								Section 9.6
Clean sensor windows	X							Section 9.7
Change lamp power settings								Section 9.8
Change detector temperature setpoint								Section 9.9
Change chopper frequency								Section 9.10
Replace Source board								Section 9.11
Replace Detector board								Section 9.12
Replace Temperature Controller board								Section 9.13

Procedure	Daily	Weekly	Months		Years			Task Details
			1	6	1	3	5	
Replace Interface board								Section 9.14
Replace Detector								Section 9.15
Replace lamp				X				Section 9.16
Replace motor								Section 9.17
Replace chopper detector								Section 9.18
Replace motor controller								Section 9.19

9. Tasks

This section contains procedures for maintaining optimal function and/or troubleshooting issues with the sensor.

ATTENTION

Activity numbers that appear in the Task description tables are for use of the **Sensor Diagnostics** display only, and do not reflect model numbers for the tasks. To determine whether the Task applies to the sensor, check Applicable Models.

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

9.1. Dynamic verification

Activity Number:	Q4405-30-ACT-001	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	None
Availability Required:		**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	1 week
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

Dynamic correction corrects for any difference between static calibration readings on samples and onsheet readings.

Dynamic calibration should only be performed after static calibration has been performed and verified. Dynamic verification is necessary whenever a quartz window is replaced, a filter is changed, or the static calibration is significantly changed. Dynamic verification should be performed on a regular basis.

See Chapter 6 for detailed instructions on Dynamic verification

9.2. Check hardware stability

Activity Number:	Q4405-30-ACT-002	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	None
Availability Required:		**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	1 week
Duration (time period):	10 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

To assess the sensor hardware performances, regularly record and inspect the following variables:

- Source and receiver head temperature (degrees C)
- Source and receiver chopper frequency (Hertz)
- Lamp voltage and current (Volts and Amps)
- IR detector temperatures (degrees C)

To set the Trend plot to record the variables:

1. Click **HOME** on the horizontal dispatcher.
2. Select the **Trend** plot, then **Setup**.
3. Navigate to *scanner x/mss/ssx ir* (see Figure 9-1).

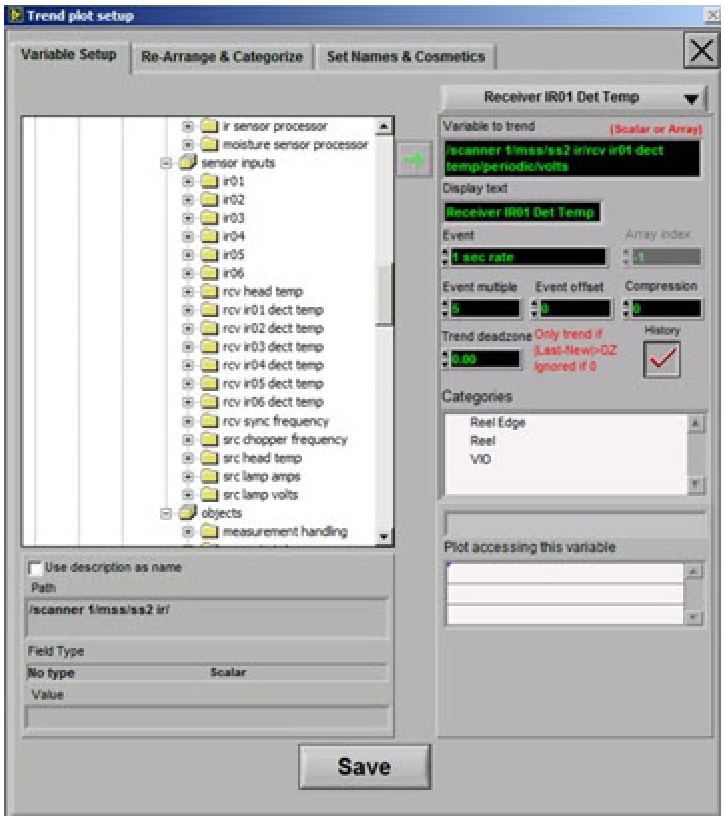


Figure 9-1 Trend Plot Setup Display

4. For each of the variables, for example, *rcv ir01 dect temp*, select **periodic/volts**.
5. Use 1 sec rate in Event and 5 as Event multiple.

Note that the variable path name ending with volts is misleading because the variables of interest listed here are given in engineering units.

The chopper frequency is measured using two independent techniques:

1. First, hall sensors embedded in the motor sense the rotation of the shaft and send a signal to the Source board and the EDAQ. The EDAQ reports a frequency referred to as *src chopper frequency*, which corresponds to 180º rotation of the shaft.

2. Second, the reference signal used to demodulate both the reference and the measure channels is sent to the frequency input of the receiver EDAQ. The receiver EDAQ reports a chopper frequency referred to as *rcv sync frequency*, which corresponds to the true modulation frequency of the light.

The default chopper frequency is 1200Hz. The *src chopper frequency* should read 1/6 of this value or 200Hz. Both frequency measurements should track each other, show very low jitter, and a 12-hour stability of better than 0.1% (see Figure 9-2).

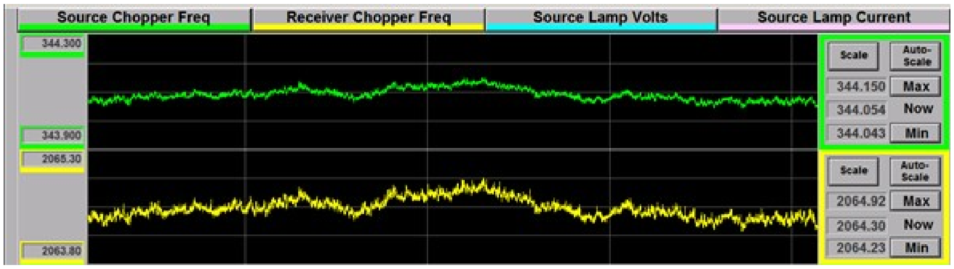


Figure 9-2 Trend Plot: Chopper Frequency

If both frequency signals show signs of instability, the motor and/or motor bearings might be failing (see Section 9.17).

If the *rcv frequency* signal only is unstable or missing, check the EDAQ jumper settings (see Section 9.6), check the reference signal strength and reference channel detector temperature.

The lamp voltage should show low noise and not vary by more than 1% over a 12-hour period.

Note the expected correlation between the source temperature and the lamp voltage (see Figure 9-3). The lamp current is expected to show less than 1% noise and be stable to better than 1% over a 12-hour period.

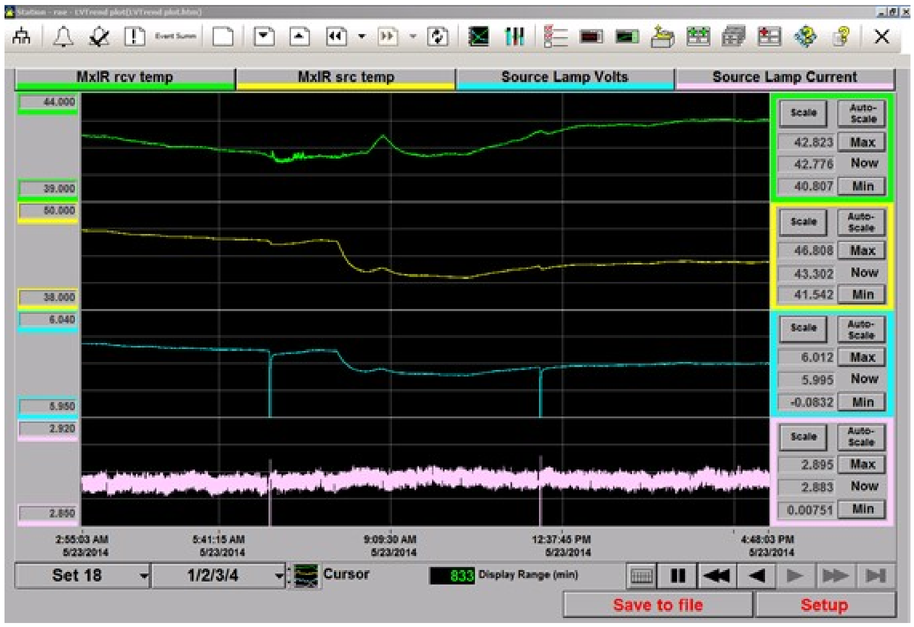


Figure 9-3 Trend Plot: MXIR rcv temp; MXIR src temp, Source Lamp Volts; Source Lamp Current

The default lamp power is 50% of full power which corresponds to approximately 20 watts.

The downwards spikes in the voltage and current measurements correspond to Backgrounds. The lamp is turned off during the background phase.

The detectors temperatures should be within 0.5ºC (32.9ºF) of each other. They should show a very high degree of correlation with each other as well as with the receiver temperature (see Figure 9-4). The maximum variation in the detector temperature is expected to be 10% of the receiver head temperature variation.

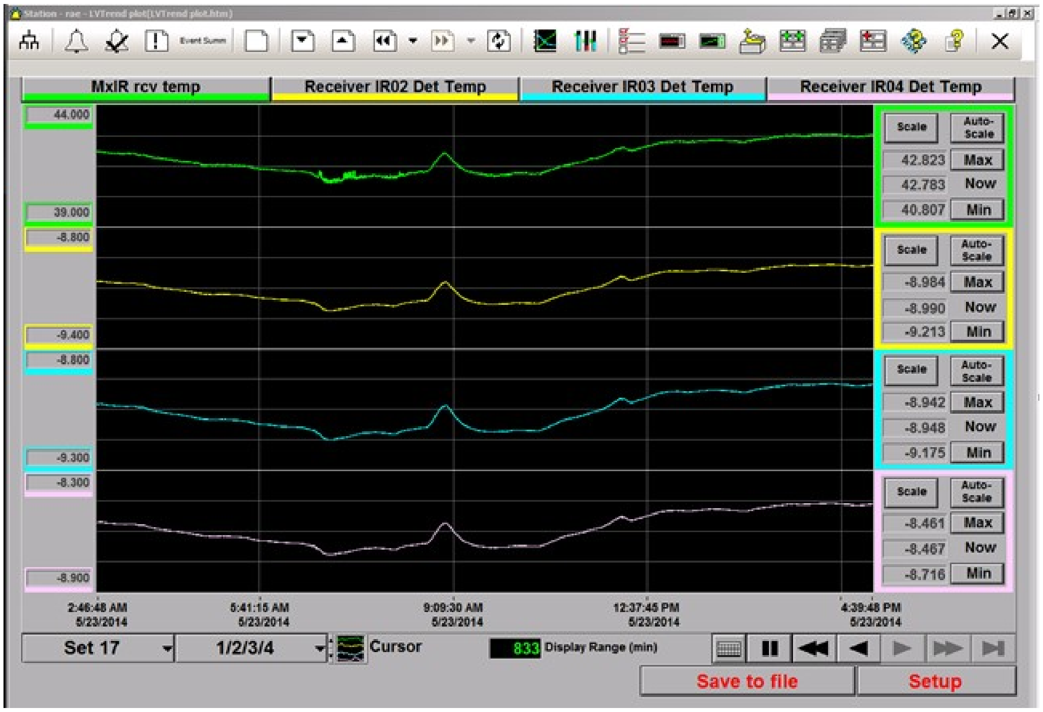


Figure 9-4 Trend Plot: MXIR rcv temp; Receiver IR02 Det Temp; Receiver IR03 Det Temp; Receiver IR04 Det Temp

If the detector temperature variation is significantly greater with one channel than with the others, change the corresponding temperature controller board (see Section 9.13).

A detector temperature of -37 ºC (-34.6 ºF) indicates that the detector or detector temperature controller board is missing, unconnected or faulty.

9.3. Check short term stability

Check the sensor short term stability regularly for indication of sensor noise and instability.

Activity Number:	Q4405-30-ACT-003	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	None
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	

Overdue Grace Period:		**Frequency (time period):**	1 week
Duration (time period):	15 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

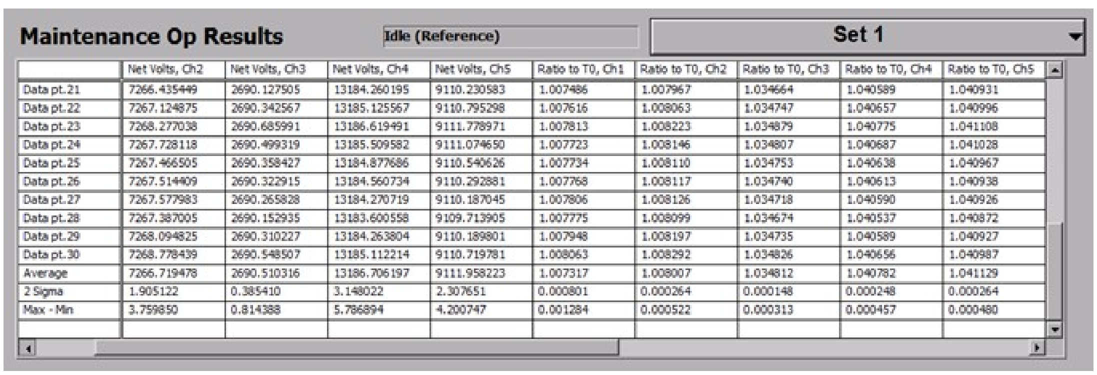
Perform a couple of backgrounds:

1. Go into maintenance mode.
2. On the **Sensor Maintenance** display for the IR Sensor Processor, set the **Background Integration** time to two seconds.
3. Perform two backgrounds. The background readings should be in the range of 3–6 and repeat to within two percent.

Sensor short term stability is assessed by doing repeated references:

1. Set **Integration Time** for reference (in seconds) to 2.00.
2. Request 10 or more consecutive references in a 10 minute period with nothing in the gap.

The sensor is stable if the 2 sigma of the **Ratio to T0** for all the channels is less than 0.005 (see Figure 9-5).


Maintenance Op Results
Idle (Reference)
Set 1

	Net Volts, Ch2	Net Volts, Ch3	Net Volts, Ch4	Net Volts, Ch5	Ratio to T0, Ch1	Ratio to T0, Ch2	Ratio to T0, Ch3	Ratio to T0, Ch4	Ratio to T0, Ch5
Data pt.21	7266.435449	2690.127505	13184.260195	9110.230583	1.007486	1.007967	1.034664	1.040589	1.040931
Data pt.22	7267.124875	2690.342567	13185.125567	9110.795298	1.007616	1.008063	1.034747	1.040657	1.040996
Data pt.23	7268.277038	2690.685991	13186.619491	9111.778971	1.007813	1.008223	1.034879	1.040775	1.041108
Data pt.24	7267.728118	2690.499319	13185.509582	9111.074650	1.007723	1.008146	1.034807	1.040687	1.041028
Data pt.25	7267.466505	2690.358427	13184.877686	9110.540626	1.007734	1.008110	1.034753	1.040638	1.040967
Data pt.26	7267.514409	2690.322915	13184.560734	9110.292881	1.007768	1.008117	1.034740	1.040613	1.040938
Data pt.27	7267.577983	2690.265828	13184.270719	9110.187045	1.007806	1.008126	1.034718	1.040590	1.040926
Data pt.28	7267.387005	2690.152935	13183.600558	9109.713905	1.007775	1.008099	1.034674	1.040537	1.040872
Data pt.29	7268.094825	2690.310227	13184.263804	9110.189801	1.007948	1.008197	1.034735	1.040589	1.040927
Data pt.30	7268.778439	2690.548507	13185.112214	9110.719781	1.008063	1.008292	1.034826	1.040656	1.040987
Average	7266.719478	2690.510316	13186.706197	9111.958223	1.007317	1.008007	1.034812	1.040782	1.041129
2 Sigma	1.905122	0.385410	3.148022	2.307651	0.000801	0.000264	0.000148	0.000248	0.000264
Max - Min	3.759850	0.814388	5.786894	4.200747	0.001284	0.000522	0.000313	0.000457	0.000480

Figure 9-5 Maintenance Op Results

If the sensor is close to, but does not meet, the specifications, check that the head temperature is stable. If the head temperature is not stable, wait until it becomes stable (or fix head temperature stability issue-refer to the scanner manual) and then redo the stability test. If the sensor still does not meet the specifications, see Section 9.2.

Ratio to T0, Chx represents the ratio of the channel volts to the channel volts at time 0 for channel x (x = 1–2). These ratios should be close to 1 (± 0.1) for both channels. If they are still far from 1 after the sensor windows have been cleaned, adjust the time-zero values.

The drift of channel volts with respect to their time-zero values may indicate hardware issues. Regularly adjusting time-zero values may mask an underlying problem. If the **Ratio to T0** for both channels have drifted down by a similar amount, it is possible that the issue is due to an aging lamp.

To change the time-zero values:

1. On the **Sensor Maintenance** display for the IR sensor processor, select **T0 Net Open** (see Figure 9-6).

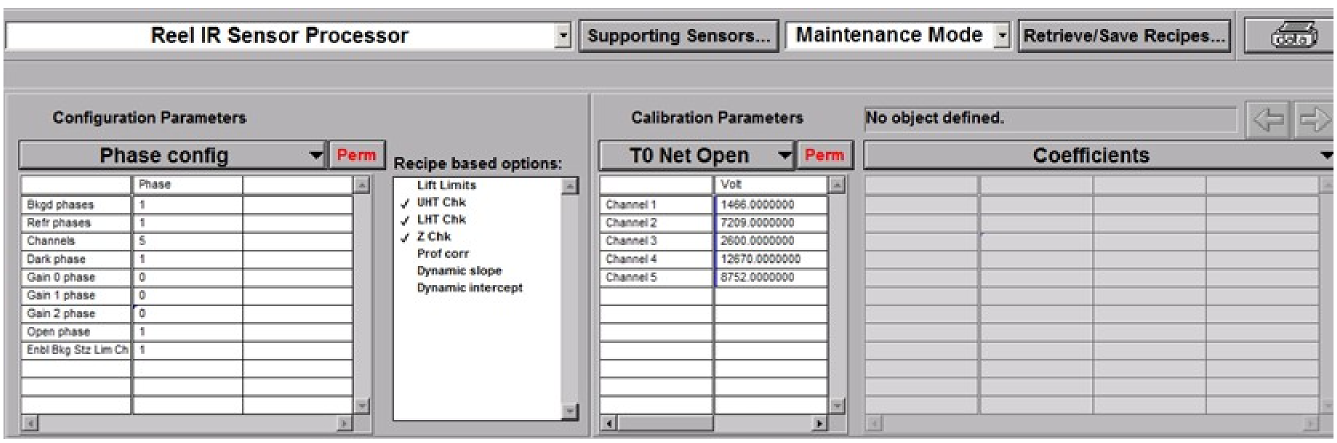


Figure 9-6 Sensor Maintenance Display

2. Enter the current reference values from the short-term stability test. They should be between 500 and 80000.

3. Click **Perm** to make these values permanent.

9.4. Check sensor stability

Activity Number:	Q4405-30-ACT-004	**Applicable Models:**	All
Type of Procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	1 week
Duration (time period):	20 minutes	**# of People Required:**	1
Prerequisite Procedures:	Check short term stability	**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time
	• sample paddle • 1 set of customer samples used as standard samples		

Sensor stability over the long term can be assessed by shooting standard samples regularly. Standard samples are product samples which, if stored properly, can stay stable for years. A large shift in the sensor reading can be the indication of a hardware issue.

To verify the standard samples (see Section 7 for detailed instructions on verification using the advanced display):

1. Go into maintenance mode.
2. Check the sensor stability (see Section 9.3).
3. In the **Sensor Maintenance** display for the IR Sensor Processor, click **Advanced…** and select **Verification** on the drop-down menu.
4. Perform a background.
5. Load the file containing the samples basis weight using the **Open File…** command, or enter the values manually.
6. Load the code for the standard 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 interlocking black rings only (for 4.5”samples) in the paddle.
8. Insert a sample in the paddle and perform a Sample operation. Repeat for each sample within a grade code.
9. Save the verification file using the **Save File…** function.
10. Repeat Steps 5–9 for each grade code.

A sudden shift in the readings is indicative of a problem. In this case:

1. Ensure that the proper calibration constants and correctors are loaded.
2. Confirm that the sample is not damaged (that is, use more than one verification sample).
3. If a hardware issue is suspected, see Chapter 10.

Additional details on the verification procedure can be found in Section 7.

9.5. Check EDAQ jumper settings

Activity Number:	Q4405-30-ACT-008	**Applicable Models:**	All
Type of Procedure:	Inspect	**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):	15 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

The EDAQ frequency input is used to monitor the chopper frequency by the source and by the receiver. The proper jumper setting on the EDAQ (see Figure 9-7) is required to achieve a robust frequency measurement. Ensure that:

- The jumper is out for the source EDAQ
- The jumper is in for the receiver EDAQ

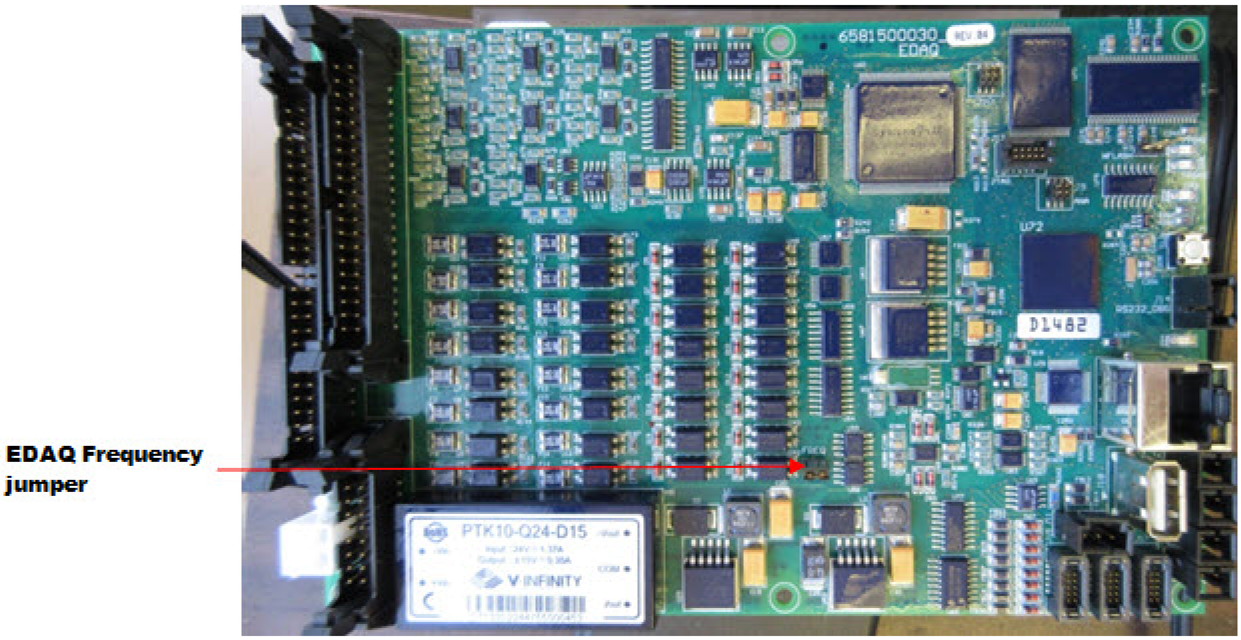


Figure 9-7 Frequency Jumper Setting For the Receiver EDAQ

9.6. Clean sensor windows

Activity Number:	Q4405-30-ACT-009	**Applicable Models:**	All
Type of Procedure:	Maintain	**Expertise Level:**	Operator
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	1 day
Duration (time period):	5 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
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 towel dipped in methanol or isopropyl alcohol. If it is impractical to split the heads, wrap cloth on a thin stick.

CAUTION

> The windows are made of thin quartz and are fragile. Broken windows must be replaced.

Dirt buildup, if significant, can affect the accuracy of the gauge.

If the dirt buildup causes the standardize volts to time 0 or standardize ratios to time 0 to go out of limits, clean the plates more often. The default limits are selected so that no adverse effects on the measurement are expected until they are reached. In some cases, it may be necessary to change one or more of these limits to prevent or to trigger alarms from dirt buildup.

To change limits:

1. Click **Scanner/Sensor** on the horizontal dispatcher and select **Sensor Maintenance**.
2. Select **IR Sensor Processor** on the drop-down menu.
3. Under **Calibration Parameters**, select **Stdz Ratio Drift Limits**, **Abs Ratio Min Limits**, or **Abs Ratio Max Limits**.
4. Change any of those values.

If, after cleaning the windows, the Ratios to T0 are not close to 1, check hardware stability (see Section 9.2).

To change limits for the Opacity sensor:

1. Select Opacity Sensor Processor on the drop-down menu.
2. Under **Calibration Parameters**, select **Limits**.
3. Change **Ratio Drift Limit** and/or **Opac Shift Limit**.

9.7. Change lamp power settings

Activity Number:	Q4405-30-ACT-010	**Applicable Models:**	All
Type of Procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	5 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

The lamp power may need to be increased if:

- An increase in signal to noise is required for some or all the grades
- Premature lamp failure (in under 6 months) is regularly observed

The lamp power may need to be decreased if:

- Source temperature is too high and triggers a high temperature alarm
- Premature lamp failure (in under 6 months) is regularly observed

Do not operate the lamp at more than 85% of full power, as it will dramatically shorten its life (down to 2000 hours).

At low power, the halogen cycle may not operate efficiently, which also shortens the life of the lamp.

To change the power to the lamp:

1. Open the database browser (see Figure 9-8).

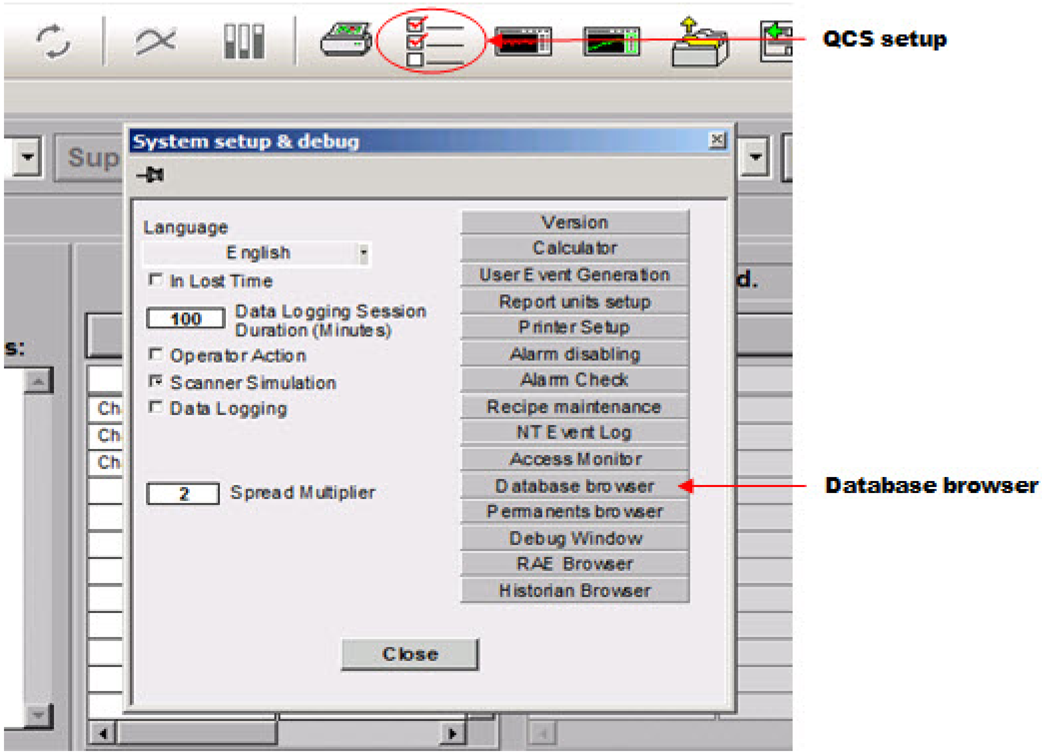


Figure 9-8 System setup & debug Display

2. Navigate to */scanner x/Mss/Ss1 ir/Setup/Src lamp power sp* (see Figure 9-9).

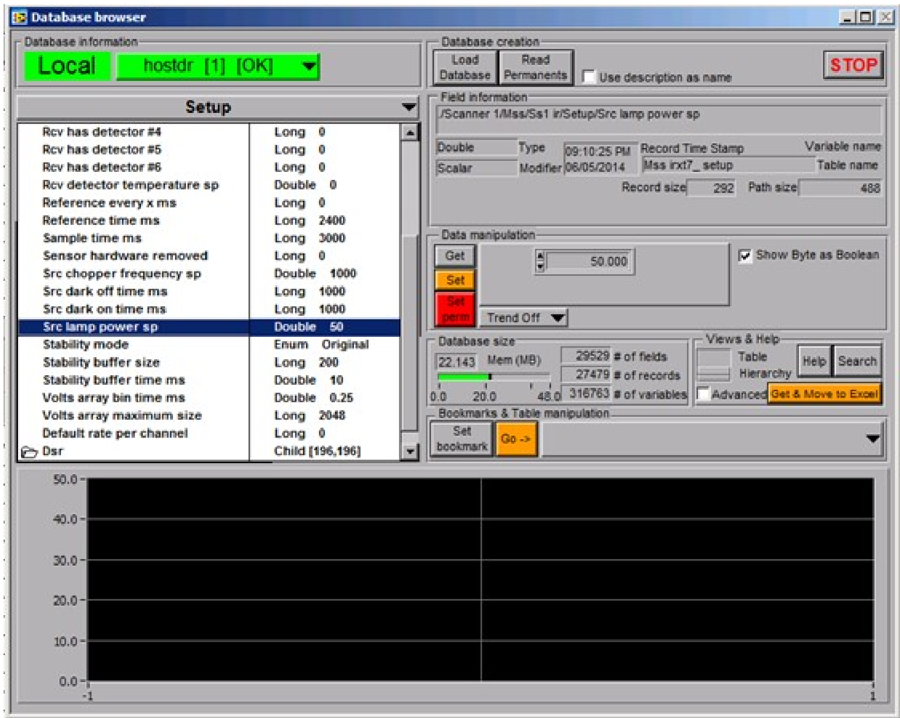


Figure 9-9 Database Browser: RTDR Entry For Lamp Power

3. Change the value (0–100%), and set to **Perm**.
4. Open the MSS web page, and click on the MXIR source EDAQ.
5. Do a hard reset of the MXIR source EDAQ.
6. Wait 1-2 minutes to ensure that the EDAQ is up and that the lamp is fully on, then initiate a Standardize.
7. Update the time-zero values to prevent drift alarms from being triggered (see Figure 9-6).

9.8. Change detector temperature setpoint

Activity Number:	Q4405-30-ACT-011	**Applicable Models:**	All
Type of Procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock

Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	5 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

The detector temperature can be set to four distinct values (approximately):

- 7ºC (44.6°F)
- -6ºC (21.2°F)
- -14ºC (6.8°F)
- -25ºC (-13°F)

The lower the temperature, the higher the detector S/N. However, an improvement in S/N and profile spread with a decrease in detector temperature will only be noticed on high basis weight products.

The detector cooler is capable of maintaining a difference in temperature between the hot side and the cool side (ΔT) of approximately 70ºC (126°F). To avoid stressing the cooler, do not exceed ΔT=60ºC (108°F), for example, detector temperature of -20ºC (-4°F) for an MXIR receiver temperature of 40ºC (104°F).

Change the detector temperature setpoint to any value between 18ºC (64.4°F) and -25ºC (-13°F). The sensor brings the detectors to one of the four temperatures listed above, whichever is the closest to the setpoint.

To change the detector temperature:

1. Open the database browser (see Figure 9-8).

2. Navigate to */scanner x/Mss/Ss1 ir/Setup/Rcv detector temperature sp* (see Figure 9-10).

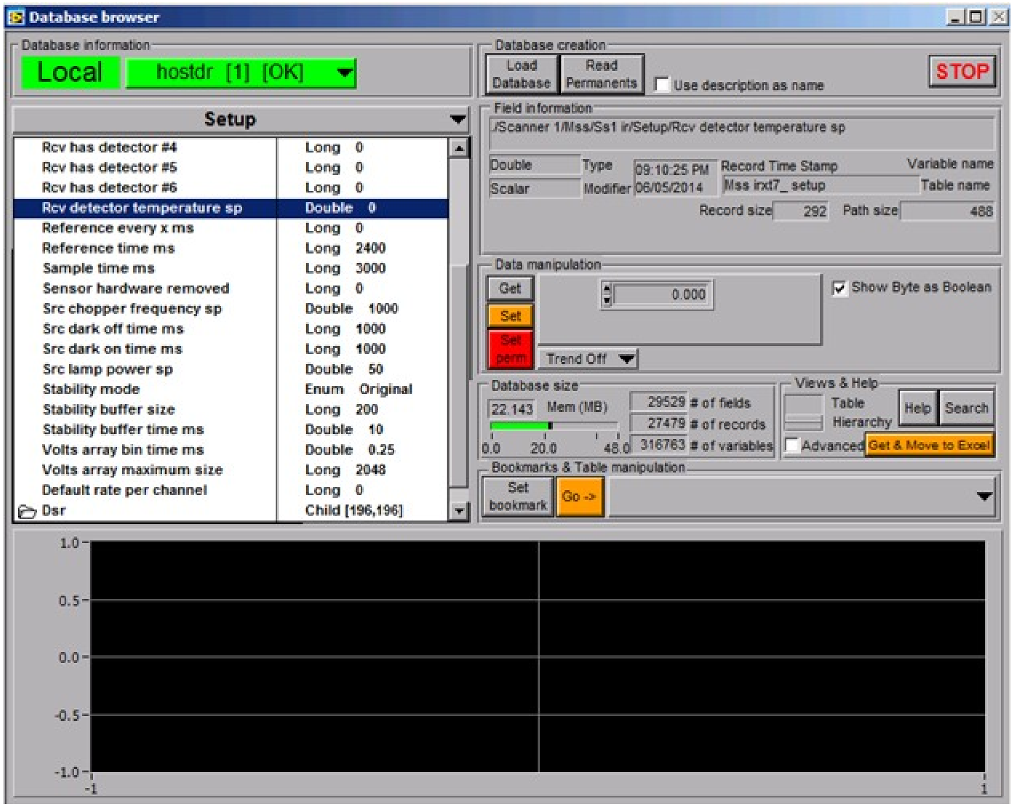


Figure 9-10 Database Browser: RTDR Entry For Detector Temperature

3. Change the value (+18 to -25), and set to **Perm**.

4. Open the MSS web page, and select **MXIR receiver EDAQ**.

5. Do a hard reset of the MXIR receiver EDAQ.

6. Wait 1–2 minutes to ensure that the EDAQ is up, then initiate a Standardize.

7. It may be necessary to update the time-zero values to prevent drift alarms from being triggered (see Figure 9-6).

9.9. Change chopper frequency

Activity Number:	Q4405-30-ACT-012	**Applicable Models:**	All
Type of Procedure:	Maintain	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	5 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

Default chopper frequency is 1200Hz

To change the chopper frequency:

1. Open the database browser (see Figure 9-8).
2. Navigate to */scanner x/Mss/Ss1 ir/Setup/Src chopper frequency sp* (see Figure 9-11).

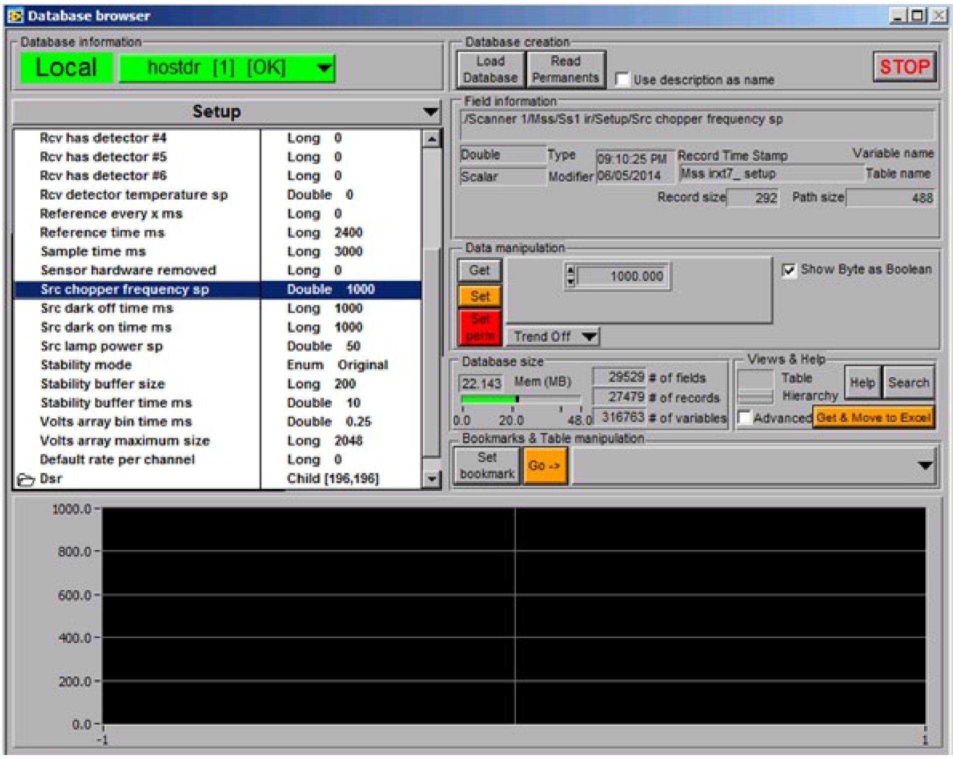


Figure 9-11 Database Browser: RTDR Entry For Chopper Frequency

3. Change the value (0–3000), and set to **Perm**.
4. Open the MSS web page, and select **MXIR source EDAQ**.
5. Do a hard reset of the MXIR source EDAQ.
6. Wait 1-2 minutes to ensure that the EDAQ is up and that the lamp is fully on, then initiate a Standardize.
7. Update the time-zero values to prevent drift alarms from being triggered (see Figure 9-6).

9.10. Replace Source board

Activity Number:	Q4405-30-ACT-013	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock
Availability Required:	Sensor offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	30 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Check hardware stability
			Check short term stability
Required Parts:	Part Number	Quantity	Lead Time
	6581500051: PCBA MXIR source board		
Required Tools:	Part Number	Quantity	Lead Time

The source board:

- Provides power to the lamp
- Measures the voltage across the lamp and the current flowing through the lamp
- Provides power to the motor and motor controller
- Conditions the signal generated by the motor hall sensors
- Powers and conditions the signal from the optical chopper detector
- Interfaces with the EDAQ

If there are issues with the lamp, chopper rotation, and/or chopper detection, the source board might be faulty and might need to be replaced.

To replace the source board:

1. Turn the sensor power off.
2. Disconnect all the source board cables starting with the power cable (see Figure 9-12).

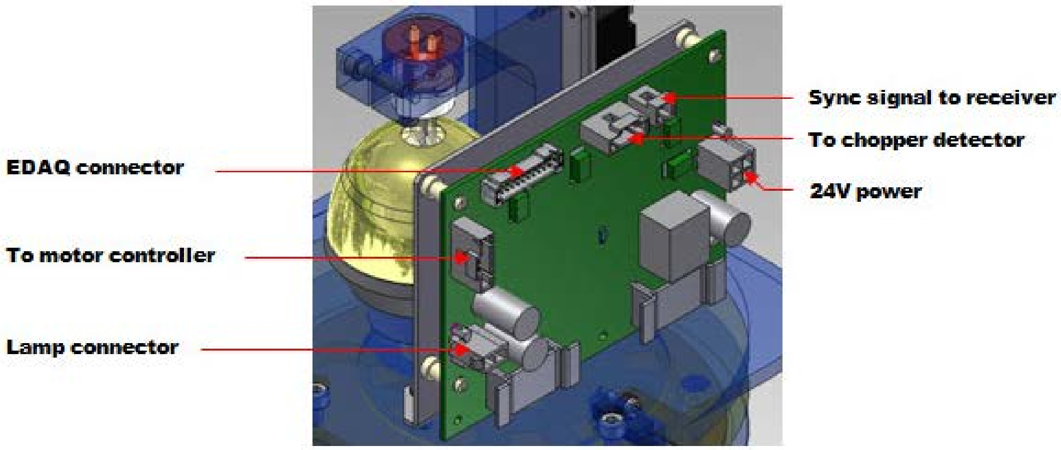


Figure 9-12 Source Board

3. To take the source board off, squeeze the two halves of the standoffs together while pulling the board away from the board bracket.
4. To install a new source board, align the board mounting holes with the standoffs, then push on the board.
5. Reconnect all cables, finishing with the power cable.

ATTENTION

Tag each board removed from the system and describe the suspected failure. If a premature failure of the board is confirmed, send it back to the factory for credit and to allow Honeywell Engineering to identify the failure mode.

9.11. Replace Detector board

Activity Number:	Q4405-30-ACT-014	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock

Availability Required:	Sensor offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	30 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Check hardware stability Check short term stability
Required Parts:	Part Number	Quantity	Lead Time
	6581500052: PCBA MXIR detector board		
Required Tools:	Part Number	Quantity	Lead Time
	• 2.5 mm Allen key • latex gloves		

The detector board:

- Amplifies and demodulate the signal generated by the extended InGaAs detector
- Measures the detector temperature

If noise or gain instability issues exist with a specific channel, the corresponding detector board may need to be replaced.

To replace the detector board:

1. Turn the sensor power off.
2. To disconnect the detector cable, squeeze both sides of the connector with fingertips.
3. Remove the temperature controller board (see Section 9.13).

4. Using a 2.5 mm Allen key, unscrew the detector assembly from the beamsplitter standoffs (see Figure 9-13).

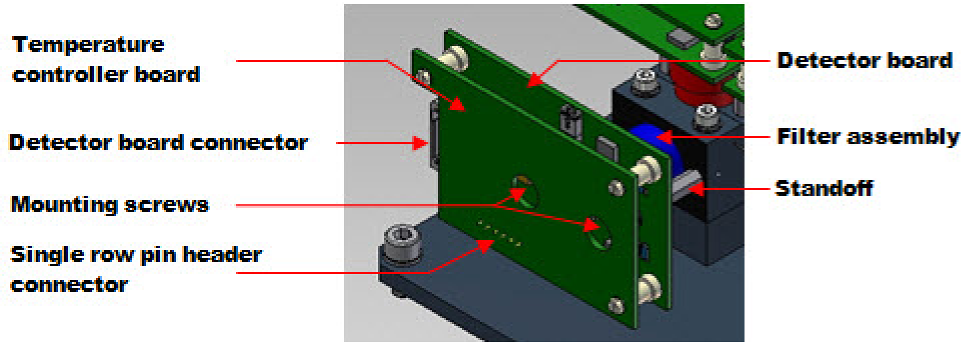


Figure 9-13 Temperature Controller and Detector Boards

5. Remove the detector assembly and the filter assembly. Be careful not to drop the filter assembly because the filter could break.

6. Gently pull the detector from the detector board, holding the detector can with fingertips.

   Avoid leaving fingerprints on the detector window.

   Do not pry the detector out using a tool.

   Do not touch the detector pins.

7. Immediately insert the detector into the new detector board. Ensure that the new detector board has the right jumper setting for W1. If the detector assembly is mounted in the direct optical tower, for example, directly opposite the light source, the jumper should be IN. If the detector assembly is mounted in the offset optical tower, for example, offset from the light source, the jumper should be OUT.

8. Reinstall the filter assembly and screw the detector assembly back in place.

9. Reinstall the temperature controller board, and reconnect the detector cable.

CAUTION

Do not touch the detector pins with bare hands as static electricity could cause permanent damages to the detector.

CAUTION

Keep both the detector window and the filter free of fingerprints. Clean with a lint free tissue dipped in isopropyl alcohol if necessary.

CAUTION

Do not drop the filter assembly on the floor as the filter could break and it is an expensive part to replace.

ATTENTION

Tag each board removed from the system and describe the suspected failure. If a premature failure of the board is confirmed, send it back to the factory for credit and to allow Engineering to identify the failure mode.

9.12. Replace Temperature Controller board

Activity Number:	Q4405-30-ACT-015	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock
Availability Required:	Sensor offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	30 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Check hardware stability
			Check short term stability
Required Parts:	Part Number	Quantity	Lead Time
	6581500056: PCBA MXIR TEC driver board		
Required Tools:	Part Number	Quantity	Lead Time

The Temperature Controller board provides power to the detector Peltier (thermoelectric) cooler. It interfaces with the Detector board using a single row pin header connector.

If there are detector cooling issues, or detector temperature instability with a specific channel, the corresponding temperature controller board might need to be replaced.

To replace the temperature controller board:

1. Turn the sensor power off.
2. To disconnect the detector cable, squeeze both sides of the connector with fingertips.
3. To take the board off, squeeze the two halves of the standoffs together while pulling the board away from the detector board. Ensure that the Temperature Controller board is pulled out as straight as possible so that no damage the pin header connector occurs (see Figure 9-13).
4. Insert the new temperature controller board by first aligning the pin header connector, and then pressing the temperature controller board against the three plastic standoffs.
5. Reconnect the detector cable.

9.13. Replace Interface board

Activity Number:	Q4405-30-ACT-016	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock
Availability Required:	Sensor offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	30 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Check hardware stability
			Check short term stability
Required Parts:	Part Number	Quantity	Lead Time
	6581500053: PCBA MXIR interface board		
Required Tools:	Part Number	Quantity	Lead Time
	• Phillips screwdriver		

The Interface board:

- Provides ± 15V power to the detector boards and 3.3V to the temperature controller boards
- Conditions the sync signal from the source, and sends it to each detector to be used for detector signal demodulation
- Routes the detector DC outputs and detector temperature signals to the EDAQ
- Controls the detector signal gains and the detector temperatures

If there are detector signal and/or detector temperature issues that are common to all channels, the interface board might need to be replaced.

To replace the Interface board:

1. Turn the sensor power off.
2. Disconnect all the cables starting with the power cable. Make sure to note the order in which the detector cables are plugged into the interface board. To disconnect the detector cables, squeeze both sides of the connector with fingertips.
3. Using a Phillips screwdriver, unscrew the interface board.

4. Before installing the new Interface board, ensure that the jumpers are set exactly as per the previous board (see Figure 9-14).

Figure 9-14 shows the Interface board with connections and test points.

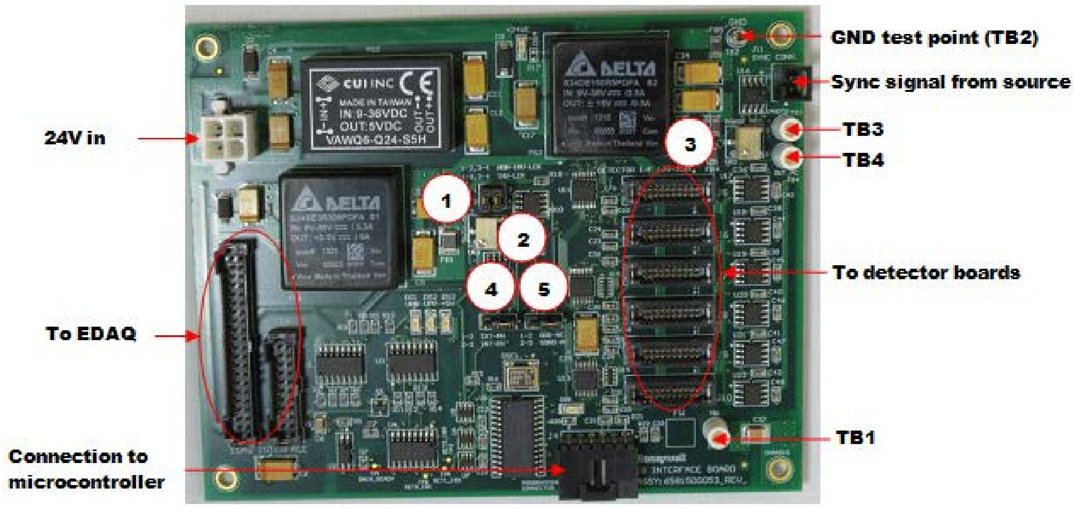


Figure 9-14 Interface Board

Table 9-1 lists and describes the numbered items in Figure 9-14.

Table 9-1 Interface Board Items

Item	Description
1	Jumper W1: used to invert the sync signal. Factory default is non inverted (1-2 and 3-4 jumpered).
2	Potentiometer VR1: used to tune the duty cycle of the sync signal (factory set)
3	Potentiometer VR2: used to tune the delay of the sync signal (factory set)
4	Jumper W2: set the source for the sync signal to internal or external (see Table 2-2).
5	Jumper W3: set the channel 1 AC signal to be squared or not. Factory default is not squared (1-2 jumpered)

5. Install the new board and reconnect all cables, finishing with the power cable.

ATTENTION

Tag each board removed from the system and describe the suspected failure. If a premature failure of the board is confirmed, send it back to the factory for credit and to allow Honeywell Engineering to identify the failure mode.

9.14. Replace Detector

Activity Number:	Q4405-30-ACT-017	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock
Availability Required:	Sensor offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	30 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Check hardware stability
			Check short term stability
Required Parts:	Part Number	Quantity	Lead Time
	6581200106: Detector, InGaAs 2mm diameter, TO-66 9 pin		
Required Tools:	Part Number	Quantity	Lead Time
	• 2.5mm Allen key • sharp wire cutter • small pliers • latex gloves		

The Detector is either an extended InGaAs detector when used with a reference (black), measure (blue), or cellulose (red) filter assembly or a Silicon detector when used with an opacity (green) filter assembly.

If there are noise or drift issues with a specific channel, the corresponding detector may need to be replaced.

To replace the Detector:

1. Turn the sensor power off.
2. To disconnect the detector cable squeeze both sides of the connector with fingertips.
3. Remove the Temperature Controller board (see Section 9.13).
4. Using a 2.5 mm Allen key, unscrew the detector assembly from the beamsplitter standoffs (see Figure 9-13).

5. Remove the Detector assembly and the filter assembly. Be careful not to drop the filter assembly because the filter could break.

6. Gently pull the Detector from the detector board holding the detector can with fingertips.

   Avoid leaving fingerprints on the Detector window.

   Do not pry the Detector out using a tool.

   Do not touch the Detector pins.

7. Insert a new Detector into the Detector board.

8. With a sharp wire cutter, cut the detector pins 1–2 mm above the detector sockets on the side of the detector board opposite from the detector.

9. If possible, using small pliers, squeeze the tip of the detector pins so they recover a round shape. Cutting the detector pins may leave sharp edges that could damage the detector sockets the next time the detector is removed from the detector board.

10. Reinstall the filter assembly and screw the detector assembly back in place.

11. Reinstall the temperature controller board and reconnect the detector cable.

CAUTION

Do not touch the Detector pins with bare hands as static electricity could cause permanent damages to the detector.

CAUTION

Keep both the Detector window and the filter free of fingerprints. Clean with a lint free tissue dipped in isopropyl alcohol if necessary.

CAUTION

Do not drop the Filter assembly on the floor as the filter could break and it is an expensive part to replace.

ATTENTION

Tag each board removed from the system and describe the suspected failure. If a premature failure of the board is confirmed, send it back to the factory for credit and to allow Engineering to identify the failure mode.

9.15. Replace lamp

Activity Number:	Q4405-30-ACT-018	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock; burn
Availability Required:	Sensor offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	6 months
Duration (time period):	30 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Check hardware stability Check short term stability
Required Parts:	Part Number	Quantity	Lead Time
	6581200109: Lamp, halogen 50 W 12 V, T10 bulb, MXIR 6564120003: Lamp socket assembly		
Required Tools:	Part Number	Quantity	Lead Time
	• 3 mm Allen key • cloth		

Regular replacement of the IR lamp ensures continuous operation of the moisture sensor and prevents unexpected failures. The IR lamp is powered by the source board.

The lifetime of the lamp can vary greatly from one lamp to another and is hard to predict. However, if premature failure (in under 6 months) is often observed, it might be necessary to increase or to decrease the power to the lamp.

Do not operate the lamp at more than 85% of full power, as it will dramatically shorten its life (down to 2000 hours).

At low power, the halogen cycle may not operate efficiently, which also shortens the life of the lamp.

To replace the lamp:

1. Turn the sensor power off.
2. Disconnect the lamp cable from the Source board (see Figure 9-15).

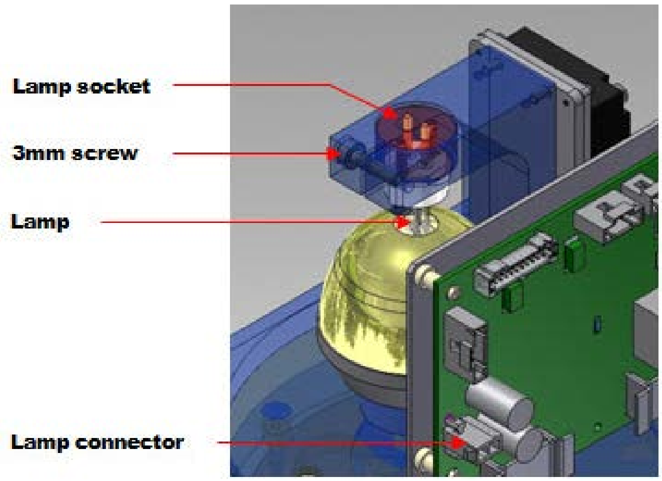


Figure 9-15 Lamp Assembly

3. Loosen the 3 mm screw holding the lamp socket.
4. Pull the lamp socket and lamp out. Do not touch the lamp with bare hands because it might still be hot.
5. Replace the lamp and lamp socket if necessary. Use a clean cloth or lint-free tissue to mount the new lamp; do not touch it with bare hands. Push the lamp until the leads bottom out.
6. Reinstall the lamp and socket. Push the socket until it bottoms out.
7. Tighten the 3mm screw.
8. Reconnect the lamp cable.

CAUTION

Keep the lamp free of fingerprints. Skin oils may create a hot spot on the bulb and shorten the life of the lamp. Clean with a lint free tissue dipped in isopropyl alcohol if necessary.

ATTENTION

Change the lamp socket regularly as well. Poor electrical connection between the socket and the lamp leads can cause heating of the socket contacts and instability in the lamp output.

9.16. Replace motor

Activity Number:	Q4405-30-ACT-019	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock
Availability Required:	Sensor offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	1 hour	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Check hardware stability
			Check short term stability
Required Parts:	Part Number	Quantity	Lead Time
	6581200107: Motor, high rpm, 24 V DC, MXIR		
Required Tools:	Part Number	Quantity	Lead Time
	• 4mm Allen key • 3mm Allen key • small Phillips screwdriver • 5.5mm wrench • 10mm open wrench		

At 1.2kHz chopper frequency, the motor is significantly under run to increase its lifetime.

Motor bearings will degrade rapidly if motor is running at 80ºC (176ºF) or higher.

Ensure that the source temperature is below 60ºC (140ºF). A high source temperature alarm will be triggered is the source temperature reaches 65ºC (149ºF) (default value).

If the chopper is not rotating, the motor, motor controller, or Source board could be faulty.

To replace the motor:

1. Turn the sensor power off.
2. Disconnect all the cables from the Source board (see Figure 9-12).

3. Remove the four, 4 mm sensor assembly mounting screws (see Figure 9-16).

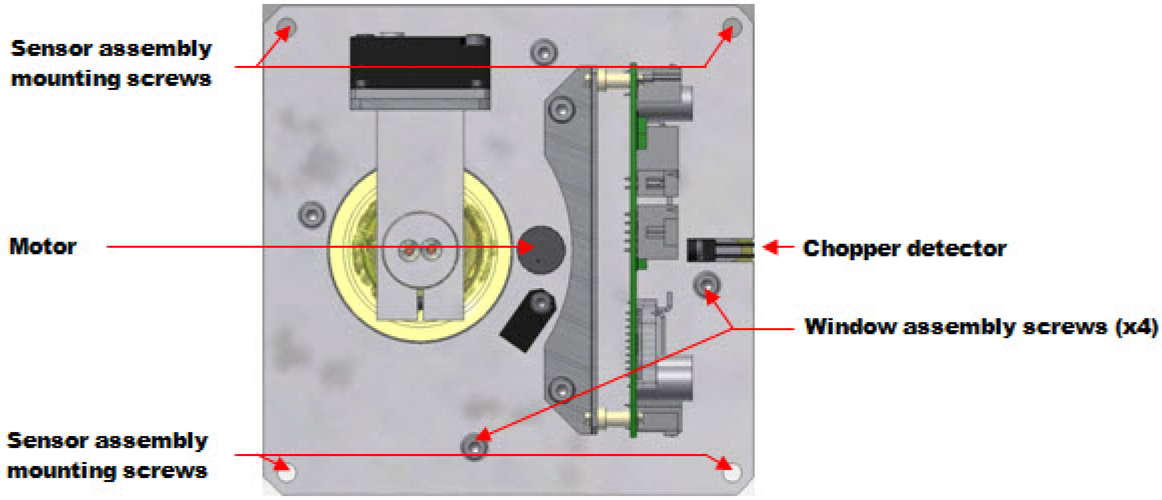


Figure 9-16 Source Assembly

4. Take the sensor off from the head and bring it in a clean environment.

5. Remove the four, 3mm window assembly screws (see Figure 9-16).

6. Take the window assembly apart and set it aside.

7. Using a small Phillips screwdriver, remove the chopper detector (see Figure 9-17).

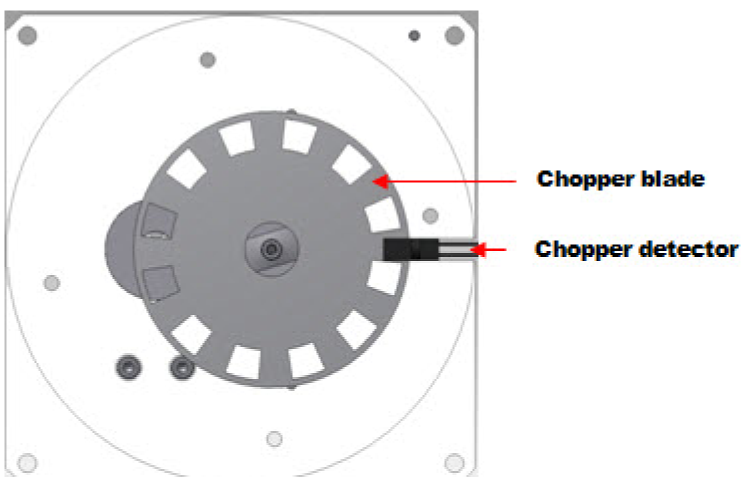


Figure 9-17 Source Assembly: Chopper Blade and Detector

8. To remove the chopper blade, use two wrenches (a 5.5mm and a 10mm open wrench) to unscrew the top nut.

9. Remove the nut, the top chopper retainer, the chopper blade, and the bottom chopper retainer.

10. Remove the three screws holding the motor using a small Phillips screwdriver (see Figure 9-18).

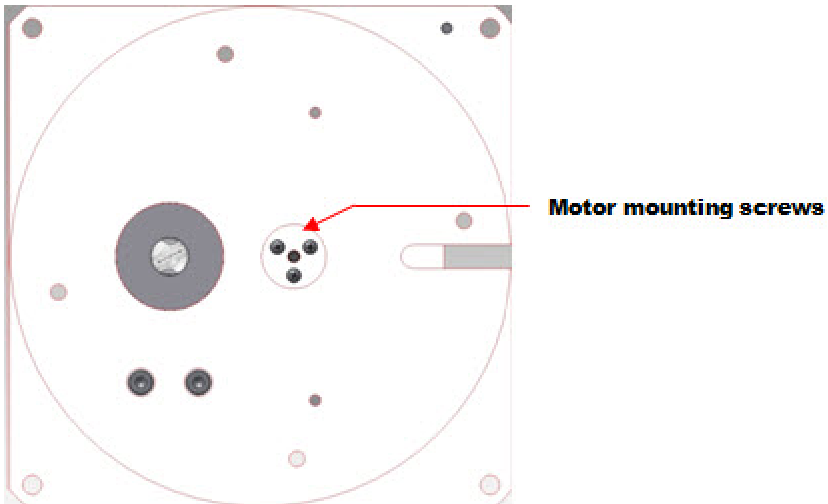


Figure 9-18 Source Assembly: Motor Mounting Screws

11. Disconnect the motor from the motor controller. Remove the motor and put it aside.

12. Install a new motor taking the above steps in reverse order.

13. Ensure that the chopper blade is fully inserted in the motor shaft, and that it can move freely, before reassembling the window assembly.

9.17. Replace chopper detector

Activity Number:	Q4405-30-ACT-020	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:		**Cautions:**	Electric shock
Availability Required:	Sensor offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):		**# of People Required:**	1

Prerequisite Procedures:		**Post Procedures:**	Check hardware stability Check short term stability
Required Parts:	Part Number	Quantity	Lead Time
	6581800398: MXIR chopper photodetector assembly		
Required Tools:	Part Number	Quantity	Lead Time

The chopper detector is not used in Zipline.

If the receiver indicates that the sync signal is missing but the source reports a functioning chopper, the issue may be with the interface board (see Section 9.13) or with the detector board for channel 1 (see Section 9.11) .

9.18. Replace motor controller

Activity Number:	Q4405-30-ACT-021	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	High	**Cautions:**	Electric shock
Availability Required:	Sensor offline	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	1 hour	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	Check hardware stability
			Check short term stability
Required Parts:	Part Number	Quantity	Lead Time
	6581200108: Motor controller, 12–40V DC, 69X40X19.5mm		
Required Tools:	Part Number	Quantity	Lead Time
	• 2mm Allen key		

If the chopper is not rotating, the motor, motor controller, or source board could be faulty.

To replace the motor controller:

1. Turn the sensor power off.
2. Disconnect the motor controller from the motor and from the source board.

3. Remove the four mounting screws using a 2mm Allen key (see Figure 9-19).

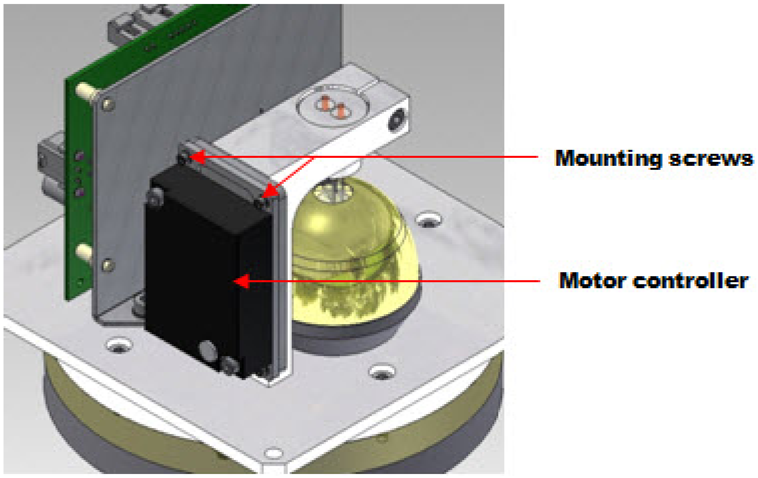


Figure 9-19 Source Assembly: Motor Controller

4. Install the new motor controller and reconnect it to the motor and source board.

10. Troubleshooting

This chapter covers possible issues with the IR Weight, and Opacity Measurements. It is divided into two sections:

- Section 10.1 Alarm based troubleshooting: Troubleshooting steps to be taken in response to a specific alarm generated in the Experion MX system.
- Section 10.2 Non-alarm based troubleshooting: Troubleshooting steps that may not be related to a specific alarm in the Experion MX system.

10.1. Alarm based troubleshooting

Depending on system configuration, the Experion MX system might display only some of these alarms.

10.1.1. Z Reading Bad

Symptom	Possible Causes	Solutions
The Z corrector is on and the Z sensor standardize is flagged as bad	Z sensor is not present	Disable Z correction
	Z sensor is not working properly	Consult the scanner manual

10.1.2. Bad Dark Volts

ATTENTION

Default values for upper and lower limits for dark volts are 0 and 5, respectively.

Symptom	Possible Causes	Solutions
Dark volts are outside limits. For any channel, $Volts_{Dark}$ ≥ Upper Limit or $Volts_{Dark}$ ≤ Lower Limit	Lamp did not turn off during dark phase (for all channels: $Volts_{Dark}$ >> Upper Limit)	Replace Source board
	Detector board failure ($Volts_{Dark}$ outside limits for a specific channel only)	Replace Detector board

10.1.3. Drifting Standardize Ratio

ATTENTION

Default value for the limit for the drifting standardize ratio is 0.1.

Symptom	Possible Causes	Solutions
One or more of the standardize ratios have drifted too far from the time-zero values. For any of the standardize ratios: $\lvert Ratio_{Std} / Ratio_{Time0} - 1 \rvert$ > Limit	Too much dirt on sensor windows	Clean sensor windows
	Various hardware issues	See Non-alarm based troubleshooting

10.1.4. Bad Standardize Ratio

ATTENTION

Default values for upper and lower limits for the bad standardize ratio are 1.5 and 0.5, respectively.

Symptom	Possible Causes	Solutions
One or more of the standardize channel volts have drifted too far from the time-zero values. For any of the channel volts: $Volts_{Std} / Volts_{Time0}$ > Upper Limit, or $Volts_{Std} / Volts_{Time0}$ < Lower Limit	Too much dirt on sensor windows	Clean sensor windows
	Various hardware issues	See Non-alarm based troubleshooting

10.1.5. Source Temperature Too High

ATTENTION

Default value for upper limit is 65ºC (149ºF).

Symptom	Possible Causes	Solutions
Source temperature exceeds upper limit	Head temperature control failed	Consult the scanner manual
	Lamp power too high	Change lamp power settings

10.1.6. Receiver Temperature Too High

ATTENTION

Default value for upper limit is 55ºC (131ºF).

Symptom	Possible Causes	Solutions
Receiver temperature exceeds upper limit	Head temperature control failed	Consult the scanner manual
		Change detector temperature setpoint

10.1.7. Wrong Lamp or Bad Lamp

Symptom	Possible Causes	Solutions
The lamp was flagged as bad	Lamp failed	Replace lamp
	Wrong lamp installed	
	Source board failure	Replace Source board

10.1.8. Chopper Rotation Not Detected

Symptom	Possible Causes	Solutions
Chopper rotation was not detected. Sync signal is not detected by the Source and by the Receiver	Motor failure	Replace motor
	Motor controller failure	Replace motor controller

10.1.9. Phasing Signal Lost

Symptom	Possible Causes	Solutions
Sync signal is not detected by the Source or the Receiver	If Receiver sync signal missing: Interface board not configured properly or failed	Replace Interface board
	Source or Receiver EDAQ frequency input bad	Check EDAQ jumper settings
		Replace EDAQ

10.1.10. Wrong Chopper Frequency

Symptom	Possible Causes	Solutions
Source and Receiver chopper frequencies are too far from set point	Chopper frequency too high	Change chopper frequency
	Motor controller bad	Replace motor controller
	Motor bad	Replace motor

10.1.11. Detectors Temperature Bad

Symptom	Possible Causes	Solutions
Temperature of one or more detectors does not reach set point	If true for all detectors: Head temperature too high or detectors temperature set point too low	Lower head temperature (consult scanner manual)
		Change detector temperature setpoint
	If true for one detector only: temperature controller board or detector failed	Replace Temperature Controller board
		Replace Detector

10.1.12. Signal Gain Bad

Symptom	Possible Causes	Solutions
Gain change by one or more detector boards is erratic	If true for all detectors: Interface board or EDAQ failed	Replace Interface board
		Replace EDAQ
	If true for one detector only: detector board failed	Replace Detector board

10.2. Non-alarm based troubleshooting

Symptom	Possible Causes	Solutions
Lamp not lit	EDAQ did not start or failed	Perform a hard reset on source EDAQ; Consult the scanner manual
	Lamp failed	Replace lamp
	Source board failed	Replace Source board
Standardize volts very low and close to background levels	Lamp failed	Replace lamp
	Chopper is not rotating	Replace motor
		Replace motor controller
	Sync signal is not detected by receiver	Replace Interface board
Standardize volts low	Dirty sensor windows	Clean sensor windows
Standardize volts unstable	Lamp is about to fail	Replace lamp
	Source hardware unstable	Check hardware stability
	Detector gain erratic	Replace Interface board
Measurement profile noisy	Hardware issue	Check hardware stability
		Check short term stability
	Detector gain erratic	Replace Interface board
	Lamp power too low	Change lamp power settings
	Detector temperature too high	Change detector temperature setpoint
One channel is drifting or noisy	Detector assembly is faulty	Replace Temperature Controller board
		Replace Detector board
		Replace Detector
Detector temperatures unstable	Detector temperature is too low	Change detector temperature setpoint
Detector temperature reads -37°C (-34.6°F)	Detector assembly is faulty or missing	Replace Temperature Controller board
		Replace Detector board
		Replace Detector

11. Storage, Transportation, End of Life

This chapter summarizes Honeywell policy with regards to the storage and disposal of system components.

11.1. Storage and transportation environment

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

Table 11-1 Storage and Transportation Parameters

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

11.2. Disposal

Honeywell supports the environmentally conscious disposal of its products when they reach end of life or when components are replaced. All equipment should be reused, recycled or disposed of in accordance with local environmental requirements or guidelines. This product may be returned to the Honeywell manufacturing location, and it will be disposed using environmental friendly methods. Contact the factory for further details and instructions.

Guidelines for disposal of equipment by Honeywell or the customer for sensor-specific materials are as described in Subsection 11.2.1.

11.2.1. Solid materials

- Metals should be recycled, and in many cases have value as scrap
- Remove all non-metallic parts (except plastic) from the sensor and dispose through the local refuse system
- Recycle plastic parts if possible
- Wire and cabling should be removed and recycled; the copper may have value as scrap

Electrical and electronic components (for example, solder, circuit boards, batteries, and oil-filled capacitors) should be recycled or handled as special waste to prevent them from being put in a landfill, as there is potential for lead and other metals leaching into the ground and water.

Also contact Honeywell Certified Recycled Parts center.

12. 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 (MD) 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
InGaAs	Indium Gallium Arsenide. Semiconductor alloy used by the infrared detectors in the MXIR sensors
IRP	InfraRed sensor Processor. The RAE processor which produces channel and sensor ratios to be used by MXIRMoiP, the Moisture Processor for MXIR
LHT	Lower Head Temperature
Machine Direction (MD)	The direction in which paper travels down the paper machine.
MXIRMoiP	Moisture Processor for MXIR. The RAE processor which produces moisture values using channel and sensor ratios from the IR Processor (IRP).
OPCP	Opacity sensor Processor. The RAE processor which produces opacity values using a channel ratio from the IR sensor Processor (IRP).
Quality Control System (QCS)	A computer system that manages the quality of the product produced.
Real-Time Application Environment (RAE)	The system software used by 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.
REFA	A measure of the attenuation of the reference channel (typically channel 1). REFA is used by the carbon correction, the Z-correction and the Dirt correction algorithms.
Sensor Set	The term used in the Sensor Maintenance displays to describe a set of sensors working together on a scanner to perform one measurement.
Setpoint (SP)	Target value (desired value). Setpoints are defined process values that can be modified by entering new values through the monitor, loading grade data, and changing a supervisory target.
Slice	See Bin.
Standardize	An automatic periodic measurement of the primary and auxiliary sensors taken offsheet. The standardize measurements are used to adjust the primary sensors' readings to ensure accuracy.
Tending Side (TS)	The side of the paper machine where the operator has unobstructed access. Also called Front Side.
Trend	The display of data over time.
TRSQ	Transmission Squared. The square of the transmission (TR) of the opacity channel (typically channel 5). Used by the opacity sensor processor.
UHT	Upper Head Temperature