Honeywell

Q4303-xx (Sx18) Basis Weight Measurement

System Manual

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Sx18 Basis Weight Measurement

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Introduction

The purpose of this manual is to provide an introduction to the operation, installation, calibration, and maintenance of the Experion Basis Weight Measurement.

This version of the manual covers the Basis Weight Measurement for Source 18, variants of which are listed below:

- 4303-01 – Krypton 85 with 10mm measurement gap for medium ash applications
- 4303-02 – Krypton 85 with 10mm measurement gap for high ash applications
- 4303-03 – Krypton 85 with 25mm measurement gap for high ash applications
- 4303-04 – Strontium 90 with 10mm measurement gap for low ash applications
- 4303-07 – Strontium 90 with 25mm measurement gap for low ash applications
- 4303-08 – Promethium 147 with 10mm head gap for arbitrary ash appllications

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 16 chapters and one appendix.

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

Chapter 2, **Radiation Safety and Interlocks**, describes the safety components of Basis Weight Measurement.

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

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

Chapter 5, **Operations and Calibration System Constants**, describes typical calibration and provides correction constants for the sensors.

Chapter 6, **Static Calibration**, describes calibration and verification procedures.

Chapter 7, **Basis Weight Calibration Details**, describes the various operations available to the nuclear sensor, and corrections that can be applied to the raw reading.

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

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

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

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

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

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

Related reading

The following documents contain related reading material:

Honeywell Part Number	Document Title / Description
6510020381	*Experion MX MSS and EDAQ Data Acquisition System Manual*
6510020197	*Radiation Safety Manual For Honeywell Customers*

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 chapter provides an overview of the operation of Basis Weight Measurement using the ZipLine scanner.

This chapter also covers the physical principles of operation of basis weight sensors that use beta emitting sources.

1.1. Sensor models and nomenclature

The are several types of weight sensors available for the ZipLine system. Each sensor is optimized for a particular type of product, and a particular basis weight and ash range. The common term for this product range is “source 18” or “Sx18”, and forms part of the current range of sources (Sx6, 12, 15, and 18) that Honeywell currently ships.

Table 1-1 shows the basis weight sensors currently available, and the range of applicability.

Table 1-1 Basis Weight Measurement Ranges

Model	Basis Weight Range: g/m^2 (lbs/3000 ft^2)	Sheet Ash Range	Head Gap
Pm147 4303-08	15–200 (9–120)	Any	10 mm (0.4 in)
Kr85 4303-00	140–1200 (85–730)	< 5%	10 mm (0.4 in)
Kr85 4303-01	16–1200 (10–730)	2–20%	10 mm (0.4 in)
Kr85 4303-02	20–1000 (12–610)	> 20%	10 mm (0.4 in)
Kr85 4303-03	20–1000 (12–610)	> 20%	25 mm (1.0 in)
Sr90 4303-04	100–5000 (61–3070)	small	10 mm (0.4 in)
Sr90 4303-07	100–5000 (61–3070)	small	25 mm (1.0 in)

Ash refers to inorganic additives, or fillers, with higher atomic numbers than the hydrocarbons in paper and plastics. Commonly used fillers are TiO2, clay, talc, and CaCO3.

1.2. General principles of basis weight measurement

Beta particles are electrons that are emitted from atomic nuclei during nuclear decay. After they have left the nucleus, they may be thought of as an electron beam as found in the cathode ray tube used in older model televisions or computer monitors. Beta particles are not of a single energy but are emitted at a continuum of energies up to a maximum value. This maximum value is dependent on the type of capsule used. The more energetic the beta energy, the more penetrating it is and can therefore be used for heavier products.

The most commonly used capsules, in order of increasing maximum energy, are Promethium-147 (Pm-147), Krypton-85 (Kr-85), and Strontium-90 (Sr-90), where the number signifies the particular isotope used. The emitted beta particles may be scattered from the sheet, may be absorbed by the sheet, or may lose energy in the sheet. The betas that make it through the sheet and into the receiver enter an ionization chamber. This is a detector with a small current output (approximately 1 nanoampere) proportional to:

(the average energy of the betas) × (number of betas per second)

The current from the ion chamber goes through a short lead to a detector amplifier with an output that is an analog voltage on the order of 1–8 V. This signal is sent to an electronic circuit and is read by a computer that averages the signal for some prescribed time interval. Then, using stored algorithms, the software converts the average signal to a calculated basis weight of the product.

The basic physical principle used in the basis weight sensor is: As the basis weight of the sheet increases, the signal at the ionization chamber decreases in a prescribed manner.

A principal advantage of using beta emitters as sources for basis weight sensors is that beta particles are absorbed nearly uniformly by all substances: the absorption is dependent on the basis weight and not on color, texture, state of matter, or other factors. However, the air in between the source capsule and the ionization chamber, as well as any debris that may accumulate on the windows of the heads, will absorb beta particles just like the product being measured. Therefore, several correctors need to be applied in order to maintain the required accuracy of the sensor.

The correctors account for:

- debris (dirt) build-up on the heads
- changes in air density due to air temperature changes
- changes in the height of the air column due to changes in head separation (Z)
- any difference in absorption properties between the Mylar® calibration standard and the customer product (known as the KCM)
- any sensitivity of the sensor due to head misalignment in the machine direction or cross direction (profile correction)
- any change in the product in-between the area that the sensor measures the product and the area where the sample is taken for dynamic correlation, referred to as the Basis Weight Dynamic Offset (BWDO)

  An example of BWDO would be if the sheet were under tension during the manufacturing process but was allowed to relax after taking a sheet as a dynamic sample. If the sheet stretched online, a dynamic offset would be added to account for this fact.

Another very important attribute of basis weight sensors is that because the nuclear decay process is statistical, the sensor reading always has some random noise component. This may be reduced by either increasing the beta ray flux, or by averaging the signal for longer time periods.

Increasing the flux is one of the main goals of the beta gauge designer. The sensor measurement always contains a random noise level that may only be reduced for a given set of hardware by increasing the amount of time that the signal is averaged. For example, whenever the sensor stability specification is given it is always given for some prescribed integration (averaging) time interval.

Sensor stability improves by the square root of the number of particles emitted, which in turn implies that it depends on the square root of the integration time (assuming all the noise comes from nuclear statistics, rather than air density changes or other factors). For example, the sensor will be about twice as stable when integrating for four seconds as when integrating for one second. This noise is present in all measurements made by the Basis Weight sensor, including standardization, reference, sample, and onsheet measurements.

The same random noise calculation also applies to source half-life. Because a single half-life period implies half the radioactive material is remaining, the source will now produce half the number of particles in a given period. This means the noise will increase by only the square root of 2 (~1.41) after one half-life.

Random error is commonly expressed using a concept known as sigma. Sigma is a property of a group of numbers, and is computed by means of a standard algorithm. For a randomly varying quantity, such as the measured basis weight of a sample, or the flag-to-air (F/A) ratio, 68% of the numbers (results of the measurements) lie within ± 1 sigma of the mean, 95% lie within ± 2 sigma of the mean, 99.5% of the numbers lie within ± 3 sigma of the mean, and so on. Sigma can be defined as a measure of how tightly grouped, or repeatable, the group of numbers is.

1.3. Basis weight correctors

To accurately measure the product, several correction algorithms (correctors) are added. These effects should remain small relative to the raw or uncorrected basis weight reading. Correctors, positive or negative, are all calculated in *basis weight units* (gsm) and are added to the uncorrected basis weight reading. Being in basis weight units allows easy comparison of the relative magnitudes of the various correctors. A brief description of the correctors follows.

1.3.1. Ash

Basis weight sensors using beta ray attenuation are inherently sensitive to higher atomic number additives (ash). This sensitivity may be reduced significantly by the design of the compensator. However, reducing this sensitivity in general has other effects on the sensor such as changing the usable basis weight range and sensor repeatability so that the sensor family has a model which is optimized for the parameters of a particular product.

Sensitivity to ash is commonly expressed as the percentage of measured basis weight change for a 1% change in ash loading.

The ideal sensor would have a sensitivity to ash of 0/% change in ash. Ash would have absorption characteristics exactly like that of paper (no change from paper). Insensitivity to ash is a key attribute of the sensor in order to have a single grade group for all products. There is no correction made in software for ash.

1.3.1.1. Ash-insensitive models

The different models of the gauge have different ash sensitivities. There is an inherent trade off between the highest measurable basis weight range, the gauge repeatability, and the ash insensitivity. For that reason, high ash-insensitive models should be selected only if the *variation in* (not *amount of*) ash between grades is large. Ash sensitivity is a complex function of the type of ash and the basis weight that is measured-there is no single figure describing the measurement error obtained when, for example, changing the amount of ash from 5% to10%. Ash insensitivity is controlled by the type of compensator located on top of the basis weight receiver ion chamber.

1.3.2. Dirt

Dirt, as used here, means any change in mass between the source and receiver from one standardization to the next. For example:

- debris on the source or receiver window
- change in air density due to air temperature or pressure changes
- change in window mass due to window replacement

Changes in air temperature in-between standardizations (onsheet) are handled by means of the air temperature correction, not the dirt correction. Updating the air counts will make a linear dirt correction, but this still leaves non-linear dirt effects, which can be quite large. Non-linear dirt effects are handled by a Honeywell patented dirt correction technique.

A quantity called DFRAC (dirt fraction) is computed at each standardize or reference and depends on:

- F/A_{last} (last flag-to-air measurement)
- T0FA (flag-to-air at scanner maintenance or installation)
- T0CF (change in F/A ratio when known dirt is inserted)

The first quantity is the F/A ratio at the last standardize. The T0FA is the F/A value obtained at calibration (when the scanner was presumably clean). The T0CF value is the change in F/A expected when the amount of dirt in the gap equals that of the dirt Mylar inserted during the dirty calibration.

DFRAC determines whether the clean calibration curve is used (DFRAC = 0) or the dirty calibration curve (DFRAC = 1) or some fraction thereof. Note that 0 < DFRAC < 1. Values of DFRAC larger than 1 indicate some computational error.

ATTENTION

Note that $T0FA + T0CF = F/A_{dirty}$ and that $T0FA = F/A_{clean}$.

1.3.3. Air temperature

Beta particles are absorbed by the air just as they are by the web, so that as the basis weight of the air between the source and receiver changes, the beta absorption will change also. An amount of 25.4 mm (1 in) of air at standard temperature and pressure has a basis weight of 32 g/m^2.

Air density effects due to air temperature changes are one of the principal sources of potential error in the Basis Weight sensor, particularly for lighter weight sheets, so this is a very important correction. According to the *Perfect Gas Law*, the change in basis weight of an air column is proportional to:

$[1/T_{initial} - 1/T_{final}]$

where temperature is expressed in K = °C + 273

The air temperature correction for each air column is expressed as:

$AGAn * [1/T_{stdz} - 1/T_{now}]$

where AGAn is a calibration constant; 1800 g/m^2 K for half of the standard 10.16 mm (0.4 in) gap

It is necessary to measure the air temperature in each zone between the source and receiver where the air temperature may change in order to make a correction. The air temperature corrections for each zone are added together to give the total correction, which is an additive correction with units of grams per square meter (g/m^2). The AGAn values for each sensor type are specified in Chapter 7, and are entered with the calibration constants. In terms of measured weight, Promethium and Krypton gauges are equally sensitive to temperature changes.

1.3.4. Z-head displacement

The principal reason for sensitivity to head displacement in the Z-direction is because the height, and therefore the basis weight, of the air column between the heads changes as the heads move relative to one another. The strategy for dealing with this is very similar to that for air temperature changes: measure Z and compute changes in Z from standardize and make a real time correction. The Z-correction is an additive correction with the units of g/m^2. The calibration constant that is entered at calibration is referred to as CFZ, expressed in m^2/g.

1.3.5. X-Y head displacement

Basis weight sensors are inherently sensitive to relative head displacement in the X-Y directions: cross direction (CD) and machine direction (MD). The compensator reduces this sensitivity significantly; however, there may be some residual sensitivity. To correct for any remaining sensitivity use the profile correction. The profile correction is an additive correction with units of g/m^2, calculated for each bin of the profile, with separate correctors for forward and reverse scanner motion.

1.3.6. Sheet passline variations

Basis weight sensors are inherently sensitive to relative sheet displacement in the Z-direction, commonly known as passline sensitivity or flutter sensitivity. The compensator greatly reduces this sensitivity. Different models of basis weight sensors have different residual sensitivities to flutter. For a given model of basis weight sensor the sensitivity to passline is often somewhat basis weight-dependent. There is no software correction for sheet passline changes. Passline on a sensor is minimized by careful design of the compensator, which sits on top of the ion chamber in the sensor receiver.

1.3.7. KCM

Although beta particles are relatively insensitive to anything other than the basis weight of the sheet, there may be slight differences in beta absorption between the calibration standard and the customer product. During calibration, a quantity called KCM is determined for each grade of product.

KCM determines the offset of the customer product (paper, plastic, and so on) calibration relative to the calibration standard (Mylar). For nearly all systems, all grades have the same KCM and one grade group.

1.3.8. Dynamic offset

The basis weight dynamic offset, BWDO, allows a grade-dependent offset. The offset is only used *onsheet* (not at sample), and is meant to account for effects such as moisture flashoff and sheet stretch, effects where the basis weight of the sheet at the scanner is physically different from that as measured at the mill lab.

Do not change BWDO just because a dynamic check does not agree with a measurement. Use it as a last option when it is clear that the sensor and all corrections are reading properly.

1.4. Model Q4303-XX sensor

This section contains an explanation of the major features of the 4303 series of sensors. The explanation starts at the source capsule and continues through the chain of major features.

The basic components of the sensor are:

1. Source holder assembly containing the radioactive capsule and the backplane board
2. A source head containing the source holder,
3. The receiver assembly containing an ion chamber and amplifier,
4. The receiver head with the receiver assembly and its backplane.

1.4.1. Source Assembly

Figure 1-1 shows a view of the source holder assembly. Major features are identified on the image.

WARNING

Call the Honeywell Radiation Safety Department before servicing any compontnets on the source holder assembly.

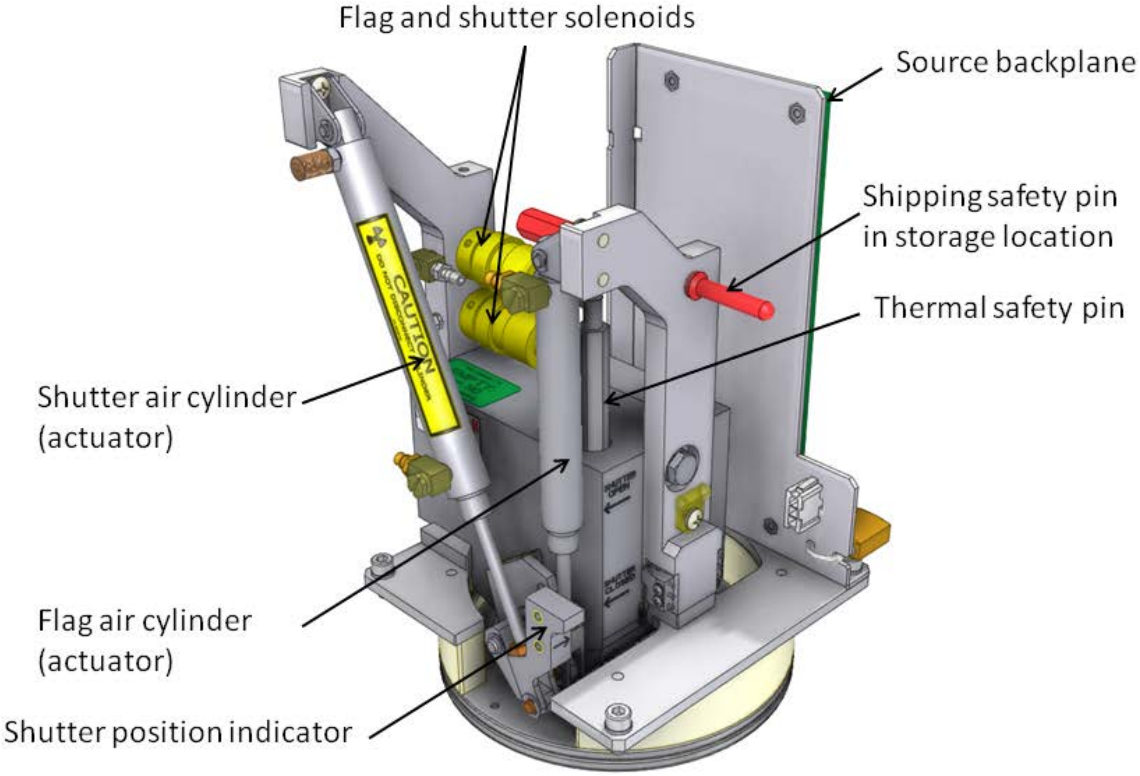

Figure 1-1 Source Components

The radioactive capsule itself is mounted on a wheel which rotates inside the source holder aluminum block. This capsule is not accessible or serviceable in the field. A pneumatic rotary actuator is used to rotate the capsule so that it faces the aperture and the beta particles can escape the sensor. The pneumatic rotary actuator does not produce any heat, so there is no warm-up time associated with source body heating. In this document, the phrase *opening and closing of the shutter* refers to the rotation of the source body to face the aperture.

The *shutter is open* when the rotary actuator has power applied (air pressure of at least 40 psi is needed to overcome an internal spring, and this is supplied by a compressor in the ZipLine head). The position of the shutter can be seen by looking at the position of the pin relative to the labels on the rotary actuator, see Figure 1-1. The position of the shutter is additionally indicated via a green light circuit, and is displayed on the head and on the scanner's endbell.

The fire safety pin prevents accidental opening of the shutter after a fire. In case of high temperature from a fire, the solder melts releasing the spring which forces a pin down to close the shutter. There is a separate maintenance procedure for replacement of the fire safety pin. Contact Honeywell Measurex Radiation Safety Office for details.

A small padlock blocks access to one of the screws that holds the sensor in the head (or in the shipping shield). This is required by law to prevent unauthorized removal of the radioactive source. Remove the padlock’s key once the sensor is installed, and store it in a safe location.

The ZipLine basis weight source has two temperature measurements : Sx air column and Sx backplane. Additionally, the receiver has two temperature measurements: Rx air curtain, and Rx backplane. All temperatures are measured by a direct readout temperature device. The voltage output of this device is linear with temperature. On the backplanes, there is gain of 10. To convert to degrees Centigrade multiply the signal output voltage (measured at test points or by the computer) by 10. For example, 2.2 V is 22 C. The measurement device looks very much like a transistor, having three pins extending out of a small plastic package.

The source includes an internal standard, or FLAG1, which is used during so-called *standardize* or *reference* measurements to provide a standard and constant reading for comparison purposes. It is actuated via an air cylinder, see **Figure 1-1.**

1.4.1.1. Source backplane (05427200)

This section is a functional description of the 05427200 Sx BACKPLANE PCB. This board interfaces between the Source head electronics and the ZipLine PDB (power distribution board). It is mounted in the source assembly which itself is housed inside the ZipLine head. The board provides power, signal conditioning and interlock signals to various source electronics. The backplane contains 12 test points, with the test points’ functions are clearly labeled. These features are explained in more detail by the following sections.

LED Indicators

The board has five LED's to indicate the status of the SHUTTER, FLAG1, FLAG2, HEAD SPLIT and POWER ON signals. These functions are tabulated in the following table.

LED Indicators source Backplane (05427200)			
DS #	**Color**	**Label**	**Meaning When On**
1	Red	SHTR	Power is applied to open shutter
2	Yellow	FLAG 1	Power is applied to insert flag 1
3	Yellow	FLAG 2	Power is applied to insert flag 2 (not used)
4	Yellow	HEAD SPLIT	Heads are split (not used)
5	Yellow	PWR ON	+24 volt head power is on

Table 1-2 LED indicators on source backplane PCB

Test Points

There are 12 test points on the backplane. These allow easy access to measure electrical signals. As a further aid for trouble shooting the test points are labeled as follows:

Sx 15 Source Backplane Test Points (05427200)		
Label	**Test Point**	**Return**
+24V Return	1	
Ground	2	
Column Temperature (Sx)	3	2
Cur Temperature	4	2
Head Temperature	5	2
+24 Volts	6	1
Z return	7	
Z sensor signal	8	7
-15 Volts	9	2
Ground	10	
+15 Volts	11	2
Ceiling Temperature	12	2

Table 1-3 Source backplane testpoints

The source backplane clearly labels test points for power and signals. Use test point 1 for 24 volts return only. Test points 2 and 10 are connected.

Power

The PCB is powered by a +24V supply power. A power on LED indicator is provided. Input power has a 1 amp fuse and an on board spare. There is an over temperature sensor that open circuits the power line at 165 - 170 degrees F. There is a 3 Watt, isolated, switching, dual output, +15 volts at 0.1 Amp and -15 volts at 0.1 Amp output power supply. This provides power to the on board signal conditioning electronics and the z-axis sensor amplifier.

Head-Split Interlock

The lower head has a magnetic (reed) switch while the upper head has a magnet. These assemblies are part of the ZipLine head (not part of the sensor itself). They are mounted both facing toward the gap. When the heads move apart, the reed switch opens.

The state of this switch is read by the EDAQ (not the sensor backplane) and drives interlock logic, which will prevent the shutter from being open when the heads are split.

The head split signal on the backplane is jumpered, and is not used on this sensor.

Ground

It is important to note there are 3 grounds on this board. Power ground (24VRTN), electrical ground (GND) and chassis ground (PLATFORM GND). These grounds are all tied to a single point ground at the power supply source. Platform ground is connected to a pad on one of the mounting holes and provides for an electrical connection to the supporting head.

Temperature Measurements

There is support for 3 temperature measurements on the backplane. All provide a direct temperature readout in degrees C with a linear scale factor of 0.1volts/degrees C. Currently, only the Air Column temperature is provided. An additional direct readout temperature chip is mounted on the board to provide “head temperature”.

Shutter and Flag

A magnetic head separation contact input provides for a safety interlock that enables shutter power only when the heads are aligned. Continuous power is supplied to the FLAG1 solenoid. The SHUTTER and FLAG1 contact outputs from the computer are connected to the board through the power distribution board.

1.4.2. Basis Weight Receiver

Figure 1-2 shows the 4303-XX receiver. The receiver assembly consists of a compensator, the ion chamber detector, the detector amplifier card, and backplane. The various components are described in more detail below.

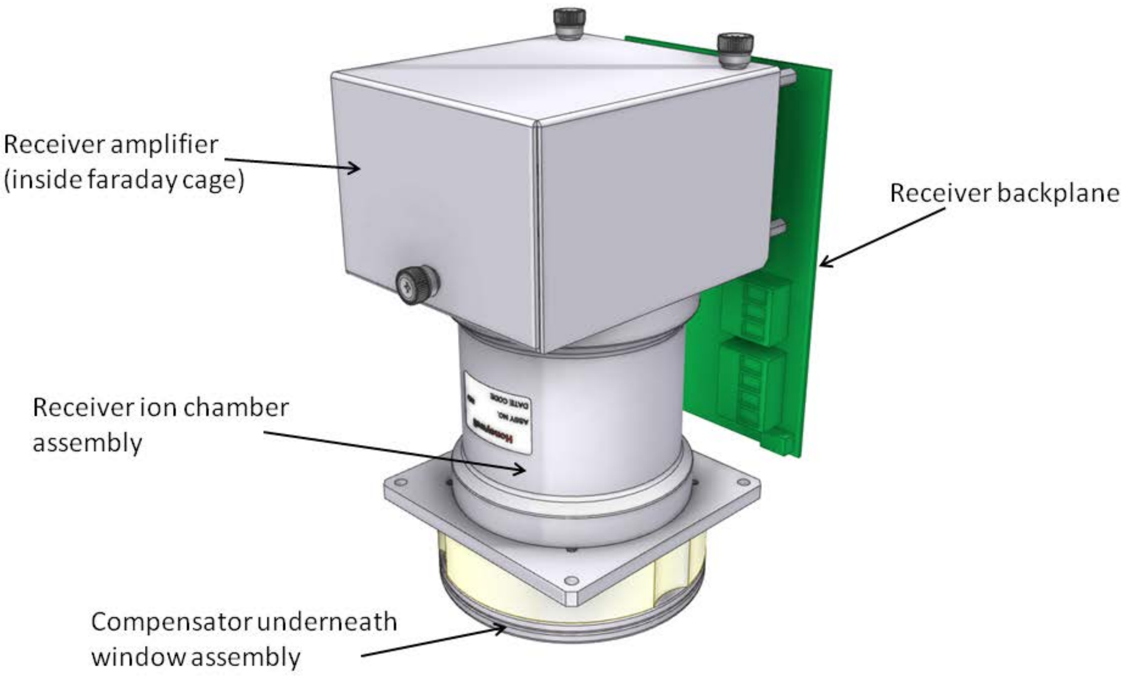

Figure 1-2 4303-XX Receiver

Compensator

The compensator sits just below the kapton window, on top of the ion chamber. It can be accessed by removing the window assembly. The function of the compensator is to correct for ash variations and for passline effects. There are different types of compensators for different gauge models. The compensator normally does not require servicing.

Ion Chamber

The ion chamber sits below the compensator, underneath the window assembly, and is held in place by a black plastic ring. It is connected to the detector amplifier card below it; to remove the ion chamber, open the Faraday cage to disconnect the leads, and then lift the ion chamber out. The ion chamber is filled with a pressurized gas, and the metal window is delicate. It should be handled with extreme care.

WARNING

The ion chamber is filled with a pressurized gas, and the metal window is delicate. ***It should be handled with extreme care.***

Detector Amplifier card (054316XX)

This board is used as an interface between the ion chamber assembly and the Receiver Backplane PCBA. It is mounted under the ion chamber in a Faraday cage. The board provides power to the ion chamber as well as signal conditioning to the low level current output generated from the ion chamber. The gain of the amplifier card is adjustable, as detailed below. Test points are also explained below.

Hardware Gain Select

Gain changing is done by means of a rotary switch. Gains steps are equal, with three steps doubling the gain. (Each step is a 26 % increase.) For each board there is a sixteen position hexadecimal switch for fine adjustments. There are three board versions, used for different gauge models.

Table 1-4 below shows the amplifier board variations and the gain select values. The gains are normalized to 1.0 for the variation-00 board at switch position 0.

Switch Pos	VARIATION -02	VARIATION -01	VARIATION -00
0	0.04	0.20	1.00
1	0.05	0.25	1.26
2	0.06	0.32	1.60
3	0.08	0.40	2.00

4	0.10	0.50	2.50
5	0.13	0.63	3.15
6	0.16	0.77	3.87
7	0.20	0.98	4.92
8	0.24	1.22	6.11
9	0.32	1.60	7.98
A	0.40	2.02	10.1
B	0.52	2.62	13.1
C	0.64	3.20	16.0
D	0.82	4.12	20.6
E	1.04	5.18	25.9
F	1.24	6.20	31.1

Table 1-4 Receiver gain settings

A small rotary potentiometer sits next to the gain select switch. This is used to set the threshold voltage.

Test Points

Color coded test points of all power supplies are provided on board with RED indicating power and BLACK ground. The test points are all clearly silk-screened.

Test Point	Meaning
1	-15 volt
2	ground
3	+5 volt
4	+15 volt

Table 1-5 Detector Amplifier test points

Sx 15 Receiver Backplane (054280XX)

This board is an interface between the receiver head electronics and the power distribution board. The board provides power and signal conditioning to various receiver electronics.

Indicators And Test Points

The board has LEDs to indicate the status of the +24V power, GAIN1, GAIN2, GAIN3, TEST and ON SHEET signals. Test points of all power supplies and some of the analog signals that are important for troubleshooting are provided. The ceiling temperature is brought out of the head on an optional second power track. There is no input for test point six.

TP	Return	Label	Meaning
1	9	LV Bias	Low V monitor ion chamber bias voltage[1]
2	9	Air Curt	Air curtain temperature
3	9	BW	Raw basis weight voltage
4	9	Hd/Snsr	Head (RX backplane PCB) temperature
5	9	Ceil Tmp	Optional ceiling temperature
6	9	Snsr Tmp	Not used in (Optional extra temperature)
7	9	+5 V	
8	9	-15 V	
9		Gnd	
10	9	+15 V	
11		24 V Rtn	
12	11	+24 V	
13	9	Edge Thresh	Analog voltage set to edge detect threshold, for optional IR edge detect
14	9		-500 V ion chamber bias

Table 1-6 Receiver Backplane test points

Receiver backplane test points for power and signals are clearly labeled on the printed circuit board. Use test point 9 for return for all except test point 12, +24 volt, which has test point 11 as return. Do not use jumpers in W2-W4.

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[1] 5 V monitor = -500 V

1.4.3. Electrical and air requirements

The sensor boards require 24 V DC, supplied by the head's power distribution board (PDB). The pneumatic actuators for the flag and shutter require 45 psi ± 5 psi very clean air, which is supplied by a small compressor in the ZipLine head. There is only a small amount of flow required. During normal operation, the compressor will turn on and off.

1.5. Signal inputs and outputs

There is one output from the Basis Weight Sensor: the basis weight voltage signal. Each head (receiver and source) has an air column temperature that is used for corrections, for a total of two measurements.

The z-sensor which forms part of the ZipLine head (not the sensor) is used for corrections also and is read directly by the EDAQ. Additional head temperatures are also measured by the EDAQs in the upper and lower heads. An average of all EDAQs is reported to the measurement system.

The only inputs to the sensor are the digital logic signals to insert the flag and the shutter.

1.6. Sensor performance specifications

Table 1-7 summarizes the specifications for various sensor models that are currently shipping.

Model	147Pm 4303-08	85Kr 4303-00	85Kr 4303-01
Basis Weight Range	15–175 g/m^2	140–1200 g/m^2	15–1200 g/m^2
Sheet Gap	10 mm (0.4 in)	10 mm (0.4 in)	10 mm (0.4 in)
Sheet Ash Range	Any	< 5%	2–20%
Repeatability on Mylar, (2 sigma, 16 s integration).	± 0.05%	± 0.02%	± 0.05% or 0.03 g/m^2 (whichever is greater)
Static Accuracy (2 sigma on Mylar, 16 s integration).	± 0.25%	± 0.25%	± 0.25% or 0.10g/m^2 (whichever is greater)

Measurement Spot Diameter (FWHM)	17mm (0.67 in) FWHM	17mm (0.67 in) FWHM	17mm (0.67 in) FWHM
Sensor Response Time (analog signal, to see 63% of step change)	1 ms	1 ms	1 ms

Model	85Kr 4303-02	85Kr 4303-03
Basis Weight Range	15–1200 g/m^2	15–1200 g/m^2
Sheet Gap	10 mm (0.4 in)	25 mm (1.0 in)
Sheet Ash Range	>20%	>20%
Repeatability on Mylar, (2 sigma, 16 s integration).	± 0.05% or 0.07 g/m^2 (whichever is greater)	± 0.05% or 0.05 g/m^2 (whichever is greater)
Static Accuracy (2 sigma on Mylar, 16 s integration).	± 0.25% or 0.10 g/m^2 (whichever is greater)	± 0.25% or 0.20 g/m^2 (whichever is greater)
Measurement Spot Diameter (FWHM)	17mm (0.67 in) FWHM	17mm (0.67 in) FWHM
Sensor Response Time (analog signal, to see 63% of step change)	1 ms	1 ms

Model	90Sr 4303-04	90Sr 4303-07
Basis Weight Range	100-5000 g/m^2	100-5000 g/m^2
Sheet Gap	10 mm (0.4 in)	25 mm (1.0 in)
Sheet Ash Range	<5%	>20%
Repeatability on Mylar, (2 sigma, 16 s integration).	± 0.10% or 0.20 g/m^2 (whichever is greater)	± 0.10% or 0.40 g/m^2 (whichever is greater)
Static Accuracy (2 sigma on Mylar, 16 s integration).	± 0.25% or 0.50 g/m^2 (whichever is greater)	± 0.25% or 0.50 g/m^2 (whichever is greater)
Measurement Spot Diameter (FWHM)	17mm (0.67 in) FWHM	17mm (0.67 in) FWHM
Sensor Response Time (analog signal, to see 63% of step change)	1 ms	1 ms

Table 1-7 Sensor Specifications

2. Radiation Safety and Interlocks

This chapter describes the safety components of the Basis Weight Measurement in the ZipLine measurement system.

2.1. Radiation safety

WARNING

Under no circumstances place any part of the body in the gap.

The Basis Weight Sensor produces hazardous radiation. Anyone working with this sensor must have participated in radiation safety training, be familiar with radiation safety practices, and carry a radiation badge.

For more information, consult the *Radiation Safety Manual For Honeywell Customers* (p/n 6510020197).

The radiation safety system for a ZipLine scanner consists of a number of redundant hardware and software systems.

The main user indicators are the red and the green light systems that are present on all scanners. The general rule is:

- Green ON indicates that all radiation shutters on a scanner are in the closed state. It is safe to split the heads and work in the sensor gap area.
- Red ON means only that the command to open the shutters was given by the controlling hardware. ***It does not necessarily mean that the shutters actually opened (see Section 2.2); when the red light is OFF, it does not mean that the shutters are closed.***

2.2. Green light circuit

The green light circuit is hardwired through the entire scanner. The green light circuit is a loop that starts with + 24 V at the endbell HMI assembly, passes through the wires to the head and into the PDB (power distribution board), and then passes through the green light LEDs in the heads, the head shutter switches, and finally to ground.

The green light extinguishes in case of a shutter opening or a LED or general power failure. There is no software involved. **Figure 2-1** shows the signal path for the green light circuit.

2.3. Red light circuit

In the ZipLine scanner, all red light-related signals are handled through the EDAQ boards in the head. The decision to allow shutter open commands is made on the basis weight source EDAQ CPU board based on information received over the Ethernet. Examples of such information is a relevant switch (head alignment), or condition of the lights (red light lit up). **Figure 2-1** shows the complete red light circuit wiring.

The EDAQ controlling the radiation source subscribes to the status of these switches or lights. If feedback from the respective EDAQ is not received within a short time-out period, the gauge controlling EDAQ will block a subsequent shutter open command, or, if the shutter is already open, the EDAQ will close the shutter and disable the shutter drive logic. For example, when the signal is not received, any of the following three actions will happen:

- the EDAQ will not relay a shutter command if a shutter command is sent
- the EDAQ will close the shutter if the shutter was open
- the EDAQ will turn off power to the gauge if the gauge had power (applicable to ash, not basis weight gauges)

The feedback signals are monitored constantly for as long as the shutter is open; the gauge EDAQ needs to get continuous information on the state of switches and lights to keep the shutter open. If communication fails with any of the devices that supply this information, the shutter is closed, or power is removed.

The nuclear gauge (and similarly, the ZipLine xray gauge) is not powered directly, but through a separate hardware interlock circuit (the “watchdog supervisory circuitry”) that is part of the Power Distribution Board (PDB). This is in order to handle fatal software problems or board lock-up. The interlock circuit expects a regular, < 500 ms period digital signal from the controlling EDAQ. If that fails to arrive, the + 24 V to the gauge is disconnected.

In order to maintain the shutter open signal to the nuclear sensor, the gauge source controlling EDAQ requires the following conditions (all of the following also apply to the X-ray gauges):

- the red light be lit (active feedback from a light sensor)
- the interlock board receives a regular watchdog signal from the controlling EDAQ
- the receiver signal strength corresponds to the state of the shutter:
    - HIGH when the shutter is commanded open
    - LOW after it is commanded shut

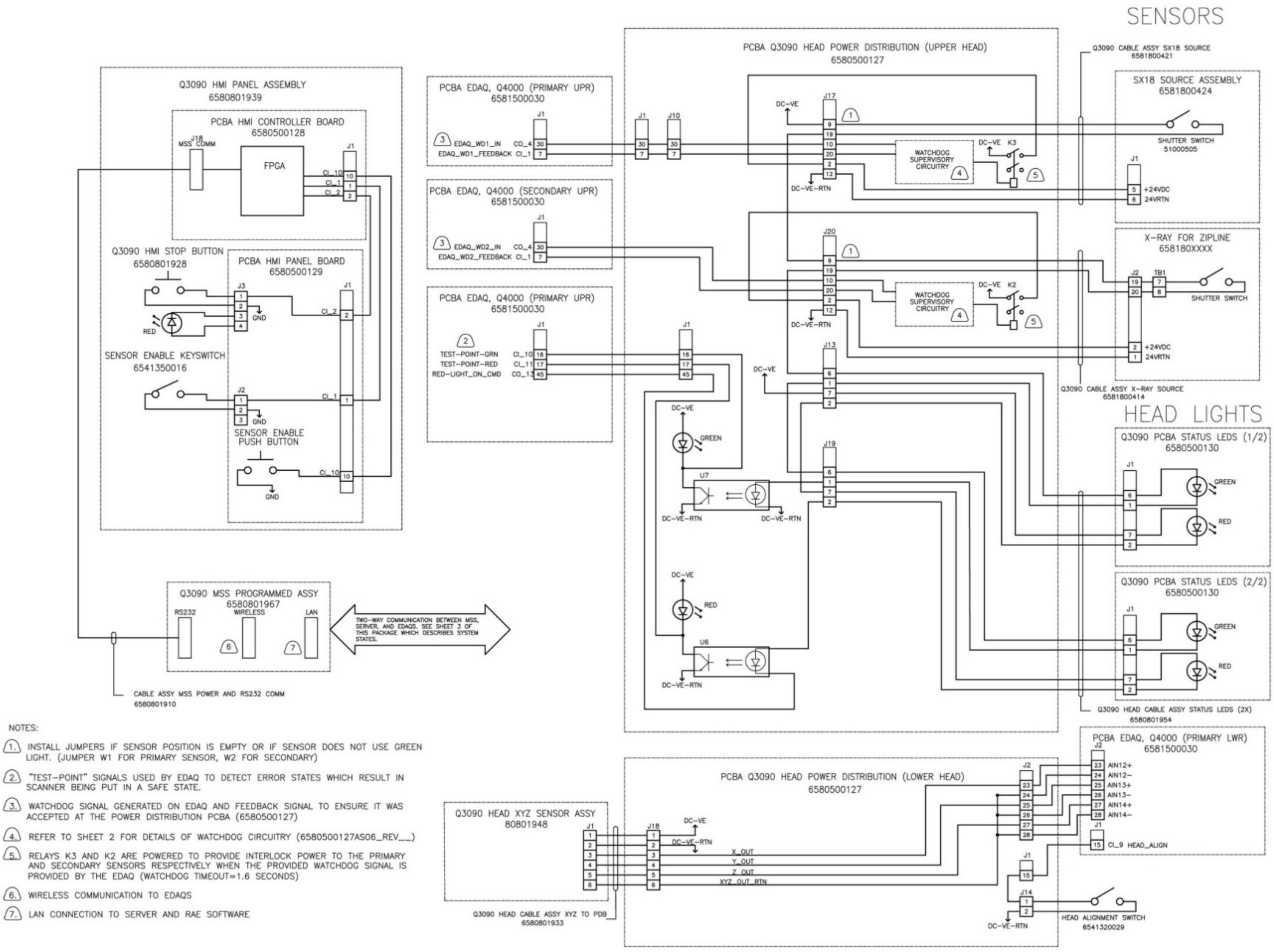
The time out for any of these conditions is 500 ms or less, meaning that a shutter will be closed within 500 ms of any of the conditions failing.

New to the ZipLine scanner is a **Nuclear Gauge Enable** button, located at the endbells. This button disables any command from being executed by the EDAQ. It operates similarly to the amber light for the X-ray sensor.

Figure 2-2 shows the detailed schematics for the interlock circuits.

Figure 2-3 shows the state machine which controls the radiation safety interlocks, as implemented in the EDAQ software. X-ray and nuclear sensor application-specific EDAQ software defines the following five states of operation:

1. Sensor-disabled: source module is not powered and no safety tests are performed. Amber and red lights are OFF.
2. Sensor-powered: source module EDAQ accepted enable request and turned ON sensor power. Shutter is in closed state. Amber light is ON and red light is OFF.
3. Shutter-open-pending: source EDAQ accepted a shutter open command and requested frame controller to turn red lights ON. Amber light is ON.
4. Shutter-open: red light is turned ON and source EDAQ opened the shutter. Sensor is measuring and fully functional.
5. Safety-fault: source EDAQ detected a safety test failure and cut the power to the sensor after closing the shutter.



NOTES:

1. INSTALL JUMPERS IF SENSOR POSITION IS EMPTY OR IF SENSOR DOES NOT USE GREEN LIGHT. (JUMPER W1 FOR PRIMARY SENSOR, W2 FOR SECONDARY)
2. "TEST-POINT" SIGNALS USED BY EDAQ TO DETECT ERROR STATES WHICH RESULT IN SCANNER BEING PUT IN A SAFE STATE.
3. WATCHDOG SIGNAL GENERATED ON EDAQ AND FEEDBACK SIGNAL TO ENSURE IT WAS ACCEPTED AT THE POWER DISTRIBUTION PCBA (6580500127)
4. REFER TO SHEET 2 FOR DETAILS OF WATCHDOG CIRCUITRY (6580500127AS06_REV__)
5. RELAYS K3 AND K2 ARE POWERED TO PROVIDE INTERLOCK POWER TO THE PRIMARY AND SECONDARY SENSORS RESPECTIVELY WHEN THE PROVIDED WATCHDOG SIGNAL IS PROVIDED BY THE EDAQ (WATCHDOG TIMEOUT=1.6 SECONDS)
6. WIRELESS COMMUNICATION TO EDAQS
7. LAN CONNECTION TO SERVER AND RAE SOFTWARE

Figure 2-1 Green and Red Light circuits

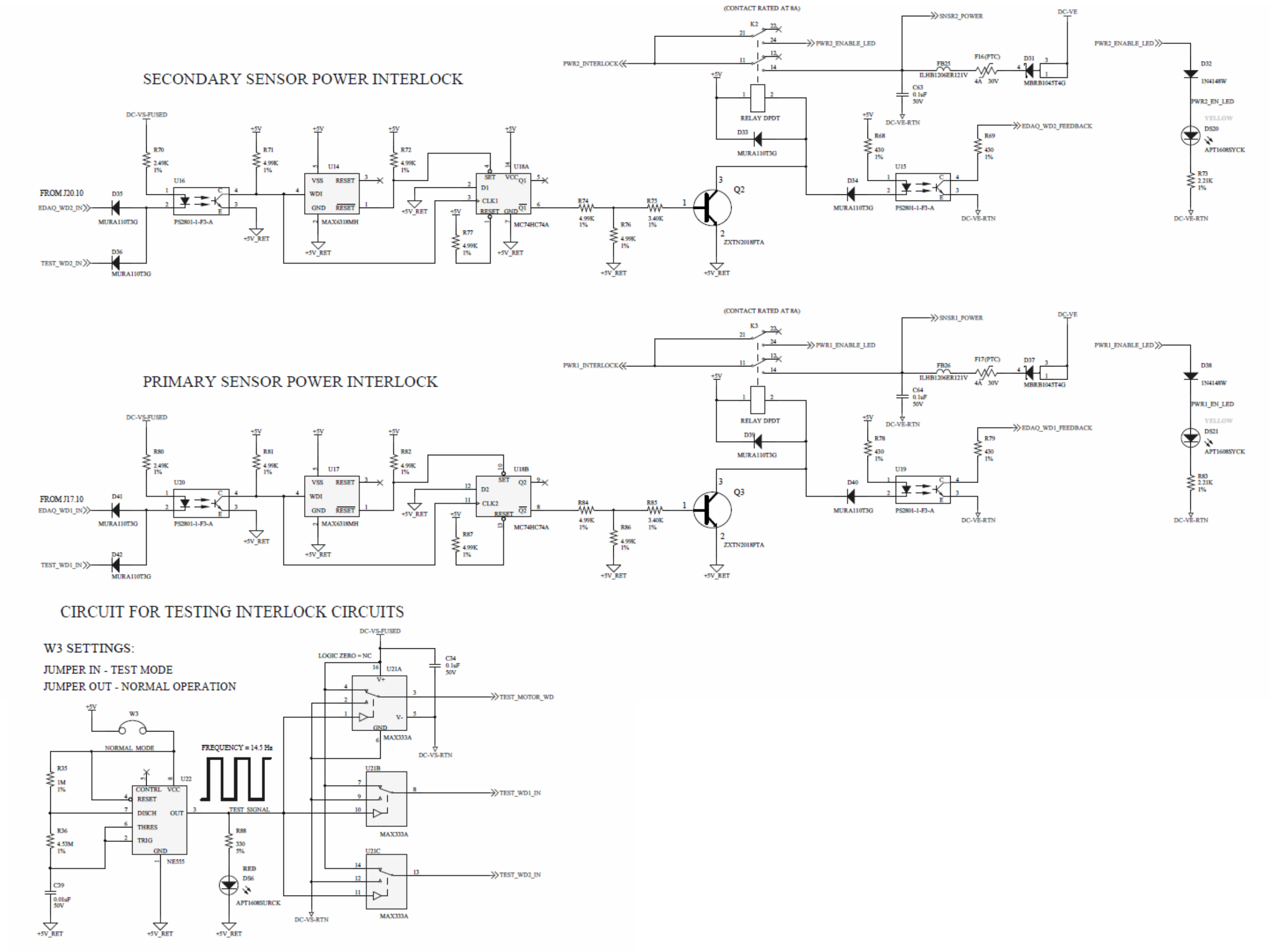


Figure 2-2 schematic diagrams for interlock circuitry

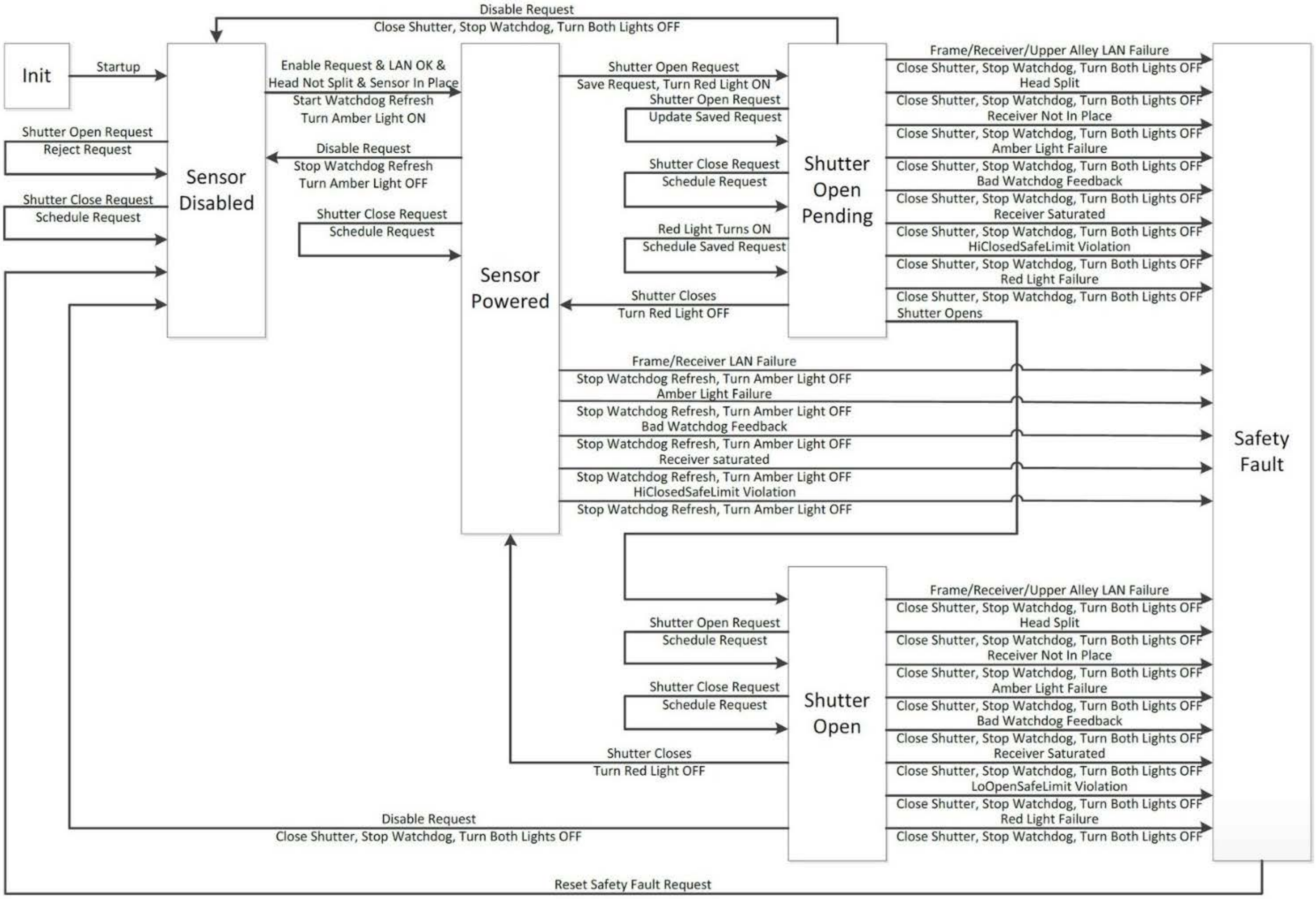


Figure 2-3 State Machine diagram for radiation interlock logic

3. EDAQ

This chapter gives a brief overview of the Ethernet Data Acquisition (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. Overview

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

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

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

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

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

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

- frequency input (400 Hz to 500 kHz)
- three serial ports
- USB (presently unused)
- Ethernet

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

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

3.2. Physical layout

Figure 3-1 and Figure 3-2 show the EDAQ PCBA as it is mounted next to a sensor. To the left are the digital and analog I/Os, which connect directly to a sensor. Below these two large connectors is a 16-pin expansion connector that is only used when the EDAQ is attached to the FC expansion board.

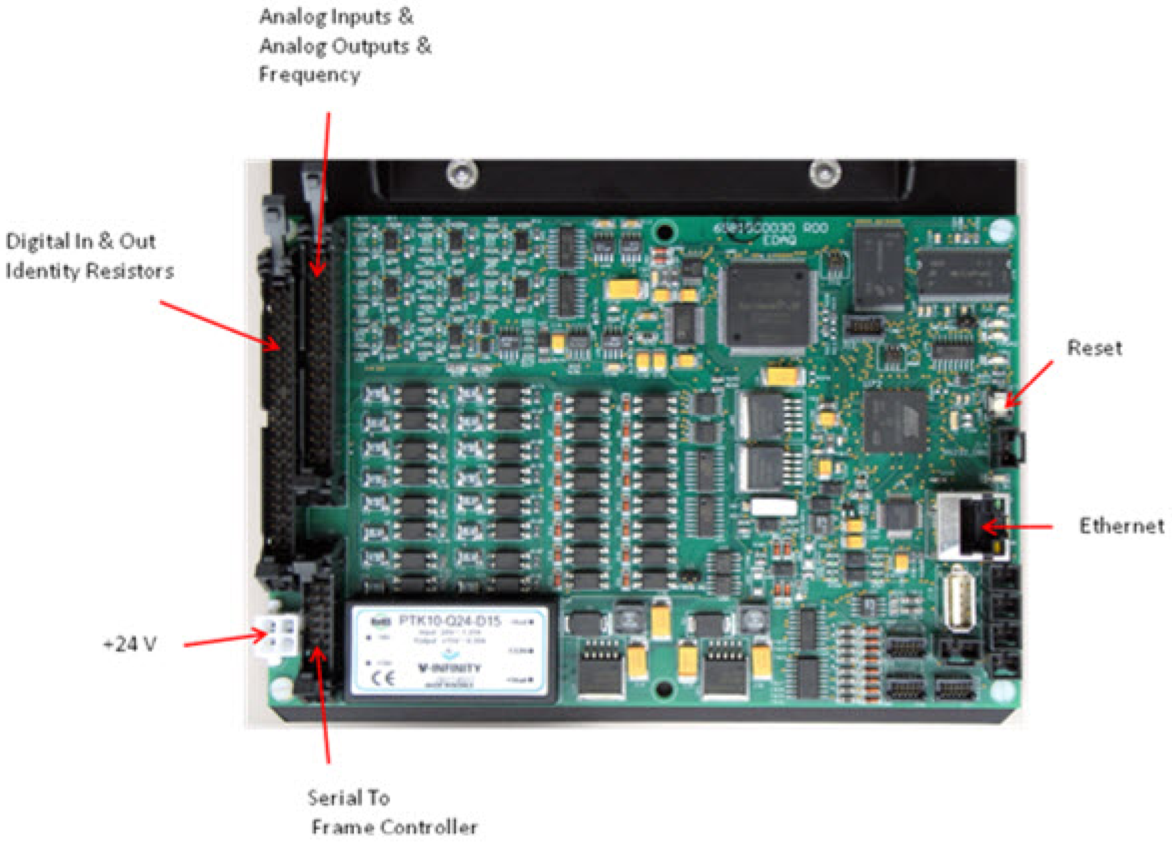


Figure 3-1 EDAQ Board

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

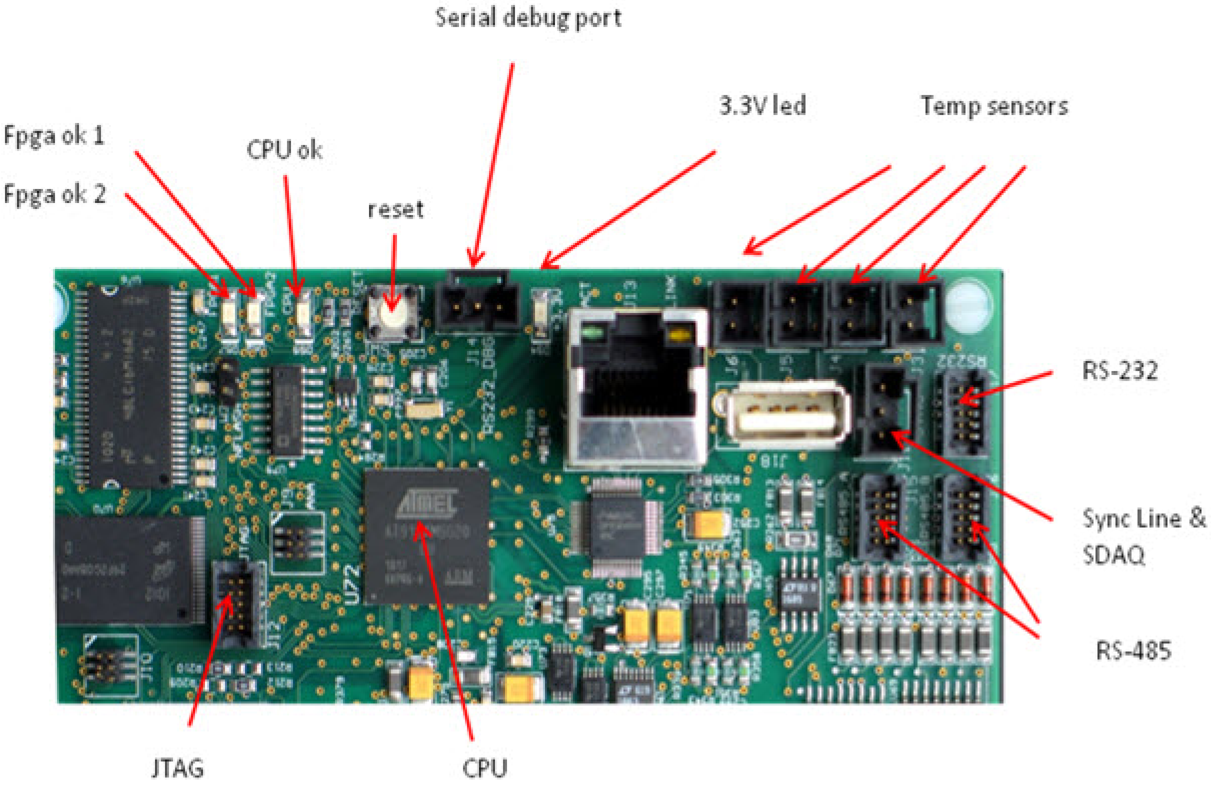


Figure 3-2 EDAQ Board: Ports and Diagnostic LEDs

3.3. Hardware status information

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

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

The Ethernet connector contains two LEDs:

- amber, indicating a good link to the switch
- green, indicating activity on the network

3.4. EDAQ reset

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

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

3.5. EDAQ sensor identification and IP addressing

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

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

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

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

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

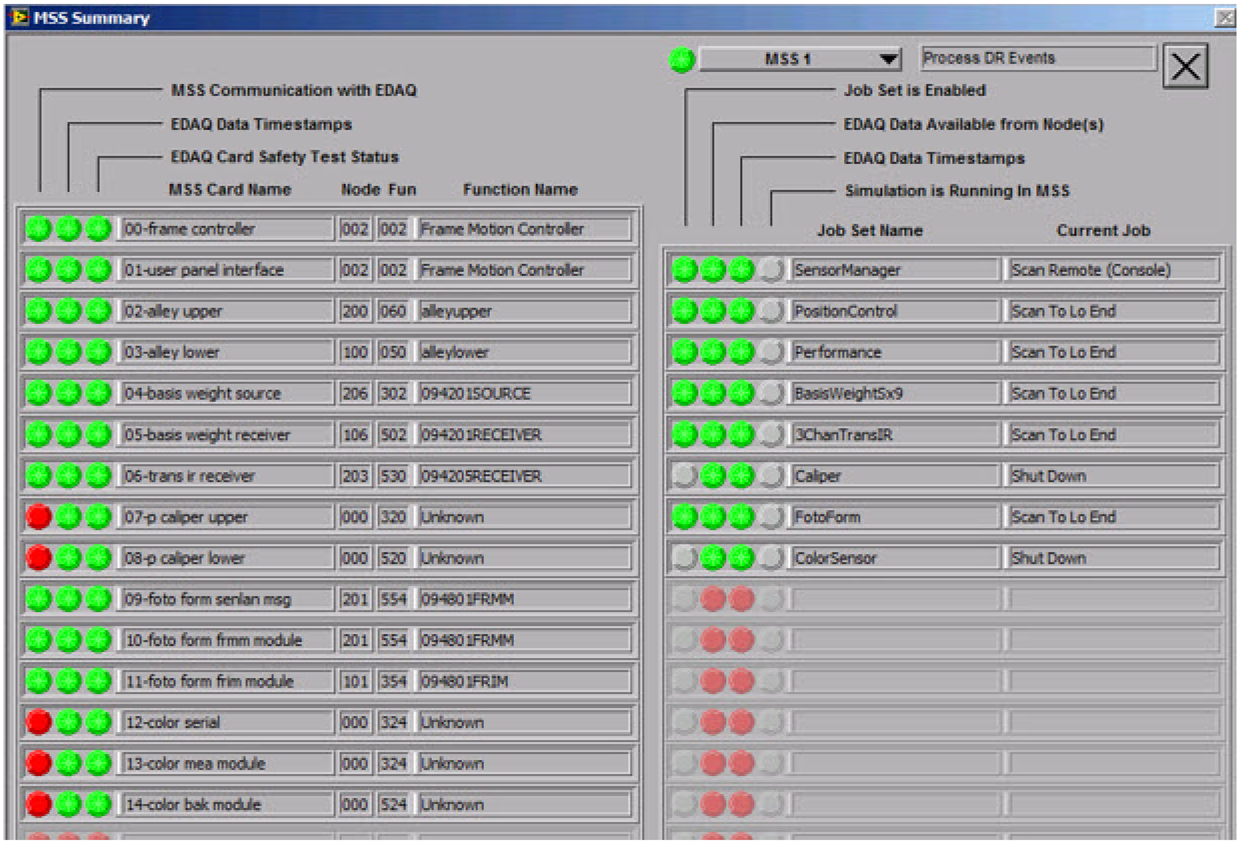
Every EDAQ has a unique IP address on the scanner network. If the EDAQ can identify its position, it will set its IP address to 192.168.0.*XYZ* (where *XYZ* is the position number in the head). The FC-EDAQ always sets itself to IP number 192.168.0.2. The MSS is always 192.168.0.1 on the scanner network, 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.

3.6. 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).



🟢 MSS 1 ▼ Process DR Events

			MSS Card Name	Node	Fun	Function Name
🟢	🟢	🟢	00-frame controller	002	002	Frame Motion Controller
🟢	🟢	🟢	01-user panel interface	002	002	Frame Motion Controller
🟢	🟢	🟢	02-alley upper	200	060	alleyupper
🟢	🟢	🟢	03-alley lower	100	050	alleylower
🟢	🟢	🟢	04-basis weight source	206	302	094201SOURCE
🟢	🟢	🟢	05-basis weight receiver	106	502	094201RECEIVER
🟢	🟢	🟢	06-trans ir receiver	203	530	094205RECEIVER
🔴	🟢	🟢	07-p caliper upper	000	320	Unknown
🔴	🟢	🟢	08-p caliper lower	000	520	Unknown
🟢	🟢	🟢	09-foto form serlan msg	201	554	094801FRMM
🟢	🟢	🟢	10-foto form frmm module	201	554	094801FRMM
🟢	🟢	🟢	11-foto form frim module	101	354	094801FRIM
🔴	🟢	🟢	12-color serial	000	324	Unknown
🔴	🟢	🟢	13-color mea module	000	324	Unknown
🔴	🟢	🟢	14-color bak module	000	524	Unknown

				Job Set Name	Current Job
🟢	🟢	🟢	○	SensorManager	Scan Remote (Console)
🟢	🟢	🟢	○	PositionControl	Scan To Lo End
🟢	🟢	🟢	○	Performance	Scan To Lo End
🟢	🟢	🟢	○	BasisWeightSx9	Scan To Lo End
🟢	🟢	🟢	○	3ChanTransIR	Scan To Lo End
○	🟢	🟢	○	Caliper	Shut Down
🟢	🟢	🟢	○	FotoForm	Scan To Lo End
○	🟢	🟢	○	ColorSensor	Shut Down
○	🔴	🔴	○		
○	🔴	🔴	○		
○	🔴	🔴	○		
○	🔴	🔴	○		
○	🔴	🔴	○		
○	🔴	🔴	○		

Figure 3-3 MSS Summary

Table 3-1 lists and describes the **MSS Summary** display status indicators.

Table 3-1 MSS Summary Display Status Indicators

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

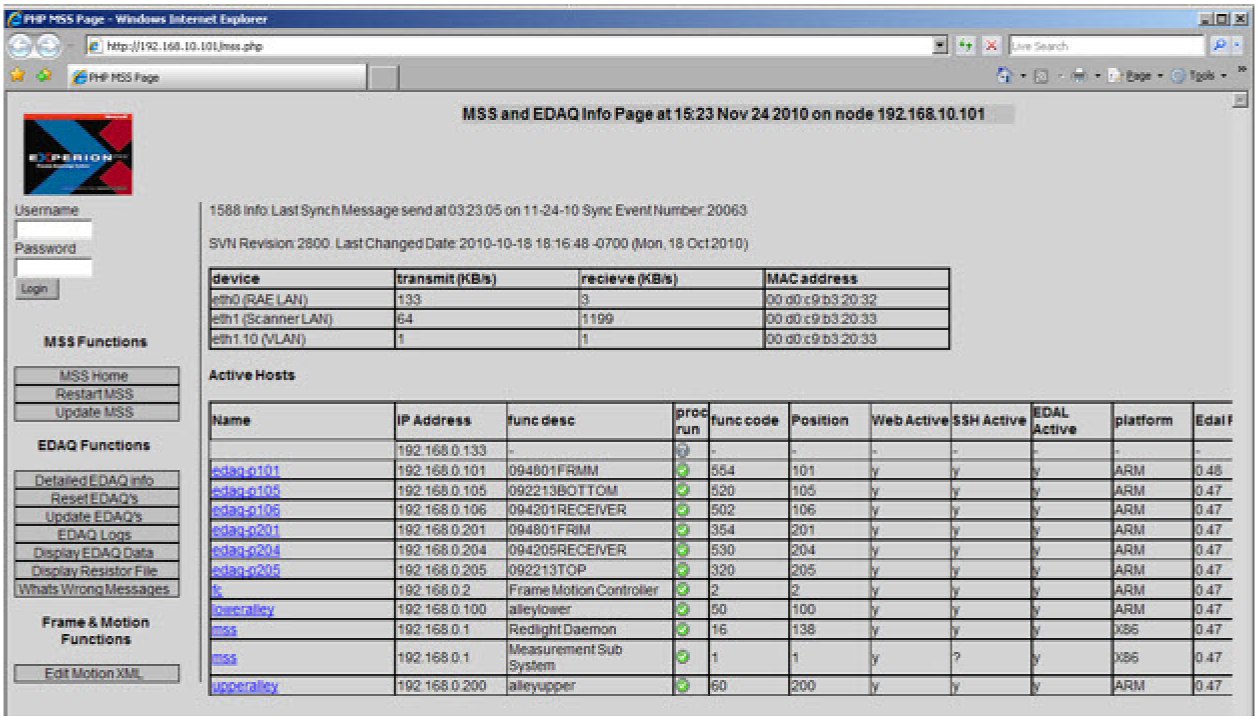
Sensors that are part of the QCS database, but are not enabled on the scanner, appear in the left column indicators in red, for example, *07-caliper upper* in **Figure 3-3**.

3.7. MSS and EDAQ web pages

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

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

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



MSS and EDAQ Info Page at 15:23 Nov 24 2010 on node 192.168.10.101

1588 Info: Last Synch Message send at 03:23:05 on 11-24-10 Sync Event Number: 20063

SVN Revision: 2800. Last Changed Date: 2010-10-18 18:16:48 -0700 (Mon, 18 Oct 2010)

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

Active Hosts

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

Figure 3-4 PHP MSS Page

The left panel shows a column of options divided into:

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

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

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

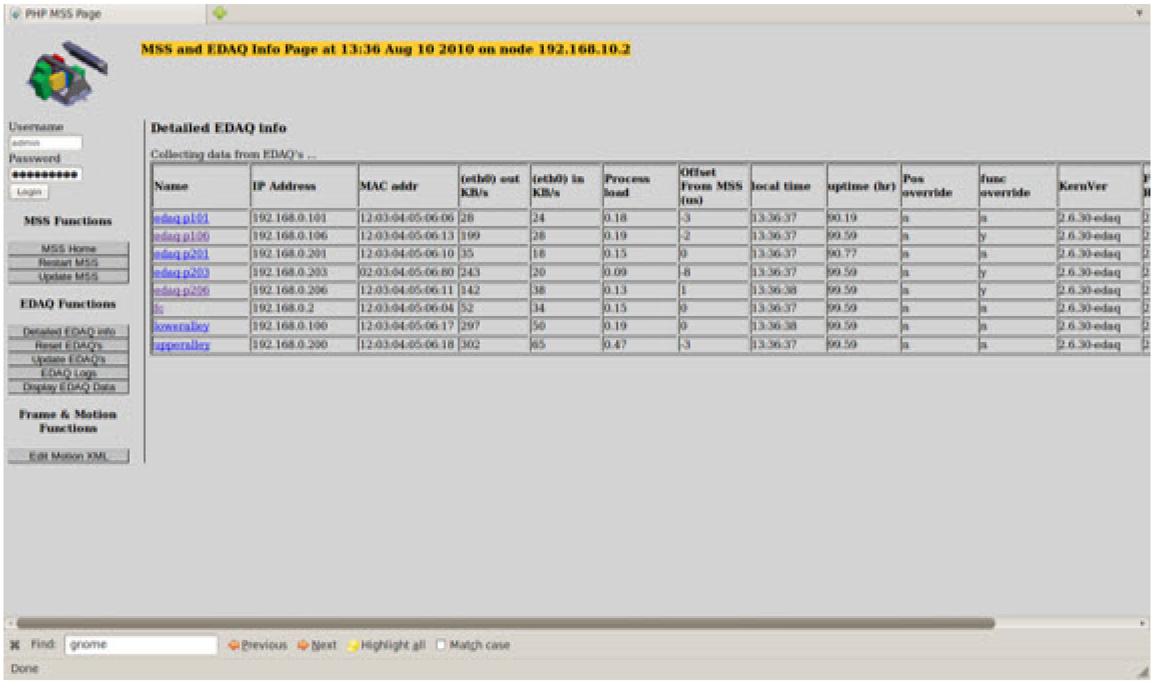
The second table lists all EDAQs discovered on the scanner LAN, their IP numbers, a brief description (related to model number), a program status column, the associated function code and position code, and whether the communication protocols are running (http, SSH, and Edal, the proprietary sensor data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

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

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

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

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



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

Detailed EDAQ info

Collecting data from EDAQ's ...

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

Figure 3-5 PHP MSS Page: Detailed EDAQ Info (partial display)

3.8. Other diagnostic tools

The proper operation of the basis weight gauge and the EDAQ can also verified using the following tools:

1. EDAQ/MSS log files: The EDAQ writes all BW shutter open/close and other significant I/O operations to a log that is stored on the MSS.

   These log files can be viewed and downloaded from the MSS main web page. It is possible to view several weeks of shutter movement.

   In addition, when an interlock error occurs, the EDAQ dumps a large amount of BW signal data leading up to the fault to the log file for analysis.

2. The EDAQ Scope Tool: A Windows/Linux platform executable program is available from Engineering which allows direct access to all the EDAQ raw signals in parallel to the Experion MX system obtaining those data. Data can be plotted, save and analyzed.

4. Installation

This chapter describes the installation of the Basis Weight Measurement in the ZipLine heads.

4.1. Mechanical installation and removal

It is convention to install the source in the top head, and the receiver in the bottom head, but this can be reversed without affecting the measurement. Configuration is automatic, because the EDAQ board recognizes the new position of the source/receiver pair and passes the information on to the MSS and the real-time application environment (RAE).

To remove the sensor module in either head, undo the upper lid using the clips and remove it. The sensor modules can be removed by removing the 4 screws located in each corner of the aluminum carriage, see **Figure 4-1**.

Be sure to disconnect the air line from the compressor as well as all the electrical harnesses.

There is a rubber o-ring between the window assembly and the sheet guide that keeps both the receiver and source module in snugly. You will need to tug rather firmly at the module to lift it out.

The window assembly can be removed (see **Figure 4-2**) either while the sensor is in the head, or when you have removed it. Remove the middle screws of the groups of three that show on the window side.

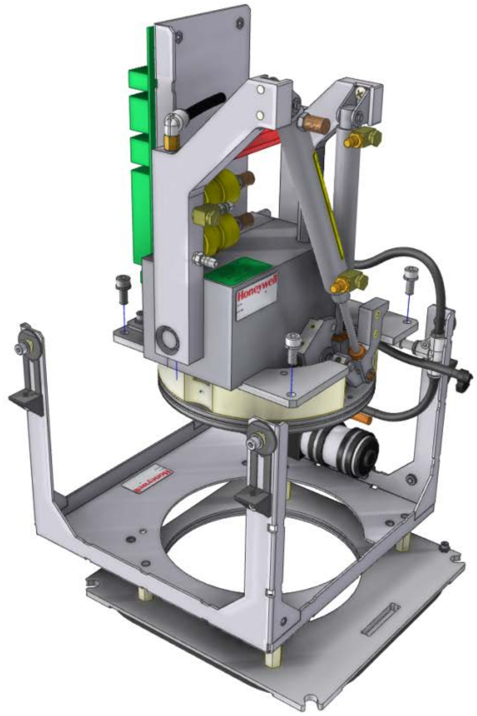


Figure 4-1 Source Removal

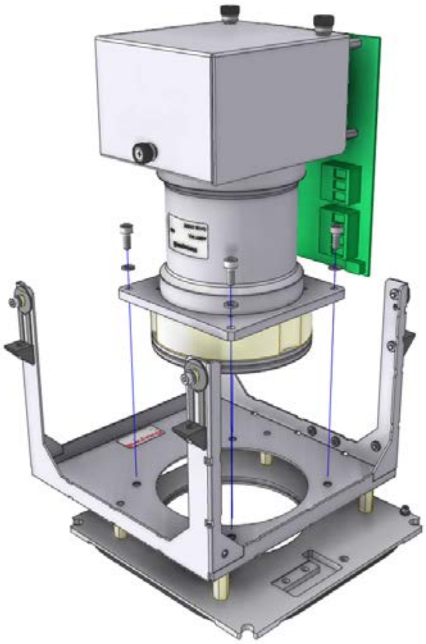


Figure 4-2 Receiver Removal

5. Operations and Calibration System Constants

5.1. 4303-08 Pm-147 (lightweight sheet applications)

Table 5-1 lists and describes gauge range information.

Table 5-1 Gauge Range Information

Range	15-200 g/m^2
Ash range	any
Hardware set-up	Gain = step B on amplifier 05431601; Gap = 10.16 mm (0.4 in); Flag = 1 mil or 32 g/m^2 Mylar

5.1.1. Typical values of constants determined during Mylar calibration

Table 5-2 provides the typical nominal calibration coefficients when a single curve fits the entire weight range. Coefficients vary for other weight ranges.

Table 5-2 Sensor Constants (during Mylar calibration)

Clean	**Dirty Using ½ mil Mylar Dirt**
BA0 ≅ -0.2	BD0 ≅ 0.05
BA1 ≅ -63	BD1 ≅ -2
BA2 ≅ -5	BD2 ≅ -0.5
BA3 ≅ -0.5	BD3 ≅ -0.1

5.1.2. Grade-dependent constants

Table 5-3 lists and describes grade-dependent constants.

Table 5-3 Grade-dependent Constants

BWDO = 0
KCM = Depends on application but expect to be between 0.97 and 1.02

5.1.3. Accuracy specifications

Table 5-4 lists and describes accuracy specifications.

Table 5-4 Accuracy Specifications

Specification	**Value**
Calibration fit accuracy	± 0.25%
Static Mylar verification accuracy for all points; Mylar dirt for verification = 1/4 mil:	± 0.10 g/m^2 below 25 g/m^2 ± 0.40% above 25 g/m^2

5.1.4. Constants supplied by the sensor development department

Table 5-5 lists typical measurements of constants.

Table 5-5 Measured Constants (typical values)

Constant	**Value**
Background	15 mV
Air Volts	7.5 ± 1.5 V (set gain for 6-9V)
T0FA	0.59 ± 0.3
T0CF	-0.0082 ± 0.001 for ½ mil Mylar
T012	Not applicable
T0F2	Not applicable

Table 5-6 lists and describes constants supplied by the sensor development department.

Table 5-6 Sensor Constants (sensor development department)

Constant	**Value**	**Definition**
AGAU	1800 $g/m^2/K$	Upper Air Gap Temp Corrector
AGAL	1800 $g/m^2/K$	Lower Air Gap Temp Corrector
AGAR	0 $g/m^2/K$	Rx Air column Temp Corrector
AGAS	4300 $g/m^2/K$	Sx Air column Temp Corrector
CFZ	16	Z-correction coefficient on-sheet (normal or default CFZ)
CFZS	0.0	Z-correction coefficient standardize
KCM2	0.0	used for Mylar curve to customer product curve transformation

5.1.5. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration time. Waiting interval between references = zero.

Table 5-7 lists and describes stability specifications.

Table 5-7 Stability Specifications

Typical 1 sigma F/A ratio = 0.00006
Investigational limit 1 sigma F/A = 0.00012

5.2. 4303-00 Kr-85 (low-ash board applications)

Table 5-8 lists and describes gauge range information.

Table 5-8 Gauge Range Information

Range	140-1200 g/m^2
Ash range	low
Hardware set-up	Gain = step 8 on amplifier 05431602; Gap = 10.16 mm (0.4 in); Flag = 10 mil or 320 g/m^2 Mylar

5.2.1. Typical values of constants determined during Mylar calibration

Table 5-9 provides the typical nominal calibration coefficients when a single curve fits the entire weight range. Coefficients vary for other weight ranges.

Table 5-9 Sensor Constants (during Mylar calibration)

Clean	**Dirty Using 1 mil Mylar Dirt**
BA0 ≅ -0.9	BD0 ≅ 0.4
BA1 ≅ -420	BD1 ≅ 6.7
BA2 ≅ -42	BD2 ≅ 1
BA3 ≅ -3	BD3 ≅ 0.05

5.2.2. Grade-dependent constants

Table 5-10 lists and describes grade-dependent constants.

Table 5-10 Grade-dependent Constants

BWDO = 0
KCM = Depends on application but expect to be between 0.97 and 1.02

5.2.3. Accuracy specifications

Table 5-11 lists and describes accuracy specifications.

Table 5-11 Accuracy Specifications

Specification	**Value**
Calibration fit accuracy	± 0.25%
Static Mylar verification accuracy for all points; Mylar dirt for verification = 1/2 mil:	± 0.40%

5.2.4. Constants supplied by the sensor development department

Table 5-12 lists typical measurements of constants.

Table 5-12 Measured Constants (typical values)

Constant	**Value**
Background	15 mV
Air Volts	7.5 ± 1.5 V (set gain for 6-9V)
T0FA	0.40 ± 0.02
T0CF	-0.0039 ± 0.002 for 1 mil Mylar
T012	Not applicable
T0F2	Not applicable

Table 5-13 lists and describes constants supplied by the sensor development department.

Table 5-13 Sensor Constants (sensor development department)

Constant	**Value**	**Definition**
AGAU	1800 $g/m^2/K$	Upper Air Gap Temp Corrector
AGAL	1800 $g/m^2/K$	Lower Air Gap Temp Corrector
AGAR	0 $g/m^2/K$	Rx Air column Temp Corrector
AGAS	4300 $g/m^2/K$	Sx Air column Temp Corrector
CFZ	(with Z sensor); 40 g/m^2; Normal or ratio algorithm (default)	Z-correction coefficient on-sheet (normal or default CFZ)
CFZS	0.0	Z-correction coefficient standardize
KCM2	0.0	used for Mylar curve to customer product curve transformation

5.2.5. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration time. Waiting interval between references = zero.

Table 5-14 lists and describes stability specifications.

Table 5-14 Stability Specifications

Typical 1 sigma F/A ratio = 0.00004
Investigational limit 1 sigma F/A = 0.00010

5.3. 4303-01 Kr-85 (medium-ash board applications)

Table 5-15 lists and describes gauge range information.

Table 5-15 Gauge Range Information

Range	15-1200 g/m^2
Ash range	5-20%
Hardware set-up	Gain = step C on amplifier 05431602; Gap = 10.16 mm (0.4 in); Flag = 2 mil or 65 g/m^2 Mylar

5.3.1. Typical values of constants determined during Mylar calibration

Table 5-16 provides the typical nominal calibration coefficients when a single curve fits the entire weight range. Coefficients vary for other weight ranges.

Table 5-16 Sensor Constants (during Mylar calibration)

Clean	**Dirty Using 1 mil Mylar Dirt**
BA0 ≅ 0	BD0 ≅ 0.1
BA1 ≅ -350	BD1 ≅ 6
BA2 ≅ --27	BD2 ≅ 0.5
BA3 ≅ 6	BD3 ≅ -0.5
BA4 ≅ 4	BD4 ≅ 0
BA5 ≅ 1	BD5 ≅ 0
BA6 ≅ 0.1	BD6 ≅ 0

5.3.2. Grade-dependent constants

Table 5-17 lists and describes grade-dependent constants.

Table 5-17 Grade-dependent Constants

BWDO = 0
KCM = Depends on application but expect to be between 0.97 and 1.02

5.3.3. Accuracy specifications

Table 5-18 lists and describes accuracy specifications.

Table 5-18 Accuracy Specifications

Specification	**Value**
Calibration fit accuracy	± 0.10 g/m^2 below 40 g/m^2 ± 0.25% above 40 g/m^2
Static Mylar verification accuracy for all points; Mylar dirt for verification = 1/2 mil:	± 0.14 g/m^2 below 40 g/m^2 ± 0.40% above 40 g/m^2

5.3.4. Constants supplied by the sensor development department

Table 5-19 lists typical measurements of constants.

Table 5-19 Measured Constants (typical values)

Constant	Value
Background	15 mV
Air Volts	7.5 ± 1.5 V (set gain for 6-9V)
T0FA	0.82 ± 0.02
T0CF	-0.002 ± 0.001 for 1 mil Mylar
T012	Not applicable
T0F2	Not applicable

Table 5-20 lists and describes constants supplied by the sensor development department.

Table 5-20 Sensor Constants (sensor development department)

Constant	Value	Definition
AGAU	1800 g/m^2/K	Upper Air Gap Temp Corrector
AGAL	1800 g/m^2/K	Lower Air Gap Temp Corrector
AGAR	0 g/m^2/K	Rx Air column Temp Corrector
AGAS	4300 g/m^2/K	Sx Air column Temp Corrector
CFZ	30 (<550 g/m^2) 35 (550-1000 g/m^2) 55 (>1000 g/m^2)	Z-correction coefficient on-sheet (normal or default CFZ)
CFZS	0.0	Z-correction coefficient standardize
KCM2	0.0	used for Mylar curve to customer product curve transformation

5.3.5. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration time. Waiting interval between references = zero.

Table 5-21 lists and describes stability specifications.

Table 5-21 Stability Specifications

Typical 1 sigma F/A ratio = 0.00004
Investigational limit 1 sigma F/A = 0.00016

5.4. 4303-02 Kr-85 (high-ash board applications)

Table 5-22 lists and describes gauge range information.

Table 5-22 Gauge Range Information

Range	20-1000 g/m^2
Ash range	>20%
Hardware set-up	Gain = step B on amplifier 05431601; Gap = 10.16 mm (0.4 in); Flag = 2 mil or 65 g/m^2 Mylar

5.4.1. Typical values of constants determined during Mylar calibration

Table 5-23 provides the typical nominal calibration coefficients when a single curve fits the entire weight range. Coefficients vary for other weight ranges.

Table 5-23 Sensor Constants (during Mylar calibration)

Clean	**Dirty Using 1 mil Mylar Dirt**
BA0 ≅ -1.5	BD0 ≅ -0.4
BA1 ≅ -270	BD1 ≅ 3
BA2 ≅ -38	BD2 ≅ -4
BA3 ≅ -13	BD3 ≅ -4
BA4 ≅ -3.5	BD4 ≅ -1
BA5 ≅ -0.4	BD5 ≅ 0.2
BA6 ≅ 0	BD6 ≅ 0

5.4.2. Grade-dependent constants

Table 5-24 lists and describes grade-dependent constants.

Table 5-24 Grade-dependent Constants

BWDO = 0
KCM = Depends on application but expect to be between 0.97 and 1.02

5.4.3. Accuracy specifications

Table 5-25 lists and describes accuracy specifications.

Table 5-25 Accuracy Specifications

Specification	**Value**
Calibration fit accuracy	± 0.10 g/m^2 below 40 g/m^2 ± 0.25% above 40 g/m^2
Static Mylar verification accuracy for all points; Mylar dirt for verification = 1/2 mil:	± 0.14 g/m^2 below 40 g/m^2 ± 0.40% above 40 g/m^2

5.4.4. Constants supplied by the sensor development department

Table 5-26 lists typical measurements of constants.

Table 5-26 Measured Constants (typical values)

Constant	**Value**
Background	15 mV
Air Volts	7.5 ± 1.5 V (set gain for 6-9V)
T0FA	0.78 ± 0.02
T0CF	-0.0032 ± 0.001 for 1 mil Mylar
T012	Not applicable
T0F2	Not applicable

Table 5-27 lists and describes constants supplied by the sensor development department.

Table 5-27 Sensor Constants (sensor development department)

Constant	**Value**	**Definition**
AGAU	1800 $g/m^2/K$	Upper Air Gap Temp Corrector
AGAL	1800 $g/m^2/K$	Lower Air Gap Temp Corrector
AGAR	0 $g/m^2/K$	Rx Air column Temp Corrector
AGAS	4300 $g/m^2/K$	Sx Air column Temp Corrector
CFZ	15 (<550 g/m^2) 35 (550-1000 g/m^2) 83 (>1000 g/m^2)	Z-correction coefficient on-sheet (normal or default CFZ)
CFZS	0.0	Z-correction coefficient standardize
KCM2	0.0	used for Mylar curve to customer product curve transformation

5.4.5. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration time. Waiting interval between references = zero.

Table 5-28 lists and describes stability specifications.

Table 5-28 Stability Specifications

Typical 1 sigma F/A ratio = 0.00012
Investigational limit 1 sigma F/A = 0.00016

5.5. 4303-03 Kr-85 (1" gap)

Table 5-29 lists and describes gauge range information.

Table 5-29 Gauge Range Information

Range	15-1000 g/m^2
Ash range	5-20%
Hardware set-up	Gain = step 3-5 on amplifier 05431601; Gap = 25.0 mm (1 in); Flag = 2 mil or 65 g/m^2 Mylar

5.5.1. Typical values of constants determined during Mylar calibration

Table 5-30 provides the typical nominal calibration coefficients when a single curve fits the entire weight range. Coefficients vary for other weight ranges.

Table 5-30 Sensor Constants (during Mylar calibration)

Clean	**Dirty Using 1 mil Mylar Dirt**
BA0 ≅ 0.1	BD0 ≅ 0.03
BA1 ≅ -440	BD1 ≅ 9
BA2 ≅ -45	BD2 ≅ 10
BA3 ≅ -14	BD3 ≅ 11
BA4 ≅ -8	BD4 ≅ 5
BA5 ≅ -2	BD5 ≅ 1
BA6 ≅ -0.2	BD6 ≅ 0.1

5.5.2. Grade-dependent constants

Table 5-31 lists and describes grade-dependent constants.

Table 5-31 Grade-dependent Constants

BWDO = 0
KCM = Depends on application but expect to be between 0.97 and 1.02

5.5.3. Accuracy specifications

Table 5-32 lists and describes accuracy specifications.

Table 5-32 Accuracy Specifications

Specification	**Value**
Calibration fit accuracy	± 0.20 g/m^2 below 80 g/m^2 ± 0.25% above 80 g/m^2
Static Mylar verification accuracy for all points; Mylar dirt for verification = 1/2 mil:	± 0.32 g/m^2 below 80 g/m^2 ± 0.40% above 80 g/m^2

5.5.4. Constants supplied by the sensor development department

Table 5-33 lists typical measurements of constants.

Table 5-33 Measured Constants (typical values)

Constant	Value
Background	30 mV
Air Volts	7.5 ± 1.5 V (set gain for 6-9V)
T0FA	0.87 ± 0.02
T0CF	-0.0016 ± 0.001 for 1 mil Mylar
T012	Not applicable
T0F2	Not applicable

Table 5-34 lists and describes constants supplied by the sensor development department.

Table 5-34 Sensor Constants (sensor development department)

Constant	Value	Definition
AGAU	4500 g/m^2/K	Upper Air Gap Temp Corrector
AGAL	4500 g/m^2/K	Lower Air Gap Temp Corrector
AGAR	0 g/m^2/K	Rx Air column Temp Corrector
AGAS	4300 g/m^2/K	Sx Air column Temp Corrector
CFZ	0 (no Z sensor)	Z-correction coefficient on-sheet (normal or default CFZ)
CFZS	0.0	Z-correction coefficient standardize
KCM2	0.0	used for Mylar curve to customer product curve transformation

5.5.5. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration time. Waiting interval between references = zero.

Table 5-35 lists and describes stability specifications.

Table 5-35 Stability Specifications

Typical 1 sigma F/A ratio = 0.00005
Investigational limit 1 sigma F/A = 0.00012

5.6. 4303-04 Sr-90 (low-ash heavy sheets)

Table 5-36 lists and describes gauge range information.

Table 5-36 Gauge Range Information

Range	100-5000 g/m^2
Ash range	5-20%
Hardware set-up	Gain = unknown on amplifier 05431602; Gap = 10.0 mm (0.4 in); Flag = 20 mil or 640 g/m^2 Mylar

5.6.1. Typical values of constants determined during Mylar calibration

Table 5-37 provides the typical nominal calibration coefficients when a single curve fits the entire weight range. Coefficients vary for other weight ranges.

Table 5-37 Sensor Constants (during Mylar calibration)

Clean	**Dirty Using 5 mil Mylar Dirt**
BA0 ≅ -2.6	BD0 ≅ 1
BA1 ≅ -1924	BD1 ≅ 17
BA2 ≅ -166	BD2 ≅ -16
BA3 ≅ -15	BD3 ≅ -8
BA4 ≅ -0	BD4 ≅ 0

5.6.2. Grade-dependent constants

Table 5-38 lists and describes grade-dependent constants.

Table 5-38 Grade-dependent Constants

BWDO = 0
KCM = Depends on application but expect to be between 0.97 and 1.02

5.6.3. Accuracy specifications

Table 5-39 lists and describes accuracy specifications.

Table 5-39 Accuracy Specifications

Specification	**Value**
Calibration fit accuracy	± 0.50 g/m^2 below 200 g/m^2 ± 0.25% above 200 g/m^2
Static Mylar verification accuracy for all points; Mylar dirt for verification = 3 mil:	± 0.80 g/m^2 below 200 g/m^2 ± 0.40% above 200 g/m^2

5.6.4. Constants supplied by the sensor development department

Table 5-40 lists typical measurements of constants.

Table 5-40 Measured Constants (typical values)

Constant	**Value**
Background	30 mV
Air Volts	7.5 ± 1.5 V (set gain for 6-9V)
T0FA	0.69± 0.02
T0CF	-0.002 ± 0.001 for 1 mil Mylar
T012	Not applicable
T0F2	Not applicable

Table 5-41 lists and describes constants supplied by the sensor development department.

Table 5-41 Sensor Constants (sensor development department)

Constant	**Value**	**Definition**
AGAU	1800 g/m^2/K	Upper Air Gap Temp Corrector
AGAL	1800 g/m^2/K	Lower Air Gap Temp Corrector
AGAR	0 g/m^2/K	Rx Air column Temp Corrector
AGAS	4300 g/m^2/K	Sx Air column Temp Corrector
CFZ	430 (<950 g/m^2) 455 (950-1950 g/m^2) 485 (>1950 g/m^2)	Z-correction coefficient on-sheet (normal or default CFZ)
CFZS	0.0	Z-correction coefficient standardize
KCM2	0.0	used for Mylar curve to customer product curve transformation

5.6.5. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration time. Waiting interval between references = zero.

Table 5-42 lists and describes stability specifications.

Table 5-42 Stability Specifications

Typical 1 sigma F/A ratio = 0.00005
Investigational limit 1 sigma F/A = 0.00012

5.7. 4303-07 Sr-90 (high-ash, 1” gap)

Table 5-43 lists and describes gauge range information.

Table 5-43 Gauge Range Information

Range	100-5000 g/m^2
Ash range	>20%
Hardware set-up	Gain = 2 on amplifier 05431601; Gap = 25.0 mm (1.0); Flag = 20 mil or 640 g/m^2 Mylar

5.7.1. Typical values of constants determined during Mylar calibration

Table 5-44 provides the typical nominal calibration coefficients when a single curve fits the entire weight range. Coefficients vary for other weight ranges.

Table 5-44 Sensor Constants (during Mylar calibration)

Clean	**Dirty Using 5 mil Mylar Dirt**
BA0 ≅ 2.0	BD0 ≅ -1.6
BA1 ≅ -2057	BD1 ≅ 84
BA2 ≅ -571	BD2 ≅ 111
BA3 ≅ -660	BD3 ≅ 88
BA4 ≅ -597	BD4 ≅ 13
BA5 ≅ -315	BD5 ≅ -24
BA6 ≅ -86	BD6 ≅ -14
BA7 ≅ -10	BD7 ≅ -2

5.7.2. Grade-dependent constants

Table 5-45 lists and describes grade-dependent constants.

Table 5-45 Grade-dependent Constants

BWDO = 0
KCM = Depends on application but expect to be between 0.97 and 1.02

5.7.3. Accuracy specifications

Table 5-46 lists and describes accuracy specifications.

Table 5-46 Accuracy Specifications

Specification	**Value**
Calibration fit accuracy	± 0.50 g/m^2 below 200 g/m^2 ± 0.25% above 200 g/m^2
Static Mylar verification accuracy for all points; Mylar dirt for verification = 3 mil:	± 0.80 g/m^2 below 200 g/m^2 ± 0.40% above 200 g/m^2

5.7.4. Constants supplied by the sensor development department

Table 5-47 lists typical measurements of constants.

Table 5-47 Measured Constants (typical values)

Constant	**Value**
Background	30 mV
Air Volts	7.5 ± 1.5 V (set gain for 6-9V)
T0FA	0.74± 0.02
T0CF	-0.006 ± 0.001 for 5 mil Mylar
T012	Not applicable
T0F2	Not applicable

Table 5-48 lists and describes constants supplied by the sensor development department.

Table 5-48 Sensor Constants (sensor development department)

Constant	**Value**	**Definition**
AGAU	4500 $g/m^2/K$	Upper Air Gap Temp Corrector
AGAL	4500 $g/m^2/K$	Lower Air Gap Temp Corrector
AGAR	0 $g/m^2/K$	Rx Air column Temp Corrector
AGAS	4300 $g/m^2/K$	Sx Air column Temp Corrector
CFZ	0 (no Z sensor)	Z-correction coefficient on-sheet (normal or default CFZ)
CFZS	0.0	Z-correction coefficient standardize
KCM2	0.0	used for Mylar curve to customer product curve transformation

5.7.5. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration time. Waiting interval between references = zero.

Table 5-49 lists and describes stability specifications.

Table 5-49 Stability Specifications

Typical 1 sigma F/A ratio = 0.00006
Investigational limit 1 sigma F/A = 0.00023

6. Static Calibration

This chapter is organized into four sections:

- general calibration instructions
- calibration interface and how to use it
- calibration procedures
- verification procedures

The calibration of the sensor can only be achieved when the sensor is known to be stable. The sensor is calibrated, both clean and dirty, using Mylar samples.

This data is fit using a UniCal proprietary fit routine. The calibration constants are entered, and the sensor is then verified, both clean and with approximately half the dirt used during the generation of the dirty curve.

Customer samples are read in the sensor, and a mulitiplicative factor called KCM is applied to the Mylar calibration curve. The KCM represents the small difference in absorption properties of the customer product relative to the base Mylar curve. Transfer samples are set up to maintain long term sensor accuracy.

6.1. General calibration instructions

6.1.1. Conversion constants

Table 6-1 provides conversion constants between common basis weight units.

Table 6-1 Conversion Constants

Customer Units	Unit Conversion Factor
g/m^2	1.0
$lb/3{,}300\ ft^2$	0.6759
$lb/3{,}000\ ft^2$	0.6145
$lb/1{,}000\ ft^2$	0.2048
$lb/yard^2$	0.001843
$oz/yard^2$	0.02949

For example, 1 g/m^2 is 0.6145lbs/3000 ft^2.

6.1.2. Required tools

The following tools are required for calibration:

- Mylar sample set including simulated dirt for calibration and verification
- sensor calibration constants from original calibration
- 11.43-cm (4.5-in) and 17.78-cm (7-in) dies
- customer samples
- sample paddle for appropriate head
- lab balance

For an 11.43-cm (4.5-in) sample the conversion factor is:

(weight in grams) × (97.458) = sheet basis weight in g/m^2

For a 17.78-mm (7.0-in) sample the conversion factor is:

(weight in grams) × (40.276) = sheet basis weight in g/m^2

Details on using the paddle (Figure 6-1) can be found in the scanner system

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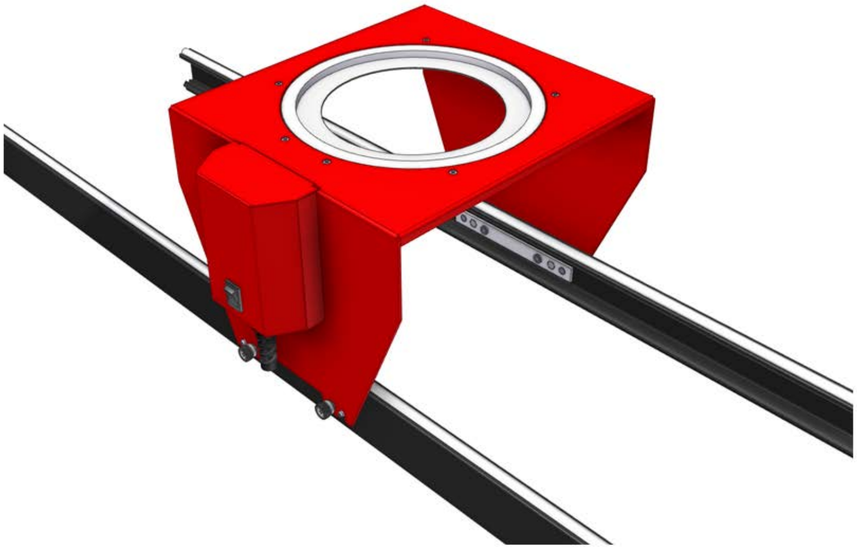


Figure 6-1 Sample Paddle

6.1.3. Pre-calibration sensor checks

Before calibrating:

1. Verify that the sensor meets the F/A stability standards as listed in calibration package. When doing an F/A stability, make sure that the heads are thermally stabilized and the integration time for reference/standardize is set to 16 seconds.

   References should be done in groups of 30, and a 1 sigma for the F/A can be computed for each group of 30. It is a good idea to do at least two groups of 30 to verify that the sensor has reached a stable condition. The stability test can be done using the **Sensor Maintenance** display by choosing maintenance mode.

2. For optimum stability:

   close up heads

   establish thermal equilibrium (takes approximately 2 hours)

3. Check sample paddle interference: without a sample in the paddle, sample should give sensor ratios of 1.0000 ± 0.0010 or better.

4. Ensure that the integration times for references and samples are 16 seconds, and if possible do a screen copy to document these integration times.

6.1.4. Mylar calibration procedure

For Mylar calibration:

1. Determine the customer basis weight range.

2. Put together a Mylar sample set with at least one, and preferably two, samples lighter and heavier than the lightest and heaviest customer samples.

   The set should contain at least 10 samples. More samples are needed if the calibration is to be over a wide range (see Step 6). The samples should be carefully weighed and their basis weights recorded.

   A Mylar dirt simulation sample for calibration, and a dirt simulation sample for verification, which is typically about one half the basis weight of the dirt simulation sample for calibration, are also needed.

   Six transfer samples spanning the weight range should also be prepared. Transfer samples are individual samples of varying weight (rather than thin samples to be stacked).

3. After the sensor has passed the pre-calibration checks, do a background and reference, and read each sample. Rotate and stir the samples to ensure uniform illumination of the sample by the beam.

   Drift Check: Read an air sample (empty paddle, 16 seconds) at the beginning of the calibration. Read another air sample at the end of the calibration, or every 10 samples if additional samples are required. If the drift exceeds the following limits, do another reference and repeat the preceding samples:

   - sensor ratio drift limit: ± 0.0003

4. Put the appropriate dirt simulation (see Chapter 5) sample in the paddle, do a reference (with the dirt), and read each sample (with the dirt). At this point each sample has an associated clean and dirty ratio. Again, read a dirty air sample (empty paddle except for the dirt) at the beginning and end of the calibration to check for drift.

5. Fit the clean and dirty data to determine the UniCal fit coefficients.

6. See Chapter 5 for the fit goodness in the accuracy specification section, or allow the calibration department to check when doing the fit. If the fit is not as good as listed, and the weight range is large, try breaking the fit into two fit segments. There should be at least eight points per range.

7. Compare the fit coefficients with those in Chapter 5, or with the original fit. The coefficients should be generally similar. If the weight range is similar and the same number of coefficients are chosen, the fit coefficients should be very close to those given, particularly BA1 and T0CF ([dirty F/A] - [clean F/A]).

6.1.5. Mylar verification procedure

For Mylar verification:

1. Do a clean reference and then read at least six of the samples throughout the range. Chapter 5 lists the applicable verification accuracies, and these are listed in the calibration package shipped with each system.

2. Using half the amount of dirt as was used in the original calibration, do a dirty reference and then read the same samples with the dirt in place. The calibration package from the original calibration lists the applicable verification accuracies.

6.1.6. Mylar transfer samples

The Mylar transfer samples are intended to be long-term repeatability samples used as part of a regular sensor preventative maintenance program. After calibration has been verified on Mylar standards, determine the basis weights of the Mylar transfer samples as follows:

1. Do a clean reference.

2. Read transfer samples clean.

3. Do a dirty reference.

4. Read transfer samples dirty.

5. Average the clean and dirty basis weights for each sample. This average becomes the Lab Basis Weight for each transfer sample, and is marked on the sample.

6. Compare the average basis weight to the basis weight clean and the basis weight dirty. Basis weight clean and basis weight dirty should verify to average basis weight within the accuracy specifications given in Chapter 5.

6.1.7. Customer product procedure

The purpose of reading the customer product is to determine the offset of the sensor response for the customer product relative to the calibration standard, Mylar. This offset is expressed as a multiplicative quantity called KCM.

In general, all grades will have the same KCM values even though the software allows the possibility for each grade to have its own KCM. The two known reasons why KCM may differ from one grade to the next are:

- Additives such as barium sulfate. Because barium has an atomic number of 56, the sensor reads these samples as heavier than they really are, giving a KCM value *lower* than ash-free paper.

- Formation in the paper may cause non-linear averaging of the weights. This will cause the KCM value to read *high*. This should not be confused with formation effects showing up as random noise when sampling, due to the fact that the sample is not completely uniformly illuminated by the beam no matter how carefully the sample paddle is designed.

Random effects from non-uniformity are best handled by reading several samples from each grade, averaging all the KCM values, then using this average for the grade. A general rule is to average the KCM values of various grades if no sample has a KCM more than 0.0075 from the average.

1. Prepare the customer samples by dieing-out one or more seven-inch disks for each sample.

2. Make sure the sensor has verified clean and dirty on Mylar.

3. Do a clean reference.

4. Read one or more samples of each grade.

5. Die-out an 11.43-cm (4.5-in) center of each sample read. This is done because the sample paddle only allows the center 11.43 cm (4.5 in) of the sample to be illuminated by the beam.

6. Weigh each 11.43-cm (4.5-in) sample and calculate the basis weight: g/m^2 or customer units using the unit conversion factors (UCF) shown in Table 6-1: multiple grams by 97.46.

7. Calculate KCM.

6.2. Using the calibration interface

Perform all the general maintenance procedures in this section using the **Sensor Maintenance** display.

Have a laptop computer at the scanner during the calibration process so that the results of each of the samples can be seen. The laptop can be connected to a port on the Ethernet switch in the endbell. A local IP address is provided through DHCP. Remote-desktop to the RAE server by any number of methods such as VNC, PCAnywhere, RDP, Windows Remote Desktop, and others. The IP address of the server as seen by the MSS-RAE network should be used to connect to the server.

6.2.1. Verify sensor stability

Before starting to perform any further maintenance procedure, always ensure that the sensor is in a working condition by verifying its stability. Generally, this procedure involves requesting multiple references. The statistics, such as the average and the standard deviation (sigma), of the readings should be reasonably within the tolerance limit set forth in the sensor manual.

Usually, if the statistical numbers do not fall into specification, there may be some hardware or environment issues associated with the sensor. Stop and resolve the problem before going any further.

1. In maintenance mode, request at least one background operation before requesting references.

2. Set up to request a set or multiple sets of 30 references using the method described in the scanner documentation. The results of more than one set of operations usually give a more reliable view of the stability of the sensor.

3. Compare the resulting statistics against the specification in Chapter 5.

4. If within specification, proceed to the next maintenance procedure. Otherwise, troubleshoot the sensor to find out what caused the problem reading.

6.2.2. Calibration

Advanced maintenance procedures are performed on the display called up by the Advanced maintenance selector while RAE is in maintenance mode (see **Figure 6-2**).

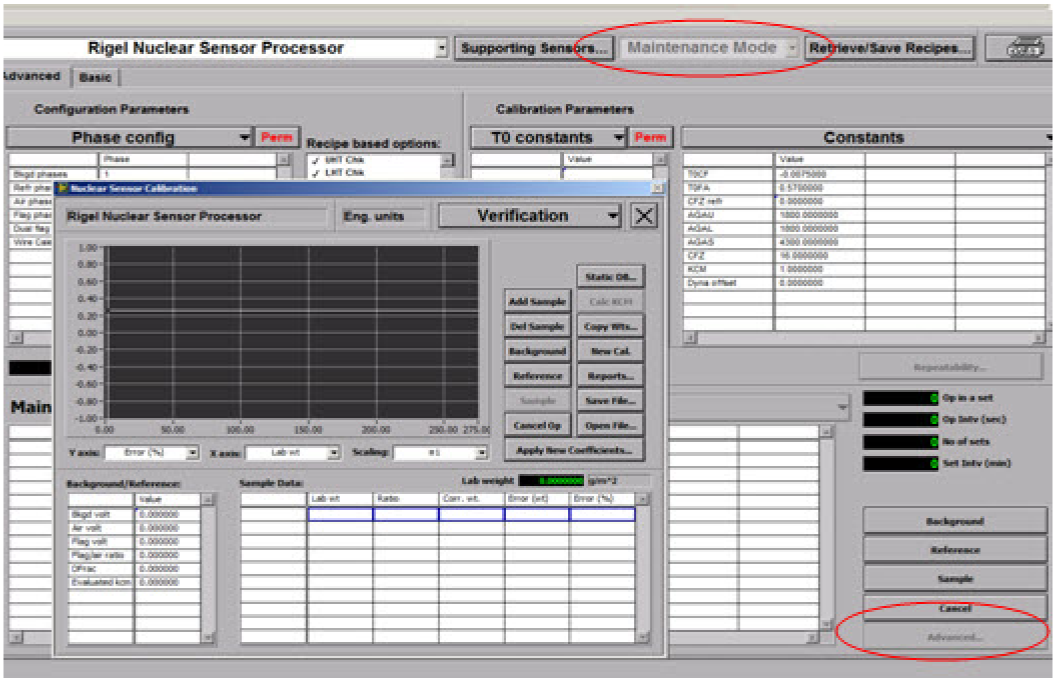


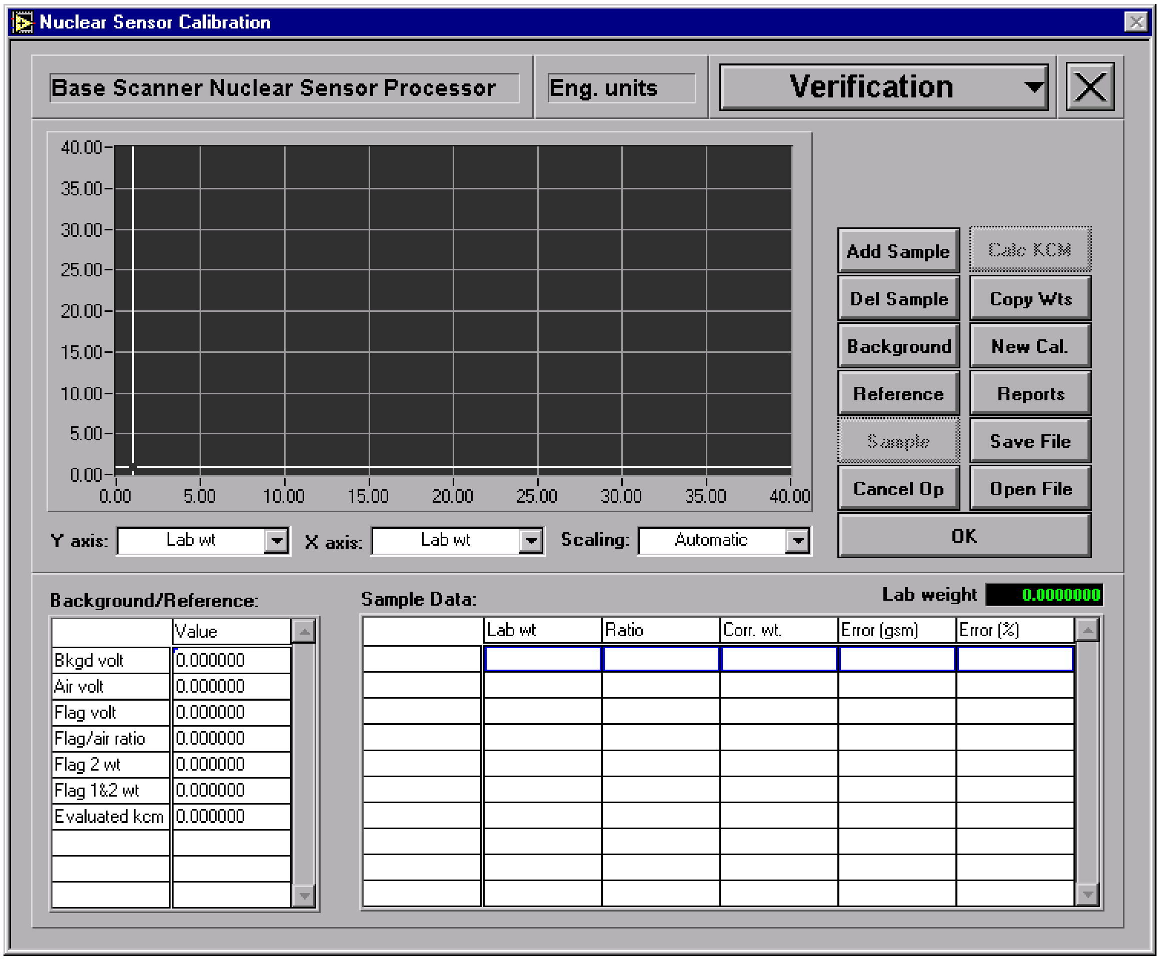
Figure 6-2 Calibration Display

Finish the calibration procedure or, more generally, the advanced procedure of a processor before engaging in the calibration procedure of another processor of the same sensor type, because the common interface maintains only one copy in working memory for the calibration of a sensor type. By selecting a processor other than the one currently being calibrated, for example, nuclear sensor on scanner 2 while the calibration of the nuclear sensor on scanner 1 is underway, acts as a request to the common interface server to prepare the memory for a brand new procedure. As a result, the memory gets re-initialized.

If pre-empting the calibration of one processor with the calibration of another is necessary, click **Save File** to save the calibration data into a file before the switching. Retrieve it later by clicking **Open File**.

6.2.3. Nuclear sensor Advanced display

The advanced display for the nuclear sensors is called **Nuclear Sensor Calibration** display (see **Figure 6-3**).



Nuclear Sensor Calibration

Base Scanner Nuclear Sensor Processor

Eng. units

Verification

Y axis: Lab wt

X axis: Lab wt

Scaling: Automatic

Lab weight 0.0000000

Background/Reference:

	Value
Bkgd volt	0.000000
Air volt	0.000000
Flag volt	0.000000
Flag/air ratio	0.000000
Flag 2 wt	0.000000
Flag 1&2 wt	0.000000
Evaluated kcm	0.000000

Sample Data:

	Lab wt	Ratio	Corr. wt.	Error (gsm)	Error (%)

Figure 6-3 Nuclear Sensor Calibration Display

The upper part of the display shows which nuclear sensor in the system is under maintenance and what system of units, either the engineering units or the customer units, are being used. These two settings are inherited from the **Sensor Maintenance** display, and can only be changed from there.

6.2.3.1. Available modes

The calibration window has three operation modes, accessible through the top right-hand drop-down menu:

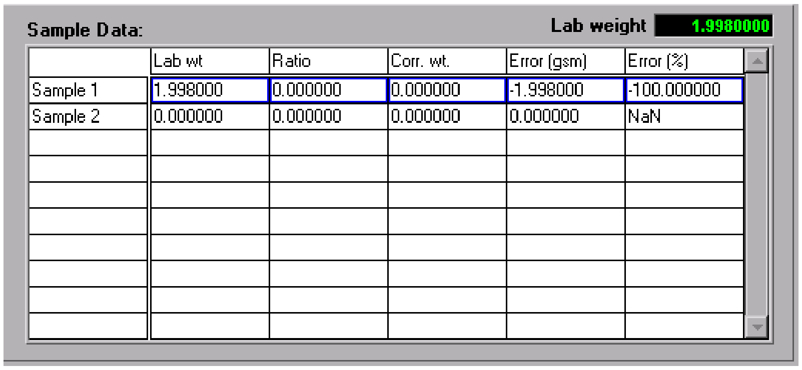
- **Verification**: used to verify a previously obtained calibration and/or determine the multiplicative correction factor, KCM, which accounts for the material difference between individual customer product and the standard material used in calibration.

- **Clean calibration**: used by the calibration procedure to hold results on the standard clean samples.
- **Dirty calibration**: used by the calibration procedure to hold results on the standard dirty samples (clean samples plus a dirt simulation sample).

6.2.3.2. Add a sample

To add a sample in any mode, click **Add Sample**. If there are already samples in the **Sample Data:** table, the new entry will be added immediately after the highlighted sample.

A new sample entry will be added to the **Sample Data:** table at the bottom of the **Advanced** display (see **Figure 6-3**, and **Figure 6-4**). By default, the new sample entry has a lab weight of 0.000000. To modify, highlight the new sample entry and change the value in the **Lab wt numeric control** text box.



Sample Data:

Lab weight 1.9980000

	Lab wt	Ratio	Corr. wt.	Error (gsm)	Error (%)
Sample 1	1.998000	0.000000	0.000000	-1.998000	-100.000000
Sample 2	0.000000	0.000000	0.000000	0.000000	NaN

Figure 6-4 Sample Data: Table

6.2.3.3. Delete a sample

To delete a sample from the **Sample Data:** table of a mode, that is, **Verification**, **Clean calibration**, or **Dirty calibration**, highlight the sample by clicking on the row, then click **Del Sample**.

6.2.3.4. Copy sample weights

It is possible to save the time of re-entering all the weights for a different mode, if they turn out to be identical, by copying them from one mode to the other. To copy sampling weights:

1. Click **Copy Wts** (the user is prompted to select the source).
2. Select the desired mode from which to copy.
3. Click **OK** to accept the choice.

6.2.3.5. Start a new calibration/verification

To start a new calibration/verification, click **New Cal**.

6.2.3.6. Open and save a calibration/verification file

At any time during the calibration/verification procedure, save the data into a file by clicking **Save File**. The path for nuclear sensor is defaulted to *%MXRoot%HMX\Database\Calibration Data\Nuclear* and requires entering a name.

6.3. Calibration procedures

Start from a blank working space. The Calibration area will be blank the first time the **Advanced** display is called up. If not, click **New Cal.**, or load a previous file.

6.3.1. Clean calibration

For clean calibration:

1. Select **Clean Calibration** mode.
2. Ensure to select to clear the **Curve Fit** check box.
3. Click **Background** to request a background operation (nothing in the gap). The result shows up in the **Background/Reference** table at the lower leftmost corner of the display.
4. Click **Reference** to request a reference operation without anything in the sensor gap. The result also shows up in the **Background/Reference** table. This is the clean reference and the

result will be included in the time-zero constant calculation, should the calibration be adopted.

5. Add entries for weights in the standard set. Modify lab weight fields. The sensor is now ready to shoot clean samples.
6. Select the first entry in the **Sample Data:** table.
7. Place the corresponding standard sample in the paddle, insert it into the sensor gap, and request the sample operation either from the RAE display, or from the sample paddle switch.
8. When the operation is done, the result is read and incorporated into the **Sample Data:** table. The highlighted row automatically shifts down to the next entry.
9. Stack the second sample on top of the first one to make up the lab weight entered for the second entry.
10. Stir and request the sample operation again.
11. Repeat Steps 8–10 for the third entry, the fourth entry, and so on until all the standard weights are measured.
12. There is now data for the clean calibration.
13. Save the data to a file as a safety measure.

6.3.2. Dirty calibration

For dirty calibration:

1. Remove all the samples from the paddle.
2. Select **Dirty calibration** mode.
3. Place the dirt simulation sample in the paddle, insert it to the sensor gap, and perform a reference on it. This is your dirty reference, and the result will be used in the time-zero constant calculation.
4. Click **Copy Wts** to copy the lab weights of the standard set from **Clean calibration** mode. The sensor is now ready to shoot dirty samples.

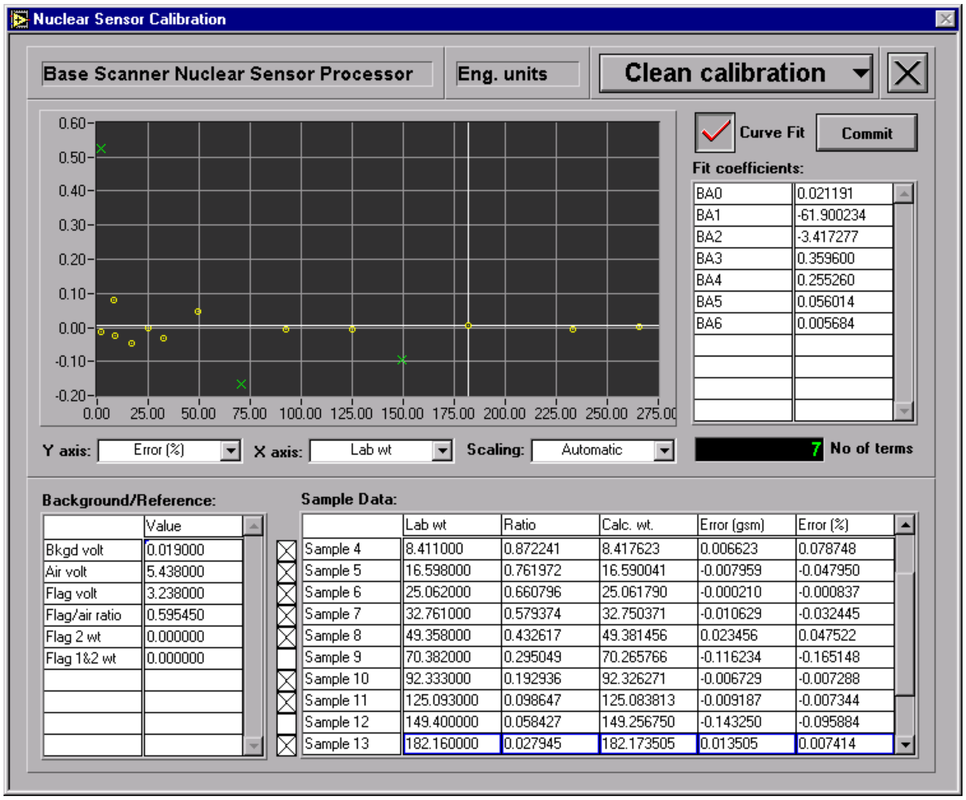
5. Highlight the first entry in the **Sample Data:** table, stack the sample that corresponds to the weight entered in this entry on top of the dirt simulation sample, stir it, and perform a sample operation.

6. Stack the second sample on top of the first one and the dirt simulation sample, and perform a sample operation for the second entry. Continue stacking and performing sample operations for each of the rest of the entries until all of them are done.

7. There is now data for the dirty calibration. Save the data again. To avoid a circular overwrite problem, save the data to the same file created for the clean calibration procedure.

6.3.3. Fit clean and dirty curves

Figure 6-5 shows typical results for a clean Mylar calibration.



☑ Curve Fit

Fit coefficients:

BA0	0.021191
BA1	-61.900234
BA2	-3.417277
BA3	0.359600
BA4	0.255260
BA5	0.056014
BA6	0.005684

Y axis: Error (%)
X axis: Lab wt
Scaling: Automatic
7 No of terms

Background/Reference:

	Value
Bkgd volt	0.019000
Air volt	5.438000
Flag volt	3.238000
Flag/air ratio	0.595450
Flag 2 wt	0.000000
Flag 1&2 wt	0.000000

Sample Data:

		Lab wt	Ratio	Calc. wt.	Error (gsm)	Error (%)
☒	Sample 4	8.411000	0.872241	8.417623	0.006623	0.078748
☒	Sample 5	16.598000	0.761972	16.590041	-0.007959	-0.047950
☒	Sample 6	25.062000	0.660796	25.061790	-0.000210	-0.000837
☒	Sample 7	32.761000	0.579374	32.750371	-0.010629	-0.032445
☒	Sample 8	49.358000	0.432617	49.381456	0.023456	0.047522
☐	Sample 9	70.382000	0.295049	70.265766	-0.116234	-0.165148
☒	Sample 10	92.333000	0.192936	92.326271	-0.006729	-0.007288
☒	Sample 11	125.093000	0.098647	125.083813	-0.009187	-0.007344
☐	Sample 12	149.400000	0.058427	149.256750	-0.143250	-0.095884
☒	Sample 13	182.160000	0.027945	182.173505	0.013505	0.007414

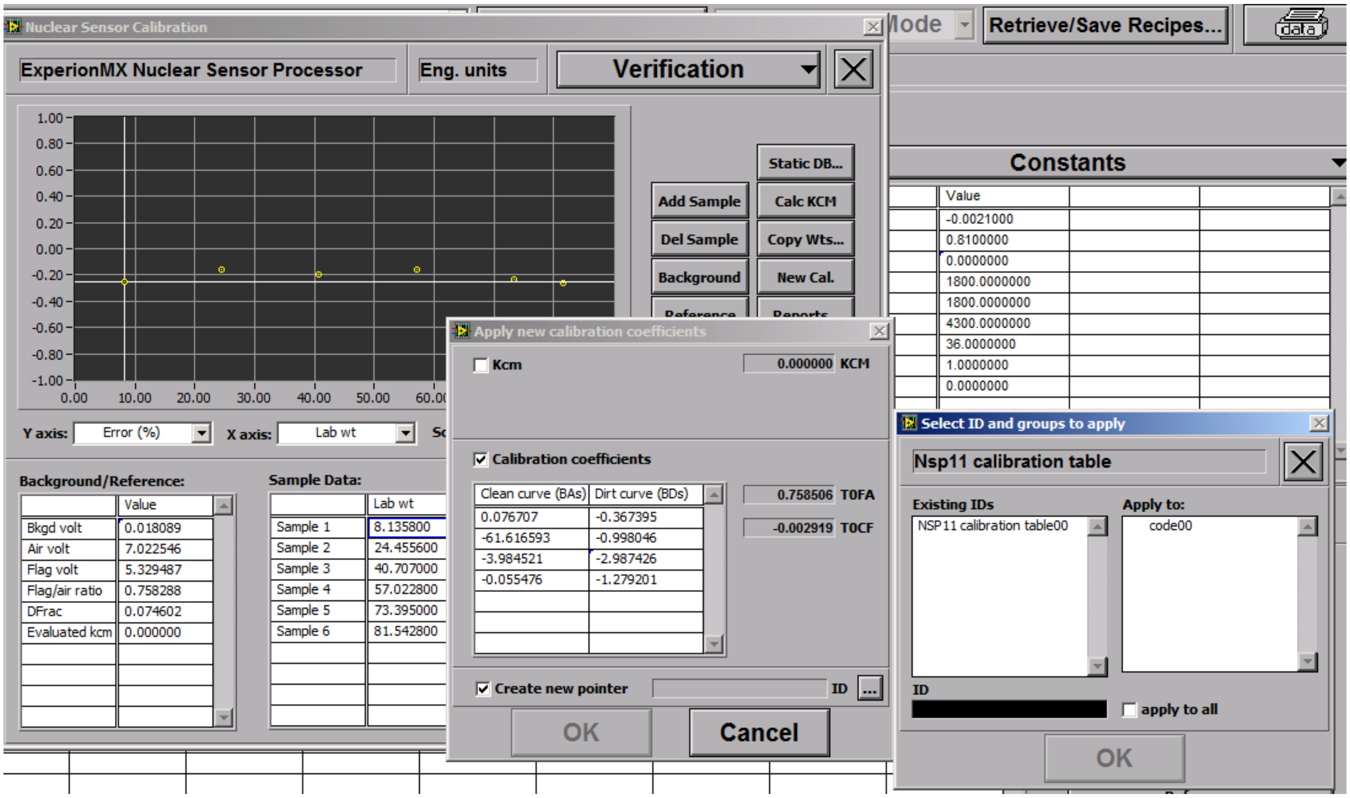
Figure 6-5 Nuclear Sensor Calibration Display

To fit curves:

1. Select **Clean calibration** mode.
2. Select the **Curve Fit** check box to fit the clean sample result.
3. The calibration results can be plotted on the graph with virtually any combination of variables. Select a view, for example, Error (%) vs. Lab weights, or Calculated weights vs. Lab weights, that is the most informative in determining the goodness of the fit.
4. Adjust the number of terms (polynomial orders) used in the curve (**No of terms** text box). Outliers can be identified by looking at the graph, and clicking to clear the check box next to the appropriate sample and refitting the data. Click **Commit** to commit the changes. Take care not to over-fit the curve by selecting too many terms. A general rule is that the number of samples should always be greater or equal to two-times the number of terms used (# of samples ≥ 2 * # of polynomial terms in use).
5. Repeat Step 4 for the **Dirty calibration** mode. Remember to have the obtained clean and dirty curves working correctly for a nuclear sensor. The number of terms must be the same. Once the number of terms is decided in the **Clean calibration** mode, do not change it in the **Dirty calibration** mode. However, if revising (if revising is necessary), go back to **Clean calibration** mode to fit the curve with the new term number again.

6.3.4. Activate the new calibration

Figure 6-6 shows the **Nuclear Sensor Calibration** display, and the **Apply new calibration coefficients**, and **Select ID and groups to apply** dialogs.



Y axis: Error (%)   X axis: Lab wt

Background/Reference:

	Value
Bkgd volt	0.018089
Air volt	7.022546
Flag volt	5.329487
Flag/air ratio	0.758288
DFrac	0.074602
Evaluated kcm	0.000000

Sample Data:

	Lab wt
Sample 1	8.135800
Sample 2	24.455600
Sample 3	40.707000
Sample 4	57.022800
Sample 5	73.395000
Sample 6	81.542800

Constants:

	Value		
	-0.0021000		
	0.8100000		
	0.0000000		
	1800.0000000		
	1800.0000000		
	4300.0000000		
	36.0000000		
	1.0000000		
	0.0000000		

Apply new calibration coefficients

☐ Kcm   0.000000 KCM

☑ Calibration coefficients

Clean curve (BAs)	Dirt curve (BDs)
0.076707	-0.367395
-61.616593	-0.998046
-3.984521	-2.987426
-0.055476	-1.279201

0.758506 TOFA
-0.002919 TOCF

☑ Create new pointer   ID ...

Select ID and groups to apply

Nsp11 calibration table

Existing IDs: NSP11 calibration table00

Apply to: code00

ID

☐ apply to all

Figure 6-6 Select ID and groups to apply Dialog

To permanently add the calibration coefficients into the recipe database:

1. Click **Apply New Coefficients** to call up the **Apply new calibration coefficients** dialog (see Figure 6-6).
2. Select the **Create new pointer** check box, and specify a recipe pointer ID for the set of nuclear sensor coefficient just obtained.
3. On the **Apply new calibration coefficients** dialog, click the browse option button ... to the right of **ID** (see Figure 6-6) to browse existing IDs and see what production code applies.
4. A new or old pointer can be associated with a system recipe later on using the **Recipe Maintenance** display.

The Calibration coefficients portion includes the Clean curve (BAs) and the Dirt curve (BDs) (calculated from both the clean and dirty curves), as well as the time-zero constants. For a dual-flag nuclear sensor, use the current set of calibration coefficients as the one used to calculate the flag weights. Click **OK** to update.

To have the system use the new coefficient in this maintenance mode only, do not select the **Create new pointer** check box, but click **OK** on the **Apply new calibration coefficients** dialog (see Figure 6-6).

6.4. Verification procedures

6.4.1. Clean verification

For clean verification:

1. Ensure that the new calibration coefficients are used by the GSP.
2. In the **Advanced** display, select the **Verification** mode.
3. Request a background operation.
4. Request a reference operation with nothing in the gap.
5. Request a sample operation with nothing in the gap. Verify that the ratio returned is virtually equivalent to 1.
6. Add entries for weights from the standard set. This can be the full set, or just a subset of it.
7. Highlight the first entry in the **Sample Data:** table.
8. Place the corresponding standard sample in the paddle, insert it into the sensor gap, stir it, and request a sample as during the calibration procedure.
9. When the operation is done, verify that the measured result is within the tolerance limit set forth by the sensor manual. Usually, for a nuclear sensor with integration time of 16 seconds, the error should not exceed ± 0.1 g/m^2, or the percentage error should not exceed ± 0.4%.
10. Repeat Steps 7–9 for the second entry, the third entry, and so on, and stack the samples as done during calibration procedures until all the verification weights are measured and verified.

6.4.1.1. Dirt correction verification

For dirt correction verification:

1. Select the **Verification** mode.
2. Insert a dirt simulation sample, usually of half of the weight of the dirt simulation sample that is used in **Subsection 6.3.2**, in the sensor gap. Request a reference operation.
3. Ensure that the dirt correction option for the sensor is turned on, on the **Sensor Maintenance** display.
4. Add entries for weights from the standard set. This can be the full set or just a subset of it; it is not necessary for it to be the same as those used in clean verification; however, they are often the same because it is much simpler to prepare.
5. Leave the dirt simulation sample in the paddle, highlight the first entry in the **Sample Data:** table, stack the corresponding standard sample on top of it, stir, and request a sample operation.
6. Verify that the measured result is within the tolerance limit when the operation is done. This is to see whether the dirt correction is accurate and effective enough to correct the effect of the dirt simulation sample on the samples.
7. Repeat Steps 5 and 6 for the rest of the entries until all the weights are measured and verified.

6.4.2. KCM determination

For KCM determination:

1. Prepare at least five samples of a customer product to determine the KCM value.
2. Measure the basis weight of these samples in the lab, or use samples with weights that are already known.
3. On the **Sensor Maintenance** display, retrieve the recipe for that product using the **Retrieve/Save Recipes** button.
4. If the weights of these samples are known in customer units, go to the **Unit Setup** of the **Measurement Setup** tab, and set up the system customer unit for basis weight to the proper one. Check **In Customer**

Unit? on the **Sensor Maintenance** display to ensure that lab weights can be entered in customer unit.

5. In the verification mode of the **Advanced** display, add entries to the **Sample Data:** table for the product samples. Modify the lab weights. If **In Customer Unit?** on the **Sensor Maintenance** display is selected, these weights should be entered in whatever unit is set up; otherwise, they should be in g/m^2.
6. Request a reference operation without anything inserted in the sensor gap.
7. Request a sample operation for each of the product samples until all of them are done.
8. Click **Calc KCM** to have the KCM value automatically calculated. This routine takes into account the effect of the previous KCM if the KCM correction was enabled during the execution of sample operations. The resulting value is shown in the lower left of the **Background/Reference** table, and is directly applicable to the system.
9. Click **OK** to call up the confirmation dialog. The KCM option is automatically selected if there is one available to update to the system.
10. Click **OK** to confirm the update.
11. Unlike the calibration coefficients, selecting the **Create new pointer** option of the confirmation dialog has no effect on the KCM value. Use the **Retrieve/Save Recipes** dialog to store this value into recipe.

6.4.3. Calibration/KCM reports

To export the calibration and KCM results from the **Advanced** display to a set of standard format printed reports, click **Reports**, then select the reports to print.

7. Basis Weight Calculation Details

This chapter describes the various operations available to the nuclear sensor, and corrections that can be applied to the raw reading. A good understanding of these correctors is required for optimal correlation to customer measurements.

7.1. Sensor operations

7.1.1. Background

A background is scheduled periodically, typically every eight hours. It is taken by reading the basis weight signal after the shutter closed (retracting the capsule). The counts are stored and subtracted from air, flag, sample, and onsheet readings.

7.1.2. Reference and standardize

A reference is manually requested. A standardize is scheduled periodically during the scanning process. Typical standardization times are 20-minute intervals, although it should be done more frequently if there are environmental changes.

A reference is done to one sensor at a time, while a standardize is done to all sensors at the same time. Otherwise, these functions are identical. The reference/standardize is done in two phases: an air phase and a flag phase.

After completion of the second phase the F/A ratio is computed by:

F/A = (Flag_In - Background)/(Air phase - Background)

After this, a quantity used to compute the dirt correction, referred to as the DFRAC, is computed. During reference/standardize the temperatures are read and averaged, as well as the Z-value, and stored as standardize values.

7.2. Online basis weight calculation and corrections

The principal measurement comes from the transmission ratio which, to first approximation, is related to the basis weight of the product by:

$R = e-\mu W$

where W is the basis weight and µ is the absorption coefficient

This is known as *Beer's Law*. In practice a more accurate, and more complicated, algorithm is used that uses weighted higher-order terms to smoothly represent the data.

In order to make the measurement more accurate under scanning conditions, several different correctors are applied. All of the correctors except for the KCM have basis weight units (g/m^2, sometimes written as gsm) and are additive correctors. This feature makes it possible to understand them from a physical basis and to be aware of relative magnitudes of the correctors.

All calculations are always done in the International System of Units (SI units) (grams, meters, Kelvin, and so on), and then converted to any selected customer units for display. A UCF is used to convert basis weight from g/m^2 to customer units.

The correctors are described in this document. The following notation is used:

Sx = Source
Rx = Receiver
Stdz = Reading at last standardize or reference
Now = Now reading (onsheet, while scanning)
U and Up = Upper
L and Low = Lower
Time-zero = The time at which the Mylar calibration is done and T0FA and T0CF are determined
R = Sensor Ratio: Onsheet sensor voltage minus background divided by the air volts minus background

BWUC (uncorrected basis weight): the basis weight of a sample with the same absorption properties as Mylar at the measured ratio. The exact algorithm is proprietary but involves the ratio (R) and BA0, BA1, BA2, and BA3 (and possibly higher terms). The algorithm fits the data very well over a wide range of basis weights; however, it is sometimes necessary to split the calibration fit into two ranges, lighter and heavier.

BWDRT (dirt correction): the dirt correction accounts for any change in mass between the source capsule and the ion chamber that is not product-related from one standardize to the next, for example, debris build-up on the sensor heads, or change in air density.

The DFRAC is computed during standardization. The DFRAC is multiplied by the (dirty-clean) curve computed at the now-ratio to form an additive dirt correction in g/m^2. The DFRAC can best be understood by noting if the F/A value at the last standardize is the same as T0FA then DFRAC = 0, if it is the same as the dirty F/A (= T0FA + T0CF) at calibration then DFRAC = 1.0.

BWKC (KCM correction basis weight): the KCM correction accounts for the fact that there may be slight differences in the absorption properties of the customer product compared to the calibration standard (Mylar). It is determined by reading customer samples and noting the fractional offset relative to the Mylar calibration. The algorithm is:

BWcustomer product = KCM*BWmylar

so that (KCM-1)*100 = % offset of paper relative to Mylar

A KCM of 0.996 means that this grade of paper has an offset of 0.4% relative to Mylar. Typically, KCM is between 0.99 and 1.02 (<± 2% offset from Mylar). KCM is grade-dependent, but for nearly all systems it has the same value for all grades.

BWZ (Z-correction basis weight): the Z-correction accounts for the possibility that the scanner may change shape in the Z-direction so that the height of the air gap and thus the basis weight of the air between the heads can change dynamically. The Z-correction then adds a correction to account for changes in the basis weight of the air between the heads. The algorithm is:

BWZ= CFZ*[(Znow-Zstdz)/Zstdz]

BWTEMP (temperature correction basis weight): the temperature correction accounts for any air density changes due to temperature changes in any of the three or four zones between the source capsule and the ion chamber entrance window. The zones in-between the heads are known as air gaps, and the zones inside the heads are known as air columns. Most models of the basis weight sensors have three correction zones, not four, because the receiver air column thermistor is not present due to the fact that the ion chamber is so close to the source window. The AGA coefficients (see Chapter 7) are the calibration constants for the temperature correction. Tup, stdz, for example, is the upper air gap temperature as measured at the last standardize. For the algorithm, see **Table 7-1.**

Table 7-1 AGA Coefficients

BWTEMP =
AGAU*[(1/Tupr,stdz) - (1/Tupr,now)] +
AGAL*[(1/Tlow,stdz) - (1/Tlow,now)] +
AGAS*[(1/TSx,stdz) - (1/TSx,now)] +
AGAR*[(1/TRx,stdz) - (1/TRx,now)]

BWDO (dynamic offset basis weight): the dynamic offset correction is only applied dynamically, and is meant to account for sheet stretch, flashoff, and so on. That is, actual physical changes in the basis weight of the sheet between the point of measurement and the dynamic laboratory weight measurement. It should not be used without a good reason, and not without checking for other sources of basis weight error. BWDO is an additive correction with units of g/m^2 and does not depend on any calibration constants.

BWPC (profile correction basis weight): the profile correction accounts for any sensitivity of the sensor to changes in the MD and CD head alignment. It is bi-directional, that is, two arrays are stored:

- left-to-right
- right-to-left

BWPC is generated by scanning on a sample. It is an additive correction with units of g/m^2 and does not depend on any calibration constants.

The algorithms that are used during the static sampling process and when scanning are:

BW-sample = BWUC+BWDIRT+BWTEMP+BWKC
BW-scanning = BWUC+BWDIRT+BWTEMP+BWKC+BWZ+BWPC+BWDO

7.3. Calibration constants description

Table 7-2 lists and describes calibration constants.

Table 7-2 Calibration Constants

Name	Description
BA0, BA1, BA2, BA3	Clean Mylar fit coefficients (can have more, depending on the order chosen)
BD0, BD1, BD2, BD3	(Dirty-clean) Mylar fit coefficients
T0FA	Time-zero clean F/A ratio, determined at Mylar calibration
T0CF	Time-zero (dirty F/A-clean F/A) ratio, determined at Mylar calibration
AGAS, AGAR	Source and receiver air column temperature correction coefficients (internal to head)

Name	Description
AGAU, AGAL	Upper and lower air gap temperature correction coefficients (external to head) – not used in ZipLine
CFZ	Z-correction coefficient
CFZS	CFZS = 0 always (because it is not currently used)
KCM	Grade dependent multiplicative factor to account for offset between Mylar and customer product
KCM2	Always set = 0 (because it is not currently used)
BWDO	Dynamic offset to account for sheet stretch, flash-off, and so on
UCF	Converts g/m^2 to customer basis weight units for display and printouts

7.4. Sensor Maintenance display

The **Measurement Calculation** area on the **Sensor Maintenance** display contains all the raw values-intermediate calculated values as well as final calculated values for the uncorrected basis weight as well as all the corrections.

7.5. Scanner Sensor Status display

The **Scanner Sensor Status** display is a very useful diagnostic tool. Whenever there are problems with the basis weight sensor, consult the **Scanner Sensor Status** display. Bad background, standardize, now readings, and so on will be displayed here.

7.6. Printouts

Summary information is printed at background, reference/standardize, and sample. These printouts contain valuable information about the sensor and are also useful as diagnostics.

7.7. Daily sensor report

Although the details vary from one software version to the next, most systems have a daily sensor report that contains summary information about the sensors covering the previous 24 hours.

7.8. Sensor checks

Although the sensor, along with the entire system, is checked at the factory before shipment, it is good practice to thoroughly check out the sensor during installation. Save inspection records, and use the preventative maintenance schedule (see Chapter 8).

7.8.1. Stability

Verify sensor F/A stability using numbers from initial calibration as guide to performance.

7.8.2. Mylar verification

Samples must be checked clean and dirty, but it is probably not necessary to verify all samples. Three or four from the customer product range should be sufficient, but always read them clean and dirty. This is a good time to begin a transfer sample procedure (see Section 6.1.4).

7.8.3. Z-correction details

The Z-correction refers to the fact that as the heads separate from one another, the basis weight of the air in between the heads changes, which then appears to be a change in the sample basis weight unless a correction is made.

There are two parts to the Z-correction:

- accurate measurement of Z, the distance between the heads
- actual correction to the measured basis weight done in software

The Z-correction may be verified by reading a Mylar sample at a basis weight near that of a typical product at various Z-values, at differing head separations. This procedure involves changing the Z-dimension between the heads, which can be accomplished by either putting shims under the wheels of the top head, or by loosening the top head and letting it rest against shims placed on the bottom head.

The advantage of resting the top head on shims on the bottom head is that the Z-sensor calibration can be verified at the same time if the shim thicknesses are accurately known.

Take care so that no metal blocks the Z-sensor, for example, from the sample ring.

It may be convenient to use cardboard sample rings for this test. Typically four or five points can be read, for example 8, 9, 10, 11, and 12 mm (0.31, 0.35, 0.39, 0.43, and 0.47 in) for a sensor that has a nominal 10 mm (0.39 in) gap.

The percent difference from the gap center basis weight, for both the uncorrected and the Z-sensor corrected basis weight of the sample, can be plotted on the Y-axis versus Z-displacement on the X-axis. If done properly, this curve should be smooth.

The Z-correction should make the corrected basis weight nearly insensitive to Z-head displacements or, in other words, the curve for the Z-sensor corrected basis weight should be flat. The algorithm used for the Z-correction is:

BWZ = CFZ * [(Znow-Zstdz)/Zstdz]

So that if the correction is too large or small, CFZ can be changed by the appropriate amount. Regard changes of more than approximately 25% from the nominal CFZ as very suspicious.

7.8.4. KCM correction

Check the KCM correction by reading customer samples. One or two samples should be sufficient to ensure everything is working properly.

7.8.5. Profile correction

Getting an accurate profile correction can be difficult due to the fact that it must be done when the sheet is not in the gap. However, some scanners may change shape depending on the temperature conditions, so that when the heat source (the sheet) is not present, the scanner may assume a different shape than when the sheet is present and heating the scanner.

Generate the profile correction arrays as fast as possible in order that the scanner not change shape too much, but if too little time is spent on each slice, there will be too much statistical noise.

Typically, two to four seconds dwell time (that is the total time spent in the zone for all the scans) per correction zone is about right. Each system should be considered individually. The thermal stability of the scanner and the general thermal conditions will dictate the appropriate dwell time to use.

The profile correction should be generated on a sample, not the flag. The reason for this is that the flag, due to its position very near the source capsule, behaves in a different manner than a sample in the gap when the heads move relative to one another. It is true that a profile correction can be generated on the flag and will verify, but it is not the correction that will make a sheet in the gap center have a flat profile.

The profile correction is stored in two bi-directional arrays:

- left to right
- right to left

To generate a good profile correction:

1. Ensure that the Z-sensor is enabled.
2. Build the profile correction array with the scanner in thermal conditions as close to realistic as possible.
3. For basis weight measurement sensors, set the number of scans so that two to four seconds of data are accumulated per correction zone for each direction. If the scanner is very thermally stable, longer periods can be used; if it is unstable, shorter periods must be used.
4. Place a Mylar sample at the light-weight end of the calibration range in the gap in such a way that it does not impinge on the Z-sensor, and allows air flow over and under the sample.
5. Generate the profile correction arrays (L-to-R and R-to-L).
6. Typical corrections are at most a few tenths of a gram per square meter (for example, ± 0.1 g/m^2 and ± 0.2 g/m^2) and smoothly varying. Numbers over 0.5 g/m^2 could indicate a scanner alignment or scanner track issue.
7. Put a Mylar sample with a weight that is also at the light-weight end of the calibration, set the filter factor to 0.1 or 0.2 and scan on the sample. Check the flatness of the measured sample.

7.8.6. Dynamic offset

The dynamic offset correction is done through the additive constant BWDO. This constant should be set to zero until it can be proven beyond doubt that all other aspects of the sensor are working correctly. When lab measurements consistently show higher or lower data than the scanner, use the difference as BWDO. Again, the purpose of the dynamic offset is to account for effects that change the basis weight of the sheet between the point of the measurement and the lab. Sheet stretch and moisture flashoff are the two primary examples.

7.9. Dynamic verification

The dynamic verification is the most important check by which the sensor performance is judged. Dynamic verification techniques vary from industry to industry and even from mill to mill. This section outlines general techniques that can be followed or adapted to the particular situation found.

There are two general dynamic verification techniques:

- roll check
- die out samples from end of roll

Other informal techniques, such as grab samples, are only valid to a few percent and should be avoided since they generally lead to invalid conclusions about the sensor performance. If the sensor performance is going to be judged, the technique used must be accurate and based on a valid technique.

7.9.1. Roll check

In the roll check method, the reel total weight is obtained from a scale, and the total length, for example, from a tachometer, and the width from either the Honeywell system or an actual measurement of the trim to obtain the average basis weight for the entire reel. That is compared to the Honeywell reel average basis weight.

This can be a very accurate technique since it averages the entire roll; however no information is retained about profile accuracy. An accurate scale and accurate methods for measuring roll length and width are required.

7.9.2. Die-out samples from end-of-roll

In this technique, samples are died out across the sheet and compared to average profile readings at end-of-reel, or filtered scan average basis weight at end-of-reel. Although very time consuming, it potentially yields more information, because it checks the profile accuracy.

1. Choose several positions across the sheet where the basis weight profile is flat, and provide a template to allow repeatable locations of these positions.

2. Ensure that the slice number is accurately known.

3. At reel turn-up, automatically print the basis weight profile on a slice-by-slice basis as well as the profile display.

4. Ensure that there have not been any MD upsets during this period.

5. Prepare sealable containers, such as Ziploc® bags (marked with slice numbers), to put samples into.

6. Slab off 20–30 wraps at the end of a reel. Use the template to mark positions of slices, and die-out as many samples, as deep as possible, using a sharp die. As the paper gets heavier, it becomes more difficult to die-out more samples but the test will be more accurate the more samples that can be died-out.

7. Place the samples in the marked containers. Quickly discard the top and bottom sample or two to avoid moisture conditioning problems.

8. When all samples have been gathered, take the containers to the lab and weigh them. Be very careful to not let the sample condition change moisture content. Either the samples plus the containers weighed and then the container weight subtracted, or only the samples are weighed. The samples must be counted, and the average basis weight per sample computed.

9. At this point, the average basis weight at the end of the reel can be computed for the slices that were checked and then compared with slice averages for the end of the reel, or the samples can be used to calculate an end-of-reel scan average basis weight.

8. Preventive Maintenance

Preventive maintenance, when performed on a periodic basis, can prevent many failures, and catch minor problems before they become major ones.

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	2	1	2	5	
Inspect head gap		X						Section 9.1
Inspect source column temperature sensor			X					Section 9.2
Inspect and replace source flag			X					Section 9.3
Check receiver voltages				X				Section 9.4
Verify transfer samples				X				Section 9.6
Verify gauge stability			X					Section 9.7
Verify shutter operation			X					Section 9.8
Verify wiring					X			Section 9.9

9. Tasks

The information in this chapter is helpful for performing maintenance tasks.

Useful tools:

- digital multimeter (to at least three decimal places, for example, 1.999)
- metric and imperial hex drivers with ball ends: all Experion MX scanner bolts are metric, but sensor bolts are imperial sizes
- computer with spreadsheet and graphics programs (not required, but very helpful)
- calibration sample set
- sample paddle
- transfer sample set

9.1. Inspect head gap

Activity Number:	Q4303-00-ACT-001	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Operator
Priority Level:	Average	**Cautions:**	Radiation
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	1 week
Duration (time period):	10 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	

Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time
	• Digital multimeter for grounding check		

9.2. Inspect source column temperature sensor

The source column temperature measurement is intended to correct for changing of the air density in the volume between the radioactive capsule and the Mylar window. It is visible when the window assembly is removed.

Activity Number:	Q4303-00-ACT-002	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician,
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
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
	• Voltmeter		

The signal from the air column sensor is routed through the sensor backplane and then to the EDAQ.

WARNING

> Only personnel qualified under radiation safety license and with clearance from Honeywell ACS Global Radiological Operations are allowed to replace the temperature measuring device on the source body assembly (source air column measurement).

9.3. Inspect and replace source flag

A flag may break due to old age, or to exposure to chemicals in the environment. Radiation damage is usually not an issue for the flag.

A cracked or broken flag will show an increase in flag voltage, and an increase in F/A ratio, but no change in air volts or background volts.

Activity Number:	Q4303-00-ACT-003	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	60 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time
	• Screw drivers • Allen keys		

Q4303-XX (Sx-18) has only one flag. It can be inspected by splitting the heads and removing the window ring assembly. To replace it:

1. Remove the sensor source from the head and remove the kapton window assembly by removing the middle screw of the groups of three which hold the window in place.
2. The flag assembly is exposed and the flag can be easily removed.

After replacing the flag, move the flag solenoid by hand to make sure the flag does not stick against the surface of the sensor.

9.4. Check receiver voltages

For stable operation, the basis weight receiver requires that the correct voltages are generated on the backplane board. The following procedure uses the test points available to verify the + 24 V, ± 12 V, and - 350 V ion chamber voltage.

Activity Number:	Q4303-00-ACT-004	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	Electric Shock
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	1 week
Overdue Grace Period:		**Frequency (time period):**	2 months
Duration (time period):	30 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

Measure the test points on the receiver backplane PCB and verify against tolerances as shown in **Table 9-1**. Use TP9 as the return for all test points except TP12 (+24V), which uses TP11 as its return.

Table 9-1 Receiver Backplane Test Points

Test Point	**Function**	**Expected**	**Tolerance (± unless otherwise indicated)**
TP1	Ion chamber bias voltage monitor	-3.5V	0.1V
TP2	Air curtain Temp	Not used	n/a
TP3	Basis weight V	6-9V	with shutter open
TP4	Backplane PCB Temp	2.5V	0.5V
TP5	Ceiling Temp	Not used	n/a
TP6	Sensor Temp	Not used	n/a
TP7	+5V	5V	0.1V
TP8	-15V	-15V	0.1V
TP9	Gnd	gnd	
TP10	+15V	+15V	0.1V
TP11	24V return	gnd	0.1V
TP12	+24V	+24V	0.1V

Test Point	Function	Expected	Tolerance (± unless otherwise indicated)
TP13	Edge detect voltage for IR edge detect	Not used	n/a
TP14	-500V ion chamber bias	Do not measure	

9.5. Check Basis Weight Receiver amplifier

The Basis Weight Receiver has a very high gain current-to-voltage amplifier. It is sensitive to static. When failed, the most common characteristic is that the EDAQ ADC is railed at + 10 V, generating a high basis weight alarm or closed high voltage alarm.

Activity Number:	Q4303-00-ACT-005	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	60 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

Typical operational air volts from the receiver should be in the range 6–9 V. The Krypton source decays with a half-life of about 11 years, and it is recommended that the amplifier gain be increased (strapped) every five years to compensate for the signal levels. The Promethium sources decay with a half life of 2.6 years, and those amplifiers should be strapped every year if possible. See section 1.4.2.

With the shutter closed, the amplifier should read a voltage near zero. It should be adjusted to 15 mV ± 5 mV using the trim pot on the PCB. If the signal is still near 10 V, the main OpAmp is broken and the board needs to be replaced.

To replace the amplifer board:

1. Remove the faraday cage cover.
2. Remove the 2 ion chamber signal cables and pull gently to remove the card from the bracket.
3. Note the existing gain switch position.
4. Modify the new amplifier to have the same rotary dial position.
5. Use rubber gloves or a grounding strap while replacing the amplifier to avoid static discharge.

9.6. Verify transfer samples

Activity Number:	Q4303-00-ACT-006	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	Radiation
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	1 week
Overdue Grace Period:		**Frequency (time period):**	2 months
Duration (time period):	60 min	**# of People Required:**	1
Prerequisite Procedures:	Verify gauge stability	**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
	Mylar transfer set		
Required Tools:	Part Number	Quantity	Lead Time
	• Digital multimeter for grounding check		

Read transfer samples using the sample paddle. Do both clean and dirty readings to check calibration and dirt correction. Plot percent deviation from nominal for each sample as a function of time. See Chapter 6 for details.

9.7. Verify gauge stability

Activity Number:	Q4303-00-ACT-007	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	1 week
Overdue Grace Period:		**Frequency (time period):**	1 month
Duration (time period):	30 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

See Chapter 6 for expected values. See Subsection 6.2 for detailed instructions.

9.8. Verify shutter operation

This section describes possible issues with the shutter not closing on command or not opening on time.

Activity Number:	Q4303-00-ACT-008	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	Radiation
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	10 min	**# of People Required:**	2
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time

Required Tools:	Part Number	Quantity	Lead Time

9.8.1. Shutter not closing

There are two independent fault conditions that can occur if the shutter does not close when the digital output is cleared. First, the green light circuit, which connects + 24 V through the green lights through the shutter switches to a ground at the scanner HMI panel, will not turn on.

Secondly, the RAE system will alarm that the receiver voltage is high, but the shutter was commanded closed (red lights are off).

ATTENTION

Beyond the visual inspection described here, field personnel are not allowed to repair a stuck shutter. Honeywell ACS Global Radiological Operations must be called in this event.

Remove power to the EDAQ, or disconnect the sensor harness cable from the head power distribution board, to ensure that all digital outputs are low.

If the actuator closed when the power was removed, the problem is likely a faulty safety interlock circuitry that is part of the PBD (power distribution board). It is unlikely to be a faulty EDAQ digital output because both the digital out for the shutter and the watchdog pulse are required to activate the shutter.

Also, if the EDAQ digital output is shorted on, the feedback signal from the interlock circuitry is now inconsistent with the request from the EDAQ to close the shutter, and this is reported by the software to the RAE system.

With the shutter command off, the shutter indicator should be in the Close position.

Try to manually try to rotate the actuator to the closed position. If the shutter can be closed manually, but does not close automatically, contact Honeywell ACS Global Radiological Operations. Do not attempt to replace shutter mechanism or investigate the cause of failure. Field service is not permitted to replace the shutter solenoid.

9.8.2. Shutter not opening

Some of the reasons are similar to the shutter not opening above, such as a failed EDAQ Digital Output. It is also possible that the fire-safety pin has released or partially released. Check if rod is still attached to housing by solder. If there is any indication it has, contact Honeywell ACS Global Radiological Operations.

Field service is not permitted to replace the shutter solenoid. Contact Radiological Operations.

9.8.3. Shutter not opening, or opening slowly

A low open safe volts alarm can be the result of the shutter not opening when requested. Basis weight stability test failure, or drifting F/A ratios, can be a result of the shutter opening too slowly. One of the common reasons is low or no air pressure at the sensor. Disconnect the quick release tubes at the compressor, and verify that air is coming out.

The EDAQ stores and writes the receiver signals to a log file prior to a safety fault. These can be analyzed by Honeywell Engineering to check for slow moving shutters.

Check whether the shutter is attempting to move when the command is given:

1. Navigate to the MSS **Setup Diagnostic** tab.
2. Click **IO Point Monitor** and choose the basis weight source from the drop-down menu listing all EDAQs.
3. Select **Digital Outputs**, and turn on the first output. With the head covers off, watch the shutter air cylinder. If the heads are aligned and the receiver is in place, attempt to move the shutter manually and verify that the shutter movement is smooth. If not, call Honeywell ACS Global Radiological Operations. Do not attempt to diagnose.

9.9. Verify wiring

This task is a generic placeholder for electrical failures.

Activity Number:	Q4303-00-ACT-009	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician

Priority Level:	Average	**Cautions:**	None
Availability Required:		**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	30 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

The part numbers listed in **Table 9-2** might be useful. The schematics can be requested from Honeywell Engineering.

Table 9-2 Part Numbers For Q2201-XX Electrical Wiring

Part Number	**Description**
6581800421	Sx18 Q3090 source harness
6581800422	Sx18 Q3090 receiver harness
6580500127	Power Distribution Board

9.10. Replace Basis Weight Receiver ion chamber

The Basis Weight Receiver ion chamber usually has a life time of several years; however, failure of the welding joint or punctures of the thin steel window can cause component failure. This often shows up as poor repeatability and lower signal amplitude.

Activity Number:	Q4303-00-ACT-010	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Honeywell Expert
Priority Level:	Average	**Cautions:**	Electric shock
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	60 min	**# of People Required:**	1

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

The removal of the ion chamber is somewhat involved, and should only be performed if all other causes of issues have been ruled out.

WARNING

The ion chamber shell is connected to a low-current - 350 V source. Ensure that the sensor is disconnected from power before attempting to remove it.

Removing the ion chamber requires removing both the amplifier and the receiver window. Ensure that the ion chamber replacement is covered with a heat shrink sleeve to prevent issues with condensation.

1. After completing the replacement, place the system in maintenance mode for that particular scanner.
2. On the **Sensor Maintenance** display, select **Nuclear Sensor Processor**.
3. Shoot three references to check the basis weight voltage. Ensure that it is below 8.5 V. If it is not, re-strap the preamp to use a lower gain setting.
4. shoot verification samples to confirm calibration.

   If samples are off by more than 0.3%, or more, from previous verification, perform a full re-calibration on the system (clean and dirty). Apply new calibration coefficients and T0FA.
5. Ensure that after re-calibration is done the T0FA is set to the average from 30 references. At this time the DFRAC should be around 0.00; if not at 0.00, redo the T0FA.

9.11. Replace EDAQ

In case of a suspect EDAQ hardware failure (such as a shutter not opening when requested, resulting in an interlock alarm) the EDAQ should be replaced.

Activity Number:	Q4303-00-ACT-11	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	20 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
	6580801773: Loop-back harness		
Required Tools:	Part Number	Quantity	Lead Time

For details of EDAQ replacement and programming, refer to the *Experion MX MSS and EDAQ Data Acquisition System Manual* (p/n 6510020381). The following four steps should be performed:

1. From the **MSS** main web page or the **MSS Summary** page on the RAE system (under **MSS Setup Diagnostics**), note down the position (node) and function number for the EDAQ. For example, a basis weight source might have function code 302, and might be in position 201-206 in the upper head.

2. Replace the EDAQ with a spare.

3. Check whether the new EDAQ reports with the expected position (node) and function numbers in the main **MSS** web page. If not, refer to the *Experion MX MSS and EDAQ Data Acquisition System Manual* (p/n 6510020381) for information on how to correct the assignment.

4. Upgrade the EDAQ to the software revision present on the other EDAQs. Refer to the *Experion MX MSS and EDAQ Data Acquisition System Manual* (p/n 6510020381) for details.

The removed EDAQ may be self-tested to verify whether it is functional or not. A loop-back harness is required for this operation. The self-test can be performed from any PC connected to the EDAQ. For details, refer to the *Experion MX MSS and EDAQ Data Acquisition System Manual* (p/n 6510020381).

9.12. Replace compensator

The compensator is used to reduce passline effects, and to reduce ash sensitivity. This usually results in shifted F/A data or spikes in the basis weight profile.

Activity Number:	Q4303-00-ACT-012	**Applicable Models:**	All
Type of Procedure:	Inspect	**Expertise Level:**	Technician,
Priority Level:	Average	**Cautions:**	None
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	60 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

Remove the window assembly from the receiver head. The compensator is directly below the window.

The compensator depends on the model number. **Table 9-3** lists sensor and compensator part numbers.

Table 9-3 Compensator Part Numbers

Sensor	**Compensator**
094303-00	08630800
094303-01	08639300
094303-02	08639400
094303-03	08739700
094303-04	08746600
094303-07	08752200
094303-08	08638801

After completing the replacement, enter the system into maintenance mode for that particular scanner.

1. On the sensor **Maintenance** screen, select **Nuclear Sensor Processor**.
2. Shoot three references to check the BW Voltage. Ensure that it is below 8.5 V; if not, re-strap the preamp to use a lower gain setting.
3. shoot verification samples to confirm calibration.

   If samples are off by more than 0.3%, or more, from previous verification, perform a full re-calibration on the system (clean and dirty). Apply new calibration coefficients and T0FA.
4. Ensure that after re-calibration is done, the T0FA is set to the average from 30 references. At this time the DFRAC should be around 0.00; if not at 0.00, redo the T0FA.

9.13. Enable sensor on human/machine interface panel

All radiation sensors must be explicitly enabled at the scanner HMI panel.

Activity Number:	Q4303-00-ACT-013	**Applicable Models:**	All
Type of Procedure:	Replace	**Expertise Level:**	Technician
Priority Level:	Average	**Cautions:**	None
Availability Required:		**Reminder Lead Time:**	
Overdue Grace Period:		**Frequency (time period):**	
Duration (time period):	1 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
Required Parts:	Part Number	Quantity	Lead Time
Required Tools:	Part Number	Quantity	Lead Time

A `Reset MSS to Clear Safety Fault` command from the RAE server disables the radiation sensors (this may be configurable in future software releases). This ensures that remote commands cannot open the shutter while maintenance activities are being performed at the scanner.

Ensure that the sensor is enabled:

1. Turn the key switch to the ON position.
2. Press the BW button on the HMI/UPI panels at either end of the scanner.
3. The amber light turns on and stays on.

If the amber light does not stay on, a *What's Wrong* message generates and passes to the RAE system. These are visible in the **MSS Diagnostic** tab under the **MSS Summary Page** or the **I/O point monitor**. Refer to the scanner system manual.

10. Troubleshooting

This chapter covers possible issues with the Basis Weight Sensor. 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 system.
- **Section 10.2** Non-alarm based troubleshooting: Troubleshooting steps that may not be related to a specific alarm in the system.

10.1. Alarm based troubleshooting

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

10.1.1. Receiver (Rx) Sensor Not in Place

Symptom	Possible Causes	Solutions
Micro-switch between nuclear receiver body and platform is not closed as expected	Receiver module not screwed in place	
	EDAQ digital input failure	Replace EDAQ

10.1.2. No BW Signal

Symptom	Possible Causes	Solutions
	EDAQ receiver harness not plugged into EDAQ	Check harness

Symptom	Possible Causes	Solutions
BW signal below background voltage (usually 15 mV)	No ± 12 V power generated on receiver	Check receiver voltages
	Amplifier not installed	Check Basis Weight Receiver amplifier

10.1.3. BW Signal High

Symptom	Possible Causes	Solutions
BW receiver signal above maximum allowed voltage (usually near 10 V)	Amplifier OpAmp broken	Check Basis Weight Receiver amplifier
	Amplifier gain set to high	Check Basis Weight Receiver amplifier

10.1.4. High Closed Safe Volts

Symptom	Possible Causes	Solutions
Shutter was closed or requested to close but receiver signal higher than expected	Receiver amplifier failed	Check Basis Weight Receiver amplifier
	Shutter did not close	Verify shutter operation

10.1.5. Low Open Safe Volts

Symptom	**Possible Causes**	**Solutions**
Shutter was open or requested to open but the receiver voltage was below threshold	Shutter did not open due to EDAQ hardware failure	Replace EDAQ
	Receiver module not functioning	Check receiver voltages
	Shutter did not open due to mechanical issues (air, power)	Verify shutter operation
	Thick material in the gap	Inspect head gap
	Source and receiver are not aligned	Inspect head gap
	Orifice at inlet of pneumatic actuator in source is plugged (Sx-12 only)	Contact Honeywell ACS Global Radiological Operations

10.1.6. Sensor Not Enabled

Symptom	**Possible Causes**	**Solutions**
Sensor is enabled in RAE but not at the scanner HMI panel (amber light is off)	MSS or frame controller reboot or clear safety fault disabled the sensor and it was not re-enabled before requesting scanning operations	Enable sensor on human/machine interface panel

10.1.7. Flag to Air Shift Out of Limits

Symptom	**Possible Causes**	**Solutions**
F/A ratio drift from the time-zero value exceeds the limit	Excessive dirt on the sensor	Inspect head gap
	Broken flag	Inspect and replace source flag
	Bad ion chamber	Replace Basis Weight Receiver ion chamber
	Low air pressure	Verify shutter operation

A careful analysis of the *Standardize Report* will confirm whether the shift is due to changes in air volts, changes in flag volts, or both. If both vary, the cause is likely to be the ion chamber or low air pressure. If only the flag value changes, the flag is likely broken.

10.1.8. Source Column Temperate Below Limit

Symptom	**Possible Causes**	**Solutions**
Temperature processor computes a temperature from input data which is above the minimum limit	Disconnected or broken temperature sensor	Inspect source column temperature sensor

10.1.9. Source Column Temperate Above Limit

Symptom	**Possible Causes**	**Solutions**
Temperature processor computes a temperature from input data which is below the minimum limit	Disconnected or broken temperature sensor	Inspect source column temperature sensor

10.1.10. Source Column Temperature Drifting

Symptom	**Possible Causes**	**Solutions**
Temperature processor computes a temperature from input data which has drifted too far from the standardize value	Disconnected or broken temperature sensor	Inspect source column temperature sensor

10.1.11. Sensor Processor Bad Input

Symptom	**Possible Causes**	**Solutions**
Sensor input data required for processor is not within valid range	Bad analog signal from basis weight receiver	Check receiver voltages

10.1.12. Net Flag Voltage Negative

Symptom	**Possible Causes**	**Solutions**
The voltage read with the shutter open and flag in was less than background (shutter closed) voltage	Bad background voltage	Replace EDAQ
		Check receiver voltages
		Check Basis Weight Receiver amplifier

10.1.13. Net Air Voltage Negative

Symptom	**Possible Causes**	**Solutions**
The voltage read with the shutter open was less than background (shutter closed) voltage	Bad background voltage	Replace EDAQ
		Check receiver voltages
		Check Basis Weight Receiver amplifier

10.2. Non-alarm based troubleshooting

This Section provides additional trouble shooting information for the sensor. **Subsection 10.2.1.1** lists some symptoms that are not directly alarmed by the system. **Subsection 10.2.1.2**, and **Subsection 10.2.1.3** list common failure modes by the hardware in the sensor.

10.2.1.1. Symptoms not directly alarmed

Symptom	Probable Causes	Solutions
Low or no on-sheet, sample, flag1, flag2, or air counts	1) Not enough pressure at pneumatic actuator	1) Check pressure at source body and adjust supply regulator or look for air leaks (especially at hose to actuator). Do not adjust air regulator inside head.
	2) Fire safety pin has partially or fully activated	2) Call Radiation Safety in Cupertino
	3) Red light bulb(s) has burned out	3) Replace light bulb(s)
	4) Red light circuit logic PCB malfunctions or blown fuses	4) Replace fuses, if problem persists replace board. Check connections for shorts.
	5) Pneumatic solenoid valve in source	5) Check valve by removing exit hose and listening or feeling for air
	6) Orifice at inlet of pneumatic actuator in source is plugged	6) Call Radiation Safety for orifice cleaning or replacement Procedure (IMPORTANT: always replace with an identical orifice from spare parts since size of hole is critical to operation)
	7) Water or debris on inside or outside of head window	7) Visually inspect and clean
	8) Excessive friction in bearing	8) Call Radiation Safety in Cupertino
	9) Leaking pneumatic gasket or O-rings. Note that a small leak down stream of the regulator can disable source from operating since the source has high pneumatic input impedance	9) Call Radiation Safety in Cupertino
	10) Corrosion on actuator shaft.	10) Call Radiation Safety
	11) Something external to pneumatic actuator is catching on rotating pin	11) Visual inspection of pneumatic actuator

Symptom	Probable Causes	Solutions
Low or no on-sheet, sample, flag or air counts (continued)	12) Pressure regulator in source head malfunctions	12) Replace
	13) Actuator fails	13) Try to move manually, call Radiation Safety to receive instructions for replacement
	14) Internal stops	14) Call Engineering to receive instructions
	15) Ion chamber leak, symptoms are a decrease in air and flag counts but an increase in F/A	15) Replace ion chamber
	16) Head misalignment	16) Align heads
Background counts drifting or noisy	1) Bad ground	1) Check all grounds
	2) If background counts follow head temperature where the counts go down as the head temperature goes up	2) Replace detector amp.
	3) Problem is either a bad detector amp or dirty insulator on ion chamber.	3) Replace them one at a time.
Drifting or noisy air, flag or F1/A ratio Note: the F1/A is supposed to vary during on-line conditions since this is how the dirt correction is made. The questions is whether the excess variation is caused by the environment, in which case nothing should be done, or is caused by a faulty component, in which case something needs to be done.	1) Test under stable environmental conditions. Run several sets of 30 F/A stability tests with mill off for long enough to be cool. If F/A values meet or nearly meet lab stability spec, cause is likely to be an environmental one rather than due to a sensor component malfunction.	If F/A meets specification under stable thermal conditions, system is probably behaving properly
	2) Check 24 VDC at sensor head not at power supply. (Significant voltage drops can and do occur between head and bay). Also check receiver test points.	2) Adjust or replace 24 VDC power supply, take appropriate action if test points do no measure satisfactorily.
	3) Check for extraneous material on window, or broken window.	3) Replace or repair as necessary
	4) F/A ratio drifting such that as the air counts go down and the F/A goes up	4) Replace leaky ion chamber.

10.2.1.2. Sensor failure mode: source components

Component	Function	Power Requirements	Tests	Failure Modes
Flag/Flag solenoid	Rotate flag into inserted or retracted positions	20–26 V DC		Flag may tear Flag may become bent and jam Solenoid can overheat and jam
Fire safety pin	Forces capsule to retract in event of high temperature condition	Activated by temperatures exceeding 260 °C (500 °F)	Check if rod is still attached to housing by solder. Try to move actuator with source in head by manually lifting and lowering mechanical indicator flag	May creep (slowly move under pressure) May inadvertently activate
Temperature measuring device for source air column (is located near aperture)	Measure the air temperature in the air space between the source capsule and the head window	5–24 V DC	Backplane TP5-TP6 Interlock TB2 11,10. 10 mV = 1 degree C	Physical damage
Green light switches (2)	These switches are in series and provide a positive indication that the capsule has been closed	None	NO contact/COM contact: measure continuity when power is off (shutter closed)	

10.2.1.3. Sensor failure mode: receiver components

Component	Function	Power Requirements	Tests	Failure Modes
High Voltage Bias Supply	Provides -350 V DC ion chamber bias	On detector back-plane	Check test points on receiver backplane. The ion chamber output is rather insensitive to changes of a few volts of bias although in general bias voltage is stable to within a volt.	Output voltage goes to nearly zero volts is most common failure mode

Component	**Function**	**Power Requirements**	**Tests**	**Failure Modes**
Ion Chamber	Converts beta flux to current for conversion in detector amplifier	none	Refer to Preventive Maintenance graphs of F/A and sample ratios and air and flag counts versus time	Gas leak: output voltage will go down and flag and sample ratios will go up
			Refer to Preventive Maintenance graphs of background counts versus time	Insulator around center post exit becomes dirty and provides a variable leakage path across ion chamber bias which results in drifting background
			Physical inspection of ion chamber and casting. Look for metal labels peeling off, debris or casting burrs	Intermittent short between ion chamber and housing. This can induce a down going spike in sensor output. Loose leads
Detector Amplifier	Convert small current from ion chamber to voltage	none	Monitor background counts (should be .010-.020 V DC) and check ± 12 V DC	Offset (Background) voltage wanders
			Monitor head temperatures	Thermal drift of amplifier
			Visual inspection	Damage to wire that connects to Ion Chamber
Receiver Power Supply Temperature PCB	24 V DC to ± 12 V DC and provide processing for receiver air column (if available)	± 12 V DC on receiver backplane	± 12 V DC output bad	± 12 V DC output on receiver backplane

11. Storage, Transportation, End of Life

This chapter summarizes Honeywell policy with regards to the storage and disposal of components of the Basis Weight sources.

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 9-1**.

Table 9-1 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.

Except where identified in this chapter, the scanner does not contain hazardous or restricted materials.

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

- remove all non-metallic parts (except plastic) from the sensor and dispose of through the local refuse system
- recycle plastic parts
- wires and cables should be removed and recycled (copper may have value as scrap)
- electrical and electronic components should be recycled or handled as special waste to prevent them from being put in a landfill, because there is potential for lead and other metals leaching into the ground and water
- metals should be recycled (in many cases they have value as scrap)

11.2.2. Disposal of radioactive sources

Contact Honeywell Radiological Operations, and they will advise and facilitate safe disposal.

11.3. Storing radioactive sources

WARNING

While in storage, a shipping shield must be bolted to each sensor head containing a radioactive source.

If a sensor head containing a radioactive source has to be stored for a period of time before it can be mounted on the scanner, it must be placed in an area to which access is controlled by licensed personnel. This generally means that the sensor head must be stored in a locked room or cabinet. If such storage will be for a period of weeks or months, arrangements often can be made to have Honeywell store the sensor. Contact Honeywell ACS Global Radiological Operations.

The main contact numbers for Radiological Operations are:

First level of support:

ACS Global Radiological Operations
3079 Premiere Parkway
Duluth GA 30097
+1.770.689.0500

Europe, the Middle East, and Africa are supported by Waterford at:

+ 353 (0) 51 372 151

12. Glossary

Actuator	Mechanical or electronic device that performs the control action in a control loop
Air Gap Temperature Sensor (AGT)	Device to measure the temperature of the air in the gap or space inside the sensor between the capsule and window. Used as corrector to the total basis weight.
Air Measurement	Reading of the basis weight receiver when the shutter is opened but there is no sample in the gap. Used to normalize the on-sheet measurement; re-calculated at standardize
Back Side	See Drive Side
Background Measurement	Shutter closed basis weight receiver voltage reading. This measurement reflects only the electronic offsets and is subtracted from every shutter open reading.
Bin	The smallest measurement zone on the frame. Also called Bucket or Slice.
Bucket	See Bin
BWDO	Dynamic Offset Basis Weight. A corrector (in units of basis weight) that corrects between on-sheet measurements and lab verification.
Cable End	Location of the electronics and/or the entry point for communications and power on the scanner
Cable end	Formed steel channel welded to the upper and lower box beams at the Cable End
CD Spread	Variation in the profile data equal to twice the standard deviation of the measured variable
Code	See Recipe
Cross Direction (CD)	Used to refer to those properties of a process measurement or control device that are determined by its position along a line that runs across the paper machine. The cross direction is transverse to the machine direction that relates to a position along the length of the paper machine.
Dirt Frac or DFRAC	Calculated amount of dirt on the sensor. This is calculated from the flag-to-air ratio. Zero percent (0%) means no dirt, 100% means an amount that corresponds to the dirt sample used in the dirt calibration.
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.
EDAQ	Ethernet Data Acquisition board. Digitization and control board used on each sensor on the Experion MX platform
F/Alast	Last flag-to-air measurement
Flag	Mylar sample which can be rotated into the beam to simulate a weight measurement. Usually the measurement is used in the dirt correction calculation
Flag To Air Ratio (F/A)	The signal from the basis weight receiver with the shutter open, with and without the flag inserted
Front Side	See Tending Side
Green Light	One of the two radiation interlock lights. Green is on when the shutter is physically closed
GSP	Gauge support processor
High End Calibrate Distance	The distance from a fixed point on the sensor head to the closest vertical member of the scanner when it is located at the High End Limit switch. This position is determined during scanner calibration.
High End Calibrate Position	The value of the head position when the sensor head reaches the High End Calibration Position. This is only updated during a scanner calibration procedure.
HMI	Human/machine interface. Also referred to as user program interface (UPI).
Isotope	Periodic table element with a particular atomic weight. Common isotopes used in weight measurements include Promethium-147 (Pm), Krypton-85 (Kr) and Strontium-90 (Sr).
KCM	Customer sample calibration constant. A multiplier used to correct the basis weight calculation if the samples are not Mylar.
Linux	Computer operating system running on the EDAQ CPU as well as the Measurement Sub System (MSS) computer
Low End Calibrate Distance	The value of the head position (in millimeters) when the sensor head reaches the Low End Calibrate Position
Low End Calibrate Position	This position is only updated during a scanner calibration procedure
Low End Offset	The distance in millimeters from the cable end of the scanner to where bucket zero is located
Machine Direction (MD)	The direction in which paper travels down the paper machine
Measurement Sub System (MSS)	Intel based CPU performing data collection from sensor EDAQs and binning the data before sending to the RAE (Experion MX) system. Responsible for binning sensor data and controlling standardization operations.
MIS	Management Information System. System or subsystem that collects and manages information on the paper production.
Motor End	Location of the motor on the scanner

Motor End Support	Formed steel channel welded to the upper and lower box beams at the motor end
MXOpen	(obsolete) software quality control system. See QCS.
Quality Control System (QCS)	A computer system which manages the quality of the paper produced
Real-Time Application Environment (RAE)	The system software used by Da Vinci and Experion MX QCS to manage data exchange between applications (with Performance CD being one of them)
Recipe	A list of pulp chemicals, additives, and dyes blended together to make a particular grade of paper
Red Light	One of the radiation interlock lights. Red light is on when the driving electronics receives a command to open the shutter.
Real-Time Data Repository (RTDR)	The database managed by RAE to store system data and data for individual applications
Scan Position	A constant position (in millimeters) measured from the cable end
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
Smoothing Width	A value that determines the amount of averaging that will be applied to a measurement 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.
Streak	A narrow cross-directional section of paper where a measured quality deviates significantly from the average of the entire width of the paper. Also an area in an array of cross-directional measurements that deviates more than a certain amount from its surroundings. The amount of allowed deviation can be set up as an absolute number or as a percentage.
T0CF	Change in F/A ratio when known dirt is inserted
T0FA	Time-zero F/A ratio. F/A ratio when the system is known to be in a clean state
Tending Side	The side of the paper machine where the operator has unobstructed access. Also called Front Side.
TES	Thermal Equalization System
Trend	The display of data over time

A. Part Numbers

Table A-1. lists part numbers for Sx-18 ZipLine Basis Weight Measurement.

Table A-1 Sx-6 Part Numbers

Part Number	**Name/Description**
08353503 (-73 model)	Compensator (receiver)
08353700 (-72 model)	Ion chamber assembly (receiver)
08353706 (-73 model)	Ion chamber assembly (receiver)
08434100 (-72 model)	Compensator (receiver)
05277501	Detector amplifier (receiver)
05323500	Backplane
05323900	PCB backplane (receiver)
05404600	Receiver power supply and thermistor
05410000	PCB high voltage (receiver) HV inverter, - 350 V DC
07687600	Dashpot (source)
08441102	Flag assembly (source)
08441102	Flag assembly (receiver)
08479301	Thermal safety nut (source)
22000070	Flag solenoid (source)
47000006	Temperature sensor (source)
48140061	Diodes (source)
51000034	Microswitch (source)