Source 15 Basis Weight Measurement

System Manual

6510020418

Source 15 Basis Weight

June, 2012

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Notice

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

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Introduction

The purpose of this document is to provide a description of the installation, operation, and maintenance of the Source 15 Basis Weight Sensor, Model Q4203-XX.

If you are familiar with earlier Honeywell basis weight sensors, see Chapter 3 for a comparison of Sources 6 (092201 and 094262), Sources 9 (Q4201-XX), Source 12 (Q4202) and the Source 15 (Q4203).

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.

Some procedures referred to in this manual may only be performed by persons appropriately licensed. Such procedures and permission to perform them must be obtained directly from Honeywell ACS Global Radiological Operations.

About this manual

This manual contains 12 chapters and an appendix.

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

Chapter 2, **Measurement Principles**, describes the components for the system.

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

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

Chapter 5, **Detailed Sensor Description**, provides detailed descriptions of the system components.

Chapter 6, **Calibration Constant Specifications provides correction constants.**

Chapter 7, **Calibration**, describes calibration and verification procedures.

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
6510020199	Radiation Safety Training Manual (for Honeywell employees)
6510020197	Radiation Safety Manual for Honeywell Customers
6510020381	Experion MX MSS EDAQ Data Acquisition System Manual

Conventions

The following conventions are used in this manual:

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

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

Radiation safety

This Honeywell system contains a nuclear sensor, requiring radiological or other licensing for import and/or use.

Regulatory requirements can vary significantly between countries and regulatory jurisdictions. Information is provided at the time of order through delivery to guide customers on how to negotiate the licensing process. Customers see the *Radiation Safety Manual for Honeywell Customers*, p/n 6510020197. A copy of this manual is provided along with the system delivery. Honeywell employees refer to the *Radiation Safety Training Manual* p/n 6510020199.

Every country where Honeywell products containing nuclear sensors are sold has a *Radiation Liaison* supporting customers in that country for licensing issues. The Radiation Liaison is a Honeywell employee operating at the local country level supporting customers on behalf of Honeywell's ACS Global Radiological Operations. Any questions or requests for assistance should first be routed directly to the appropriate Radiation Liaison. Direct contact with ACS Global Radiological Operations can also be obtained by telephone at +1 770-689-0500 or by e-mail at dlacsglobalradops@honeywell.com.

Some procedures referred to in this manual may only be performed by persons appropriately licensed. These procedures must be obtained directly from the Honeywell Radiation Safety Department.

Design changes

While every effort is made to provide correct and current information on the Source 15 Basis Weight Sensor, the contents of this manual cannot be guaranteed to be updated every time there is a change to the design.

References to specific part numbers have been minimized so as not to be out of date or obsolete. For the current part number, when ordering spare parts, consult a current bill of material.

When first introduced, the sensor was placed only inside a G-Head (p/n 09462301). Installation in other heads is expected. This manual only describes G-Head configuration.

1. System Overview

This section contains an explanation of the major features of the Source 15 Basis Weight Sensor. This explanation starts at the source capsule and continues through the chain of major Source 15 features. Although there is new source and receiver hardware, the functions are the same as earlier designs.

1.1. Shutter

When this manual refers to *shutter*, it means the mechanism which allows the beam to leave the head. This manual uses the term shutter to refer to the actuator that allows the beam to exit the device.

For several historical designs, Sources 6, 12, and X-ray sensors, this mechanism is a physical shutter that rotates out of the beam's path.

However, for Source 15 and in Source 9, there is a wheel that rotates the source capsule to the beam on position. The source capsule is attached to a wheel that rotates 135 degrees.

Normally the source points diagonally away from the measurement gap and the steel body of the Sx 15 source holder provides radiation protection. The source bodyis rotated in that position unless the linear pneumatic actuator over powers the spring . The loss of either electric power or pneumatic (air) pressure allows the spring to rotate the source back to the shielded position. An orifice in the air line slows the action of the shutter to insure smooth repeatable positioning and long life. All fasteners and mechanical parts shielding the radioactive capsule are made from stainless steel or tungsten for resistance to melting in case of fire. If the temperature exceeds a preset value, a fire safety pin will activate, causing the shutter to close until the mechanism has been disassembled.

1.2. Flags

Source 15 has the normal flag, here called Flag1. Periodically, the sensor goes offsheet and measures the signal with just this Flag1 in the beam. This measurement is called *reference* or *standardize*. By comparing the current Flag1 reading to the reading at calibration, the sensor measures the dirt build up. A dirt correction is based on this standardize flag reading (This method will attribute to dirt a change anything that has changed since last standardize, not just dirt build up on the windows).

Source 15 has a second flag assembly. Both flags are activated by linear pneumatic actuators identical to the shutter's. The flags lie in separate planes both directly opposite the shutter. Because they are in separate planes, both flags can be inserted into the beam path simultaneously.

In addition to the normal Honeywell three point standardization, this allows two point verification: Flag2 and Flag1 + Flag2. Source 15 software supports this new standardization: three point standardization provides the usual correction factors, which are then applied to evaluate the weights of Flag2 and Flag1 + Flag2. The combination of Flag1 and Flag2 is called Flag12 (flag one two). The weights of the flags should be constants since corrections have been applied for temperature, Z, dirt, new background, and air readings. The readout of the weights constitutes a true quality indicator which can be tracked over time. Differences in the weight readings from the weights at calibration time are referred to as Flag2 error and Flag12 error. More detail can be found in Chapter 2.

1.3. Air curtains

Source and receiver Air Curtains are another key feature in Source 15. Each Air Curtain consists of an air plenum and window frame that replaces the standard window frame. The new frame has a series of holes located at 15 degree intervals through which air from the plenum flows outward into the gap, perpendicular to the window like a curtain. This window frame allows for easy changes in the air flow pattern to accommodate special considerations in field applications. Typical flow rates are in the range of 2 - 3 CFM per head. The air curtain eliminates the need for external air wipes, and uses the same hose in the power track that is otherwise used by the external air wipes (the large rubber hose, .5 in outside diameter and .25 in diameter inside diameter). The standard air flow pattern has been tested on very thin films (down to 0.6 µm) and does not have any negative effects on the sheet at reasonable flow rates, even scanning on and off the edges repeatedly. At high flow rates, greater than 6 CFM total, a very light sheet can be pulled against one of the heads. Exercise caution in setting the flow with extremely thin films.

The air curtain eliminates influences of external temperature from the measuring gap. Because of the sensitivity low energy betas to light weights, uncertainty and fluctuations in the air gap temperature could otherwise limit the sensor's repeatability.

The air curtain provides sufficient flow of air at a known and stable temperature to allow the sensor to achieve the desired accuracy. The temperature of the air is measured by a direct readout device in the air manifold, just before the air enters the gap, but after it has dropped to a lower pressure. No attempt is made to control the temperature, since this would introduce additional complexity, additional cost, and possibly precision limiting temperature gradients. Once it is measured the correction is quite straightforward, as it is based on the ideal gas law.

1.4. Measurement Gap Air Temperatures

Because the air gap temperature is measured directly in the air manifold, there is no need for the external air gap temperature sensors used in previous basis weight sensor designs. This simplifies and cleans up the head design externally and eliminates the need for thermistor support circuitry. The software is also simplified since the temperature devices read out in voltage proportional to the temperature, for example, 2.5 V = 25 °C. Perhaps the biggest benefit of direct readout is in troubleshooting. All the temperatures related to Source 15 - air gaps, source air column, and head temperature, use the direct readout devices.

There is no receiver air column temperature measurement, as there is very little space between the ion chamber window and the head window.

1.5. Coefficients

The UniCal calibration algorithm has been extended from 4 to 8 coefficients (from 3rd order to 7th order). This allows for better fits, particularly when the fit is over a wide range. It can help reduce the instances of breaking the fit into separate weight ranges. Since the sensor can measure reliably a wide range, the wide range capability can be quite useful. Do not use the extra coefficients unless there are an adequate number of data points to make the fit statistically meaningful. It is generally safe to use no more than one half the number of fit coefficients, as there are data points at separate weights. Under some circumstances, depending on the pattern of behavior of the residual fit errors, somewhat fewer data points may be used.

Another new feature of the Source 15 software allows a standardization to be automatically performed whenever the temperature of either head has changed from the temperature at the last standardization by more than an amount set by the user. This prevents absolute measurement errors caused by temperature-induced drift in electronic components. Since the heads are well insulated the temperatures tend to change only slowly, the periodic standardization is both simpler and more predictable than the alternative of direct head temperature control.

2. Measurement Principles

This chapter describes the physical operating principles of beta emitting basis weight sensors. If you are already familiar with the measurement principles of Honeywell basis weight sensors, see Chapter 3.

2.1. Beta particles and Basis Weight measurement

Beta particles (or betas) are electrons emitted from atomic nuclei during nuclear decay. After leaving the nucleus they may be thought of as an electron beam such as in a cathode ray tube (CRT), found in a televisions and computer monitors.

Beta particles from nuclear decay are not of a single energy but are emitted in a continuum of energies up to a maximum value. This maximum energy value depends on the type of source capsule or isotope. Higher energy betas are more penetrating and therefore can be used on heavier products.

The most commonly used capsules, in order of increasing maximum energy (the number signifies the particular isotope used) are:

- Promethium-147 (Pm-147)
- Krypton-85 (Kr-85)
- Strontium-90 (Sr-90).

The emitted beta particles interact with the sheet in two different ways. It may be scattered from the sheet, or it may lose some or all energy in the sheet. The betas that pass through the sheet and into the receiver enter an ionization chamber. This is the detector. The ion chamber outputs a small current (approximately one nano-ampere), which is proportional to the energy deposited in the ion chamber. The current from the ion chamber goes through a short wire to an amplifier with an output that is an analog voltage on the order of 0 - 10 volts. This signal is sent to an electronic circuit and is read by a computer that averages the signal for some prescribed time interval. Using proprietary algorithms, the software converts the average signal to a calculated basis weight of the product.

The more material in the beam of betas, the more scattering and absorption, so the smaller the signal. Beta particles are absorbed nearly uniformly by all substances, because as normal variations in the chemical composition have very little effect on the absorption or basis weight reading. Absorption is dependent on the basis weight and not on color, texture, state of matter, or other factors. This is a principal advantage of using beta sources in basis weight sensors. However, the air in between the source capsule and the ionization chamber as well as any debris in the beam will absorb beta particles just as the product being measured.

2.2. Statistical nature of Basis Weight Measurement

The nuclear decay process is statistical. The sensor signal will always have some random noise component. Noise can be reduced in two ways, either by

a) increasing the beta ray flux or

b) increasing signal averaging time.

Increasing the flux is one of the main goals of the beta sensor designer. However, for a given design, remember the measurement always contains this random noise that can only be reduced by increasing signal averaging time.

The sensor stability specification must be for some prescribed integration (averaging) time. Generally, the sensor stability improves by the square root of the integration time (Assuming all the noise comes from nuclear statistics, not other factors such as changes in air density or induced noise from poor grounding).

For example, the sensor will be about twice as stable when integrating for four seconds as compared to integrating for one second. This behavior is called *scaling*.

When a sensor exhibits scaling, it means the noise is limited to that inherent in the nuclear decay process. Nothing in the signal processing makes the signal nosier than the limits imposed by the flux (for a given flux, the signal is as good as it gets). All Honeywell Source 15 basis weight sensors are tested specifically for this scaling in the factory. This noise is present in all measurements made by the basis weight sensor, including Standardization, Reference, Sample and On-Sheet measurements.

Random error or variation is expressed using the statistical measure of standard deviation or sigma. Standard deviation is equal to the square root of the sum of the squares of the differences, divided by the number of measurements in the group.

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \overline{x})^2}$$

where n = number of measurements

x_i = individual measurement and

$\bar{x}$ = measurement average

For a randomly varying quantity (such as the measured basis weight of a sample, or the 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. The sigma is a measure of how tightly grouped, or repeatable, the group of numbers are (Sigma is only valid for groups of numbers greater than a certain size. Thirty measurements are standard for laboratory. Where that number is not practical, do not use fewer than ten).

2.3. Correctors

To accurately measure the product, several correction algorithms (correctors) are added. An ideal basis weight sensor signal would change only when the sheet's basis weight changed. Unfortunately, despite the designer's efforts, there remain external influences that affect the signal.

For example, any increase in the mass between the source and receiver causes a larger basis weight reading. Several factors can cause this: dirt build up on windows, increase in air mass due to temperature change, or change in the distance between heads. These effects should remain small relative to the raw or uncorrected basis weight reading.

To compensate, these external influences are measured and corrected (calculated) out of the basis reading. Correctors, positive or negative, are all calculated in basis weight units (gsm) added to the uncorrected basis weight reading. Being in basis weight units allows easy comparison of the relative magnitudes. A brief description of these correctors is in the next sections (see Section 5.4 for a more detailed discussion on this topic).

2.3.1. Dirt

Dirt Correction corrects for debris build up on the heads and for changes in air density due to air temperature, or pressure changes. Dirt correction is based on the flag reading from the most recent standardize. If dirt build up is significant between window cleanings, increasing the standardize frequency decreases inaccuracies due to dirt build up.

2.3.2. Z

Z correction compensates for basis weight changes due to changes in the height (and basis weight) of the air column. Head gap separation also affects beam geometry. Z correction compensates for both. Z correction is based on the on sheet (now) Z readings (Z corrector requires the presence of the optional Z sensor).

2.3.3. KCM

Corrects for any difference in absorption properties between the calibration standard and the customer product. KCM is grade dependent. Typical KCM values are very close to 1.00.

2.3.4. Profile correction

Corrects for any sensitivity of the sensor due to head misalignment in the machine direction or cross direction, also for changes in Z when there is not a Z sensor. For optimum performance, build the Profile Correction on site. Build the profile correction under conditions that are identical to normal machine conditions, particularly the temperature (that is, build the Profile Correction immediately following a break or other shut down, while the scanner is still warmed to operating temperatures).

2.3.5. BWDO (basis weight dynamic offset)

Corrects for any change in the product in between the position that the sensor measures the product and the position where the sample is taken for dynamic correlation. As an example, 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 on-line, a dynamic offset would be added to account for this fact.

3. Data Acquisition in the 4080 Scanner

In the 2080 scanner series the signals were transported from the sensor through the power to the endbell. From the endbell termination boards, long coaxial cables connected the signals to the Measurement Sub-System (MSS). The MSS enclosure consisted of a PC, a frame controller board, a number of National Instrument data acquisition cards, some signal termination electronics, and in some cases, an x-ray radiation fault board.

With the release of the 4080 scanner, the data acquisition is performed at the endbell, reducing the signal path and simplifying the scanner installation. The signals are digitized and converted to Ethernet data packets on the Ethernet Data Acquisition (EDAQ) boards. A single sensor system has one EDAQ, and a dual sensor system has two.

The frame controller (motion control) task is also performed on an EDAQ but with a special expansion board to handle scanner, digital mill signals as well as the position tachometer readings. The MSS PC was replaced with a small form factor embedded PC that is running, as are the EDAQs, the Linux™ operating system.

The MSS performs the same basic data binning tasks as before but it also hosts a web server capable of providing diagnostic information. It also receives the internal log files from the EDAQs. For more detail, refer to *Experion MX MSS EDAQ Data Acquisition System Manual* (p/n 6510020381).

3.1. The EDAQ board

The Ethernet Data Acquisition (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 MSS by Ethernet.

The EDAQ contains sensor-specific code for all sensors. All EDAQs, including the EDAQ performing Frame Motion Control (in the endbell) and the head alley EDAQ, are identical and can be interchanged without reprogramming.

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

3.2. Physical layout

Figure 3-1 and Figure 3-2 show the EDAQ. To the left are the digital and analog I/O, which connect directly to a sensor. Below these two large connectors is a 16-pin expansion connector that is only used when the EDAQ is attached to the frame controller (FC) expansion board.

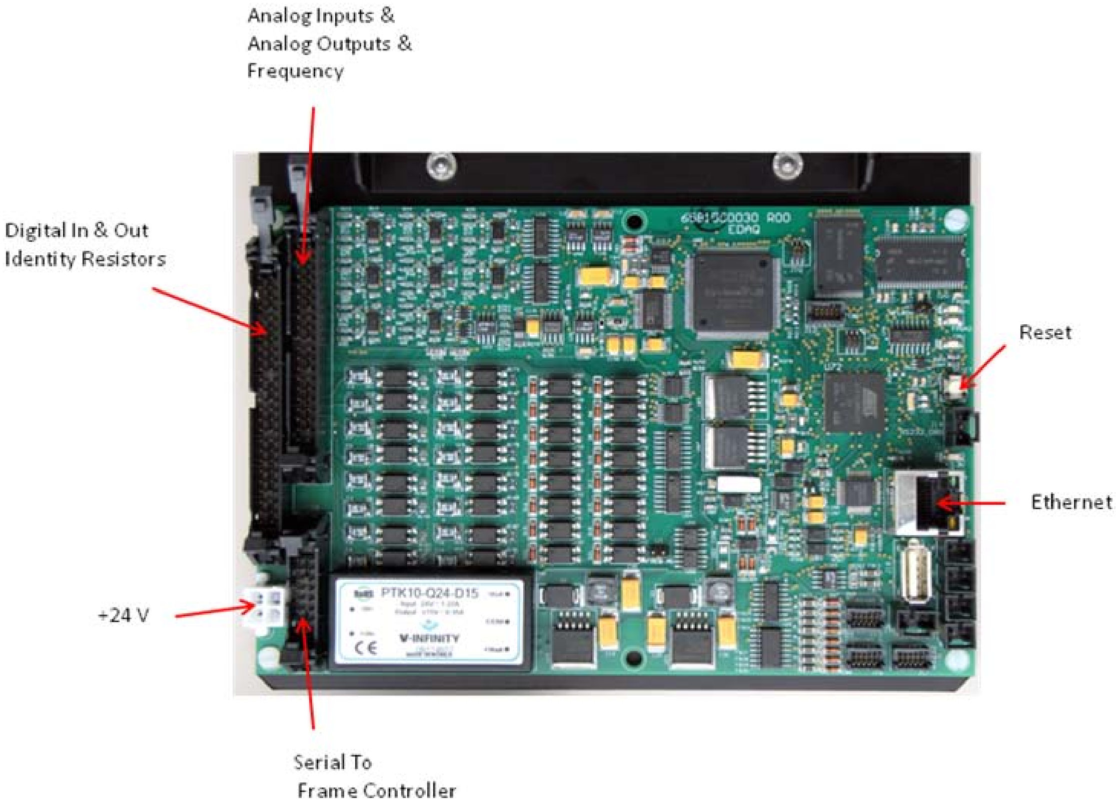


Figure 3-1 EDAQ Board

J1 is the large 50-pin connector on the far left. J2 is the smaller 40-pin connector. J8 on the lower left is used for the Frame Controller (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 such a serial cable between this debug port and the RS-232 of any neighboring EDAQ.

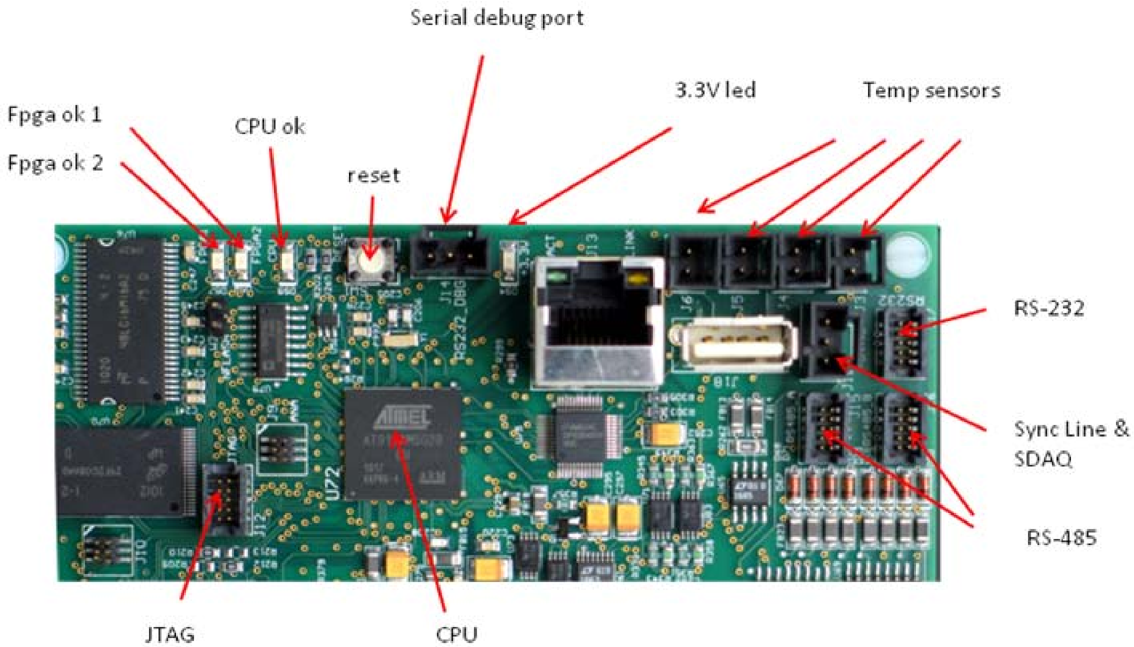


Figure 3-2 EDAQ Board: Ports and Diagnostic LEDs

3.3. 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.

In addition, the Ethernet connector contains two LEDs: amber indicates a good link to the switch, and green indicates 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 real-time application environment (RAE) station or any web browser running on the RAE server by going to the MSS IP address (factory default is http://192.168.10.101).

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. In rare cases it may be necessary to toggle the scanner +24 V power.

3.5. EDAQ sensor identification and IP addressing

Assuming the firmware (flash code) revision is the same, all EDAQs are identical. EDAQs of the same hardware revision can be freely interchanged at the end-bell or even between Q4000 series and the 4080 series scanners.

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

A sensor model resistor is embedded in the cable harness connecting the end bell PCB to the EDAQ. This resistor determines the function code. Function codes allow the EDAQ to run different code for different sensor configuration. At the time of writing, there is only one value for all BW/X-ray/Caliper configurations in the CWS scanner.

In addition, the endbell distribution board has a resistor for each of the two possible endbell EDAQs. These are referred to as the position identifying resistor. The complete table of resistor values and their meaning is accessible from the main MSS web page.

The 4080 frame controller similarly has identifying resistors. These are mounted directly on the outside of the enclosure in terminal block TB2.

Refer to *Experion MX MSS EDAQ Data Acquisition System Manual* to troubleshoot if the EDAQ does not identify itself properly (or to find the correct resistor values).

Every EDAQ has a unique IP address on the scanner network. The two endbell EDAQs have IP addresses *192.168.0.3* and *192.168.0.4*. The FC-EDAQ always sets itself to IP number *192.168.0.2*. The MSS is always *192.168.0.1* on this scanner network. On the RAE server network its address is usually *192.168.10.(n+100)*, where *n* is the number of MSSs on the same MX Experion network. The MSS is assigned *192.168.10.101* at the factory, but this can be set to any IP address with any netmask by using the MSS Web page.

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). Similarly, any user laptop gets an IP address assigned once plugged into the scanner Ethernet switch. This will be in the range *192.168.0.[20-50]*.

3.6. Obtain the MSS IP and MAC addresses

The MSS has two Ethernet interface cards. One connects to the internal scanner network and one connects to the Experion MX QCS server. The QCS server needs to know both the IP and MAC address of the MSS.

The MSS IP and MAC addresses are displayed prominently on the main mss web page. If the IP address of the MSS on the RAE network side is known (for example, 192.168.10.101), browse from the server to http://192.68.10.101 and look for the MAC address. If the IP address is not known one has to connect a computer to the scanner switch. This PC obtains an address automatically through DHCP from the MSS. Once that is established, browse to the fixed MSS scanner LAN IP address at http://192.168.0.1 .

The final option is to connect to the MSS with a monitor and keyboard. Enter **`[CTRL]-[ALT]-[F5]`** or **`[ALT]-[F5]`** to get a login prompt. Enter username **`evolution`** and password **`evolution`**. Once logged into the console, enter the command **`ifconfig eth0`** to see the IP and MAC address for the first Ethernet interface.

3.7. Obtain Status Information – Experion MX Platform

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

Figure 3-3 shows, on the left, a list of all expected EDAQs on a system with a single Basis Weight sensor. Figure 3-4 shows the same display for 4080 scanner with two sensors. There are three types of status indicators (from left to right) that are detailed in Table 3-1.

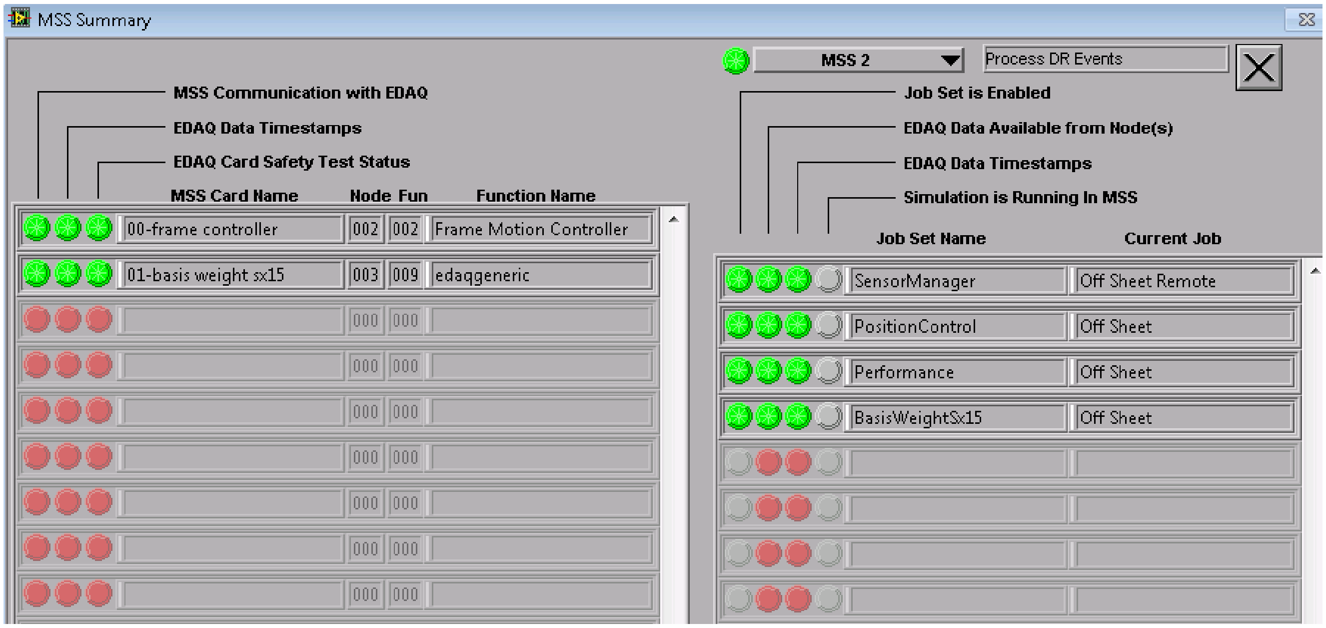


Figure 3-3 MSS Summary

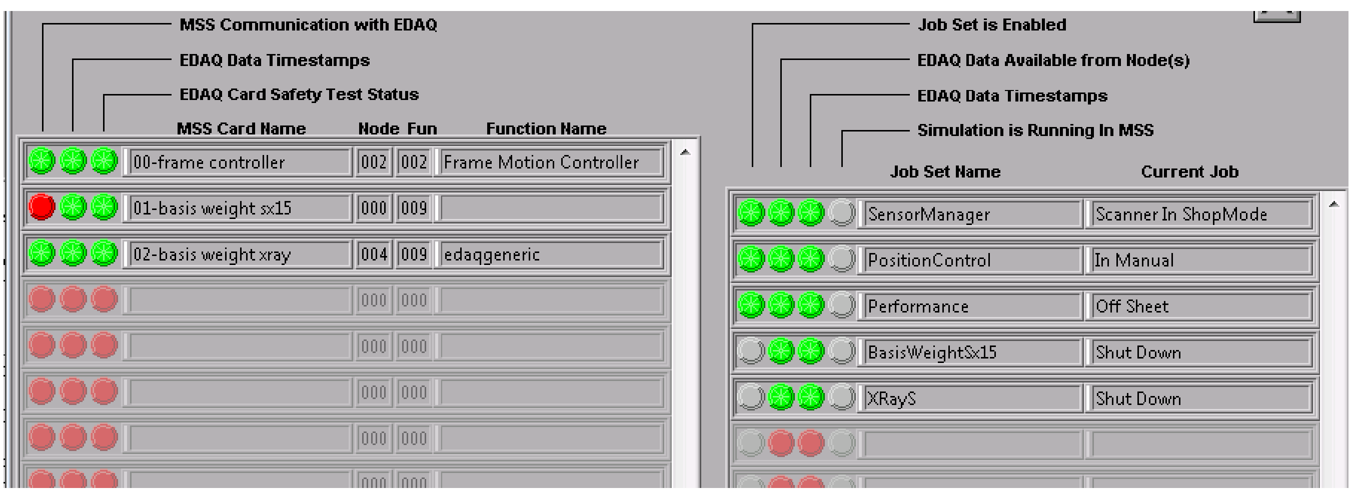


Figure 3-4 MSS Summary screen for a system with 2 sensors

Table 3-1 MSS Summary Display Status Indicators and Descriptions

Column	Description
MSS Communication with EDAQ	EDAQ is communicating (through the EDAL protocol) with the MSS

Column	Description
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

The 4080 scanner will either have two EDAQs (single sensor scanner) or three EDAQs (dual sensor scanner). If the status on the summary display is not correct, refer to *Experion MX MSS EDAQ Data Acquisition System Manual* to troubleshoot if the EDAQs are not communicating.

3.8. Changes to the Radiation Interlocks in the 4080 scanner

The 4080 scanner maintains much the radiation safety interlocks of the 2080 scanner. In particular, the green light circuit is still a continuous circuit from +24V, through the power tracks, through the shutter open switches, and back through the power track to ground. A lit green light indicates all shutters are closed. A green light that is off means either the system is not powered or the shutters are open.

The red lights are driven based on the state of the shutter digital output on the EDAQ. When the output state goes low, the red lights turn on. Current flow in this circuit turns on a transistor that in turn drives the actual BW shutter signal low. This has two consequences: if the EDAQ digital output fails in the closed state, the shutter remains open and the red light remains on; if the red lights fail, the lack of current turns off the transistor and the shutter closes. Refer to page 8 of the endbell schematic (658050121) for details.

There is one additional check implemented with the new Ethernet based data acquisition system. The software running on the EDAQ expects to see a periodic signal from the MSS through the Ethernet. When this fails to arrive, the EDAQ turns off all the digital outputs, closing any open shutters. Therefore, disconnecting or rebooting the MSS results in the closing of the shutters. The time-out time is adjustable by editing two fields in the RAE RTDR under the sensor jobsets:

../Setup/EDAQ Watchdog TimeOut Sec and

../Setup/EDAQ Watchdog Every x ms

The first field sets the time the EDAQ will wait before concluding the MSS is not operating. The second field determines the frequency with which the MSS is sending the keep-alive message. Do not change this value.

4. Installation and Checkout

4.1. Installation service requirements

Installing the Source 15 basis weight requires setting two air regulators in addition head cooling, mechanical, and electrical connections.

System hardware requirements are:

- Air: Quality must be filtered (filter supplied), and free of contaminates (oil/water). Should use dry instrument air.

  air curtain air 4–6 SCFM

  shutter air 45 ± 5 psi, minimal flow

- Constant temperature potable cooling water, 70–100 °F (21 - 38 °C) maximum change 1 °F/hour (0.6 °C /hour). Closed loop preferred:

  2 g/min (8 l/min)

  maximum pressure 60 psi (410 kPa). Please note that water cooling is not always required at site. If the environment is well controlled and at normal ambient temperatures, the sheet is not hot and the measurement range such that changing air temperatures do not significantly affect the basis weight measurement, cooling is not required. Please contact Engineering for advice.

- + 24 V DC electrical power less than 1 amp.

- three contact outputs: shutter and two flags.

- one contact input: green light status (shutter closed).

- six analog inputs: basis weight, Sx air column temp., Sx head temp., Sx air col temp., Rx head temp., Rx air curtain temp.

- five Optional analog inputs: Z, Sx ceiling temp., Rx ceiling temp., bias voltage, amp temp. These require a second power track ribbon cable.

4.2. Required sensor support kits

Air Regulator and Flow Meter, 20-200 SCFH

Required for air supply to source actuator. Honeywell general license requires the use of this filter on the actuator air line. Use one per sensor.

Air Regulator and Flow Meter, 1-10 SCFM

Required for air supply to air curtains. Must be filtered. Use one per sensor.

4.3. Head alignment and gap adjustment

There are radiation safety concerns for anyone who works on this sensor. These concerns cannot all be adequately addressed here. Customers should refer to the *Honeywell Radiation Safety Manual for Customers*. A copy of this manual is provided along with the system delivery. Honeywell employees should refer to the *Radiation Safety Training Manual*.

Some procedures referred to in this section may only be performed by persons appropriately licensed. Those procedures must be obtained directly from the Honeywell Radiation Safety Department.

4.3.1. Head alignment

For precise head alignment, use the internal alignment holes. Access to these alignment holes requires removing both covers. Figure 5-1 and Figure 5-3 show these internal holes. For 0.4 inch gap, use Honeywell part number 07680300 as alignment pins (the exterior holes are not suitable being of larger diameter and the cover being sheet metal does not have a fixed position. Source 15 sensor is mounted top down, right to the head carriage).

WARNING

If air counts or shutter closed counts are unusual, do not proceed. Contact your Radiation Safety Officer.

WARNING

It is very important to follow each of the steps given in the following procedure to avoid the possibility of direct exposure to the radiation beam.

1. Verify shutter closure: Observe the warning lights. Only the green Shutter Closed radiation warning lamps should be lit. If possible, request background counts and verify they are within the normal range for shutter closed.

   If there is any question of whether all shutters are closed, *do not proceed*. Contact Honeywell ACS Global Radiological Operations.

2. Turn off power to the sensor heads.

3. Verify that power to the sensor heads has been disconnected by confirming that all radiation warning lights attached to the scanner are off.

4. Tag the appropriate location to warn that power must not be reconnected.

5. Separate the heads: Unlock the lock holding the head split mechanism. On 2080-03 and 4080 scanners, it is on the upper belt near the head. Push heads apart.

6. Remove covers: Do source cover first.

   a. Disengage small tab (10 mm or 3/8 in wide) first by pushing on angle section. Disengage large lever (50 mm or 2 in).

   b. Immediately re-engage small tab to prevent changing tension setting.

   c. Loosen all four latches. If working with the source head, keep hands out of the area directly below (or above) the Kapton window while removing cover (hold the cover by the sheet guide handles and do not allow hands or arms below or above the sensor).

   d. Carefully remove cover.

   e. Check mechanical shutter indicator arrows. See Figure 4-1. Verify shutter is closed. Remove receiver cover.

CAUTION

High voltage is under the Kapton window. The -500 VDC may still be present for some time after the +24 VDC power has been off. Always assume the high voltage is present until you can confirm that it is not.

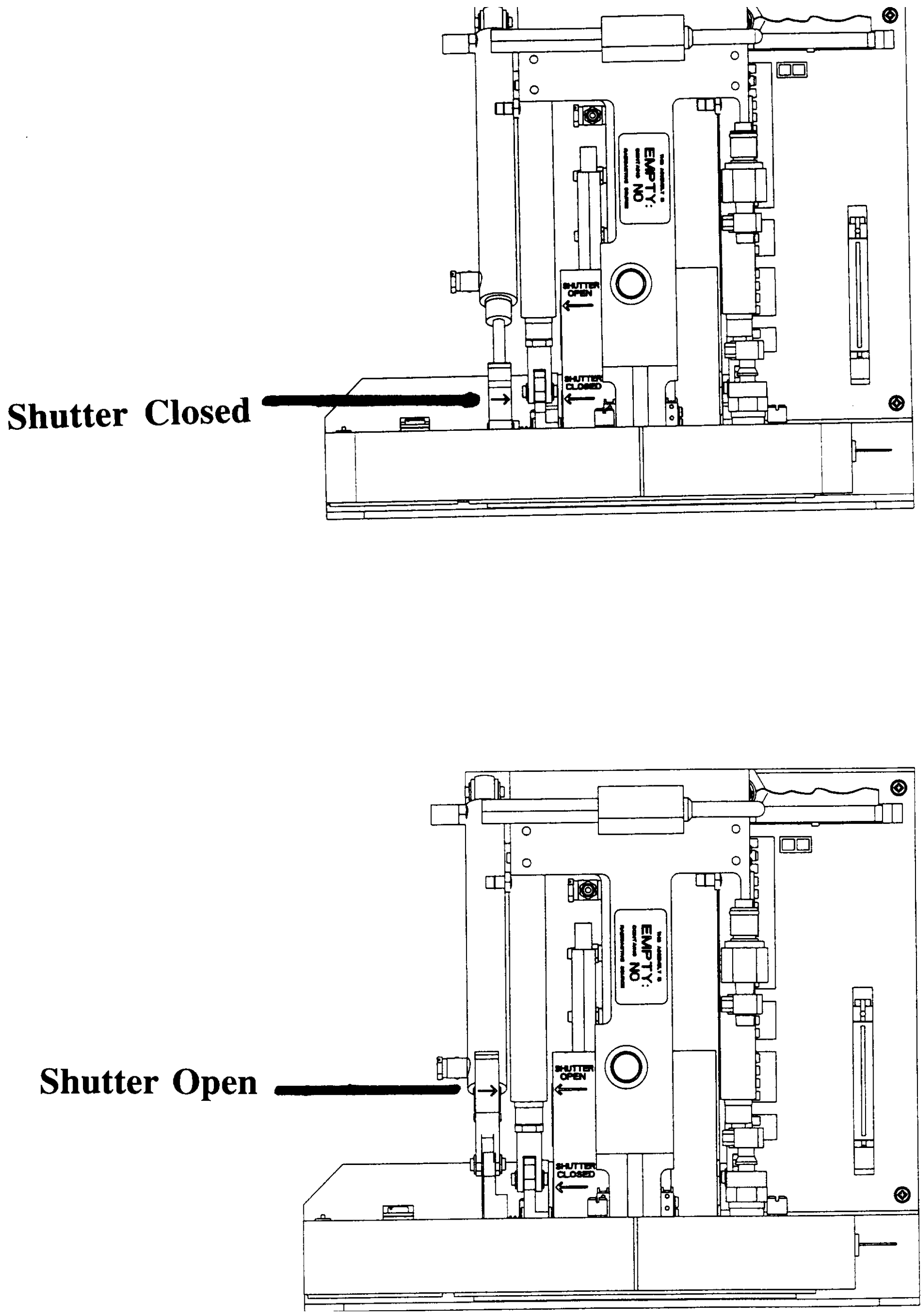


Figure 4-1 Shutter Indicator Positions

f. The two shutter positions are clearly marked. Remember, if the shutter is not closed, assume it is open. If the indicator does not indicate fully closed, assume the shutter is open.

7. Slide heads back together.

8. Use pins and align heads.
9. Re-split heads.
10. Orient head cover, carefully, so holes center on window(s). Tighten all four latches.
11. Slide heads back together. Replace lock on head split mechanism. Secure the key to the head split lock.
12. Turn power back on. Verify functioning of green and red lights.

4.3.2. Adjusting heads for parallelism

Gap bars must be used on the window frames, not on the aluminum sheet metal covers. Take care not to damage the windows. The window frames are made of stainless steel and are approximately five inches in diameter. Unlike the Modular Heads, the G-Head cover does not determine the sensor's position. The sensor is mounted to the carriage plate. The cover isolates and protects the sensor from the environment. Refer to your scanner manual for carriage adjustment.

5. Detailed Sensor Description

5.1. Versions

When ordering parts, or seeking help troubleshooting, you must know the correct sensor version or model number. Source 15 (Q4203-XX), like Source 9 (Q4201-XX), is a family of sensors for different applications. The version number is the last two digits of the part number. This is sometimes referred to as the dash number.

5.2. Source 15 hardware

An understanding of the major hardware components and their functions is necessary for proper maintenance. The Source 15 Basis Weight Sensor hardware and its heads consist of:

- Source holder assembly containing the radioactive source capsule backplane, and source air curtain.
- Source head containing source holder.
- Receiver assembly containing detector, amplifier, and integral air curtain.
- Receiver head containing receiver assembly (with integral air curtain) and backplane.

5.2.1. Source 15 source holder

Figure 5-1 is a view of the Source 15 Source Holder assembly. Major features identified are: aperture, shutter, source air column temperature measuring device, mechanical shutter indicator arm, mounting tabs, fire safety pin, the air cylinders and solenoid actuators for the shutter and both flags, orifice restrictors, and plumbing fittings. Contact Honeywell's ACS Global Radiological Operations before servicing. There are no field serviceable parts under the stainless steel side plate.

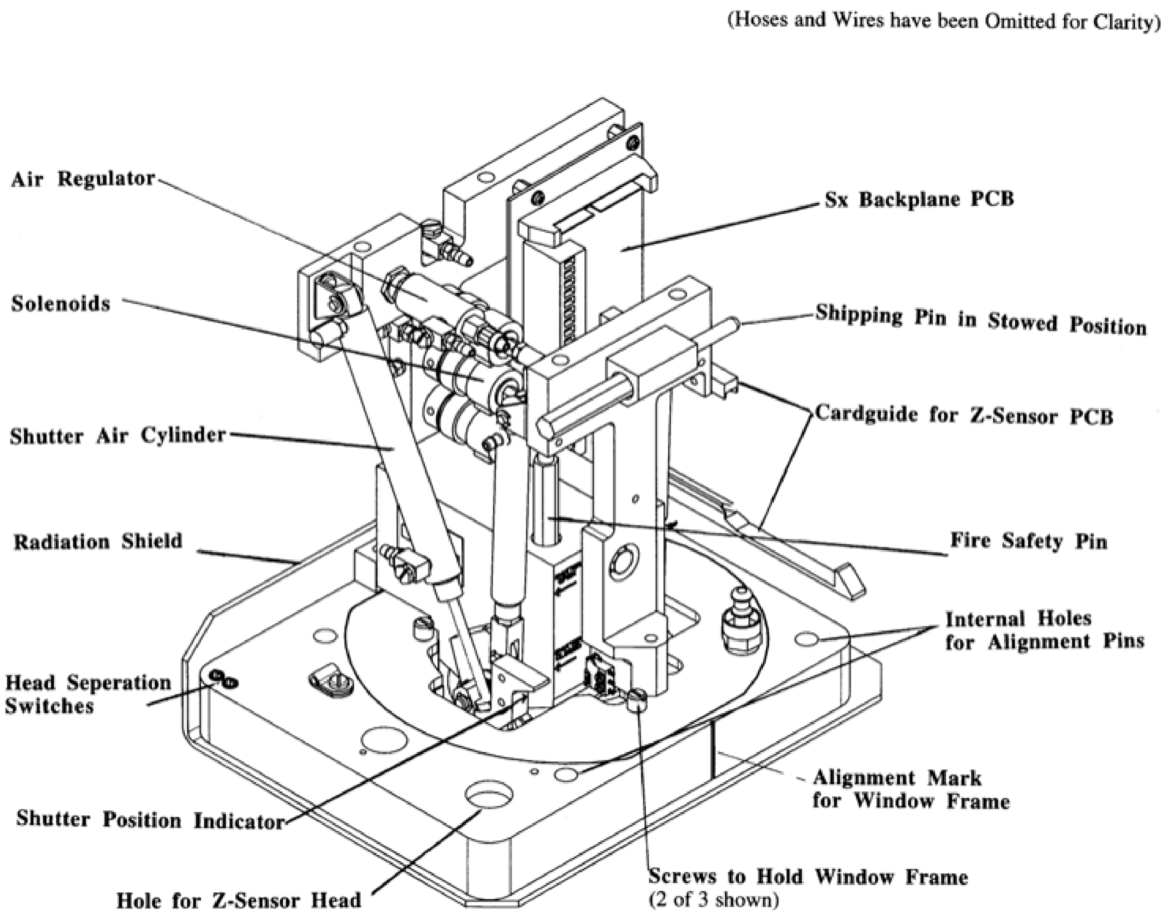


Figure 5-1 Major Features of Source 15 Source Holder Assembly

5.2.2. Source 15 source holder components

5.2.2.1. Aperture and shutter

An important safety feature of the shutter mechanism is the requirement for both air pressure and electrical power in order to open the shutter. If either air pressure or electrical power is lost while open, the shutter closes.

The shutter opens by a chain of events: first electrical, then pneumatic, and finally mechanical.

First, the computer closes a switch, sometimes referred to as making a contact output closure. This signal is sent to the head, through the source backplane to the shutter solenoid. This energizes the solenoid, which opens, allowing pressurized air into the shutter air cylinder. When pressurized, this air cylinder rotates an internal wheel that holds the capsule. Unless pressurized, the air cylinder's internal spring keeps the wheel closed. This spring is an important shutter safety mechanism, forcing the shutter closed if electrical power or air pressure is lost.

Through the source capsule's window passes the beam of beta particles. The aperture is a round hole in a stainless steel plate. Below this plate is the rotating wheel that holds the source capsule. When commanded to open, the wheel rotates away from its normal resting which is 135 degrees away from the sheet and moves towards the aperture. This allows the beta particles out through the open aperture.

5.2.2.2. Mechanical shutter arm

This arm indicates if the shutter is open or closed. The shutter is open when the indicator is away from the sheet. There is an arrow on this arm that lines up with text **Shutter Closed** and **Shutter Open**. Using the mechanical arm, the shutter can be manually opened and closed. When this arm is in its normal non-energized state, the shutter is closed. Always assume if the mechanical indicator is not fully in the closed position, and that the shutter is open.

The G-Head option gives visual indication of shutter position with the cover on. To do this, two special parts are used: a special head cover with a hole and an indicator with green and red sheet dots. The dots are visible outside the head, green for shutter closed, red for shutter open.

5.2.2.3. Temperature measuring device

Temperature measurement is simplified in Source 15 compared to Source 6 and Source 9.

Source 15 has five temperature measurements: Sx column, Sx backplane, Sx air curtain, Rx air curtain, and Rx backplane. All Source 15 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. This measurement device looks very much like a transistor, having three pins extending out of a small plastic package.

5.2.2.4. Fire safety pin

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 that forces a pin down to close the shutter. There is a separate maintenance procedure for replacement of the fire safety pin. Contact Honeywell’s ACS Global Radiological Operations for details.

WARNING

Only those qualified under radiation safety license and getting clearance from the Honeywell’s ACS Global Radiological Operations are allowed to replace the fire safety pin.

5.2.2.5. Source backplane

The Source 15 Sx Backplane PCB interfaces between the Source 15 Source head electronics and the G-Head power track. It is mounted in the source assembly which itself is housed inside the G-Head. The board provides power, signal conditioning and interlock signals to various source electronics.

This board provides the following features: head-split interlock, temperature measurements, Z-sensor support, and over temperature cut-out. The backplane contains 12 test points, with the test points' functions clearly labeled. These features are explained in more detail by the following sections.

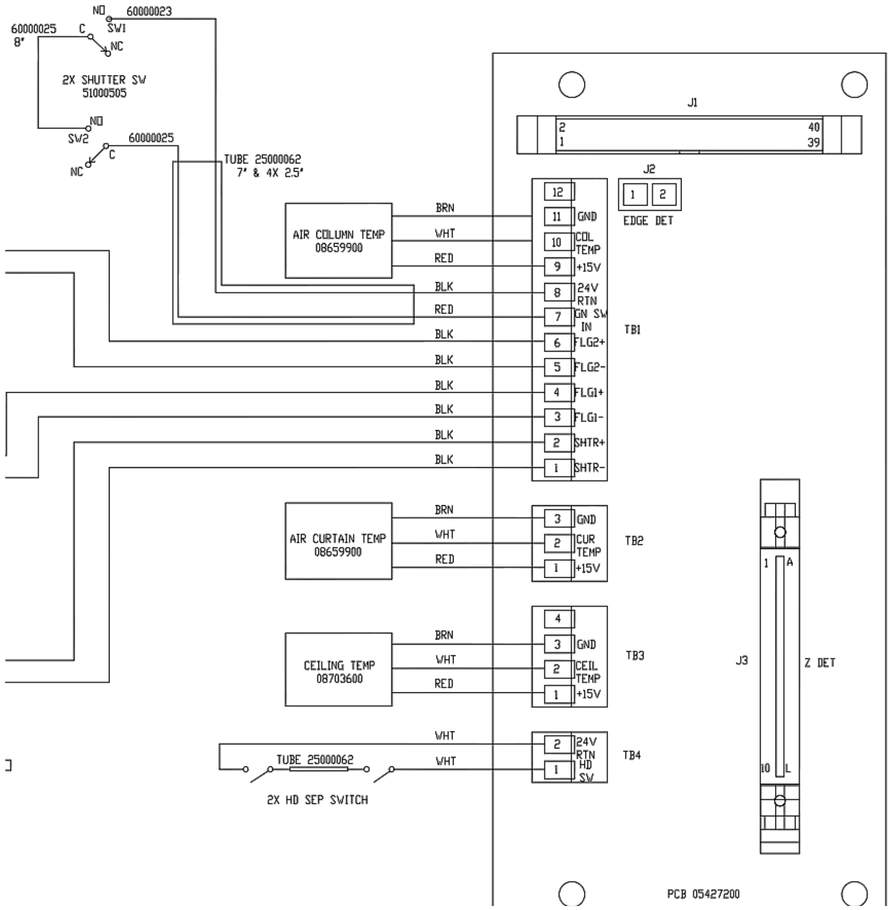


Figure 5-2 Partial Schematic and location of the test points on the source backplane

LED Indicators

The board has five LEDs to indicate the status of the **SHUTTER**, **FLAG1**, **FLAG2**, **HEAD SPLIT**, and **POWER ON** signals. See Table 5-1.

Table 5-1 Source 15 Backplane LEDs

DS Number	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
4	Yellow	HEAD SPLIT	Heads are split
5	Yellow	PWR ON	+24 volt head power is on

Test Points

There are 12 test points on the backplane. These allow easy access to measure electrical signals. See Table 5-2.

Table 5-2 Source 15 Backplane Test Points

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

Source 15 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 source head has magnetic (reed) switches while the receiver head has a magnet. These are mounted both facing toward the gap. When the heads move apart, the reed switches open. These switches drive a relay.

When the switch is closed, the relay is closed, which permits the computer to drive the shutter. When the switches are open the relay is open. This not only breaks the line from the computer, but pulls the line going to the shutter high, preventing the shutter from opening.

A yellow LED provides the status of the switch. It is lit when the heads are split (switch open). Labeled on the backplane is **HEADS SPLIT**. This feature permitted the removal of the external head-in-place and receiver-in-place switches.

Ground

It is important to note there are three grounds on this board:

- power ground (24VRTN)
- electrical ground (GND)
- 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 Measurement

There are four temperature signals generated on the board. All provide direct temperature readout in degrees C with a linear scale factor of 0.1volts/degrees C. For example, 2.57V = 25.7°C. The Air Column, Air Curtain, and the Ceiling temperature transducers are connected through TB1, TB2, and TB3 terminal blocks respectively. A direct readout temperature device is mounted on the board to provide temperature status.

Shutter and Flags

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 and FLAG2 solenoids. The SHUTTER, FLAG1, and FLAG2 contact outputs from the computer are connected to the board through the power track.

Z-Sensor Support

A 20 pin card edge connector and edge guides are provided to support the board for the optional Z-sensor. This PCB provides for an interface to a z-axis sensor amplifier assembly. A 24 VDC to ±15V DC converter mounted on the board provides power for it. This converter also provides power for the head temperature sensor.

Edge Detector Source Power

Edge detector source power is supplied by the input +24 volt power. A 2 terminal header is used to connect power.

Over Temperature Cutout

An over temperature cutout device opens the +24 VDC electrical line when the temperature in the head exceeds 165 - 170°F. This is to protect the electronics should an over temperature condition occur.

Connections

There are four green Phoenix and one 40 pin ribbon cable on the backplane. All connectors are keyed so it is impossible to invert the cable. All connections are all different sizes so it is not possible to interchange the connectors. The source backplane supports the Z-sensor card having a slot to plug in the card.

5.2.2.6. Source Air Curtain

The source air curtain is a separate assembly from the source holder assembly. This air curtain contains a temperature measuring device, contained in assembly p/n 08659900 (temperature sensor assembly). As with all temperature measurements on the Source 15, the voltage output of this device is linear with temperature in degrees Celsius.

Externally there is a ring with holes. This ring holds the 4.328 inch diameter conductive windows, p/n 00482400 (The silver colored side is mounted outwards). The pattern of the holes allows uniform air flow.

This air management is a major feature of the Source 15.

5.2.2.7. Regulator

The regulator is on the air line to the shutter solenoid. It prevents a high pressure surge on the supply air line from reaching the air cylinder. This regulator is purchased preset. Do not make adjustments. The air curtain and shutter pneumatic lines are separate so this brass cylinder, approximately 1.5 inch long .5 inch diameter, is only on the solenoid line.

5.2.3. Receiver Assembly

The receiver assembly consists of a compensator, the ion chamber detector, the amplifier card, backplane, and an integral air curtain.

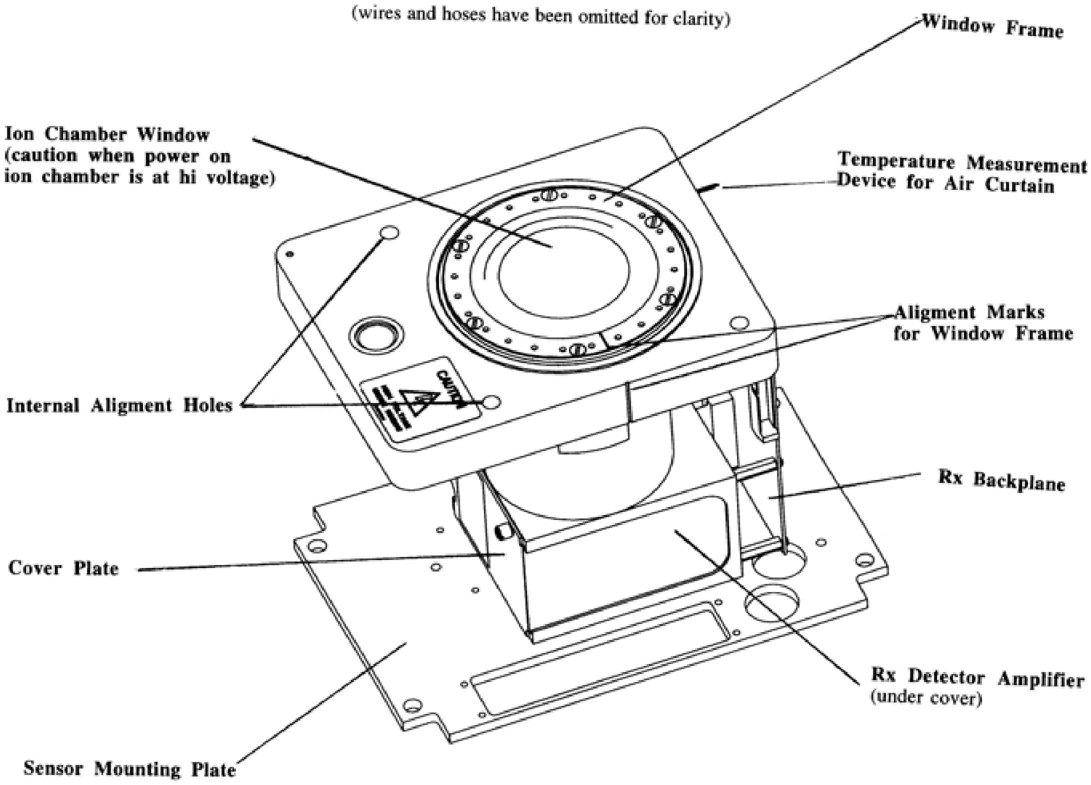


Figure 5-3 Source 15 Receiver Viewed from Window Side

The receiver assembly used in Source 15 is a new design. The electronics boards have been redone and reduced to two cards. Additionally all machined parts have been designed for the G-Head. The exception to this is that the ion chambers are the same as used on the corresponding Source 9 Basis Weight sensors.

The air curtain is a major design improvement. Its purpose is to control the air temperature in the gap and stabilize the sheet. In order to accomplish both objectives, the air flow must be uniform.

5.2.3.1. Source 15 Receiver Detector Amplifier Card

This board is used as an interface between the Sx15 ion chamber assembly and the Sx15 Receiver Backplane PCBA. It is mounted in the receiver assembly inside the G-Head. The board provides power to the ion chamber and signal conditioning to the low level current output generated from the ion chamber. The circuit design has the functionality of a nuclear amplifier and an X-Ray amplifier that's implemented with two cascaded gain stages. One stage for nuclear sensors with hardware switch gain select and another stage for x-ray sensors with computer controlled gain select.

Hardware Gain Select

Gain changing is much simplified in Source 15, just rotate a switch. No soldering or board removal is required.

Gains steps are equal, with three steps doubling the gain. (Each step is the cubed root of two, or a 26 % increase.) For each board there is a sixteen position hexadecimal switch for fine. There are three board versions. Each variation has a different feedback resistor for a coarse range in gain values. The detector amplifier cards use a 20, 100 or 500 Meg ohm resistor.

The table below shows the variation numbers and the gain select values. The gains are normalized to 1.0 for the variation-00 board at switch position 0.

Table 5-3 Amplifier Gain Settings

Switch Position	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

Gain steps are uniform, 26% each, making three steps a factor of two. This gain table is silk-screened on the cover.

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 labeled.

Table 5-4 Amplifier Test Points

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

Ground

The ground for the on board electronics (GND) is separate from the ion chamber bias voltage ground (500V_RTN). These grounds are tied together on the backplane.

Temperature Transducer

There is an on board temperature transducer and its associated compensation network located close to the input amplifier to get the best possible temperature indication of the input stage. The remainder of the signal conditioning is located on the backplane board.

Power

The PCBA is powered from the aforementioned backplane with +15VDC, -15VDC and +5VDC regulated power supplies. Also, a -500VDC ion chamber bias voltage is routed through the board from the backplane to a power connector on the board. The ion chamber is powered from this connector.

Diagnostics

An active low logic level test input (/TEST) is provided for diagnostics. This input isolates the ion chamber from the circuit and switches in a constant +0.24V test signal to the output stage amplifier. This DC voltage is then amplified by a factor determined by the software gain select inputs according to the aforementioned software gain select table.

Input Trans-impedance Amplifier

This PCBA provides an interface to the ion chamber current output through a single conductor SMB connector whose contact is isolated from the board to preclude leakage current effects. The associated input circuit electronic component leads are directly soldered to the isolated SMB connector contact. The input stage is an ultra low input bias current operational amplifier that functions as a current to voltage converter. The amplifier has offset null pins and a trim circuit to adjust output offset voltage to the desired level. This offset is typically set to 15±1 mV.

Input Time Constant

The input circuit time constant is created from the combination of the high impedance mega-ohm feedback resistor, R3, and the 15 pf capacitor, C4, on the input amplifier stage. The 20 MΩ (variation -02), 100 MΩ (variation -01), and 500 MΩ (variation -00) have time constants of 0.3 ms, 1.5 ms, and 7.5 ms, respectively.

5.2.3.2. Source 15 Receiver Backplane

This board is an interface between the Sx15 receiver head electronics and the G-Head power track. It is mounted in the receiver assembly of the G-Head. Typically the Source 15 basis weight receiver is in the upper head. 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. In Source 15, there is no input for test point six.

Table 5-5 Source 15 Receiver Backplane Test Points

TP Number	Return TP	Label	Meaning
1	9	LV Bias	Lo v monitor ion chamber bias voltage
2	9	Air Curt Tmp	Air curtain temperature
3	9	BW	Raw basis weight voltage
4	9	Hd/Snsr Tmp	Head (RX backplane PCB) temperature
5	9	Ceil Tmp	Optional ceiling temperature
6	9	Snsr Tmp	Not used in Source 15 (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

TP Number	Return TP	Label	Meaning
14	9		-500 V ion chamber bias

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.

Power

The PCBA is powered by a +24 V supply voltage. A power on LED indicator is provided. Input power has a 1.5 amp fuse and an on board spare fuse. An over temperature sensor open circuits the power line at 165 - 170 degrees F to disable power. There is a 3 W, isolated, switching, dual output power supply with an output rating of +15 volts at 0.1 amp and -15 volts at 0.1 amp. There is another 3 W, isolated, switching, single output power supply with an output rating of +5 volts at 500 ma. These provide power to the on board signal conditioning electronics and the detector amplifier.

An isolated high voltage power supply is used to provide a -500 V bias to the ion chamber. This variable DC to high voltage converter output voltage is set by a 3 terminal adjustable linear regulator. The linear regulator supplies 4.6 volts to the high voltage supply for a nominal -500 V output.

Ground

It is important to note there are three grounds on this board:

- power ground (24VRTN)
- electrical ground (GND)
- 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.

Detector Amplifier

This PCBA interfaces to a detector amplifier assembly with a 20 pin card edge connector. Multiple power outputs of -500 V, +15 V, -15 V, and +5 V are supplied to the detector amplifier board. The conditioned nuclear sensor signal is directly routed to the power track. There are four optically isolated digital outputs used to switch various detector amplifier gains and a diagnostic test signal.

Gain Set Contact Inputs

Do not use jumpers in W2, W3, or W4 for Source 15.

Test Diagnostic Contact Input

A switch closure to ground at the /TEST_BIT input enables the test diagnostic function. The circuit on the detector amplifier bypasses the nuclear signal and injects a +0.25 volt test voltage into the final amplifier stage. This diagnostic can also be enabled by installing jumper W5(/TEST). The jumper is wired either/or with the board input so either signal will toggle the circuit.

Temperature Sensors

There are three temperature signals on the board and one temperature transducer. All provide direct temperature readout in degrees Celsius with a scale factor of 0.1volts/degrees C, at the backplane test points. (For example, 2.57 V = 25.7°C). The head temperature transducer is located on board. The Air Curtain and Ceiling temperature transducers are connected through TB1 and TB2 terminal blocks respectively. The Sensor temperature transducer is located on the detector amplifier and is connected to a signal conditioning circuit on this PCBA. A LM35 direct readout temperature device is mounted on the board to provide head temperature status.

Edge Detector

This feature supports the IR edge detect sensor. This optional sensor fits in a hole in the G-Head 4.5 inches in the cross direction away from the center of the basis weight beam (do not confuse this edge detect sensor with the computer edge detect available on some systems, which is based on the level of the basis weight sensor). An edge detect circuit senses the edge of the product and conditions the photo detector current input to a high level analog voltage and a digital switch closure. The analog voltage output is set by the photo detector current multiplier feedback resistor of 499KΩ. The digital edge contact output closes when on sheet and opens when off sheet as indicated on LED DS4. Its threshold level is adjustable from 0 to +5 V by potentiometer R2.

5.3. Differences between Sources

Table 5-6 summaries hardware differences between Sources 6, 9, 12, and 15. This table is provided primarily for those already familiar with earlier Honeywell basis weight sensors, to speed their understanding of Source 15 (this chart is a discussion of sensors and not their related heads).

Table 5-6 Differences between Sources

	Source 6	Source 9	Source 12	Source 15
Radionuclides	Kr-85, Sr-90, Am-241, (Pm-147 obsolete)	Kr-85, Pm-147	Pm-147 only	Kr-85, Sr-90, Am-241
Source Capsule/ Beam Spot	Round disk	Round disk	Rectangular line	Round disk
Air Curtain	None	None	Internal to both source and receiver heads.	Internal to both source and receiver heads.
Flags	1	1	2	2
Shutter Actuator	Electric solenoid	Pneumatic capsule rotator	Linear pneumatic	Linear pneumatic
Flag Actuator	Electric solenoid	Electric solenoid	Linear pneumatic	Linear pneumatic
Air Supply (head internal)	None	1 line for shutter (1/4 inch OD) 45 ± 5 psi	1 line for shutter, flags (1/4 inch OD) 45 ± 5 psi 2nd for air curtain :1 Sx , 1 Rx. (1/2 inch OD)	1 line for shutter, flags (1/4 inch OD) 45 ± 5 psi 2nd for air curtain :1 Sx , 1 Rx. (1/2 inch OD)
Green light switches (Sense shutter closed)	1	2	2	2
Temperatures Measured	Sx air column	Sx air column	Sx air column, Air curtain (Sx and Rx)	Sx air column, Air curtain (Sx and Rx)
Source Window	3.46 inch dia	3.46 inch dia	3.715 in dia	4.328 in dia
Receiver Window	3.46 inch dia	3.715 inch dia	3.715 in dia	4.328 in dia

Major differences between Sources 6, 9, 12, and 15 can be quickly identified in Table 5-6. For example, Source 15 uses only one size window 4.328 in diameter, while Source 9 uses two sizes.

5.4. Correctors

5.4.1. General

An understanding of correctors is vital for obtaining best sensor performance. It is important to understand the magnitudes of the various correctors. The correctors are all displayed in absolute values (that is, not as ratios), typically in customer basis weight units. When an operating sensor gives questionable results, you need to know nominal corrector values so you can compare them with the current values, to help determine what area to troubleshoot.

The physical basis of the correctors will be explained in this section. Calibration is discussed in Chapter 7. There are two general approaches to handle external influences on the sensor: one is to design the hardware to minimize the effect of the external influence on the sensor, the other is to measure the quantity doing the influencing and make a correction in software.

Both approaches, individually and in combination, are used. Ash in the sheet is an example of the first, air temperature is an example of the second and X-Y head alignment sensitivity is an example of both approaches being used.

5.4.2. Dirt

Dirt means any change in mass between the source and receiver from one standardization to the next. Examples are: debris on the source or receiver window, change in air density due to air temperature or pressure changes, and change in window mass due to window replacement. It is important to understand that changes in air temperature between standardizations (on-sheet) 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. These nonlinearities can be quite large, and 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/Alast (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 (see Chapter 7).

DFRAC determines whether the clean calibration curve is used (DFRAC = 0) or the dirty calibration curve (DFRAC = 1) or some fraction thereof (0 < DFRAC < 1). The best way to understand DFRAC is through an example (see Table 5-7).

Table 5-7 DFRAC

If	Then
If F/Alast = T0FA	then DFRAC = 0.0
If F/Alast = (T0FA + T0CF)	then DFRAC = 1.0

ATTENTION

Note that T0FA + T0CF = F/Adirty and that T0FA = F/Aclean.

5.4.3. Second Flag

Source 15 has the normal flag, here called Flag1, which is used for the dirt correction. It also has a second flag assembly

To allow for influences which can affect the sensor's reading in ways not corrected by the usual means, and which would cause the flag weights to vary from their original values, the Source 15 software allows for a correction to be applied to subsequent on-line measurements. Designated as the Second flag corrector, it can be calculated in four different ways to allow for maximum flexibility in real-world situations. The Second flag corrector was coded to be as general as possible, so that the optimum algorithm could be easily implemented on site, based on experience. It also allows for the fact that different sites may have different influences requiring different approaches.

The default situation is to disable the corrector. The corrector can be determined from the error in the flag weights in either percentage terms or in absolute weight units (g/m2, g/m^2, or gsm), with arbitrary weighting of the two verification samples. This weighting allows for correction of influences that are percentage or weight based. Finally, the corrector can be a function of weight, determined by a slope and intercept from the errors of the two samples, and this can be either percentage or weight based.

In order to maintain a consistent evaluation for the of Flag2 and Flag12 weights, there is a dedicated set of calibration coefficients used exclusively for flag weight calculations: FA0 - FA7 and FD0 - FD7. FAs are for the clean calibration curve while FDs are for the dirty curve. They are established at the factory using polyester samples, and are themselves made of polyester (Mylar). For example, in the medium ash Source 15 sensor, model number 09420301, Flag1 is nominally .001 inch (.025 mm or ~32 gsm) and Flag2 .0005 inch (.013 mm or ~16 gsm), making the combination .0015 inch (.038 mm or ~48 gsm). The exact values are not very important, as the concern is any change in the flag weights, not their absolute values.

Calculating the weights of Flag2 and Flag12 is fundamentally different from the common but sometimes misleading practice of calculating the weight of the single flag (as in Source 6 and Source 9). Calculating the weight of the single flag is not as independent as measuring at another weight. This is because the dirt correction is based on the single flag ratio just as is the weight of the single flag. At this ratio, the nature of the dirt correction tends to compensate exactly, whether or not the correction is appropriate. Using a second flag, at a different weight and ratio, there is both statistical and systematic independence. Thus the Flag2 and Flag12 errors are much better quality indicators than the old style flag weight, and also far better than common attempts to use the F/A (Flag to Air) ratio as a quality indicator. The latter is true because the F/A ratio is, by design, the basis of a corrector, and is expected to change, much as the air gap temperatures will.

5.4.4. Ash

Basis Weight sensors using beta ray attenuation are inherently sensitive to higher atomic number additives. These additives are called ash because they are the residual left when the sample is oxidized at a high temperature. 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:

% measured basis weight change for a 1% change in ash loading

The ideal sensor would have sensitivity to ash of 0%/1% 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.

5.4.5. 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. It is a convenient rule that one inch of air (25.4 millimeters) at standard temperature and pressure has a basis weight of 32 gsm. 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 Ideal Gas Law, the change in basis weight of an air column is proportional to

[1/Tinitial - 1/Tfinal]

where temperature is expressed in

degrees Kelvin = degrees C + 273.

The air temperature correction for each air column is expressed as

AGAn * [1/TStdz - 1/TNow]

where AGAn is a calibration constant determined through the ideal gas law.

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 gsm. The AGAn values for each sensor type are specified in the Calibration Specification and are entered with the calibration constants.

5.4.6. Z-Head Displacement

Head displacement in the Z-direction changes basis weight readings primarily due to the change in the mass of air between the heads. Correcting for Z is similar to correcting for air temperature changes. In both cases, a real-time correction is calculated based on the differences from the last standardize to the current value. Unlike the air temperature, the Z-sensor is optional. CFZ is the Z-correction calibration constant that is entered at calibration. The Z-correction is an additive correction with the units of gsm.

5.4.7. X-Y Head Displacement (profile correction)

Besides changes in Z, Basis Weight Sensors are inherently sensitive to relative head displacements in the X-Y directions (CD-MD). To correct for any remaining sensitivity, use Profile Correction. The profile correction is an additive correction with units of gsm. When the optional Z-sensor is not present, profile correction also corrects for changes in Z-profile.

For optimal Source 15 performance, properly build the profile correction arrays. The profile correction is built with the same conditions as when the machine runs, at temperature.

For systems without a smoothing function in profile correction build, it is very important to build the profile correction arrays with a the sensor spending enough total time in each mini-slice, at least four seconds. This time reduces the nuclear noise in the correction array. For example if the sheet is 100 inches wide, with 0.5 inch wide mini-slices, scanning at 5 inch per second, 40 scans would be required for 4 seconds per mini-slice.

Time in each mini-slice each scan:

$$t = \text{minislice width / scan speed} = \frac{0.5\ \text{inch}}{5\ \text{inch/sec}} = 0.1\ \text{second}$$

Total number of scans:

$$N = \text{number of scans} = \frac{(t\ \text{total time})}{(t\ \text{each scan})} = \frac{4\ \text{sec}}{0.1\ \text{sec}} = 40\ \text{scans}$$

This example assumes smoothing is not available.

With smoothing, the time required to build is less. Build the correction on a light weight sample in the gap, not an internal flag. The flag is not in the same plane as the sample; therefore it has different X-Y sensitivity.

Basis Weight Sensors are inherently sensitive to relative sheet displacements 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 generally basis weight dependent. There is no software correction for sheet passline changes.

5.4.8. 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, or other) calibration relative to the calibration standard (Mylar TM).

5.4.9. Dynamic Offset

The dynamic offset, BWDO, corrects for differences between static and on sheet conditions. This offset is only used on-sheet (not at sample) and accounts for effects such as moisture flash-off and sheet stretch. That is, effects where the basis weight of the sheet at the scanner is physically different from that as measured at the mill lab.

BWDO should not be changed just because a dynamic check does not agree with a measurement but should be used as a last option when it is clear that the sensor and all corrections are reading properly.

6. Calibration Constant Specifications

This chapter provides the specifications needed for the checkout and calibration of the Source 15 Basis Weight Sensor, including nominals for values individually determined at calibration (calibration constants), database values that vary, and performance limits.

All values are typical and nominal except for Flag to Air (F/A) stability, which has an investigational limit. If F/A stability is greater than this limit, initiate troubleshooting on the sensor / system. The first step in troubleshooting is comparing the system's various constants to their typical values listed here.

6.1. Stability

The value for stability specifications were determined using sets of 30 references, taken sequentially, with no additional interval between readings. They pertain to conditions of thermal equilibrium in the heads and constant gap temperature. The typical values are from twelve or more sets of thirty references each. The investigational limit is approximately 35 percent higher and represents the largest value usually obtained in a single set of thirty references. If data is taken before thermal equilibrium, the stability values may be several times greater -- more for air counts then for F/A ratios.

When testing F/A and Air Counts stability, background stability must be checked:

- If while adjusting the background (offset) voltage the meter readings indicate an oscillation or drift of more than ± 1 mV (.001 Volt), stop and look into the cause of this drift, that is, grounding, ion chamber, detector amp. Once this is resolved or if drift cannot be observed, proceed with the next step.

- On systems not providing a background stability analysis, command a background and record the value before and after each stability run. On (test) systems having a background reading with each standardize, check these readings. Investigate if there is a variation of more than 1 % in background counts.

Here the term *standardize* is interchangeable with *reference*. While there is a scheduling difference, the calculations are identical.

6.2. Corrector Constants supplied by Sensor Development Department

For a gap of 0.4 inches (10.2 mm):

Table 6-1 Corrector Constants

Constant	Value	Definition
AGAU	1,800 gsm / K (.4 inch gap)	Upper Air Gap Temp Corrector
AGAL	1,800 gsm / K (.4 inch gap)	Lower Air Gap Temp Corrector
AGAR	0 gsm / K	Rx Air Column Temp Corrector
AGAS	4300 gsm / K	Sx Air Column Temp Corrector
CFZ	(with Z sensor) varies by sensor and weight[1]	Z-correction coefficient on-sheet
CFZ	0 (with no Z sensor)	Z correction requires Z readings
CFZS	0.0	Z-correction coefficient standardize
KCM2	0.0	Constant added to Mylar curve for customer product curve transformation

These constants, except AGAS, scale linearly.

For example, doubling the gap would require doubling the values in the above table.

[1] There are two algorithms widely used for Z correction.
The normal or ratio method: Zcorrection = CFZ * (Zref-Znow)/Zref +CFZS
The other method is the absolute method: Zcorrection = CFZ * (Zref-Znow). With the absolute method, CFZ from the normal method is divided by the gap in mm, typically about 10 mm.

6.3. 4203-00 Kr-85 Linerboard Sensor LAI 0.4 inch gap

Basis Weight Range: 140 - 1200 gsm

Hardware:

Gain: 8 (.24) on 05431602 20 Meg ohm feedback resistor

Flag1: 320 gsm (»10 mil MylarÔ)

Flag2: 160 gsm (»5 mil MylarÔ)

6.3.1. Sensor constants

Measured constants (typical):	
Background:	15 mV
Air VAir volts:	7.0 V (set gain for 6-9 volts)
T0FA:	0.40 ± .02
T0CF:	-0.0039 ± .002 for .001 inch MylarÔ
T012:	0.242
T0F2:	0.644

Supplied by sensor engineering:	
AGAU	1,800 gsm / K
AGAL	1,800 gsm / K
AGAR	0 gsm / K
AGAS	4,300 gsm / K
CFZ	40 gsm with normal or ratio Z algorithm
CFZ	3.6 gsm with absolute algorithm
CFZ	0 with no Z sensor
CFZS	0
BWDO	0
KCM2	0

ATTENTION Use the Normal or Ratio Method by default.

6.3.2. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration period, zero (or minimum) waiting between references. Set air curtain to 4 - 6 SCFM (standard cubic feet per minute), flow requirements determine psi setting. With the air curtains on, gap must be open, that is, cannot be taped.

Typical F/A ratio 1 sigma	=	.00004	
Investigational Limit F/A 1 sigma	=	.00006	on test bench
Investigational Limit F/A 1 sigma	=	.00009	on system

Typical curve fit constants from MylarÔ calibration, for the entire weight range 104 -1254 gsm. Dirt curve is built on .001 inch Mylarä dirt. Dirt verification is on .0005 inch Mylarä .

Clean		Dirty	
BA0	-0.875	BD0	0.359
BA1	-420	BD1	6.663
BA2	-41.85	BD2	0.962
BA3	-2.967	BD3	0.044
BA4	0	BD4	0
BA5	0	BD5	0
BA6	0	BD6	0
BA7	0	BD7	0

6.3.3. Accuracy specifications

Calibration fit accuracy:

2 sigma of residuals < 0.25% from 140 to 1200 gsm

Static MylarÔ verification accuracy of all points are within:

± 0.40% from 140 - 1200 gsm

The beam half widths, delay times:

Primary Sensor Delay ms (Da Vinci, MXProLine)	2.9 msec
Primary Sensor Beam Half Width mm	14.5 mm
Lo End Edge Detector Beam Half Width mm	9.3 mm
Hi End Edge Detector Beam Half Width	9.3 mm

Note that the primary sensor beam half-width value is nominal but may be tuned using the streak test. The above parameters are input on the MXProLine RAE software under the Mss Setup Diagnostics Tab, choose Mss Job Set IO Setup Frame, then from drop down lists choose the MSS and look under NuclearSensorSx and Position Control

6.4. 4203-01 [-11] Kr-85 Medium Ash Insensitive Sensor 0.4 inch gap

There are two versions of the Sx15 Kr 0.4 inch gap MAI (Medium Ash Insensitive) basis weight sensor. The –11 version has less flux and no second flag.

Basis Weight Range: 16 - 1200 gsm

Hardware:

Gain: C (.64) on 05431602 20 Meg ohm feedback resistor

[05431601 100 Meg Ohm feedback resistor –11]

Flag1: 65 gsm (»2 mil MylarÔ)

Flag2: 130 gsm (»4 mil MylarÔ) [NA –11]

6.4.1. Sensor constants

Measured constants (typical):	
Background:	15 mV
Air V Air volts:	7.0 V (set gain for 6-9 volts)
T0FA:	0.82 ± .02
T0CF:	-0.002 ± .001 for .001 inch MylarÔ
T012:	0.0.555 ± .020 [NA –11]
T0F2:	0.68 ± .02 [NA –11]

Supplied by sensor engineering:	
AGAU	1,800 gsm / K
AGAL	1,800 gsm / K
AGAR	0 gsm / K
AGAS	4,300 gsm / K
CFZS	0
BWDO	0
KCM2	0

CFZ Normal or Ratio Method gsm (Default)	CFZ Absolute Method gsm/mm	Z Sensor	BW Range
30.1	2.96	yes	< 550 gsm
35.0	3.48	yes	550 – 1000 gsm
55.0	5.50	yes	>1000 gsm

If there is no Z sensor, CFZ = 0.

ATTENTION

Use the Normal or Ratio Method by default.

6.4.2. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration period, zero (or minimum) waiting between references. Set air curtain to 4 - 6 SCFM (standard cubic feet per minute), flow requirements determine psi setting. With the air curtains on, gap must be open, that is, cannot be taped).

Typical F/A ratio 1 sigma	=	.00004	
Investigational Limit F/A 1 sigma	=	.00012	on test bench
Investigational Limit F/A 1 sigma	=	.00016	on system

Typical curve fit constants from MylarÔ calibration, for the fit weight range 8 - 1200 gsm. Dirt curve is built on .001 inch Mylarä dirt. Dirt verification is on .0005 inch Mylarä .

Clean		Dirty	
BA0	» 0.0 ± 0.1	BD0	» .1 ± 0.1
BA1	» -354 ± 4	BD1	» 6 ± 2
BA2	» -27 ± 4	BD2	» 0.5 ± 4
BA3	» 6 ± 4	BD3	» -0.2 ± 4
BA4	» 4 ± 2	BD4	» 0 ± 2
BA5	» 1 ± 0.2	BD5	» 0 ± 0.1
BA6	» .1 ± 0.1	BD6	» 0
BA7	» 0	BD7	» 0

6.4.3. Accuracy specifications

Calibration fit accuracy:

± 0.10 gsm for all points below 40 gsm

2 sigma of residuals < .25% for all points above 40 gsm

Static MylarÔ verification accuracy of all points are within:

± 0.14 gsm below 40 gsm

± 0.40% from 40 - 1200 gsm

Beam half widths, delay time:

	-01	-11
Primary Sensor Delay ms (Da Vinci, MXProLine)	2.9 msec	3.8 msec
Primary Sensor Beam Half Width mm	14.5 mm	14.6 mm
Lo End Edge Detector Beam Half Width mm	9.3 mm	9.1 mm
Hi End Edge Detector Beam Half Width	9.3 mm	9.1 mm

Note that the primary sensor beam half-width value is nominal but may be tuned using the streak test. The above parameters are input on the MXProLine RAE software under the Mss Setup Diagnostics Tab, choose Mss Job Set IO Setup Frame, then from drop down lists choose the MSS and look under NuclearSensorSx and Position Control

6.5. 4203-02 Kr-85 High Ash Insensitive Sensor 0.4 inch gap

Basis Weight Range: 20 - 1000 gsm

Hardware

Typical Gain: B (.64) on 05431601 100 Meg ohm feedback resistor

Flag1: 65 gsm (»2 mil MylarÔ)

Flag2: 130 gsm (»4 mil MylarÔ)

6.5.1. Sensor constants

Measured constants (typical):	
Background:	15 mV
Air V Air volts:	7.5 ±1.5 V (set gain for 6-9 volts)
T0FA:	0.78 (± .02)
T0CF:	-0.0032 (± .001) for .001 inch MylarÔ
T012:	0.46 (± .02)
T0F2:	0.60 (± .02)

Supplied by sensor engineering:	
AGAU	1,800 gsm / K
AGAL	1,800 gsm / K
AGAR	0 gsm / K
AGAS	4,300 gsm / K
CFZS	0
BWDO	0
KCM2	0

CFZ Normal or Ratio Method gsm (Default)	CFZ Absolute Method gsm/mm	Z Sensor	BW Range
14.5	1.42	yes	< 550 gsm
36.1	3.56	yes	550 – 850 gsm
83.0	8.30	yes	>850 gsm

If there is no Z sensor, CFZ = 0.

ATTENTION

Use the Normal or Ratio Method by default.

6.5.2. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration period, zero (or minimum) waiting between references. Set air curtain to 4 - 6 SCFM (standard cubic feet per minute), flow requirements determine psi setting. With the air curtains on, gap must be open, that is, cannot be taped).

Typical F/A ratio 1 sigma = 0.00012

Investigational Limit F/A 1 sigma = 0.00014 on test bench
Investigational Limit F/A 1 sigma = 0.00016 on system

Typical curve fit constants from MylarÔ calibration, for the weight range 70-971 gsm. Dirt curve is built on .001 inch Mylarä dirt. Dirt verification is on .0005 inch Mylarä .

Clean		Dirty	
BA0	» -1.45	BD0	» -0.37
BA1	» -267	BD1	» 3
BA2	» -38.1	BD2	» -4
BA3	» -12.7	BD3	» -4
BA4	» -3.5	BD4	» -1
BA5	»-0.4	BD5	» 0.2
BA6	0	BD6	0
BA7	0	BD7	0

6.5.3. Accuracy specifications

Calibration fit accuracy:

± 0.10 gsm for all points below 40 gsm

2 sigma of residuals < 0.25% for all points above 40 gsm

Static MylarÔ verification accuracy of all points are within:

± 0.14 gsm below 40 gsm

± 0.40% from 40 - 1200 gsm

Beam half widths, delay time:

Primary Sensor Delay ms (Da Vinci, MXProLine)	4.1 msec
Primary Sensor Beam Half Width mm	14.5 mm
Lo End Edge Detector Beam Half Width mm	9.3 mm
Hi End Edge Detector Beam Half Width	9.3 mm

Note that the primary sensor beam half-width value is nominal but may be tuned using the streak test. The above parameters are input on the MXProLine RAE software under the Mss Setup Diagnostics Tab, choose Mss Job Set IO Setup Frame, then from drop down lists choose the MSS and look under NuclearSensorSx and Position Control

6.6. 4203-03 [-13] Kr-85 Sensor 1.0 inch gap

There are two versions of the Sx15 Kr 1inch gap basis weight sensor. The –13 version has less flux and no second flag.

Basis Weight Range: 16 - 1200 gsm

Hardware

Gain: Step 3-5 , 05431601 100 Meg Ohm

Flag1: 65 gsm (»2 mil MylarÔ)

Flag2: 130 gsm (»4 mil MylarÔ) [NA –13]

6.6.1. Sensor constants

Measured constants (typical)	
Background:	30 mV
Air Volts:	7.0 V (set gain for 6-9 volts)
T0FA:	.87 ± .02
T0CF:	-0.0016 ± .0010 for .001 inch MylarÔ
T0F12	.65 ± .02 [NA –13]
T0F2	.75 ± .02 [NA –13]

Supplied by sensor engineering	
AGAU	4,500 gsm / K
AGAL	4,500 gsm / K
AGAR	0 gsm / K
AGAS	4,300 gsm / K
BWDO	0
CFZ	0 (No Z sensor)
CFZS	0
KCM2	0

ATTENTION

Use the Normal or Ratio Method by default

6.6.2. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration period, zero (or minimum) waiting between references. Set air curtain to 4 - 6 SCFM (standard cubic feet per minute), flow requirements determine psi setting. Gap must be open with the air curtains on, that is, cannot be taped.

Typical F/A ratio 1 sigma = .00005

Investigational Limit F/A 1 sigma = .00010 on test bench
Investigational Limit F/A 1 sigma = .00012 on system

Typical curve fit constants from MylarÔ calibration, for the fit weight range 8 - 1200 gsm. Dirt curve is built on .001 inch Mylarä dirt. Dirt verification is on .0005 inch Mylarä .

Clean		Dirty	
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
BA7 »	0	BD7 »	0

6.6.3. Accuracy specifications

Calibration fit accuracy:

± 0.20 gsm for all points below 80 gsm

2 sigma of residuals < .25% for all points above 80 gsm

Static MylarÔ verification accuracy of all points are within:

± 0.32 gsm below 80 gsm

± 0.40% from 80 - 1000 gsm

Beam half widths, delay time:

	-03	**-13**
Primary Sensor Delay ms (Da Vinci, MXProLine)	2 msec	2 msec
Primary Sensor Beam Half Width mm	8 mm	8 mm
Lo End Edge Detector Beam Half Width mm	18 mm	18 mm
Hi End Edge Detector Beam Half Width	18 mm	18 mm

Note that the primary sensor beam half-width value is nominal but may be tuned using the streak test. The above parameters are input on the MXProLine RAE software under the Mss Setup Diagnostics Tab, choose Mss Job Set IO Setup Frame, then from drop down lists choose the MSS and look under NuclearSensorSx and Position Control

6.7. 4203-04 Sr-90 Low Ash Insensitive Sensor .4 inch gap

Basis Weight Normal Range: 100 – 5000 gsm

Hardware

Gain: unknown on 05431602 amp 20 meg ohm

Flag1: 640 gsm (»20 mil MylarÔ)

Flag2: 320 gsm (»10 mil MylarÔ)

6.7.1. Sensor constants

Measured constants (typical)	
Background:	15 mV
Air Volts:	7.5 ± 1.5 V (set gain for 6-9 volts)
T0FA:	.69 (± .03)
T0CF:	-.002 ± .001 for .005 inch MylarÔ
T0F12	.575 (± .03)
T0F2	.83 (± .03)

Supplied by sensor engineering	
AGAU	1800 gsm / K
AGAL	1800 gsm / K
AGAR	0 gsm / K
AGAS	4,300 gsm / K
BWDO	0
CFZS	0
KCM2	0

ATTENTION Use the Normal or Ratio Method by default.

CFZ Normal or Ratio Method gsm (Default)	CFZ Absolute Method gsm/mm	Z Sensor	BW Range
430	42.7	yes	< 950 gsm
455	44.7	yes	950 – 1950 gsm
485	48.5	yes	>1950 gsm

If there is no Z sensor, CFZ = 0.

ATTENTION Use the Normal or Ratio Method unless notified Z correction is the Absolute Method for the particular system.

6.7.2. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration period, zero (or minimum) waiting between references. Set air curtain to 4 - 6

SCFM (standard cubic feet per minute), flow requirements determine psi setting. Gap must be open with the air curtains on, that is, cannot be taped.

Typical F/A ratio 1 sigma	=	.00005	
Investigational Limit F/A 1 sigma	=	.00010	on test bench
Investigational Limit F/A 1 sigma	=	.00012	on system

Typical curve fit constants from MylarÔ calibration, for the fit weight range 175 - 2800 gsm. Dirt curve is built on .005 inch Mylarä dirt. Dirt verification is on .003 inch Mylarä .

Clean		**Dirty**	
BA0 »	-2.6 ± 0.5	BD0 »	1 ± 1
BA1 »	-1924 ± 10	BD1 »	17 ± 5
BA2 »	-166 ± 20	BD2 »	-16 ± 4
BA3 »	-15 ± 6	BD3 »	-8 ± 2
BA4 » 0		BD4 » 0	
BA5 » 0		BD5 » 0	
BA6 » 0		BD6 » 0	
BA7 » 0		BD7 » 0	

6.7.3. Accuracy specifications

Calibration fit accuracy:

± 0.50 gsm for all points below 200 gsm

2 sigma of residuals < .25% for all points above 200 gsm

Static MylarÔ verification accuracy of all points are within:

± 0.80 gsm for all points below 200 gsm

± .40 % for all points above 200 gsm

Beam half widths, delay time:

Primary Sensor Delay ms (Da Vinci, MXProLine)	4.2 msec
Primary Sensor Beam Half Width mm	14.5 mm
Lo End Edge Detector Beam Half Width mm	8.8 mm
Hi End Edge Detector Beam Half Width	8.8 mm

Note that the primary sensor beam half-width value is nominal but may be tuned using the streak test. The above parameters are input on the MXProLine RAE software under the Mss Setup Diagnostics Tab, choose Mss Job Set IO Setup Frame, then from drop down lists choose the MSS and look under NuclearSensorSx and Position Control

6.8. 4203-05 Sr-90 Low Ash Insensitive Sensor 1.0 inch gap

Basis Weight Normal Range: 100 – 5000 gsm

Hardware

Gain: step 2 (.32) on 05431601 amp 100 meg ohm

Flag1: 640 gsm (»20 mil MylarÔ)

Flag2: 320 gsm (»10 mil MylarÔ)

6.8.1. Sensor constants

Measured constants (typical)	
Background:	15 mV
Air Volts:	7.5 ± 1.5 V (set gain for 6-9 volts)
T0FA:	.75 (± .03)
T0CF:	-.006 ± .001 for .005 inch MylarÔ
T012	.65 (± .03)
T0F2	.86 (± .03)

Supplied by sensor engineering	
AGAU	4,500 gsm / K
AGAL	4,500 gsm / K
AGAR	0 gsm / K
AGAS	4,300 gsm / K
BWDO	0
CFZ	0 No Z sensor

Supplied by sensor engineering	
CFZS	0
KCM2	0

ATTENTION Use the Normal or Ratio Method by default.

6.8.2. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration period, zero (or minimum) waiting between references. Set air curtain to 4 - 6 SCFM (standard cubic feet per minute), flow requirements determine psi setting. Gap must be open with the air curtains on, that is, cannot be taped.

Typical F/A ratio 1 sigma	=	.00005	
Investigational Limit F/A 1 sigma	=	.00015	on test bench
Investigational Limit F/A 1 sigma	=	.00021	on system

Typical curve fit constants from MylarÔ calibration, for the fit weight range 350 - 2300 gsm. Dirt curve is built on .005 inch Mylarä dirt. Dirt verification is on .003 inch Mylarä .

Clean		Dirty	
BA0 =	6 ± 1	BD0 =	-4.6 ± 1
BA1 =	-1946 ± 30	BD1 =	29 ± 6
BA2 =	-98 ± 15	BD2 =	31 ± 3
BA3 =	-8 ± 1	BD3 =	18 ± 1
BA4 =	0	BD4 =	0
BA5 =	0	BD5 =	0
BA6 =	0	BD6 =	0
BA7 =	0	BD7 =	0

6.8.3. Accuracy specifications

Calibration fit accuracy:

± 0.50 gsm for all points below 200 gsm

2 sigma of residuals < .25% for all points above 200 gsm

Static MylarÔ verification accuracy of all points shall be within:

± 0.80 gsm for all points below 200 gsm

± .40 % for all points above 200 gsm

Beam half widths, delay time:

Primary Sensor Delay ms (Da Vinci, MXProLine)	4.9 msec
Primary Sensor Beam Half Width mm	13.3 mm
Lo End Edge Detector Beam Half Width mm	8 mm
Hi End Edge Detector Beam Half Width	8 mm

Note that the primary sensor beam half-width value is nominal but may be tuned using the streak test. The above parameters are input on the MXProLine RAE software under the Mss Setup Diagnostics Tab, choose Mss Job Set IO Setup Frame, then from drop down lists choose the MSS and look under NuclearSensorSx and Position Control

6.9. 4203-07 Sr-90 High Ash Insensitive Sensor 1.0 Inch Gap

Basis Weight Normal Range: 100 – 5000 gsm

Hardware

Gain: step 2 (.32) on 05431601 amp 100 meg ohm

Flag1: 640 gsm (»20 mil MylarÔ)

Flag2: 320 gsm (»10 mil MylarÔ)

6.9.1. Sensor constants

Measured constants (typical)	
Background:	15 mV
Air Volts:	7.5 ± 1.5 V (set gain for 6-9 volts)
T0FA:	.74 (± .03)
T0CF:	-.006 ± .001 for .005 inch MylarÔ
T012	.62 (± .03)
T0F2	.86 (± .03)

Supplied by sensor engineering	
AGAU	4,500 gsm / K
AGAL	4,500 gsm / K
AGAR	0 gsm / K
AGAS	4,300 gsm / K
BWDO	0
CFZ	0 No Z sensor
CFZS	0
KCM2	0

ATTENTION

Use the Normal or Ratio Method by default.

6.9.2. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration period, zero (or minimum) waiting between references. Set air curtain to 4 - 6 SCFM (standard cubic feet per minute), flow requirements determine psi setting. Gap must be open with the air curtains on, that is, cannot be taped.

Typical F/A ratio 1 sigma	=	.00006	
Investigational Limit F/A 1 sigma	=	.00017	on test bench
Investigational Limit F/A 1 sigma	=	.00023	on system

Typical curve fit constants from MylarÔ calibration, for the fit weight range 70 - 5179 gsm. Dirt curve is built on .005 inch Mylarä dirt. Dirt verification is on .003 inch Mylarä .

Clean		Dirty	
BA0 =	1.9	BD0 =	-1.6
BA1 =	-2057	BD1 =	84
BA2 =	-571	BD2 =	111
BA3 =	-660	BD3 =	88 ± 1
BA4 =	-597	BD4 =	13
BA5 =	-315	BD5 =	-24
BA6 =	-86	BD6 =	-14
BA7 =	-9.6	BD7 =	-2

6.9.3. Accuracy specifications

Calibration fit accuracy:

± 0.50 gsm for all points below 200 gsm

2 sigma of residuals < .25% for all points above 200 gsm

Static MylarÔ verification accuracy of all points are within:

± 0.80 gsm for all points below 200 gsm

± .40 % for all points above 200 gsm

Beam half widths, delay time:

Primary Sensor Delay ms (Da Vinci, MXProLine)	4.9 msec
Primary Sensor Beam Half Width mm	13.3 mm
Lo End Edge Detector Beam Half Width mm	8 mm
Hi End Edge Detector Beam Half Width	8 mm

Note that the primary sensor beam half-width value is nominal but may be tuned using the streak test. The above parameters are input on the MXProLine RAE software under the Mss Setup Diagnostics Tab, choose Mss Job Set IO Setup Frame, then from drop down lists choose the MSS and look under NuclearSensorSx and Position Control

6.10. 4203-08 Pm-147 Sensor .4 inch gap

Basis Weight Normal Range: 4 – 200 gsm

Hardware

Gain: step B (2.62) on 05431601 amp 100 meg ohm

Flag1: 32 gsm (»1 mil MylarÔ)

Flag2: 16 gsm (»0.5 mil MylarÔ)

6.10.1. Sensor constants

Measured constants (typical)	
Background:	15 mV
Air Volts:	7.5 ± 1.5 V (set gain for 6-9 volts)

T0FA:	.59 (± .03)
T0CF:	-.0082 ± .001 for .0005 inch MylarÔ
T012	.44 (± .03)
T0F2	.76 (± .03)

Supplied by sensor engineering	
AGAU	1800 gsm / K
AGAL	1800 gsm / K
AGAR	0 gsm / K
AGAS	4,300 gsm / K
BWDO	0
CFZ	16 gsm with Z sensor ratio method
CFZS	0
KCM2	0

ATTENTION Use the Normal or Ratio Method by default.

6.10.2. Stability specifications

Sigmas and averages are for 30 consecutive references at a 16 second integration period, zero (or minimum) waiting between references. Set air curtain to 4 - 6 SCFM (standard cubic feet per minute), flow requirements determine psi setting. Gap must be open with the air curtains on, that is, cannot be taped.

Typical F/A ratio 1 sigma	=	.00006	
Investigational Limit F/A 1 sigma	=	.00010	on test bench
Investigational Limit F/A 1 sigma	=	.00012	on system

Typical curve fit constants from MylarÔ calibration, for the normal weight range 8 - 151 gsm. Dirt curve is built on .0005 inch Mylarä dirt. Dirt verification is on .00025 inch Mylarä .

Clean		**Dirty**	
BA0 »	-0.18	BD0 »	0.04
BA1 »	-63	BD1 »	1.9
BA2 »	-4.8	BD2 »	-0.05
BA3 »	-0.46	BD3 »	-0.08
BA4 »	0	BD4 »	0
BA5 »	0	BD5 »	0

Clean		Dirty	
BA6 »	0	BD6 »	0
BA7 »	0	BD7 »	0

6.10.3. Accuracy specifications

Calibration fit accuracy:

± 0.02 gsm for all points below 8 gsm

2 sigma of residuals < .25% for all points above 8 gsm

Static MylarÔ verification accuracy of all points shall be within:

± 0.10 gsm for all points from 2 - 25 gsm

± .40 % for all points above 25 gsm

Beam half widths, delay time:

Primary Sensor Delay ms (Da Vinci, MXProLine)	**3.7 msec**
Primary Sensor Beam Half Width mm	**14.5. mm**
Lo End Edge Detector Beam Half Width mm	**14.7 mm**
Hi End Edge Detector Beam Half Width	**14.7 mm**

Note that the primary sensor beam half-width value is nominal but may be tuned using the streak test. The above parameters are input on the MXProLine RAE software under the Mss Setup Diagnostics Tab, choose Mss Job Set IO Setup Frame, then from drop down lists choose the MSS and look under NuclearSensorSx and Position Control

7. Calibration

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

Consider calibrating directly on the customer samples only when the difference between the absorption on Mylar and the customer samples is very large (more than 20%).

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 factor, called KCM, is used as a multiplicative factor from the Mylar calibration curve. The KCM represents the 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.

7.1. General calibration instructions

7.1.1. Conversion constants

Table 7-1 provides conversion constants between common basis weight units.

Table 7-1 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

Customer Units	Unit Conversion Factor
oz/yard^2	0.02949

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

7.1.2. Required tools

- Mylar sample set including simulated dirt for calibration and verification
- 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

7.1.3. Pre-calibration sensor checks

1. Verify that the sensor meets the flag-to-air (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. Do references in groups of 30, and compute a 1 sigma for the F/A 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 through the **Sensor Maintenance** display by choosing maintenance mode.

2. For optimum stability wait about two hours until the heads have established thermal equilibrium.

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 capture to document these integration times.

7.2. Mylar calibration sets

When the gauges were released, two Mylar sets were created for calibration. The Krypton gauges used the calibration set p/n 08740600 and Strontium gauges used the calibration set p/n 08740610.

It is now preferred to create calibration sets based on the customer range, see Section 7.3.

7.3. Mylar calibration procedures

1. Determine the customer basis weight range.

2. A Mylar sample set has been put together with at least one, and preferably two, samples lighter and heavier than the customer's lightest and heaviest samples.

   The set should contain at least 10 samples. More samples will be needed if the calibration is to be over a wide range (see Step 6). The samples have been 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 have been prepared. Transfer samples are individual samples of varying weight (rather than thin samples to be stacked).

3. Once 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) 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 Kr85 & Sr90 sensors: ± 0.0005

sensor ratio drift limit Pm-147 sensors: ± 0.0010

4. Put the appropriate dirt simulation sample in the paddle, do a reference (with the dirt), and read each sample (with the dirt). At this point each sample will have 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 6 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. See Chapter 6 to compare the fit coefficients, or compare with the original fit. The coefficients should be generally similar.

   If the weight range is similar, the fit coefficients should be very close to those given, particularly BA1 and T0CF ([dirty F/A] - [clean F/A]).

7.4. Mylar verification procedures

1. Do a clean reference and then read at least six of the samples throughout the range. See Chapter 6 for the applicable verification accuracies. These are also 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.

7.5. 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:

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. See Chapter 5.

7.6. Customer product procedures

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 thus giving a KCM value lower than ash-free paper.
- Formation in the paper may cause non-linear averaging of the weights. The non-linear averaging of the weights causes 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 and averaging all the KCM values and then using this average for the grade. 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 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 Section 7.1.2).
7. Calculate KCM.

7.7. The Experion MX Calibration interface

All the calibration procedures described in the previous sections are to be performed using the **Sensor Maintenance** display.

It might be advantageous to have a laptop computer at the scanner during the calibration process so that you can see the results of each of the samples. The laptop can be connected to a port on the Ethernet switch in the endbell. A local IP address will be provided through DHCP. You can then remote-desktop to the QCS server using a third party application. The IP address of the server as seen by the Measurement Sub System- (MSS) network should be used to connect to the server.

7.7.1. Verifying 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 from the sensor’s 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, go ahead to the next maintenance procedure. Otherwise, troubleshoot the sensor to find out what caused the problem reading.

7.7.2. Calibration

Advanced maintenance procedures are performed on the display called up by the **Advanced maintenance selector** while RAE is in maintenance mode.

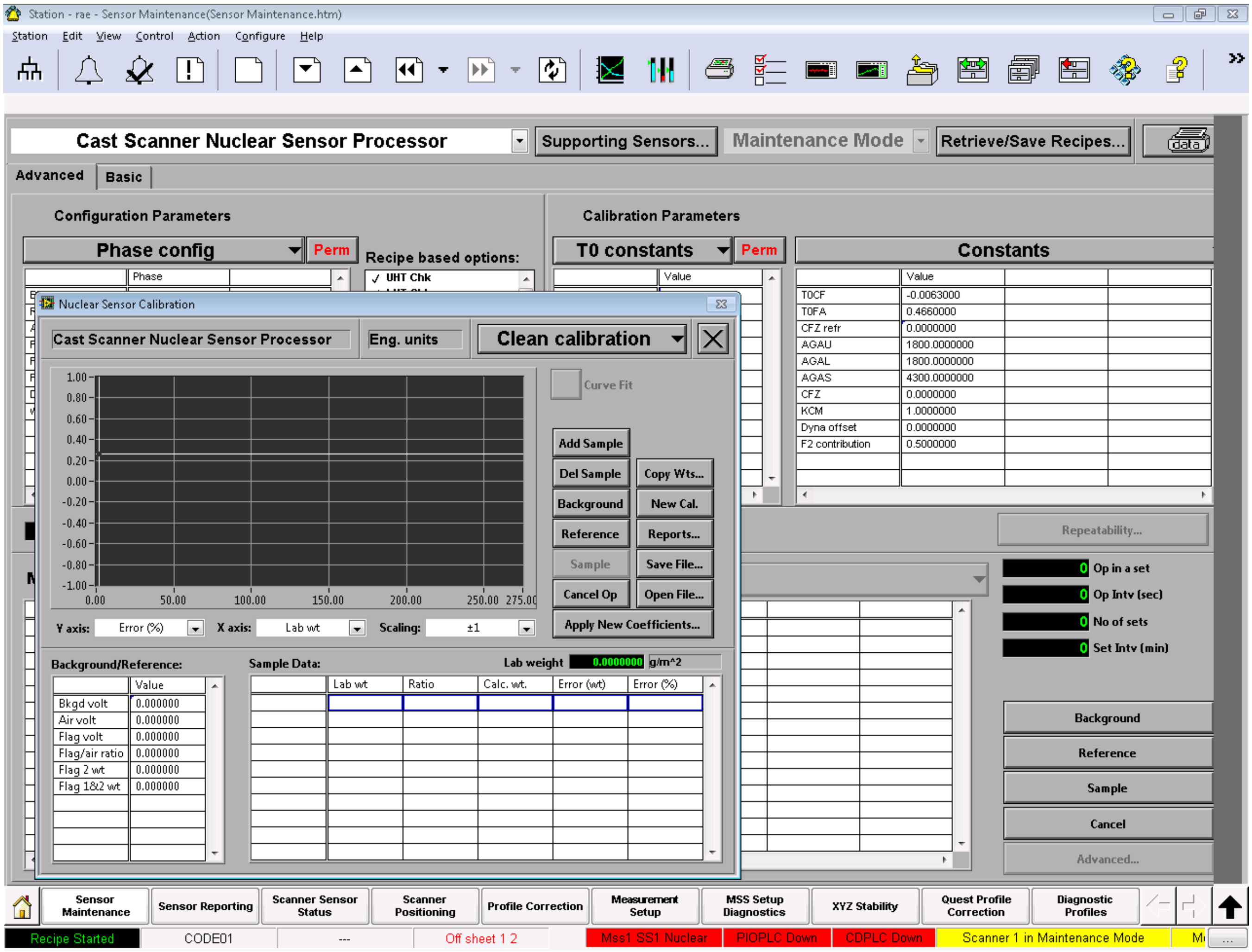


Figure 7-1 Basis Weight Sensor Calibration Display

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 of working memory for the calibration of a sensor type.

For example, by selecting a processor other than the one you are currently calibrating, 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**.

7.7.3. Nuclear Sensor advanced display

The advanced display for the nuclear sensors is called **Nuclear Sensor Calibration** (see Figure 7-2).

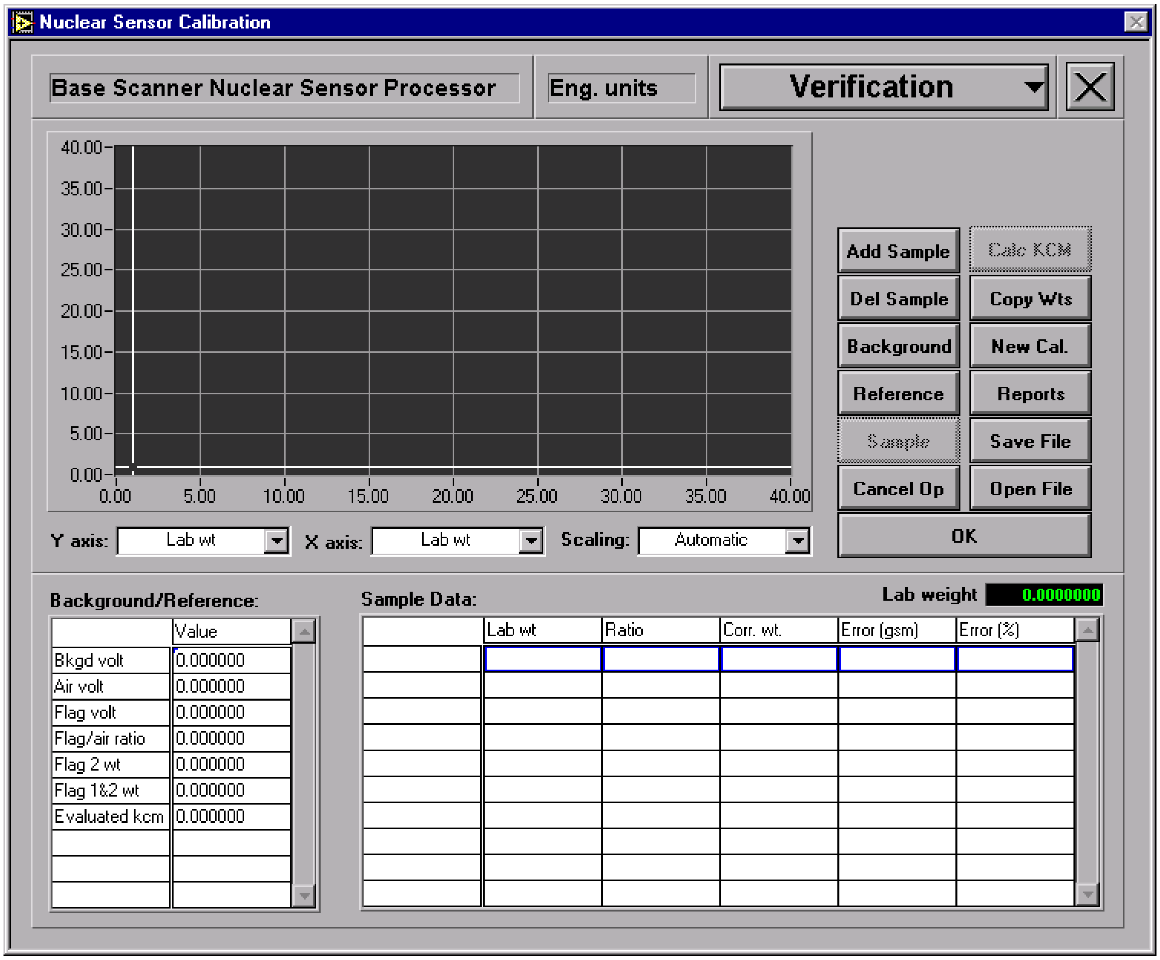


Figure 7-2 Nuclear Sensor Calibration Display

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, is being used. These two settings are inherited from the **Sensor Maintenance** display and can only be changed from there.

7.7.4. Available modes

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

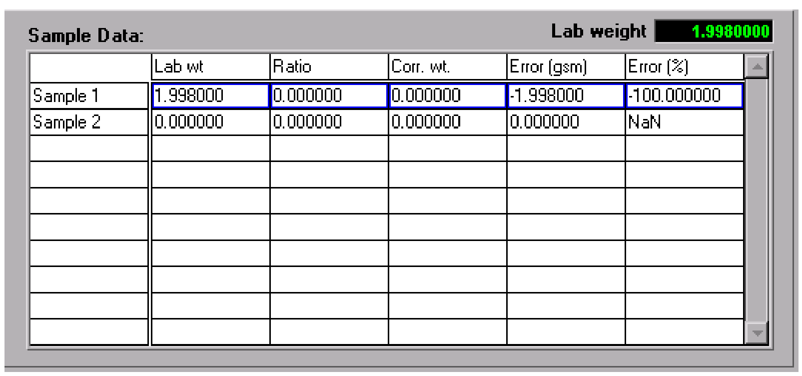
- **Verification**–used to verify a previously obtained calibration and/or determine the multiplicative correction factor, KCM, which accounts for the material difference between individual customer product and the standard material used in calibration.

- **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).

7.7.5. 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 window. 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.



	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 7-3 Lower Portion of the Nuclear Sensor Calibration Display

7.7.6. 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 and click **Del Sample**.

7.7.7. 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** (you are prompted to select the source).
2. Select the desired mode from which to copy.
3. Click **OK** to accept the choice.

7.7.8. Start a new calibration/verification

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

7.7.9. Open and save a calibration/verification file

At any time during the calibration/verification procedure, you can 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.

7.8. Experion MX calibration procedures

Start from a blank working space–it is blank the first time the **Advanced** display is called up; otherwise, click **New Cal.**, or load a previous file.

7.8.1. Clean calibration

1. Select **Clean Calibration** mode.
2. Click 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 will be 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 at this time as a safety measure.

7.8.2. Dirty calibration

1. Take out all the samples from 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 will be 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 entries until all of them are done.

7. There is now data for the dirty calibration. Save the data again; however, in order not to have a circular overwrite problem, save the data to the same file created for the clean calibration procedure.

7.8.3. Fit clean and dirty curves

Figure 7-4 shows typical results for a clean Mylar calibration.

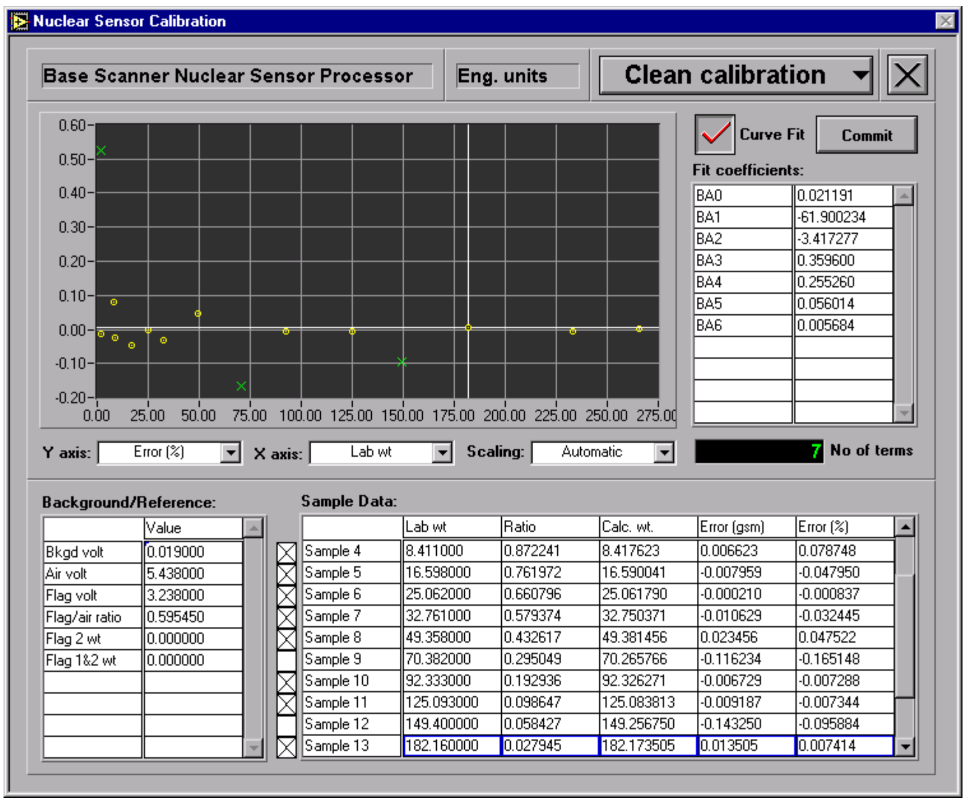


Figure 7-4 Clean Calibration Screen After the Curve Fit

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 ³ 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.

7.8.4. Activate the new calibration

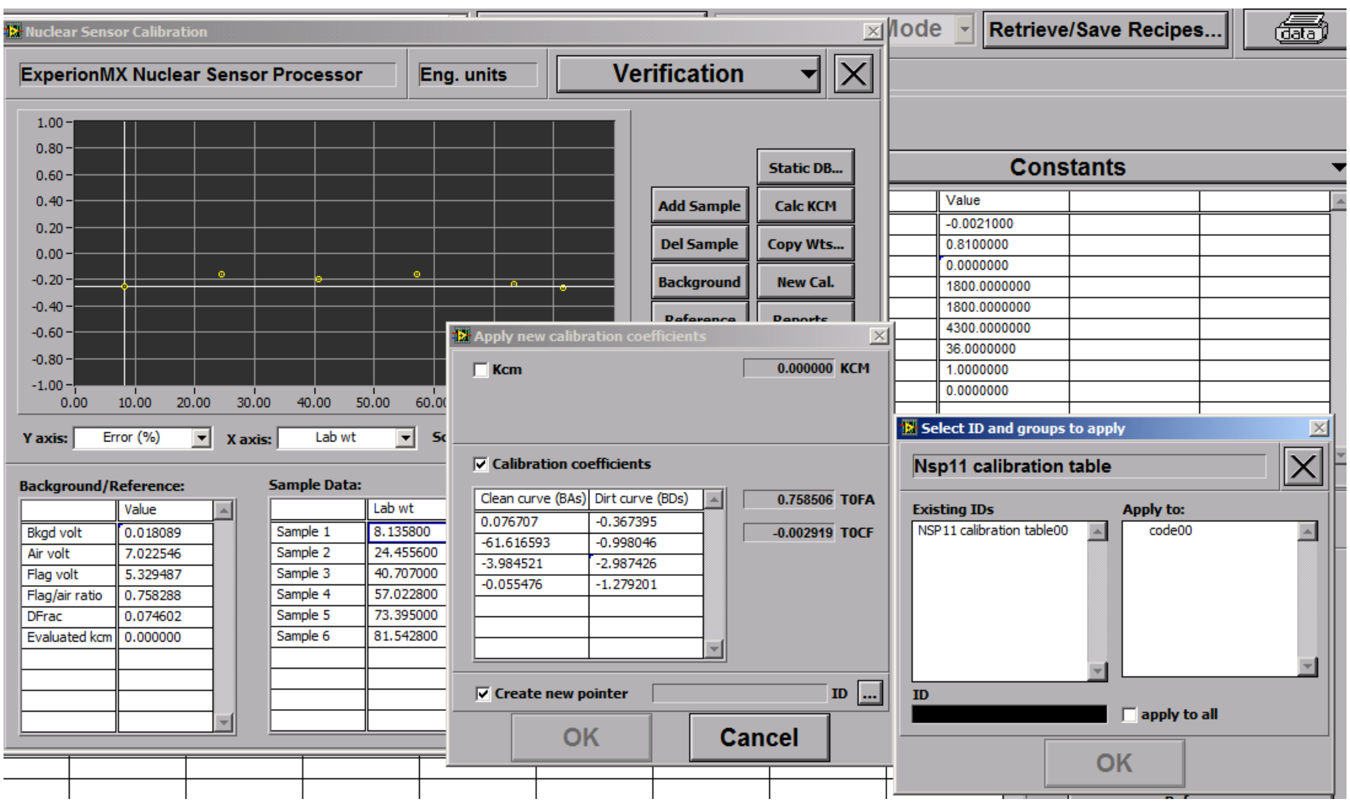


Figure 7-5 Applying New Calibration Coefficients

To permanently add the calibration coefficients into the recipe database:

1. Click **Apply New Coefficients**.
2. Select **Create new pointer** and specify a recipe pointer ID for the set of nuclear sensor coefficient just obtained.
3. Click the browse option (**...**) to the right of **ID** (see Figure 7-5) 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 curve), as well as the time-zero constants. For a dual-flag nuclear sensor, you can elect to 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 **Create new pointer**, but instead click **OK** on the **Apply new calibration coefficients** screen (see Figure 7-5).

7.9. Verification procedure

7.9.1. Clean verification

1. Ensure that the new calibration coefficients are used.
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 you do 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.

7.9.2. 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 7.8.2, 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, and is not necessary 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.

7.10. 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 through the Retrieve/Save Recipes button dialog.

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 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.

7.11. Calibration/KCM reports

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

8. Preventive Maintenance Schedule

Table 8-1 Preventive Maintenance Internal Checklist

Procedure	Daily	Weekly	Months		Years			Task Details
			1	>	1	3	5	
Inspect Head gap and Windows		X						Section 9.1
Verify transfer samples				2 m				Section 9.3
Verify Gauge stability			X					Section 9.4
Have Six month radiation tests performed by licensed individual				6m				Refer to *Radiation Safety Training Manual*, p/n 6510020199

The following tools are helpful to have to perform many maintenance tasks:

- digital volt meter (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. Tasks

This chapter covers procedures. See Chapter 10 for the Experion MX alarms, as their solutions map to these tasks.

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

9.1. Inspect Head gap and window replacement

Activity Number:	Q4203-XX-ACT-001	**Applicable Models:**	All
Type of procedure:	Inspect	**Expertise Level:**	Operator
Priority Level:	Average	**Cautions:**	Radiation
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	0
Overdue Grace Period:		**Frequency (time period):**	1 week
Duration (time period):	10 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:	· Key to head split lock		
	Part Number	Quantity	Lead Time
Required Tools:	Digital multimeter for grounding check		

Visual inspection of windows (be sure there are no tears and that aluminized side is facing out toward the gap). The actual frequency that this needs to be done is site dependent, so adjust accordingly. Also check window conductivity to ground plane.

When trouble shooting basis weight alarms related to low open safe volts or interlock faults, check whether the gap is clear and that the top and bottom heads are aligned.

9.2. Window replacement

Activity Number:	Q4203-XX-ACT-002	**Applicable Models:**	All
Type of procedure:	Replace	**Expertise Level:**	Operator
Priority Level:	Average	**Cautions:**	Radiation
Availability Required:	Scanner offsheet	**Reminder Lead Time:**	0
Overdue Grace Period:		**Frequency (time period):**	6 months
Duration (time period):	30 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:	· Window frame. p/n 08683300 (the assembled frame with window; if you are using the window frame already on the head, then you need the new window p/n 00482400) · Key to head split lock.		
	Part Number	Quantity	Lead Time
Required Tools:	Digital multimeter for grounding check		

The source and receiver windows are mounted in identical frames. To minimize time spent at the scanner, prepare an extra frame with a window, before approaching the sensor head. When properly installed, the window should be flat, without holes or wrinkles.

WARNING

> If air counts or shutter closed counts are unusual, do not proceed. Contact your Radiation Safety Officer.

It is very important to follow each of the steps given in these instructions in order to avoid the possibility of direct exposure to the radiation beam.

To replace a window for either source or receiver sensor head:

1. Verify shutter closure: Observe the warning lights. Only the green **Shutter Closed** radiation warning lamps should be lit. If possible, request background counts and verify they are within the normal range for shutter closed.

   If there is any question of whether all shutters are closed, do not proceed. Contact Honeywell ACS Global Radiological Operations.

2. Turn off power to the sensor heads.

3. Verify that power to the sensor heads has been disconnected by confirming that all radiation warning lights attached to the scanner are off.

4. Tag the appropriate location to warn others that power must not be reconnected.

5. If replacing the source head window, keep hands out of the area directly below (or above) the Kapton window during the entire replacement process.

6. If replacing the receiver (detector) head window, attach the shipping shield to the source sensor head before separating the heads. When separating the heads, move heads several feet apart, if room permits. If possible, position the source head at least three feet from where you work.

CAUTION

> The -500 V DC may still be present on the ion chamber for some time after the +24 V DC power has been off. Always assume the high voltage is present until you can confirm that it is not.

7. Separate the heads: Unlock the lock holding the head split mechanism. On 2080-03 and 4080 scanners, it is on the upper belt near the head. Push heads apart.

8. Remove cover. Loosen all four latches. If working with the source head, keep hands out of the area directly below (or above) the Kapton window while removing cover (hold the cover by the sheet guide handles and do not allow hands or arms below (or above) the sensor). Carefully remove cover.

9. If working on the source head, confirm mechanical shutter indicator shows shutter closed. The arrow should be down, towards the sheet

and match up with the text (**Shutter Closed**). If not, call your Radiation Safety Officer.

10. Note alignment marks, on the window frame and the plastic platform. There is only one orientation of the window which allows all three thumb screws to align with the corresponding holes. Loosen the three thumb screws. Window frame should fall out. If not, gently push on one of the thumb screws to dislodge the frame.

11. Orient replacement frame alignment mark as noted above. Insert into position. If working on the source window, be careful to keep fingers and hands away from where the beam would be, if on. Hold the frame only by the edges. Do not let fingers, hands, or arms be below aperture. Tighten three thumb screws.

12. Orient head cover, carefully, so holes center on window(s). Tighten all four latches.

13. Slide heads back together. Replace lock on head split mechanism. Remove shipping cover if used. Secure the key to the head split lock.

14. Turn power back on.

15. Verify functioning of green and red lights.

9.3. Verify transfer samples

Activity Number:	Q4203-XX-ACT-003	**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:**	
	Part Number	Quantity	Lead Time
Required Parts:			
	Mylar transfer set	Quantity	Lead Time

Required Tools:	Digital multimeter for grounding check

Read transfer samples using 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.

9.4. Verify Gauge stability

Activity Number:	Q4203-XX-ACT-004	**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:**	
	Part Number	Quantity	Lead Time
Required Parts:			
		Quantity	Lead Time
Required Tools:			

See Subsection 7.7.1. for detailed instructions.

See Chapter 6 for expected values.

9.5. Check Receiver voltages

For stable operation the basis weight receiver requires that the correct voltages are generated on the back plane board. The following procedure uses the test points available to verify the + 24 V, ± 15 V, and -500 V ion chamber voltage.

Activity Number:	Q4203-XX-ACT-005	**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 month
Duration (time period):	30 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:			
		Quantity	Lead Time
Required Tools:			

Measure the test points on the receiver backplane PCB using Table 5-5.

9.6. Basis Weight Receiver Amplifier checks

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 Ethernet Data Acquisition (EDAQ) ADC is railed at + 10 V, generating a high basis weight alarm or closed shutter high voltage alarm.

Activity Number:	Q4203-XX-ACT-006	**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:**	
	Part Number	Quantity	Lead Time
Required Parts:			
		Quantity	Lead Time
Required Tools:			

Typical operational air volts from the receiver are in the range 6–9 V. As the source decays with a half-life of about 11 years for Krypton and 2.6 yrs for Promethium, increase (strap) the amplifier gain every year to compensate for the signal levels.

See Subsection 5.2.3.1 for details on the amplifier and table of test points.

With the shutter closed, the amplifier should read a voltage near zero. Adjust 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.

Use rubber gloves or a grounding strap while replacing the amplifier to avoid static discharge.

1. Remove the amplifier shielding cover.
2. Remove the ion chamber signal cable.
3. Note the existing gain settings.
4. Modify the new amplifier to have the same rotary dial position.

9.7. 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:	Q4203-XX-ACT-007	**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:**	
	Part Number	Quantity	Lead Time

Required Parts:			
		Quantity	Lead Time
Required Tools:	Pliers, Phillips screw driver		

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 500 V source. Ensure that the sensor is disconnected from power before attempting to remove it.

Removing the ion chamber requires removing the receiver window and disconnecting the leads to the amplifier board.

1. With the head covers off, loosen the three thumb screws. See Figure 9-1.

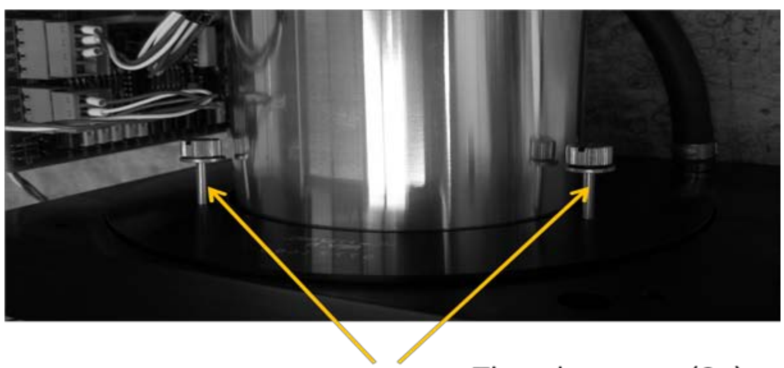


Figure 9-1 Thumbscrew locations on Receiver ion chamber

2. Remove the Kapton window assembly from the top of the sensor and remove the mounting ring with six screws. Remove the black ring with the compensator assembly. See Figure 9-2.

.

Figure 9-2 Mounting ring (right) and compensator assembly (top left) removed

3. Unscrew the thumb screws on the amplifier assembly and disconnect both the cables. See Figure 9-3. Pliers might be needed to pull off the coaxial shielded ion chamber signal cable.

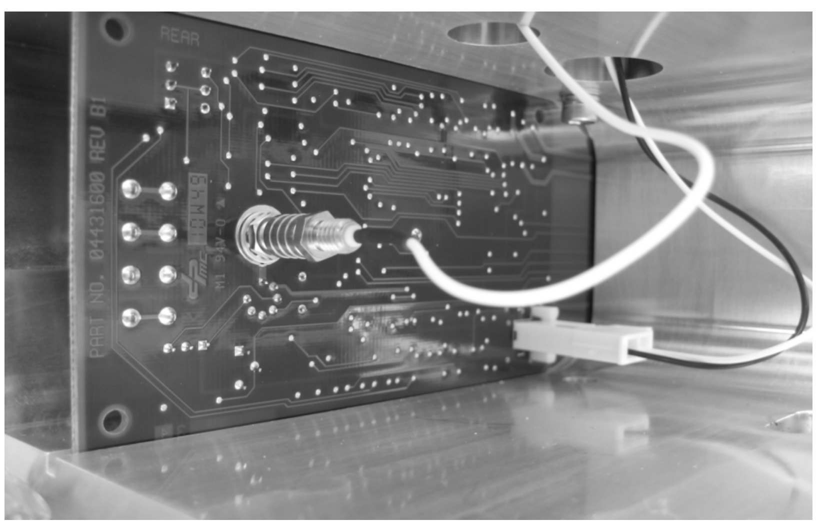


Figure 9-3 Ion chamber signal cable (left) and the ion chamber high voltage cable (right)

4. Lift the ion chamber up and out of the receiver assembly.

9.8. Service Kapton Window

The kapton windows on the source and receiver should be cleaned periodically to avoid excessive dirt built up. After cleaning, the Dirt Fraction should return to near zero.

Activity Number:	Q4203-XX-ACT-008	**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):	12 min	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:	08683300 (window assembly) if replacing		
		Quantity	Lead Time
Required Tools:	Pliers, Phillips screw driver		

If the kapton window is torn, replace it as soon as possible. Installation involves removing the captive screws inside the head that hold the window assembly – see Figure 9-1 and Figure 9-2. When replacing the window, make sure the conductive (silver) side is facing towards the measurement gap.

9.9. Verify Shutter operation

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

Activity Number:	Q4203-XX-ACT-009	**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:**	
	Part Number	Quantity	Lead Time
Required Parts:			
		Quantity	Lead Time
Required Tools:			

9.9.1. 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 endbell panel, will not turn on.

Second, the real-time application environment (RAE) system will alarm that the receiver voltage is high but the shutter was commanded closed (red lights are off).

WARNING

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 power track cable to ensure that all the digital outputs are low.

If the actuator closed when the power was removed, the problem is likely a faulty EDAQ or endbell termination board that is grounding the return line from the shutter signal.

With the shutter command off, the shutter indicator should be in the **Close** position (see Figure 5-1). If the actuator is still in the open position, try to manually 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.

9.9.2. 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 tests failure or drifting flag-to-air 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. Check whether the input pressure to the scanner is at least 50 psi. Disconnect the quick release tubes at the sensor and verify that air is coming out.

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

1. Navigate to the Measurement Sub System (MSS) **Setup Diagnostic** tab.
2. Click the **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. Watch the shutter indicator. If the heads are aligned and the receiver is in place, you may attempt to move the shutter manually and verify that the shutter movement is smooth. If not, Honeywell ACS Global Radiological Operations must be called. Do not attempt to diagnose.

9.10. Verify or Replace EDAQ

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

Activity Number:	Q4203-XX-ACT-010	**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:**	
	Part Number	Quantity	Lead Time
Required Parts:	loop-back harness, Honeywell p/n 6580801773		
		Quantity	Lead Time
Required Tools:			

For details of EDAQ replacement and programming, refer to *Experion MX MSS and EDAQ Data Acquisition System Manual*. The following steps should be performed:

1. Replace the EDAQ with a spare.
2. Check whether the new EDAQ reports with the expected position (node) and function numbers in the main MSS web page. If not, refer to *Experion MX MSS and EDAQ Data Acquisition System Manual* for information on how to correct the assignment.
3. Upgrade the EDAQ to the software revision present on the other EDAQs. Refer to *Experion MX MSS and EDAQ Data Acquisition System Manual* 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 *Experion MX MSS and EDAQ Data Acquisition System Manual*.

9.11. 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. The measurement is performed using an integrated circuit temperature chip that produces a temperature in Centigrade.

Activity Number:	Q4203-XX-ACT-011	**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:**	
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:			

The LM35 chip requires a + 12 V supply. See Figure 5-2 for test points on the backplane.

9.12. Inspect Z-Sensor

The Z-sensor is used to measure the instantaneous gap size.

Activity Number:	Q4203-XX-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):	20 minutes	**# of People Required:**	1
Prerequisite Procedures:		**Post Procedures:**	
	Part Number	Quantity	Lead Time
Required Parts:			
	Part Number	Quantity	Lead Time
Required Tools:	Multi-meter		

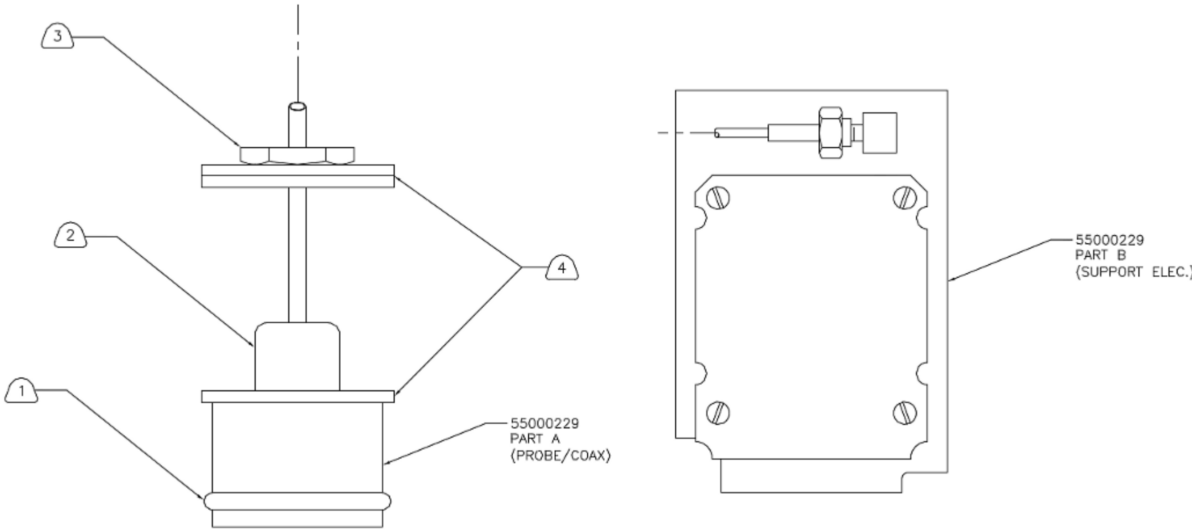


Figure 9-4 Z-sensor and signal conditioning PCB

At the time of the release of this manual, the z-sensor is part 55000229, which consists of the actual sensor and a sensor signal conditioning board (see Figure 9-4). The board attached to the G-Head backplane PCB 05427200. A part of that schematic is show on Figure 9-5. There are two test points TP8 and TP7 that can be used to check whether the z-sensor is responding to head gap changes. The z-sensor also receives power from the backplane. Test points TP11 and TP9 should show +15 (-15) V with respect to test point TP10.

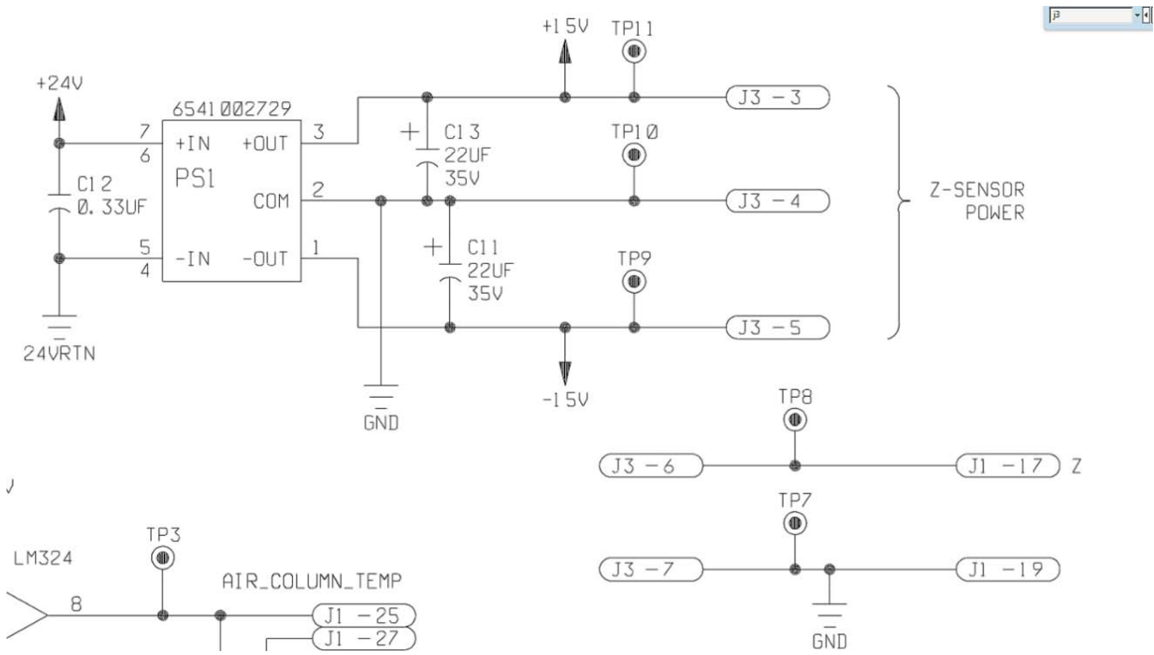


Figure 9-5 Part of the head backplane PCB schematic showing the connections to the z-sensor

10. Troubleshooting

10.1. Alarm-based troubleshooting

This section lists the alarms that Experion MX system can generate and reference the appropriate maintenance sections.

10.1.1. No BW Signal

Symptom	Possible Cause(s)	Solution (Tasks)
BW signal below background voltage (usually 15 mV)	EDAQ to endbell harness not plugged	Check Receiver voltages
	No ± 15 V power generated on receiver	Check Receiver voltages
	Amplifier not installed	Basis Weight Receiver Amplifier checks

10.1.2. BW Signal High

Symptom	Possible Cause(s)	Solution (Tasks)
BW receiver signal above maximum allowed voltage (usually near 10 V)	Amplifier OpAmp broken	Basis Weight Receiver Amplifier checks
	Amplifier gain set too high	Basis Weight Receiver Amplifier checks

10.1.3. High Closed Safe Volts

Symptom	Possible Cause(s)	Solution (Tasks)
Shutter was closed or requested to close but receiver signal higher than expected	Receiver amplifier failed	Basis Weight Receiver Amplifier checks
	Shutter did not close	Verify Shutter operation

10.1.4. Low Open Safe Volts

Symptom	Possible Cause(s)	Solution (Tasks)
Shutter was open or requested to open but the receiver voltage was below threshold	Shutter did not open due to EDAQ hardware failure	Verify or Replace EDAQ
	Shutter did not open due to interlock board failure	Replace Interlock Board
	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 and window replacement
	Source and receiver are not aligned	Inspect Head gap and window replacement

10.1.5. Flag to Air Shift Out of Limits

Symptom	Possible Cause(s)	Solution (Tasks)
Flag to Air ratio (F/A) drift from the time-zero value exceeds the limit	Excessive dirt on the sensor	Inspect Head gap and window replacement
	Broken flag	Flag Inspection
	Bad ion chamber	Replace Basis Weight Receiver Ion Chamber
	Low air pressure	Verify Shutter operation

A careful analysis of the *Standardize Report* confirms 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.

10.1.6. Dual Flag Shift Out of Limits

Symptom	Possible Cause(s)	Solution (Tasks)
The 2nd Flag weight drift from the time-zero value exceeds the limit	Excessive dirt on the sensor	Inspect Head gap
	Broken flag	Flag Inspection
	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 this flag value changes, but the first flag ratios are within specification than the flag is likely broken.

10.1.7. Source Column Temperate Below Limit

Symptom	Possible Cause(s)	Solution (Tasks)
Temperature processor computes a temperature from input data which is above the minimum limit	Disconnected or broken temperature sensor	Inspect Source Column Temperature Sensor

10.1.8. Source Column Temperate Above Limit

Symptom	Possible Cause(s)	Solution (Tasks)
Temperature processor computes a temperature from input data which is below the minimum limit	Disconnected or broken temperature sensor	Inspect Source Column Temperature Sensor

10.1.9. Source Column Temperature Drifting

Symptom	Possible Cause(s)	Solution (Tasks)
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

10.1.10. Sensor Processor Bad Input

Symptom	Possible Cause(s)	Solution (Tasks)
Sensor input data required for processor is not within valid range	Bad analog signal from basis weight receiver	Check Receiver voltages

10.1.11. Sensor Processor Bad Intergauge Input

Symptom	Possible Cause(s)	Solution (Tasks)
Data received from other sensor processor is not within a valid range	No valid result for a basis weight corrector, such a the z-sensor or air curtain temperature input	Inspect Z-Sensor

10.1.12. Set Flag Voltage Negative

Symptom	Possible Cause(s)	Solution (Tasks)
The voltage read with the shutter open and flag in was less than background (shutter closed) voltage	Shutter did not open	Replace Interlock Board
	Bad background voltage	Verify or Replace EDAQ
		Check Receiver voltages
		Basis Weight Receiver Amplifier checks

10.1.13. Set Air Voltage Negative

Symptom	Possible Cause(s)	Solution (Tasks)
The voltage read with the shutter open was less than background (shutter closed) voltage	Shutter did not open	Replace Interlock Board
	Bad background voltage	Verify or Replace EDAQ
		Check Receiver voltages
		Basis Weight Receiver Amplifier checks

10.2. Non-Alarm based troubleshooting

10.2.1. Basic guidelines

These basic guidelines are provided for both beginning and experienced service personnel. Beginners should follow this list until the guidelines become automatic.

Some basic troubleshooting actions:

- Problem isolation - Isolate problem to: source, receiver, wiring, EDAQ ADC, or software, for example, calibration constants.
- Use standardize values to plot information to help diagnose problem.
- Refer to log book data taken during Preventive Maintenance.
- Record in a log book, dedicated to the system, all malfunctions and actions (including data base changes to calibration constants, all hardware changes...) for future reference.
- If time or sensor access allow, make only one change at a time.
- Remember many problems can be found by a visual inspection.

10.2.2. Troubleshooting guide

There are radiation safety concerns for anyone who works on this sensor. These concerns cannot all be adequately addressed here. Customers refer to the

Honeywell Radiation Safety Manual for Customers, p/n 6510020197. A copy of this manual is provided along with the system delivery. Honeywell employees refer to the *Radiation Safety Training Manual*, p/n 6510020199.

Some procedures referred to in this section may only be performed by persons appropriately licensed. These procedures must be obtained directly from the Honeywell ACS Global Radiological Operations.

10.2.3. Symptom-based troubleshooting

Symptom	Probable Cause	Solution (Tasks)
Low or no on-sheet, sample, flag1, flag2, or air counts	Not enough pressure at pneumatic actuator	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.
	Fire safety pin has partially or fully activated	Contact Honeywell ACS Global Radiological Operations
	Red light bulb(s) has burned out	Replace light bulb(s)
	Red light circuit logic PCB malfunctions or blown fuses	Replace fuses, if problem persists replace board. Check connections for shorts.
	Pneumatic solenoid valve in source	Check valve by removing exit hose and listening or feeling for air
	Orifice at inlet of pneumatic actuator in source is plugged	Contact Honeywell ACS Global Radiological Operations for orifice cleaning or replacement Procedure (important: always replace with an identical orifice from spare parts since size of hole is critical to operation)
	Water or debris on inside or outside of head window	Visually inspect and clean
	Excessive friction in bearing	Contact Honeywell ACS Global Radiological Operations
	Leaking pneumatic gasket or O-rings. A small leak downstream of the regulator can disable source from operating since the source has high pneumatic input impedance	Contact Honeywell ACS Global Radiological Operations
	Corrosion on actuator shaft	Contact Honeywell ACS Global Radiological Operations
	Something external to pneumatic actuator is catching on rotating pin	Visual inspection of pneumatic actuator
	Pressure regulator in source head malfunctions	Replace

Symptom	Probable Cause	Solution (Tasks)
	Actuator fails	Try to move manually, Contact Honeywell ACS Global Radiological Operations to receive instructions for replacement
	Internal stops	Call Honeywell Engineering to receive instructions
	Ion chamber leak, symptoms are a decrease in air and flag counts but an increase in F/A	Replace ion chamber
	Head misalignment	Align heads
Background counts drifting or noisy	Bad ground	Check all grounds
	If background counts follow head temperature where the counts go down as the head temperature goes up	Replace detector amp
	Problem is either a bad detector amp or dirty insulator on ion chamber	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.**	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
	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.	Adjust or replace 24 VDC power supply, take appropriate action if test points do no measure satisfactorily
	Check for extraneous material on window, or broken window	Replace or repair as necessary
	F/A ratio drifting such that as the air counts go down and the F/A goes up	Replace leaky ion chamber

10.2.4. Source component functional description with failure modes

Component	Function	Power Requirements	Test Points	Failure Modes
Hoses on body: head-to-regulator	Pressurized air transport	NA	Visually inspect for contamination (oil, bits of rubber, and so on)	May come loose
Hoses on body: regulator-to-source assembly	Pressurized air transport	NA	Visually inspect for contamination (oil, bits of rubber, and so on)	May clog
Flag/ Flag solenoid	Rotate flag (internal standard) 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 500 degrees F	Visually see 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 TP3-TP2 °C = 10*volts accuracy: ± 0.25 °C at 25 °C ± 0.75 °C-55–150 °C	Physical damage
Green light switches (two)	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)	

10.2.5. Receiver component functional description with failure modes

Component	Function	Test Points	Known Failure Modes/Symptoms	Diagnostic Procedures
High Voltage Bias Supply(part of receiver backplane)	Provides -500 VDC ion chamber bias.	On receiver back-plane. TP14, TP9(rtn)	Output voltage goes to nearly zero volts is most common failure mode	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.
Ion Chamber	Converts beta flux to current for conversion in detector amplifier	none	Gas leak: Output voltage will go down and flag and sample ratios will go up.	Refer to Preventative Maintenance graphs of F/A and sample ratios and air and flag 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	Refer to Preventative Maintenance graphs of background counts versus time
			Intermittent short between ion chamber and housing. This can induce a down going spike in sensor output	Physical inspection of ion chamber and casting. Look for metal labels peeling off, debris or casting burrs
			Loose leads	Physical inspection of ion chamber and casting
Detector Amplifier	Convert small current from ion chamber to voltage	None	Offset (Background) voltage wanders	Monitor background counts (should be 0.010–0.020 V DC) and check ± 15 V DC
			Thermal drift of amplifier	Monitor head temperatures
			Damage to wire that connects to Ion Chamber	Visual inspection

Component	Function	Test Points	Known Failure Modes/Symptoms	Diagnostic Procedures
Receiver Power Supply for Temperature measuring	24 V DC to ± 15 VDC and provide processing for receiver air column (if available)	± 15 V DC on receiver backplane TP10 TP9 (rtn)	± 15 V DC output bad	± 15 V DC output on receiver backplane

10.2.6. Source and Receiver component functional description with failure modes

Component	Function	Test Points	Known Failure Modes/Symptoms	Diagnostic Procedures
Windows	Protect sensor	Visual inspection Monitor air and flag counts and F/A	Window Breaks	Visual inspection
				Monitor air and flag counts and F/A
				Replace window if broken
Air Curtain Direct Readout Temperature Devices	Measure air curtain temperatures	Status Frame air gap temperatures Air gap temperature print-outs at standardize. Test points on backplanes	Direct readout temperature device breaks	Status Frame air gap temperatures indicate very low reading
				Air gap temperature print-outs at standardization
24 V DC Power	Provide head power	Test points in source and receiver heads	Voltage too low at head due to IR drop in line	Always monitor voltage at head and be sure it is 24–26 V DC
			Noisy 24 V DC power at head	Verify with scope noise at head on 24 V DC
Cooling (details differ from type head to the next)	Provides head cooling	Monitor head temperature print-out at standardize	Cooling lines clog reducing the flow	Monitor head temperature print-out at standardization
	Provides stable temperature environment for electronics, particularly important for the high voltage power supply and the detector amplifier		Coolant flow shut-off	Check coolant circuit, valves, and so on

11. Storage, Transportation, and End of Life

This chapter summarizes Honeywell policy with respect to the storage and disposal of the basis weight sources.

11.1. Storage and transportation environment

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

Table 11-1 Storage and Transportation Parameters

Duration of Storage	Acceptable Temperature Range	Acceptable Humidity Range
Short term (less than one week)	-20 to 45 °C (-4 to 113 °F)	20–90% non-condensing
Long term	-10 to 40 °C (14 to 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 of 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 described in Subsections 11.2.1 and 11.2.2.

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 ACS Global 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 Honeywell ACS Global 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.
ADC	Analog to Digital Converter
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.
BA0-BA7[2]	Calibration coefficients for clean curve
BD0-BD7	Calibration coefficients for dirty curve
Bin	The smallest measurement zone on the frame. Also called **Bucket** or **Slice**.
Bkg	Background
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.
Code	See **Recipe**.

[2] Some computer systems only handle four calibration coefficients BA0 - BA3 and BD0 - BD3 . Even with a system that displays seven calibration coefficients, verify the software uses all seven.

Cross Direction	Used to refer to those properties of a process measurement or control device that are determined by its position along a line that runs across the paper machine. The cross direction is transverse to the machine direction that relates to a position along the length of the paper machine.
Cts	Counts
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.
FA0-FA7	Flag calibration coefficients for clean curve
FD0-FD7	Flag calibration coefficients for dirty curve
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.
Flag12	Reading with flag1 and flag2 in the beam
Flag-to-Air Ratio (F/A ratio)	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.
gsm	grams per square meter (sometimes written as g/m2)
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 (UPI)	**Human/machine interface.**
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).

K	Kelvin absolute temperature reading
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	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** real-time application environment **(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**.
NewC	New system with ADC based data acquisition
PrecisionPak	A set of upper and lower heads mounted on the Precision Platform. The sensors are installed within the PrecisionPak, which travels back and forth on the rails of the Precision Platform.
Quality Control System (QCS)	A computer system that 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).
Real-Time Data Repository (RTDR)	The database managed by RAE to store system data and data for individual applications.
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.
Rx	Receiver

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.
Sx	Source
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
T012	Time zer0 Flag12 basis weight (flag1 and flag2 in beam)
T0F2	Time zer0 Flag2 basis weight
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.
VFC	Voltage to Frequency Converter

A. Part Numbers

Table A-1 Part Numbers

Part Number	Description
00482400	4.328 inch diameter conductive window
05427200	Source 15 Sx Backplane PCB
054280XX	Receiver Backplane
05431600	Receiver Detector Amplifier Card
086561XX	Receiver Assembly
08659900	Source Holder Assembly
08683300	Window Frame
09462301	G-Head
6580801773	Loop Back Harness
65805000121	Endbell Schematic
09848800	G-Head option
6580500121	Endbell Distribution Board
07680300	Pin, Head Alignment
08740600	Krypton gauge calibration set
08740610	Strontium gauge calibration set