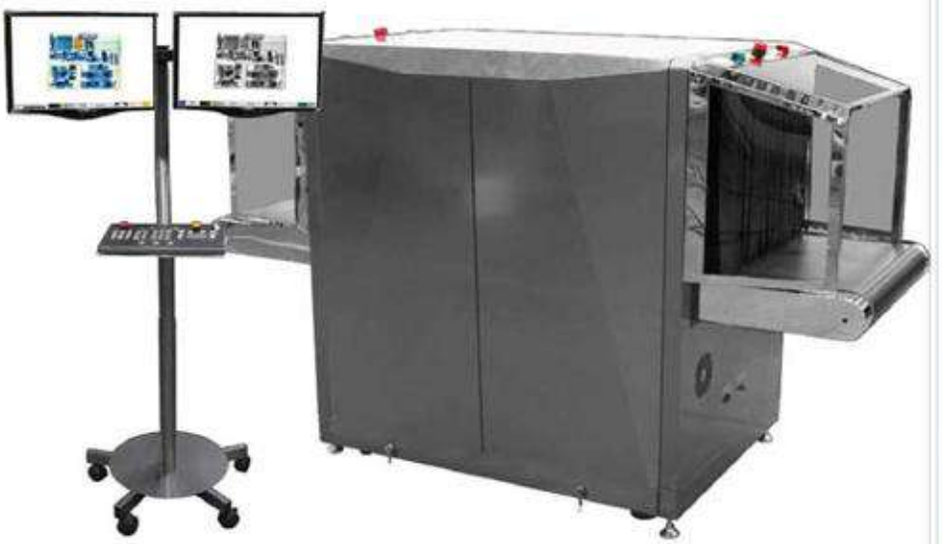
Astrophysics Inc. XIS Installation and Maintenance Manual



XIS Security X-ray Machines

(non-pallet)

Document Description

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DESCRIPTION	Installation and Maintenance Guide for the Astrophysics X-ray Imaging Systems.
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A	Francois Zayek	2004.05 First Release	First Draft
B	Rob Tobin	2013.09 All chapters revised, several new chapters, tables, figures added.	All chapters
C	Rob Tobin	2014.01	New Logo

Notice

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Confidential and Proprietary Notice

Conventions Used In This Manual

Throughout this manual, the Astrophysics *X-ray Imaging System* (XIS) is referred to as the *XIS*.

Operator console button presses are specified in "square" ("[", "]") brackets. For example, pressing the STOP button on the keypad operator console is represented as [**STOP**]

"Control" key characters are denoted with square bracket notation, [Ctrl-character]. For example, [Ctrl-x] refers to simultaneously pressing the [Ctrl] key and the [x] key on the PC keyboard.

"Alt" key characters are denoted with square bracket notation, [Alt-character]. For example, [Alt-x] refers to simultaneously pressing the [Alt] key and the [x] key on the PC keyboard.

[Alt-Ctrl-del] refers to simultaneously pressing the [Alt] key, the [Ctrl] key, and the [Del] key.

IMPORTANT
Very important notices are highlighted by the "IMPORTANT" text box. These messages involve critical safety issues and deserve special attention.

B/W refers to the Black & White (left side) video display monitor
[**B/W**] refers to the button *B/W* on the keypad operator console.

VERY IMPORTANT OPERATIONAL INFORMATION is highlighted in yellow and preceded by the word "**NOTE**" bolded and in caps.

INFORMATION RELATED TO PERSONAL SAFETY is highlighted in red and preceded by the word "**CAUTION"** or "**WARNING!**" bolded and in caps, and by the following symbol:

Abbreviations

ACHE	Air Cooled Heat Exchanger
Astrophysics	Astrophysics, Inc.
CA	Cabinet A
CB	Cabinet B
CC	Cabinet C
CDRH	US FDA Center for Devices and Radiological Health
DAS	Data Acquisition System
ER	Entry Rollers
ER1	Entry Roller (Bed) #1
ER2	Entry Roller (Bed) #2
EX	Exit Rollers
EX1	Exit Roller (Bed) #1
EX2	Exit Roller (Bed) #2
FDA	United States Food and Drug Administration
LXDA	Linear X-ray Detector Assembly
M1	Module #1
M2	Module #2
M3	Module #3
M4	Module #4
M5	Module #5
OSHA	United States Dept of Labor, Occupational Safety and Health Administration
NRC	United States Nuclear Regulatory Commission
WI	Work Instructions
PPE	Personal Protective Equipment
XIS	X-ray Imaging System
XRG	X-ray Generator
XRT	X-ray Tube

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Introduction

The Astrophysics Inc line of XIS (X-ray Inspection Systems) machines consists of several models. This manual will cover generalities that apply to non-pallet Astrophysics X-ray inspection systems.

To facilitate instructions, in most cases an Astrophysics XIS-6545 will be used for illustrations and in photographs. When possible, variations peculiar to specific models will be described. If your X-ray machine is a different model from the models shown in a particular figure, you can determine the location of a component using the appearance of the component shown in the figure and the relative location of other components shown in the figure.

The following figures show the Astrophysics XIS models covered by this manual. Please note that XIS pallet units are covered in a separate manual.

XIS 5335

XIS-5335S

XIS-6040

XIS-6040M (mobile)

XIS-6545

6545VI

7858VI

XIS-6545DV

XIS-7858

XIS-100X

XIS-5878

XIS-100XDV

XIS-1080

XIS-1080D

XIS1210D

XIS 100XD

XIS-100XDX

XIS-5335DS

Safety

WARNING!

The Astrophysics X-ray Imaging System (XIS) produces and uses ionizing X-ray radiation. X-rays can be harmful to human health. They cannot be directly detected by any of the human senses. Please exercise the utmost safety.

Chapter Overview

This chapter provides important safety information on operating the Astrophysics X-ray Imaging System (XIS). It is intended for all users of the XIS.

The warnings, cautions, and instructions discussed in this instruction manual cannot cover all possible conditions and situations that may occur. It must be understood by the operator and personnel who maintain and repair the machines described in this manual, that common sense and caution are factors which cannot be built into this product, but must be supplied by the operator.

Safety Features

The Astrophysics X-ray Imaging System (hereinafter referred to as the XIS) has many safety features to protect the operator and others including:

- Lead shielded construction to minimize radiation leakage.
- Lead fabric curtains at the inspection tunnel openings to help block scattered X-rays from escaping the tunnel.
- Interlock switches that stop (power off) the X-ray generator and conveyor belt when an access panel is opened or removed.
- Steel frame and heavy gauge steel panels that reduce any residual external X-ray radiation emissions.
- Infrared Photocells inside the inspection tunnels that sense when objects enter and exit the inspection tunnel. The X-ray generator is activated only for the minimum amount of time necessary to image items traversing the inspection tunnel. X-rays are NOT produced when the X-ray machine is idle, or when the conveyor is stopped, or when the inspection tunnel is empty.
- Emergency Stop switches (at both the entrance and exit of the X-ray tunnel), that can be pressed to immediately stop (power off) the X-ray generator and the conveyor belt.

- Green Power-ON LED lamps at each end of the X-ray tunnel and on both the Pedestal Control Panel (PCP) and the Advanced Operator Control Panel (AOCP) to indicate when the system is powered on and ready for use.
- Red warning X-ray ON LED lamps at each end of the X-ray tunnel and on both the Pedestal Control Panel (PCP) and the Advanced Operator Control Panel (AOCP) to indicate when X-rays are being generated.
- Circuit breakers that disconnect power from the main AC input into the XIS if the unit becomes overloaded.
- A key-switch that requires that a key be inserted and turned to the “ON” position to power up and operate the XIS unit.
- A foot-mat switch that requires the continuous presence of an operator, manning the controls, while the conveyor and X-ray generator are being used.
- Password protected access to the application software.
- Prominent labels that warn users to not insert any part of their body when the X-rays are produced.
- The following diagram identifies the various safety features on a typical (non-pallet) Astrophysics X-ray Imaging System.

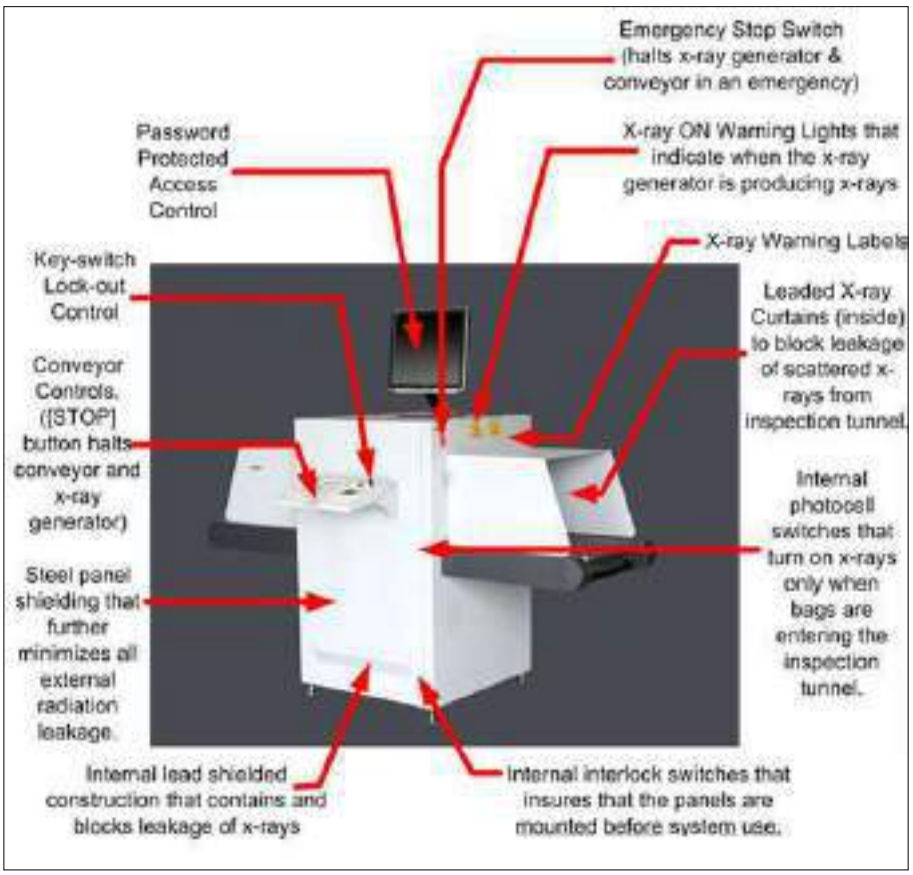

Figure 1: XIS Safety Features

Safety Precautions

The Astrophysics X-ray Imaging System (XIS) is designed to be safe and easy to use. However, all major electromechanical devices can be hazardous and should be treated with care and respect. When operating the XIS, follow the safety precautions below:

- Do NOT operate the unit outdoors. The XIS must be protected from moisture, precipitation, and extremes of temperature.

- Connect the unit to a well grounded power outlet. The XIS requires a reliable protective earth ground to operate.

- Do not operate an X-ray machine without a good earth (electrical) ground.
- Do NOT operate the unit when the X-ray curtains are torn or missing.

- Clear the X-ray tunnel of all items before starting the unit.
- Do NOT insert any part of the body into the inspection tunnel while X-rays are energized. Avoid all unnecessary radiation exposures.

- If material should become jammed during operation, the machine must be turned off before an attempt is made to clear the inspection tunnel area. Either:
    - Press the Emergency **Stop** button, or
    - Turn the main AC switch to the **OFF** position, or
    - Turn the key-switch to the **OFF** position **BEFORE** attempting to clear the tunnel.
- Although the system utilizes an extremely low X-ray dose, wait until scanned items are completely out of the inspection tunnel in order to avoid any unnecessary radiation exposure.
- Ensure that the conveyor and X-rays are off before reaching into the inspection tunnel. The X-ray **ON** warning lights is lit when X-rays are being

produced. The X-ray ***ON*** lights are located above the entrances of the inspection tunnel, on the operator console, and on bottom right of the status bar on the X-ray imaging screen.

- If required, post appropriate signs around the XIS to warn people that they are in the vicinity of a device that produces and uses X-ray radiation.

- Check the *Power* ***ON*** and the *X-ray* ***ON*** lights for proper operation before using the baggage X-ray machine. The Power **ON** light becomes lit when the key-switch is turned to the **ON** position. The X-ray **ON** light will momentarily turn on and off when the conveyor belt is just started. (The momentary operation of the X-rays allows for "*X-ray data normalization*"). The X-ray **ON** light becomes lit again when the X-ray generator is producing X-rays for imaging. This occurs when objects are carried through the X-ray tunnel by the conveyor.

- The XIS internally uses high voltages. All cover panels must be closed and securely fastened before system operation.

- Be careful of sharp objects that can cut the X-ray curtains and conveyor belt.

- If a threatening object is identified, follow the procedures established at your facility for handling such objects.
- Always perform a comprehensive radiation survey and safety inspection after an XIS is serviced.
- Turn "OFF" the equipment as soon as an unsafe operating condition or procedure develops or might develop. Inform your supervisor who will contact the maintenance technician. The machine is a sophisticated piece of electronic equipment and must be treated with care. All service adjustments or repairs must be done only by qualified personnel.
- Do not open the access panels during operation. These panels are designed with safety switches to prevent exposure to high voltage and radiation.
- The foot mat switch is a design safety component that requires the operator to stand on it when operating the machine. Do not place heavy objects on the foot mat switch to defeat it.
- Keep hands, finger, clothing and hair away from conveyor rollers.
- Do not sit on or attempt to ride the conveyor. Never use the machine as a toy.
- Do not stand closer than necessary to the X-ray machine. Do not allow anyone to loiter within 2 meters of the X-ray chamber or conveyor belt at any time. Never leave the machine unattended.
- Do not place any objects such as plants, coffee cups, pop cans, bottles etc. on top of the machine. The liquid, if spilled from these containers, could create a potential shock hazard which may be fatal.
- Do not obscure or cover the X-ray "ON" warning lights or the x-radiation warning signs. These items must be clearly visible at all times.

WARNING!

Always turn off and disconnect power to the XIS BEFORE servicing the X-ray generator or removing any radiation shielding.

- Do NOT operate the XIS unless all radiation shielding is properly installed and functioning correctly. Ensure that all access panels are closed before operating the XIS.
- Perform a comprehensive radiation survey after servicing the XIS.
- Do NOT allow the XIS to operate if external radiation leakage exceeds 0.1 mR/hr (0.001 mSv/hr).
- The XIS is recognized by the U.S. Food and Drug Administration (FDA) as a cabinet X-ray device.
- In the U.S., the XIS is regulated by *U.S. FDA Center for Devices and Radiological Health*. The XIS complies with U.S. Statutes including but not limited to *U.S. Code of Federal Regulation (CFR), Title 29, Section 1020.40,* Performance Standards for Cabinet X-ray Device.
- In Canada, the XIS is regulated by *Health Canada*. The XIS complies with Canadian statutes including but not limited to *Canada Safety Code 29*.
- In Canada, Health Canada requires registration of all baggage X-ray machines.
- United States and Canadian law requires that the XIS should ONLY be installed, relocated, and serviced by a (factory) trained and certified technicians. There are no user serviceable parts inside the machine.
- American and Canadian law requires the usage of only factory certified replacement parts in the XIS.

For service and support contact:

U.S. Federal Health and Safety Regulatory Compliance

The XIS is classified as a *Cabinet X-ray Device*. It complies with the following U.S. Federal Health and Safety Regulations applicable at time of manufacture:

- U.S. Food and Drug Administration, Department of Health and Human Services, Center for Devices and Radiological Health, Code of Federal Regulations Title 21 Section 1020.40, *Radiological Health Standards for Cabinet X-ray Systems*;

- U.S. Federal Aviation Administration, Code of Federal Regulations Title 14 Section 108.17, *Use of X-ray Systems*; and;

- U.S. Federal Aviation Administration, Code of Federal Regulations Title 14. Section 129.26, *Use of X-ray Systems*.

Local Regulatory Compliance

- Local radiation safety requirements differ significantly from one jurisdiction to another.

- Some jurisdictions require the registration of X-ray producing equipment ***PRIOR*** to their usage.

- Many jurisdictions require initial and annual radiation safety surveys.

- Some jurisdictions, including Canada, require certification of baggage X-ray machine operators.

- In Canada, personal dosimeters are not required for baggage X-ray machine operators.

- XIS users are responsible for their compliance with all applicable Federal, state, and local laws. Failure to comply may result in substantial penalties.

Facility Safety

During security screening operations you may identify hazardous contraband, weapons, explosives, and other threats in the bags, packages, and articles that you are examining with your XIS. Plan ahead. Have your facility security manager prepare clear and concise instructions for handling these situations. Be prepared to follow them.

Differences Between Dual- and Single-View

This manual covers both single view and dual view machines. Though there are numerous similarities in technology and use between single and dual-use XIS machines, there are also significant differences that need to be taken into account when installing, operating and maintaining these machines.

LXDA Arrays and PCs

Single-View machines

Single View machines have a single LXDA array, controlled by a single PC.

Dual View machines

Dual-view machines include two independent LXDA arrays with two corresponding PCs, master & slave, each with a PCI DAS board for collecting imaging data for the given view's array.

The main functions of the slave PC are displaying and archiving its own images. The slave handles no other control or interfacing tasks.

The master PC handles all input and output control signals to/from the system, Inputs from the system include:

- key switch
- photocells
- interlocks
- all diagnostics signals;
- outputs to the PLC:
    - heartbeat
    - conveyor L/R
    - X-ray on command for both generators
    - system shutdown signal

Each PC runs Xray Client software. Only the master PC runs AstroDiagnostics since it interfaces with the DAQ (LabJack or DCI board).

The two PCs are networked on a Gigabit LAN connection via crossover cable for passing all control and sensor signals from master to the slave PC.

Each PC has a unique static IP address and Windows PC name.

Each PC has a “DAS synch board” to synchronize the digital clock signals to the LXDAs. This minimizes cross-talk between the two DAS boards. This cross-talk is a source of image noise, which is especially visible in high-penetration tests.

Dual View machines have added or changed relays:

- Slave PC power relay added (E-M).
- Fan relay added (high-amp E-M).
- X-ray relay added (E-M, DPDP for the two XRG control boards to use the same X-ray output signal from the PLC).
- E-stop changed (from E-M to SSR).

Diode Plot must be running on both the master and slave in order for imaging adjustments to be made on the slave.

The master PC assigns all inputs to the PLC. The PLC in turn outputs the control signal to the X-ray relay for turning on both generators.

The slave PC has no direct command of its own X-ray generator and therefore requires the Diode Plot on the master to be running in order to give the technician X-ray control.

NOTE: In the 200kV dual-view system, each PC does control its X-ray generator directly via RS232 serial port communication. However, the master PC Diode Plot must still be used for X-ray on commands due to the software handling of the X-ray signal.

Two screens is the standard setup for all DV systems. Early systems had a three-screen design with two-screens dedicated to the master view and one to the slave, but that arrangement has been superseded by the two-screen arrangement. Many three-screen systems still exist in the field. Also, in certain cases (special order), a four-screen arrangement is used, with two screens per PC.

Screen selection (via Screen 1 / Screen 2 AOCP buttons) is necessary for the six primary imaging functions:

- Color
- Organic
- Inorganic
- B/W
- B/W Reverse
- Pseudo Color.

This is much like a single-monitor, single-view system, where each view has a single-monitor. As with all systems, XIS, Zone Zoom and Contrast adjustments also still require screen selection.

NOTE: In some older versions of DV software, the Operator must also use a form of screen selection for HiPen and Edge Trace, by pointing the cursor on a particular PC's monitor screen with the touchpad. In these older versions, these functions were mouse cursor "focus-dependent." In even earlier versions, the operator also had to point the mouse cursor for focus-dependent screen selection when using the Save RGB function.

Software

Dual View machines use Synergy or Input Director multi-PC KVM synchronization software. This third-party software allows seamless sharing of the AOCP keypad and mouse pad between screens as if they were a single computer, similar in look to a two-monitor, single-view system in "Horizontal Stretch" or "Horizontal Span" mode.

Following are the Runtime.ini Dual-View Parameters for Dual View systems.

[Display]

```
DualDisplay=
                ;Number of monitors per PC:
                ;                Master    Slave
                ;Two-screen DV     =0        =0
                ;Three-screen DV   =2        =0
                ;Four-screen DV    =2        =2
```

[Options]

```
Two Screen DV=
                ;Set for given number of screens in the ;system to let the
                software know how to ;display the X-ray status bar. If it's a
                ;two-screen ;system then the value is =1. ;If it's other than
                a two-screen system ;then the value is =0.
```

[Dual View]

```
Dual View=1
                ;0=single-view, 1=master, 2=slave.
Remote Machine=192.168.1.251
                ;static IP address of the other PC in ;dual-view system.
DualView Delay=940
                ;number of video columns to delay the ;display of lead view
                for a given scan ;direction to synchronize the scrolling of
                ;both images.
DualView Queue Size=1
                ;N/A.
Remote Server=Slave
                Windows PC name of the other PC set via ;System
                Properties > Computer Name tab. ;Only necessary on the
                Master PC.
```

DAS 2.0 Synch Board Configuration in Dual-View XIS

Dual-view XIS machines use an auxiliary board in both PCs called the “DAS Synch Board.” The DAS Synch Board facilitates the use of a shared clock signal between the two DAS boards. The purpose is to eliminate cross-talk between the two 800kHz DAS clock signals which injects noise in the imaging data.

The cross-talk noise shows up as thin periodic vertical lines, especially in very low signal/high density regions of scanned objects. The problem is mostly apparent with steel penetration performance testing.

The apparent penetration of steel step wedges may be significantly reduced by the effect of cross-talk. Normal scanning is not generally affected by DAS clock cross-talk, so if synch boards fail in the field, it’s not an immediate requirement to repair unless a performance test is required. The machine will generally continue to run for normal use.

The relatively small DAS Synch Boards are connected locally to their respective DAS boards by a 20-pin ribbon cable (inside the PC), and remotely to each other by an 8-pin mini-DIN cable.

The DAS Synch Boards are mounted on a bracket and occupy a space next to the DAS boards. This is a space that would normally be used for one of the motherboard PCI card expansion slots. However, the Synch Boards do not actually use the PCI slots, and are connected only indirectly to the PC via their respective DAS boards.

The two Synch Boards act in a master/slave configuration. The slave shares the clock of the master DAS board. Thus the clocks are not technically “synched.” Instead, both Synch Boards share the common clock of the master DAS board, with the slave DAS board’s clock remaining unused. In this sense, either Synch Board may be the master or slave, unlike the “master PC” and “slave PC” relationship of the Dual View XIS machine itself.

The configuration of the dual-DIP switch on each Synch Board determines the master/slave roles as follows:

DIP Switch	1	2
Meaning	Board enabled	Board role
Master synch board setting	ON	OFF
Slave synch board setting	ON	ON

Figure 2: Normal DIP Switch Settings

NOTE: Which Synch Board is configured as Master and which is configured as Slave is not critical, as long as both boards have DIP Switch 1 set ON (board enabled), and one board or the other, not both, has DIP Switch 2 set ON to designate it as Slave, so that it follows/uses the other DAS board’s clock.

When connected and configured correctly, and both PCs are booted, the LED indicators on each of the synch boards are as follows:

LED	Green	Amber	Red
Master synch board	ON	Flashing at same frequency as DAS clock (amber LED on DAS)	OFF
Slave synch board	Flashing at same frequency as DAS clock (amber LED on DAS)	Flashing at same frequency as Master's DAS clock (amber LED on DAS). Will generally be out of synch with its own PC's DAS clock.	OFF

Figure 3: Normal LED Indications: When configured according to Table 1

When connected, but configured incorrectly, and both PCs are booted, the LED indicators on each of the synch boards are as follows:

LED	Green	Amber	Red
Both synch boards	ON	Flashing at same frequency as DAS clock (amber LED on DAS)	ON

Figure 4: Abnormal LED Indications: Both configured as Master synch board in Table 1

LED	Green	Amber	Red
Both synch boards	Flashing at same frequency as DAS clock (amber LED on DAS)	OFF	ON

Figure 5: Abnormal LED Indications: Both configured as Slave synch board in Table 1

Dual-View Configuration Points

1. Windows Startup folder contents:

Figure 6: Primary PC (left) and Secondary PC (right)

2. Static IP Addresses

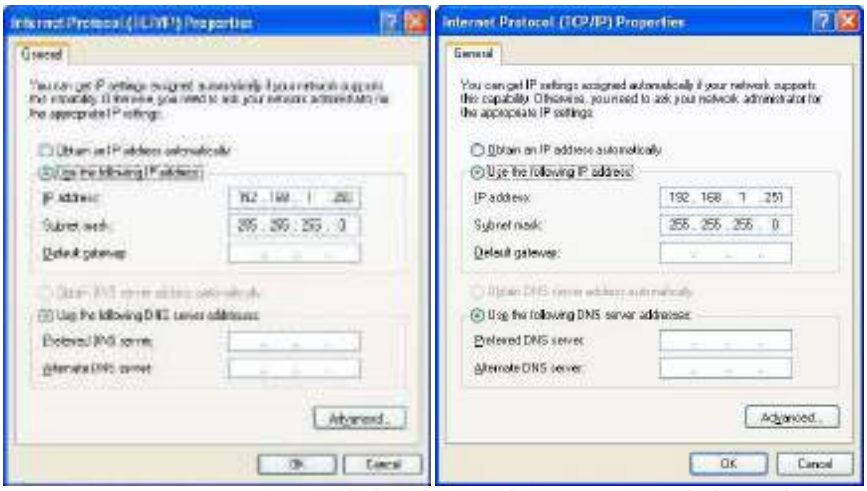

Figure 7: Primary PC (left) and Secondary PC (right)

3. Shared folder settings required for the secondary PC “Xray Client” folder:

Figure 8: Secondary PC

Dual-View PC Network Troubleshooting

Network:

1. Confirm the cable is a proper cross-over cable, is not damaged, and is connected securely at each end. The LEDs in the Ethernet connector on each PC should also be flashing when connected.
2. Confirm that the Windows firewall is turned off on both PCs via: Start > Control Panel > Windows Firewall > General > select “Off” > OK.
3. Confirm the network adapter speed is the same on both PCs. This is set via: Start > Control Panel > System > Hardware > Device Manager > Network Adapters > right-click on the network card (usually “…Gigabit Network Connection”) > Link Speed > Speed and Duplex: > 1.0 Gbps Full Duplex > OK.
4. Confirm the actual IP address of each PC is different. These are typically 192.168.1.250 for the Master PC and 192.168.1.251 for the Slave PC, and set via: Start > Control Panel > Network Connections > right-click on Local Area

Connection > Properties > General > select Internet Protocol (TCP/IP) > Properties > General > select "Use the following IP address:" > IP Address: > OK.

5. Confirm the local area network is now connected via: Start > Control Panel > Network Connections > Name > Local Area Connection & Status > Connected.

Keyboard/Mouse Sharing:

Confirm the Master PC's Windows name is "Master" and the Slave PC's Windows name is "Slave." The multi-PC keyboard/mouse sharing applications use the PC name when setting the master/slave relationship. This is set via: Start > Control Panel > System > Computer Name > Change > Computer name: > OK.

Imaging Software:

1. Confirm that Xray Client's runtime.ini file for each PC has the correct settings for critical dual-view parameters under the header [Dual View] near the bottom of the file:
    a. Master PC:

i. Dual View=1	Sets it as the Master PC
ii. Remote Machine=192.168.1.251	Points to the other PC's IP address (Slave)
iii. Remote Server=Slave	Parameter exists only on the Master PC

    b. Slave PC:

i. Dual View=2	Sets it as the Slave PC
ii. Remote Machine=192.168.1.250	Points to the other PC's IP address (Master)

2. Confirm that the slave PC's Xray Client folder is shared with full privileges. This is set via:

    Slave PC > right-click on the folder C:\Program Files\Xray Client > Properties > Sharing > select "Share this folder" > select "Share this folder on the network" & select "Allow network users to change my files" > OK.

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Installation

The non-pallet XIS systems covered by this manual ship in one package, which consists of the following items:

1. A complete X-ray machine consisting of:
    a. A frame and panels
    b. One conveyor bed consisting of one segment
    c. One Conveyor belt
    d. One motor and one end roller
    e. Double X-ray curtains at each end of the tunnel
    f. One X-ray source
    g. One Computer with associated electronics
    h. 10 detector boards with associated electronic
    i. PLC with interface electronics
    j. Electrical system and power supplies
    k. Two 19 inch monitors placed inside the tunnel,
    l. One AOCP (Advanced Operator Control Panel)
    m. One set of manuals (User and Installation/Maintenance).

This section is divided into four (4) basic parts.

Pre-Arrival Work Instructions

1. Get a copy of the sales order for the unit(s) being installed.
    a. Get the following customer contact information:
        - The shipping address
        - The contact's name
        - The contact's telephone number
        - The contact's email address
    b. Check for any special configuration requirements.
    c. Check for any special training requirements.
    d. Identify the electrical requirements (110VAC or 220VAC operation).
    e. Identify the "foot-print" and width of the XIS unit.
    f. Prepare your installation toolkit.
2. Get shipping information:
    a. Determine the expected delivery date of the unit(s).
    b. Follow up with the shipper to confirm the delivery schedule.

3. Call the customer:
    a. Check the background of the customer. Ask if he or she has previous experience with installing and operating other X-ray imaging systems.
        - Does the customer have special or unique training needs?
    b. Advise the customer of the site requirements:
        - Advise the customer on the physical clearance requirements of the unit(s).

XIS Model	Maximum (uncrated) length*	Maximum (uncrated) width*	Maximum (uncrated) Height*
5335	132 cm (52.0 in)	77 cm (35 in)	123 cm (49 in)
5335S	132 cm (52.0 in)	77 cm (35 in)	123 cm (49 in)
5878	253 cm (100 in)	138 cm (54 in)	126 cm (50 in)
6040	142 cm (56 in)	85 cm (33 in)	126 cm (49 in)
6040M	142 cm (56 in)	85 cm (33 in)	137 cm (54 in)
6545	217 cm (86 in)	88 cm (35 in)	132 cm (52 in)
6545VI	217 cm (86 in)	95.2 (37 in)	131 cm (52 in)
6545DV	213 cm (84 in)	107 cm (42 in)	129 cm (51 in)
7858	188 cm (74 in)	103 cm (41 in)	140 cm (55 in)
7858VI	188 cm (74 in)	103 cm (41 in)	140 cm (55 in)
1080	258 cm (102 in)	138 cm (54.0 in)	171 cm (68 in)
1080D	237 cm (94 in)	128 cm (51 in)	172 cm (68 in)
100X	278 cm (110 in)	138 cm (54.0 in)	192 cm (76 in)
100XD	237 cm (94 in)	128 cm (51 in)	191 cm (76 in)
100XDX	305 cm (120 in)	184 cm (73 in)	189 cm (75 in)
100XDV	314 cm (124 in)	174 cm (67 in)	196 cm (77 in)
1210D	287 cm (113 in)	146 cm (58 in)	189 cm (75 in)
1517	671 cm (264 in)	260 cm (102 in)	225 cm (88 in)
1517DV	793 cm (312 in)	260 cm (102 in)	286 cm (112 in)
1517 200kV	671 cm (264 in)	260 cm (102 in)	225 cm (88 in)
1517DV 200kV	793 cm (312 in)	260 cm (102 in)	286 cm (112 in)
1517 320kV	974 cm (384 in)	279 cm (110 in)	241 cm (95 in)
1517DV 320kV	1096 cm (431 in)	279 cm (110 in)	292 cm (113 in)
1818	671 cm (264 in)	290 cm (114 in)	236 cm (93 in)
1818DV	793 cm (312 in)	290 cm (114 in)	316 cm (124 in)
1818 200kV	671 cm (264 in)	290 cm (114 in)	235 cm (92 in)
1818DV 200kV	793 cm (312 in)	290 cm (114 in)	316 cm (124 in)
1818 320KV	996 cm (393 in)	311 cm (122 in)	240 cm (95 in)
1818DV 320kV	1117 cm (440 in)	311 cm (122 in)	315 cm (124 in)
1819	766 cm (300 in)	333 cm (131 in)	233 cm (92 in)

Figure 9: Machine Dimensions (Uncrated)

*All dimensions rounded up (e.g. 32.1 in. rounded up to 33 in., 92.5 cm rounded up to 93 cm) in order to ensure adequate site space for the various models.

c. Get information about the site
    - Verify that the install site is ready.
    - Verify that the power requirement of the XIS unit matches the available AC outlet power.
    - Verify that the install site is located inside and protected from weather.
    - Verify that the ambient temperature of the install site is within the operating range of the XIS (5oC to 40oC).
    - Verify that the install site is level.
    - Verify that there is room for the XIS and that there is adequate clearance for the operator.

d. Confirm that there is a clear path from the receiving area to the final install site.

e. Ask the customer to notify you when the unit(s) arrives.

f. Confirm that the appropriate users will be available for training.

g. Schedule the installation.

h. Get information on where to park (if necessary).

i. If the XIS will be crated, ask the customer if a forklift or pallet jack is available to lift the XIS off of the crate's base.

j. Advise the customer that you will be bringing in tools and that you may need an escort to get past their security staff.

k. Advise the customer that after the system has been setup, it will be necessary to discard the crating, wrapping, and other packaging materials afterward.

4. Book your travel arrangements.
    a. Advise the customer of your itinerary.

Required Resources

Tools

- Fluke 123 Travel O-Scope
- Fluke Amp Probe 80i-110s
- Radiation meter
- Jensen Tool Kit JTK-17 WW includes more than 100 tolls in all, as follows:
    - Alignment tools (2)
    - Feeler gauge

- Hammer, ball peen, 4 oz.
- Handle, driver blades (2): 3-1/8, 4-1/8"
- Hex key set (10), .028-5/32"
- Hex key set (7): Fold up 1.5-6mm
- Hexdriver blades (9): .050, 1/16, 5/64, 3/32, 7/64, 1/8, 9/64, 5/32, 3/16"
- Icepick scribe
- Knife, electrician's
- Mirror, inspection
- Nutdriver blades (9): 3/16, 7/32, 1/4, 9/32, 5/16, 1-1/32, 3/8, 7/16, 1/2"
- Penlight w/batteries
- Pliers (6): diagonal cutter, 4-1/4"; diagonal cutter, 5-1/4"; groove joint, 10"; long nose, 4-3/4"; long nose with cutter, 6-3/4"; retaining ring, external/internal
- Punch, center, 3/32"
- Punch, Pin (2): 1/16, 1/8"
- Rule, stainless, 6"
- Screwdriver, offset ratchet, Phillips/slotted
- Screwdriver, Phillips #0 x 3", pocket clip
- Screwdriver, Phillips (3): #1 x 3"; #2 x 1-1/4"; #2 x 4"
- Screwdriver, slotted 3/32 x 3", pocket clip
- Screwdriver, slotted (6): 1/8 x 4"; 1/8 x 8"; 3/16 x 3"; 1/4 x 1-1/4"; 1/4 x 4"; 5/16 x 6"
- Screwdriver set, jeweler's, (7 pc.)
- Screwstarter, Phillips/slotted
- Socket set, 1/4" drive, (14 pc.)
- Solder aid, fork and hook
- Soldering iron, 115V*
- Spring tool, pull
- Spring tool, push

  - Tweezer, reverse action
  - Wire crimper/stripper
  - Wire stripper/cutter
  - Wrench, adjustable (2): 4"; 8"
  - Wrench set, ignition, (8 pc.)
  - Tool case with pallets
- Soft Rubber Mallet for aligning generator mount
- Small flashlight for checking funnel mount alignment
- Chain Adjustment tool for installing chains
- Leather Gloves for handling wooden crates
- ½" ratchet for fastening bolts
- Medium Phillips Screw Driver
- 2mm bubble level for leveling frame modules
- "Click" Torque Wrench for tightening mounting bolts
- Power screwdriver
- Volt meter
- Ladder
- Adjustable lift table for the top and front panels of the radiation shield box and generator.

Recommended Personal Protective Equipment

- Fall harness
- Auto retractable fall harness lanyard
- Eye protection
- Suction Panel lifters

On-Site Work Instructions

The site should be large enough to not only accommodate the XIS machines themselves, but also to allow for receiving, uncrating/unwrapping and installing the final, working machine. It is important to convey this to the customer, and to insure that there is space not only to locate and operate the machine, but for service personnel to work freely both while installing and, later, servicing the machine.

1. Locate the customer's principal site contact person. The customer's principal site contact is the person that accepts and "signs-off" on the completed installations. Get to know this person well.
    a. Clearly identify yourself. Bring photo ID.
    b. Note the names of everyone you meet.
    c. Exchange business cards.
2. Visit the XIS unit.
3. Note the condition of the unit.
    a. Check the packing list immediately.
    b. Verify that the correct unit has arrived by model and serial number.
4. Inspect the shipment for any damage.
    a. Note any damage on the shipping manifest.
    b. Photo-document all shipment damage. Include a sign in the photo, identifying the date and serial number of the unit(s) in all photographs.
5. If the unit is not in its final install site, visit the final install site immediately.
    a. Find a clear path from the receiving site to the final install site.
    b. Verify that the XIS unit can safely pass through all doors and elevators along the way.

Once all the crated unit has been moved to the final installation site:

1. Inventory the XIS machine and any additional packages that may have shipped with it (e.g. accessories). Compare the actual delivery to the delivery manifest.

NOTE: Machines can be shipped with optional extension conveyor or roller beds. Each of these beds (entry or exit) will require its own crate. So, for example, a machine shipping with two additional exit and two additional entry extension roller or conveyor beds will necessitate four crates in addition to the XIS machine itself.

2. Inspect the crated and/or wrapped XIS machine and all additional crates or packages for damage that might indicate corresponding damage to the equipment inside the crates or wrapping.
3. Inspect "TiltWatch" and "Shockwatch" monitors where these are present (Figure 10).
4. Photo-document all damage to crates or wrapping before removing the machine or accessories from such crating or wrapping.

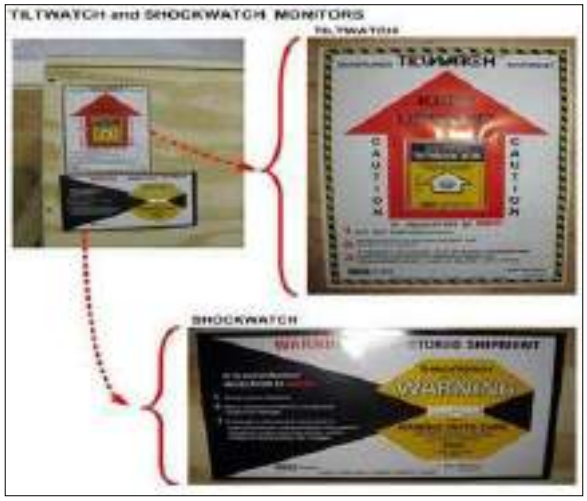

Figure 10: TiltWatch and Shockwatch Monitors

Uncrating/Unwrapping the XIS Machine

XIS units can be shipped either crated or wrapped. If the unit is shipped within the continental U.S., it is wrapped but not crated. If it shipped anywhere else, the units are always crated, no matter what the size or model of the XIS unit.

Figure 11 shows an XIS-100X being uncrated, while Figure 12 shows an XIS-100 wrapped but not crated, ready for shipping.

Therefore, the instructions for uncrating in this section may not apply to your particular unit, depending on where you are located. If your unit was wrapped but not crated, disregard the specific references to crating.

Figure 11: Uncrating an XIS-100X

Figure 12: XIS-100x Wrapped for Shipping

If the unit has still to be moved to its final installation/operation site:

1. Find a clear path from the receiving site to the final install site.
2. Verify that the unit can safely pass through all doors and elevators along the way.
3. Determine whether keeping the unit crated or wrapped will facilitate its safe (undamaged) arrival at the final install site.
4. Verify that the final location has enough space not only for the assembled machine, but to accommodate the crated (and possibly disassembled) unit.

If the XIS arrives at the installation site in a crate (as opposed to being only wrapped), the top, sides and floor of the crate are fastened to each other with drywall screws. When uncrating the machine, it is important to proceed in the following order:

1. Use a ladder if necessary to be able to access and remove the screws from the crate's lid.
2. Carefully remove the lid from the crate and set it aside.

NOTE: Protect the LED lights and Emergency Stop switches from damage when removing the top and sides of the crate.

3. Remove the drywall screws from each of the crate's sides, careful not to allow the sides to fall.
4. Remove the crate's end panels.
5. Remove and discard all of the crating material.
6. Cut the internal restraining straps holding the equipment to the base of the crate.
7. Discard all straps.
8. Locate and check the packing list. Verify that the correct unit has arrived by model and serial number.
9. Unwrap the system(s):
    a. Cut any remaining restraining straps.
    b. Cut the plastic wrapping and bubble wrap at the corners of the XIS frame.

NOTE: ***Carefully*** cut away the wrapping. Do NOT cut or scratch the sides of the XIS.

c. Pull the plastic wrapping and bubble wrap away from the XIS.

d. Discard the plastic wrapping and bubble wrap.

10. Inspect the XIS unit for any damage.

a. Note any damage and record it on the shipping manifest.

b. Photo-document all shipment damage. Include a sign identifying the date and serial number of the unit(s) in all photographs.

c. Report any and all damage to the shipper and to Astrophysics.

11. Take inventory.

a. Check-off items on the packing list.

b. Note any missing or damaged items on the packing list.

c. Locate the key switch key(s) and panel key(s).

NOTE: The keys to the key-switch and panel are very important. Keep track of the keys!

12. If necessary, remove the components from the crate using a forklift.

NOTE: If using a forklift to move a machine or a section of a machine, the load must be lifted a minimum of 17inches above the ground while being moved. A pallet jack will not work.

13. When using a forklift to move a machine or large accessory such as a roller or conveyor bed, use the forklift holes when present to move the machines or accessories to their final installation location.

14. Move the system to its final operating location/position.

a. Clear the transit path of all obstacles.

b. Carefully push the system into its final install site.

NOTE: Enlist all the help you need when you push (or forklift) the XIS.

c. Set the leveling feet on the XIS.

Figure 13: Leveling Feet

15. Unwrap the monitor boxes.

a. Install the base stand on the monitor.

b. Discard the monitor boxes.

c. For models that include supervisor and other upgraded or custom stations, see the manuals for those models for more detailed instructions for setting up monitors and PCs.

16. Remove the X-ray Generator (XRG) side panel.
17. Perform an internal visual inspection.

Assembly and Adjustment

1. Verify that all PC cables are correctly connected.
2. Connect the monitors.
   a. Plug in the monitor's power cord.

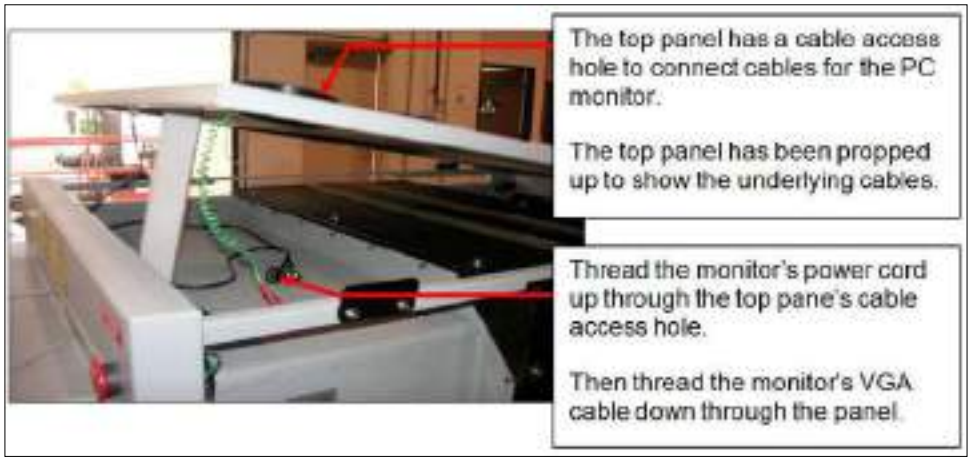

Figure 14: XIS 6545 with the top cover panel lifted up

   b. Plug the video monitor cords into the VGA extension cable inside the XIS.

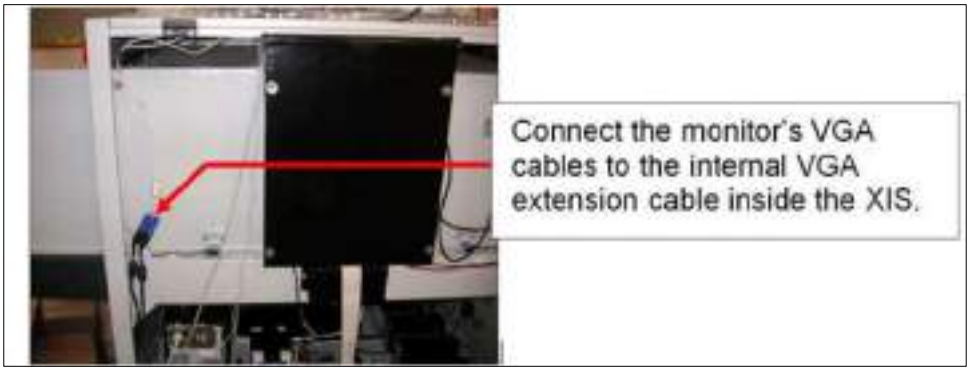

Figure 15: XIS 6545 with Side Panel Removed

3. If necessary, assemble the AOCP panel stand.
   a. Mount the panel stand on the side panel.
   b. Place the AOCP on the panel stand.
   c. Connect the AOCP USB cable to the USB extension cable.
4. If required, assemble the remote table.

a. Put the monitors on the remote stand.
b. Connect the monitor's power cord.
c. Connect the monitor's VGA cables.
d. Connect the XOC's USB cable to the USB extension cable.

5. If the monitors are to be located on top of the top panels of the XIS, place the monitors on the top panel and connect the monitor cables.
    a. Place the monitor on the top panel.
    b. Connect the monitor's power cord.
    c. Connect the monitor's VGA cables.
6. Plug the main power cord into the XIS.
    a. Use the correct XIS 14 AWG power cord.
7. Clockwise twist and pull out all Emergency Stop switches.
8. Turn the main AC circuit breaker to the ON position.
    a. Allow the XRG(X-ray Generator) to preheat the X-ray generator for at least 30 minutes.
    b. Clean up the area around the XIS while you are waiting.
9. Briefly inspect conveyor belt alignment. Ensure that the conveyor belt is ready to run.
    a. Ensure the conveyor belt is aligned.
    b. Ensure that the conveyor belt and tunnel are clear.
10. If extended length conveyor beds were ordered for the unit, the conveyor beds may be shipped separately. If the extended conveyor beds are not already installed, install them now.
11. Install the conveyor belt.
12. Run the conveyor belt in the "FORWARD" motion and track the belt. See "Belt Tension, Tracking and Replacement" on page 83.
13. Move the UPS switch to the "ON" position.
14. Plug the key into the key-switch and turn the key-switch to the ON (horizontal) position.

Run the Diode Plot Program. See "Diode Plot" on page 69.

    a. Check diode output (baseline) with the XRG off.
    b. Check diode output with the XRG on.

15. Check the imaging of the XIS.
    a. Take screen captures of the sample images.
    b. When you are satisfied that everything is running properly, securely close all open side panels.
16. Carefully check the conveyor belt alignment.

17. If conveyor belt requires alignment, align the conveyor belt. See "Belt Tension, Tracking and Replacement" on page 83.
18. Run the conveyor belt for at least 30 minutes to verify that the conveyor belt is well aligned.
    a. Complete the System Installation Report (SIR) while you are waiting.

Pre-Power Up Inspection

This procedure is a visual inspection of key internal items to the instrument, which should be performed prior to initial power up.

1. Temporarily bypass interlocks as required.
2. Open and/or remove access covers to verify the proper operation of the:
    - Computer and interfacing connections
    - DC Power Supplies
    - X-ray Generator
    - Power Rollers
    - Programmable Logic Controller (PLC)
    - Uninterruptible Power Supply (UPS)
3. Verify that no oil is leaking from the X Ray Generator tank.
    a. Repair or replace leaking part(s) as necessary.
4. Verify that no oil is leaking from the power rollers.
    a. Replace leaking parts as necessary
5. Verify that the computer and cables are present and that the PC boards are seated properly inside the PC.
    a. Record and address any deficiencies.
6. Verify that the necessary ICs for the DAS board are present and seated correctly.
    a. Reseat the ICs as necessary.
7. Verify model and serial number.
    a. Record on installation report.
8. Verify that the inside of the inspection tunnel is clear of all foreign matter.
    a. Clear as necessary
9. Verify that the photo sensors are unobstructed.
10. Verify that the UPS is switched to the ON position.

Initial AC PWR Connection and Checks

After all pre-power up inspections have been satisfactorily completed, begin initial AC power connection and checks.

1. Verify that the key is NOT in the key-switch on the control panel.
2. Turn the breaker/switch on the AC power unit connector at the exit end of the unit to the OFF position.
3. Connect the supplied power cord to the AC power input connector at the exit end of the unit.
4. Connect the other end of the power cord to the facility power receptacle.
5. Verify that all EMERGENCY STOP switches are in the CLOSED position.
6. Turn the breaker/switch on the AC power unit connector at the exit end of the unit to the ON position.
7. Verify the status of the PLC. The green LED should be “ON”, for power on.
8. Verify DC voltages at Power supply 1, 2, and 3. They should measure +5.2 VDC (+/- 0.2 VDC)
9. Verify DC voltages at Power supply 4, 5, and 6. They should measure –5.2 VDC (+/- 0.2 VDC)
10. Verify DC voltages at Power supply 7. They should measure +12 VDC (+/- 0.2 VDC)
11. Verify DC voltages at Power supply 8. They should measure +65VDC (+/- 5 VDC)
12. If AC voltage is correct but DC voltages are not, attempt to adjust at DC power supply.

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XIS Startup / Shutdown Procedures

Introduction

This chapter covers only the most basic operating procedures for Astrophysics non-pallet units. For more detail, refer to the Astrophysics User Manual.

The XIS has four phases of operation:

1. System Startup
2. *Login*
3. *X-ray Screening*
4. *System Shutdown*

Procedures for each phase of operation are described below.

Starting the XIS

The first phase of operation is *System Startup*. System Startup involves the following steps:

1. The XIS AC power cord should already be “plugged-in”. If it is not plugged in, plug it in now. The cord is located under the exit end conveyor bed.

Figure 16: AC Power Cord and Main Circuit Breaker Switch

2. The main circuit breaker switch should already be in the **ON**, or up position. If it is not in the **ON** position, push it up to the **ON** position now. The circuit breaker is also located beneath the exit end conveyor bed.

NOTE: Always leave the main AC switch in the **ON** position. This allows the batteries in the internal UPS (Uninterruptible Power Supply) to remain fully charged. The UPS battery slowly discharges on its own if the XIS is not plugged in and turned **ON**. If the UPS battery becomes fully discharged, it may require up to eight hours to fully recharge.

3. Turn the key-switch on the **AOCP** 90 degrees clockwise from the vertical "**OFF**" position to the horizontal "**ON**" position. Leave the key-switch in the "**ON**" position until you have finished using the XIS.

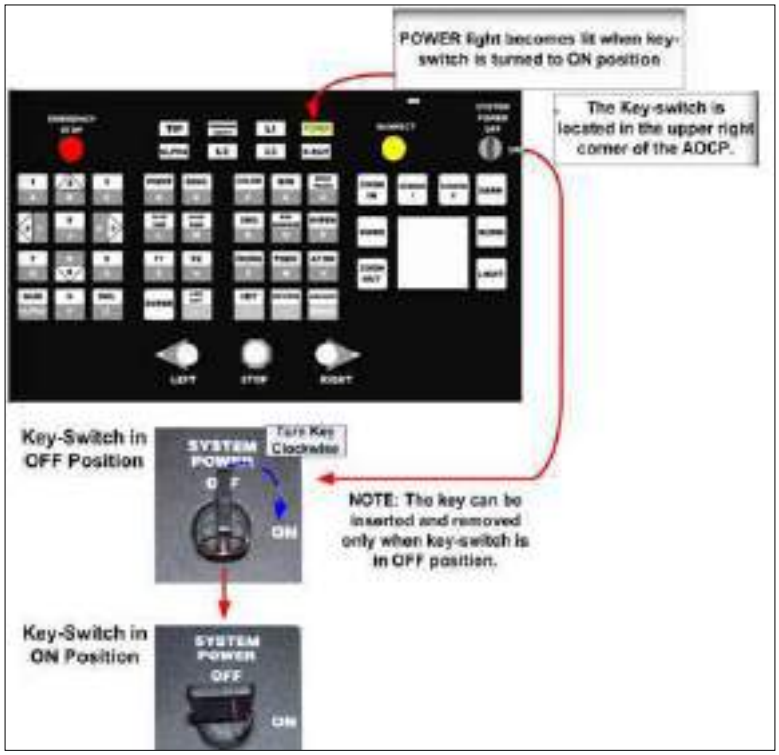

Figure 17: AOCP (Advanced Operator Control Panel) Key-switch sequence

NOTE: When the key-switch is turned to the **ON** position, the following sequence of events will occur:

a. The LED lights on the computer monitor screen(s) turn on (if the monitor is turned on; if not turned on, turn on now).

b. The computer screen briefly displays the PC computer's BIOS startup messages.

c. The Windows Operating System briefly displays its startup messages on the monitor screen(s).

d. The Windows Operating System briefly displays the Windows Desktop screen.

4. Wait for the "Please Log In" screen to appear.

Logging In

There are two versions of operating systems currently used on XIS machines: Version 2.0 and the more recent Version 2.1, as shown in Figure 18. Though using slightly different interface designs, the instructions herein can be used with either operating system. Both make use of the AOCP touchpad's "double tap" feature which is equivalent to clicking the left mouse button in the Microsoft ™ Windows operating system.

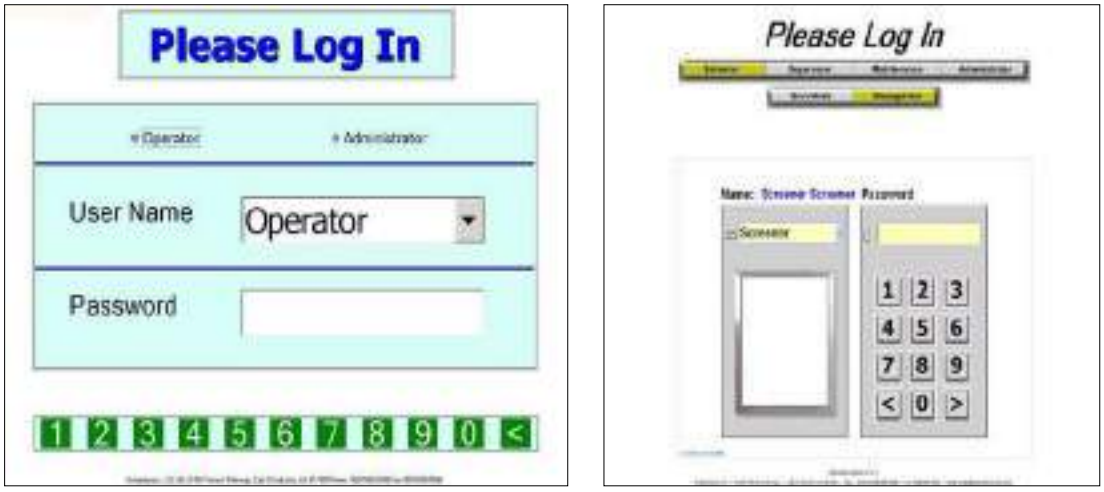

Figure 18: "Please Log In" Screen (Version 2.0 on left, 2.1 on right)

Operating System Version 2.0

1. In operating system version 2.0, use the AOCP touchpad to position the cursor over the [**Operator**] button and double tap the touchpad. This selects the Operator rather than Administrator mode.

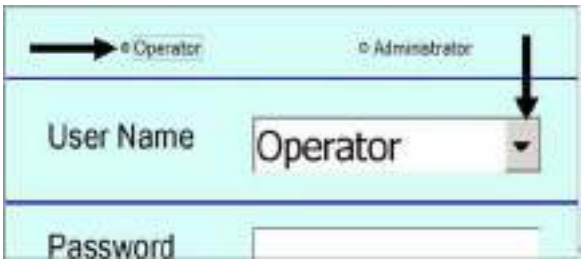

Figure 19: Operator Button and Down Arrow

2. Double-tap the down arrow, [⩛] (located to the right of the User Name entry box).
3. Position the cursor over your User Name in the drop down list and double tap the touchpad (i.e. click on your User Name). Select your User Name from the drop down list. You cannot add a new User Name if it does not appear on the drop down list. Contact your supervisor if you need to change or add a new User Name and Password for yourself.
4. Enter your password. Please note:
    a. Asterisk characters (*) are displayed on the screen when you type in your password entry. To ensure security, the actual password characters are never shown on the screen.
    b. All passwords are four characters long. Shorter or longer password entries are not allowed.
    c. Passwords can consist of either alphabetic (alpha) or numeric characters.

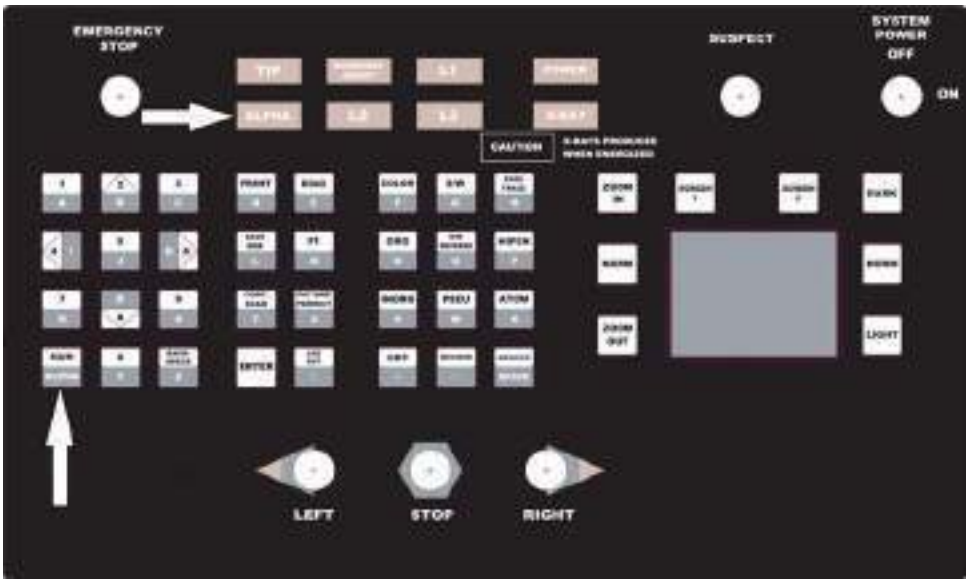

Figure 20: AOCP [ALPHA] Shift Button and ALPHA Status Light

d. To enter alpha characters, press the [ALPHA] shift button to enter alpha entry mode. In alpha entry mode, the XIS recognizes the alpha (i.e. upper shift) characters of each button. Alpha shift characters are labeled on the operator control panel. The ALPHA status light will be lit when you are in alpha entry mode.

e. Pressing [ALPHA] shift button again will toggle you into numeric entry mode. The ALPHA status light will be off (unlit) when you are in numeric entry mode.

f. You can also enter your password numbers by positioning the cursor over the digits on the bottom of the screen and then double tapping the touchpad.

Figure 21: Digits at Bottom of Log In Screen

g. If a PC keyboard is available, you can also enter your password by typing the characters in and pressing the [Enter] key. All alpha character entries are automatically shifted into upper case characters for entry.

5. Wait for the “System Ready” screen to appear. The system is now ready for immediate use.

NOTE: Windows will display “**Warming Up**” messages before the “**System Ready**” screen appears.

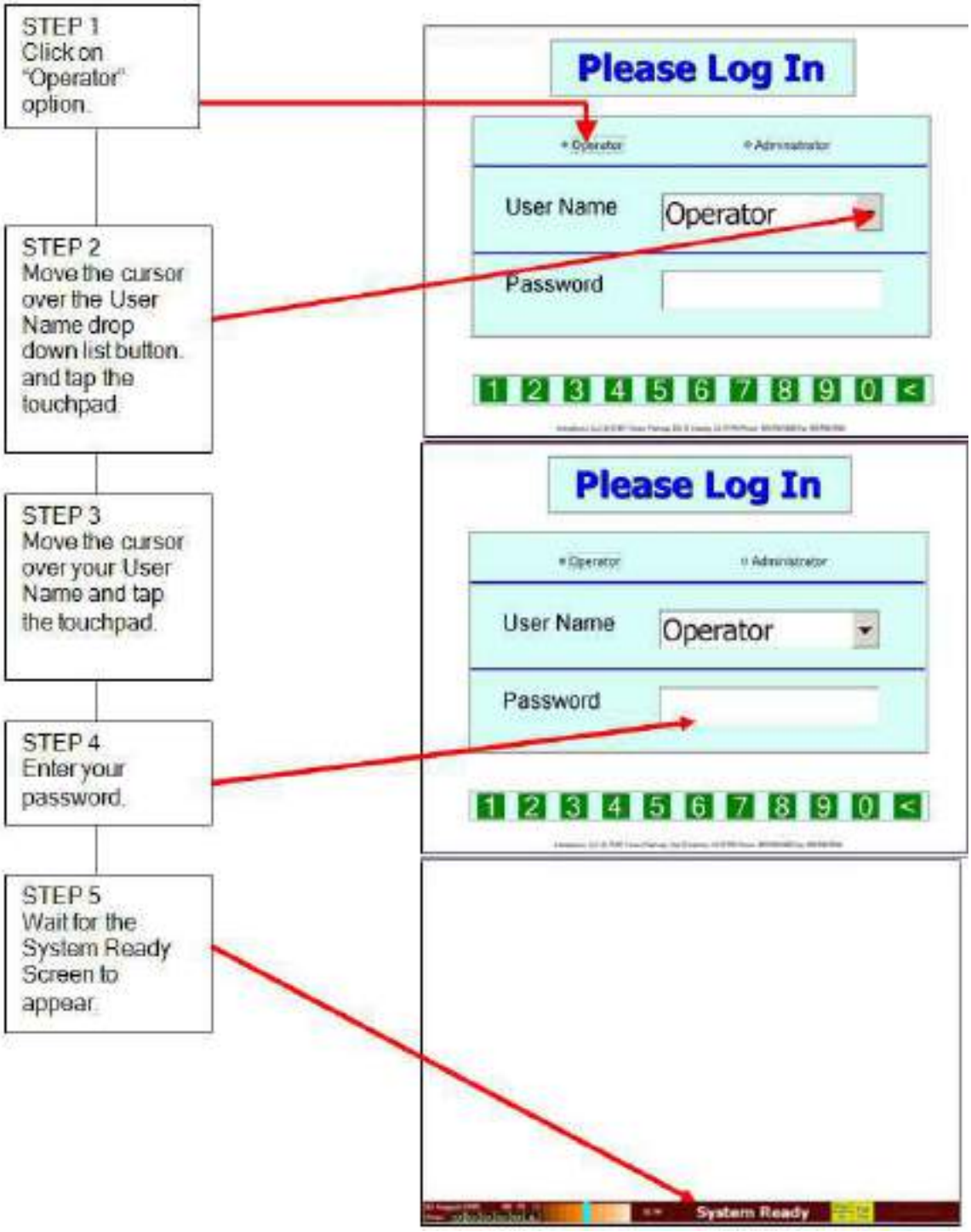

Figure 22: Version XIS 2.0.X.X - Login Steps

Operating System Version 2.1

Figure 23 shows the Advanced Operator Control Panel (AOCP) and the key-switch sequence.

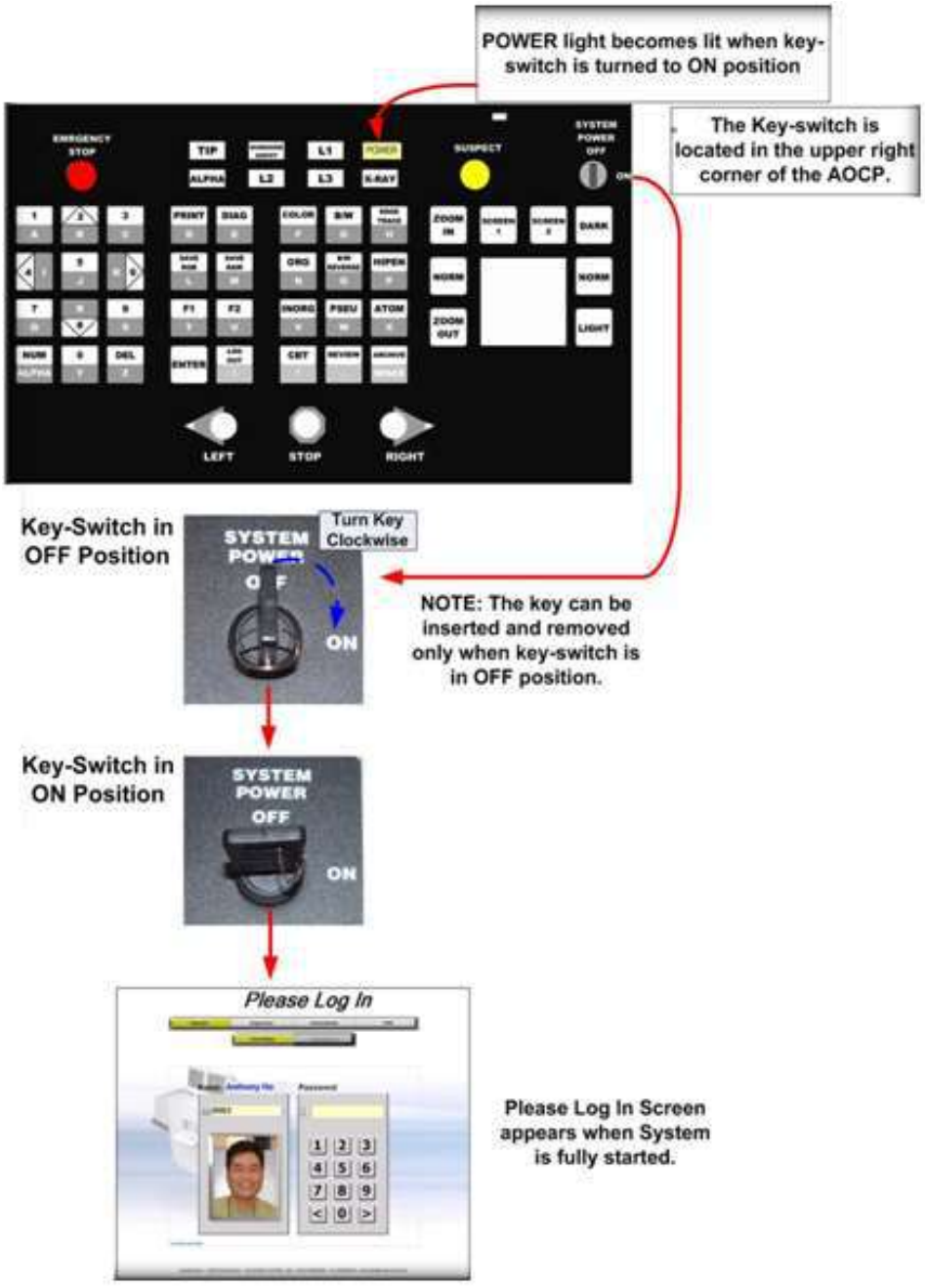

Figure 23: Advanced Operator Control Panel (AOCP)

In order to log in, follow these steps:

1. Switch the key-switch to the “ON” position. After a brief warm-up, the following message will appear (Figure 24). Click “Continue.”

Figure 24: "Calibration Required" screen

2. When the following message appears, click "OK."

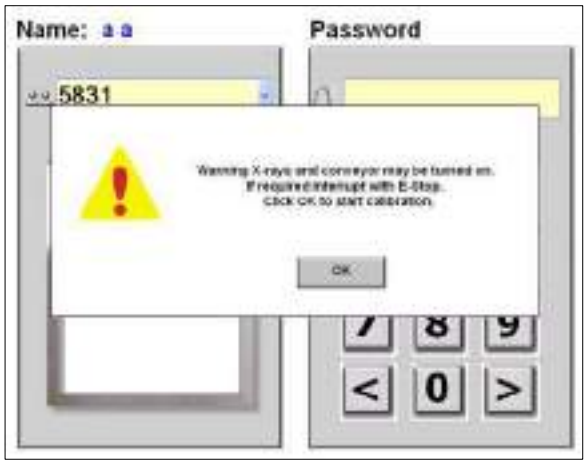

Figure 25: "Warning X-rays" screen

Once the XIS completes calibration, including turning the X-rays and conveyors on and off, the Log In screen will be available.

3. Click on [Screener].
4. Click on [Scan Mode].

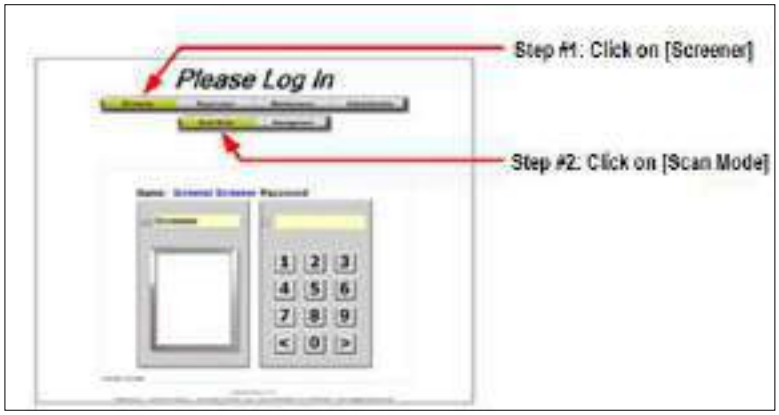

Figure 26: Log In Screen Enabled

5. Click on the drop-down list button, and select your username.
6. Type in your password, using the control panel keyboard or clicking on the screen keypad.

Figure 27: Entering User Information

After a brief pause, the “System Ready” screen will appear. You are now logged in.

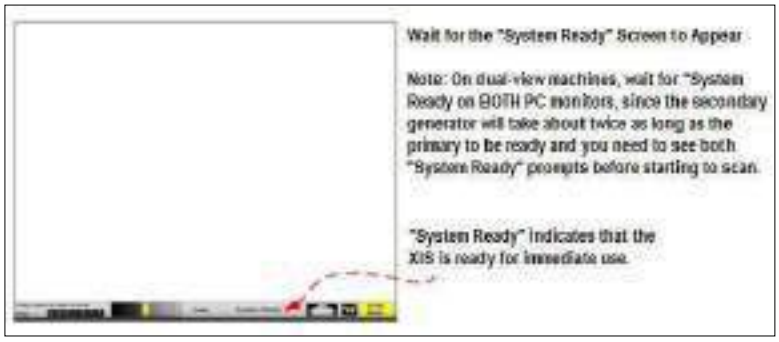

Figure 28: “System Ready” screen

The System Ready screen differs slightly from Version 2.0 to Version 2.1. The Version 2.0 System Ready screen is shown in Figure 29.

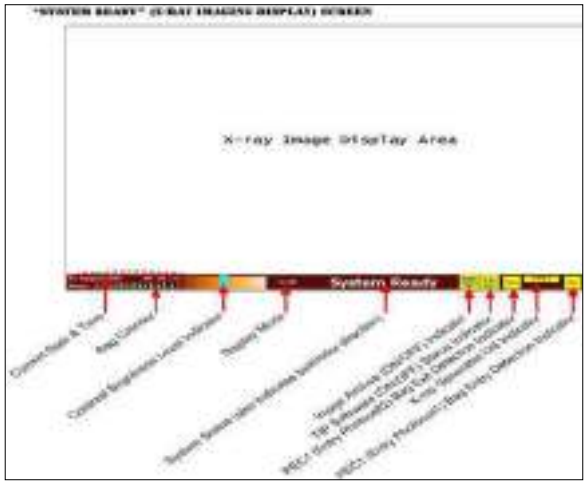

Figure 29: "System Ready" Screen – XIS Application Software Version 2.0.x.x

The Version 2.1 System Ready screen is shown in Figure 29 and Figure 30.

Figure 30: "System Ready" Screen – XIS Application Software Version 2.1.x.x

X-ray Image Screening Procedures

Successful X-ray imaging security screening requires:

- knowledge of how to operate the X-ray imaging system to produce X-ray images
- knowledge of how to interpret those X-ray images

This section provides you with instructions on how to use the Astrophysics X-ray Imaging System to scan objects and interpret the scanned images. Since need differs, it is beyond the scope of this manual to provide specific instructions on how to analyze and interpret X-ray images for every situation. Contact the Astrophysics Sales Department for further information and referrals on training on X-ray imaging security image analysis.

In *X-ray Screening Mode,* bags, packages, and other articles are placed on the conveyor belt and are carried through the inspection tunnel by the conveyor belt. Inside the X-ray tunnels, items are exposed to penetrating X-rays. The XIS then generates and displays a scanned "X-ray" image revealing the internal contents of each item.

1. Press the [LEFT] button to start the conveyor in the left (forward) direction. If your system has a foot-mat switch, stand on it. Pressing the [**STOP**] button will stop the conveyor.

NOTE: If a foot-mat switch is present, the XIS requires the presence of an operator standing on the foot-mat in order to run the machine. If no one is standing on foot-mat, the XIS will stop and display an "INTERLOCK" warning message on the bottom right corner of the screen. Stepping on the foot mat will clear the INTERLOCK message from the screen and allow further operation of the machine. If the INTERLOCK warning is not cleared in 30 seconds, the XIS application will logout the user and return to the "Please Login Screen". Make sure the foot-mat is properly plugged into the XIS and placed near the operator control console.

NOTE: Do **NOT** continuously run the conveyor in the RIGHT (reverse) direction for more than 30 seconds at a time. Running the belt in the forward direction keeps the conveyor belt in optimum alignment.

2. Place the articles that you want inspected on the conveyor so that they are carried into the X-ray inspection tunnel.

Items carried into the inspection tunnel are automatically X-ray scanned and imaged. The resulting X-ray image is displayed on the computer monitors.

Scanned bag images remain on the screen (i.e. do not scroll off) until next item is scrolled on to the screen.

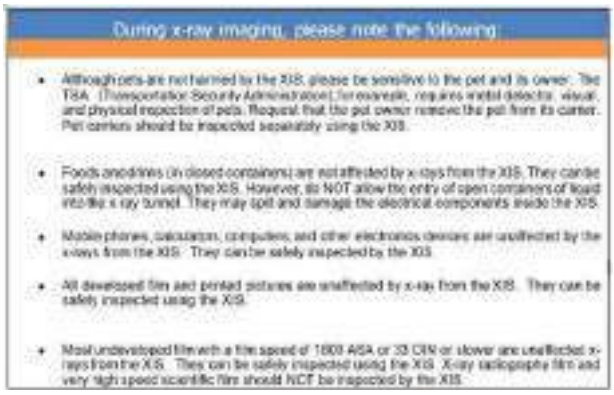

Figure 31: X-ray Safety Warning

3. Carefully inspect each scanned image.
4. Repeat Steps #2 and #3 for every bag.
5. To LOGOUT press the [**EXIT**] button on the Operator Console.
    - Logout allows others to login and continue using the system.
    - Logout also prevents unauthorized persons from using the system when it is unattended.

XIS Shutdown

When installing or servicing the XIS, it is often necessary to shut down the XIS. This procedure describes how to shutdown the XIS.

1. Turn the key-switch to **OFF** position.

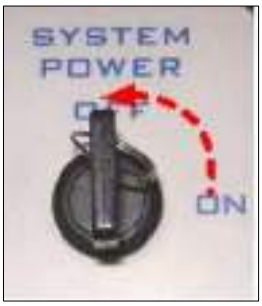

Figure 32: AOCP Key Switch "ON" Position

2. Wait for the monitors to shut down.
3. Turn the main AC breaker to the off position.
4. Confirm that the XIS is **off**.
    a. The XIS frame fan should be off and not audible.
    b. The XIS monitor screens should be blank.
    c. The XIS monitors should be turned **off**.
    d. The keypad "System **ON**" and the "System **ON**" light on the frame unlit are **off**.

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Operational Testing

After the initial installation and inspections have been performed it is necessary to verify the satisfactory performance of the XIS. Performance verification may be viewed as three (3) general areas:

- Functional Testing
- X-ray Image Quality
- Radiation Survey.

NOTE: These tests are useful not just when installing the machine, but when servicing it.

Functional Testing

Functional testing encompasses all routine operations of the instrument. It includes, but is not limited to:

- Indicator Lights
- Conveyor Operations
- Control Panel Operation
- Monitor Operation

Following are the steps necessary to perform functional testing on the instruments. See “XIS Startup / Shutdown Procedures” on page 47 for more detailed instructions on Start-up and Shut-down.

1. Insert the key into the key-switch on the control panel and turn the key to the "ON" (horizontal) position.
2. The computer starts booting, and after about 45 seconds, it will prompt the “LOG-IN” screen. After logging in, the green light indicators will be energized.

The monitors should now be displaying “SYSTEM READY”. At this time you can operate the machine, or you can exit and continue testing.

3. Verify that the PC and PLC are operating.
4. Verify that the system fan is operating.
5. Verify that the instrument performs a self-test. When the self-test is successfully completed, a "SYSTEM READY” message is displayed in the message bar at the bottom of the monitor screen.
6. Verify proper KV and MA settings are correct.
    a. Record and adjust if necessary.
7. Compare against XIS Final Inspection Test Data Sheet.
8. Verify that the conveyor operates properly by standing on the foot-mat (if present) and using the control panel:

9. Press the FWD button. The conveyor should move forward, and the message “Forward” should be indicated on the monitor.
10. Press STOP to stop the conveyor.
11. Press the REV button. The conveyor should move in the reverse direction, and the message “Reverse” should be indicated on the monitor.
12. Press STOP to stop the conveyor.
13. If the conveyor does not operate correctly, refer to conveyor subsystem adjustments and troubleshooting.

NOTE: When the conveyor is moving in either direction, pressing any of the conveyor control buttons (FWD, STOP, or REV) stops the conveyor.

14. Verify that the conveyor is tracking correctly and is properly tensioned. See “Diagnostics” on page 69.
15. Verify system operation by scanning a "test bag" in both forward and reverse directions and observing the image.
16. If the general image quality is poor, verify monitor adjustments, computer operation, and possible EMI issues to resolve the problem before continuing.
17. If ONLY the X-ray image is poor, continue functional testing of the instrument and address the problem in the X-ray Image Quality procedure below.
18. Verify settings and enter any necessary corrections.
19. Verify that the operator control panel functions operate correctly:
    - Zoom Keypad
    - 2 times ZOOM up to 32 times zoom
    - Color Imaging
    - Inorganic Imaging
    - Organic Imaging
    - Black and White
    - Pseudo Color
    - Reverse monochrome
20. If these functions do not operate correctly change the PC or AOCP if necessary.
21. Verify that interlocks and EMERGENCY STOP switches (if installed) stop the conveyor and de-energize the X-ray generator when access panels are opened or removed.

X-ray Image Quality

After the functional testing of the instrument is complete, it is necessary to optimize X-ray image quality. X-ray image quality is dependent upon a number of factors:

- X-ray generator condition and alignment
- X-ray controller operation
- X-ray KV and MA settings
- Collimation
- Alignment of the diode boards.
- DAS board operation

Before continuing it is important to distinguish between a general image quality issue and an X-ray image quality issue.

"Ghosting" and "fuzzy" images (including the menus) are general image quality issues and should be addressed before continuing.

Black or Green screens and "banding" are X-ray image quality issues and can usually be resolved through X-ray alignment, collimation, and LXDA corrections (See X-ray Collimation on page 101.)

NOTE: Typical instruments shipped from the factory will have very good X-ray image quality.

If the X-ray images displayed during the functional testing were acceptable, no adjustments are necessary. If there are problems with the X-ray images, see Diagnostics on page 69” and specifically the instructions on how to use Diode Plot.

1. Display the Diode Plot and view diode response with X-ray OFF.
2. Verify that with X-ray OFF all diodes are even, with no spike or dip in the graph line. Any gap, spike or dip in the graph line is a suspected bad diode and the applicable detector board might need to be replaced or the bad diode bypassed (See “Bad Diode Elimination” on page 106).
3. Display the Diode Plot and view diode response with X-ray ON .
4. Verify with X-ray ON that all diodes are even, with no spike or dip in the graph line. If necessary, adjustments can be made to "correct" the Diode Plot response curve (see “Diode Plot” on page 69).
5. Adjust alignment of collimator bars, X-ray generator, and/or detector boards as required. See “ X-ray Collimation” on page 101.
6. Once an acceptable Diode Plot is achieved, X-ray image quality testing can begin:
    a. Scan the new ASTM "test bag" for image evaluation. If the test bag is not available, use the old ASTM tests or their equivalent.

b. Verify operation against the Standard Minimum Acceptance Criteria. The criteria are available in a document titled "Standard Practice for Evaluating the Imaging Performance of Security X-ray Systems, Designation F792-08." Copies are available from ASTM International, service@astm.org (e-mail); or through the ASTM website (www.astm.org).

c. Upon successful completion of the Minimum Acceptance Criteria, remove all interlock bypasses, and replace all panels.

Radiation Leakage Survey

This section describes the procedure for surveying an XIS for radiation emission. Astrophysics, Inc suggests you use one of the following meters:

- Victoreen® 190
- 450P Ion Chamber Survey meter
- Geiger-Mueller #489-4 probe.

The survey meter must be calibrated by a recognized laboratory on a regular basis — usually once annually. Keep copies of the calibration report with the survey results. The most recent calibration date must be marked on the meter.

Astrophysics, Inc offers training of clients and technicians to perform a radiation survey. Depending on local or national regulations, a different checklist may be required. Specific countries or states will likely require that the radiation survey be repeated according to a fixed timetable.

Astrophysics, Inc recommends a radiation survey every three months. Write the results in the approved form, which is filed in a special file cabinet. Copies of the report are often sent to the State or Country, and extra copies are often sent to a remote data warehouse.

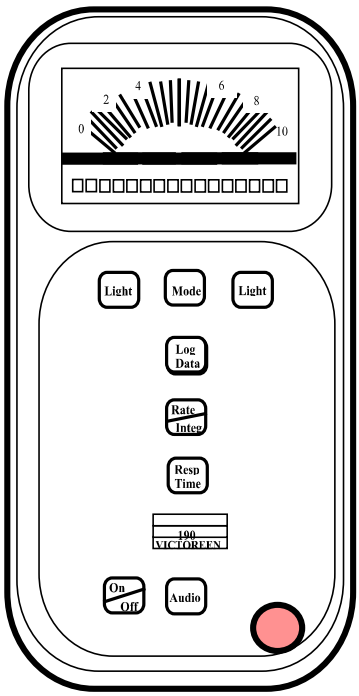

Figure 33: Handheld Radiation Survey Meter (Victoreen Model 190)

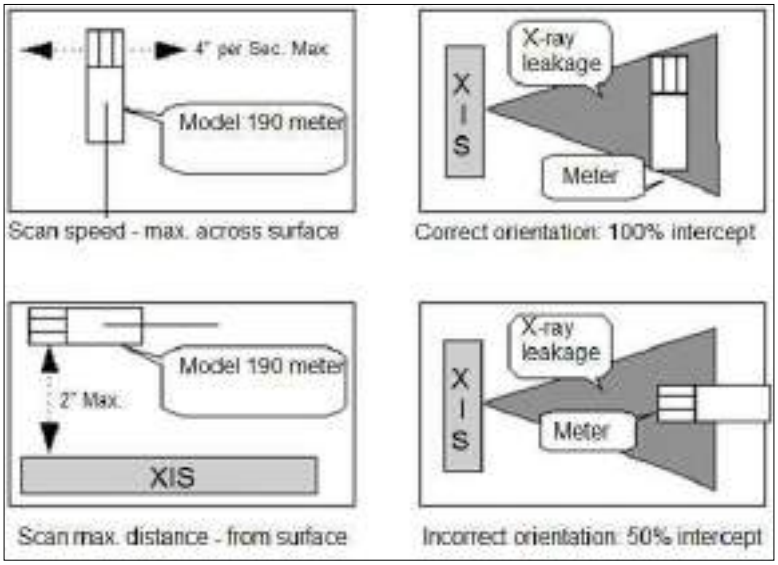

Figure 34: Radiation Scan Test Points (Model 190)

Performing the X-ray Safety Scan

Items in hand:

- X-ray Radiation Survey form
- meter (Victoreen 190, Victoreen 450P, Geiger-Mueller 489-4 or equivalent)
- calibration certification dated not more than a year ago

Calibrate the meter:

1. Expose the probe.
2. Press the “ON/OFF” button.
3. Wait until meter completes its self test (several seconds during which the calibration date appears on the indicator).
4. Press the “RESP TIME” button to display “RESPONSE IS 6S.”
5. Expose the CHECK SOURCE—a bit of radioactive material supplied with the meter.
6. Put meter probe on the CHECK SOURCE and check for a suitable reading.
7. Cover the CHECK SOURCE and move the meter away from it.

If you get no reading from the check source, shake the meter ***gently*** and check for rattling sounds from the probe, indicating that the meter is damaged.

Radiation “background”

With the X-ray machine “OFF,” measure & record the BACKGROUND radiation. Background radiation is a natural low-level radiation that exists everywhere at all times regardless of any other radiation source.

1. Turn on X-rays
    a. Turn the remote-console key-switch “on” (sideways).
    b. Wait until “System Ready” appears on screen.
    c. Run the conveyor belt continuously to keep the X-ray machine generating X-rays. Alternatively, run the Diode Plot program.
2. Scan Meter over X-ray machine
    a. Scan the meter over all surfaces of the X-ray machine.
    b. Move very slowly, at a maximum of 4 inches per second (10 cm/second).
    c. Stay within 2” (5 cm) of the X-ray machine surface.

NOTE: Orient the meter so that the flat side of probe faces the X-ray machine. Do not hold the meter probe “sideways,” as this gives readings that are too low.

3. Record readings from each surface on the form entitled **X-RAY RADIATION SAFETY TEST RECORD** (See Figure 35) or your local equivalent. All readings should be below 0.5 mR/h.
4. Remember to scan the meter over the following areas:
    - Input conveyor opening
    - Exit conveyor opening

NOTE: All readings should be below 0.5 mR/h.

5. Complete a Site Acceptance Test (SAT) form (Figure 36).
6. Complete a Commissioning Record (Figure 37).

X-RAY RADIATION SAFETY TEST RECORD

Model Number	Background Radiation Level mR per hour	Test Date
System Serial Number		Tested By

WARNING LABEL VERIFICATION		
Required Label:	**Required Location:**	**Accepted**
"X-Ray On"	Adjacent to each x-ray on indicator	
"Caution: X-Rays Produced When Energized"	Adjacent to each x-ray on indicator	
"Caution: Do Not Insert Any Part Of The Body When System Is Energized - X-Ray Hazard"	Adjacent to each port	
X-RAY ON INDICATORS		
Required Location:	**Required Function:**	**Accepted**
Visible from each access panel and port	Illuminates when x-rays are on	
SAFETY DEVICES and INTERLOCKS		
Device:	**Required Function:**	**Accepted**
Safety interlock at each access panel	Terminates x-ray generation when actuated by panel removal	
System power key switch	Starts and shuts down machine	
Log In Screen	Cannot start application software without operator logging In	
Emergency stop switch (when installed)	Terminates x-ray generation when actuated.	

DOSE RATE (If Applicable)	
Meter: Victoreen Model , Serial Number	Calibration Due Date:
Average dose per inspection after ten passes	mR

EXTERNAL RADIATION EMISSION RATE	(Federal Limit 0.5 mR/hr)
Meter: Victoreen Model , Serial Number	Calibration Due Date:
Entry end panel(s) and port	mR per hour
Exit end panel(s) and port	mR per hour
Left side panels (when viewed from entry end)	mR per hour
Right side panels (when viewed from entry end)	mR per hour
Top panel(s)	mR per hour

CERTIFICATION and SERIAL NUMBER LABELS	By
One label applied on system exterior panel near AC power line receptacle	
One label applied on side of frame near access panel	

Figure 35: X-ray Radiation Safety Test Record

XIS 6545 SITE ACCEPTANCE TEST (SAT)

Instructions	• Initial each step as performed. • Record any comments in the NOTES section. • Refer to XIS 6545 Installation Procedure for detailed instructions on each step.					
Instrument	Serial Number:	Model Number:	Date of Manufacture			
Step	Action					Initials
1	Measure site AC power	VAC	Hz	Neutral to GND		
2	Uncrate and check visually the machine.					
3	Verify all components and accessories are present.					
4	Verify exterior condition of instrument, check for damage.					
5	Verify condition of x-ray generator. Check for oil leak.					
6	Check conveyor motor for oil leaks.					
7	Verify configuration of computer.	USB Ports	Serial port	Parallel port		
8	Verify that all cables connectors are seated correctly (reseat as necessary).					
9	Verify AC circuit breaker is OFF, "plug" into site AC power. Turn ON					
10	Verify that Emergency stop button work properly.					
11	Verify that PLC starts properly with power ON.					
12	Measure voltages -	VAC	+5 VDC	-5 VDC		
		+12 VDC	+65 VDC			
13	Verify successful start-up	Log On Screen				
14	Verify successful shutdown.					
15	Test conveyor operation. (FWD, STOP REV"	FWD	STOP	REV	Tracking	Tension
16	Verify light indicators	POWER ON	X-RAY ON			
17	Verify operation of x-ray generator					
18	Test operation of interlocks.					
19	Test operation of Photocells					
20	Verify image clarity.					
21	Test imaging functions.	Color	Organic	Inorganic	Lighter	Darker
		B & W	Reverse	Pseudo	Zoom up	Zoom down
22	Test x-ray image quality		Penetration		Wire Gauge Resolution	
23	Collimation adjustment required?	YES		NO		
24	Perform radiation leakage survey.	mR/hr.		mR/hr.		
25	Instrument demonstrated to customer?	YES		NO		

Notes:

Customer Information:

CUSTOMER NAME	CUSTOMER ADDRESS

Instrument installed by:

PRINT NAME	SIGNATURE	DATE OF INSTALLATION

Figure 36: Site Acceptance Test (for XIS-6545)

COMMISSIONING RECORD FOR XIS 6545

Equipment Model Number/Type: _____

Equipment Serial Number: _____

Equipment Facility Identification Number _____

Results: (circle as applicable)

Visual Examination	Pass	Fail
Color / organic / inorganic imaging	Pass	Fail
B&W / Reverse monochrome / Pseudo	Pass	Fail
Performance Requirements	Pass	Fail
Conveyor Starting	Pass	Fail
Conveyor Control	Pass	Fail
Radiation Safety and Emissions	Pass	Fail

Commissioning By: _____ _____
Astrophysics LLC Representatives Date

Approved By: _____ _____
Astrophysics LLC Site Manager Date

Approved By: _____ _____
Company Representative Date

Figure 37: Commissioning Record (for XIS-6545)

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Diagnostics

Diode Plot

The Diode Plot Program (DPP) is a standalone utility program that monitors the real-time output from the Linear X-ray Detector Assembly (LXDA). LXDA output is crucial in creating X-ray images that are displayed on the screen. X-rays from the X-ray generator are first projected through the inspection tunnel and then through to the LXDA. X-ray images are created when items entering the inspection tunnel attenuate (i.e. lower) the X-ray signal.

Following are examples of Diode Plot readouts, including Diode Plot with X-rays on and off, and with “History,” meaning it simultaneously shows current and previous Diode Plot results on the graph.

Figure 38: Diode Plot, X-ray Off, History Off

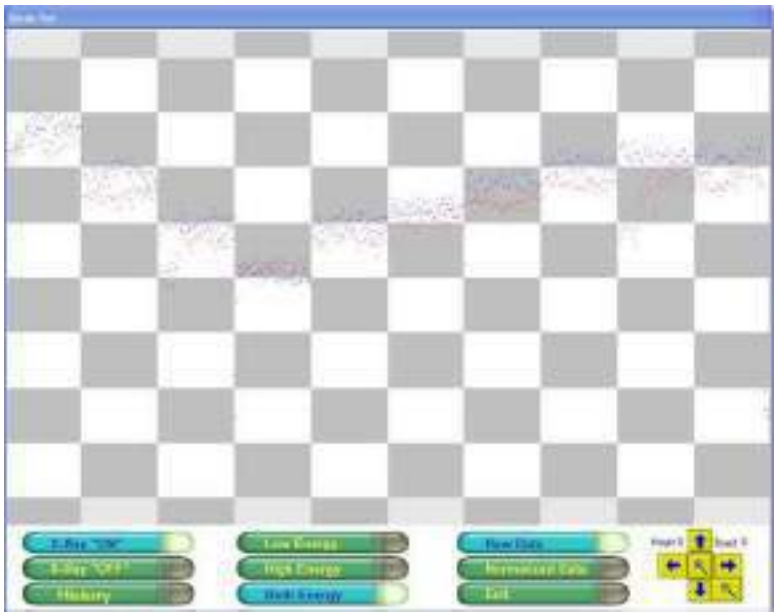

Figure 39: Diode Plot, X-ray on, History Off

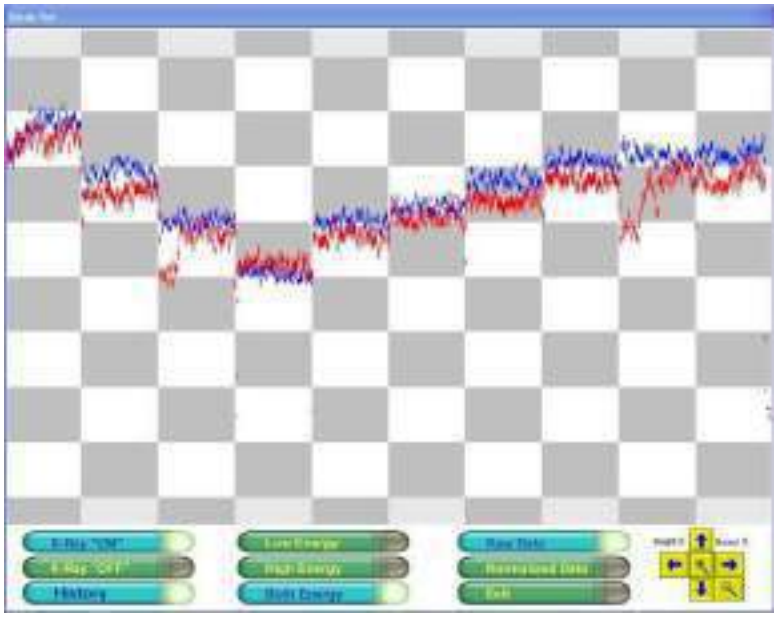

Figure 40: Diode Plot with History

Instead of displaying X-ray images, the Diode Plot Program (DPP) displays a graph of blue and red dots. The red dots represents output from the “high-energy” (i.e. high frequency spectra output) X-ray detectors and the blue dots represents the output from the “low-energy” detector X-ray detectors. The Y-AXIS of the graph represents signal strength. The detectors are mounted on circuit boards. Each board has 64 diode sets. Each set consists of a “stacked” high energy and low energy diode set. The high energy diode is physically on top of the low energy diode. On the graph, each diode set displayed as a set of one red and one blue dot. The high energy, red dot, is shown next to (i.e. higher than) its corresponding low energy diode, blue dot.

The XIS1818, for example, has 20 boards with 64 high/low energy diode sets (20 x 128=2560 total diodes). The DPP is a powerful diagnostic tool. With it you can inspect and rapidly verify that:

- The X-ray generator is properly working.
- If the X-ray generator is properly working, that indicates that the X-ray machine is properly powered, the DC power supplies are working, the PLC is working properly, the X-ray controller is working properly, the X-ray tube is powered and working, and that the X-ray generator is powered and ON.
- It also indirectly indicates that the X-ray tube oil cooler is powered and properly working.
- It also indirectly indicates that all Emergency Stop switches are “clear” and that all safety inter-lock switches are closed (i.e. all panels are closed and fastened).
- All 20 LXDA boards are working.
- If they are all working, that indicates that all necessary +5, -5, & +12VDC power supplies are properly working, connected and powered up.
- This also indirectly indicates that the computer is properly working and that the DAS (Data Acquisition System) is properly powered, connected, and working.
- All 20 LXDA boards are properly aligned.
- If they are aligned, vertical lines on the screen will appear as a contiguous, straight vertical line.
- All LXDA boards are not blocked and do not overlap.
- That all 20 LXDA boards are generating proper output.
- If they are generating proper output, they DPP will display a characteristic graph that shows a “saddle” (low point) in the middle.

Diode Plot Program – Test Instructions

	Steps	Expected results	PASS?
1.	Start Diode Plot Program (DPP)	The DPP starts up.	
2.	Verify that the DPP started correctly.	The DPP Screen shows the proper format with 20 vertical columns.	
	Inspect the Diode Plot Graph (DPG) with X-rays OFF	The DPG display a characteristic blue-red dot spread (not perfectly linear) at 0.	
	Turn the X-rays ON.	The DPG rises up in steps and stays up. (i.e. it does not rise up and drop down immediately.)	
	Inspect the DPG.	The DPG displays a characteristic blue-red dot spread. The red dots are typically above the blue dots. The dots do NOT show signal saturation. (they do not cluster at the top)	

Diagnostics Screen

The Diagnostics Screen is a diagnostics tool available on your PC monitor, via the AOCP.

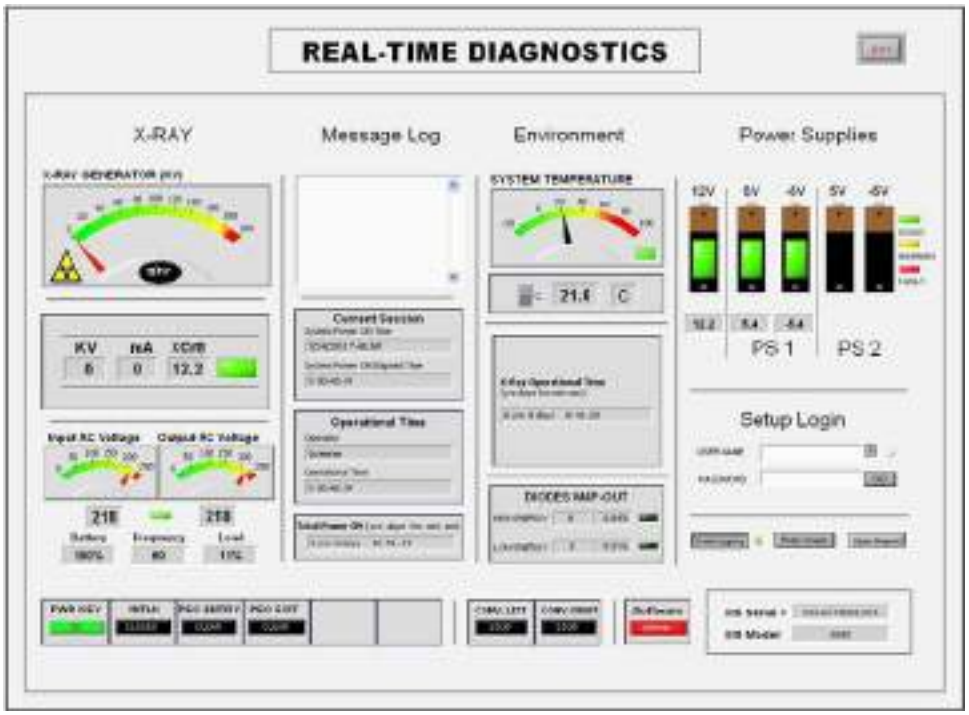

Figure 41: Diagnostics Screen

To access this screen:

- Press the [DIAG] button to activate and display the Real-Time Diagnostic Screen.
- Press the [DIAG] button again to return to the regular X-ray imaging screen.

Error Log – Error Message List

The list below itemizes the various types of error messages that may be displayed in the Diagnostic Screen's ERROR LOG. For a full list of X-ray generator error codes, refer to the Gulmay CP 12 Bit RS232 PCB Version 5.0 Technical Manual.

	ERROR LOG MESSAGE	COMMENTS & DISCUSSION
1	X-RAY Generator's/Controller's malfunction. (KV/mA is under min or over max)	DESCRIPTION X-ray generator has malfunctioned and NO X-rays are being produced. XIS may show a "scrolling" black screen. RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
2	System 12VDC Power Supply's malfunction.	DESCRIPTION The 12VDC power supply has failed. The key-switch, warning lights, and DAS board will fail to operate. The XIS will not display proper X-ray images. RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
3	+5VDC PS1's malfunction.	DESCRIPTION The +5VDC power supply (first set) has failed. The X-ray detector assembly will fail to operate. The XIS will not display proper X-ray images RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.

	ERROR LOG MESSAGE	COMMENTS & DISCUSSION
4	-5VDC PS1's malfunction.	DESCRIPTION The -5VDC power supply (first set) has failed. The X-ray detector assembly will fail to operate. The XIS will not display x-proper ray images RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
5	+5VDC PS2's malfunction.	DESCRIPTION The -5VDC power supply (second set) has failed. The X-ray detector assembly will fail to operate. The XIS will not display x-proper ray images RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
6	-5VDC PS2's malfunction.	DESCRIPTION The -5VDC power supply is not operational. The X-ray detector assembly will fail to operate. The XIS will not display X-ray images RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
7	No System malfunction has been detected.	DESCRIPTION The XIS is operating normally. RECOMMENDATION Continue using XIS.

Diode Plot Program – Test Instructions

	Steps	Expected results	PASS?
1.	Start Diode Plot Program (DPP)	The DPP starts up.	
2.	Verify that the DPP started correctly.	The DPP Screen shows the proper format with 20 vertical columns.	
	Inspect the Diode Plot Graph (DPG) with X-rays OFF	The DPG display a characteristic blue-red dot spread (not perfectly linear) at 0.	
	Turn the X-rays ON.	The DPG rises up in steps and stays up. (i.e. it does not rise up and drop down immediately.)	
	Inspect the DPG.	The DPG displays a characteristic blue-red dot spread. The red dots are typically above the blue dots. The dots do NOT show signal saturation. (they do not cluster at the top)	

Table of Diagnostic Screen Display Fields

Real-Time Diagnostic Field	Comments
X-ray Tube kV Setting	Displays X-ray tube kV setting (anode potential)
kV & mA OK Indicator	Displays kV & mA feedback OK indicator
X-ray Tube kV Output (digital display)	Displays X-ray tube kV (feedback output)
X-ray ON/OFF Indicator	Displays X-ray ON status. Green indicates that X-ray generator is powered and producing X-rays.
X-ray Tube kV Output (analog meter display)	Displays X-ray tube cathode mA (feedback) output
X-ray Tube mA Setting	Displays X-ray tube cathode mA setting in milliamperes
Error Message Log	Displays Error Message Log
C & F Toggle	Centigrade / Fahrenheit indicator C = Centigrade temperature display F = Fahrenheit temperature display
Temperature (digital display)	Displays internal frame temperature with digital display
Temperature (analog meter display)	Displays internal frame temperature with analog (meter) display
C / F (Centigrade / Fahrenheit indicator)	Displays Centigrade / Fahrenheit indicator. “C” indicates centigrade. “F” indicates Fahrenheit.
+24VDC Power Supply Status	Displays +12VDC power supply #1 output status Green = Good Yellow = Warning Red = Fault

Real-Time Diagnostic Field	Comments
+5VDC Power Supply #1 Status	Displays +5VDC power supply #1 output status Green = Good Yellow = Warning Red = Fault
-5VDC Power Supply #1 Status	Displays -5VDC power supply #1 output status Green = Good Yellow = Warning Red = Fault
+5VDC Power Supply #1 Output Voltage	Displays +5VDC power supply #1 output voltage. Output should be within +/- 10% of +5V.
-5VDC Power Supply #1 Output Voltage	Displays -5VDC power supply #1 output voltage. Output should be within +/- 10% of +5V.
24VDC Power Supply #1 Output Voltage	Displays 24VDC power supply #1 output voltage. Output should be within +/- 10% of +5V.
Username Entry	Username login entry field for access to diagnostic report and sub-graph menu
Password Entry	Password entry field for access to diagnostic report and graph sub-menu
Display Report Sub-Menu (button)	Display Report Sub-menu (after successful display)
Display Graph Sub-Menu (button)	Display Graph Sub-menu (after successful display)
Conveyor Right Direction	Green = Conveyor motor is on and moving right (i.e. from left to right)
Conveyor Left Direction	Green = Conveyor motor is energized and moving left (i.e. from right to left)
PEC Photocell Detect	Displays all photocell (photo-sensor) status. Green = Exit photo-cell is “triggered”, indicating bag is exiting inspection tunnel.
Key-switch ON/OFF Status	Displays AOCP (Operator Console) key-switch status Green = key-switch is ON position.

Error Log – Error Message List

The list below itemizes the various types of error messages that may be displayed in the Diagnostic Screen's ERROR LOG. For a full list of X-ray generator error codes, refer to the Gulmay CP 12 Bit RS232 PCB Version 5.0 Technical Manual.

	ERROR LOG MESSAGE	COMMENTS & DISCUSSION
1	X-RAY Generator's/Controller's malfunction. (KV/mA is under min or over max)	DESCRIPTION X-ray generator has malfunctioned and NO X-rays are being produced. XIS may show a "scrolling" black screen. RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
2	System 12VDC Power Supply's malfunction.	DESCRIPTION The 12VDC power supply has failed. The key-switch, warning lights, and DAS board will fail to operate. The XIS will not display proper X-ray images. RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
3	+5VDC PS1's malfunction.	DESCRIPTION The +5VDC power supply (first set) has failed. The X-ray detector assembly will fail to operate. The XIS will not display proper X-ray images RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.

	ERROR LOG MESSAGE	COMMENTS & DISCUSSION
4	-5VDC PS1's malfunction.	DESCRIPTION The -5VDC power supply (first set) has failed. The X-ray detector assembly will fail to operate. The XIS will not display x-proper ray images RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
5	+5VDC PS2's malfunction.	DESCRIPTION The -5VDC power supply (second set) has failed. The X-ray detector assembly will fail to operate. The XIS will not display x-proper ray images RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
6	-5VDC PS2's malfunction.	DESCRIPTION The -5VDC power supply is not operational. The X-ray detector assembly will fail to operate. The XIS will not display X-ray images RECOMMENDATION Contact Customer Support for assistance. Report error message. Request assistance.
7	No System malfunction has been detected.	DESCRIPTION The XIS is operating normally. RECOMMENDATION Continue using XIS.

Bypassing the PLC During Diagnostics

The proprietary Astrophysics diagnostic software access the X-ray generator via the PLC, sending startup, stop and diagnostic signals to and from the generator through the PLC. If, however, the problem with the unit is with the PLC itself, the maintenance engineer will not be able to receive signals from the generator. In this case it is possible to bypass the PLC when accessing the generator, with the use or third party software loaded onto every XIS 320kV machine.

This third party diagnostics software is called Gulmay Panel.exe. If you are running Gulmay Generator Control software, you must exit the program before starting Panel.exe.

1. Click on the GulmayGeneratorControl.vi shortcut.

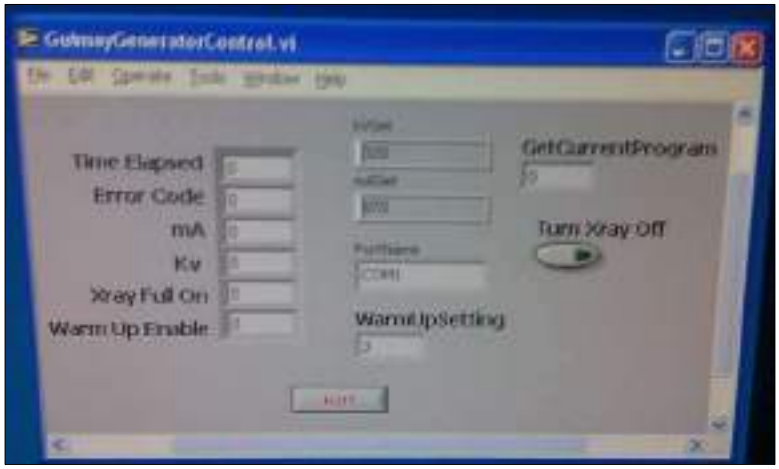

Figure 42: GulmayGeneratorControl.vi Screen

2. Click [Exit].
3. Open the Windows START menu.

Figure 43: START Menu Shortcut to Panel.exe

4. Select “Shortcut to Panel.exe” which brings up the Panel.exe main screen.

Figure 44: Main Screen

If you get a full kV and mA reading on the Panel.exe main screen but were unable to get any readings from the Astrophysics diagnostics screen, this is a clear indication that the problem lies with the PLC itself.

Belt Tension, Tracking and Replacement

The conveyor belt on an XIS security X-ray machine travels through the conveyor assembly, over a series of rollers (see Figure 45 as an example of a typical conveyor assembly).

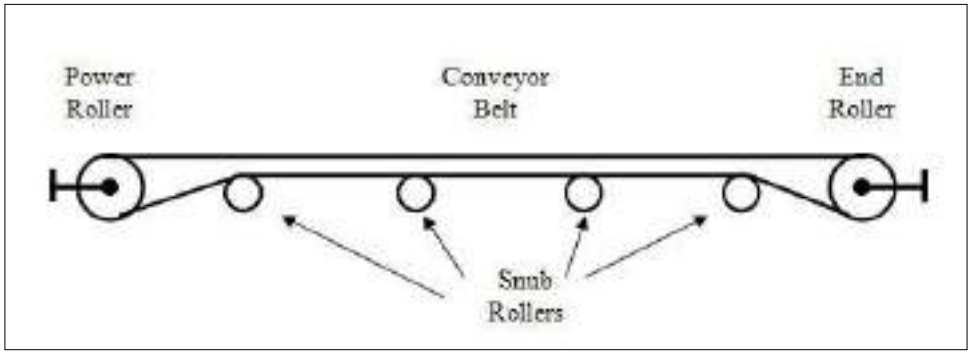

Figure 45: Conveyor belt tension adjustment

The belt is driven by a “Power Roller” on one end, and is guided by an “End Roller” on the other end of the conveyor belt and by a series of snub rollers in between.

Tension is applied to the conveyor belt by adjusting bolts on either side of the entry and exit conveyor ends. The bolts move the entry conveyor power roller in or out, thus decreasing or increasing tension on the belt. Moving the “End Roller” in or out also decreases or increases tension on the conveyor belt. The tension on both sides of the exit and entry conveyor rollers should be adjusted equally. If tension is applied only on one side, the belt will lose tracking, which means it will veer to one side or the other of the conveyor assembly.

If a belt is too loose, the belt may slip when items are placed on the conveyor. It is difficult to over tighten the belt, but setting the tension too high could result in premature failure of the conveyor rollers, particularly the power roller.

When adjusting conveyor belt tension, it is important to maintain proper belt tracking. If the belt is tracking properly, the belt will stay in the center of the rollers while the conveyor is running. If the belt is not tracking properly, the belt will move to the edge of the rollers while the conveyor is running.

Tools required:

- Duct Tape
- Razor Blade
- Phillips Screwdriver
- Crescent Wrench
- Socket Wrench

Types of Conveyor Brackets

There are three main styles of conveyor/bracket, as shown in the three following figures.

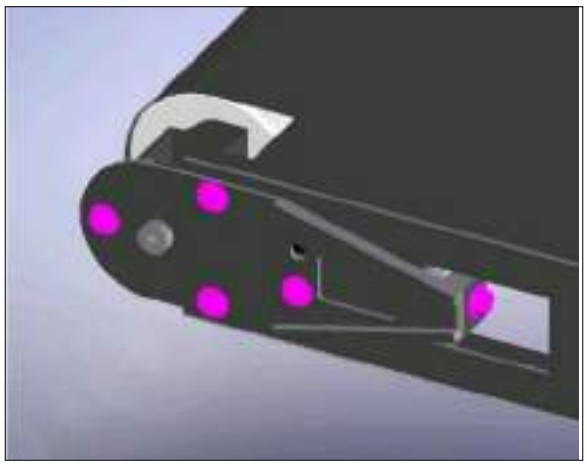

Figure 46: Conveyor Bracket Style 1

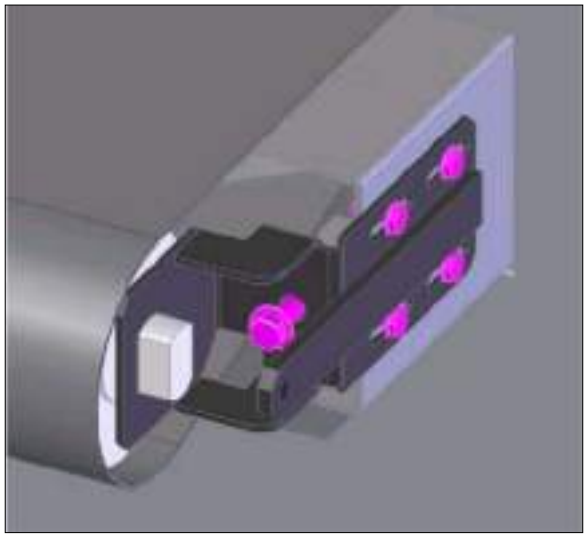

Figure 47: Conveyor Bracket Style 2

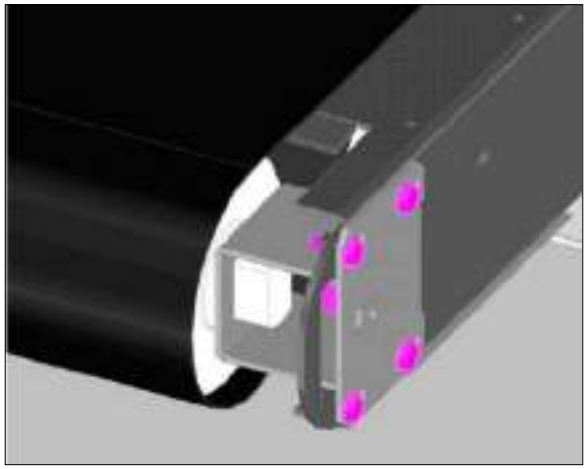

Figure 48: Conveyor Bracket Style 3

Removing a Conveyor Belt

1. Turn the control panel key to the “OFF” (vertical) position.
2. Unplug the power cord for the XIS unit.
3. Remove the two side covers on one end of the conveyor, and relieve the belt tension (See “Adjusting Conveyor Belt Tension” below).
4. If the old belt is a laced-style belt, remove the nylon wire to open it up. If the old belt is a continuous-style belt, carefully cut the belt laterally with a razor blade. In either case, do not remove the old belt from the machine at this time, because you will need it to help you pull the new belt into place.
5. Unfold the replacement belt (laced-style belt only).
6. Tape one open end of the new belt to one open end of the old belt. Make sure it is taped very securely because it will be pulled through the machine.
7. Slowly pull the other end of the old belt (the end not taped to the new belt) in order to thread the new belt through the conveyor system / rollers.
8. Once the new belt has gone all the way through the conveyor and rollers, locate the nylon wire which is located on one end of the new belt, and pull it out.
9. Connect both ends the new belt and insert nylon wire in between lace holes.

Once the belt has been replaced, it will be necessary to adjust tension and tracking. The type of bracket used on the machine you’re working on will determine the procedure for adjusting conveyor belt tension and tracking.

Adjusting Conveyor Belt Tension

In order to adjust the belt tension on a conveyor assembly, make sure the conveyor bracket mounting bolts on the non-motor end of the conveyor remain fixed in position -- you will adjust the bracket bolts only on the non-motorized end of the conveyor. See Figure 49 in which the Observer is standing at the non-motorized, “Variable” end of the conveyor assembly.

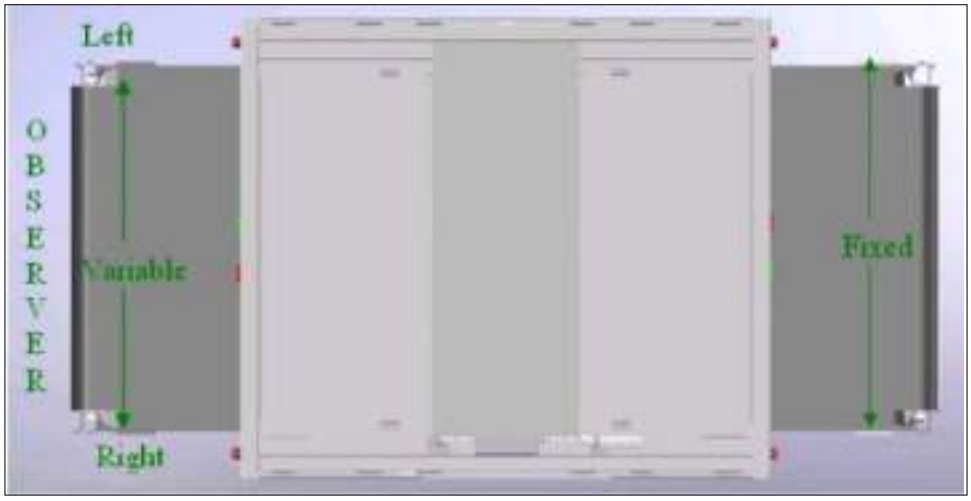

Figure 49: Beginning Position

Measuring Belt Tension

To measure the tension of the conveyor belt, stop the belt. When the belt has stopped completely, lift the belt straight up, as high as you can from the conveyor bed. The distance between the roller bed and the belt at its greatest height as you hold it up, should not exceed two inches (not enough tension) and it should not be less than 0.5 inches (too much tension).

Reference Distance

Figure 50 shows a conveyor assembly with a Type 1 bracket. The distance between the edge of the conveyor and the edge of the bracket (as shown in the figure) is known as the "***Reference Distance***." We use the Reference Distance to determine the optimum tension of the conveyor belt.

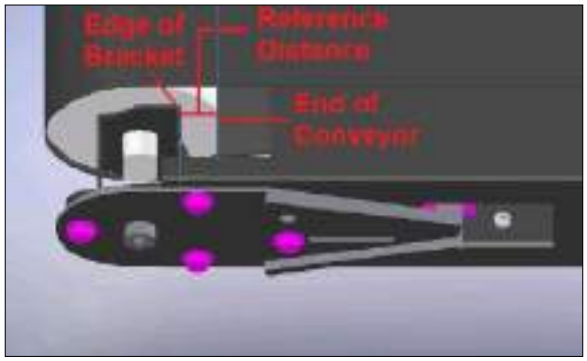

Figure 50: Reference Distance

Style 1 Conveyor Bracket

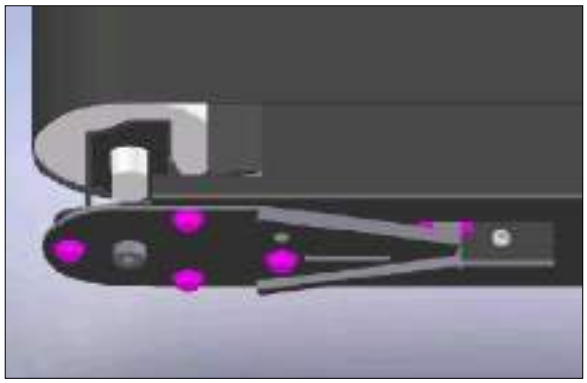

Figure 51: Style 1 Conveyor / Bracket

1. Turn the control panel key to the “OFF” (vertical) position.
2. Unplug the power cord for the XIS unit.
3. Remove any roller tables or slides attached to the entry or exit end of the conveyor.
4. Remove the “Power and End Roller” conveyor covers.
5. Loosen the mounting bolts on the conveyor bracket and move the bracket so that the Reference Distance is between 0.6in and 1.0in, measured from the edge of the conveyor to the edge of the bracket as shown in Figure 50.
6. Once the desired Reference Distance is achieved, tighten the mounting bolts.

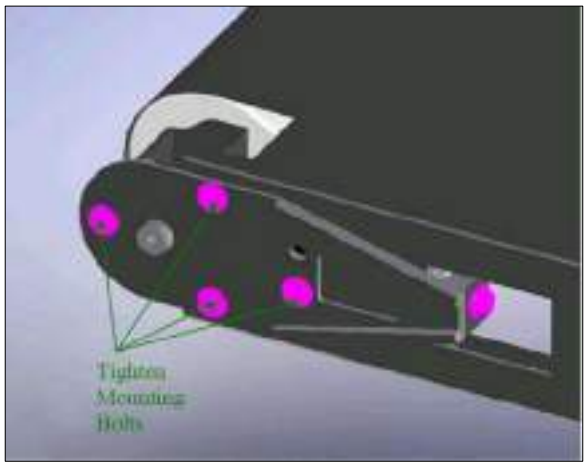

Figure 52: Tighten Mounting Bolts

7. Repeat for the other side of the conveyor assembly (ensuring that the Reference Distance is the same on both sides).
8. Once the desired Reference Distance is achieved on both sides, tighten the mounting bolts of both conveyor brackets.
9. Once all the mounting bolts have been tightened, turn the Key-switch to “On” and operate the machine so that the upper side of the belt moves towards you. The belt will experience one of three possible displacements. The three possible displacements are:

a. The lateral displacement to the right of the conveyor.
b. The lateral displacement to the left of the conveyor.
c. Stable.

Thus, in order to achieve belt alignment, it is necessary to perform the following iterative procedure:

1. Determine the displacement of the belt (right or left), and apply the appropriate solution (descriptions of the solutions are described below).
2. After correction, run the conveyor for approximately 10 minutes, to determine if the displacement still occurs.
3. If the displacement recurs or shifts to the other side, repeat step 1 and 2. If the displacement does not reoccur, operate the conveyor for about 2 hours to confirm stability of the belt.

Lateral Belt Displacement to the Right of the Conveyor

In the event of lateral belt displacement to the right, the observer will notice the following displacement when the machine is operated over time:

Figure 53: Belt Displacement to the Right

The solution to right-sided displacement is either:

- Rotate the left-side Tension/Tracking bolt counterclockwise, OR:
- Rotate the right-side bolt clockwise.

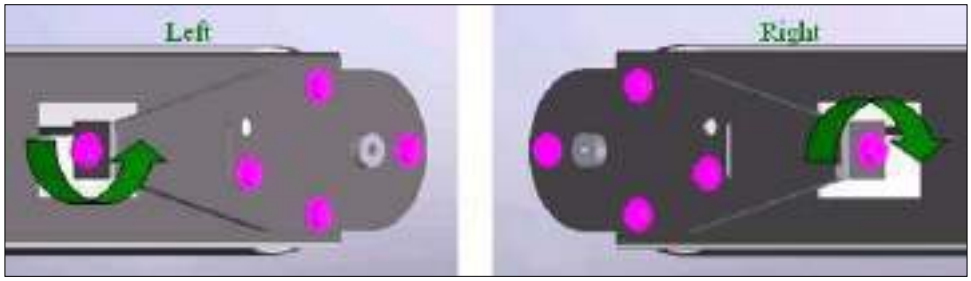

Figure 54: Left Bolt Counterclockwise, Right Bolt Clockwise

In both cases, turn the Tension/Tracking bolt approximately a quarter of a turn.

NOTE: Turning either bolt excessively may cause an increase or decrease in tension on the bracket and possible misalignment of the belt.

Lateral Belt Displacement to the Left

In the event of lateral belt displacement to the left, the observer will notice the following displacement when the machine is operated over time:

Figure 55: Displacement to the Right

The solution to right-sided displacement is either:

- Rotate the left-side Tension/Tracking bolt clockwise, OR:
- Rotate the right-side bolt counterclockwise.

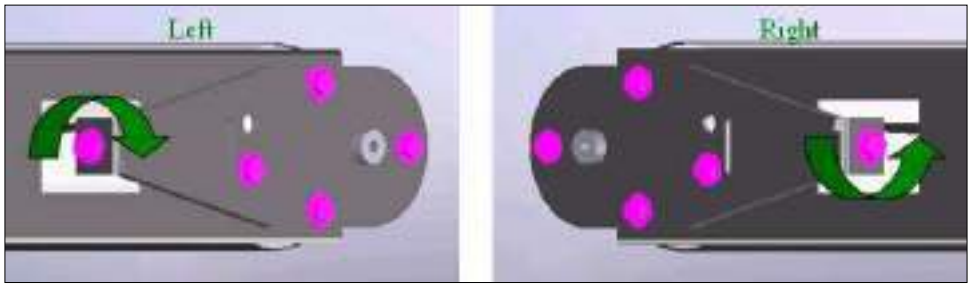

Figure 56: Left Bolt Clockwise, Right Bolt Counterclockwise

In both cases, turn the Tension/Tracking bolt approximately a quarter of a turn.

NOTE: Turning either bolt excessively may cause an increase or decrease in tension on the bracket and possible misalignment of the belt.

Stable

When stability has been achieved, the observer will notice the following lack of displacement when the machine is operated over time:

Figure 57: Stable Conveyor Belt

Once stability has been achieved, tighten the bracket bolts and confirm stability by running the conveyor for at least two hours.

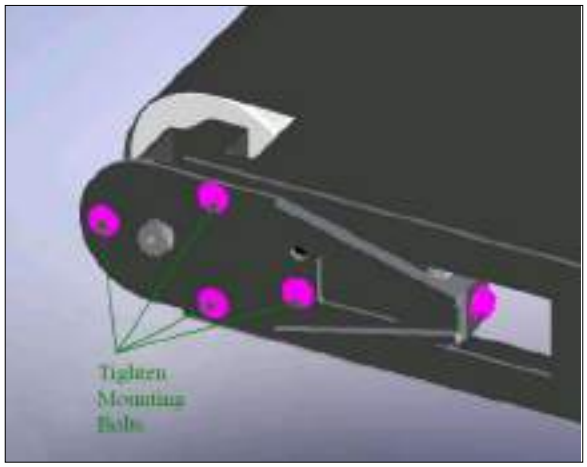

Figure 58: Tighten Mounting Bolts

Style 2 Conveyor Bracket

Figure 59 shows a conveyor assembly with a Type 2 bracket.

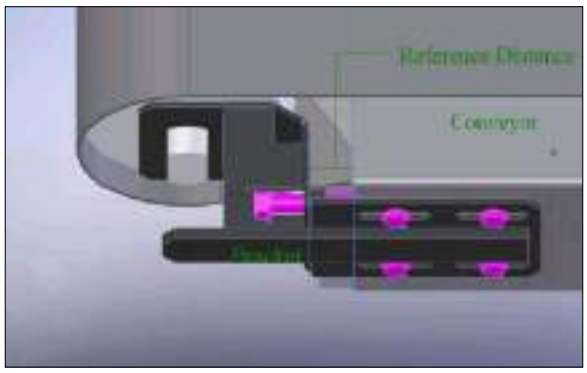

Figure 59: Style 2 Bracket Reference Distance

1. Turn the control panel key to the “OFF” (vertical) position.
2. Unplug the power cord for the XIS unit.
3. Remove any roller tables or slides attached to the entry or exit end of the conveyor.
4. Remove the “Power and End Roller” conveyor covers.
5. Loosen the mounting bolts on the conveyor bracket and move the bracket so that the Reference Distance is between 0.6in and 1.0in, measured from the edge of the conveyor to the edge of the bracket as shown in Figure 50.
6. Once the desired Reference Distance is achieved, tighten the mounting bolts.

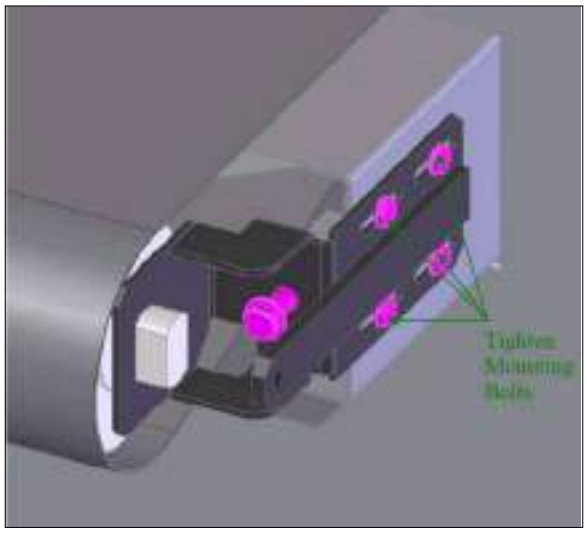

Figure 60: Style 2 Mounting Bolts

7. Repeat for the other side of the conveyor assembly (ensuring that the Reference Distance on both sides is the same).
8. Once the desired Reference Distance is achieved, tighten all the mounting bolts of the conveyor brackets.

9. Once all the mounting bolts have been tightened, turn the Key-switch to “On” and operate the machine so that the upper side of the belt moves towards you. The belt will experience one of three possible displacements. The three possible displacements are:
    a. The lateral displacement to the right of the conveyor.
    b. The lateral displacement to the left of the conveyor.
    c. Stable.

Thus, in order to achieve belt alignment, it is necessary to perform the following iterative procedure:

1. Determine the displacement of the belt (right or left), and apply the appropriate solution (descriptions of the solutions are described below).
2. After correction, run the conveyor for approximately 10 minutes, to determine if the displacement still occurs.
3. If the displacement recurs or shifts to the other side, repeat step 1 and 2. If the displacement does not reoccur, operate the conveyor for about 2 hours to confirm stability of the belt.

Lateral Displacement to the Right of the Conveyor

In the event of lateral belt displacement to the right, the observer will notice the following displacement when the machine is operated over time:

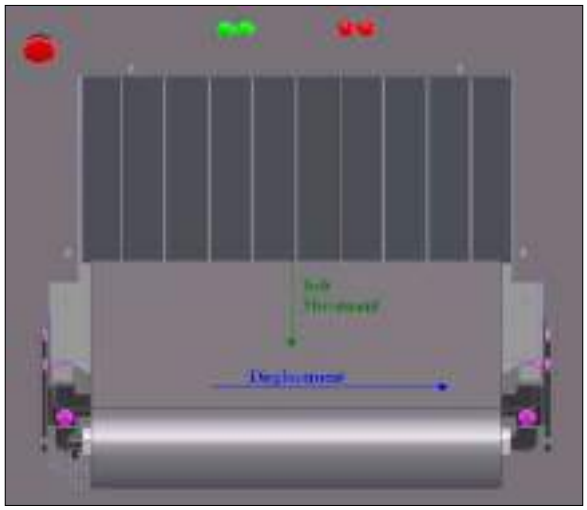

Figure 61: Belt Displacement to the Right

The solution to right-sided displacement is either:

- Rotate the left-side Tension/Tracking bolt counterclockwise, OR:
- Rotate the right-side bolt clockwise.

In both cases, turn the Tension/Tracking bolt approximately a quarter of a turn.

NOTE: Turning either bolt excessively may cause an increase or decrease in tension on the bracket and possible misalignment of the belt.

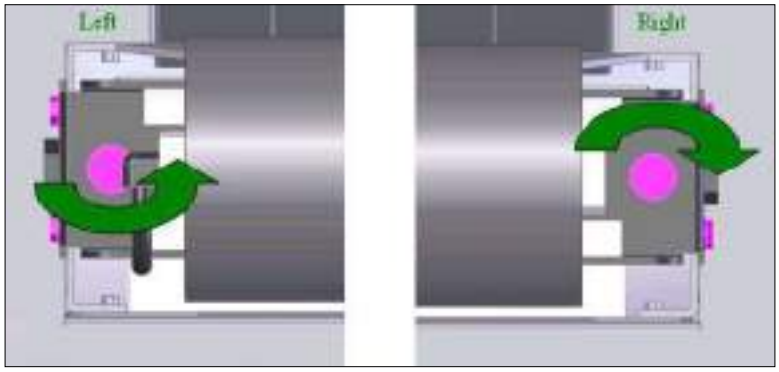

Figure 62: Left Bolt Counterclockwise, Right Bolt Clockwise

Lateral Displacement to the Left of the Conveyor

In the event of lateral belt displacement to the left, the observer will notice the following displacement when the machine is operated over time:

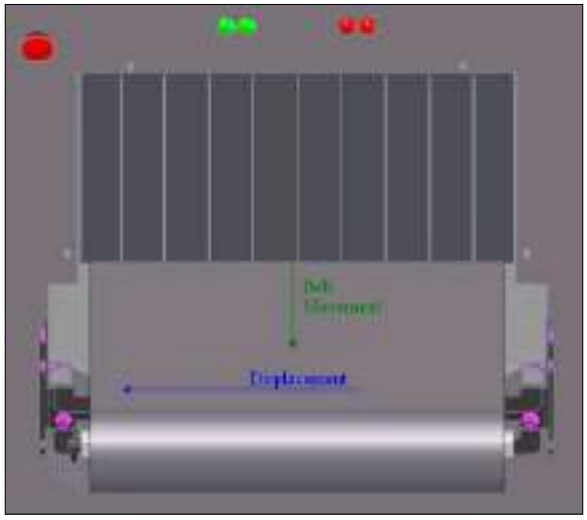

Figure 63: Displacement to the Left

The solution to left-sided displacement is either:

- Rotate the left-side Tension/Tracking bolt clockwise, OR:
- Rotate the right-side bolt counterclockwise.

In both cases, turn the Tension/Tracking bolt approximately a quarter of a turn.

NOTE: Turning either bolt excessively may cause an increase or decrease in tension on the bracket and possible misalignment of the belt.

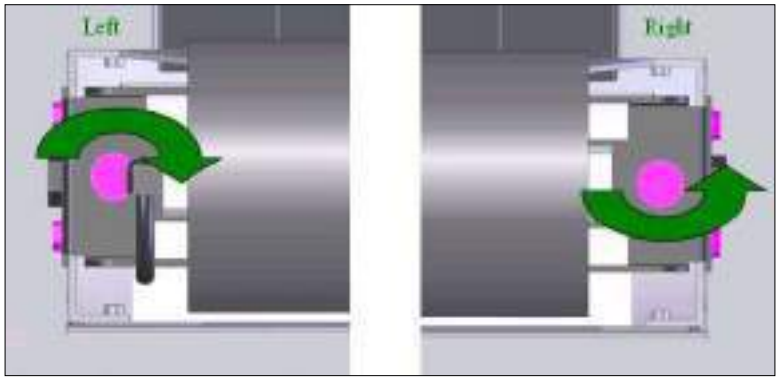

Figure 64: Left Bolt Clockwise, Right Bolt Counterclockwise

Stable

Once stability has been achieved, the observer will notice the following lack of displacement when operating the machine over time:

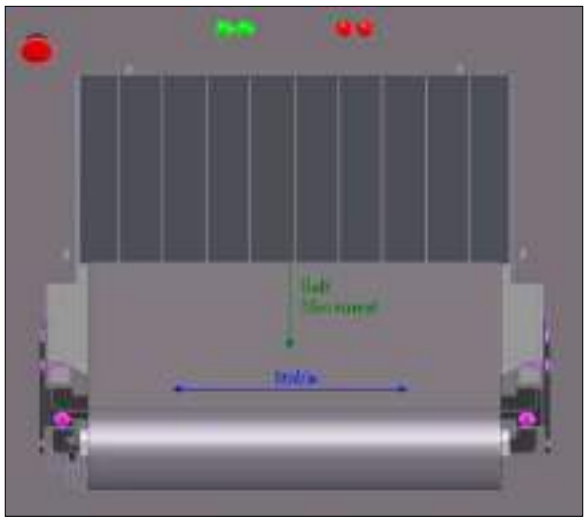

Figure 65: Stable

Once stability has been achieved, tighten the bracket bolts and confirm stability by running the conveyor for at least two hours.

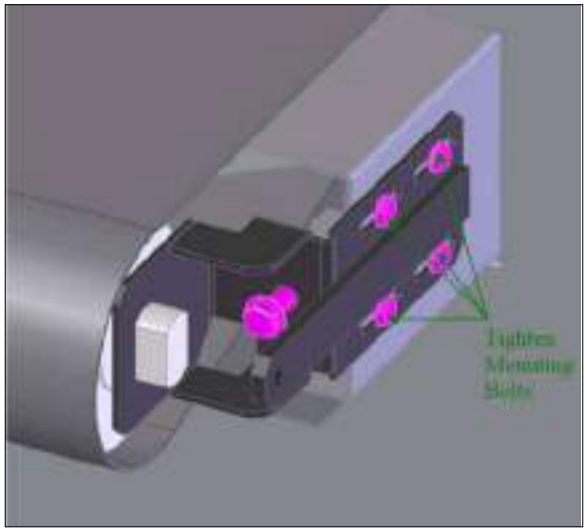

Figure 66: Tighten Mounting Bolts

Style 3 Conveyor Bracket

Figure 67 shows a conveyor assembly with a Type 3 bracket.

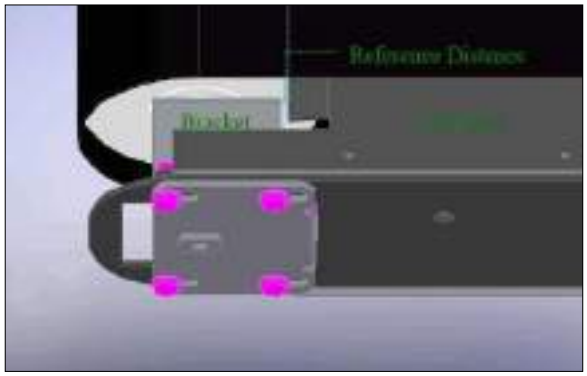

Figure 67: Style 3 Bracket Reference Distance

1. Turn the control panel key to the “OFF” (vertical) position.
2. Unplug the power cord for the XIS unit.
3. Remove any roller tables or slides attached to the entry or exit end of the conveyor.
4. Remove the “Power and End Roller” conveyor covers.
5. Loosen the mounting bolts on the conveyor bracket and move the bracket so that the Reference Distance is between 0.6in and 1.0in, measured from the edge of the conveyor to the edge of the bracket as shown in Figure 50.
6. Once the desired Reference Distance is achieved, tighten the mounting bolts.

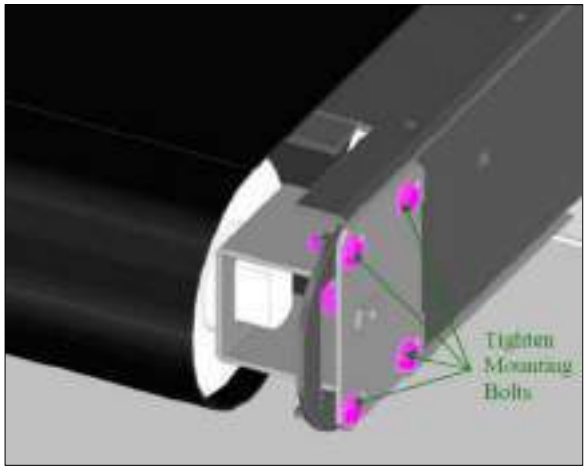

Figure 68: Style 3 Mounting Bolts

7. Repeat for the other side of the conveyor assembly (ensuring that the Reference Distance on both sides is the same).
8. Once the desired Reference Distance is achieved, tighten all the mounting bolts of the conveyor brackets.
9. Once all the mounting bolts have been tightened, turn the Key-switch to "On" and operate the machine so that the upper side of the belt moves towards you. The belt will experience one of three possible displacements. The three possible displacements are:
    a. The lateral displacement to the right of the conveyor.
    b. The lateral displacement to the left of the conveyor.
    c. Stable.

Thus, in order to achieve belt alignment, it is necessary to perform the following iterative procedure:

1. Determine the displacement of the belt (right or left), and apply the appropriate solution (descriptions of the solutions are described below).
2. After correction, run the conveyor for approximately 10 minutes, to determine if the displacement still occurs.
3. If the displacement recurs or shifts to the other side, repeat step 1 and 2. If the displacement does not reoccur, operate the conveyor for about 2 hours to confirm stability of the belt.

The Lateral Displacement to the Right of the Conveyor

In the event of lateral belt displacement to the right, the observer will notice the following displacement when the machine is operated over time:

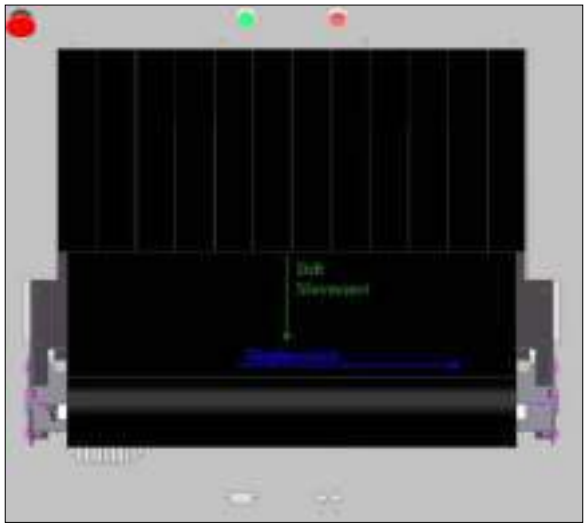

Figure 69: Belt Displacement to the Right

The solution to right-sided displacement is either:

- Rotate the left-side Tension/Tracking bolt counterclockwise, OR:
- Rotate the right-side bolt clockwise.

In both cases, turn the Tension/Tracking bolt approximately a quarter of a turn.

Turning either bolt excessively may cause an increase or decrease in tension on the bracket and possible misalignment of the belt.

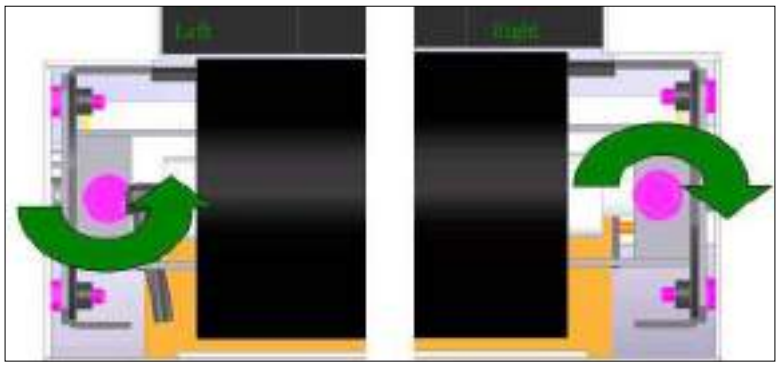

Figure 70: Left Bolt Counterclockwise, Right Bolt Clockwise

Lateral Displacement to the Left of the Conveyor

In the event of lateral belt displacement to the left, the observer will notice the following displacement when the machine is operated over time:

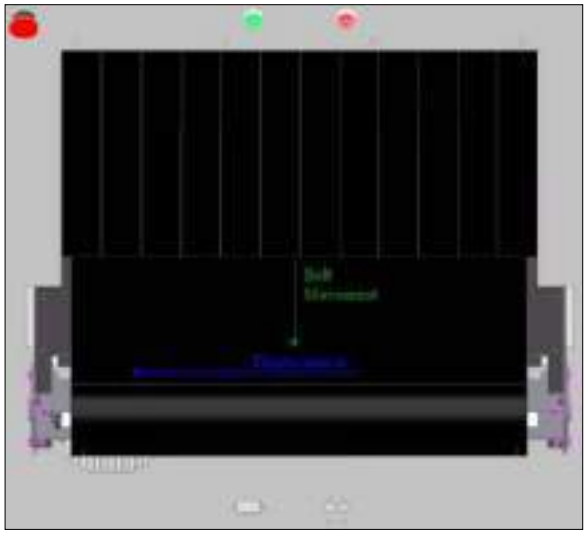

Figure 71: Displacement to the Left

The solution to left-sided displacement is either:

- Rotate the left-side Tension/Tracking bolt clockwise, OR:
- Rotate the right-side bolt counterclockwise.

In both cases, turn the Tension/Tracking bolt approximately a quarter of a turn.

Turning either bolt excessively may cause an increase or decrease in tension on the bracket and possible misalignment of the belt.

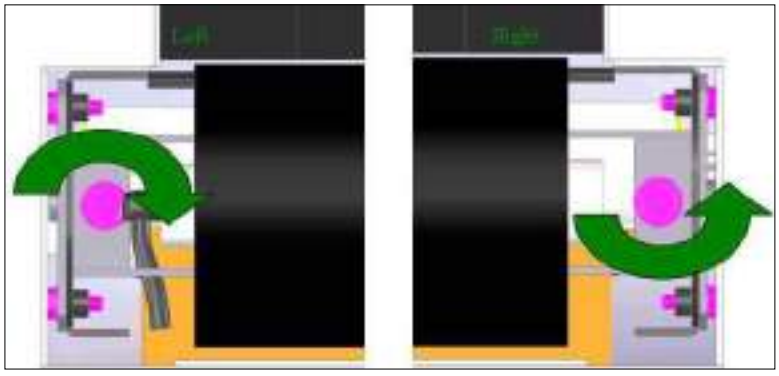

Figure 72: Left Bolt Clockwise, Right Bolt Counterclockwise

Stable

Once the conveyor belt has been stabilized, the observer will notice the following lack of displacement while operating the machine over time:

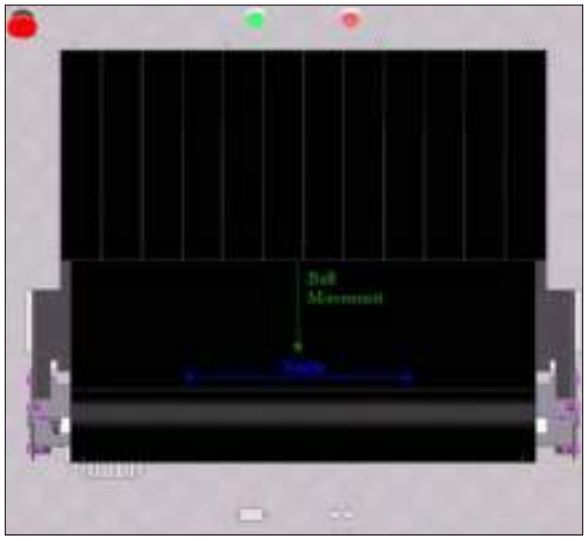

Figure 73: Stable

Once stability has been achieved, tighten the bracket bolts and confirm stability by running the conveyor for at least two hours.

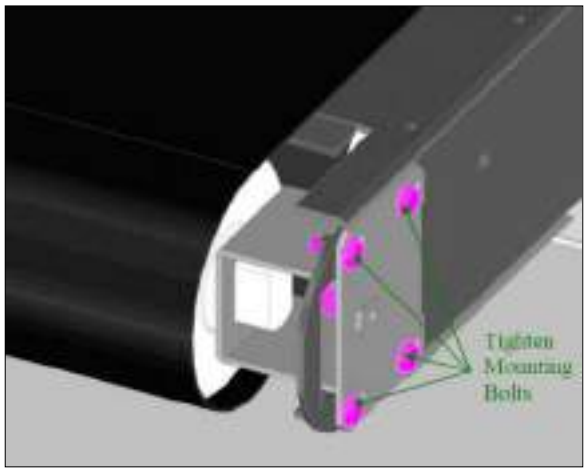

Figure 74: Tighten Mounting Bolts

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X-ray Collimation

WARNING!

Follow proper radiation and electrical safety safeguards while performing any inspection or maintenance procedure when the system is in the “powered" state

Collimation and Alignment: Definitions

Collimation involves widening or narrowing two collimation bars to widen or narrow the X-ray beam so that it falls on the correct area of LXDA boards on the side of the tunnel opposite the X-ray generator.

“Aligning” an XIS machine means moving either the entire collimation assembly to one side or another, or moving the LXDA boards to one side or another. This is done in order to ensure that the X-ray beam falls on the optimal area of the LXDA boards. This allows the XIS to create the optimal image of a scanned object.

Both the width (“gap”) and position (“position”) of the collimation bars on XIS machines are set and locked at the factory. In theory, then, there should be no need to adjust either of these in the field. It is possible that shipping may cause changes in these settings or in the rest of the machine that require adjustment of gap and/or position.

Most likely, however, the only alignment that will need to be made in the field is in the position of the LXDA boards (as opposed to adjusting the collimation bars). Again, the position of the LXDA boards is set at the factory, but if shipping or other factors have affected collimation (alignment of LXDA boards with the generator and collimator), then adjusting the position of LXDA boards will be the preferred method of re-collimating the XIS.

All three procedures (gap, position and LXDA board alignment) will be described below, even though LXDA board alignment will most likely be the only adjustment needed, and even then only if the shipping process has changed the collimation of the machine.

Purpose of Collimation

The objective of proper collimation is to improve the X-ray image. When all diode responses are similar to one another, the result is a smoother, more-defined image. The best results can only occur if there are no bad diodes and the crystals are accurately placed on the detector boards.

The best responses for both HE (high-energy) diodes and LE (low energy) diodes are to have the maximum HE value on the Diode Plot graph be about 3000 (the reason for this is explained below), with a minimum of 800 (if any individual board gets less than 800 on the x axis of the Diode Plot, that board should be replaced). There is no one setting that

will accomplish this for every machine, and therefore it is necessary to perform the following collimation procedures to ensure that every machine has the optimum HE and LE values for optimum scanning efficiency.

Adjusting Gap and Position

There are two collimator bars in every XIS machine (two sets of collimator bars in dual-view machines, one set for each of the two generators) that confine the X-ray beam to a narrow fan. The width of the gap between the two collimator bars (the “gap”) and the position (the “position”) of the collimator bar assembly can be adjusted (although again these are usually set and locked at the factory).

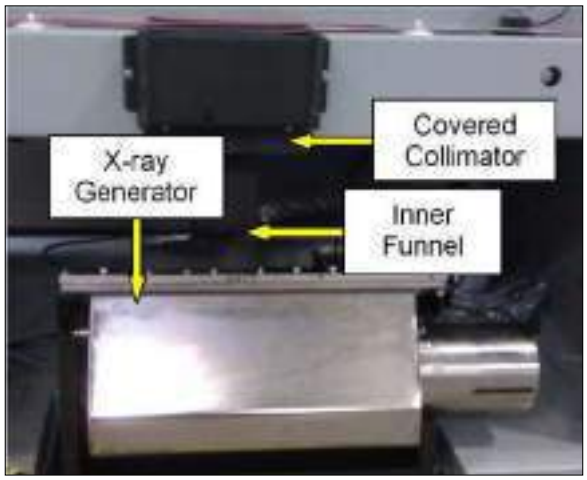

Figure 75: Generator, Inner Funnel, Collimator

The position adjustment screw is on the right side of the uncovered collimator as shown in Figure 76.

Figure 76: Collimator Bars and Gap Adjustment Screw

Turning the position adjustment screw either pushes the collimator assembly to the left, or pulls it to the right, until the perfect alignment between generator and LXDA boards is achieved. Use Diode Plot (page 69)) in conjunction with the position adjustment screw to determine when the optimal position has been achieved.

Figure 77: Adjusting Gap

Adjusting the gap increases or decreases the distance between two collimator bars. The gap is adjusted and fixed in place at the factory. In order to fix it properly, thin washers (about 0.7 mm thick) are placed on one side of the collimator to form a gap of 1.4 mm, and three washers with a gap of 2.1 mm are placed on the other side of the collimator. The gap is tightened and secured in order to contain the amount of X-ray that travels through the tunnel.

In order to make adjustments for the position of the collimator, the system monitor must display the diode array plot with the X-ray on. The following section describes the step-by-step collimation procedure.

Collimator Bar Adjustments

1. Begin by turning “ON” the XIS system. The XIS will boot up to the login screen. Insert your password and ID. See “XIS Startup / Shutdown Procedures” on page 47.
2. When "SYSTEM READY" appears at the bottom of the screen, press “Forward” for the motor to run in the forward direction, and a few seconds later press “STOP” for the motor to stop. At this time you can enter your commands for the Diode Plot (see “Diode Plot” on page 147).
3. Select “Menu” by pressing the appropriate button.
4. Select “Diode Plot” to view all the diodes. The plot is displayed on the left monitor.
5. Select “X-ray ON” to turn the X-ray generator ON and to view the Diode Plot with X-rays on.
6. Adjust the position adjustment screw, watching the Diode Plot graph. The values will rise to a certain point and then start to descend. As soon as the values begin to descend, back off until the values are again at their highest level.
7. Press “1” to turn X-rays “OFF.”
8. Press “9” to Exit.
9. Press “7” to Exit from the MENU program.
10. Press “FORWARD” to turn the belt in the forward position.
11. Place a test object on the belt, and determine if the signal is adequate. If not, repeat the steps under Collimator Bar Adjustments, or go on to LXDA Board Adjustment.

LXDA Board Adjustment

The collimation of the LXDA boards requires removal of the top or side panel (depending on whether it is a down-shooter or side shooter) from the machine, but it does NOT require removing the LXDA box cover. The LXDA box cover is leaded, and should always remain securely positioned on the LXDA boards before turning X-rays on and at all times while X-rays are on.

WARNING!

The LXDA cover should always be securely positioned on the LXDA before turning X-rays “ON,” and at all times while X-rays are on.

The adjustment screw for the LXDA boards is accessible from outside the LXDA, without having to remove the LXDA cover, as shown in Figure 78.

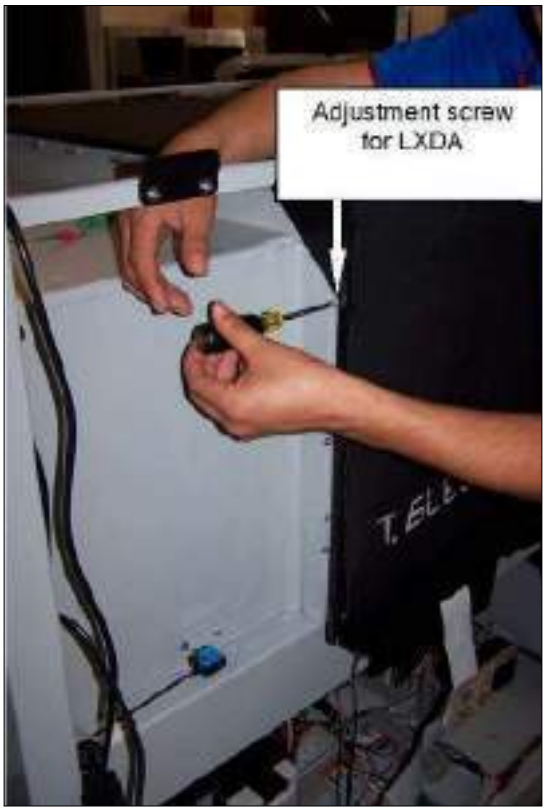

Figure 78: LXDA Board Adjustment Screw

1. Begin by turning “ON” the XIS system. The XIS will boot up to the login screen.
2. Insert your password and ID. See “XIS Startup / Shutdown Procedures” on page 47.
3. When "SYSTEM READY" appears at the bottom of the screen, press “Forward” for the motor to run in the forward direction, and a few seconds later press “STOP” for the motor to stop. At this time you can enter your commands for the Diode Plot.
4. Select “Menu” by pressing on the appropriate button.

5. Select “Diode Plot” to view all the diodes. The diode plot is displayed on the left monitor.
6. Select “X-ray ON” to turn on the X-ray generator, and to view the Diode Plot with X-rays ON.
7. Adjust each LXDA board position by turning the side screw to one side gradually as shown in Figure 78, watching the Diode Plot graph. The values of the diodes for this particular board will rise to a certain point and then start to descend. As soon as the values begin to descend, back off until the values are again at their highest level. Repeat the procedure for all the other boards until you achieve the highest HE and LE values on that Diode Plot graph.
8. Press “1” to turn X-ray “OFF”
9. Press “9” to Exit
10. Press “7” to Exit from the menu Program
11. Press “FORWARD” to turn the belt in the forward position. Place a test object and verify if the signal is adequate and the diodes are collimated.

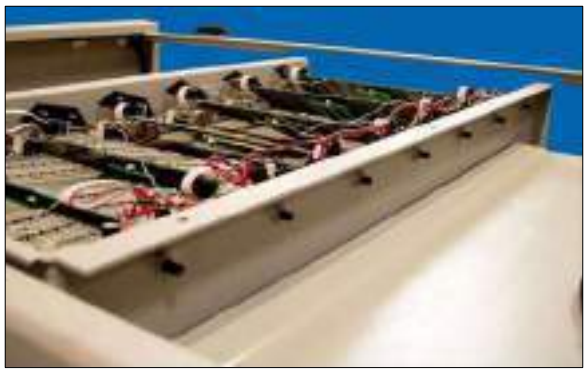

Figure 79: Collimation screws for individual LXDA Boards.

Removing and Replacing LXDA Boards

NOTE: When Removing LXDA boards due to bad diodes or bad boards, extra caution must be exercised in order to ensure that other components are not damaged during the process.

1. Determine which diode board needs replacement by studying the Diode Plot graph, noting where the line dips or spikes or has an overly large gap.
2. Turn X-rays “OFF.”
3. Open LXDA Cover and locate bad diode board. (Use gloves to handle LXDA boards)
4. Unscrew the bracket from one side, and gently remove the LXDA board.
5. Replace with a new LXDA board. Gently screw back the bracket. At this time the LXDA board must be collimated to give best image results.
6. Close LXDA cover and tighten all the screws.
7. Follow LXDA Board adjustment procedure.
8. Observe to see whether the problem has been resolved.

Bad Diode Elimination

This system of determining the locations and quantity of bad diodes is based on using a scanned X-ray image, the Windows Paint program and a Parameters Table (which is included in Figure 90.

The table includes parameters for each XIS model and a formula that includes an unknown, “y,” and two variables. An example is (y x 2) +2. In this example “y” is the unknown, while the 2s are the variables. This section shows you how to calculate the unknown “y” and the table gives you the two variables, allowing you to determine the location and number of bad diodes.

1. Log into the system.
2. Open the Runtime file.
    a. Exit the X-ray Client program.
    b. Right-mouse click on My Computer.
    c. Select Explore.

Figure 80:

    d. Open the “Local Disk (C).”
    e. Open the “Program Files” folder.
    f. Open the “Xray Client” folder.

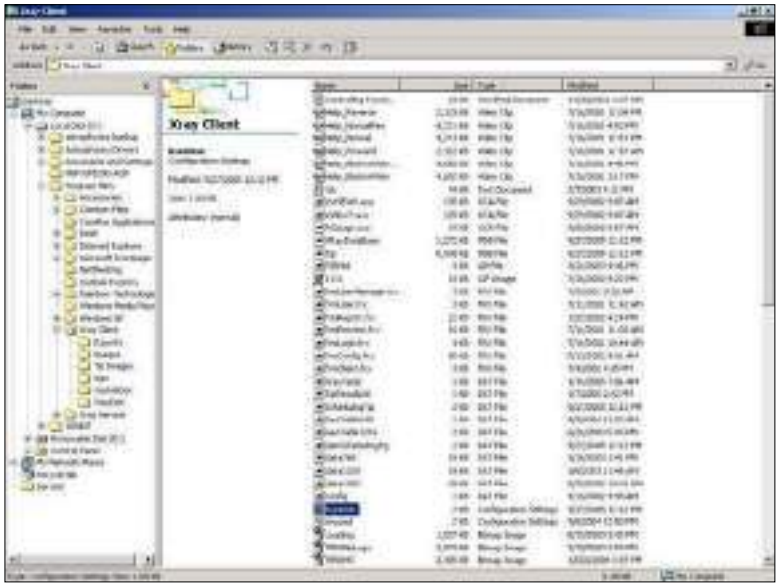

Figure 81: "Xray Client" folder

g. Scroll until you find Runtime file.

h. In order to avoid unintended modification of the Runtime file, before opening the file, save a copy of it ("runtime.ini") (located at C:\Program Files\Xray Client\runtime.ini) on the desktop or some convenient place. This will give you an unmodified version at the end of the procedure that you can use to make final changes to without having to undo all the following steps that are necessary to complete the procedure. You can also use this file in case you make a mistake at some point that you cannot easily identify and you need a fresh copy.

i. Open the active copy of "runtime.ini."

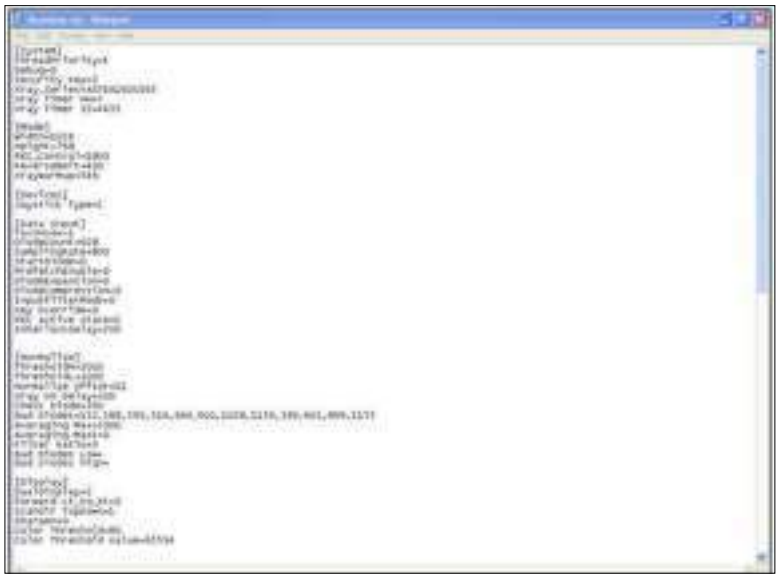

Figure 82: Runtime.ini

j. Modify the following settings in Runtime.ini:

i. Under the "[Mode]" header, change the "Width=" and "Height=" X-ray screen resolution parameter settings according to the values given in the "Bad Diode Elimination Reference Card" below (Figure 84):

1. NEW [Mode] "Width"
2. NEW [Mode] "Height"

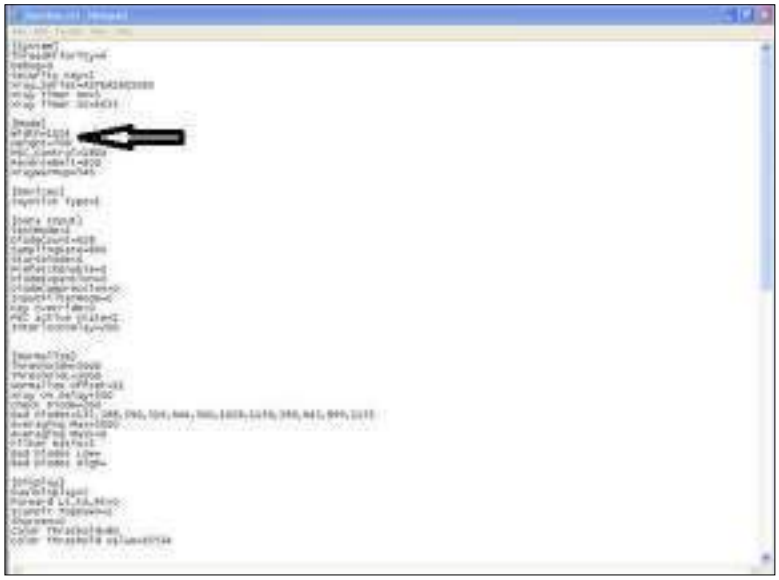

Figure 83: Width and Height X-ray Screen Resolution Parameter Settings

Figure 84: Bad Diode Elimination Reference Card

k. Ensure that the following two lines are set to zero:

i. Diode Expansion (located under [Data Input] heading)

ii. Averaging Mask (located under [Normalize] heading.

NOTE: Do not mistake “Averaging MAX” for “Averaging MASK.”

l. Press Ctrl + S to save file

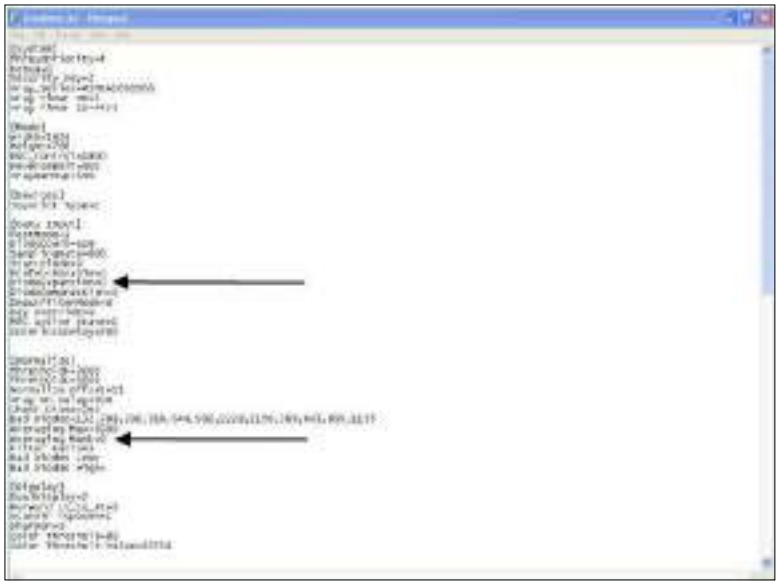

Figure 85: Diode Expansion and Averaging Mask

3. Identification of bad high energy diodes
    a. Pass an aluminum test sample through the XIS machine. (Make sure the sample is placed perpendicular to the conveyor belt.) During this pass the aluminum should be positioned so that its edge is nearly touching the generator side of the tunnel.
    b. Pass the aluminum sample thru the machine a second time. For the second pass the sample should be positioned so that its edge is nearly touching the opposite side of the tunnel.
    c. Change color setting to Pseudo Color and change intensity to +1 above normal for bad diodes in high energy. For bad diodes in low energy change intensity to -1 below normal. Note that in Pseudo Color there are several noticeable lines on the scanned images of the aluminum. These lines in the scanned images represent bad diodes.

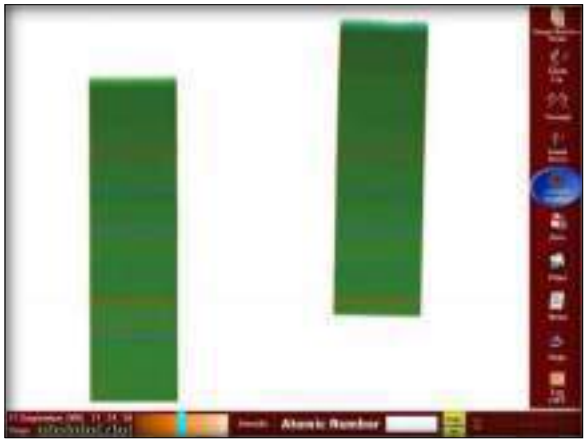

Figure 86: Scanned Image in Pseudo Color

d. Press the Print Screen key on your PC keyboard (just to the right of the F12 key) to save the scanned image.

e. Open the Paint Program.

   i. Click Start

   ii. Select Programs

   iii. Select Accessories

   iv. Click on Paint

Figure 87: Opening "Paint"

f. Press Ctrl + V to paste the scanned image into Paint.

g. Select the Pencil tool.

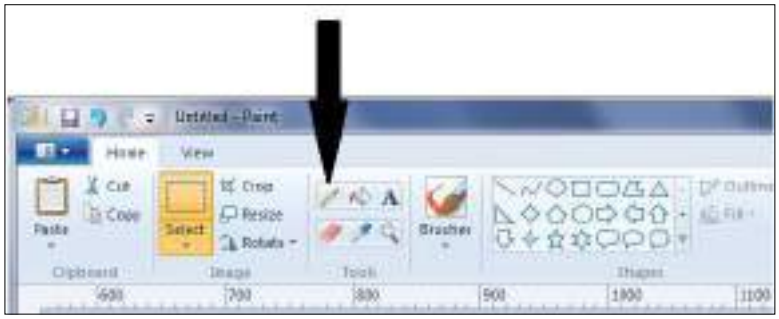

Figure 88: Pencil Tool in Windows Paint

h. Use the Pencil tool to touch each noticeable (bad diode) line on the aluminum, by placing the point of the Pencil tool on the line. Note that as you touch each line with the tip of the Pencil tool, the y-coordinate of each line shows up as the last three digits of a six-digit number in the lower left corner of the Paint screen (See Figure 89).

i. Read and record the y-coordinate of each line. These are the "y" unknowns from the formula we discussed at the beginning of this section.

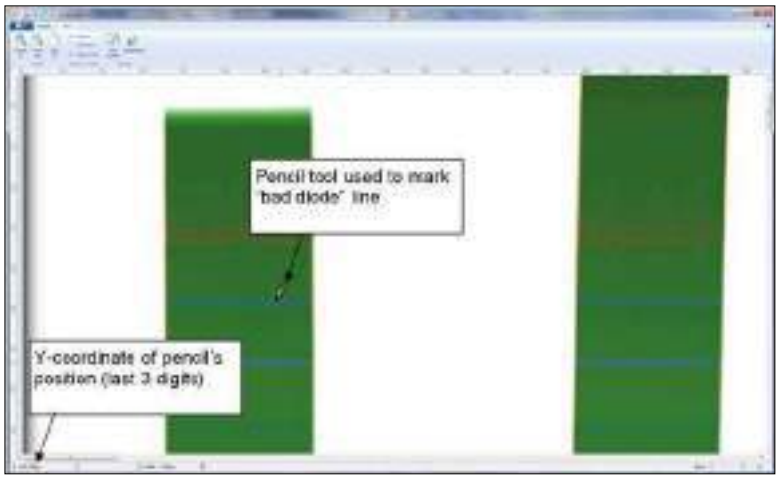

Figure 89: Identifying Lines on the Aluminum

j. After identifying and recording the Y-coordinates of all visible "bad diode" lines on the scanned image, perform the appropriate calculations from the Parameter Settings Table in Figure 90, based on the model being tested and whether it is a high or low energy test.

NOTE: The values in the following tables represent parameter settings for the configuration file *C:\Program Files\Xray Client\runtime.ini*. "NEW" values (Page 1 of 2) are the temporary values to be changed to and saved before starting the Bad Diode Elimination procedure. "ORIGINAL" values (Page 2 of 2) are the values to be restored to and saved after the procedure is completed. Before beginning, save a copy of the original *runtime.ini* file to simplify restoration back to the original settings when finished (with the exception of "Bad Diodes" which will be changed permanently). The calculated values for "Bad Diodes" are based on the *y*-coordinate of the screenshot bitmap files when opened in Microsoft Paint and using the pencil tool, per the Bad Diode Elimination procedure. They are to be listed as comma-delimited values, both high and low energy together on the same line in no required order, and spaces are not significant. Also note that the parameters "Bad Diodes Low" and "Bad Diodes High" in *runtime.ini* are not used.

XIS Model	NEW [Mode] "Width"	NEW [Mode] "Height"	NEW [Data Input] "DiodeCount"	NEW [Data Input] "StartDiode"	HIGH ENERGY [Normalize] "Bad Diodes"	LOW ENERGY [Normalize] "Bad Diodes"
5335	1024	768	512	0	= (y - 102) x 2	= [(y -102) x 2] - 1
5335S	1024	768	512	0	= (y - 102) x 2	= [(y -102) x 2] - 1
6040	1024	768	576	0	= (y - 70) x 2	= [(y -70) x 2] - 1
6545	1024	768	628	0	= (y - 44) x 2	'= (y - 44) x 2
6545DV Upshooter 1	1024	768	628	0	= (y - 44) x 2	'= (y - 44) x 2
6545DV Upshooter 2	1024	768	628	0	= (y - 44) x 2	'= (y - 44) x 2
5878	1024	768	784	30	= (y - 86) x 2	= [(y - 86) x 2] - 1
7858	1024	768	784	30	= (y - 86) x 2	= [(y - 86) x 2] - 1
1080	1600	1200	1088	0	= (y - 22) x 2	=[(y - 22) x 2] -1
1080D	1600	1200	1088	0	= (y - 22) x 2	=[(y - 22) x 2] -1
100X	1600	1200	1152	0	= (y x 2) + 2	= (y x 2) + 1

XIS Model	NEW [Mode] "Width"	NEW [Mode] "Height"	NEW [Data Input] "DiodeCount"	NEW [Data Input] "StartDiode"	HIGH ENERGY [Normalize] "Bad Diodes"	LOW ENERGY [Normalize] "Bad Diodes"
100XD	1600	1200	1152	0	= (y x 2) + 2	= (y x 2) + 1
100XDV Upshooter	1600	1200	1152	0	= (y x 2) + 2	= (y x 2) + 1
100XDV Sideshooter	1600	1200	1152	0	= (y x 2) + 2	= (y x 2) + 1
1210	1600	1200	1152	0	= (y x 2) + 2	= (y x 2) + 1
1210D	1600	1200	1152	0	= (y x 2) + 2	= (y x 2) + 1
1517	1600	1200	1088	0	= (y - 22) x 2	= (y - 22) x 2 - 1
1517DV Sideshooter	1600	1200	1088	0	= (y - 22) x 2	= (y - 22) x 2 - 1
1517DV Downshooter	1600	1200	1088	0	= (y - 22) x 2	= (y - 22) x 2 - 1
1818	1600	1200	1152	0	= (y x 2) + 2	= (y x 2) + 1
1819	TBD	TBD	TBD	TBD	TBD	TBD
2525	TBD	TBD	TBD	TBD	TBD	TBD

Figure 90: Parameter Settings for Configuration File

Refer to the formulas on the Parameter Settings table in Figure 90. As an example, let's say you used an XIS 6545 machine to obtain the scanned image you pasted into Paint. The Parameters table tells us that the formula for HE (High Energy) bad diodes on the 6545 is:

(y – 44) x 2

Let's take one of the y-axis values you obtained from the scanned image you pasted into Paint:

235

The correct calculation would thus be:

235 – 44 = 191

Then

191 x 2 = 382

Do the same calculation using the y-coordinates from each line on the scanned image you pasted into Paint. Record the results of all these calculations, and then go to Runtime.ini to do the final steps in this procedure:

1. Open the Runtime file. (Follow procedure outlined in this section)
2. Locate the Bad Diodes line (Located under the heading [Normalize])

Figure 91: Bad Diodes" Line in Runtime.ini

3. Type in all numbers previously calculated using Table 1 into this line. (Each number separated by a comma.)
4. Press Ctrl + S to save the Runtime file.
5. Enter the Xray Client program.

6. Scan the aluminum sample twice, exactly as before. Verify that the bad diode lines have been eliminated. Repeat if necessary.

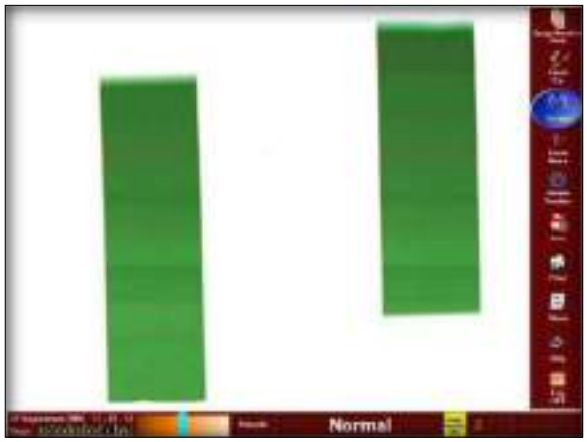

Figure 92: Bad Diode Lines Eliminated

Identification of bad low energy diodes

To identify bad Low Energy (LE) diodes, repeat the procedure with the following change:

1. After passing aluminum test sample twice and changing the color setting to Pseudo color, the intensity setting should be set to – 1 below normal.
2. Modify the Runtime file as follows:
    a. Open Runtime file as explained previously in this section.
    b. Change the Diode Expansion & Averaging Mask lines as follows:
        - Diode Expansion = 1
        - Averaging Mask = 3
    c. Press Ctrl + S to save file.

NOTE: The total number of bad diodes should not exceed a pre-specified amount. Figure 93 shows the number of bad diodes that are acceptable based on machine model number.

XIS Model	Total # of Diodes* (per energy – HE and LE)	Preferable Maximum # of Bad Diodes*	Absolute Maximum # of Bad Diodes
5335	512	5-10	15
5335S	512	5-10	15
5878	832	8-16	25
6040	576	6-12	17
6040M	576	6-12	17
6545	640	6-12	19
6545VI	640	6-12	19
6545DV	640	6-12	19
7858	832	8-16	25
7858VI	832	8-16	25
1080	1088	11-22	33
1080D	1088	11-22	33
100X	1152	12-24	35
100XD	1152	12-24	35
100XDX	Down: 1152, Side: 1216	Down: 12-24, Side: 12-24	Down: 35, Side: 36
100XDV	Up: 1152, Side: 1216	Up: 12-24, Side: 12-24	Up: 35, Side: 36
1210D	1216	12-24	36

Figure 93: Number of Bad Diodes Allowable per Model (non-pallet)

Steel Penetration Imaging Test

1. Run the “X-ray Client” Program.
2. Scan a penetration test sample.
    a. The test sample should be placed on the side of the conveyor nearest the generator side.
3. Adjust color and intensity setting.
    a. Adjust the imaging mode to Pseudo Color.
    b. Adjust intensity to +1 above normal. At least four triangles should be visible (Figure 94).
    c. Adjust intensity to +2 and +3 above normal. At least four triangles should be visible at each level.
    d. If triangles are visible at all tested levels, run test block 5 – 10 more times to verify consistent operation.

At this point the test is complete.

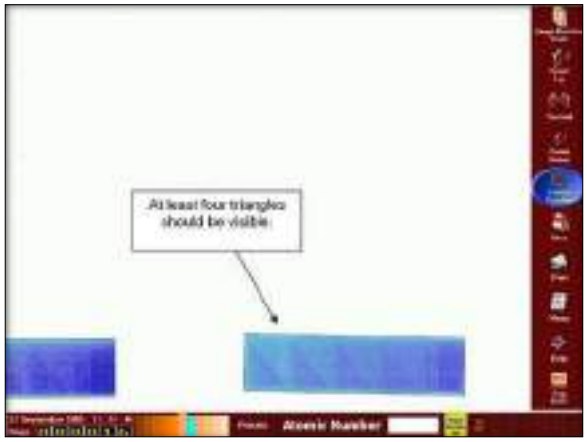

Figure 94: Steel Penetration Imaging Test

If X-ray penetration of the test sample is not within acceptable limits, see “X-ray Collimation” on page 101 for instructions on how to perform collimation and adjustment procedures.

90kV Generator Tuning Procedures

Applicability

The following instructions apply to generator control boards with the following model numbers:

- GOI-B01

NOTE: Please speak to an Astrophysics engineer to request the tuning procedures for control boards with model numbers different than GOI-B01, or see the sections in this manual on tuning 160kV and 180kV generators.

Required Tools***

- Digital Multi-Meter (DMM) with IC hook-up probes
- Oscilloscope with IC hook-up probes
- AC/DC Current Probe
- Manual hand switch for control board
- Small Flat Head Screwdriver

1. Power down the control board by unplugging the 65V power supply at PL3.
2. Ensure that the control board and tank are properly grounded to the same ground stud in the XIS.
3. Disconnect the control board from the generator head by removing the plug at PL4.
4. Measure the voltages being supplied by the power harness of the 65V power supply. Verify that they are all within the ranges specified in Figure 95.

	Required Value
Between wire #16 (yellow) and wire #000 (reference)	+11.5VDC to +12.5VDC
Between wire #17 (green) and wire #000 (reference)	-11.5VDC to -12.5VDC
Between wire #40 (blue) and wire #00 (reference)	+29VDC to +36VDC
Between wire #70 (red) and wire #00 (reference)	+65VDC to +85VDC

Figure 95: Power Harness Voltages

5. Power up the control board by connecting the power harness of the 65V power supply to PL3. Verify that the green “System On” LED (LD3) is lit.

WARNING!

Important: Ensure that the AC line to the 65V power supply is disconnected before the harness is plugged into PL3.

6. Verify that the voltage at each fuse on the control board is correct.

   VFuse1= +29VDC to +36VDC VFuse2= +2.0VDC to +3.0VDC

7. Measure and verify the kV drive signal.

	Channel 1	Channel 2
Voltage Scale	5 V/division	5 V/division
Time Scale	10uS/division	10uS/division

Figure 96: Oscilloscope Settings

   a. Connect the manual hand switch to the 14-Pin connector on the control board.

   b. Connect Channel 1 of the oscilloscope to TP5.

   c. Turn the hand switch to the **ON** position. Verify that the duty cycle of the signal is between 18% and 22%. If the duty cycle is not correct, adjust W4 until the duty cycle falls within the specified range. See Figure 95.

   d. Verify that the frequency of the signal is between 16.8 kHz and 18.8 kHz. If the frequency is not correct, adjust W6 until the frequency falls within the specified range. See Figure 1.

   e. Repeat Steps 5b-5d for TP6.

   f. Turn the hand switch to the **OFF** position

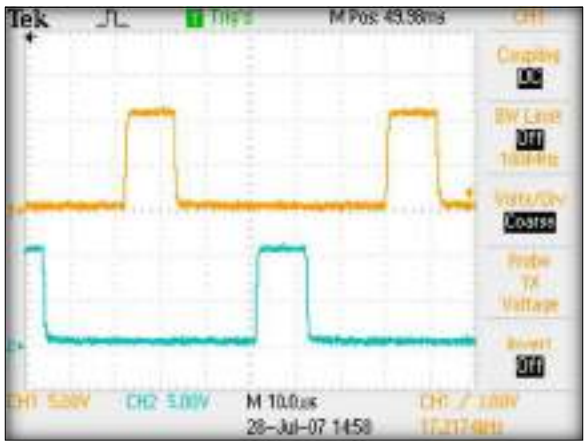

Figure 97: kV Drive Signal

8. Verify filament drive signal.

	Channel 1	Channel 2
Voltage Scale	5 V/division	5 V/division
Time Scale	10uS/division	10uS/division

Figure 98: Oscilloscope Settings

   a. Connect Channel 1 of the oscilloscope to TP20.
   b. Turn the hand switch to the **ON** position. Verify that the duty cycle is between 42% and 48%. See Figure 99. *(Note: This parameter is NOT adjustable.)*
   c. Turn the hand switch to the **OFF** position
   d. Repeat Steps 8a-8c for TP21.
   e. Turn the hand switch to the OFF position.

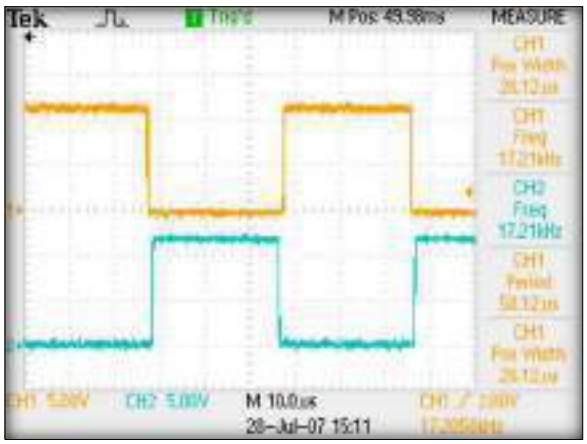

Figure 99: Filament Drive Signal

9. Measure the kV set value.
   a. Measure the kV set value at JP3 (near W5) Adjust W5 until the voltage at JP3= 1.2VDC.
10. Measure the mA set value.
   a. Measure the mA set value at JP1 (near W1) Adjust W1 until the voltage at JP1=2.0VDC.
11. Perform generator ramp up.
   a. Connect the control board to the generator head at PL4. Important: Ensure that the 65V power supply is OFF while the generator head is being connected.
   b. Connect the digital multi-meter to TP2.
   c. Turn the hand switch to the **ON** position.
   d. Perform a ramp up of the generator. Increase the kV by turning W5 clockwise in the following steps. Wait for two minutes between each step.

i. Step 1: TP2=1.4VDC
ii. Step 2: TP2=1.6VDC
iii. Step 3: TP2=1.7VDC
iv. Step 4: TP2=1.8VDC
v. Step 5: TP2=1.9VDC
vi. Step 6: TP2=2.0VDC

e. Once the ramp up is complete, turn the hand switch to the OFF position.

12. Inspect voltage at each fuse.

a. Turn the hand switch to the on position and verify that the voltage at each fuse is correct:

V_{Fuse1}= +29VDC to +36VDC V_{Fuse2}= +40VDC to +50VDC

13. Verify the stability of the mA drive signal:

	Channel 1	Channel 2
Voltage Scale	5 V/division	500 mV/division
Time Scale	10uS/division	10uS/division

Figure 100: Oscilloscope Settings

a. Connect Channel 1 of the oscilloscope to TP5.
b. Connect the current probe to Channel 2 of the oscilloscope. Set the current probe to 100mV/A. Clamp the probe around the red wires connected to Pin 3 of PL4. Ensure that the current arrow on the probe points toward the generator head. See Figure 101.
c. Turn the hand switch to the **ON** position.

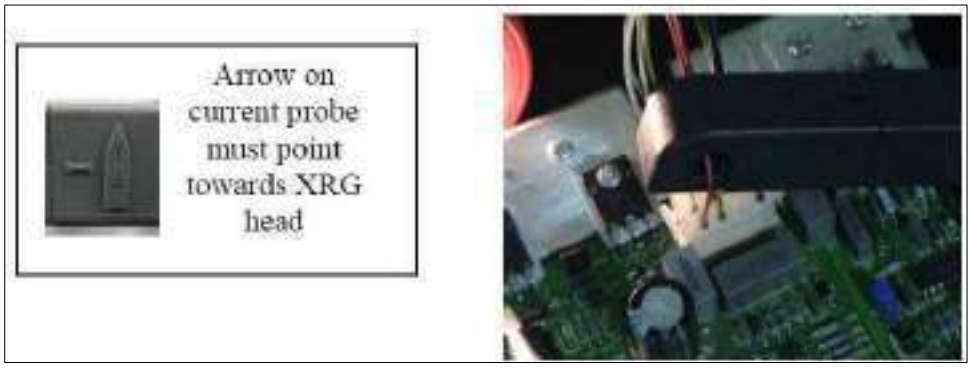

Figure 101: Current Probe Used to Observe mA Drive Signal

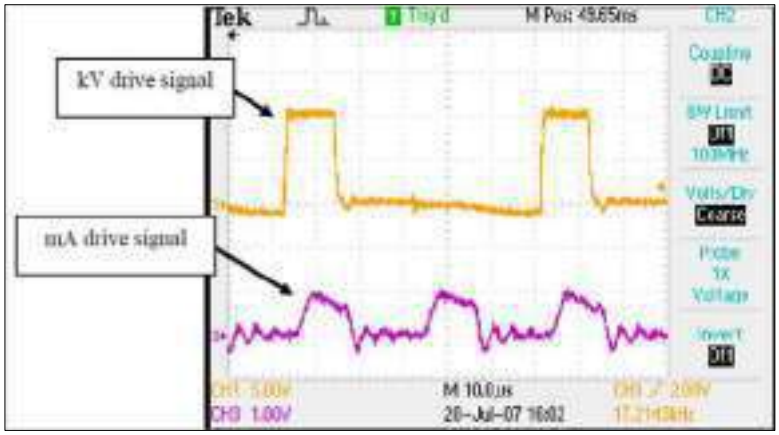

Figure 102: *Correct* kV and mA Drive Signals

NOTE: The mA waveform must be stable, i.e. not jump. Also, each primary peak should appear as in Figure 102, Figure 103 and Figure 104. If the waveform does not appear as in Figure 103 and Figure 104, adjust the kV drive signal via W6 (frequency) and W4 (duty cycle) slowly until it does. ***Remember**: Do **NOT** go outside the recommended ranges for either of these parameters.*

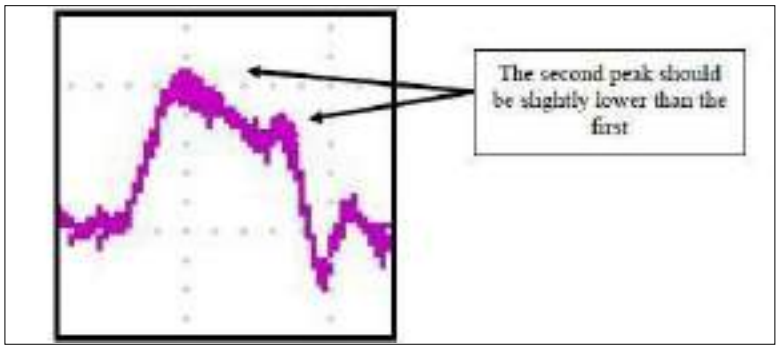

Figure 103: *Correct* mA Drive Signal Waveform

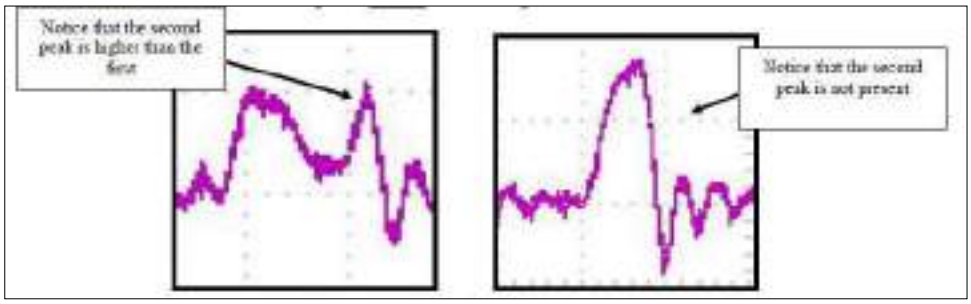

Figure 104: *Incorrect* mA Drive Signal Waveforms

14. Set the kV-mA Rise Curve

	Channel 1	Channel 2
Voltage Scale	1 V/division	1 V/division
Time Scale	50mS/division	50mS/division

Figure 105: Oscilloscope Settings

a. Connect Channel 1 of the oscilloscope to TP2.

b. Connect Channel 2 of the oscilloscope to TP15.

c. Using the vertical position knob, place Channel 2 at the first gridline form the bottom. Place Channel 1 at the third gridline from the bottom.

d. Set the Trigger Level slightly higher than the Channel 2 signal.

e. Using the hand switch, manually turn on the X-ray generator. The kV-mA rise curve should appear as in Figure 106.

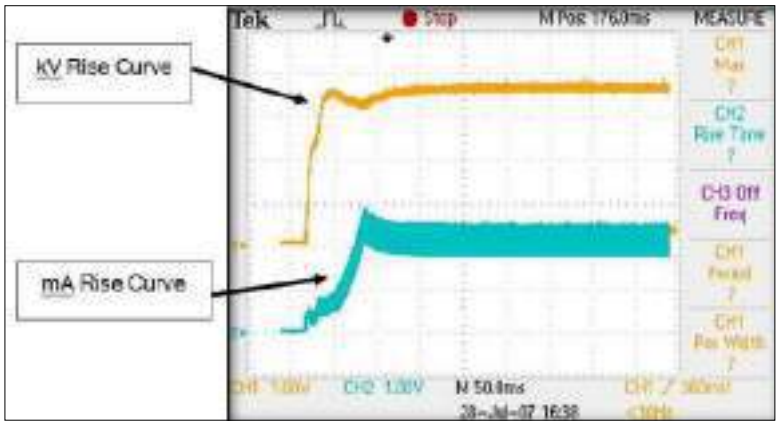

Figure 106: Correct kV-mA Rise Curves

f. If the kV-mA rise curve appears as in Figure 107, then the filament may be too cold. If the red LED's have come on, reset the control board by disconnecting and reconnecting it from the 65V power supply. Increase the Pre-Heat by turning W2 counter-clockwise slightly.

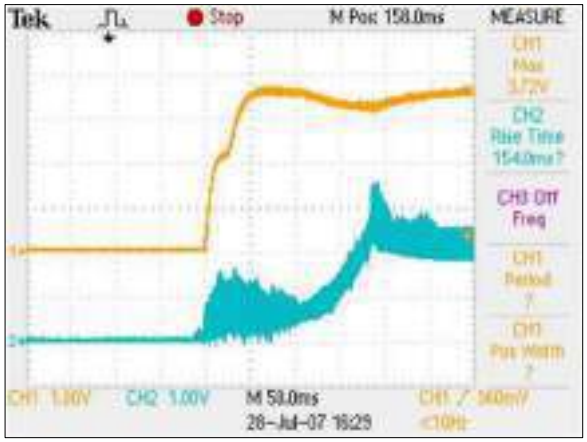

Figure 107: Incorrect kV-mA Rise Curve

(Filament too cold)

g. If the kV-mA rise curve appears as in Figure 108, then the filament may be too hot. If the red LED's have come on, reset the control board by

disconnecting and reconnecting it from the 65V power supply. Decrease the Pre-Heat by turning W2 clockwise slightly.

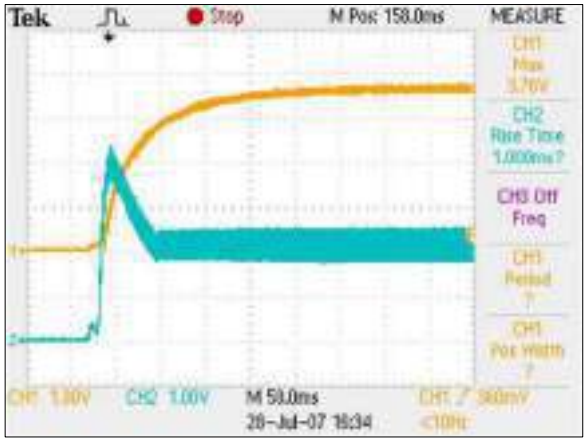

Figure 108: Incorrect kV-mA Rise Curve (Filament too hot)

NOTE: If all of the above has been completed successfully, XRG tuning is complete.

Signal	Test Point	Potentiometer	Nominal Value
mA Feedback	TP15	W1	2.0VDC
Filament Pre-Heat	TP17 (R12 or U1, Pin 10)	W2	0.66VDC – 0.88VDC
Emission Starting Point	U6, Pin 7	W3	Do NOT Adjust
kV Drive Signal	TP5, TP6	W4	18% - 22% (Duty Cycle)
kV Feedback	TP2	W5	2.0VDC
kV Drive Signal	TP5, TP6	W6	16.8kHz - 18.8kHz (Frequency)
Filament Drive Signal	TP20, TP21	-	42% - 48% (Duty Cycle)
kV Set Value	JP3 (Near W5)	W5	-
mA Set Value	JP1 (Near W1)	W1	-

Figure 109: Signal, Test Point, Potentiometer and Nominal Value

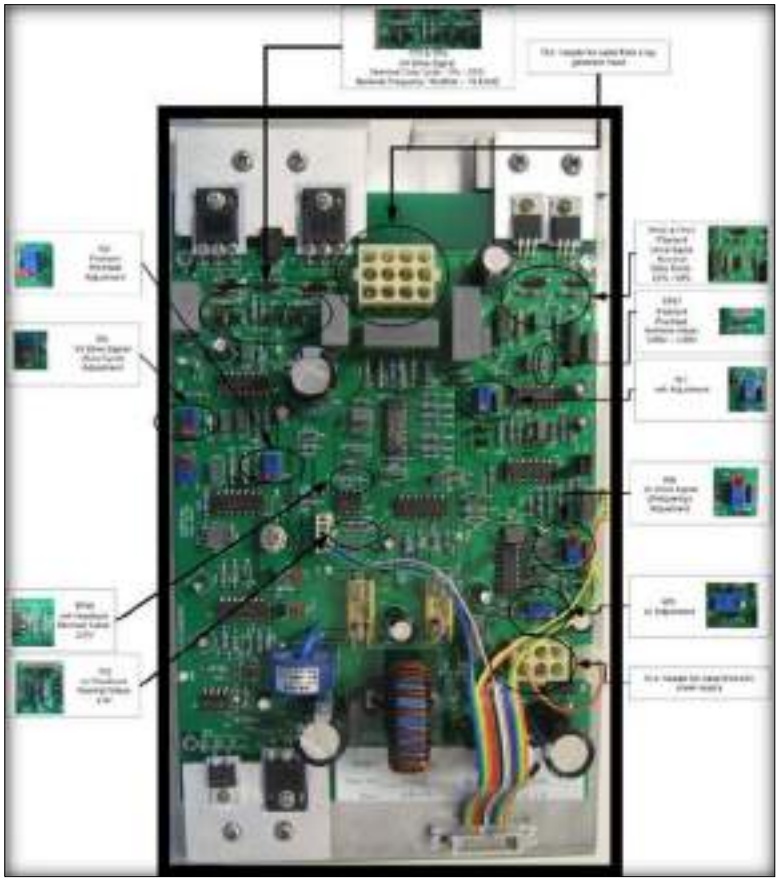

Figure 110: Top View of 90kV Control Board

ASTROPHYSICS™

Astrophysics Inc.™
Tomorrow's Technology for Today's Security

90kV Generator & Control Board Test Report

Date: _____
Inspected by: _____

Serial Numbers
XIS Unit Number: _____
Generator: _____
Control Board: _____

Applicability: The following instructions apply to control boards with the following model numbers:

- GOI-801

Please speak to an Astrophysics engineer to request the tuning procedures to control boards with model numbers different than those stated above.

1. **Visual Inspection**

   a. Visually inspect the x-ray generator assembly. Is there any physical damage? Are there any oil leaks?

   Yes ☐ No ☐

   Comments _____

2. **Inspect 65V Power Supply Output *(Note: Test prior to connecting to control board.)***

	Required Value	Actual Value
Measure voltage between wire #16 (yellow) and wire #000 (reference)	+11.5VDC to +12.5VDC	
Measure voltage between wire #17 (green) and wire #000 (reference)	-11.5VDC to -12.5VDC	
Measure voltage between wire #40 (blue) and wire #00 (reference)	+29VDC to +36VDC	
Measure voltage between wire #70 (red) and wire #00 (reference)	+65VDC to +85VDC	

Comments _____

3. **Inspect Fuse Voltages *(Note: With generator head disconnected and hand switch in the OFF position.)***

	Required Value	Actual Value	
Fuse 1	+29VDC to +36VDC		Comments
Fuse 2	+2.0VDC to +3.0VDC		

4. **Inspect kV Drive Signal *(Note: With generator head disconnected and hand switch in the ON position.)***

	Duty Cycle *(Adjustable via W4)*			Frequency *(Adjustable via W6)*		
	Required Value	Actual Value	Corrected Value	Required Value	Actual Value	Corrected Value
TP5	18% to 22%			16.8kHZ to 18.8kHz		
TP6	18% to 22%			16.8kHZ to 18.8kHz		

Comments _____

5. **Inspect mA Drive Signal *(Note: With generator head disconnected and hand switch in the ON position.)***

	Duty Cycle *(Not Adjustable)*		
	Required Value	Actual Value	
TP20	42% - 48%		Comments
TP21	42% - 48%		

6. **Inspect kV and mA Set Values *(Note: With generator head disconnected and hand switch in the OFF position.)***

(Note: If this test is being performed on a generator which has been ramped up, please continue to Step 8)

Figure 111: 90kV Generator and Control Board Test Report

	Required Value	Set Value	
kV Set Value *(Measure at JP3. Adjust via W5)*	+1.2 VDC		Comments
mA Set Value *(Measure at JP1. Adjust via W1)*	+2.0 VDC		

7. **Perform ramp up of X-Ray Generator (Connect generator head at PL4. *Note: Ensure that the 85V power supply is OFF while the generator head is being connected.*)**

Step	Voltage at TP2 *kV feedback (Adjust via W5)*	Duration	Completed	
1	1.4VDC	2 min.	☐	Comments
2	1.6VDC	2 min.	☐	
3	1.7VDC	2 min.	☐	
4	1.8VDC	2 min.	☐	
5	1.9VDC	2 min.	☐	
6	2.0VDC	2 min.	☐	

8. **Inspect Fuse Voltages *(Note: With generator head connected and hand switch in the ON position.)***

	Required Value	Actual Value	
Fuse 1	+29VDC to +36VDC		Comments
Fuse 2	+40VDC to +50VDC		

9. **Inspect mA drive signal (Proper waveform and stable.)**

- Does the waveform appear as shown in Figure 1?

Yes ☐ No ☐

If not, adjust kV drive signal via W6 (frequency) and W4 (duty cycle). ***Important*** *Do **NOT** exceed recommended ranges.*

Adjusted frequency:_____
Adjusted duty cycle:_____

- Is the signal stable (i.e. not jumping)?

Yes ☐ No ☐

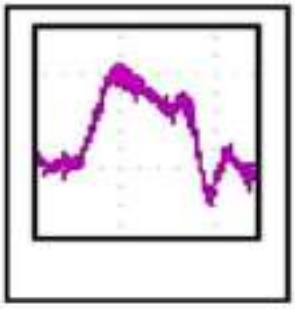

Figure 1- Correct mA drive signal waveform

Comments:_____

Figure 112: 90kV Generator and Control Board Test Report (cont'd)

10. Set kV-mA rise curve

- Do the waveforms appear as shown in Figure 2?

Yes ☐ No ☐

If not, adjust pre-heat value via W2.

Adjusted pre-heat value: _____
(Measure at TP17)

- Are the signals stable (i.e. not jumping)?

Yes ☐ No ☐

- Is the mA rise time within 100 to 150mS?

Yes ☐ No ☐

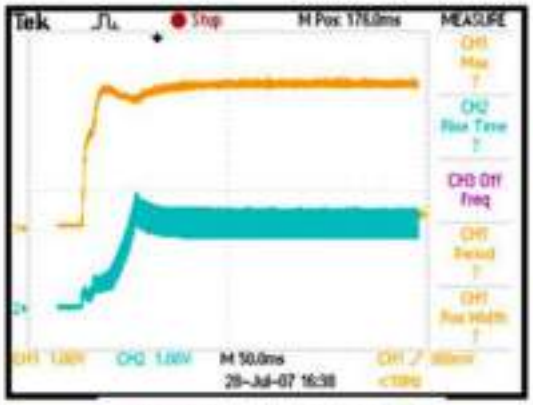

Figure 2- Correct kV-mA rise curves

- Turn X-Rays On-Off approximately once per second for one minute. Do the waveforms remain stable? Does the mA rise time remain above 50mS?

Yes ☐ No ☐

Comments

_____

_____

11. X-Ray Generator Burn-In

		Date *mm-dd-yyyy*	Total Time *hh:mm*
Full On	Start		
	End		
Pulsing	Start		
	End		
Total Burn-In Time			

12. Final Comments

_____

_____

_____

_____

Pass ☐ Fail ☐

Signature: _____ Date: _____

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160kV Generator Tuning Procedures

Applicability:

The following instructions apply to control boards with the following model numbers:

- GOL21-A04
- GOL21-A03
- GOL21-B08

Please speak to an Astrophysics engineer to request the tuning procedures to control boards with model numbers different than those stated above.

Tools Required:

- Digital Multi-Meter (DMM) with IC hook-up probes
- Oscilloscope with IC hook-up probes
- AC/DC Current Probe
- Manual hand switch for control board
- Small Flat Head Screwdriver

1. Power down the control board by unplugging the 65V power supply at PL2.
2. Ensure that the control board and tank are properly grounded to the same ground stud in the XIS.
3. Disconnect control board from the generator head by removing the plug at PL3.
4. Measure the voltages being supplied by the power harness of the 65V power supply. Verify that they are all within the ranges specified in Table 1.

	Required Value
Between wire #16 (yellow) and wire #000 (reference)	+11.5VDC to +12.5VDC
Between wire #17 (green) and wire #000 (reference)	-11.5VDC to -12.5VDC
Between wire #40 (blue) and wire #00 (reference)	+29VDC to +36VDC
Between wire #70 (red) and wire #00 (reference)	+65VDC to +85VDC

Figure 113: Voltages

5. Power up the control board by connecting the power harness of the 65V power supply to PL2. Verify that the green System On LED (LD6) is lit. *Important: Ensure that the AC line to the 65V power supply is disconnected before the harness is plugged in to PL2.*

6. Verify that the voltage at each fuse on the control board is correct.

   V_{Fuse1}= +29VDC to +36VDC V_{Fuse2}= +2.0VDC to +3.0VDC

7. Measure and verify the kV drive signal.

	Channel 1	Channel 2
Voltage Scale	5 V/division	5 V/division
Time Scale	10uS/division	10uS/division

Figure 114: Oscilloscope Settings

   a. Connect the manual hand switch to the 14-Pin connector on the control board.

   b. Connect Channel 1 of the oscilloscope to TP5.

   c. Turn the hand switch to the **ON** position. Verify that the duty cycle of the signal is between 18% and 22%. If the duty cycle is not correct, adjust W4 until the duty cycle falls within the specified range. See Figure 1.

   d. Verify that the frequency of the signal is between 16.8 kHz and 18.8 kHz. If the frequency is not correct, adjust W7 until the frequency falls within the specified range. See Figure 115.

   e. Repeat Steps 5b-5d for TP6.

   f. Turn the hand switch to the **OFF** position

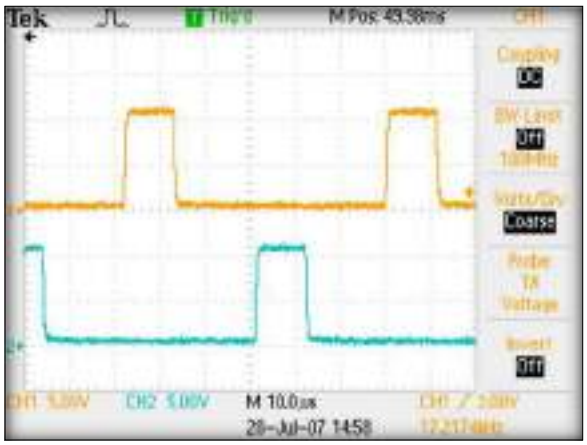


Figure 115: kV Drive Signal

8. Verify filament drive signal.

	Channel 1	Channel 2
Voltage Scale	5 V/division	5 V/division
Time Scale	10uS/division	10uS/division

Figure 116: Oscilloscope Settings

   a. Connect Channel 1 of the oscilloscope to TP20.

b. Turn the hand switch to the **ON** position. Verify that the duty cycle is between 42% and 48%. See Figure 117. *(Note: This parameter is NOT adjustable.)*

c. Turn the hand switch to the **OFF** position

d. Repeat Steps 8a-8c for TP21.

e. Turn the hand switch to the OFF position.

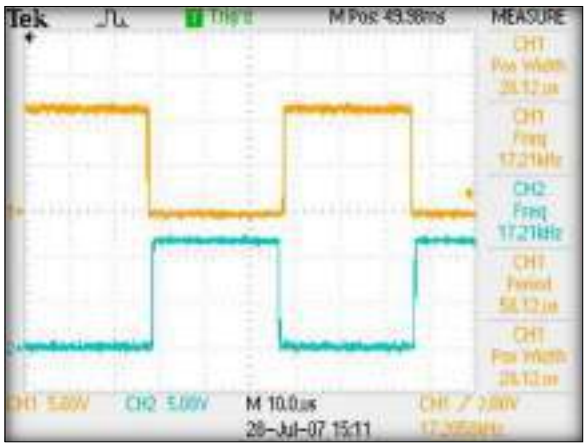


Figure 117: Filament Drive Signal

9. Measure the kV set value.

a. Measure the kV set value at JP4 (near W6) Adjust W6 until the voltage at JP4 as follows:

	Control Board Model	
	GOL21-A04	**GOL21-B08**
Scale	1V = 41.6kV	
Set Value	2.6VDC	

Figure 118: Voltages

10. Measure the mA set value.

a. Measure the mA set value at JP2 (near W1) Adjust W1 until the voltage at JP2 is as follows:

	Control Board Model	
	GOL21-A04	**GOL21-B08**
Scale	1V = 0.5mA	1V = 0.33mA
Set Value	1.4VDC	2.1VDC

Figure 119: Voltages

11. Perform generator ramp up.
    a. Connect the control board to the generator head at PL3. Important: Ensure that the 65V power supply is OFF while the generator head is being connected.
    b. Connect the digital multi-meter to TP2.
    c. Turn the hand switch to the ON position.
    d. Perform a ramp up the generator. Increase the kV by turning W6 clockwise in the following steps. Wait for two minutes between each step.
        i. Step 1: TP2=2.6VDC
        ii. Step 2: TP2=2.8VDC
        iii. Step 3: TP2=3.0VDC
        iv. Step 4: TP2=3.2VDC
        v. Step 5: TP2=3.4VDC
        vi. Step 6: TP2=3.6VDC
    e. Once the ramp up is complete, turn the hand switch to the OFF position.
12. Inspect voltage at each fuse.
    a. Turn the hand switch to the on position and verify that the voltage at each fuse is correct.

    V_{Fuse1}= +29VDC to +36VDC V_{Fuse2}= +40VDC to +50VDC

13. Verify stability of mA drive signal

	Channel 1	Channel 2
Voltage Scale	5 V/division	1 V/division
Time Scale	10uS/division	10uS/division

Figure 120: Oscilloscope Settings

    a. Connect Channel 1 of the oscilloscope to TP5.
    b. Connect the current probe to Channel 2 of the oscilloscope. Set the current probe to 100mV/A. Clamp the probe around the red wires connected to Pin 3 of PL3. Ensure that the current arrow on the probe points toward the generator head. See Figure 121.
    c. Turn the hand switch to the ON position.

Figure 121: Current Probe Used to Observe mA Drive Signal

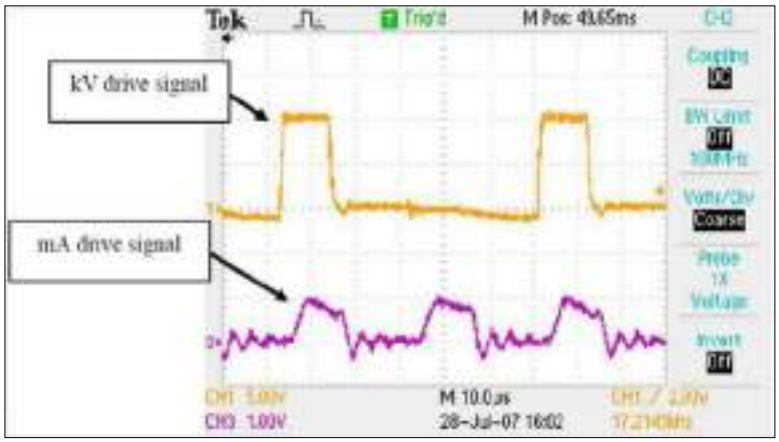


Figure 122: *Correct* kV and mA Drive Signals

NOTE: The mA waveform must be stable, i.e. not jump. Also, each primary peak should appear as in Figure 5. If the waveform does not appear as in Figures 4 and 5, adjust the kV drive signal via W7 (frequency) and W4 (duty cycle) slowly until it does. ***Remember:*** *Do* ***NOT*** *go outside the recommended ranges for either of these parameters.*

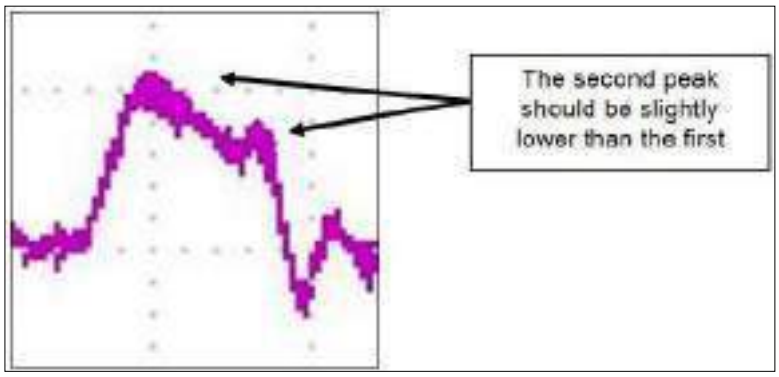


Figure 123: *Correct* mA Drive Signal Waveform

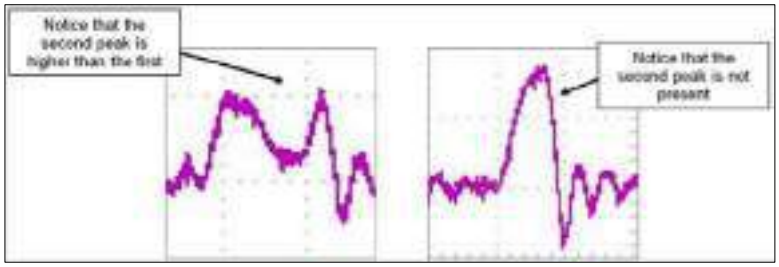


Figure 124: *Incorrect* mA Drive Signal Waveforms

14. Set the kV-mA Rise Curve.

	Channel 1	Channel 2
Voltage Scale	1 V/division	1 V/division
Time Scale	50mS/division	50mS/division

Figure 125: Oscilloscope Settings

a. Connect Channel 1 of the oscilloscope to TP2.

b. Connect Channel 2 of the oscilloscope to TP15.

c. Using the vertical position knob, place Channel 2 at the first gridline form the bottom. Place Channel 1 at the third gridline from the bottom.

d. Set the Trigger Level slightly higher than the Channel 2 signal.

e. Using the hand switch, manually turn on the X-ray generator. The kV-mA rise curve should appear as in Figure 126.

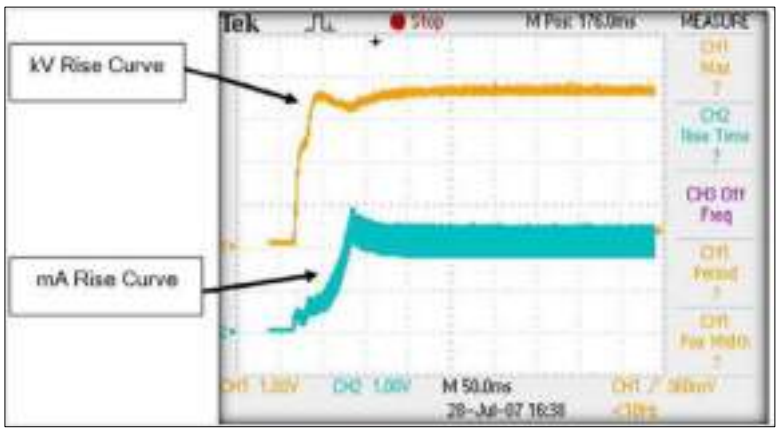


Figure 126: *Correct* kV-mA Rise Curves

f. If the kV-mA rise curve appears as in Figure 127, then the filament may be too cold. If the red LED's have come on, reset the control board by disconnecting and reconnecting it from the 65V power supply. Increase the Pre-Heat by turning W2 counter-clockwise slightly.

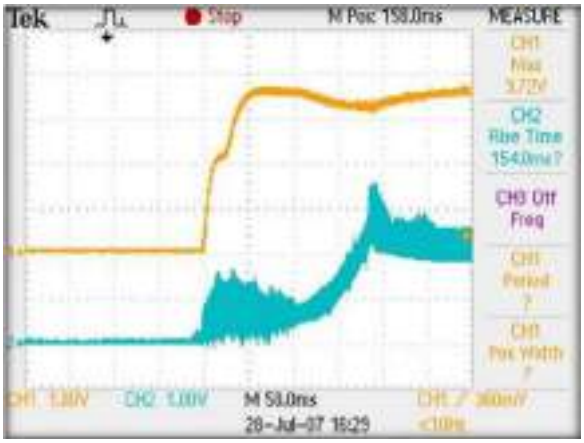


Figure 127: *Incorrect* kV-mA Rise Curve (Filament too cold)

g. If the kV-mA rise curve appears as in Figure 128, then the filament may be too hot. If the red LED's have come on, reset the control board by disconnecting and reconnecting it from the 65V power supply. Decrease the Pre-Heat by turning W2 clockwise slightly.

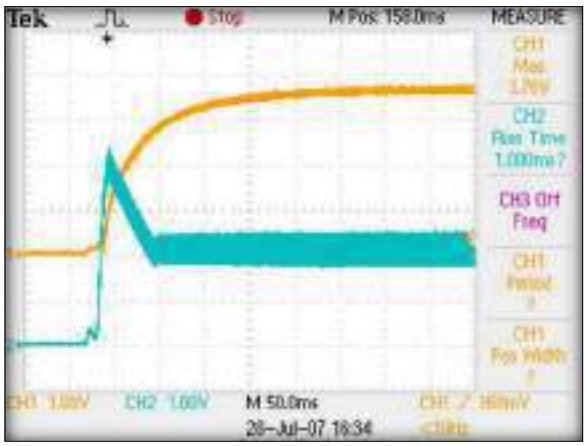


Figure 128: *Incorrect* kV-mA Rise Curve (Filament too hot)

If all of the above has been completed successfully, XRG tuning is complete.

Signal	Test Point	Potentiometer	Nominal Value
mA Feedback	TP15	W1	1.4VDC (GOL21-A04) 2.3VDC (GOL21-B08)
Filament Pre-Heat	TP17 (R37 or U9, Pin 10)	W2	0.66VDC - 0.88VDC
Emission Starting Point	TP4	W3	Do NOT Adjust
kV Drive Signal	TP5, TP6	W4	18% - 22% (Duty Cycle)
-	-	W5	-
kV Feedback	TP2	W6	3.6VDC
kV Drive Signal	TP5, TP6	W7	16.8kHz - 18.8kHz (Frequency)
Filament Drive Signal	TP20, TP21	-	42% - 48% (Duty Cycle)
kV Set Value	JP4 (Near W6)	W6	-
mA Set Value	JP2 (Near W1)	W1	-

Figure 129: Signals, Test Points, Potentiometers, Nominal Values

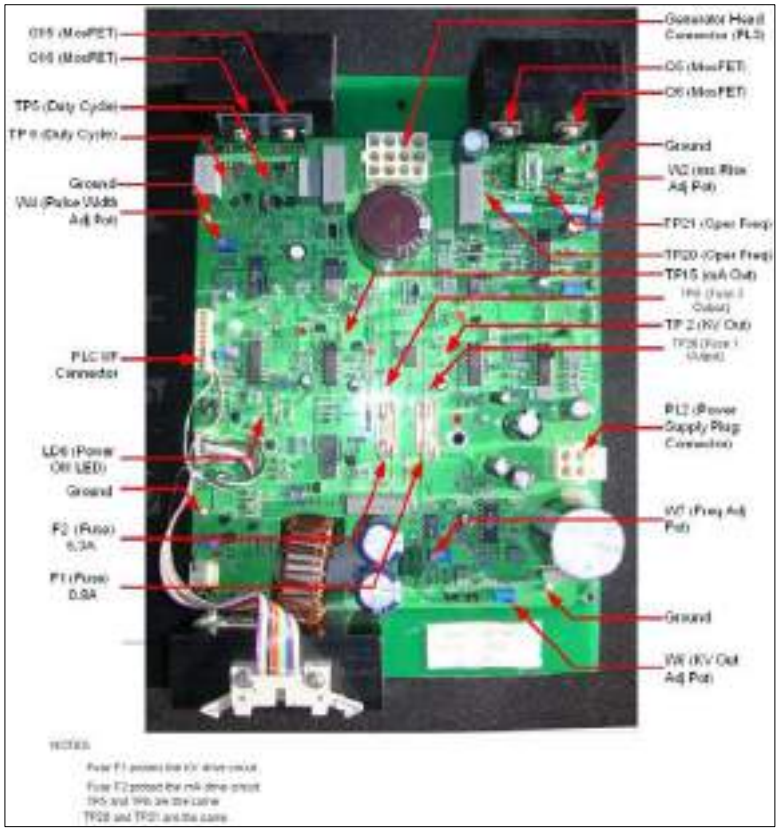


Figure 130: Top View of 160kV Control Board

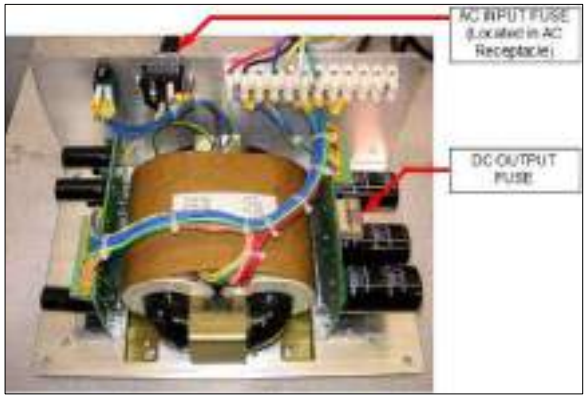


Figure 131: Top View of 160kV DC Power Supply

ASTROPHYSICS™

160kV Generator & Control Board Test Report

Date: _____

Inspected by: _____

Serial Numbers

XIS Unit Number: _____

Generator: _____

Control Board: _____

Applicability: The following instructions apply to control boards with the following model numbers:

- GOL21-A04
- GOL21-A03
- GOL21-B08

Please speak to an Astrophysics engineer to request the tuning procedures to control boards with model numbers different than those stated above.

13. Visual Inspection

a. Visually inspect the x-ray generator assembly. Is there any physical damage? Are there any oil leaks?

Yes ☐ No ☐

Comments _____

14. Inspect 65V Power Supply Output *(Note: Test prior to connecting to control board.)*

	Required Value	Actual Value
Measure voltage between wire #16 (yellow) and wire #000 (reference)	+11.5VDC to +12.5VDC	
Measure voltage between wire #17 (green) and wire #000 (reference)	-11.5VDC to -12.5VDC	
Measure voltage between wire #40 (blue) and wire #00 (reference)	+29VDC to +36VDC	
Measure voltage between wire #70 (red) and wire #00 (reference)	+65VDC to +85VDC	

Comments _____

15. Inspect Fuse Voltages *(Note: With generator head disconnected and hand switch in the OFF position.)*

	Required Value	Actual Value	Comments
Fuse 1	+29VDC to +36VDC		
Fuse 2	+2.0VDC to +3.0VDC		

16. Inspect kV Drive Signal *(Note: With generator head disconnected and hand switch in the ON position.)*

	Duty Cycle *(Adjustable via W4)*			Frequency *(Adjustable via W7)*		
	Required Value	Actual Value	Corrected Value	Required Value	Actual Value	Corrected Value
TP5	18% to 22%			16.8kHZ to 18.8kHz		
TP6	18% to 22%			16.8kHZ to 18.8kHz		

Comments _____

Figure 132: 160kV Generator & Control Board Test Report

160kV Generator & Control Board Test Report (cont.)

17. Inspect mA Drive Signal ***(Note: With generator head disconnected and hand switch in the ON position.)***

	Duty Cycle (Not Adjustable) Required Value	Actual Value	Comments
TP20	42% - 48%	_____	_____
TP21	42% - 48%	_____	_____

18. Inspect kV and mA Set Values ***(Note: With generator head disconnected and hand switch in the OFF position.)***
(Note: If this test is being performed on a generator which has been ramped up please continue to Step 9)

	Required Value GOL21-A03 GOL21-A04	Required Value GOL21-B08	Set Value	Comments
kV Set Value *(Measure at JP4. Adjust via W6)*	+2.6 VDC		_____	_____
mA Set Value *(Measure at JP2. Adjust via W7)*	+1.4 VDC	+2.1 VDC	_____	_____

19. Perform ramp up of X-Ray Generator (Connect generator head at P13. ***Note: Ensure that the 65V power supply is OFF while the generator head is being connected.)***

Step	Voltage at TP2 *kV feedback (Adjust via W6)*	Duration	Completed
1	2.6VDC	2 min.	☐
2	2.8VDC	2 min.	☐
3	3.0VDC	2 min.	☐
4	3.2VDC	2 min.	☐
5	3.4VDC	2 min.	☐
6	3.6VDC	2 min.	☐

Comments _____

20. Inspect Fuse Voltages ***(Note: With generator head connected and hand switch in the ON position.)***

	Required Value	Actual Value	Comments
Fuse 1	+29VDC to +36VDC	_____	_____
Fuse 2	+40VDC to +50VDC	_____	_____

21. Inspect mA drive signal (Proper waveform and stable.)

- Does the waveform appear as shown in Figure 1?

Yes ☐ No ☐

If not, adjust kV drive signal via W7 (frequency) and W4 (duty cycle). ***Important*** *Do* ***NOT*** *exceed recommended ranges.*

Adjusted frequency:_____
Adjusted duty cycle:_____

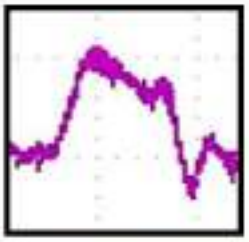


Figure 1- Correct mA drive signal waveform

- Is the signal stable (i.e. not jumping)?

Yes ☐ No ☐

Comments _____

Figure 133: 160kV Generator & Control Board Test Report (cont'd)

160kV Generator & Control Board Test Report (cont.)

22. Set kV-mA rise curve

- Do the waveforms appear as shown in Figure 2?

Yes ☐ No ☐

If not, adjust pre-heat value via W2.

Adjusted pre-heat value: _____
(Measure at TP17)

- Are the signals stable (i.e. not jumping)?

Yes ☐ No ☐

- Is the mA rise time within 100 to 150mS?

Yes ☐ No ☐

- Turn X-Rays On-Off approximately once per second for one minute. Do the waveforms remain stable? Does the mA rise time remain above 50mS?

Yes ☐ No ☐

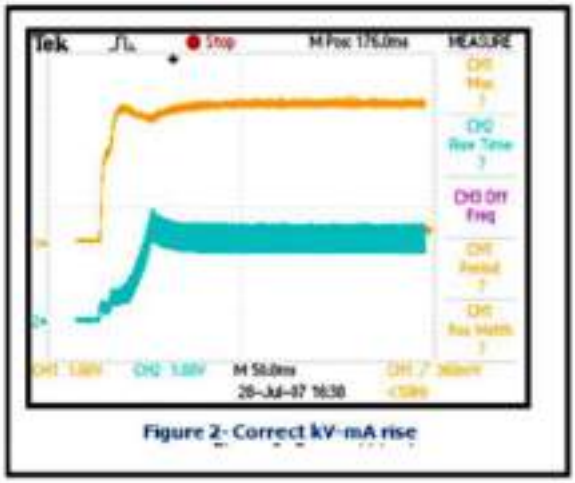


Figure 2- Correct kV-mA rise

Comments

_____

_____

23. X-Ray Generator Burn-In

		Date *mm-dd-yyyy*	Total Time *hh:mm*
Full On	Start		
	End		
Pulsing	Start		
	End		
	Total Burn-In Time		

24. Final Comments

_____

_____

_____

_____

Pass ☐ Fail ☐

Signature: _____ Date: _____

180kV Generator Tuning Procedures

The tuning instructions for the 180kV generator set are the same as for the 160kV generator set (see previous chapter), with the following exceptions:

1. 1. In procedure step 10., Table 3, make the mA “Set Value” = 4.0 VDC instead of 1.4 or 2.1 VDC.
2. 2. In procedure step 11., d., continue to increase the kV by two additional 0.2 VDC increments, to end at 4.0 VDC instead of 3.6 VDC. Still allow two minutes per increment, for a total of four additional minutes of ramp up time. Therefore, just add the following two steps to the procedure:

    11. (…)

        d. (…)

            (i. … vi.)

            vii. Step 7: TP2=3.8VDC

            viii. Step 8: TP2=4.0VDC

180kV Generator Set Test Report

Date: _____
Inspected by: _____

Model Number / Serial Number

XIS Unit: _____ / _____
DC Power Supply: _____ / _____
Control Board: _____ / _____
Generator Tank: _____ / _____

1. Visual Inspection

a. Visually inspect the x-ray generator assembly. Is there any physical damage? Are there any oil leaks?
Yes ☐ No ☐

Comments _____

2. Inspect DC Power Supply Outputs ***(Note: Test prior to connecting to control board. After test and before connecting to control board, be sure to turn off DC power supply and wait for complete discharge by monitoring voltage on wire #70 with reference to wire #00.)***

	Required Value (VDC)	Actual Value (VDC)
Measure voltage between **wire #16** and **wire #000** (reference)	+11.5 to +12.5	
Measure voltage between **wire #17** and **wire #000** (reference)	-11.5 to -12.5	
Measure voltage between **wire #40** and **wire #00** (reference)	+29.0 to +36.0	
Measure voltage between **wire #70** and **wire #00** (reference)	+65.0 to +85.0	

Comments _____

3. Inspect Fuse Voltages ***(Note: With generator head disconnected and x-ray selected OFF.)***

	Required Value (VDC)	Actual Value (VDC)
F1 - Fuse 1 (kV Drive)	+29.0 to +36.0	
F2 - Fuse 2 (mA Drive)	+1.0 to +4.0	

Comments _____

4. Inspect kV Drive Signal ***(Note: With generator head disconnected and x-ray selected ON.)***

	Frequency (kHz) *(Adjustable via **W7**)*			**Duty Cycle (%)** *(Adjustable via **W4**)*		
	Required Value	Initial Value	Corrected Value	Required Value	Initial Value	Corrected Value
TP5	16.8 to 18.8			18.0 to 22.0		
TP6	16.8 to 18.8			18.0 to 22.0		

Comments _____

5. Inspect mA Drive Signal ***(Note: With generator head disconnected and x-ray selected ON.)***

Duty Cycle (%) *(Not Adjustable)*

	Required Value	Actual Value
TP20	47.0 to 49.0	
TP21	47.0 to 49.0	

Comments _____

Figure 134: 180kV Generator Set Test Report

180kV Generator Set Test Report (cont.)

6. Inspect kV and mA Set Values ***(Note: With generator head disconnected and x-ray selected OFF.)***

	Required Value (VDC)	Set Value (VDC)	Comments
kV Set Value *(Measure at **JP4**, adjust via **W6**)*	+3.0		
mA Set Value *(Measure at **JP2**, adjust via **W1**)*	+4.0		

7. Perform Ramp-Up of X-Ray Generator ***(Note: Connect generator head at PL3. Before connecting to generator head, be sure to turn off DC power supply and wait for complete discharge by monitoring voltage on pin #10 of PL3 with reference to a control board GND. Also, be careful to use the specific "TP2" labeled "kV OUT" and not the other incorrectly-marked "TP2" test point. The incorrect test point will give a negative VDC measurement.)***

Step	**kV Feedback Value** *(VDC, measure at **TP2**, adjust via **W6**)*	Duration	Completed
1	3.0	2 min.	☐
2	3.2	2 min.	☐
3	3.4	2 min.	☐
4	3.6	2 min.	☐
5	3.8	2 min.	☐
6	4.0	2 min.	☐

Comments _____

8. Inspect mA Feedback from X-Ray Generator ***(Note: With generator head connected and x-ray selected ON.)***

	Required Value (VDC)	Initial Value (VDC)	Corrected Value (VDC)
mA Feedback Value *(Measure at **TP15**, adjust via **W1**)*	+4.0		

9. Inspect Fuse Voltages ***(Note: With generator head connected and x-ray selected ON.)***

	Required Value (VDC)	Actual Value (VDC)	Comments
F1 - Fuse 1 (kV Drive)	+29.0 to +36.0		
F2 - Fuse 2 (mA Drive)	+40.0 to +50.0		

10. Inspect mA drive signal (Proper waveform and stable.)

Does the waveform appear as shown in Figure 1?
Yes ☐ No ☐

If not, adjust kV drive signal via **W7** (frequency) and **W4** (duty cycle).
***Important**. Do **NOT** exceed recommended ranges in Step 4 above.*

Adjusted frequency (kHz): _____
Adjusted duty cycle (%): _____

Is the signal stable (i.e. not jumping)?
Yes ☐ No ☐

Comments _____

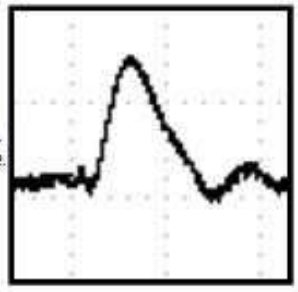


Figure 1- Correct mA drive signal waveform

Figure 135: 180kV Generator Set Test Report (cont'd)

180kV Generator Set Test Report (cont.)

11. Set kV-mA rise curve

- Do the waveforms appear as shown in Figure 2?

Yes ☐ No ☐

If not, adjust pre-heat value via **W2**.

- Are the signals stable (i.e. not jumping)?

Yes ☐ No ☐

- Is the mA rise time within **100 to 150 mS**?

Yes ☐ No ☐

- Turn X-Rays On-Off approximately once per second for one minute. Do the waveforms remain stable? Does the mA rise time remain above **50 mS**?

Yes ☐ No ☐

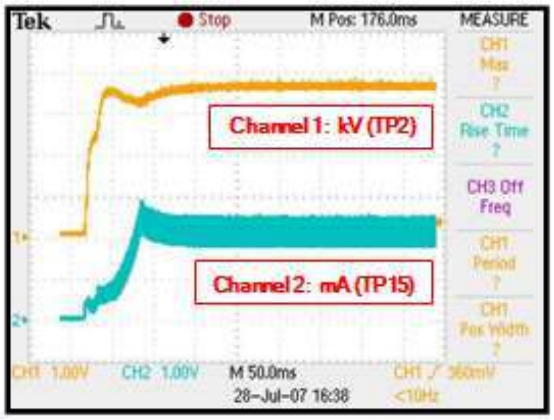


Figure 2- Correct kV-mA rise curves

Comments

_____

_____

12. X-Ray Generator Burn-In

		Date *mm-dd-yyyy*	Total Time *hh:mm*
Full On	Start		
	End		
Pulsing	Start		
	End		
	Total Burn-In Time		

13. Final Comments

_____

_____

_____

_____

Pass ☐ Fail ☐

Signature:_____ Date:_____

Figure 136: 180kV Generator Set Test Report (cont'd)

160kV, 180kV, & 200kV Generator Control Board Test Points

Reference Documents

WI-75-04-03 Rev A: “Tuning Instructions for 160kV Generator and Controller”

QF-82-03-09 Rev A: “160kV Generator & Control Board Test Report”

Plugs

PL2 = 65V power supply connector

PL3 = X-ray generator tank cable connector

Pin 3 = PL3 pin for mA drive signal

Potentiometers

W1 = mA manual set potentiometer

W2 = Filament pre-heat potentiometer

W4 = kV drive signal duty cycle potentiometer

W6 = kV manual set potentiometer

W7 = kV drive signal frequency potentiometer

Test Points

TP2 = kV out (feedback) test point

(Not TP2) = Do not use, mismarked TP2

TP5 = kV drive signal test point

TP6 = kV drive signal test point

TP9 = Fuse 2 output test point

TP15 = mA out (feedback) test point

TP20 = mA drive signal test point

TP21 = mA drive signal test point

TP26 = Fuse 1 output test point

Jumpers

JP4 = kV manual set jumper

JP2 = mA manual set jumper

LEDs

LD6 = Power LED

Other

GND = Ground points

GND Stud = Connected directly to XIS chassis ground

14-Pin Ribbon = X-ray control and feedback cable

Figure 137: Control Board Test Points

Additional Maintenance Procedures

Electrostatic Discharge

Electrostatic Discharge (ESD) refers to the rapid transfer to electrical charge from bodies of different electrical potential. ESD is a very common phenomenon. Everyone is familiar with the shocking experience of walking on a carpeted floor and then touching a metal door knob. Common sources of ESD include working surfaces, furniture, clothing, and packaging. Although static discharges are not harmful to the human body, they can be very damaging to ESD sensitive electronic components. Even small, unfelt ESD from simple touching can irrevocably harm ESD sensitive electronics.

Several critical components of the XIS are especially sensitive to ESD. These include:

- The X-ray Detector Assembly boards,
- the PC computer components,
- the Data Acquisition System (DAS) board.

When handling these items, use the following precautions:

- Wear a well grounded wrist strap.
- Use anti-static packaging to hold ESD sensitive items. Do not lay the part on the outside of the anti-static bag, as only the inside of the bag provides anti-static protection.
- Do NOT remove ESD sensitive circuit boards from the anti-static packaging until you are ready to use them.
- Do NOT hold ESD sensitive items against your clothes, even if you are wearing a grounded wrist strap.
- If installing a new component, remove the part from its anti-static bag only when you are ready to use it.
- Never slide cards or other parts over any surface. Avoid static-causing surfaces such as plastic and Styrofoam in the work area.
- Always hold cards by the edges and the metal mounting bracket. Avoid touching the components on the cards and the edge connectors that connect to expansion slots.

PC BIOS CMOS Configuration

Power Management Setup for automatic PC power ON at AC power input.

At main *CMOS Setup Utility* menu screen, move the selection cursor to ***Advanced BIOS Feature*** option and press [Enter].

Figure 138: CMOS Setup Utility screen

Figure 139: Advanced Bios Features

CMOS BIOS Maintenance Work Instructions

CMOS Setup Utility - Copyright © 1984-2004 Award Software

ACPI Suspend Type	[S1(POS)]
Power LED in S1 state	[Blinking]
Off by Power Button	[Instant-Off]
PME Event Wake Up	[Enabled]
ModemRingOn/WakeOnLAN	[Enabled]

Resume by Alarm	[Disabled]
Date (of Month) Alarm	[Everyday]
Time (hh:mm:ss) Alarm	[0 : 0 : 0]
Power On by Mouse	[Disabled]
Power On By Keyboard	[Disabled]
KB Power On Password	Enter
AC BACK Function	[Full-On]

PLC Inputs & Outputs

This is a typical view of the PLC. The PLC is usually seen upside down when viewed from the LXDA side of the machine with the side panel open.

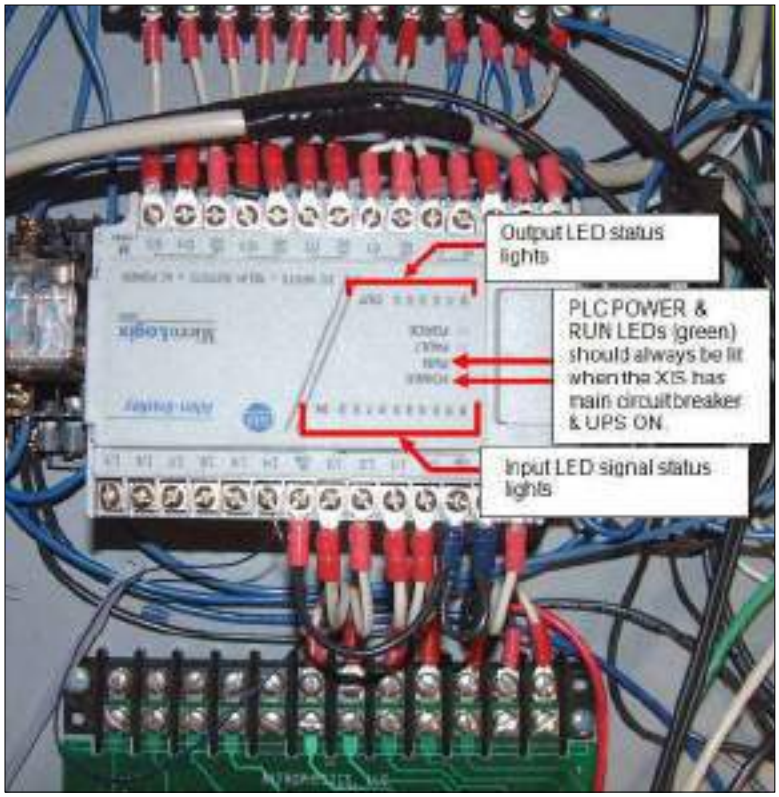


Figure 140: PLC Input and Output LED Indicators

PLC Input LED lit		PLC Output LED lit	
I/0	1 Hz Heartbeat from PC	O/0	Conveyor Power ON
I/1	Conveyor Left from PC	O/1	PC Power ON
I/2	Conveyor Right from PC	O/2	Conveyor Dir. Switched Rt.
I/3	X-ray ON from PC	O/3	X-ray ON
I/4	Key Switch turned ON	O/4	Frame X-ray ON LED lit
		O/5	Frame Power ON LED lit

Figure 141: PLC Input & Output Summary Table

PLC INPUTS				
INPUT	**PLC INPUT DEVICE**	**PLC Output LED Light is Unlit**	**PLC Output If LED Light is Lit**	**COMMENTS**
0	**PC Parallel Port** Data line #1	PC data control line.	PC HEARTBEAT (FLASHING) signal.	PC data control line.
		PC strobe this line in order to generate a PC heartbeat signal to the PLC.		PC strobe this line is to generate a PC heartbeat signal to PLC.
		If PLC loses this signal, the PLC stops conveyor and X-ray generator and brings XIS to safe state.		If PLC loses this signal, the PLC stops the conveyor and X-ray generator and brings the XIS to a safe state.
1	**PC Parallel Port** Data line #2	Conveyor is either off OR commanded to move in right direction.	Conveyor powered to move in LEFT DIRECTION.	
2	**PC Parallel Port** Data line #3	Conveyor is either off OR commanded to move in left direction.	Conveyor powered to move in RIGHT DIRECTION.	
3	**PC Parallel Port** Data line #4	X-ray generator is commanded OFF.	X-ray controller is powered to TURN X-RAY GENERATOR ON.	
4	**Key-switch 12V DC signal.**	Key-switch is in OFF position.	KEY-SWITCH IS IN ON position.	Input lines 5-9 are unused.

Figure 142: PLC Inputs

PLC OUTPUTS				
Output	**Target Device**	**PLC Output LED Light is UNLIT**	**PLC Output LED Light is LIT (indicates that PLC is controlling the following devices)**	**Sequence Of Event Controlling PLC Output**
0	**Conveyor Motor** (Forward direction)	Conveyor is stopped.	Conveyor is powered.	1. XOC [FWD] button pressed 2. XOC signals PC 3. Xray.exe sends LPT1 4. LPT1 output goes to PC-PLC Board 5. PC-PLC signals PLC. 6. PLC switches conveyor motor ON. 7. Conveyor Motor starts in forward direction.
1	**PC**	PC is switched OFF.	PC is switched ON.	1. Key-switch turned to ON. 2. Key-switch signals PC (serial port). 3. PC signals PLC. 4. PLC switches PC on.
2	**Conveyor Motor** (Reverse direction	Conveyor is stopped.	Conveyor is switched to move in right direction.	1. XOC [REV] button pressed 2. XOC signals PC 3. Xray.exe sends LPT1 4. LPT1 output goes to PC-PLC Board 5. PC signals PC-PLC. 6. PC-PLC signal PLC. 7. PLC switches conveyor motor control relays. 8. PLC switches conveyor motor ON. 9. Conveyor Motor starts in reverse direction.
3	**X-ray Controller**	X-ray generator output is switched OFF.	X-ray generator is switched ON.	1. Xray.exe sends LPT1 output 2. LPT1 output goes to PC-PLC Board 3. PLC outputs XRG output enable signal. 4. XRG outputs x-rays
4	**X-ray ON LED**	X-ray ON LED is switched OFF.	X-ray ON LED warning lights are powered ON.	1. Xray.exe sends LPT1 output 2. LPT1 output goes to PC-PLC Board 3. PC-PLC Board signals PLC 4. PLC switches on X-ray ON LED light assembly.
5	**Power ON LED**	Power ON LED is switched OFF.	Power ON LED indicator lights are powered ON.	1. Xray.exe sends LPT1 output 2. LPT1 output goes to PC-PLC Board 3. PC-PLC Board signals PLC 4. PLC switches on Power ON LED light assembly.

Figure 143: PLC Outputs

Wire Color Convention & Fuse Ratings

DC Wires Color Code

- Blue +12 VDC
- Red +5 VDC
- Brown -5 VDC
- Green Ground

AC Wires Color Code

- White 110/220 VAC Neutral
- Black 110/220 VAC Live
- Green Ground

Electrical Fuses

	FUSE (LOCATION)	FUSE RATING
1.	AC Inline Filter for 110VAC Systems	250V – 15A
	AC Inline Filter for 220VAC Systems	250V – 10A
2.	Conveyor Motor	250V – 10A
3.	X-ray Generator Controller Board F1 Fuse	250V – 0.8A
4.	X-ray Generator Controller Board F2 Fuse	for 90 KV Generators 250V – 5A
		For 160KV Generators 250V – 6.3A
5.	X-ray Generator Power Supply (input fuse)	250V – 8A
6.	X-ray Generator Power Supply (generator output fuse)	For 90 KV Generators 250V– 5A
		For 16oKV Generators 250V– 6.3A

The Astrophysics Product Serial Number

All Astrophysics products are labeled with a unique Astrophysics Product Serial Number (APSN). For example, each X-ray Imaging Systems (XIS) is branded with a unique 12 character long ASPN. The ASPN is located on three places on the XIS:

- On the main frame under the exit end of the conveyor bed.
- On the left side of the inspection tunnel. The X-ray generator side panel must be removed to reveal this ASPN.
- On the system software. The ASPN can be viewed from the System Information Screen.

A typical APSN might look like this:

ASTED160XS34

The XIS ASPN has six (6) fields of information.

XIS ASPN INFORMATION FIELDS						
FIELDS	1	2	3	4	5	6
	AST	E	D	160	XS	34

Following is a description of each of the ASPN information fields.

FIELD NUMBER	FIELD DESCRIPTION
Field #1	The first field includes characters 1 to 3. The first field describes the location of product manufacture. *AST identifies the manufacturing location as Astrophysics Inc., City of Industry.* XIS units are currently manufactured only in Astrophysics Inc, City of Industry, California, USA.
Field #2	The second field refers to the 4th character in the ASPN. It encodes the year of manufacture. *A Year of Manufacture = 2001* *B Year of Manufacture = 2002* *C Year of Manufacture = 2003* *D Year of Manufacture = 2004… (and so forth).*

FIELD NUMBER	FIELD DESCRIPTION
Field #3	The third field refers to the 5th character in the ASPN. It describes the calendar quarter of manufacture. *A Calendar Quarter of Manufacture = First Quarter* *B Calendar Quarter of Manufacture = Second Quarter* *C Calendar Quarter of Manufacture = Third Quarter* *D Calendar Quarter of Manufacture = Fourth Quarter*
Field #4	The fourth field includes characters 6 through 8. It describes the type of X-ray generator used. *090 090= Manufactured with a 90 kVp X-ray generator.* *160 160= Manufactured with a 160KVp X-ray generator.* *180 180= Manufactured with a 180kVp X-ray generator.* *200 200= Manufactured with a 200KVp X-ray generator.* *320 320= Manufactured with a 320KVp X-ray generator.*
Field #5	The fifth field includes characters 9 and10. It describes the XIS model number. *XS Model = XIS 5335* *SM Model = XIS 6040 & 6040M (Mobile)* *SS Model = XIS 6545* *SDV Model = XIS 6545DV (dual view)* *SVI Model = XIS 6545VI (aviation market)* *MN Model = XIS 5878* *MM Model = XIS 7858* *LK Model = XIS 1080* *YZ Model = XIS 1080D (downshooter)* *LL Model = XIS 100x* *LLD & LLDM Model = XIS 100XD (downshooter & downshooter mini)* *LDV Model = XIS 100XDV (dual view, upshooter)* *XDX Model = XIS 100XDX (dual view, downshooter)* *TRD Model = 1210D (downshooter)* *XL Model = 1517* *DVXL Model = 1517DV 180 kV & 200 kV (dual view)* *XDV Model = 1517DV 320 kV(dual view)* *XX Model = 1818* *DVXX Model = 1818DV 180 kV & 200 kV (dual view)*
Field #6	The sixth field includes characters 10 through 12. It describes the actual serializing unit number. *34 = Unit number 34. (35 = unit number 35, etc.)*

RUNTIME.INI

Each XIS unit has a RUNTIME.INI file (hereinafter referred to as the *Runtime File*) that contains system configuration information that is specific to that XIS. The *Runtime File* is normally preconfigured at the factory based on the configuration, options, and operating characteristics of the XIS.

Runtime Files are NOT interchangeable between different XIS units. This file should only be changed by a factory trained engineer. An improperly modified Runtime File may cause erratic operation of the XIS and may even halt normal startup of the XIS. However, an improperly modified Runtime File will not cause uncontrolled operation of the X-ray generator and conveyor belt.

The Runtime File is located in the sub-director as follows:

C:\Program Files\XrayClient\runtime.ini

Following are an example of typical configuration parameters for a Runtime File.

	XIS 5335 XIS 5335 EU XIS 5335 S	XIS 6545	XIS 7858	XIS 100x
Diode Expansion=	1	1	1	1
Diode Compression=	0	0	0	1
Diode Count=	512	640	788	1120
PEC1 Control=	1200	1800	1800	1800
ReverseBelt=	600	730	730	730
Height=	1024	1024	1280	1024
Width=	768	768	1024	768

Figure 144: Typical Configuration Parameters

A typical runtime file for a XIS 6545 is listed below.

RUNTIME.INI Parameters

Italicized text are descriptive notes describing the current line of entry.

Non-italicized text are actual entries.

[System]

ThreadPriority=4

Debug=0	*Do NOT change*
Security Key=2	*Security key software revision*
Xray_Series=ASTEA160SS-16	*Serial # (See Appendix for Serial Number Information)*
Xray Timer HH=6	
Xray Timer SS=263998	*The total time the X-ray Generator has been "ON" in milliseconds*

[Mode]

Width=1024	Number of horizontal pixels in image screen
Height=768	Number of vertical pixels (columns) in image screen
PEC_Control=1800	Delay time before X-rays turn on when a bag crosses photocell.
ReverseBelt=400	Back belt time interval
XrayWarmup=546	Delay time for X-ray generator to ramp up to full output

[Devices]

Joystick Type=1	0=Logitech type xkeypad 2=Microsoft type

[Data Input]

TestMode=1	Do NOT change
DiodeCount=628	Number of diodes
SamplingRate=800	LXDA Analog to Digital conversion sampling rate
StartDiode=0	Nbr of diodes to skip on first LXDA board before displaying image.
PrefetchEnable=0	
DiodeExpansion=0	Flag to expand image to elim. geom distortion fr folded LXDA array

DiodeCompression=0	Flag to compress diodes for folded array geometry correction.
InputFilterMode=0	
Key Override=0	0=no key-switch over-ride. 1=ignore key-switch (always ON)
PEC active state=1	This flag inverts the active state for the photo emitter cells
InterlockDelay=200	Interlock switch debounce time in milliseconds

[Normalize]

ThresholdH=3000	Do NOT change
ThresholdL=3000	Do NOT change
Normalize Offset=0	Do NOT change
Xray On Delay=300	X-ray ray on ramp up time
Check Diode=260	Do NOT change
Bad Diodes=	list of bad diodes to be interpolated
Averaging Max=3000	Do NOT change
Averaging Mask=3	Do NOT change
Filter Ratio=3	Do NOT change
Bad Diodes Low=	Do NOT change
Bad Diodes High=	Do NOT change

[Display]

DualDisplay=2	0=single display 1=dual display 2=automatic
Forward Lt_to_Rt=0	0=Scroll Images Rgt o Left 1=Scroll Lft to Right
ScanDir TopDown=1	
Sharpen	
Color Threshold=80	*Coloration adjustment parameter. Higher=less colors.*

Color Threshold Value=65534	Do NOT change
Opaque Flash=0	Do NOT change
Opaque Threshold=0	Do NOT change
Opaque Color Hi=63588	Do NOT change
Opaque Color Lo=20	Do NOT change
Opaque Black Hi=63588	Do NOT change
Opaque Black Lo=65534	*Do* NOT *change*
[Video Banks]	Do *NOT change*
Organic=1	Do NOT change
Inorganic=1	Do NOT change
BlackWhite=1	Do NOT change
A=1	Do NOT change
B=1	*Do NOT change*
[Options]	
Image Archive=1	0=IA disabled. 1=IA enabled.
Threat Project=0	0=TIP projection disabled. 1=TIP Projection enabled.
Screener Assist=0	*0*=Screener *Assist is disabled. 1=Screener Assist enabled.*
[File Pointer 768]	*For IA files* with *768 vertical pixels.*
Current Pointer=-1	Location the IA pointer. -1=Start new IA file.
Count Bag=0	Number of bags scanned
Tip Bags=0	*Number of TIP bags scanned*

[File Pointer 1024]	*For IA files with 1024 vertical pixels*
Current Pointer=-1	Location of the IA pointer. -1=Start new IA file.
Count Bag=0	*Last IA bag count.*
[File Pointer 1200]	*For IA* files *with 1200 (i.e. 1168) vertical pixels*
Current Pointer=-1	Location the IA pointer. -1=Start new IA file.
Count Bag=0	*Last IA bag count.*
[Server Name]	
Server Name=	
Debug Name=127.0.0.1	*TIP* Loopback *address*
[Protected]	
MonthReportLimit=4	*TIP* reports *will be accumulated for this number of months.*
TerminationInt=1	*0*=Disable *user exit. 1=Enable user exit.*
AstroOnOff=1	*0*=Display *generic logo. 1=Display Astrophysics logo.*
AstrophysicsModel=6545	*XIS* model *type.*
Tip OnOff=0	*0=TIP disabled. 1=TIP Enables.*
JoyStickOnOff=0	*0=Game joystick 1=Xkeypad 2=AOCP keypad*
KeyPadOnOff=1	
UserName=Operator	Username
[Printer]	
Printer OnOff=0	*0=Printer Enables or Disables Printing functions*
[Language]	
CurrentLang=English	*Default* Language

[Voltage]

Xray Voltage=80	IGNORE *THIS – Xray Controller is factory configured*
Xray Current=0	IGNORE *THIS – Xray Controller is factory configured*

[TipInfo]

TipInterval=4	*TIP* intervals
TipVariant=2	*TIP* Variant
TipTotalFiles=65	# of TIP images
Tip Dir Lib=C:\Program Files\Xray Client\Tip Images	*TIP library sub-directory name*

Installing the Xray Client Rev 2.0.2.3 Upgrade

Purpose and Description

This guide describes the steps required to upgrade the Xray Client imaging software to revision 2.0.2.3 on XIS machines currently operating in the field.

NOTE: A prerequisite for Xray Client REV 2.0.2.3 to function properly is a PLC upgrade. This is described in the separate instruction "HOW TO: Install the PLC System Shutdown Upgrade." It includes a firmware revision and minor wiring changes. Confirm that this procedure has been completed before installing Xray Client REV 2.0.2.3.

Minimum System Requirements

1. Dell OptiPlex PC (745, 755, or 760).
2. 2 GB RAM.
3. PLC with firmware REV 7 and associated additional wiring.
4. Optional: LabJack data acquisition module.

NOTE: Xray Client 2.0.2.3 currently supports only the LabJack DAQ. An XIS equipped with a National Instruments DAQ requires upgrade to a LabJack for Diagnostics 2.0 functionality.

Parts Included:

1. Replacement hard drive with Xray Client REV 2.0.2.3 pre-installed.
2. USB security key.
3. Optional: 1 GB module of non-ECC dual channel 800MHz DDR2 SDRAM.

NOTE: Dell OptiPlex 745 and 755 models are shipped with 1 GB RAM requiring upgrade to 2 GB. 760 models are already shipped with 2 GB RAM. See Procedure Step 2 below.

Required Materials and Tools:

1. Wrist grounding strap.
2. USB keyboard.
3. Optional: USB mouse for convenience instead of the AOCP touchpad. If a USB mouse is unavailable, see the figure below for the equivalent left and right-button mouse click functions.

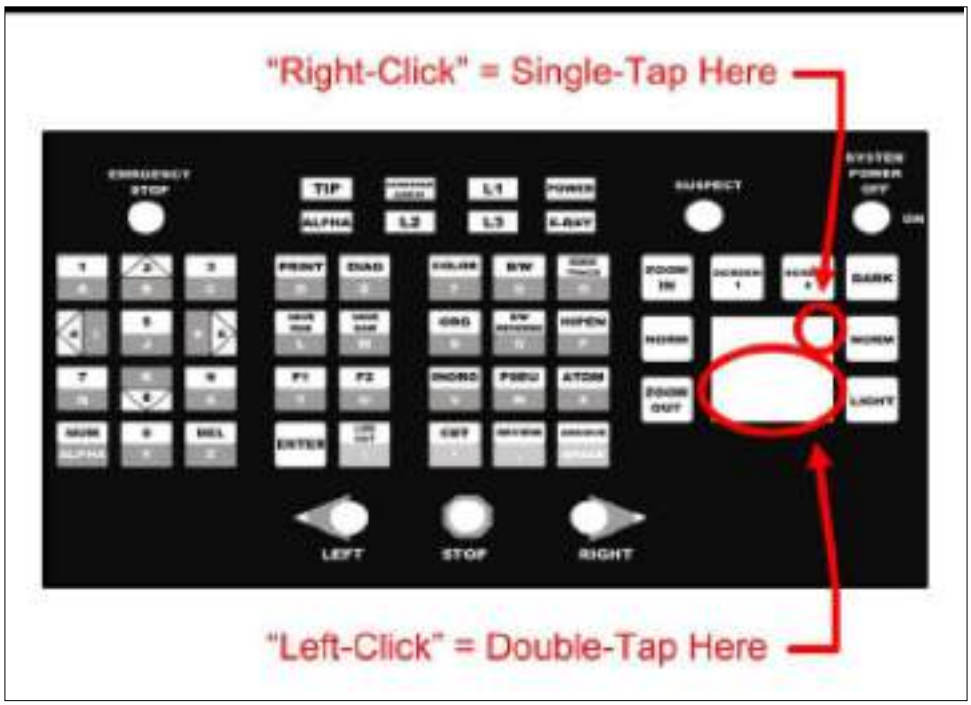


Figure 145: AOCP Touchpad's Equivalent "Mouse Click" Functions

Procedure

1. PLC Upgrade: Please confirm that the required PLC upgrade has been completed as described in the Purpose and Description section above, under "NOTE." If this is not done in advance, the system will not start up properly.
2. Copy of Old Xray Client: Make an accessible copy of the Xray Client software being replaced before replacing the hard drive. There is always a copy on the old hard

drive, but it will be necessary to have a copy on a USB flash drive or an external hard drive, as a number of system-specific files and settings from the old software will need to be copied over to the new software.

a. To copy the Xray Client folder, the technician must first access the Windows XP desktop. Begin by turning the system on with the AOCP system power key switch. After initialization is complete and the X-ray imaging log in screen will be displayed. Point and click anywhere on the log in screen (left-hand side, "Screen 1") to make it active. See Figure 146 below.

NOTE: When using the AOCP touchpad, a double-tap on the pad is the equivalent of a left-button mouse click.

Figure 146: X-ray Imaging Log In Screen

b. With the X-ray imaging log in screen active, press the AOCP's "ENTER" key or the keyboard "Esc" key to go to the Windows XP desktop. See figure below.

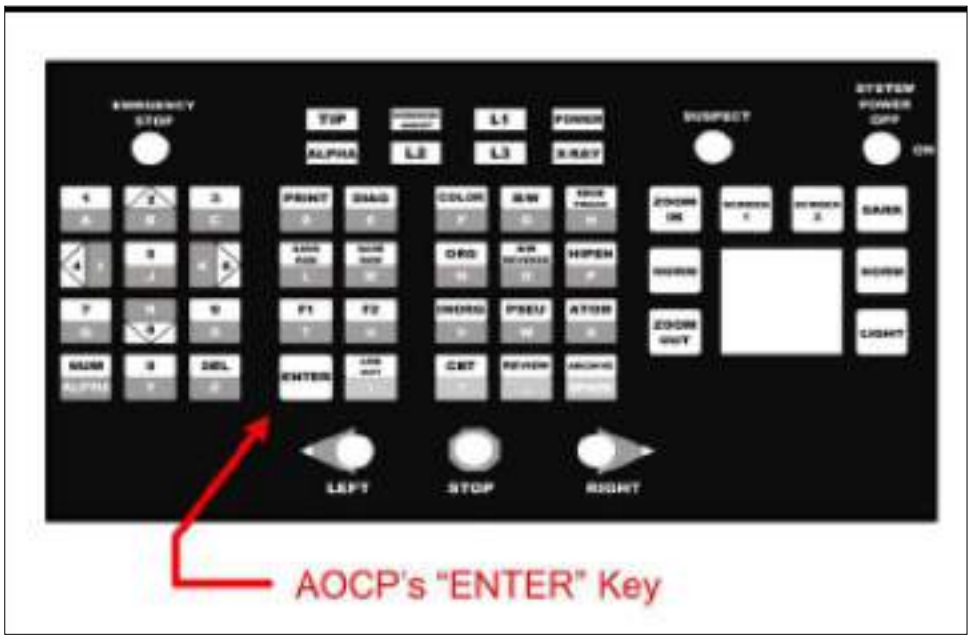


Figure 147: AOCP's "ENTER" Key

c. The Xray Client folder is located along the following path: "C:\Program Files\Xray Client." If there is any problem locating the folder, follow the steps below:

   i. Click the Windows XP "Start" button, and then the "My Computer" menu item.

   ii. Double click the "Local Disk (C:)" drive.

   iii. Double click the "Program Files" folder to open it.

   iv. Locate the "Xray Client" folder in "Program Files" contents.

d. Copy the folder to a USB flash drive or to an external hard drive. Most XIS systems have external USB access to the PC via USB extension cable, or a USB hub in one of the monitors. If there is no external USB access, make sure that all standard maintenance safety precautions are complied with, and open the cabinet to gain access to the PC. This will have to be done in Step 4 anyway to replace the hard drive. Any available USB port on the front or back of the PC is acceptable.

e. To help easily identify the copy, rename it by appending the revision number to the end of the folder name. If upgrading from 2.0.2.1 for example, rename the copied "Xray Client" folder as "Xray Client_2021."

3. Minimum RAM Requirement. Xray Client 2.0.2.3 requires the system to have a minimum of 2 GB of RAM. Please confirm this before continuing as explained below, and add additional memory if necessary. Dell OptiPlex 745 and 755 models are shipped with 1 GB of memory and normally require upgrade. 760 models are already shipped with 2 GB of memory.

   a. To view how much RAM the system currently has, the technician must again be at the Windows XP desktop as explained in Steps 2A and 2B above.

   b. Once at the desktop, the system RAM can be viewed via the "Control Panel," in the "System Properties" window, under the "General" tab in the lower right section. If there is any problem locating the system RAM value, follow the steps below.

      i. Click the Windows XP "Start" button (1-A), and then click the "Control Panel" menu item .

      ii. Double-click the "System" icon.

      iii. In the "System Properties" window, confirm the "General" tab is selected. The system RAM value may now be viewed in the lower right section of the window.

   c. If the system RAM is 1 GB, install an additional 1 GB module of 800 MHz DDR2 SDRAM to the PC mother board. See the details below. However, if the system RAM is at least 2 GB, then skip to Step 4 below, "Install Hard Drive."

      i. Make sure that all standard maintenance safety precautions are complied with, power down the XIS, switch off the main circuit breaker (near external power connection), and if the XIS cabinet is not already open, do so now to gain access to the PC. Disconnect all cables to the PC, remove its mounting bracket, and then remove it from the XIS.

ii. Carefully lay the PC on its left side (when viewed from the front). Open the cover located on the right side of the case. This is done using the cover release latch located on the top, back surface of the case. Pull the cover release latch back while lifting the cover up. It will pivot freely on three hinge tabs along the bottom edge of the case. Slip the cover off of the hinge tabs, remove the cover completely from the case, and set it in a safe place. See figure below.

Figure 148: Opening the PC Cover

WARNING!

Before working on the PC internally, be sure to ground yourself to the chassis by using a wrist grounding strap. If unavailable, periodically touch an unpainted metal surface on the computer chassis.

NOTE: Before working on the PC internally, be sure to ground yourself to the chassis by using a wrist grounding strap. If unavailable, periodically touch an unpainted metal surface on the computer chassis.

The internal layout of the PC is shown in the figure below, including locations of the RAM and the hard drive.

Figure 149: PC Internal Layout

d. Expect to see a single 1 GB module in DIMM Connector 1. Connector 1 is located closest to the processor and has white securing clips. See Figure 150.

   i. Install the additional memory module in the matched memory position, DIMM Connector 2. This is not the connector immediately next to the first, but is the other connector with white securing clips, which is two connectors over (Figure 150).

   ii. Pull open the white securing clips at each end of the memory module connector. Align the module in the DIMM connector and press it straight down into place with equal pressure at each end. The securing clips will snap into the cutouts in the ends of the module.

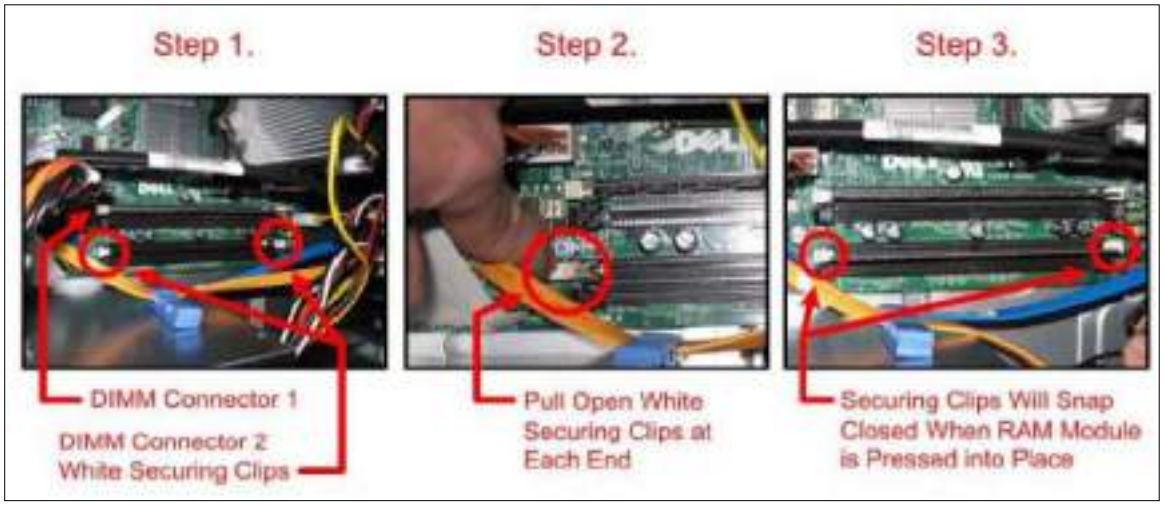


Figure 150: Installing the Memory Module in DIMM Connector 2

   iii. Next, with the PC cover still open, follow Step 4 below to remove and replace the hard drive.

4. Remove and Replace the Hard Drive. Xray Client REV 2.0.2.3 and all the necessary hardware drivers will come preconfigured on the new hard drive. Remove and replace the existing hard drive with the new hard drive. Follow the steps below:

    a. To remove the existing hard drive, first disconnect the data and power cables from the drive. Use the pull-tab on the connectors if they have them. See Figure 151 below.

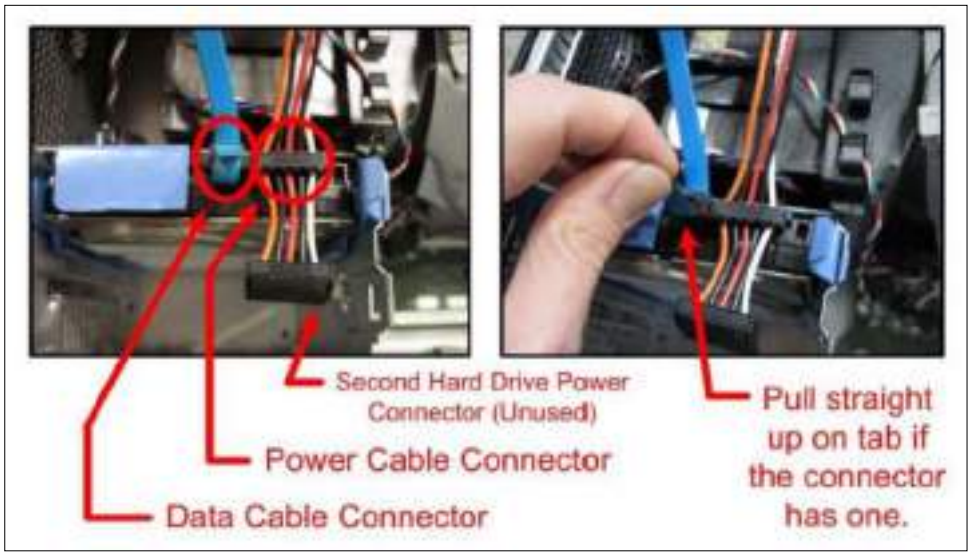


Figure 151: Disconnect Hard Drive Data and Power Cables

    b. Unlatch the drive from its tray slot, by squeezing the two finger tabs of the blue mounting bracket together while gently pulling upward. The hard drive assembly will slide out easily. See Figure 152 below.

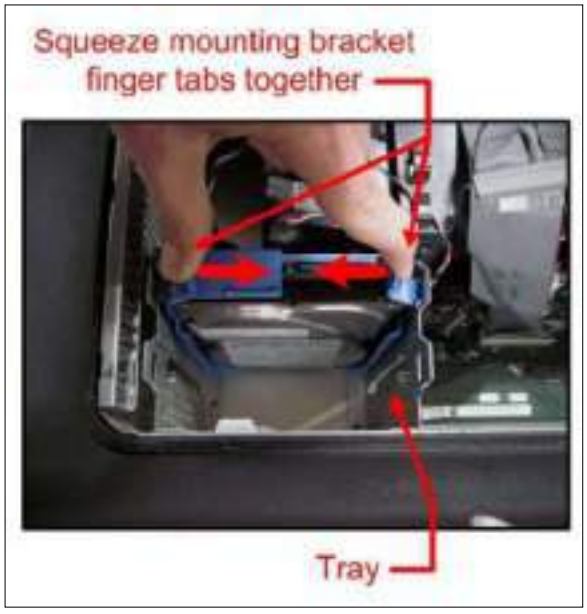


Figure 152: Removing Hard Drive from Tray Slot

c. Remove the hard drive from its blue mounting bracket. The mounting bracket is made of flexible plastic, and has four pins, which insert into matching recesses in the hard drive case. Gently spread the bracket open wide enough to disengage the bracket pins from the hard drive, and remove the hard drive. See figure below.

Figure 153: Removing Hard Drive from Mounting Bracket

d. Finally mount the new hard drive into the mounting bracket. Slide the hard drive assembly back into the same tray slot in the PC, and reconnect the data and power cables.

e. Now, replace the PC cover by hanging it back on the three hinge tabs, and then pivot it into place until the cover release latch snaps closed again.

f. Mount the PC back into the XIS with its mounting bracket, and reconnect all cables to the PC.

g. Switch the main circuit breaker back on. Start the system up and confirm that it boots normally. Again return to the Windows XP desktop, and confirm that the RAM is recognized by the PC as covered in Step 3A through Step 3C above before continuing.

5. System-Specific Files and Settings From Old Xray Client. To maintain certain important settings from the previous software, make the following changes.

a. Step 5A. Change the settings listed below in the new "runtime.ini" file to match the same settings in the old "runtime.ini" file. The files are located in their respective "Xray Client" folders. Make sure at least these changes are made, but without restriction if others require specific tuning. The header where each is located in the runtime.ini file is given in brackets.

- [System] "Xray_Series" (machine serial number)
- [System] "Xray Timer HH"
- [System] "Xray Timer SS"
- [Mode] "ReverseBelt"
- [Data Input] "DiodeCount"

- [Data Input] “StartDiode”
- [Normalize] “Normalize Offset”
- [Normalize] “Bad Diodes”
- [Display] “Opaque Threshold”
- [Options] “Diagnose On”
- [Options] “Screener Assist”
- [Protected] “Astrophysics Model”

b. Copy the “GeoTable640.dat,” “GeoTable1024.dat,” and “Geotable1216.dat” files from the old Xray Client folder, into the new Xray Client folder. This will overwrite and replace the existing files in the new folder.

c. If the old software contained operator usernames and passwords that must be kept, simply copy the “XRayDataBase.mdb” Microsoft Access file from the backup copy of the old software.

6. USB Security Key. Shutdown the XIS. Remove the old USB security key and insert the new one. Xray Client REV 2.0.2.3 will now be ready for operation. See Figure 154below.

Figure 154: USB Security Key

7. Gain Recovery. With the introduction of 2.0.2.3, a new procedure for setting a specific gain for each machine is available. This is in favor of using the generic factory setting for the particular XIS model, and will optimize image quality.

NOTE: It is best to accomplish this procedure from a cold startup. If the system has been running for an extended period of time, shut it down and let it cool to ambient temperature before proceeding.

a. Turn on the XIS machine.

b. At the log in screen, exit to the desktop.

c. Navigate to and open “runtime.ini”.

d. Under the "[gain]" header, set both "recover=0" and "saveman=1".
e. Save and close "runtime.ini".
f. Restart Xray Client and login to the X-ray application.
g. With an empty tunnel, press the "Left" button. X-rays will go on for approximately five seconds, and then will go off automatically.
h. Press the "Stop" button.
i. Logout of the X-ray application.
j. At the log in screen, again exit to the desktop.
k. Navigate to and again open "runtime.ini".
l. Both under the "[gain]" header, set "recover=1" and "saveman=0".
m. Save and close runtime.ini.
n. The correct gain for the XIS machine is now saved.

The figure below is an example excerpt from "runtime.ini" for an XIS-6545 running Xray Client Rev 2.0.2.3, and shows the parameters under the "[gain]" header. This header is the last one in the file.

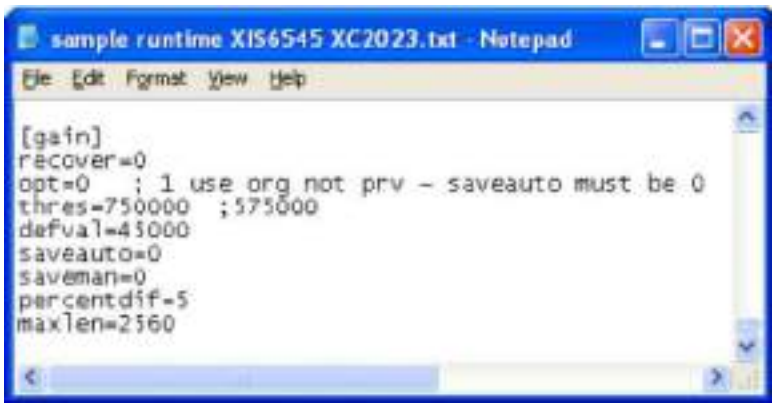


Figure 155: Example Excerpt from "runtime.ini" File ("[gain]" Header)

8. Inspect, Secure, and Test the XIS. Before closing up the system, inspect the inside of the cabinet for good connections, cleanliness, and any remaining tools. Close and secure all panels. Run a complete operational test to confirm the machine is working properly.

Troubleshooting

Condition 1: System remains in continuous scanning, X-rays will not turn off, and horizontal lines appear in the scanned images.

Confirm that the "Gain Recovery" procedure in Step 6 above was done correctly. The generic gain may be too far off and the system requires a specific gain to be established.

Changing the XIS Default Operating Direction

The majority of XIS models are designed to be operated bi-directionally subject to minor limitations/modifications as described below. The default, normal scanning direction for all XIS systems is “Right-to-Left” with the operator assumed to be on the X-ray generator side of the unit, which is where a machine-fixed AOCP is located.

For various installation and traffic flow requirements, the operator’s position may need to be reoriented, especially with Remote Workstation where the AOCP is not fixed to the frame and may be easily placed on either side of the unit. This changes the operator’s perspective of scan direction with respect to AOCP conveyor LEFT and RIGHT buttons, image scrolling direction on the monitors, etc.

There are two main scenarios for changing the default conveyor direction on an XIS machine. Figure 156 shows the first such scenario, which involved revolving the machine itself 180 degrees and changing the direction of the conveyor.

Scenario 1 – XIS frame turned 180 degrees

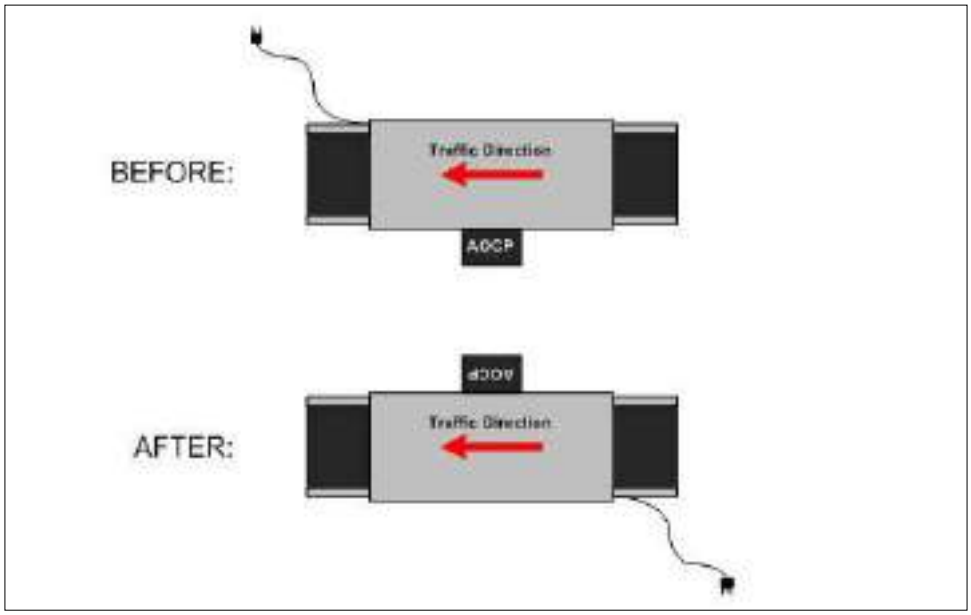


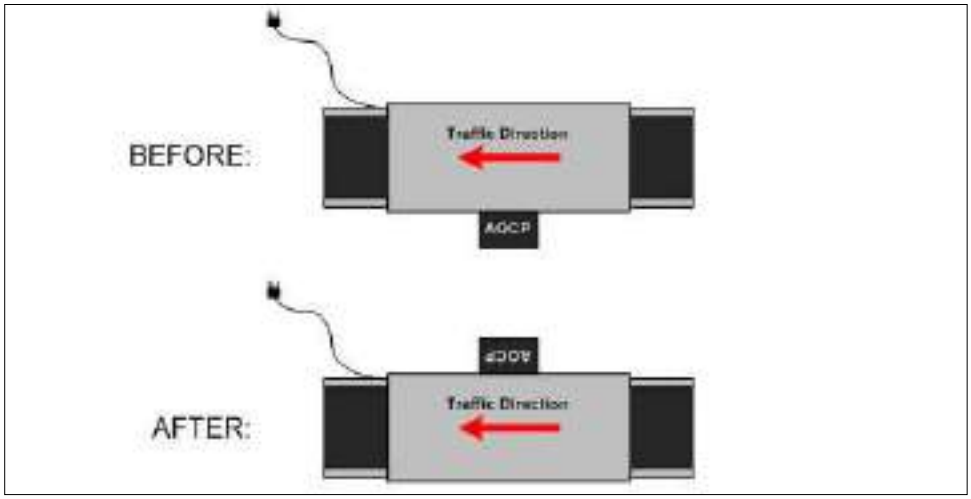
Figure 156: XIS Turned 180 Degrees

In this case, the only task is to realign the belt for the new preferred direction. The photocells will register bags correctly for X-ray operation, bag count, and image archiving. “PEC 2” will now be the entry-side photocell, and “PEC 1” will now be the exit-side photocell.

NOTE: In single-motor systems, it is best to also swap motor roller and idle roller positions in the conveyor for best mechanical stability. It isn’t absolutely necessary but the belt is more likely to stay aligned if it is pulling the parcels rather than pushing them. For dual-motor systems this is not an issue due to symmetry.

The second scenario involves leaving the machine in the same position, orientation, and belt direction, but changing the position of the AOCP.

Scenario 2 – XIS frame in original orientation, AOCP or Remote Workstation placed on opposite side of unit



1. Switch the connections of the photocell receiver wires so that the software sees the "entry" & "exit" cells in the correct order. In older systems with no DCI board, this is done at the DC terminal block where the PEC receiver signal wires come into the block, corresponding to pins 1 & 6 of the DB-9 serial port of the PC. In systems with a DCI board, this is done at the terminal block "TB4" where the PEC receiver signal wires are connected.
2. Switch the connections of the PLC inputs for conveyor left & right (input terminals I/1 & I/2). Alternatively, switch the orientation of the motor direction wires at the output terminals of the Motor Direction Relay (terminals 3 & 4). These are the blue and brown wires coming from the motor wire harness(es). Either of the two above options has the same result; choose whichever is the more easily accessible on the unit. Switching the PLC inputs, however, makes it easier to return to the machine to the original configuration when needed.
3. Change the direction of horizontal video scrolling by setting the "runtime.ini" parameter "Forward Lt_to_Rt=" to "1" instead of "0" (under the "[Display]" header).
4. *(Optional for "Up Shooter" & "Down Shooter" machines/views only, "Side Shooters" should remain unchanged).* Change the vertical video image orientation by setting the "runtime.ini" parameter "ScanDir TopDown=" to "0" instead of "1" (under the "[Display]" header). This will maintain the same relationship between the direction that a flat object is placed horizontally on the conveyor, and the direction that the image is displayed vertically on the monitor. The default orientation is to draw image columns on the display in a "top down" orientation with respect to LXDA order (from board #1 to the last board). This has the effect for example with a briefcase, of having the handle displayed at the bottom of the screen if placed on the conveyor with the handle toward the operator.

   The disadvantages to making this setting change is that the software does not support Picture Perfect or Screener Assist functions in this "bottom up" display orientation. With Picture Perfect, it will flip the image back to "top down" when it's activated. With Screener Assist, the image will still be in the same "bottom up" orientation, but it will draw the ellipses on the vertically-opposite side of the screen, as if the image was still in that "top down" orientation.

This video adjustment is never necessary for a “Side Shooter” view because anything but the default mode will result in an apparently inverted image.

NOTE 1: “Scenario 2,” “Steps 1-3” are now addressed directly by software in Xray Client 2.1.2.5 and later revisions requiring no hardware wiring changes. This is via a checkbox option in the “Management” > “System Configuration” menu called “Swap Directions.” There is a corresponding “runtime.ini” parameter (under the “[Data Input]” header) called “Swap Directions.” Xray Client will automatically update this setting. The user must make the change only in management mode, not in the runtime.ini file, because it will be overwritten by Xray Client to the last setting saved in the management menu.

NOTE 2: When running in the Left-to-Right direction, “Image Review” and “Image Archive” mirrors the images horizontally (i.e. about the vertical axis) such that they appear flipped 180 degrees. This problem is corrected in Xray Client 2.1.2.6 and later revisions, and also includes a correction to the limitations described in “Step 4” above.

Restoring the SQL Database & Desktop Engine

In Xray Client 2.1.2.X and later, an SQL database and desktop engine is installed, which maintains things such as user accounts, user transaction data (scanning session & TIP performance), administrator-defined TIP schedules, etc. If the database becomes corrupt for any reason, Xray Client will hang up and not allow machine operation.

The most common symptom of this appears at boot up; the blue initialization status bar runs indefinitely and never finishes.

The steps given below will return the system to normal operation. One disadvantage is that all existing data will be lost and the system be returned to factory default. Because of this, beginning with REV 2.1.2.5, a button will be provided in the System Configuration menu to allow manual creation of a database backup file. Presumably, the same function will also be able to be run via the Windows scheduler to periodically backup the database automatically. In the meantime and for earlier revisions (2.1.2.3 & 2.1.2.4), the following is the procedure to restore a corrupt database:

1. After system startup and at the Log In screen, if the blue status bar keeps running and the “Initializing, Please Wait” dialog remains, the database is likely corrupt.
2. Place the mouse anywhere on Screen 1, double tap the touchpad, and then press the AOCP “ENTER” key to exit to the Windows desktop.
3. Double tap “Start” > “Control Panel” > “Add or Remove Programs” > “Microsoft SQL Server Desktop Engine” > “Remove” to uninstall the database engine.
4. Double tap “Start” > “My Computer” > “C:”. Find and delete the following two items from the list on the root directory of the hard drive (C:\). Select the item then > “File” > “Delete.”
5. “Astrophysics” (this is a folder)
6. “astro” (this is a stand-alone database file)
7. Shut the system down with the key switch.
8. Wait 1 minute after the green system lights on the cabinet go out.
9. Restart the system.

10. Place the mouse anywhere on Screen 1, double tap the touchpad, and then press the AOCP “ENTER” key to exit to the Windows desktop.
11. Double tap “Start” > “My Computer” > “C:” > “Program Files” > “Database setup” > “install.bat”. This will run the installer and restore the database.
12. Double tap “Start” > “Xray Client” shortcut to restart Xray Client. The system will initialize normally with the default accounts restored. Log in and scan as normal.

Resetting the NVidia Multi-Screen Video Display Mode to “Horizontal Span”

This guide describes what is required to reset the correct video display mode in single-view XIS units using two monitors and an NVidia GeForce video card with the control application “NVIDIA Control Panel.” Because the video card is constantly communicating with the monitors, if one monitor’s power or video signal is interrupted while the PC is operating, the display mode occasionally reverts to its default “Single” setting, causing one monitor to go into standby mode (dark). The correct mode for normal operation is “Horizontal Span,” which allows the desktop to be stretched across both monitors as if they were one.

Access the Windows Desktop.

Depending on the version of Xray Client software being used, the user interface varies somewhat. Please follow the instructions below by the given version.

1. Xray Client REV 2.1.X.X
    a. Login as an Administrator to the Management mode (default password is “1111”).
    b. Click the "System Configuration" button on the main menu.
    c. Make sure the "Allow OS Access" option is checked on the left side of the System Configuration menu, then click "Save & Exit" which will close the menu. This will ensure that you are able to exit to the Microsoft Windows XP or Windows 7 environment.
    d. Back in the main menu click "Exit".
    e. Back at the Login screen, press the control panel "ENTER" button to exit to Windows. If it doesn't, then point inside the Password entry box, double-tap the control panel touchpad. Once you see a thin vertical black cursor blinking in the left side of the box, press the "ENTER" button again on the control panel.
2. Xray Client REV 2.0.X.X
    a. Login to Administrator mode w/ User Name "Administrator" and Password “929835`”.
    b. Click the "Registry" button in the upper right corner of the User Manager menu.
    c. Make sure the first option in the Optional box (upper right corner of the Protected Registry menu) is checked as "Able to Terminate", then click

"Save" which will close the menu. This will ensure that you are able to exit to the Microsoft Windows XP environment.

d. Back in the User Manager menu click "Exit".

e. Back at the Login screen, press the control panel "ENTER" button to exit to Windows. If it doesn't, then point inside the Password entry box, double-tap the control panel touchpad. Once you see a thin vertical black cursor blinking in the left side of the box, press the "ENTER" button again on the control panel.

Run the "NVIDIA Control Panel" and Reset the Correct Video Mode

1. Right-click on the Windows desktop to display the context menu shown in Figure 1 below.
2. Double-click the "NVIDIA Control Panel" menu item highlighted in the same figure.

Figure 157: Windows Context Menu

3. In the NVidia Control Panel's main menu shown in Figure 2 below, choose the following:

a. Find the "Select a Task…" pane on the left-side.

b. Find the "Display" section.

c. Select the "Set up multiple displays" highlighted in the same figure.

d. This will display the "Set Up Multiple Displays" menu shown in the pane on the right-side.

e. Under "1. Choose the nView display mode to use.", select the "As one large horizontal desktop (Horizontal span)" radio button.

f. Under "2. Select the displays you would like to use.", select the dropdown list option that gives you the correct orientation of the two displays, either "…(1 of 2) + … (2 of 2)" or "…(2 of 2) + … (1 of 2)". Try each as necessary to set the correct order.

g. Under "3. Select the display you want Windows to use as primary.", there should be no options to change.

4. Close the NVidia Control Panel.

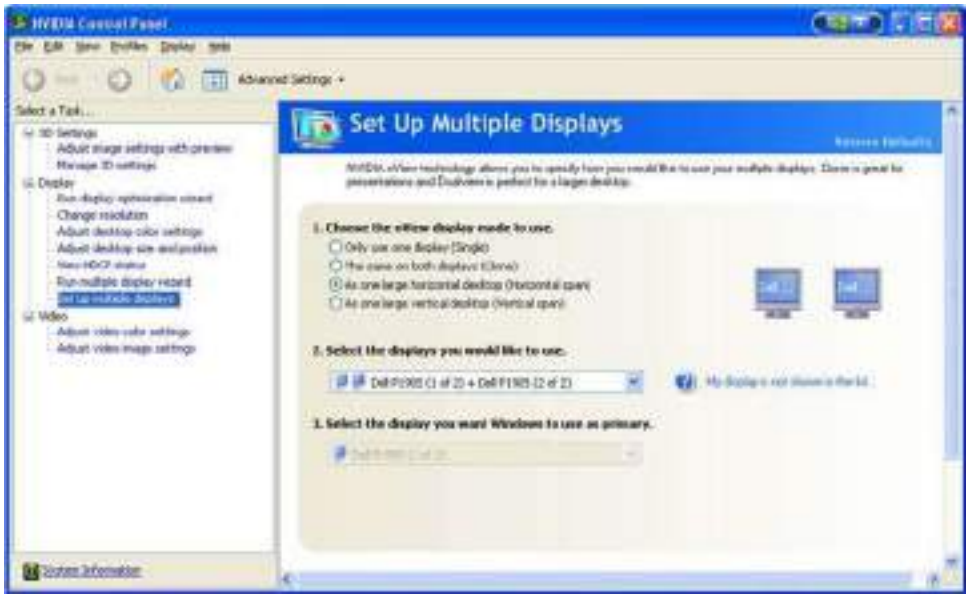


Figure 158: NVidia Control Panel

Restart the Xray Client Software

1. Place the mouse over the bottom left corner of the left-side screen to bring up the auto-hidden taskbar.
2. Click the Windows "Start" button.
3. Find and click the shortcut "Xray Client" pinned to the top of the Start menu.
4. The X-ray Login screen should be displayed again.

Resetting the AOCP X-ray On Indicator LED

If the AOCP's X-ray On indicator LED (see Figure 159 below) is out of sequence with actual X-ray operation, that is, off when X-ray is on, and on when X-ray is if, it's due to the Num Lock function being activated incorrectly in Windows. To deactivate it, please use the following steps below.

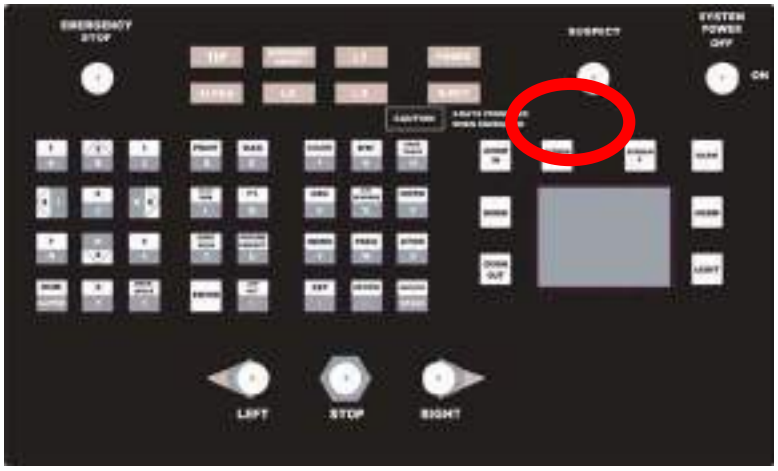


Figure 159: AOCP X-ray On Indicator LED

1. Exit to the Windows desktop.
2. Run the Windows virtual keyboard and click the "nlk" (Num Lock) button (see Figure 160below). It may be found along the path:
3. Start > All Programs > Accessories > Accessibility > On Screen Keyboard.

Figure 160: Windows XP On-Screen Keyboard "nlk" (Num Lock) Button

Deleting the “Archive Raw” images

1. Log out into Windows
    a. Exit X-ray Client program. Press the Enter key on the Control Panel to exit.
2. **Open** “**Archive Raw**” Folder
    a. Right mouse click on My Computer.
    b. Select Explore (see Figure 161 below).

Figure 161: My Computer > Explore

    c. Expand Local Disk (C:)
    d. Expand “Program Files” folder.
    e. Open “Xray Client” folder.
    f. Find and open the “Archive Raw” folder

Figure 162: Edit > Select All (“.wim” files)

    g. Click on Edit on the top menu and click on Select All.

h. Click on the Delete button. (This may take several minutes, depending on how many files.)

i. Now open the Recycle Bin on the desktop. If the files were moved there, then empty the recycle bin to delete.

3. Resetting the Bag Counter

   a. It's also important (but not required) to reset the system bag counter so it matches the number of bags in the "Archive Raw" folder.

   b. To do this, open the same "Xray Client" folder and find in it a text file named either "runtime" or "runtime.ini."

   c. Open this text file, and locate about 2/3 the way down the file a few short sections grouped together called "[File Pointer 768]," "[File Pointer 1024]," and "[File Pointer 1200]."

   d. Under each of these sections are parameters named "Count Bag=" with some integer value.

   e. Only one will likely have a non-zero value, the active bag counter. However go ahead and change any value that is not zero to be zero such that they all look like "Count Bag=0" and this will ensure the counter is set to zero.

   f. Save the file by clicking on File on the top menu and select Save.

   g. Close the file either by clicking on File again and select Exit, or by clicking the white-on-red X in the upper right corner of the window.

4. Starting Xray Client

   a. There might be a shortcut on the desktop called "Shortcut to Xray Client" or "Xray Client". Click on it and it will start up the program.

   b. If there is no shortcut on the desktop, you need to do the following:

      i. Click on the Start button

      ii. Then go to Programs

      iii. Then Startup

      iv. Then click on X-ray Client

      v. This will start up the program and take you to the log in screen.

NVIDIA Control Panel (REV 4.8.750.0) Settings for Windows 7 / XIS-6545VI

1. Right-click on the Windows desktop and choose NVIDIA Control Panel:

Figure 163: Windows Context Menu

2. Select the orientation of the two displays for proper left & right order:

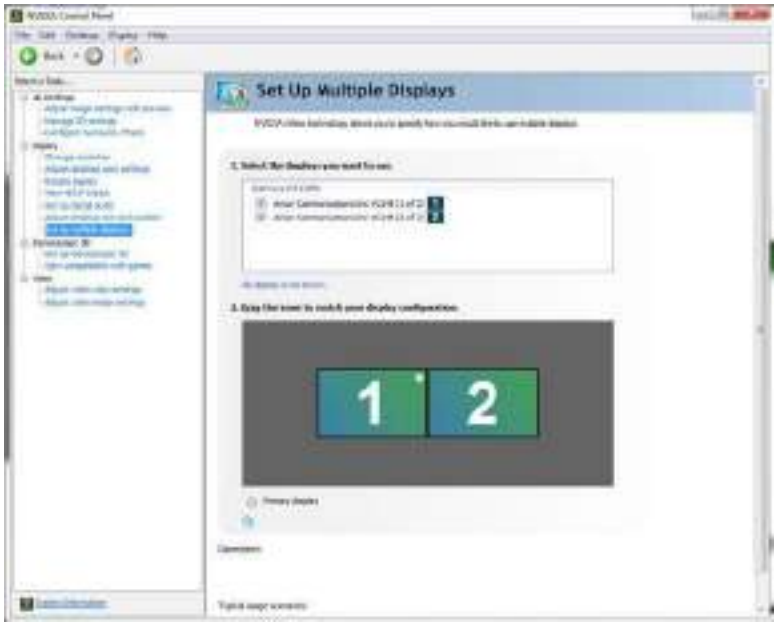


Figure 164: NVidia Control Panel

3. Choose the proper “1680 x 1050” resolution (done for each monitor at a time):

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Replacement Parts Lists

Following are lists of replacement parts for various XIS non-pallet systems. They are divided into:

- Critical Components
- Basic Common Parts
- Cables
- Belts
- Motors
- Idler Rollers
- Snub Rollers
- Curtains

Critical Components

Part No.	CRITICAL COMPONENTS
03-00-0002-10	Control Panel (ADCP), 7' side mount
03-00-0001-10	Control Panel (ADCP), 15' table mount
03-00-0004-00	LXDA Board w/ Photodiodes
03-00-0102-00	LXDA Board w/ Photodiodes 1517-1818
05-00-0058-00	PLC
05-00-0054-00	UPS, 220VAC
05-00-0055-00	UPS, 110VAC
05-00-0068-00	Power Supply 5VDC, 12A
05-00-0060-00	Power Supply 12VDC, 7A
05-00-0663-00	Switching Power Supply 12V
05-00-0664-00	Switching Power Supply 5V 6.5A
05-00-0665-00	Switching Power Supply 5V 16A
03-00-0006-00	PC, DELL w/DAS, USB Security Key
05-00-0096-00	USB Security Key
02-00-0088-00	DAS Board, 2.0
02-03-0004-00	180 KV Generator Set
02-02-0003-00	160 KV Generator Set
02-01-0005-00	90 KV Generator Set
05-00-0525-00	180 KV Generator Tank
05-00-0084-00	160 KV Generator Tank
05-00-0122-00	90 KV Generator Tank
05-00-0517-00	180 KV Controller
05-00-0049-00	160 KV Controller
05-00-0050-00	90 KV Controller
05-00-0526-00	65V Power Supply (180KV)
05-00-0085-00	65V Power Supply (160KV)
05-00-0086-00	65V Power Supply (90KV)
02-00-0159-00	PCB, DCI

Figure 165: Critical Components

Basic Common Parts

Part No.	BASIC COMMON PARTS
05-00-0056-00	10A Circuit Breaker (220V)
05-00-0057-00	15A Circuit Breaker (110V)
03-00-0007-00	PC/PLC Board
03-00-0003-00	LED Board
01-00-0023-00	ADCP Daughter Board (Interface board)
05-00-0515-00	Emergency Stop Switch, lighted
05-00-0070-00	Interlock Switch
05-00-0114-00	Key Switch
05-00-0156-00	Relay, 12VDC
05-00-0072-00	Fuse, 10A
05-00-0001-00	Eprom, DAS
02-00-0079-00	Cypress Chip
05-00-0218-00	250 GB Hard Drive
05-00-0127-00	Capacitor, 35MFD
05-00-0052-00	Photocell Transmitter
05-00-0051-00	Photocell Receiver
05-00-0454-00	Inverter Drive-Allen Bradley, 110V
05-00-0453-00	Inverter-Allen Bradley230(A)

Figure 166: Basic Common Parts

Cables

Part No.	CABLES
01-00-0025-00	20 Pin Cable & Connector
01-00-0020-00	40 Pin Cable 4 ft.
01-00-0005-00	6" 10 Pin LXDA Power Connector
01-00-0010-00	5335 LXDA Power Cable Harness
01-00-0009-00	6545 LXDA Power Cable Harness
01-00-0011-00	7858 LXDA Power Cable Harness
01-00-0008-00	100XD LXDA Power Cable Harness
05-00-0042-00	RCA Cable

Figure 167: Cables

Belts

Part No.	BELTS
01-00-0235-01	Conveyor Belt - 100X SC
01-00-0587-00	Conveyor Belt - 100X LC
01-00-0080-00	Conveyor Belt - 100XD SC
01-00-0227-00	Conveyor Belt - 100XD LC
01-00-0478-01	Conveyor Belt - 100XDV SC
01-00-0040-01	Conveyor Belt - 5335s SC
01-00-1586-00	Conveyor Belt - 5335s LC
01-00-1797-00	Conveyor Belt - 6040 SC
01-00-1798-00	Conveyor Belt - 6040 LC
01-00-1360-00	Conveyor Belt - 6545 SC
01-00-1490-00	Conveyor Belt - 6545 LC
01-00-0174-01	Conveyor Belt - 6545DV SC
01-00-2699-00	Conveyor Belt - 5878 LC
01-00-1345-00	Conveyor Belt - 7858 SC
01-00-0080-00	Conveyor Belt - 1080D SC
01-00-0942-00	Conveyor Belt - 1210D FC

Figure 168: Belts

Motors

Part No.	MOTORS
05-00-0139-00	100X Motor
05-00-0144-00	5335 Motor
05-00-0469-00	6040 Motor
05-00-0124-00	6545 Motor
05-00-0491-00	5878 Motor
05-00-0148-00	7858 Motor
05-00-0139-00	1080 Motor (same as 100X)
05-00-0549-00	1210D, Motor
05-00-0542-00	1517 .5HP, Gear Motor
05-00-0188-00	1818 1HP, Gear Motor

Figure 169: Motors

Idler Rollers

Part No.	IDLERS
05-00-0145-00	5335 Idler
05-00-0470-00	6040 Idler
05-00-0125-00	6545 Idler
05-00-0492-00	5878 Idler
05-00-0149-00	7858 Idler
05-00-0550-00	1210D, Idler

Figure 170: Idlers

Snub Rollers

Part No.	SNUB ROLLERS
05-00-0761-00	100X Roller, Heavy Duty
05-00-0146-00	5335 Roller
05-00-0471-00	6040 Roller
05-00-0126-00	6545 Roller
05-00-0262-00	5878 Roller
05-00-0150-00	7858 Roller
05-00-0761-00	1080 Roller, heavy Duty
05-00-0548-00	1210 Roller
05-00-0697-00	Roller, Grav, 1517 Zinc PL
05-00-0695-00	Roller, Sprocket, 1517
05-00-0698-00	Roller, Grav, 1818 Zinc PL
05-00-0696-00	Roller, Sprocket, 1818

Figure 171: Snub Rollers

Curtains

Part No.	CURTAINS
03-00-0230-00	Curtain, One Side, 5335/5335S
03-00-0231-00	Curtain, One Side, 6040
03-00-0232-00	Curtain, One Side, 6545
03-00-0233-00	Curtain, One Side, 7858
03-00-0234-00	Curtain, One Side, 5878
03-00-0235-00	Curtain, One Side, 1080
03-00-0236-00	Curtain, One Side, 1080D
03-00-0237-00	Curtain, One Side, 100X
03-00-0238-00	Curtain, One Side, 100XD
03-00-0239-00	Curtain, One Side, 100XDV
03-00-0240-00	Curtain, One Side, 1210D
03-00-0241-00	Curtain, One Side, 1517
03-00-0242-00	Cuurtain, One Side, 1818

Figure 172: Curtains

Preventive Maintenance

Preventive Maintenance Steps

Following is a list of Preventive Maintenance steps.

	CHECKLIST ITEM	DESIRED RESULTS	INSPECTION INTERVAL
	Inspect emergency stop switches	All emergency stop switches nominal	Weekly
1	Inspect the conveyor belt alignment	* The belt is centered at both the entry and exit ends of the belt. * The separation between the left edge of the belt and left edge of the X-ray tunnel wall should be equal to the separation between the right edge of belt and the right side of X-ray tunnel wall.	Monthly
2	Inspect the X-ray curtains	* The curtains should show no sign of abnormal wear. * The curtains sheets are layered and staggered correctly. * There are no missing vertical curtain strips. * The curtain strips are trimmed smartly allowing no light leakage into the tunnel.	Monthly
	Perform full system check	All systems are nominal	Semi-Annually
3	Inspect the Advanced Operator Control Panel	* All buttons are securely in place. * All buttons operate as required. * All buttons are properly labeled and mounted in proper order. * The USB cable is mechanically intact. * The USB connector is good shape.	Semi-Annually
4	Inspect the imaging with ASTM F792-88 Step Wedge	* XIS F792-88 image ok * All Wires Visible	Semi-Annually
5	Check Steel Penetration	Penetration within Tech Specs	Semi-Annually
6	Inspect the Diode Plot graph	* The DPG shows no diode signal saturation.	Semi-Annually
7	Inspect the conveyor belt for wear	* The belt shows no sign of abnormal wear or tear. * The edges of the belt show NO fraying cuts	Semi-Annually

	CHECKLIST ITEM	DESIRED RESULTS	INSPECTION INTERVAL
8	Inspect the conveyor belt lacing.	* The lacing strip show NO sign of abnormal wear. * The lacing wire thread through the entire threading strip. * The tail ends of lacing are properly crimped and trimmed	Semi-Annually
9	Inspect the X-ray generator (XRG)	* The XRG should show no signs of oil leakage * The XRG show no sign of internal arcing.	Semi-Annually
10	Inspect the UPS / Measure battery charge	* PEC1 and PEC2 operate normally.	Semi-Annually
11	Inspect Foot Mat	Foot mat operates properly	Semi-Annually
12	Check (measure) radiation leakage	Leakage < 0.1 mR	Annually
13	Inspect the side panels	All screws fastened.	Annually
14	Inspect the LXDA cabling	12V within specs	Annually
15	Inspect the PC keyboard	Foot mat is properly connected.	Annually
16	Inspect the PC mouse	* The PC mouse is present. * The PC mouse is properly connected. * The PC mouse operates properly.	Annually
17	Inspect the PC power cord	* The PC power cord is the correct 14 AWG cable. * The PC power cable plug is good order.	Annually

	CHECKLIST ITEM	DESIRED RESULTS	INSPECTION INTERVAL
18	Inspect the PC, PC Keyboard and PC Mouse power cord connection. d. Check the USB Security Key connection. e. Check the Ethernet Loopback connection. f. Check the DAS board data (40 conductor ribbon cable) connection. g. Check the DAS board HE and LE Coax cable, and power cable connections.	* The PC is present. * The PC is securely fastened down * All cables are properly connected and secured. * The PC Power Supplies is operational. * All cables are properly connected.	Annually
19	Inspect the PC monitors	Monitors operate correctly. Monitors are properly cabled.	Annually
20	Inspect the USB Security Key (USK)	* The USK is present. * The USK is securely installed. * The USK status LED is lit.	Annually
21	Inspect the photocells	* The photocells are properly wired and securely fastened down. * The photocells are aligned. * The receiver indicates a clear signal from the transmitter.	Annually
22	Inspect the interlocks switches.	* The interlock switches are tightly fastened down. * The interlocks switches are properly wired up. * The interlock close properly when the panels are mounted.	Annually
23	Inspect the LXDA cabling	12V within specs	Annually
24	Inspect the Power-ON LEDs lamp	* The LEDs are fastened correctly. * The LEDs are wired correctly . * The LEDs are properly labeled. * The LEDs operate correctly.	Annually

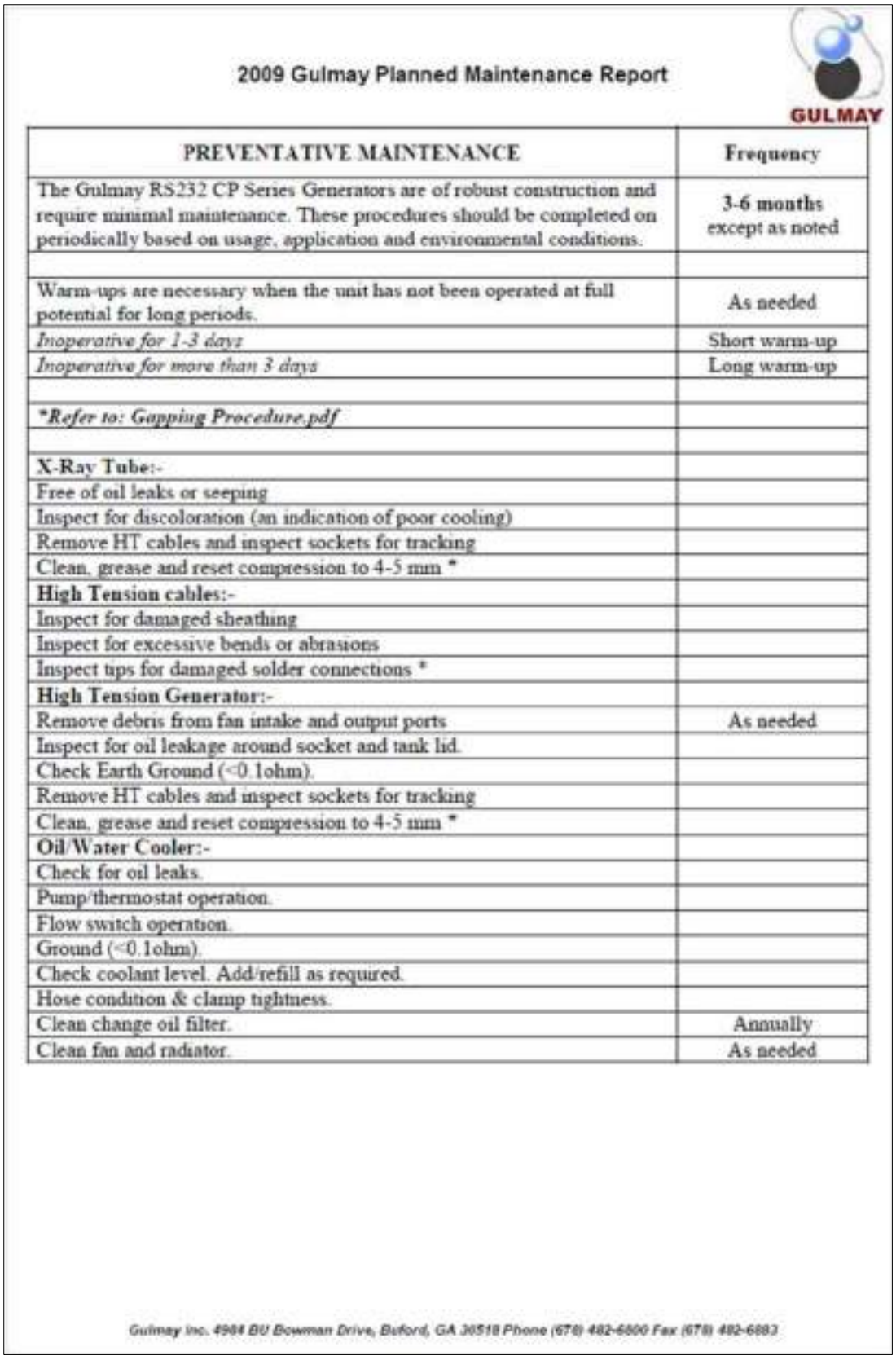
	CHECKLIST ITEM	DESIRED RESULTS	INSPECTION INTERVAL
25	Inspect the X-ray ON LEDs	* The LEDs are fastened correctly. * The LEDs are wired correctly. * The LEDs are properly labeled. * The LEDs operate correctly.	Annually
26	Inspect the PLC	* The Power LED is lit. * The Run LED is lit. * The PLC is properly connected. * The PLC properly switches the PC on. * The PLC properly switches the XRG on.	Annually
27	Inspect the power rollers	* Power roller shows no oil leakage. *Power roller evidences no unusual grinding noises.	Annually
28	Inspect conveyor operation	* The conveyor operates smoothly in both directions.	Annually
29	Inspect the X-ray controller a. Check the KV controller fuse. b. Check the KV controller fuse. c. Check the mA controller fuse d. Measure the 5VDC power input e. Measure the 65 VDC power input	* KV Controller Fuse is OK * mA Controller Fuse is OK * 5VDC P/S is within +/- 5% * 65VDC P/S is within +/- 5%	Annually

Preventive Maintenance Checklist

Preventive Maintenance Checklist					
	Customer: _____		Location: _____		
Model / Serial Number: _____					
		Completed	N/A	Notes	
I. Check internally and externally:					
	Clean external panels	☐	☐		
	Clean internal panels	☐	☐		
	Remove dust build up on PCBs	☐	☐		
	Check Curtains for wear and tear	☐	☐		
	Clean Fans	☐	☐		
II. Check all panels and doors for:					
	Missing or damaged hardware	☐	☐		
	Alignment	☐	☐		
	Secured properly	☐	☐		
III. Check power rollers for:					
	Alignment, and adjust as needed	☐	☐		
	Oil leaks	☐	☐		
	Excessive noise	☐	☐		
IV. Check idler and tension rollers for:					
	Alignment	☐	☐		
	Excessive noise	☐	☐		
	Excessive wear	☐	☐		
V. Check conveyor belt(s) for:					
	Belt splice condition	☐	☐		
	Excessive or un-even wear	☐	☐		
	Physical damage	☐	☐		
	Tracking	☐	☐		
VI. Check safety factors:					
	Indicator lights Operate	☐	☐		
	Interlock switches are properly adjusted	☐	☐		
	Emergency stop switches - secured and functional	☐	☐		
VII. Check monitor for:					
	Physical damage	☐	☐		
	Alignment	☐	☐		
	Contrast	☐	☐		
	Brightness	☐	☐		
VIII. Check diode plot:					
	Adjust gain and position as needed	☐	☐		
IX. Check hard Drive:					
	Clean	☐	☐		
	Update files	☐	☐		
X. Check and record:			Software Revision:		
KV (TP 2)	_____	Image resolution	_____	XrayClient.exe	_____
MA (TP 15)	_____	Image penetration	_____	Xray.exe	_____
Rise Time	_____			Client.exe	_____
				shutdown.exe	
Technician:	_____	_____		_____	
	Print	*Sign*		*Date*	

Figure 173: Preventive Maintenance Checklist

Gulmay Planned Maintenance Report



2009 Gulmay Planned Maintenance Report

GULMAY

PREVENTATIVE MAINTENANCE	Frequency
The Gulmay RS232 CP Series Generators are of robust construction and require minimal maintenance. These procedures should be completed on periodically based on usage, application and environmental conditions.	3-6 months except as noted
Warm-ups are necessary when the unit has not been operated at full potential for long periods.	As needed
Inoperative for 1-3 days	Short warm-up
Inoperative for more than 3 days	Long warm-up
Refer to: Gapping Procedure.pdf	
X-Ray Tube:-	
Free of oil leaks or seeping	
Inspect for discoloration (an indication of poor cooling)	
Remove HT cables and inspect sockets for tracking	
Clean, grease and reset compression to 4-5 mm *	
High Tension cables:-	
Inspect for damaged sheathing	
Inspect for excessive bends or abrasions	
Inspect tips for damaged solder connections *	
High Tension Generator:-	
Remove debris from fan intake and output ports	As needed
Inspect for oil leakage around socket and tank lid.	
Check Earth Ground (<0.1ohm).	
Remove HT cables and inspect sockets for tracking	
Clean, grease and reset compression to 4-5 mm *	
Oil/Water Cooler:-	
Check for oil leaks.	
Pump/thermostat operation.	
Flow switch operation.	
Ground (<0.1ohm).	
Check coolant level. Add/refill as required.	
Hose condition & clamp tightness.	
Clean change oil filter.	Annually
Clean fan and radiator.	As needed

Gulmay Inc. 4984 BU Bowman Drive, Buford, GA 30518 Phone (678) 482-6800 Fax (678) 482-6883

Figure 174: Gulmay Planned Maintenance Report

Troubleshooting

Faults and Suggested Causes and Solutions

Fault	Check
Vertical black line appears after scanning several images	The +/-5VDC linear power supplies may be overheating causing black lines to appear
No image display after scanning	See “No Image” below.
The software is not responding after pressing LEFT, RIGHT	change the keypad file in the software
An electrical shock from the machine	problem with the external UPS or machine is not grounding
Blue Horizontal lines appear intermittently	the 40 ribbon cable need to be change
A black screen appear will the PC is booting with error message	windows is corrupt and need to be repair
after you reset the CTR board Red Led are lit on the CTR board	the controller board is not working anymore try to tune it otherwise replace it
Xray is always ON even after turning OFF the machine	the CTR was set active low check the jumper
No Feedback on the CTR board (TP2 and TP15)--	The Generator need to be change
The color image always appears orange no matter what type of material is being scanned.	1. Check the orientation of the red and white RCA cable connections (high and low energy analog signals) at the DAS board. The red cable should be the one closest to the 20 pin ribbon cable (left/inboard side as you face the back of the PC). If not then swap the cable connections. 2. If the orientation above is correct, then try swapping them. This in case the orientation of the RCA connections at the LXDA interface board is incorrect, and would be the quickest way to correct the problem because the LXDA interface board is more difficult to access. The likelihood low however because of accessibility.

Fault	Check
The color image always appears blue no matter what type of material is being scanned.	1. Check the red RCA cable connection (high energy analog signal) at the DAS board. The red cable should be the one closest to the 20 pin ribbon cable (left/inboard side as you face the back of the PC). Unseat and reseat the cable. 2. Check the red RCA cable connection (high energy analog signal) at the LXDA interface board. The red cable should be the one on the right side as you face the LXDA interface board. Unseat and reseat the cable. CAUTION: Be sure to safe the X-ray generator by disconnecting its power supply input cable when accessing the interface board. 3. If neither of the above conditions is found, try a different RCA cable.

Fault	Check
The color image always appears white with only a few small areas of black where high-density objects are no matter what type of material is being scanned.	The color image always appears white with only a few small areas of black where high-density objects are no matter what type of material is being scanned. 1. Check the white RCA cable connection (low energy analog signal) at the DAS board. The white cable should be the one furthest from the 20 pin ribbon cable (right/outboard side as you face the back of the PC). Unseat and reseat the cable. 2. Check the white RCA cable connection (low energy analog signal) at the LXDA interface board. The white cable should be the one on the left side as you face the LXDA interface board. Unseat and reseat the cable. CAUTION: Be sure to safe the X-ray generator by disconnecting its power supply input cable when accessing the interface board. 3. If neither of the above conditions is found, try a different RCA cable.
The machine is not booting. The +12VDC is not working	disconnect the AOCP and run the machine if it works change the AOCP otherwise change +12VDC
Left button is not responding no beep when pressed	Check the AOCP otherwise change the Button
Software is logging out automatically	check the interlock, Jumper, Security key, enable local area network
Vertical black line appear	check the -5PS;Controller board
The Internal UPS is always beeping	Disable the Beeper this only happen with the OLD black UPS
The computer is always restarting	check the connection between the AOCP and the PC (if L2 is flashing)-

Fault	Check
One screen is not working	Change the resolution you need to stretch horizontally
message "Shared memory error" after logging in	Check the shortcut of Xray Clinet.exe in the startup
If I press "print" the software is not responding anymore	If no printer is attached, go to Printers & Faxes and delete the default Microsoft XPS Document Writer. Also, go to keypad.ini and delete the setting for F11=M_PRINT so that it has no value, as in F11=-
the belt is not stopping if I press stop it display the pseudo mode	change the keypad file in the software
after logging in a Direct Draw error	Go to DirectX diagnostic and enable the direct Draw
image always appear in the upper side of the screen	Change the diode count in the runtime or replace the software
The PC is not booting, you need to press it manually	Change the power management from the BIOS
The image is not in the center	change the PEC-CONTROL parameter
Each time I turn ON the Xray On the Fuse in 65PS is busted	The Generator need to be change
Each time I turn On the Xray red Led on the CTR are Lit and no Xray	CTR needs to be tune otherwise replace it-
The Diode Plot is giving a weird plot even if the Xray is OFF	Check -5PS
The signal in the Diode Plot is moving like a wave even if the Xray is OFF	The -5PS is not giving a DC output
Not all the LXDA are jumping after turning on the Xray	The DAS board is not working good
After pressing ES the +5VDC is not working anymore	Press and release the ES again sometime the PS need to be reset
After logging a message "DAS board is not found"--	Reinstall the driver of the DAS board
After I logging in the software freeze with "Please Wait" notification	Check the diagnostic software
the image is cut if I stop the belt	change the ReverseBelt parameter in runtime
Friction sound while the motor is running	check the side tension bracket
PEC1 and PEC2 are always ON	Change the Pec Active State in runtime

Fault	Check
The photocells are not working or the bag doesn't appear on the Screen	The photocells are properly wired and securely fastened down. The photocells are aligned. The receiver indicates a clear signal from the transmitter.

If No Image Appears

If there is no image and both the high and the low energies are flat lines in the "Diode Plot":

1. In "Real-Time Diagnostics," check the state and indicated voltages of the 12 VDC and each of the +/-5 VDC power supplies. If there are any power supply faults, go to the section on power supply troubleshooting.
2. Inspect, disconnect, and check for 12 VDC on the 20-pin ribbon cable going to the DAS board from the 12 VDC power supply. Pin 19 = chassis ground and Pin 17 = 12 VDC. Reconnect the 20-pin ribbon cable to the DAS board.
3. Inspect, disconnect, and reconnect the 40-pin ribbon cable connection at the DAS board.
4. Inspect, disconnect, and reconnect both the high and low energy RCA cable connections at the DAS board.
5. Check the +/-5 VDC power supply voltages starting at the Cinch block, and especially the +5 VDC if there are also no inputs, or there are erroneous inputs to the PLC. The latching and distribution IC on the PC-PLC interface board is powered by the +5 VDC power supply as well as the LXDA boards. Voltages at the Cinch block should be approximately +/- 5.4 VDC.
6. Disconnect the AC input to the X-ray generator (65 VDC) power supply, and then remove the LXDA box lead cover. Inspect, and then disconnect and reconnect the 40-pin ribbon cable connection at the LXDA interface board.
7. Check +/-5 VDC at each LXDA starting from #1 and going to the last board to confirm minimum voltage at each board. Voltages should start at approximately +/- 5.4 VDC and drop linearly approximately to +/-5.0 VDC.
8. Disconnect power to all LXDA boards, and then reconnect one board at a time, while confirming good Diode Plot results for each powered board until finding a possible failed or shorted board that is pulling the entire array down.
9. Confirm the hardware driver for the DAS board is functioning correctly via Windows "Start" > "Control Panel" > "System" > "System Properties" window > "Hardware" tab > "Device Manager" > "Other Devices" > "Custom (OEM) PCI 9030 Board" > "Custom (OEM) PCI 9030 Board Properties" window > "General" tab > "Device status" > confirm "This device is working properly." Also in the "Custom (OEM) PCI 9030 Board Properties" window, confirm > "Device usage:" > "Use this device (enable)" is selected.
10. Open the PC and confirm that the DAS board has the solid green LED illuminated (power), and the 1 Hz or 2 Hz flashing green LED illuminated (EPROM heartbeat). If

not then remove the DAS board, remove the EPROM chip, reseat the EPROM chip, and reseat the DAS board. Test the machine.

DCI Board Troubleshooting

The following information is provided to aid a technician in troubleshooting a DCI board fault condition. This is not a complete list of diagnostic steps, simply normal & abnormal indications on the board and at the PC.

1. DCI BOARD LEDs (See Figure 175 below)

A. Normal indications when XIS is in Standby Mode:
= Key switch OFF (PC not booted) and mains power & UPS on (12 VDC power supply is energized and voltage is being supplied to the DCI board)

- D1 – PWR/12V = **Solid Green**
- D3 – PWR/VCC = **Solid Green**
- D8 – MCU/STAT = **Flashing Green** (heartbeat generated by DCI board's main controller IC when powered and running)
- D20 – ESTOP = **Solid Green** when AOCP E-Stop button NOT pressed
- D23 – THREAT = **Solid Green** when AOCP Suspect button IS pressed

B. Normal indications when XIS is in Running Mode:
= Key switch ON (PC booted)

- Same as the normal indications when XIS is in Standby Mode (PC not booted) plus the following,
- D7 – SUSPEND = **Solid Green** (USB bridge IC indicator, power supplied by USB from PC)
- D16 [USB TOUCH PAD] = **Solid Green** (USB power from PC)
- D17 [USB KEY PAD] = **Solid Green** (USB power from PC)
- D19 – FAN ON = **Solid Green** (12 VDC from the power supply)

C. Abnormal indications when XIS is in Running Mode:
= Key switch ON (PC booted)

- D4 – ERR/RD = **Flashing Red** when USB read error, common when wrong DCI_USB.dll file is used for given DCI firmware.
  = **Solid Red** when DAQBoard.exe stops running after establishing communication, restarting DAQBoard.exe or resetting the USB bridge with the button on the board clears it.
- D5 – ERR/WRT = (?) **Solid or Flashing Red** when USB write error (unknown conditions).

Dual-View PC Network Troubleshooting

Basic Networking:

1. Confirm the cable is a proper cross-over cable, is not damaged, and is connected securely at each end. The LEDs in the Ethernet connector on each PC should also be flashing when connected.
2. Confirm the Windows firewall is turned off on both PCs via: Start > Control Panel > Windows Firewall > General > select "Off" > OK.
3. Confirm the network adapter speed is the same on both PCs. This is set via: Start > Control Panel > System > Hardware > Device Manager > Network Adapters > right-click on the network card (usually "…Gigabit Network Connection") > Link Speed > Speed and Duplex: > 1.0 Gbps Full Duplex > OK.
4. Confirm the actual IP address of each PC is different. These are typically 192.168.1.250 for the Master PC and 192.168.1.251 for the Slave PC, and set via: Start > Control Panel > Network Connections > right-click on Local Area Connection > Properties > General > select Internet Protocol (TCP/IP) > Properties > General > select "Use the following IP address:" > IP Address: > OK.
5. Confirm the local area network is now connected via: Start > Control Panel > Network Connections > Name > Local Area Connection & Status > Connected.

Keyboard/Mouse Sharing:

1. Confirm the Master PC's Windows name is "Master" and the Slave PC's Windows name is "Slave". The multi-PC keyboard/mouse sharing applications use the machine name when setting the master/slave relationship. This is set via: Start > Control Panel > System > Computer Name > Change > Computer name: > OK.

Imaging Software:

1. Confirm that Xray Client's runtime.ini file for each PC has the correct settings for critical dual-view parameters under the header [Dual View] near the bottom of the file.
    a. Master PC:
        - Dual View=1 ;Sets it as the Master PC
        - Remote Machine=192.168.1.251 ;Points to the other PC's IP address (Slave)
        - Remote Server=Slave ;Parameter exists only on the Master PC
    b. Slave PC:
        - Dual View=2 ;Sets it as the Slave PC
        - Remote Machine=192.168.1.250 ;Points to the other PC's IP address (Master)
2. Confirm the slave PC's Xray Client folder is shared with full privileges. This is set via: Slave PC > right-click on the folder C:\Program Files\Xray Client > Properties >

Sharing > select “Share this folder” > select “Share this folder on the network” & select “Allow network users to change my files” > OK.

DCI Board Device Driver

Figure 175: DCI Board LEDs

1. Normal indications:
    a. Shows in the Windows Device Manager under the “Universal Serial Bus controllers” section as “USBXpress Device” when driver is installed and device properly connected. See figure below.

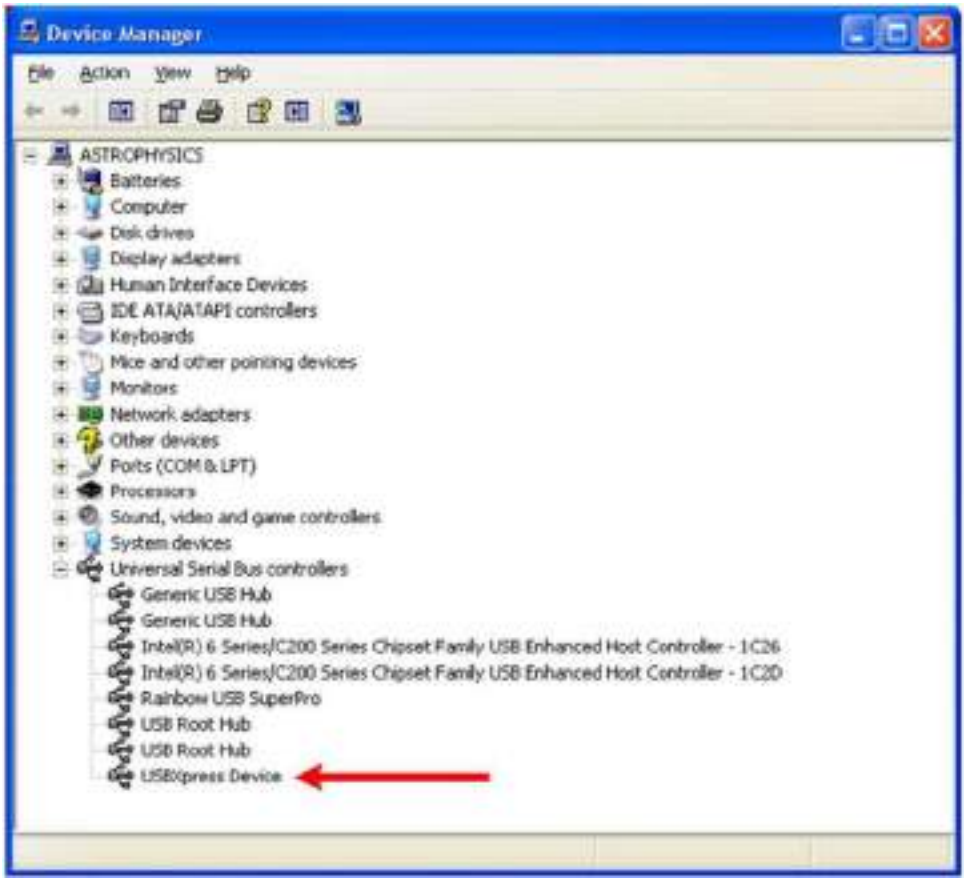


Figure 176: DCI Board Driver Installed and Device Connected

2. Abnormal indications:

   a. When the DCI board's USB bridge IC has not been programmed with the correct Astrophysics data, the chip's default configuration data is used. It shows in the Windows Device Manager under the "Other devices" section as "CP2103 USB to UART Bridge Controller" with an exclamation mark over the question mark. See figure below.

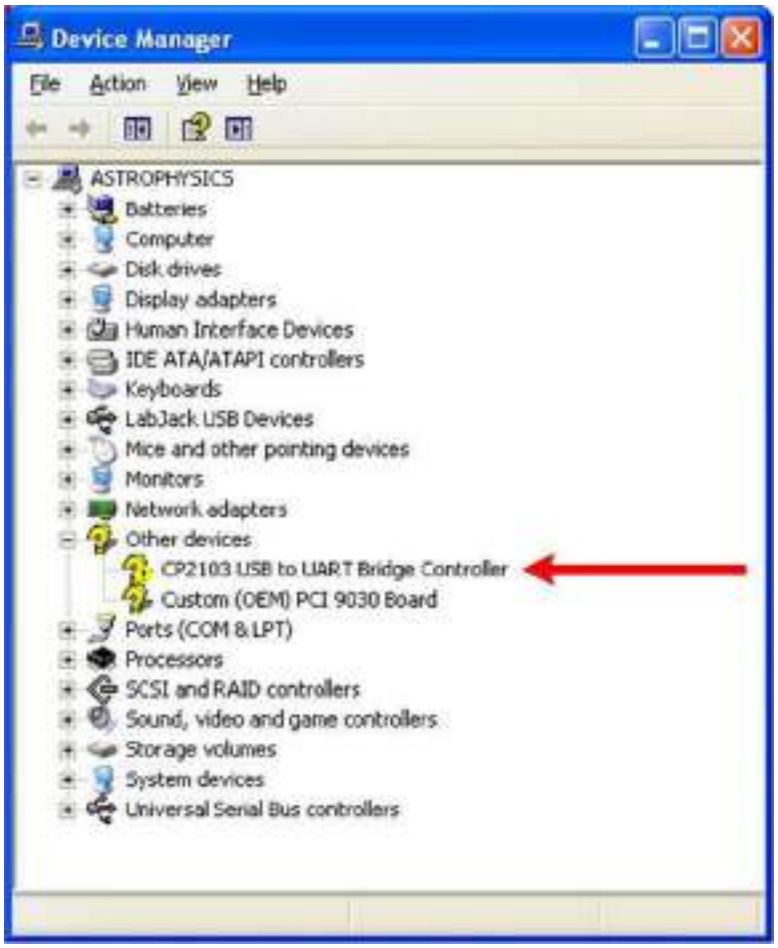


Figure 177: DCI Board's USB Bridge IC Not Programmed

AOCP Troubleshooting Guide (Firmware Rev 1.3, 1.3b & 2.0a)

Self-Testing:

1. FIRMWARE REV 1.3:
    a. Turn **OFF** a system from '**POWER**' key switch.
    b. Press the '**STOP**' button on AOCP panel to enable SELF-TESTING mode and continuing pressing one at a time to test all **LED indicators.** The LED is lit in sequence as follow *TIP -> AUTO DETECT -> IMAGE ARCHIVE -> POWER -> SERVICE -> BLANK -> STANDBY -> X-RAY -> LEFT -> RIGHT* on AOCP membrane revision 1.0 (**light gray background**).
    c. Next step is to press each key on the AOCP. Each key-press should elicit a short beep, which indicates a working key switch.
    d. Turn the AOCP key switch to the ON position, which will cancel SELF-TESTING mode.
2. FIRMWARE REV 1.3B & 2.0A:
    a. Turn **OFF** a system from '**POWER**' key switch.

b. Press the AOCP '**STOP**' button **3 times** to enable SELF-TESTING mode. Continue pressing one at a time to test all **LED indicators**. The LED is lit in sequence as follow *TIP -> AUTO DETECT -> IMAGE ARCHIVE -> POWER -> SERVICE -> BLANK -> STANDBY -> X-RAY -> LEFT -> RIGHT* on AOCP membrane revision 1.0 (**light gray background**) and *TIP -> SCREENER ASSIST -> L1 -> POWER -> ALPHA -> L2 -> L3 -> X-RAY -> LEFT -> RIGHT* on AOCP membrane revision 2.0 (**black background**).

c. Next step is to press each key on the AOCP. Each key-press should elicit a short beep, which indicates a working key switch.

d. Turn the AOCP key switch to the ON position, which will cancel SELF-TESTING mode.

USB Connection Activity Test:

1. FIRMWARE REV 1.3 & 1.3B:
    a. On the X-ray Client log in screen, press the '**UD2**' button on the AOCP, membrane revision 1.0 (**light gray background**) to test USB connectivity between the AOCP and the PC.
    b. A '**SERVICE**' (AOCP membrane rev 1.0) LED indicator will be *ON* if the AOCP has lost USB connection.
    c. A '**SERVICE**' LED indicator will be *OFF* if USB connectivity has been restored.
2. FIRMWARE REV 2.0A:
    a. On the X-ray Client log in screen, press the '**DIAG**' button on the AOCP, membrane revision 2.0 (**black background**) to test USB connectivity between the AOCP device and the PC.
    b. An '**L2**' LED indicator will be *ON* and *BLINKING* if the AOCP has lost USB connection.
    c. An '**L2**' LED indicator will be *OFF* if USB connectivity has been restored.

AOCP Soft-Reset:

1. FIRMWARE REV 1.3:
    a. USB Bus Reset can be accomplished from the AOCP, via the X-ray Client log in screen, by pressing the numbers '**9-2-2**' on the numeric pad in quick succession (< 1sec). The AOCP will enter a reset sequence that will take **more than 1 minute to complete**.
2. FIRMWARE REV 1.3B & 2.0A:
    a. USB Bus Reset can be accomplished from the AOCP, via the X-ray Client log in screen, by dialing '**9-9-2-2**' on the numeric pad in quick succession (< 1sec). The AOCP will enter a reset sequence that will take **more than 1 minute to complete**.

Troubleshooting Checklist:

If you have a problem with the AOCP control panel, please refer to this check list. If the problem persists, call the Astrophysics Service Center.

Power Source

Problem	Solution
1. 'STANDBY' indicator is NOT blinking while the XIS unit is OFF. (**NOTE:** applicable ONLY to AOCP firmware revision 1.0)	Turn the AOCP key-switch to the 'OFF' position.
2. 'POWER' indicator does NOT turn ON.	Turn the key-switch is to the 'ON' position. If the problem persists, turn the key-switch to the 'OFF' position and perform **self-testing** on the AOCP unit (See AOCP self-test instruction earlier in this section).
3. A green LED (LED3) on the AOCP system interface board does NOT turn ON.	Measure DC voltage between on terminal 8 (+12 VDC) and 9 (GND) on TB1. The voltage should read 12 VDC on DMM. If NOT, ensure that the: • +/- 12VDC spade terminals are tightened on terminal 8 (+12 VDC) and 9 (GND) on TB1. • +/- 12 VDC main power supply is working.
4. A green LED (LED13) on the AOCP main board does NOT turn ON.	Measure DC voltage between on test pins of TB4 (+12 VDC) and TP6 (GND) that the reading value should be +12 VDC on DMM. If NOT, ensure that the: • A RED (RJ-45) connector is firmly plugged into JP8 (RJ-45) socket. • AOCP RED (RJ-45) connector is firmly plugged into JP4 (RJ-45) socket. **NOTE:** The DC voltage between on test pins of TB5 (+5 VDC) and TP6 (GND) should be read 5 VDC on DMM. If NOT, replace the AOCP main board.

Operation

Problem	Solution
1. The AOCP is malfunctioning.	• Restart the XIS machine. If the problem persists proceed to the next step. • Perform a USB connectivity connection test. If the problem persists, proceed to the next step. • Set the AOCP key-switch to the OFF position. Perform self-testing. If AOCP still malfunctions, proceed to the next step (**NOTE:** This is applicable ONLY to AOCP firmware revision 1.3 and above). • If the problem persists, replace the AOCP main board.

Diagnostic

Problem	Solution
1. AOCP self-testing fails.	Go to solution proposed in steps 3 & 4 in the POWER SOURCE section above. If the problem persists, replace the AOCP main board.
2. AOCP USB connection activity testing fails (ONLY APPLICABLE to firmware revision 1.3, 1.3B and 2.0).	If the AOCP is unable to detect USB connection activity while the XIS system is ON, check the AOCP to ensure that: 1. The RED (RJ-45) connector is firmly plugged into JP4 (RJ-45) socket. 2. The BLUE (RJ-45) connector is also firmly plugged into JP3 (RJ-45) socket. 3. The USB cable is firmly plugged into JP2 socket (remove and insert cable from and into the JP2 socket several times). 4. That the USB cable is firmly plugged into the USB connector on the PC. 5. If the problem persists, replace the USB cable.

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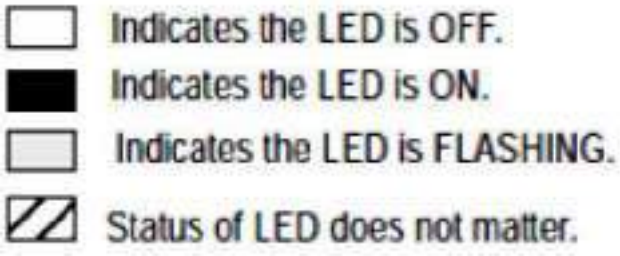
PLC Troubleshooting

Understanding the Controller LED Status

PLC LEDs indicate whether the PLC is in communication with connected programming devices.

To understand the status of the LED indicators in the illustrations in this section, refer to the following key:



When Operating Normally

When power is applied, only the power LED turns on and remains on. This is part of the normal power-up sequence.

When the controller is placed in REM Run mode, the run LED also turns on and remains on, as shown on the right in the figure below. If a force exists, the force LED is on as well.

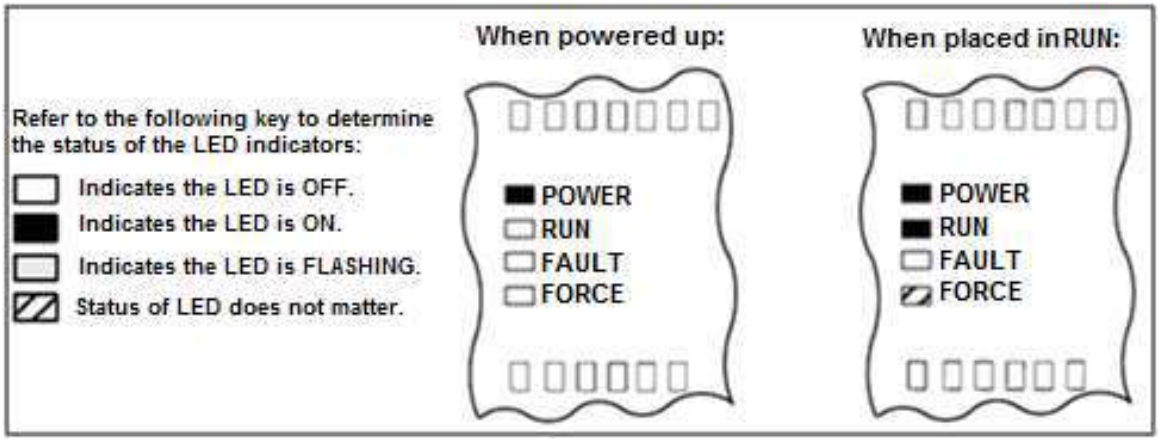
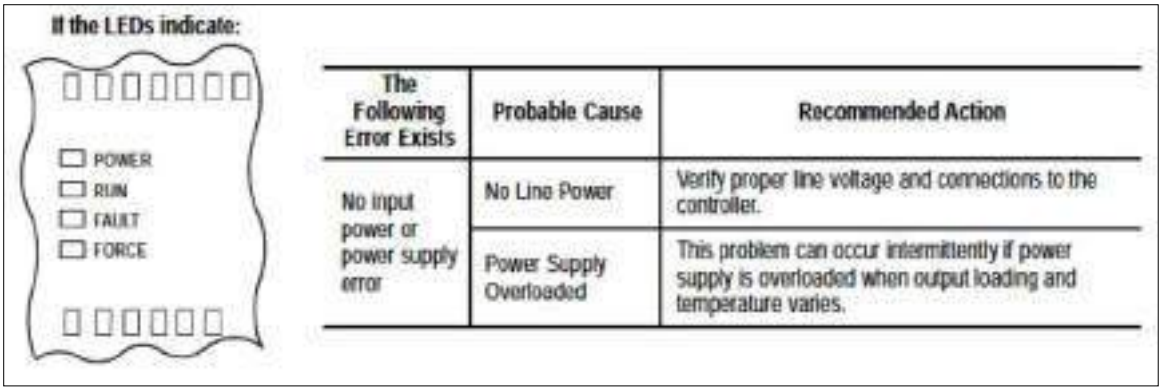


Figure 178: Status of LED Indicators

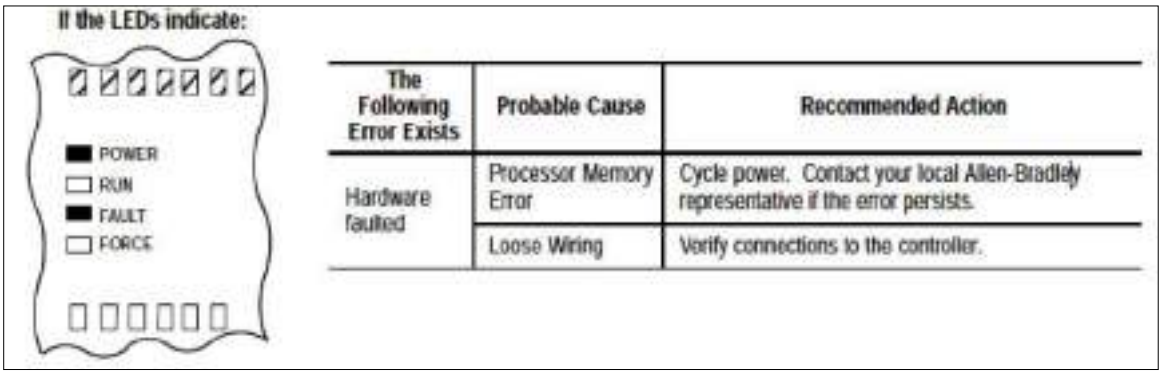
When an Error Exists

If an error exists within the controller, the controller LEDs operate as described in the following tables.



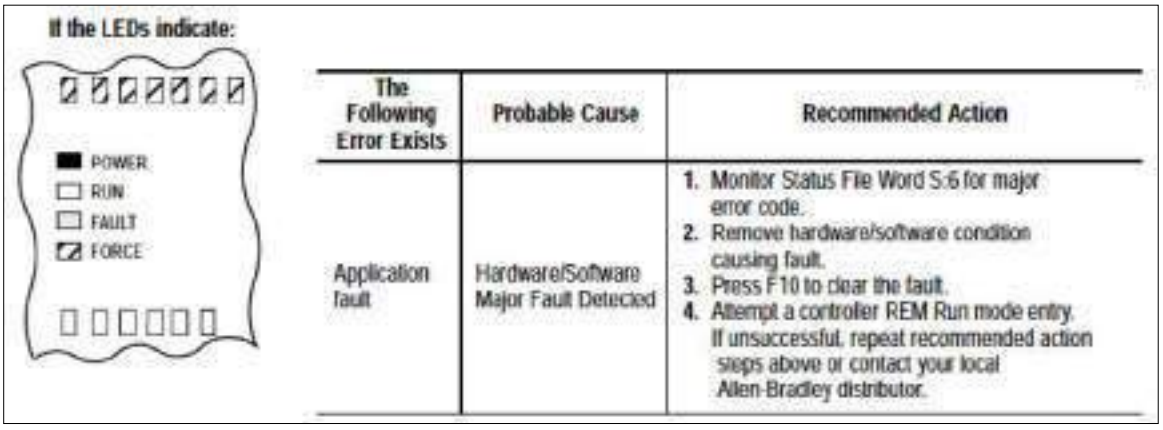
The Following Error Exists	Probable Cause	Recommended Action
No input power or power supply error	No Line Power	Verify proper line voltage and connections to the controller.
	Power Supply Overloaded	This problem can occur intermittently if power supply is overloaded when output loading and temperature varies.

Figure 179: No Input Power or Power Supply error



The Following Error Exists	Probable Cause	Recommended Action
Hardware faulted	Processor Memory Error	Cycle power. Contact your local Allen-Bradley representative if the error persists.
	Loose Wiring	Verify connections to the controller.

Figure 180: Hardware Faulted



The Following Error Exists	Probable Cause	Recommended Action
Application fault	Hardware/Software Major Fault Detected	1. Monitor Status File Word S:6 for major error code. 2. Remove hardware/software condition causing fault. 3. Press F10 to clear the fault. 4. Attempt a controller REM Run mode entry. If unsuccessful, repeat recommended action steps above or contact your local Allen-Bradley distributor.

Figure 181: Application Fault

Controller Error Recovery Model

Use the following error recovery model to help you diagnose software and hardware problems in the micro controller. The model provides common questions you might ask to help troubleshoot your system. Refer to the recommended pages within the model and to S:6 of the status file on page B–14 for further help.

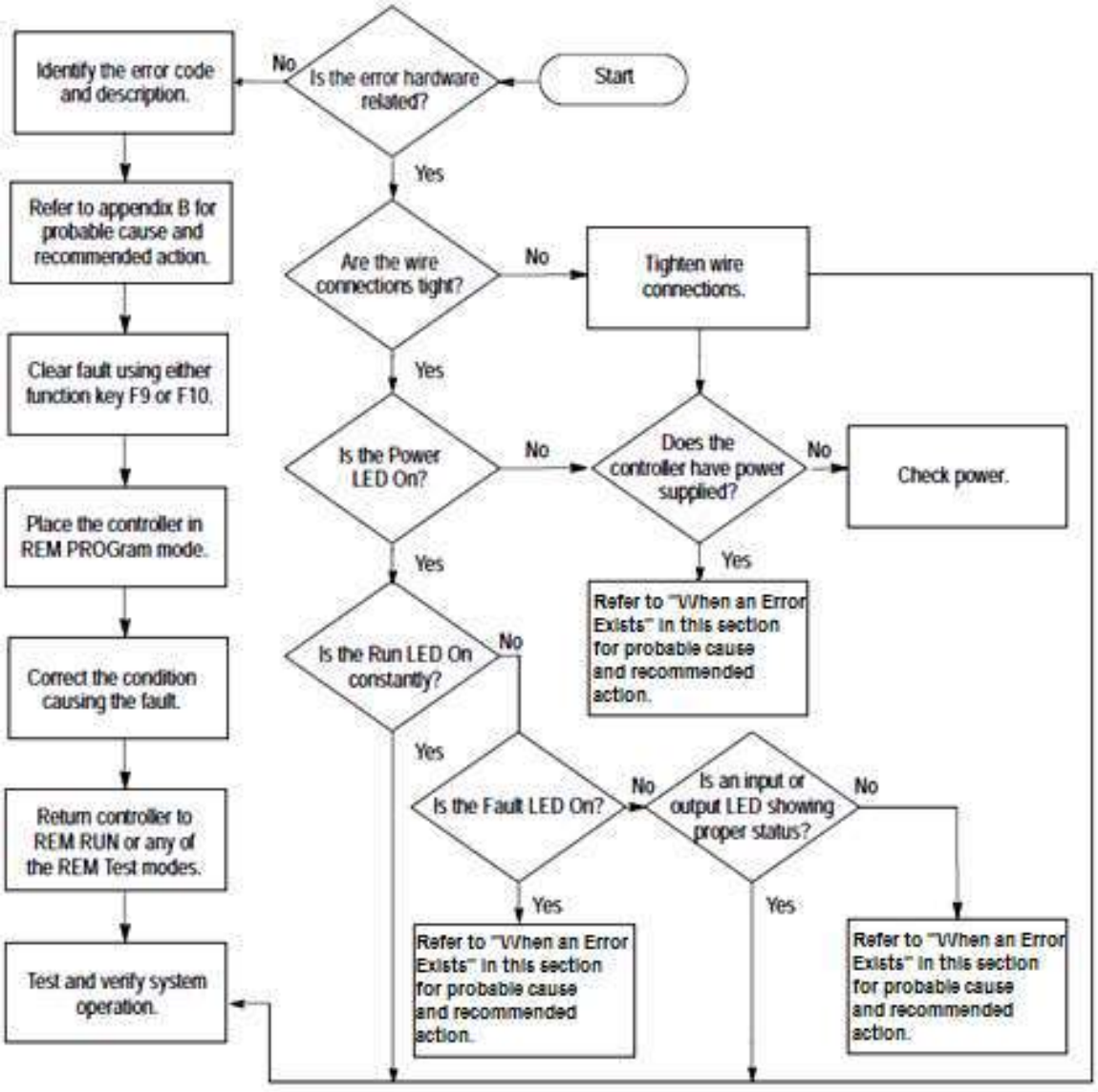


Figure 182: Control Error Recovery Model

Identifying Controller Faults

While a program is executing, a fault may occur within the operating system or your program. When a fault occurs, you have various options to determine what the fault is and how to correct it. This section describes how to clear faults and provides a list of possible advisory messages with recommended corrective actions.

Automatically Clearing Faults

You can automatically clear a fault when cycling power to the controller by setting either one or both of the following status bits in the status file:

- Fault Override at Power-up bit (S:1/8)
- Run Always bit (S:1/12)

NOTE: Clearing a fault using the Run Always bit (S:1/12) causes the controller to immediately enter the REM Run mode. Make sure you fully understand the use of this bit before incorporating it into your program.

Refer to appendix B for more information on status bits.

NOTE: You can declare your own application-specific major fault by writing your own unique value to S:6 and then setting bit S:1/13 to prevent reusing system defined codes. The recommended values for user defined faults is FF00 to FF0F.

Manually Clearing Faults Using the Fault Routine

The occurrence of recoverable or non-recoverable user faults causes file 3 to be executed. If the fault is recoverable, the subroutine can be used to correct the problem and clear the fault bit S:1/13. The controller then continues in the REM Run mode.

The subroutine does not execute for non-user faults.

Fault Messages

This section contains fault messages that can occur during operation of the MicroLogix 1000 programmable controllers. Each table lists the error code description, the probable cause, and the recommended corrective action.

Error Code (Hex)	Advisory Message	Description	Recommended Action
0001	DEFAULT PROGRAM LOADED	The default program is loaded to the controller memory. This occurs: • on power up if the power down occurred in the middle of a download • if the user program is corrupt at power up, the default program is loaded.	• Re-download the program and enter the REM Run mode. • Contact your local Allen-Bradley representative if the error persists.
0002	UNEXPECTED RESET	The controller was unexpectedly reset due to a noisy environment or internal hardware failure. If the user program downloaded to the controller is valid, the initial data downloaded with the program is used. The Retentive Data Lost Bit (S:5/8) is set. If the user program is invalid, the default program is loaded.	• Refer to proper grounding guidelines in chapter 2. • Contact your local Allen-Bradley representative if the error persists.
0003	EEPROM MEMORY IS CORRUPT	While power cycling to your controller, a noise problem may have occurred. Your program may be valid, but retentive data will be lost.	• Try cycling power again. • Contact your local Allen-Bradley representative if the error persists.
0004	RUNTIME MEMORY INTEGRITY ERROR	While the controller was in the RUN mode or any test mode, the ROM or RAM became corrupt. If the user program is valid, the program and initial data downloaded to the controller is used and the Retentive Data Lost Bit (S:5/8) is set. If the user program is invalid, error 0003 occurs.	• Cycle power on your unit. • Download your program and re-initialize any necessary data. • Start up your system. • Contact your local Allen-Bradley representative if the error persists.
0005	RETENTIVE DATA HAS BEEN LOST	The data files (input, output, timer, counter, integer, binary, control, and status) are corrupt.	• Cycle power on your unit. • Download your program and re-initialize any necessary data. • Start up your system. • Contact your local Allen-Bradley representative if the error persists.
0008	FATAL INTERNAL SOFTWARE ERROR	The controller software has detected an invalid condition within the hardware or software after completing power-up processing (after the first 2 seconds of operation).	• Cycle power on your unit. • Download your program and re-initialize any necessary data. • Start up your system. • Contact your local Allen-Bradley representative if the error persists.

Figure 183: Fault Messages

Error Code (Hex)	Advisory Message	Description	Recommended Action
0009	FATAL INTERNAL HARDWARE ERROR	The controller software has detected an invalid condition within the hardware during power-up processing (within the first 2 seconds of operation).	• Cycle power on your unit. • Download your program and re-initialize any necessary data. • Start up your system. • Contact your local Allen-Bradley representative if the error persists.
0010	INCOMPATIBLE PROCESSOR	The downloaded program is not configured for a micro controller.	If you want to use a micro controller with the program, reconfigure your controller with your programming software (choose Bul. 1761).
0016	STARTUP PROTECTION AFTER POWERLOSS; S:1/9 IS SET	The system has powered up in the REM Run mode. Bit S:1/13 is set and the user-fault routine is run before beginning the first scan of the program.	• Either reset bit S:1/9 if this is consistent with your application requirements, and change the mode back to REM Run, or • clear S:1/13, the major fault bit.
0018	USER PROGRAM IS INCOMPATIBLE WITH OPERATING SYSTEM	An incompatible program was downloaded. Either the program does not have the correct number of files or it does not have the correct size data files. The default program is loaded.	• Check the configuration and make sure the correct processor is selected. • If you want to use a micro controller with the program, reconfigure your controller with your programming software (choose Bul. 1761).
0020	MINOR ERROR AT END OF SCAN, SEE S:5	A minor fault bit (bits 0-7) in S:5 was set at the end of scan.	• Enter the status file display and clear the fault. • Return to the REM Run mode.
0022	WATCHDOG TIMER EXPIRED, SEE S:3	The program scan time exceeded the watchdog timeout value (S:3H).	• Verify if the program is caught in a loop and correct the problem. • Increase the watchdog timeout value in the status file.
0024	INVALID STI INTERRUPT SETPOINT, SEE S:30	An invalid STI interval exists (not between 0 and 255).	Set the STI interval between the values of 0 and 255.
0025	TOO MANY JSRs IN STI SUBROUTINE	There are more than 3 subroutines nested in the STI subroutine (file 5).	• Correct the user program to meet the requirements and restrictions for the JSR instruction. • Reload the program and enter the REM Run mode.
0027	TOO MANY JSRs IN FAULT SUBROUTINE	There are more than 3 subroutines nested in the fault routine (file 3).	• Correct the user program to meet the requirements and restrictions for the JSR instruction. • Reload the program and enter the REM Run mode.
002A	INDEXED ADDRESS TOO LARGE FOR FILE	The program is referencing through indexed addressing an element beyond a file boundary.	Correct the user program to not go beyond file boundaries.

Figure 184: Fault Messages (cont'd)

Error Code (Hex)	Advisory Message	Description	Recommended Action
002B	TOO MANY JSRs IN HSC	There are more than 3 subroutines nested in the high-speed counter routine (file 4).	• Correct the user program to meet the requirements and restrictions for the JSR instruction. • Reload the program and enter the REM Run mode.
0030	SUBROUTINE NESTING EXCEEDS LIMIT OF 8	There are more than 8 subroutines nested in the main program file (file 2).	• Correct the user program to meet the requirements and restrictions for the main program file. • Reload the program and enter the REM Run mode.
0031	UNSUPPORTED INSTRUCTION DETECTED	The program contains an instruction(s) that is not supported by the micro controller. For example SVC or PID.	• Modify the program so that all instructions are supported by the controller. • Reload the program and enter the REM Run mode.
0032	SQO/SQC CROSSED DATA FILE BOUNDARIES	A sequencer instruction length/position parameter points past the end of a data file.	• Correct the program to ensure that the length and position parameters do not point past the data file. • Reload the program and enter the REM Run mode.
0033	BSL/BSR/FFL/FFU/LFL/LFU CROSSED DATA FILE BOUNDARIES	The length parameter of a BSL, BSR, FFL, FFU, LFL, or LFU instruction points past the end of a data file.	• Correct the program to ensure that the length parameter does not point past the data file. • Reload the program and enter the REM Run mode.
0034	NEGATIVE VALUE IN TIMER PRESET OR ACCUMULATOR	A negative value was loaded to a timer preset or accumulator.	• If the program is moving values to the accumulated or preset word of a timer, make certain these values are not negative. • Reload the program and enter the REM Run mode.
0035	ILLEGAL INSTRUCTION (TND) IN INTERRUPT FILE	The program contains a Temporary End (TND) instruction in file 3, 4, or 5 when it is being used as an interrupt subroutine.	• Correct the program. • Reload the program and enter the REM Run mode.
0037	INVALID PRESETS LOADED TO HIGH-SPEED COUNTER	Either a zero (0) or a negative high preset was loaded to counter (C5:0) when the HSC was an Up counter or the high preset was lower than or equal to the low preset when the HSC was a Bidirectional counter.	• Check to make sure the presets are valid. • Correct the program, reload, and enter the REM Run mode.
0038	SUBROUTINE RETURN INSTRUCTION (RET) IN PROGRAM FILE 2	A RET instruction is in the main program file (file 2).	• Remove the RET instruction. • Reload the program and enter the REM Run mode.

Figure 185: Fault Messages (cont'd)

Error Code (Hex)	Advisory Message	Description	Recommended Action
0040	OUTPUT VERIFY WRITE FAILURE	When outputs were written and read back by the controller, the read failed. This may have been caused by noise.	• Refer to proper grounding guidelines in chapter 2. • Start up your system. • Contact your local Allen-Bradley representative if the error persists.
0041①	EXTRA OUTPUT BIT(S) TURNED ON	An extra output bit was set when the Extra Output Select (S:0/8) bit in the status file was reset. For 16-point controllers this includes bits 6–15. For 32-point controllers this includes bits 12–15.	• Set S:0/8 or change your application to prevent these bits from being turned on. • Correct the program, reload, and enter the REM Run mode.

① Valid for Series A – C discrete only.

Figure 186: Fault Messages (cont'd)

Calling for Assistance

If you need to contact Astrophysics, Inc Customer Service for assistance, it is helpful to obtain the following (prior to calling):

- Controller type, series letter, firmware (FRN) number (on controller's side label)
- Controller LED status
- Controller error codes (found in S:6 of status file)

90kV Generator Replacement

Applicability

The following instructions apply to generator control boards with the following model numbers

GOI-B01

Please speak to an Astrophysics engineer to request the tuning procedures for control boards with model numbers different than GOI-B01.

Responsibility and Safety

X-ray safety is the responsibility of the person who is performing the generator replacement; always minimize exposure to X-rays.

Before starting any work on the machine, disconnect all power from the machine:

Begin by removing the power cord from the machine (Figure 187).

Figure 187: Power Cord

Turn off the UPS by pressing and holding the power button, until it turns off (Figure 188).

Figure 188: UPS Power Button

Procedure

1. Remove the machine's top panel.
2. Disconnect the power cable ("A" in Figure 189), 14 pin ribbon cable ("B" in Figure 189), and generator plug ("C" in Figure 189) from the control board (Figure 189).

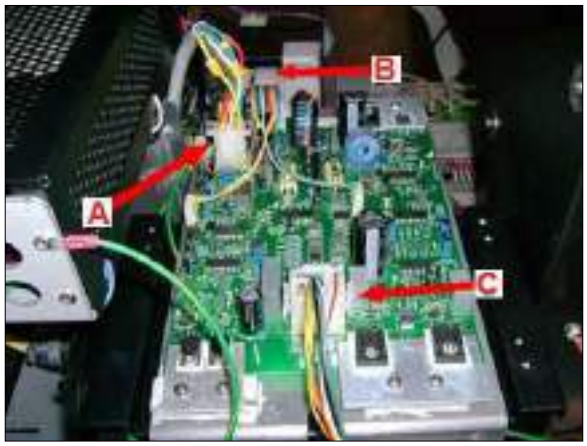


Figure 189: Generator Control Board

3. Remove the control board from the generator. You must first remove the left front bolt from the generator (A in Figure 190) and the back bolt on the same side (D in Figure 190).
4. Lift and remove the control board with the bracket attached. Unscrew all appropriate green ground wires.
5. Remove the right side front bolt from the generator (B in Figure 190) and the rear bolt (C in Figure 190). Then remove the bracket from the generator.

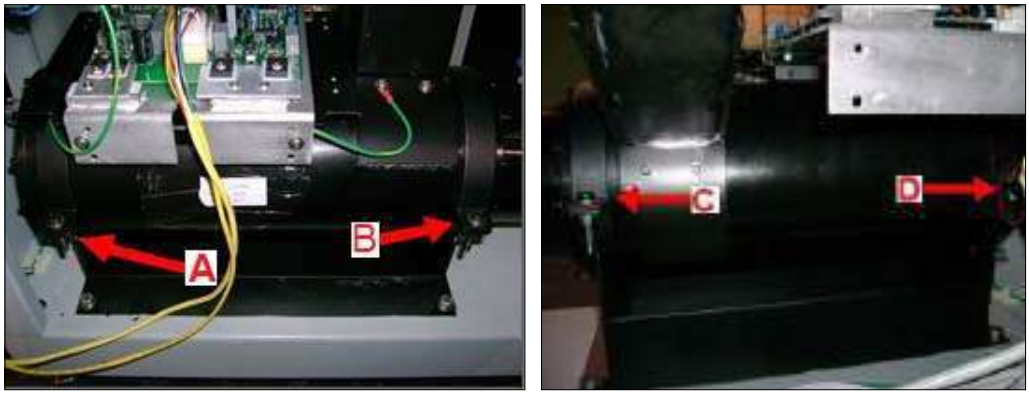


Figure 190: Generator Fastening Bolts

6. Now remove the 4 bolts from both sides of the funnel (Figure 191).
7. Remove the cover from the funnel.

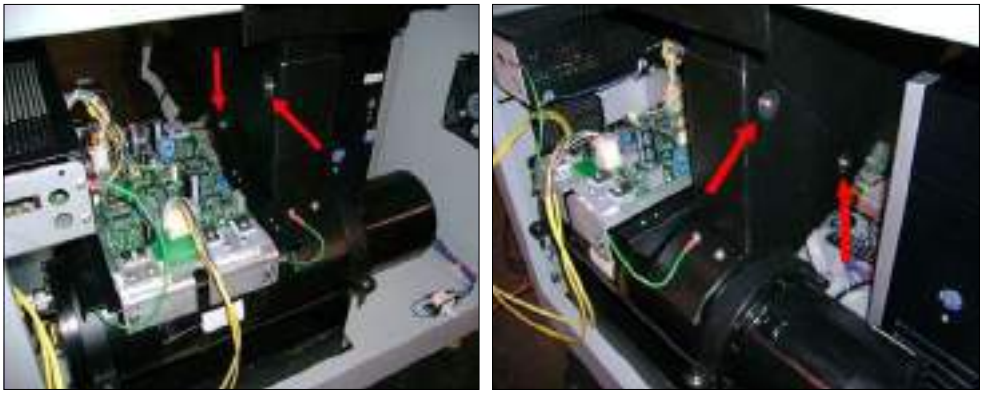


Figure 191: Funnel Bolts

8. Lift and slide the generator out of the holder and the machine.
9. Once the generator has been removed from the machine, remove the last 4 screws that attach the plate to the generator (Figure 192).

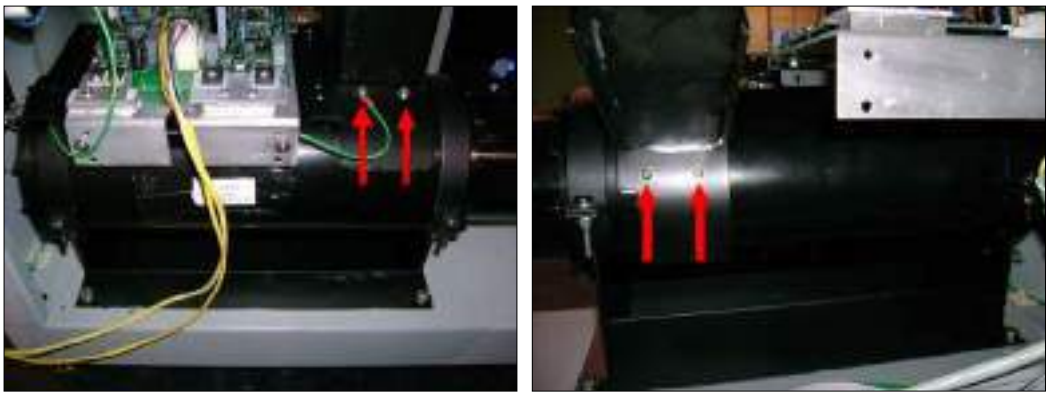


Figure 192: Plate Bolts

10. Attach the plate you removed from the old generator to the new generator.
11. Now lift and place the new generator into the holder.

12. Reattach the funnel cover with the four bolts (Figure 191).
13. Reattach the right and left brackets (See Figure 190).
14. Reattach the green ground wires from the control board back to the appropriate places.
15. Reconnect the power cable (A), 14 pin ribbon cable (B), and generator plug (C) to the control board (See Figure 189).
16. Make sure that all bolts are firmly in place, and secure the machine.

Testing

It is now necessary to test the new generator to ensure it is operating properly. See “XIS Startup / Shutdown Procedures” on page 47.

1. Plug the power cable back into the machine and power up the XIS.
2. Log in.
3. Run the conveyor belt, then stop it. You will now see a menu bar on the right side.
4. Click on MENU.
5. Click on DIODE PLOT.
6. Click on X-RAY ON.
7. If the dotted line is jumping up to the proper place, then the generator is working properly.
8. If the dotted line is **NOT** rising properly, retrace your steps to ensure that all wiring and cables have been correctly reattached:
    a. Check to make sure the three cables on the control board are seated in properly.
    b. Check the plate from the generator (Figure 192) is properly placed and not blocking the X-rays from exiting.

If retracing your steps does not reveal the problem or correct it, then it will be necessary to adjust the generator’s position. Perform the following steps only if the dotted lines on Diode Plot are not rising as they should (See “Diode Plot” on page 69).

1. Loosen the four bolts that secure the generator to the machine (Figure 193).

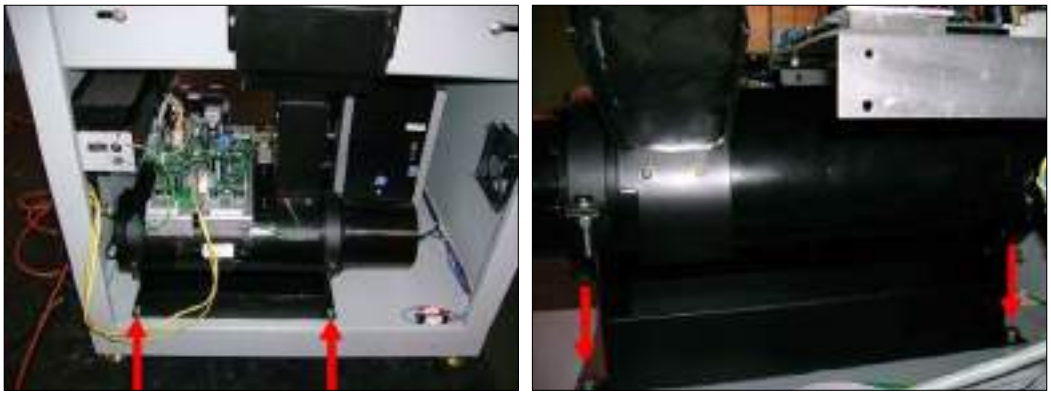


Figure 193: Loosen Generator Bolts

2. Wedge a screwdriver between the generator and the frame of the machine (Figure 194).

Figure 194: Using Screwdriver to Move Generator

3. Nudge the generator to the right with the screwdriver and then check the Diode Plot to see if the dots are jumping properly. If not, then lightly tap the generator slightly back to the left and check the Diode Plot again. Follow this process until you find the optimal position for the Diode Plot.
4. If the dotted lines on the Diode Plot still don't jump, it may be necessary to collimate the machine. Refer to "X-ray Collimation" on page 101 for instructions.
5. After collimating the machine and resolving the problem, place the panel back on the machine and use the two mounting screws to secure it in place. If collimation and/or adjustment of the LXDA boards does not resolve the issue, it may be necessary to repeat the remove-and-replace procedure with another new generator in order to ascertain if the first replacement generator may also be malfunctioning.

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160kV and 180kV Generator Replacement

Applicability

Although there are some differences between 160kV and 180kV generators, the replacement procedure described in this section applies to XIS machines with either 160kV or 180kV generators.

Responsibility and Safety

X-ray safety is the responsibility of the person who is performing the generator replacement; always minimize exposure to X-rays.

Before starting any work on the machine, disconnect all power from the machine. Begin by removing the power cord from the machine (Figure 195).

Figure 195: Power Cord

Turn off the UPS by pressing and holding the power button, until it turns off (Figure 196).

Figure 196: UPS Power Button

Replacement Procedure

1. Remove the machine's side panel to expose the generator.
2. Remove the generator control board cover (Figure 197)

Figure 197: Removing Generator Control Board Cover

3. Disconnect the control and power cables from the control board (Figure 198 and Figure 199).

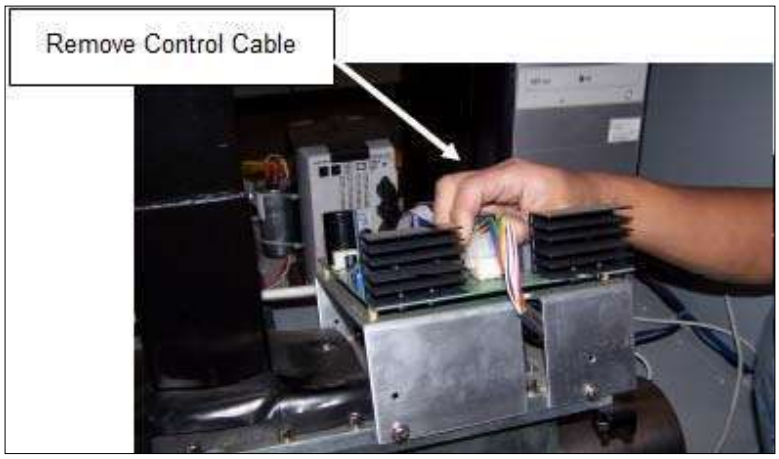

Figure 198: Removing Control Board Control Cable

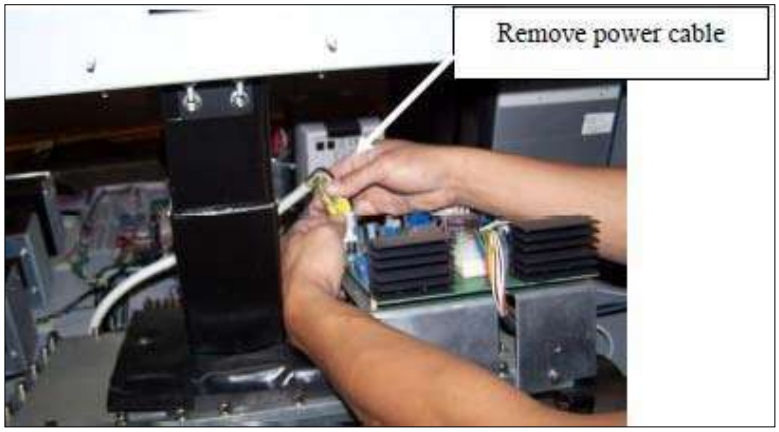

Figure 199: Removing Control Board Power Cable

4. Remove the 14-pin cable (Figure 200).

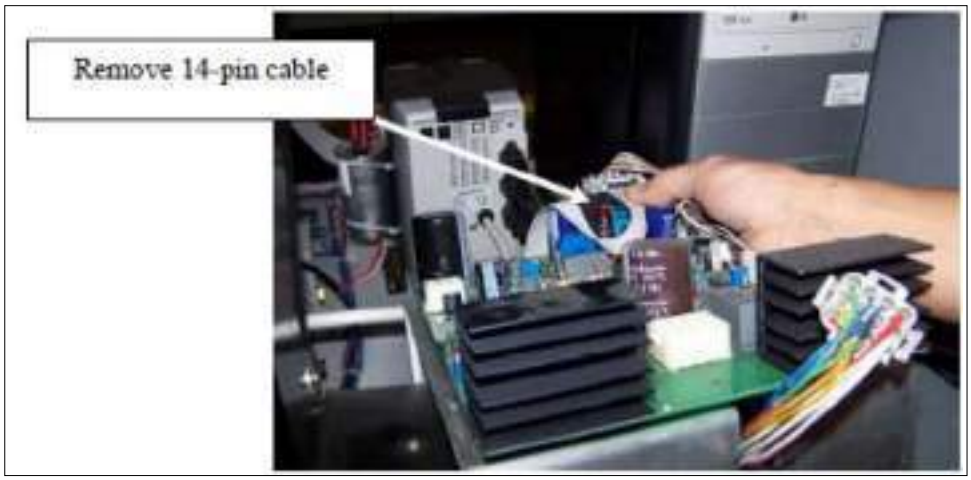

Figure 200: Removing 14-pin Cable

5. Remove the four hex screws that secure the control board mounting bracket to the generator (Figure 201).

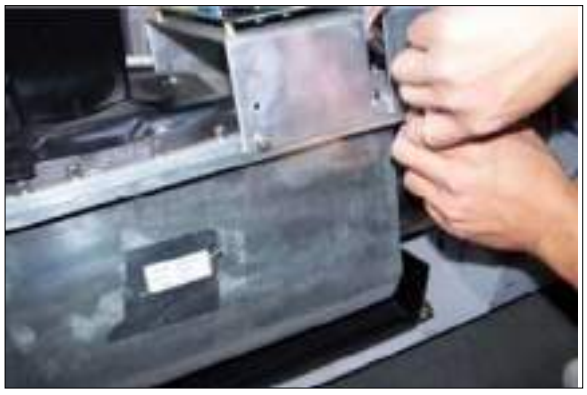

Figure 201: Undoing Control Board Mounting Screws

6. Remove the control board from generator (Figure 202).

Figure 202: Removing the Control Board

7. Remove the four screws that secure the funnel cover to the funnel assembly (Figure 203).

Figure 203: Removing Funnel Cover Mounting Screws

8. Remove the funnel cover from the funnel assembly (Figure 204).

Figure 204: Removing Funnel Cover

9. Disconnect the control cable from the X-ray generator. Remove the four bolts that secure the generator to the machine frame (Figure 205).

Figure 205: Removing Generator Mounting Bolts

10. Using a felt tip marker, mark the location of the generator on the machine frame. This will allow the generator to be placed back into the machine at the correct location at a later time.
11. Slowly remove the generator from the machine (Figure 206).

Figure 206: Removing the Generator

WARNING!

The generator is extremely heavy. To avoid injury, two people must be used to remove the generator.

To replace the generator, reverse the steps of this procedure.

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Curtains

Most of the XIS units have two strips of metal on either end of the top of the machine (beneath the top panel) that form a clamp-like fastener to hold the XIS' lead-impregnated curtains in place, as shown in Figure 207.

Figure 207: Curtain Clamp

The two metal bars are fastened to the frame of the XIS, with the top of the curtain squeezed between them, allowing the curtain to hang down to block the tunnel.

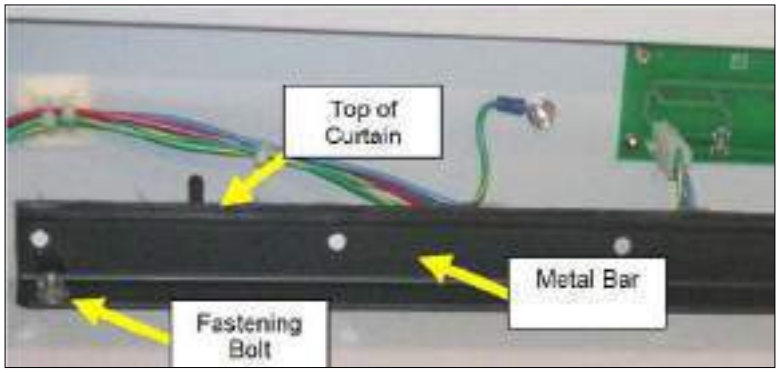

Figure 208: Curtain Clam Close-up

To remove and replace the curtains, remove the fastening bolts holding one of the metal bars in place. Be careful to hold the curtains to prevent them from falling; they are heavy and can do damage if allowed to fall freely.

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LXDA (Linear X-ray Detector Assembly)

NOTE: For information and illustrations for dual view machines, see “Installing the XIS 320kV Dual View” on page 33.

The XIS units use arrays of (varying numbers of) dual-energy LXDA (Linear X-ray Detector Assembly) boards for the detection of X-ray energy and the generation of data signals used to create images of the objects being scanned. In general, the larger the tunnel of a particular XIS model, the larger the number of boards in the LXDA array.

Each LXDA board has sixty-four (64) pairs of high-energy and low-energy photodiodes, totaling 128 channels. The photodiodes operate in the visible spectrum, so a luminescent scintillator crystal is used to convert X-ray photons into visible light photons.

When excited by ionizing radiation, visible light is generated by the scintillator. The visible light is absorbed by the photodiodes, and then converted into a low-voltage electrical signal through the photoelectric effect. These signals are amplified locally on the LXDA to produce a usable data signal transmittable back to the PC.

A DAS (data acquisition system) board inside the PC is the control and data collection device for the LXDA array. An outbound digital clock signal is sent to the LXDA array, and each LXDA board responds back to the DAS board in sequence with its respective analog data signal.

The analog signals are converted into digital signals back at the DAS board for transmission to the CPU and use by the imaging software. The LXDAs are connected in series for receiving and re-transmitting the digital clock from the DAS to the next board.

This ordered sequence provides for the multiplexing of the returned data signals on a single channel back to the DAS board, which is connected in parallel to each board. The data reporting is a domino-effect requiring no addressing of individual boards. A DIP switch on each LXDA allows addressing for use by separate software used for calibration purposes and not related to basic imaging functions.

LXDA 2.0 / 1.0 Differences

This section is provided as a quick familiarization guide for production technicians and field service technicians on the differences between LXDA 1.0 and 2.0 boards. It highlights the most important component changes made to LXDA 2.0 boards relative to LXDA 1.0 boards, and is organized by high-energy and low-energy sides.

High-Energy Side

The high-energy side of the LXDA 2.0 board, which is easily identified by the white power connector “J11” and the name “Astrophysics Inc.” printed near the edge of the board, is shown in Figure 209 below. The important component additions are highlighted. For reference, the high-energy side of the LXDA 1.0 board is also shown in Figure 210. The important component deletions are highlighted. A summary of all important changes is as follows.

Summary of Changes to High-Energy Side:

New on the LXDA 2.0:

1. JP5: Jumpers for selection of remote vs. local offset and gain trimming
2. F1: +5V resettable fuse (not visible with mounting bracket on)
3. F3: -5V resettable fuse (not visible with mounting bracket on)
4. J11: 6-circuit power connector
    a. Deleted on the LXDA 2.0
5. JP3: 8-pin JTAG to load firmware
6. J6: 3-circuit power connector
    a. Renamed on the LXDA 2.0
7. R-POT2: R759 on LXDA 1.0 (square trimming potentiometer)

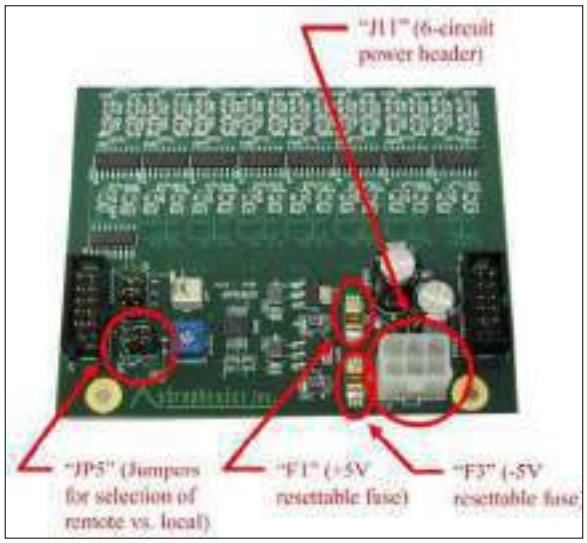


Figure 209: LXDA 2.0 High-Energy Side Additions

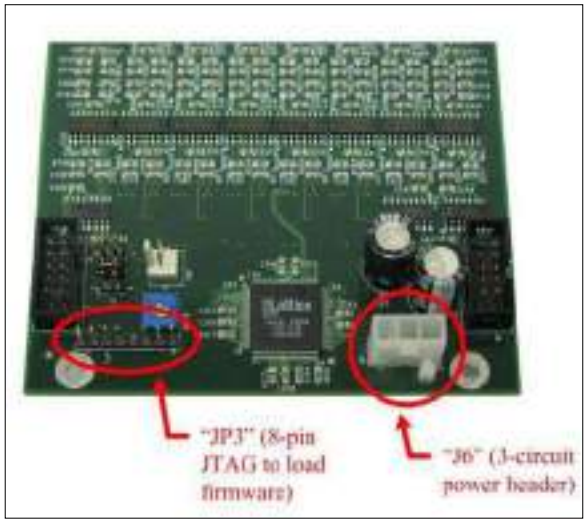


Figure 210: LXDA 1.0 High-Energy Side Deletions

Low-Energy Side

The low-energy side of the LXDA 2.0 board, which is easily identified by the six-switch DIP "SW1," is shown in Figure 211 below. The important component additions are highlighted. For reference, the low-energy side of the LXDA 1.0 board is also shown in Figure 212. The important component deletions are highlighted. A summary of all important changes is as follows.

Summary of Changes to Low-Energy Side:

New on the LXDA 2.0:

1. J12: 6-pin JTAG to load firmware
2. JP6: Jumpers for selection of remote vs. local offset and gain trimming
3. D-1: LED for LXDA communications feedback indication
4. SW1: DIP (dual in-line package) switch for setting LXDA address
    a. Deleted on the LXDA 2.0
5. JP2: 8-pin JTAG to load firmware
    a. Renamed on the LXDA 2.0
6. R-POT1: R27 on LXDA 1.0 (square trimming potentiometer)

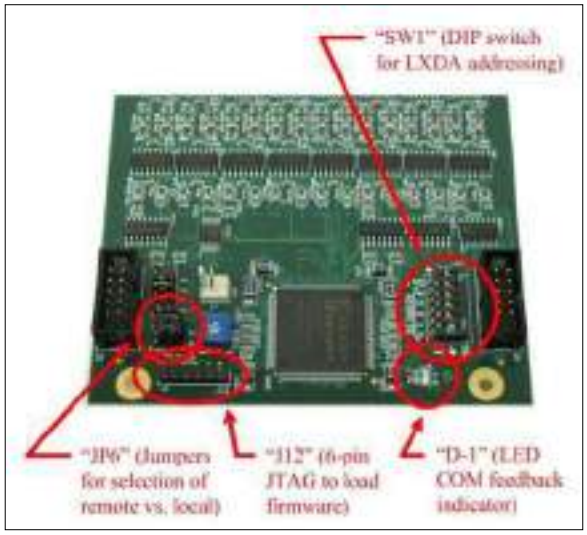


Figure 211: LXDA 2.0 Low-Energy Side Additions

Figure 212: LXDA 1.0 Low-Energy Side Deletions

Adjusting the LXDA Array

If the Diode Plot program indicates there are alignment problems interfering with efficient scanning, it is necessary to shift each board to one side or the other until it is aligned and displaying correctly on the Diode Plot program.

Getting Raw Data

To perform the LXDA board alignment, the first step is to isolate the misaligned board. To do this it is necessary to get raw data and thus a "true" picture of the alignment of the individual boards.

1. Exit the X-ray Client program.
2. Right-mouse-click on My Computer.

3. Select [Explore].

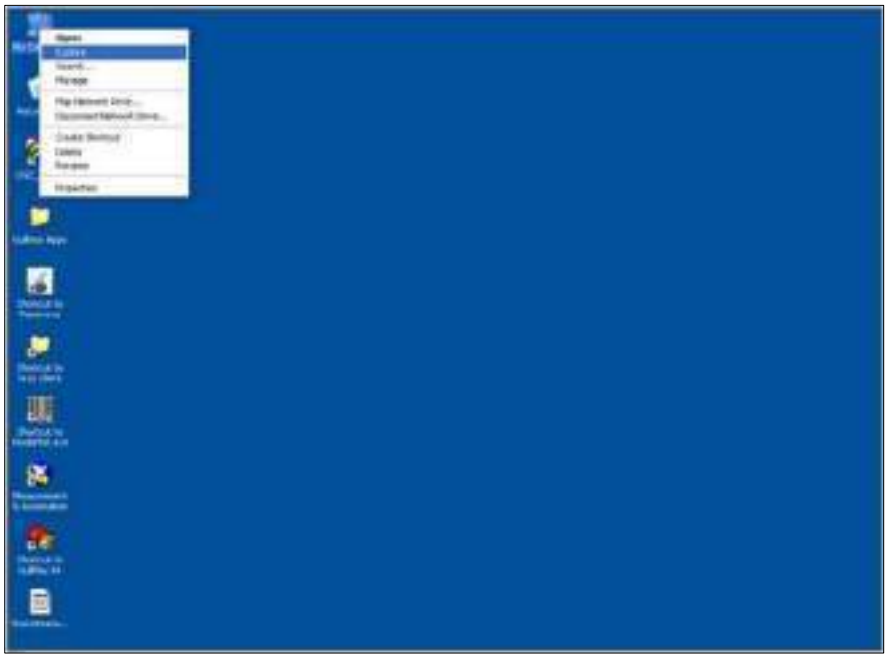


Figure 213: Selecting [Explore]

4. Expand the Local Disk (C:).
5. Expand the Program Files folder.
6. Open the X-ray Client folder.

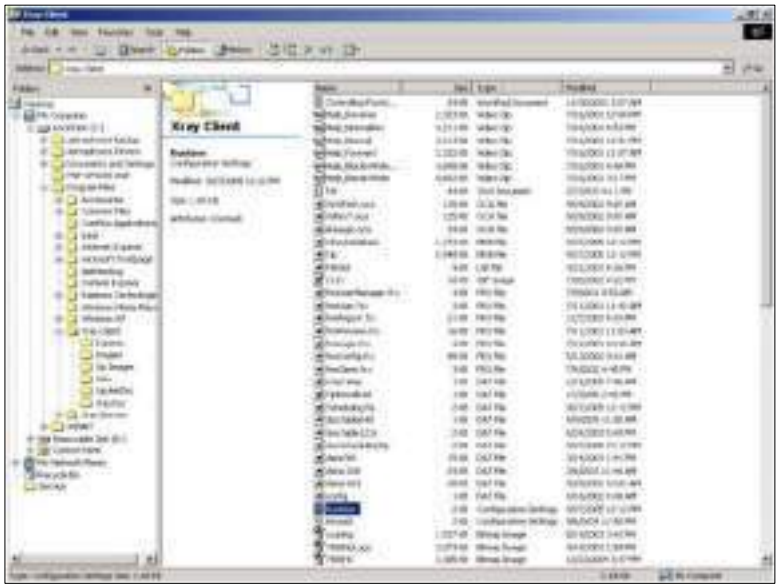


Figure 214: Finding [Runtime]

7. Scroll until you find the Runtime file, and open it.
8. Check the settings to zero for the following two lines:
    a. Diode Expansion (located under [Data Input] heading).

b. Diode Compression (located under [Data Input] heading directly under "Diode Expansion").

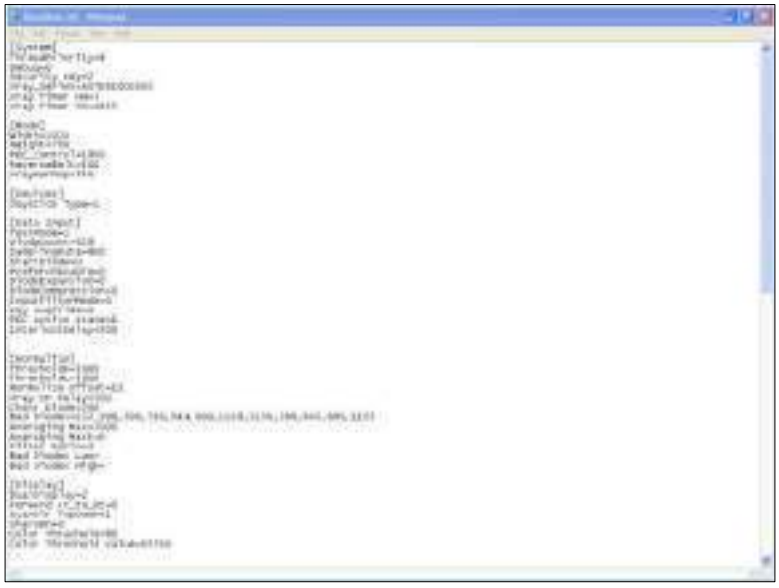


Figure 215: Runtime Screen

9. Press Ctrl + S to save the file.

Adjusting the Boards with Diode Plot

1. From within the X-ray Client program do the following:
    a. Click on Menu
    b. Select Diode Plot
    c. Select X-ray ON
    d. Select Both Energy

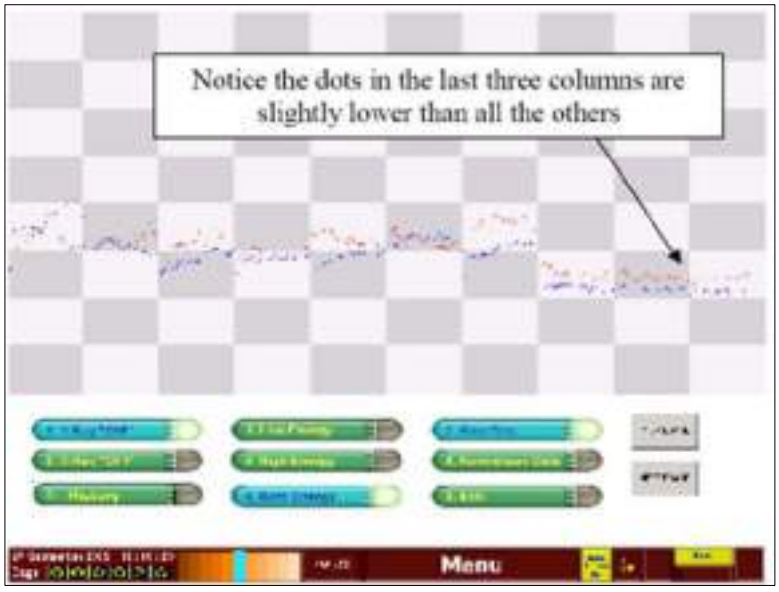


Figure 216: Diode Plot Showing Misalignment

NOTE: Each column represents an LXDA board.

It should now be possible to isolate the misaligned diode board by regarding the raw data displayed in Diode Plot. Once it has been determined which board needs adjustment, perform the following steps:

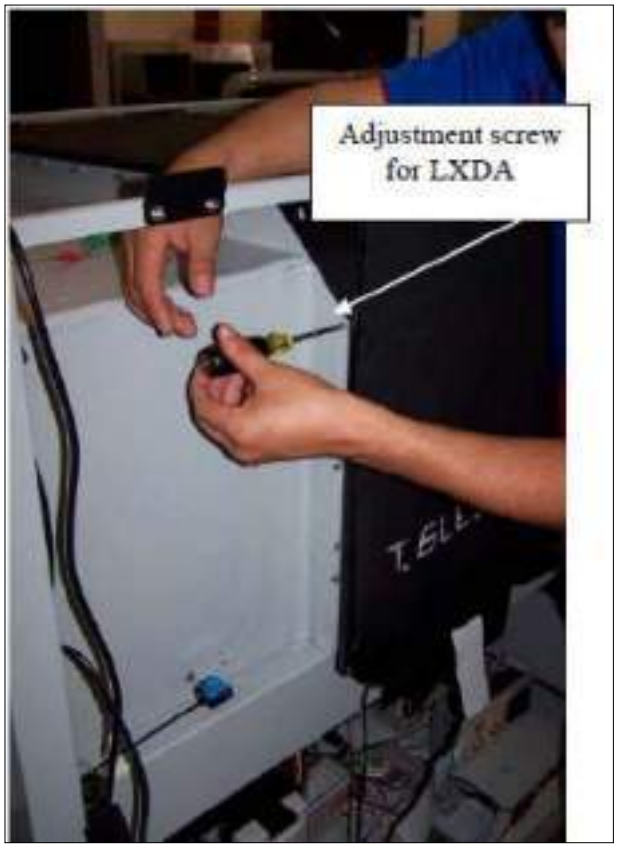


Figure 217: LXDA Adjustment Screw

1. Turn the adjustment screw for the corresponding LXDA board (as shown in Figure 217).
2. Observe that the pattern of red and blue “dots” moves upward.
3. Continue to turn the adjustment screw until the “dots” just begin to move down and then bring them back to their highest position.

Figure 218: Diode Plot Alignment Results

4. Once the optimum readout for the previously misaligned board is achieved, close the access door and replace the panel.
5. Exit the Diode Plot Screen.

LXDA Board Installation and Gain

Purpose and Description

The OGC software is used in conjunction with a standard Diode Plot. OGC offers two important capabilities not found in Diode Plot:

- In addition to remote correction, it allows much finer control than corrections made locally at the board itself.
- Offset and gain level now each have a discrete range from 0 to 254.

Parts Included:

- LXDA 2.0 Board
- LXDA Interface Board 2.0.
- USB-Serial (DB9) Adapter Cable and its Hardware Driver on a provided media (typically CD). (Generic component, may be obtained locally if required.)
- Male-to-Female Serial Cable (DB9), (Generic component, may be obtained locally if required.)
- OGC Software REV 1.0.0 on a provided media (typically CD).

Required Materials and Tools

- USB flash drive with which to copy the OGC software and hardware driver for the USB-Serial Adapter Cable to the XIS' embedded PC.
- Access to an additional PC with the drive types required to copy all files from the provided media to the USB flash drive above. For example, a PC with an optical drive (if on CD) and a USB port.
- USB keyboard and mouse for convenience.
- Tools required for LXDA assembly mounting and adjusting.

Procedure

LXDA 2.0 Board Installation

One of the primary design features of LXDA 2.0 boards is that they are part of a complete system, with two-way communication to and from the PC. For the purpose of remote offset and gain correction, a communication protocol must be carried through the LXDAs as a connected, "daisy chain" of boards. If communication is broken at any point in the chain, all LXDA 2.0 boards beyond the break will be inaccessible to the OGC software, and can only be corrected locally.

For example, if there is an LXDA 1.0 board in the system, remote correction will be unavailable to that board, and to any LXDA 2.0 boards beyond that point. However, all 2.0 boards before that point will be accessible. For this reason, if there is a mixture of LXDA 1.0 and 2.0 boards in an XIS (for example if field replacements are made), it is ideal to have all 2.0 boards at the beginning of the chain, and all 1.0 boards at the end. The chain begins at the LXDA board that has the LXDA Interface Board mounted to it, which is known as "board #1." This arrangement allows remote correction capability to all 2.0 boards in the system.

Some additional requirements for remote OGC capability are the inclusion of a new LXDA Interface Board 2.0 (2 in "Parts Included" section above), and its associated cable connections to the PC (3 and 4 in "Parts Included" section above). This hardware completes the communication link for the OGC software to the LXDAs.

The interface board has a new serial connector, and is a direct replacement for earlier LXDA Interface Board 1.0s. The cables combine to provide a USB connection at the PC, and a serial connection at the LXDA Interface Board. These components must all be included when upgrading earlier-production XIS machines.

1. While making sure that all standard safety precautions are complied with, open the XIS cabinet, and open the lead LXDA box cover to gain access to the LXDA boards.
2. If a board is being replaced, remove the existing LXDA assembly. Do this by first disconnecting all electrical input and output connectors as follows (seven total), and then remove the board assembly from the XIS.
    a. On the high-energy side disconnect:
        i. Power connector ("J6" on LXDA 1.0 or "J11" on LXDA 2.0).
        ii. 10-pin control input "J8"
        iii. 10-pin control output "J9"
        iv. Analog output "JP4"
    b. On the low-energy side disconnect:
        i. 10-pin control input "J5"
        ii. 10-pin control output "J4"
        iii. Analog output "JP1"
3. Before installation of the LXDA 2.0 board assembly, ensure that it is securely attached to its mounting bracket, and that the daughter board is also securely mounted. A complete assembly will have the steel mounting bracket and the photo diode daughter board in place. Ensure that they are clean and free from any foreign objects between components.
4. Mount the board assembly on the XIS, and connect all electrical inputs and outputs.

NOTE: For the power connectors, a change in design is currently being implemented. As the transition is made to LXDA 2.0 boards, new 6-circuit wire harnesses are replacing the older 3-circuit design. As mentioned previously, LXDA 2.0 boards are fully back-compatible, but please see the caution note below.

CAUTION: The power header "J11" on the LXDA 2.0 board is a new 6-circuit connector. It replaces the 3-circuit header "J6" on the LXDA 1.0 board. The 3-circuit connectors on the older wire harnesses are fully compatible with the 6-circuit header connectors on the

LXDA 2.0 boards, but beware of orientation and fit. The 3-circuit wire harness must be coupled to the 3 circuits on the 6-circuit header that are closest to the edge of the board. They are keyed to fit only one way, but can be fit incorrectly if forced together. The correct connection is very easy to make and will clip in place. All future production machines will have 6-cicuit power wire harnesses. However, there will be many "legacy" 3-circuit wire harnesses remaining in the field.

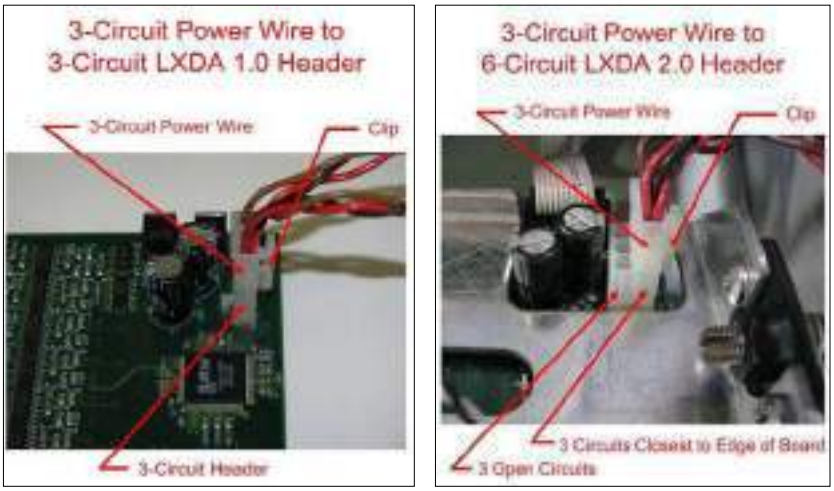


Figure 219: LXDA Power Connector Differences

Setting the LXDA Address in the DIP Switch

Once an LXDA 2.0 board is installed on an XIS, the board must be assigned its proper address using the DIP ("dual in-line package") switch "SW1" located on the low-energy side. This address is used by the OGC software to identify and communicate with each specific board. Individual switches on the DIP component act much like a typical jumper.

The board addresses are simply their position in the chain beginning with board #1 (the board the LXDA interface board is mounted to), and ending with the last board in the chain. The total number of boards varies by model of XIS, and currently would be no more than 18 boards. See an example of board numbers on the open LXDA box of an XIS-6545 in Figure 220 below.

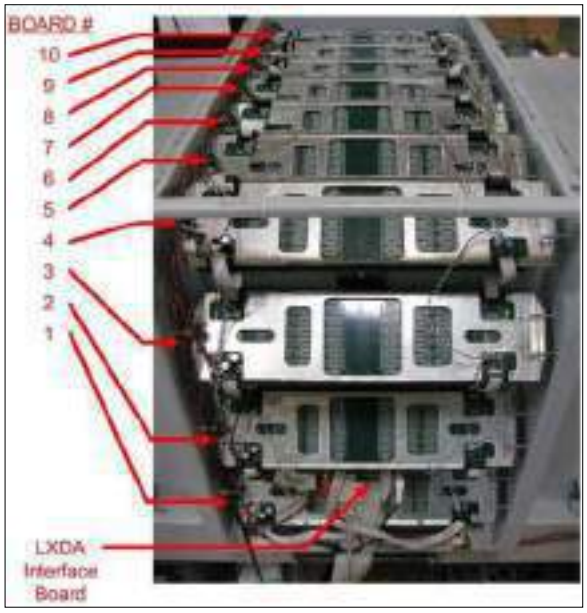


Figure 220: LXDA 2.0 Board Numbering on an XIS-6545

NOTE: The board numbering on an XIS begins from the board to which the LXDA interface board is mounted.

The board number must first be converted to “binary” (on/off) to be able to set the number using the DIP switch. The conversion is given in the figure below. To find the correct DIP switch setting, look up the board number in the first column of the table, and then find the corresponding binary board address to the right of it.

Notice that the switch numbers in the table go from right to left, the same as printed on the LXDA 2.0 board. The switch settings simply need to match the table. On the DIP switch itself, up is “On” and down is “Off,” as marked. They are very small switches which should be carefully set with a pointed device or fingernail.

NOTE: It is important to use the switch numbers printed on the LXDA 2.0 board labeled “Address,” and to ignore the numbers printed on the DIP switch component itself. They are numbered in opposite sequence. Also, all switches are not used. The switch to the left of “Switch 4” is to remain in the “Off” position.

Board Number	Switch 4	Switch 3	Switch 2	Switch 1	Switch 0
1	Off	Off	Off	Off	On
2	Off	Off	Off	On	Off
3	Off	Off	Off	On	On
4	Off	Off	On	Off	Off
5	Off	Off	On	Off	On
6	Off	Off	On	On	Off
7	Off	Off	On	On	On
8	Off	On	Off	Off	Off
9	Off	On	Off	Off	On
10	Off	On	Off	On	Off
11	Off	On	Off	On	On
12	Off	On	On	Off	Off
13	Off	On	On	Off	On
14	Off	On	On	On	Off
15	Off	On	On	On	On
16	On	Off	Off	Off	Off
17	On	Off	Off	Off	On
18	On	Off	Off	On	Off

Figure 221: DIP Switch Addressing Table for LXDA Component "SW1"

Example: Board #1 in the table in the figure above has a DIP switch configuration "Off – Of f – Off – Off – On." Compare that to the picture in the figure below. This shows an actual board #1 DIP switch configured to match the table.

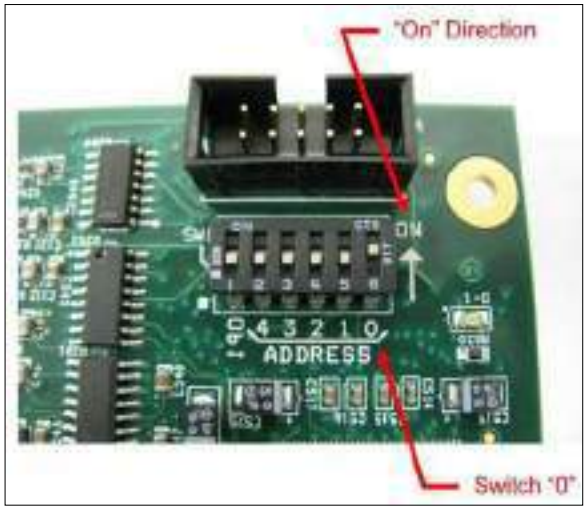


Figure 222: Address Properly Set on the "Board #1" DIP Switch

Correction Mode Selection: Local vs. Remote

It is not possible to do both local and remote corrections at the same time. One mode or the other must be selected. There are two new jumper components found on the LXDA 2.0 boards: “JP5” on the high-energy side and “JP6” on the low-energy side. Mode selection is made using these jumpers. Offset and gain each have their own pins, and are independent of each other.

Components “JP5” and “JP6” each have pin columns “A” and “B,” and pin rows “1,” “2,” and “3.” Column “A” corresponds to offset, and column “B” corresponds to gain. A jumper across rows “1” and “2” would correspond to local, and a jumper across rows “2” and “3” would correspond to remote. See the summary below.

For “JP5” and “JP6”:

A = Offset

B = Gain

Jumper Across 1 & 2 = Local

Jumper Across 2 & 3 = Remote

For quick-reference, these settings are also printed on the center of the board itself, immediately above the part number.

NOTE: Although the capability exists for both remote offset and gain correction, in general only remote offset corrections will be made. Gain will generally be set locally at production with the jumpers “J10” (high-energy) and “J1” (low-energy), and will no longer need to be corrected. Certain special applications may require the use of fine-tuned, OGC remote gain correction.

Example: On the high-energy side, to select remote correction mode for offset, do the following: On component “JP5” (high-energy), in column “A” (offset), place a jumper across rows “2” and “3” (remote). See the figure below, which shows “JP5” set up in this configuration.

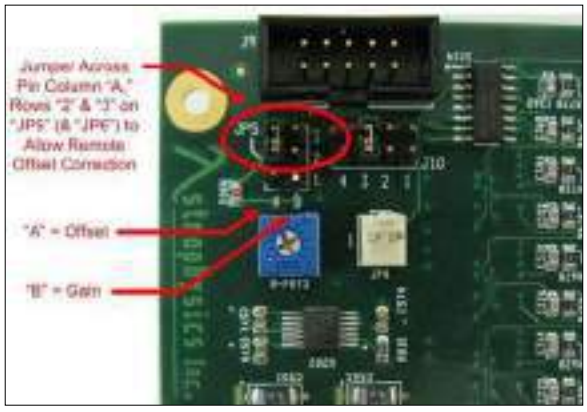


Figure 223: Remote Offset Correction Selected on High Energy Side (“JP5”)

NOTE: On early-production LXDA 2.0 boards, for both “JP5” and “JP6,” pin “B1” is to be cut off during assembly. No jumper connection across pins “B1” and “B2” is necessary to make local gain corrections. The board defaults to local, and only a jumper is needed across “B2” and “B3” to select the remote mode for gain. A different component design will be used in the future. See the figure below.

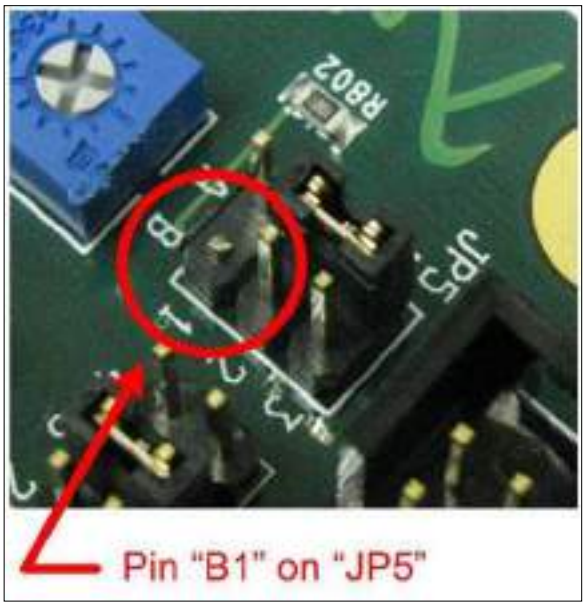


Figure 224: Pin “B1” is Removed on “JP5” and “JP6” During Assembly

When corrections are to be made locally, LXDA 2.0 boards are identical to 1.0 boards except for some component name changes. For offset, the high-energy side square trimming potentiometer is renamed “R-POT2” instead of “R759.” For the low-energy side it is renamed “R-POT1” (low-energy) instead of “R27.” For gain the jumpers have the same names, “J10” on the high-energy side and “J1” on the low-energy side.

Installing the Hardware and the Hardware Driver

The additional hardware components required to make the OGC software capable of communicating with the LXDA 2.0 boards are the following (see part numbers in the “Parts Included” section above).

A. LXDA Interface Board 2.0

B. USB-Serial (DB9) Adapter Cable and its Hardware Driver

C. Male-to-Female Serial Cable (DB9)

Newly manufactured XIS units will have an LXDA Interface Board 2.0 installed as standard, replacing the previous-generation interface boards. All others must be

upgraded for OGC capability. The new interface boards are designed to carry a serial COM link from the PC, and are mounted to the #1 LXDA board as normal.

Figure 225: LXDA Interface Board, 2.1, Rev B

The USB-Serial Adapter Cable and the Male-to-Female Serial Cable are both generic parts. They may be obtained locally if required.

The required driver for the USB-Serial Adapter Cable must be copied into the proper folder before hardware installation can begin. To install the required hardware driver, follow the steps below.

1. The technician must be at the Windows XP desktop to install the driver and complete the “Found New Hardware Wizard.” If currently in the XIS Imaging application, first logout by pressing the AOCP “Logout” key, and then press the AOCP “Enter” key (or the keyboard “Esc” key) to exit to the desktop. If pressing the “Enter” key at the login screen does not exit the application, be sure to point and click inside the password box first to activate the window, and then press the AOCP “Enter” key (or the keyboard “Esc” key). See the figure below.

Figure 226: Exiting the XIS Imaging Application to go to the Windows XP Desktop

2. Copy the provided USB-Serial Adapter Cable driver file to the correct driver folder. The full path is as follows:

C:\Program Files\Astrophysics Drivers\USB-SERIAL ADAPTER\WINDOWS

The driver file that comes with the USB-Serial Adapter Cable will typically be on a CD. However, the XIS' embedded PC does not have an optical drive, so the file will first need to be copied from the original media to a USB flash drive for transfer to the XIS' PC.

Both Astrophysics-supplied and locally obtained USB-Serial Adapter Cables will vary in appearance and driver media. One example package is given in the figure below.

Figure 227: An Example USB-Serial Adapter Cable and Driver on Mini CD

If there is a problem locating the required driver folder in the XIS' PC, follow these steps:

a. Click the Windows XP "Start" button, then click the "My Computer" menu item.
b. Double-click the "Local Disk (C:)" drive.
c. Double-click the "Program Files" folder to open it.
d. Double-click the "Astrophysics Drivers" folder to open it.
e. Double-click the "USB-SERIAL ADAPTER" folder to open it.
f. Either drag-and-drop, or copy-and-paste the USB-Serial Adapter Cable driver file from the USB flash drive into the "WINDOWS" folder.
g. Confirm that the driver file copied successfully by clicking on the "WINDOWS" folder to open it and view its contents.

3. Connect the USB end of the USB-Serial Adapter Cable to an open USB port on the PC. See the figure below. If there are no open ports available on the back of the PC, there may be additional ports on the front.

Figure 228: USB-Serial Adapter Cable to PC Connection

When the USB-Serial Adapter Cable is connected to a USB port, Windows XP will either automatically start its "Found New Hardware Wizard," or do nothing. If nothing happens, it is possible that a driver for this type of adapter has already been installed on that port, which is OK. Otherwise it could be a bad USB port or a bad adapter.

NOTE: Each USB port is independent, and will recognize the USB-Serial Adapter Cable as new hardware only if it was not previously installed on that USB port.

Once the wizard starts, follow the steps below:

1. The driver will be located manually. Check the "No, not this time" radio button.
2. Click the "Next" button.
3. The driver will be installed from where it was copied to in Step 2g above. Check the "Install from a list or specific location (Advanced)" radio button.
4. Click the "Next" button. The "Found New Hardware Wizard" may find and use the correct driver automatically if allowed to, but the best way to be certain is to locate it specifically using this option.
5. Check the "Search for the best driver in these locations" radio button.
6. Uncheck the "Search removable media" check box.
7. Check the "Include this location in the search:" check box.
8. Click the "Browse" button.
9. Navigate to the driver location that it was copied to in Step 2g above ("C:\Program Files\Astrophysics Drivers\USB-SERIAL ADAPTER\WINDOWS"). Do this using the "Browse For Folder" window which pops up. Starting from the "My Computer" location, follow the same basic procedure that was followed above. Clicking the "+" symbol to the left of an icon will expand the contents of that location for quick viewing and selection.

Figure 229: Browse for Folder

10. Click the “Next” button.
11. The wizard will now begin to install the driver. A dialog will pop up saying that the software “has not passed Windows Logo testing.” Click the "Continue Anyway" button.

NOTE: The “Prolific USB-to-Serial Bridge” hardware name that is referred to in the dialog is a brand name. Brands will vary, but look for some reference to a USB-to-Serial device.

12. If the driver installed successfully, the “Completing…” window will pop up. Click the “Finish” button to close the wizard.

The USB-Serial Adapter Cable will now be recognized and assigned a COM port number, “COM7” for example (which will be used as the example later in the OGC software instructions). To install the rest of the required hardware, follow these steps:

1. The Male-to-Female Serial Cable is necessary because both the USB-Serial Adapter Cable and the LXDA Interface Board 2.0 have male connectors. Plug the serial end of the USB-Serial Adapter Cable into the female end of the Male-to-Female Serial Cable. See the figure below.

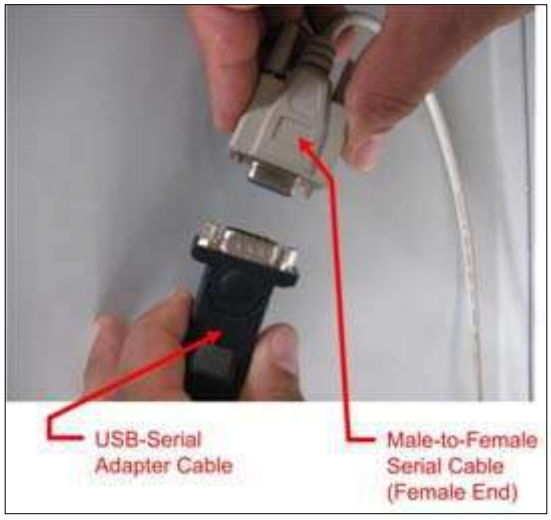


Figure 230: USB-Serial Adapter Cable to Serial Cable Connection

2. Plug the male end of the Male-to-Female Serial Cable into the LXDA Interface Board 2.0 serial connector "J6," which is mounted to LXDA 2.0 board #1. See the figure below.

NOTE: If required, remove the LXDA Interface Board 1.0, and replace it with an LXDA Interface Board 2.0 which has the serial connector.

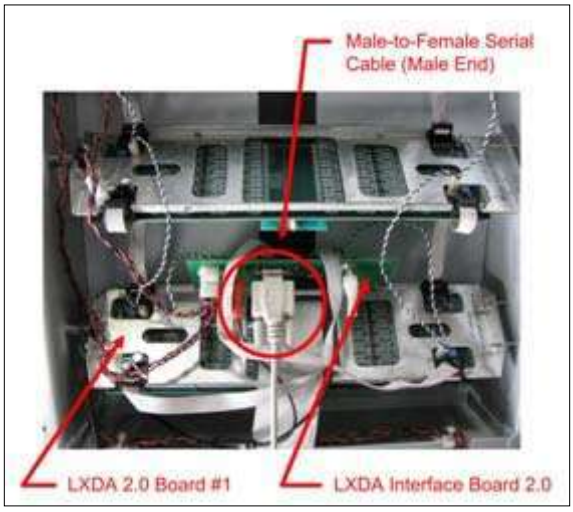


Figure 231: Male-to-Female Serial Cable Connection (Male End) to LXDA Interface Board

Installing the "Offset Gain Correction 1.0.0" (OGC) Software

If the OGC software has not yet been installed on the XIS, the procedure in this section must be completed. To install the OGC software, the folder "OGC_1_0_0" will first need to be copied to a USB flash drive from the provided media as discussed in the "Parts Included" section above.

IMPORTANT NOTE: It is strongly recommended that the technician exit all programs before running the installer, including virus-scanning utilities.

1. Connect and open the USB flash drive containing the OGC software. The "setup.exe" installer file is found in the following location:

   …\OGC_1_0_0\OGC_1_0_0 Installer\setup.exe

2. Double-click the "setup.exe" file to start the OGC installer. If there is any problem locating the "setup.exe" file, follow these steps.
   a. Open the USB flash drive and double-click the "OGC_1_0_0" folder to open it.
   b. Double-click the "OGC_1_0_0 Installer" folder to open it.
   c. Double-click the "setup.exe" file to start the OGC installer.
3. Once the installer has finished initialization (the window with the green status bar closes), the "Destination Directory" window will open. Accept the default directories for both "OGC_1_0_0" and the "National Instruments products" by clicking the "Next" button.
4. In the "License Agreement" window, select the "I accept the License Agreements(s)." radio button.
5. Click the "Next" button. See the figure below.
6. Complete the process as prompted by the installer, and then restart the PC to complete the installation.
7. After restarting the PC, return to the Windows XP desktop.
8. Create an OGC application desktop shortcut for easier technician access. To do this, navigate to and open the "OGC_1_0_0" folder in the following location:

   C:\Program Files\OGC_1_0_0

9. Drag-and-drop a copy of the "OGC_1_0_0" application file to the desktop to create a shortcut. The application file appears as shown below.

The desktop shortcut will then appear.

If there is any problem locating the "OGC_1_0_0" application file, follow the steps below:

1. Click the Windows XP "Start" button.
2. Click the "My Computer" menu item.
3. Double-click the "Local Disk (C:)" drive.
4. Double-click the "Program Files" folder to open it.
5. Double-click the "OGC_1_0_0" folder to open it.

6. Locate and then drag-and-drop a copy of the application file to the desktop to create a shortcut. If needed, resize the “OGC_1_0_0” folder window using the “Restore Down” button in the upper right corner. This will allow viewing of the folder and the desktop at the same time. See immediately below.

Using the “Offset Gain Correction 1.0.0” Software (OGC)

1. Software Start Up: Start the “Offset Gain Correction 1.0.0” software using the desktop shortcut shown below:

NOTE: If a Diode Plot has already been started, it will likely cover up the shortcut for the OGC software on the desktop. The OGC can also be started from the Windows XP “Start” > “All Programs” menu. Typically, start the OGC software and get it set up before starting a Diode Plot.

2. Once the software starts, the OGC window opens as shown in the figure below:

Figure 232: OGC Window on Software Start-Up

To become familiar with the layout and function of the controls and indicators in the OGC window, see the highlighted sections in the figure and summary below. Details follow in the procedure instructions.

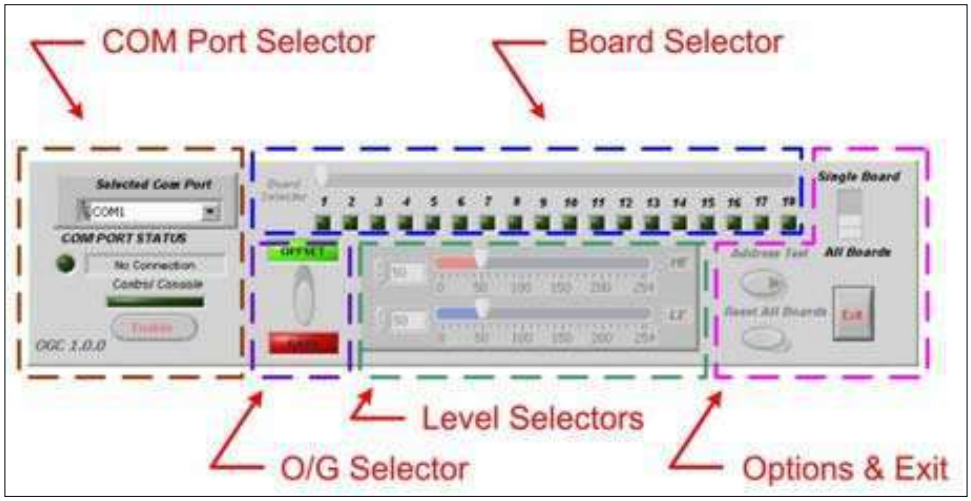


Figure 233: OGC Window by Sections

Summary of "OGC Window Layout & Functions"

COM Port Selector: On software startup, this is the active section of the window. It is where the correct COM port is selected, and communications are established with the LXDA 2.0 board chain.

Board Selector: This section has a slider control and board indicator lights to allow a specific board to be singled out for corrections. Board indicator lights are feedback for the technician, and flash whenever a board is acknowledging the receipt of a command.

Offset/Gain (O/G) Selector: This control is a toggle to select either offset or gain correction. It determines what correction the "level selectors" are enabled to make.

Level Selectors: The level selectors are divided by energy. The top selector is high-energy ("HE"), and has a red graphical level indicator, corresponding to the red high-energy points on a Diode Plot. The bottom selector is low-energy ("LE"), and has a blue graphical level indicator, corresponding to the blue low-energy points on a Diode Plot. Each energy has two basic controls, a slider on the right for "coarse," or large corrections (matched against a scale from 0 to 254), and up & down arrows immediately to the left, for "fine," or small corrections, with a digital readout text box to show the exact level selected. A technician may typically start with a coarse adjustment, by either dragging the slider, or clicking in the slider track, to quickly approach where the level needs to be on a Diode Plot. Then, a final adjustment is made either using the up and down arrows, or by directly typing a level into the text box.

Options & Exit:

- "Address Test" button: This button is used to test communication with each board, and is used to verify the proper address, and that each board is responding to commands.
- "Reset All Boards" button: A function to reset all boards to a nominal mid-range value. It is used typically by production as a starting point for setting levels on a new installation of LXDA 2.0 boards.

- "Single Board" / "All Boards" selector: A toggle control for either individual board correction, or for all boards to be corrected simultaneously to the same level.
- "Exit" button: To exit the software; this button is always enabled.

Establish a Communication Connection

Communication with the LXDA boards must now be established. Until it is, all correction controls will be inactive. To establish a communication connection, select the COM port that was assigned to the "Prolific USB-to-Serial Bridge" during the hardware driver installation. Locate it in the "Selected Com Port" dropdown list. Expand the list using the arrow on the right side of the I/O text box. See the figure below.

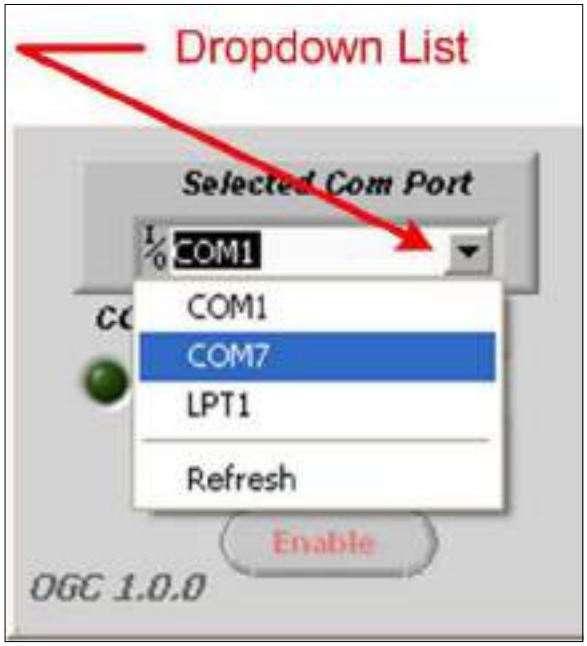


Figure 234: COM Port Selector Dropdown List

There are two simple ways to find the correct port if it is not immediately known. First, it will usually be the COM port in the list that is not COM1. COM1 is normally assigned for other purposes such as cabinet interlocks and PEC switches. LPT1 is assigned to the PLC. The second approach is simply to try each port in the list until the correct port is found. The correct one will be detected by the OGC software automatically.

When the correct COM port is detected, the message box for "Com Port Status" will switch from "No Connection" to "Detected COM7" (for example); the round indicator light immediately to the left of the message box will flash green. Very shortly after, the rectangular indicator below "Control Console" will turn green, and the "Enable" button will become active. See Figure 235.

Figure 235: Connecting to the Proper COM Port with the COM Selector

NOTE: If a communication connection cannot be established with the LXDA boards, please see "Condition 1" in the "Troubleshooting" section below.

1. Click on the "Enable" button (Figure 235). The button will switch from "Enable" to "Enabled," it will become non-active, and a dialog box will pop up with the question, "Reset All Boards?"

Figure 236: Reset All Boards

Under normal service circumstances, resetting boards is primarily used for initial production corrections. Unless otherwise required, click on "Cancel."

All of the correction controls on the right-hand-side will now be enabled and ready for use, and the OGC window will look as shown in the figure below.

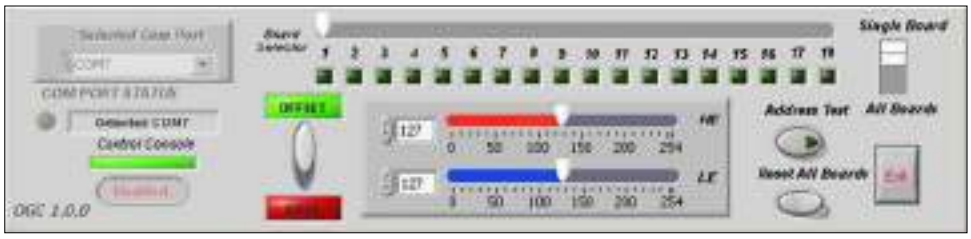


Figure 237: OGC Window After Being Enabled

Address Test

Once communication is established with the LXDA boards and the correction controls are enabled, it is a good idea to begin with an address test using the “Address Test” button (see Figure 238). This function tests communication with each of the LXDA 2.0 boards. It is an on-off toggle type control. When the button is clicked on, the board indicators in the OGC window will flash green in continuous sequence from board #1, to the last board in the system. In the example of an XIS-6545, it would flash only from 1 to 10 out of the 18 board indicators. If one board is not responding, but all other boards are, it is probably because it has been addressed incorrectly.

Again, any LXDA 1.0 boards in the chain will not respond, nor will any LXDA 2.0 boards located after an LXDA 1.0 board in the chain. LXDA 1.0 boards will stop communication to all boards after their position.

The figure below shows how the OGC window appears when an address test is being conducted. The Address Test button indicator light will be on, the board indicators will flash from left to right, and all other controls will be disabled except "Exit" and "Test Speed" (which is not visible except during an address test).

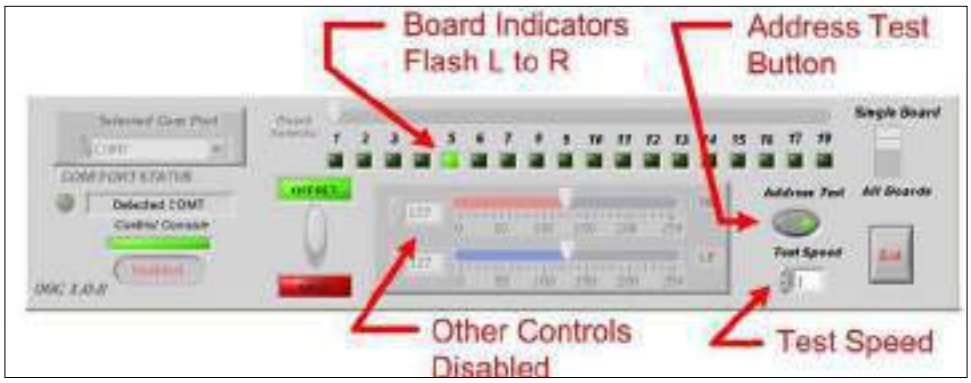


Figure 238: OGC Window During Address Test

Whenever an address test is being conducted, a new LED component “D-1” on the LXDA 2.0 boards (low-energy side) will also flash in sequence, together with the indicators in the OGC window. See Figure 239 below. Both are feedback indicators, and acknowledge control commands that are received by the LXDA 2.0 board from the OGC software.

Figure 239: LED Component "D-1" on the LXDA 2.0 Low-Energy Side

Figure 240 shows some of the differences in the OGC window controls with the "Address Test" on and off. "Test Speed" shows how quickly (on a scale of 10-1) the test runs through and flashes each board indicator. The default speed is 1, which is the fastest setting. If it is difficult to track the flashes of the board indicator lights, use the test speed arrows to adjust it to a slower speed (toward 10). See the left side of Figure 240.

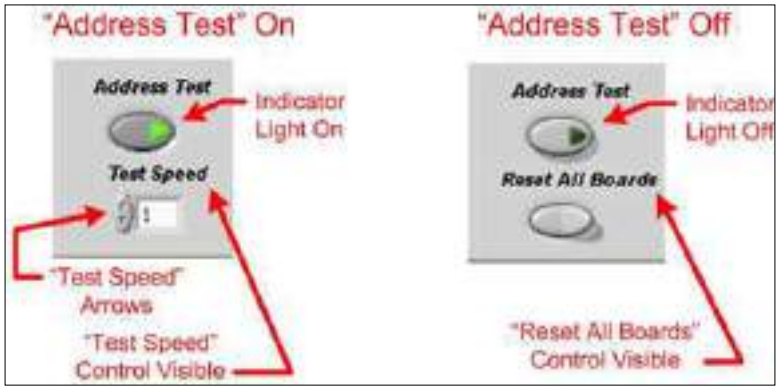


Figure 240: Detailed OGC Window Differences with "Address Test" On and Off

By first checking individual communication with an address test, it will be known to the technician what boards are available for remote correction, and to troubleshoot if required.

Setting Offset and Gain Remotely

1. While making sure that all standard safety precautions are complied with, pull the interlocks out to the service-closed position. If this is not done first, the DiodePlot application will give an "Interlock Open – Please Clear to Continue" message until the interlocks are pulled out.
2. Start the "DiodePlot" application using the desktop shortcut shown immediately below.

Figure 241: Shortcut to DiodePlot

3. After starting the Diode Plot application, it will be fixed above the OGC window, and the OGC control functions will be available for use. Confirm that the O/G Selector is in the “Offset” (up) position. Now, offset can be easily corrected for either a single board, or for all boards simultaneously.
4. By first selecting the “Single Board” option, and then the specific board number desired using the “Board Selector” control, that board may now be corrected for offset individually. See the figures below. The example in this case is board #5.

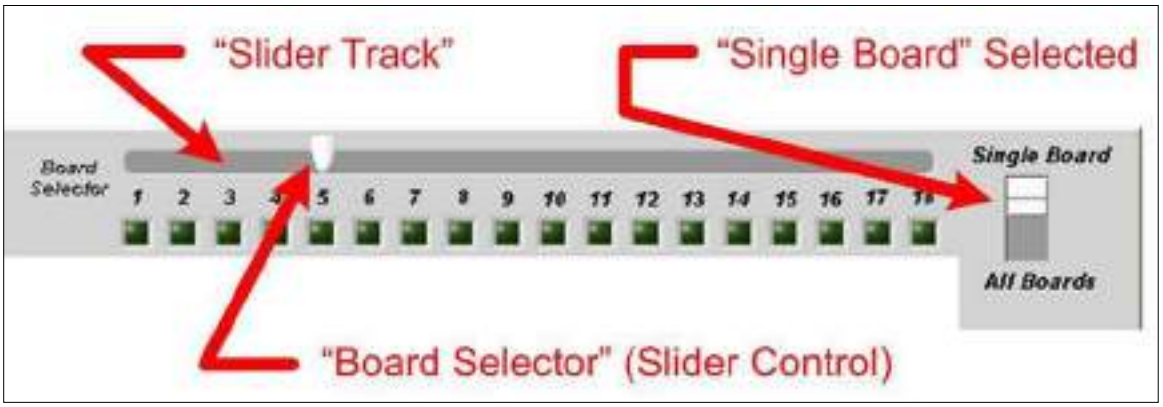


Figure 242: Board #5 Selected for Individual Correction

NOTE: When selecting the board number using the “Board Selector” (slider) control, either the slider itself can be dragged to the board number desired, or the technician may click in the dark gray area of the “Slider Track” to move the control to that point.

Figure 243: Correcting Board #5 Individually with OGC Software and Diode Plot

Alternatively, by first selecting the “All Boards” option, all boards may now be corrected for offset simultaneously. See the figures below.

NOTE: When the “All Boards” option is selected, the “Board Selector” control is disabled. See the figure below.

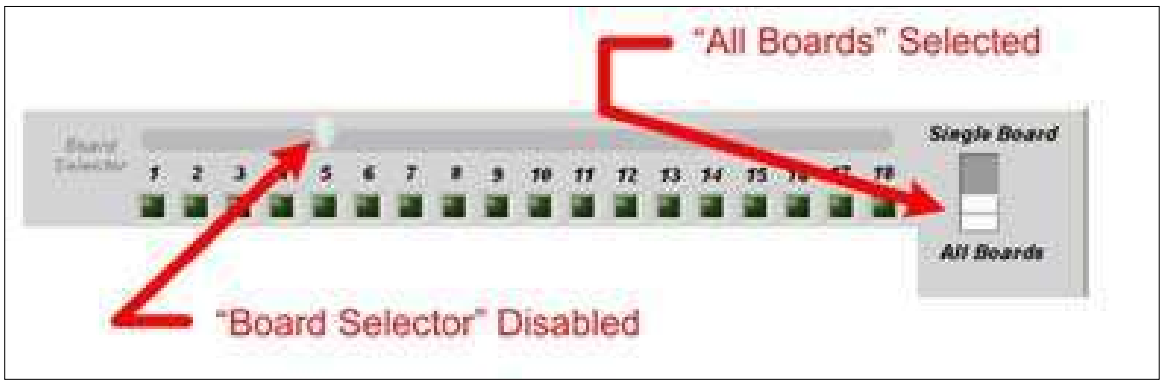


Figure 244: All Boards Selected for Correction

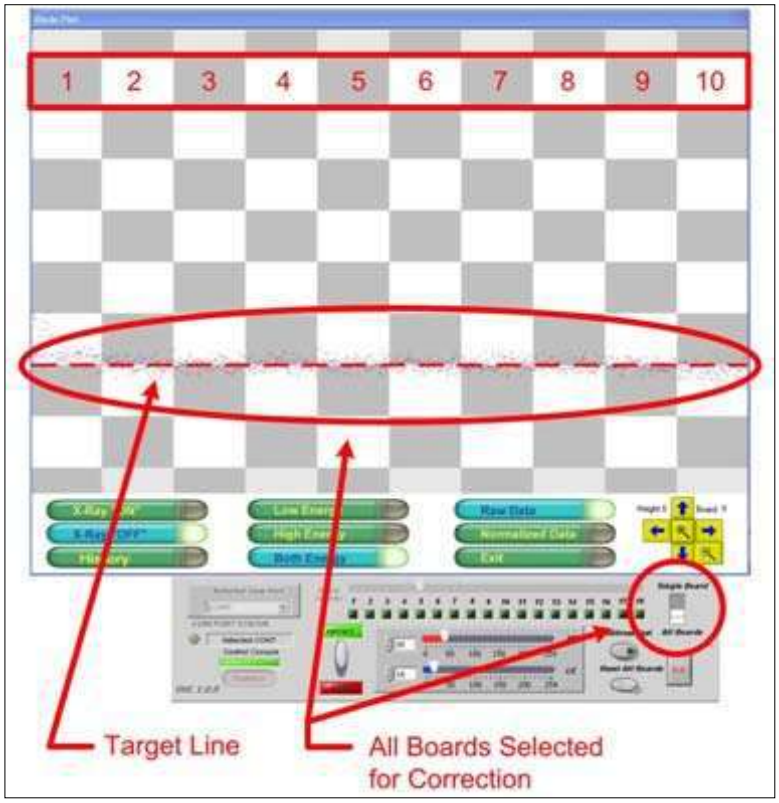


Figure 245: Correcting All Boards Simultaneously with OGC Software and Diode Plot

The figure below shows additional control details for offset and gain (O/G) level selection. There are both coarse and fine correction controls. In general, begin by dragging the "Slider Control" to make any large (or coarse) corrections required, and then make the final small (or fine) corrections by using the "Up & Down Arrows." This is also described above in the "Summary of 'Figure _. OGC Window Layout & Functions'," under the section "iv. Level Selectors:."

Two types of level indicators are available. The first are coarse "Graphical Level Indicators" in the form of horizontal bars. These are associated with the coarse slider controls. The second are fine "Digital Level Indicators," which are associated with the fine-tuning up & down arrow controls.

NOTE: Alternative methods of making coarse and fine corrections are the following. For coarse corrections, the technician may click in the "Slider Track" to move the control instead of dragging it. This is the same way that the "Board Selector" control functions as described above. For fine corrections, the technician may select and then type a value in the "Digital Level Indicator" instead of using the up & down arrows.

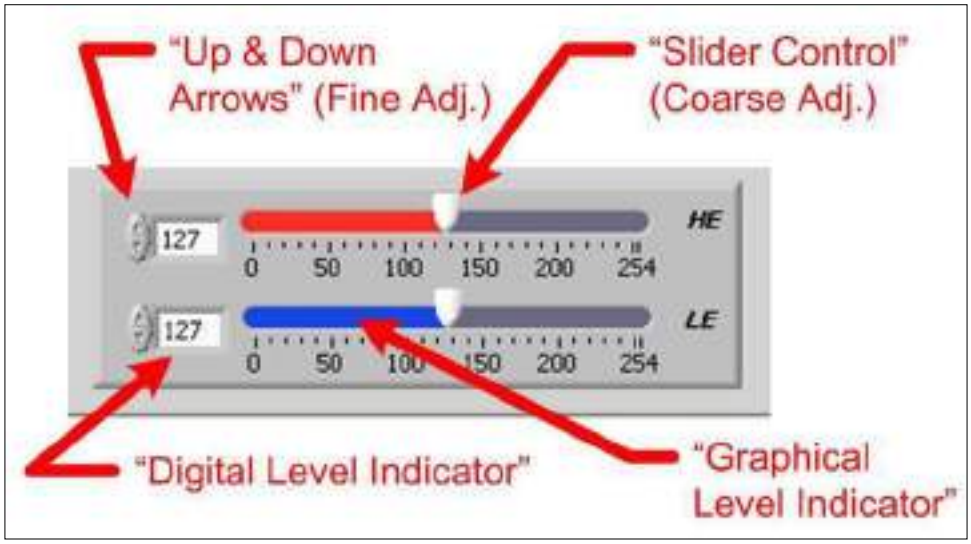


Figure 246: O/G Level Selector Controls in Detail

Exiting the OGC Software Application

When all desired corrections have been made to the LXDA boards, the OGC software application may be closed using the "Exit" button in the bottom right corner of the OGC window. The DiodePlot application may also be closed at any time.

Troubleshooting:

This section describes troubleshooting solutions for LXDA 2.0 installation, testing, and correction.

Condition 1. A communication connection cannot be established with the LXDA 2.0 boards in Step 6B above.

1. Confirm that a COM port has successfully been assigned to the USB-Serial Adapter Cable. The connection can be viewed via the hardware "Device Manger" under its "Ports (COM & LPT)" section. To navigate there quickly, see the figure and summary below.

The connection name will have a "USB-to-Serial" reference of some sort, and a COM port number. The specific name will vary by manufacturer, and the actual port assignment. The example in this case is "Prolific USB-to-Serial Bridge (COM7).

a. Click the Windows XP "Start" button, and then click the "Control Panel" menu item.
b. Double-click the "System" icon to open the "System Properties" window.
c. Click the "Hardware" tab.
d. Click the "Device Manager" button to open its window.
e. Click the "+" symbol to the left of the "Ports (COM & LPT)" icon, or double-click the icon itself, to expand and view all available connections.
f. The connection name will have a "USB-to-Serial" reference of some sort, and a COM port number. The specific name will vary by manufacturer, and

the actual port assignment. The example in this case is "Prolific USB-to-Serial Bridge (COM7)."

If the USB-Serial Adapter Cable was not successfully installed and assigned a COM port while going through the "Found New Hardware Wizard" process, the name and icon for the adapter will not appear. Instead, an exclamation mark will show up on top of the USB-Serial icon, and a generic "USB-Serial Controller" name will be given. An example of this is shown in the figure below.

Figure 247: Unsuccessful Installation and Assignment of COM Port to USB-Serial Adapter Cable

If the installation was not successful, there are several possible causes:

- the original driver was not correct
- the driver was not successfully copied to the required location
- the "Found New Hardware Wizard" process was not completed properly
- the USB port that was used is faulty

To correct these faults:

1. If the original driver is not correct, confirm that the driver is the one that was supplied with the USB-Serial Adapter Cable.
2. If the driver was not successfully copied to the required location, confirm that the driver was copied to the correct location.
3. If the "Found New Hardware Wizard" process was not completed properly and/or the USB port used is faulty, try another available USB port for the adapter, and then go back through the "Found New Hardware Wizard."

Once successfully installing the hardware driver for the USB-Serial Adapter Cable, further confirm that the file used by the system for the adapter is correct by viewing the "Driver File Details." To do so, follow these steps:

1. Double-click on either the connection's icon or its name to view its properties. The specific name will vary by manufacturer, and the actual port assignment. The example in this case is "Prolific USB-to-Serial Bridge (COM7)." Then, click on the "Driver" tab.

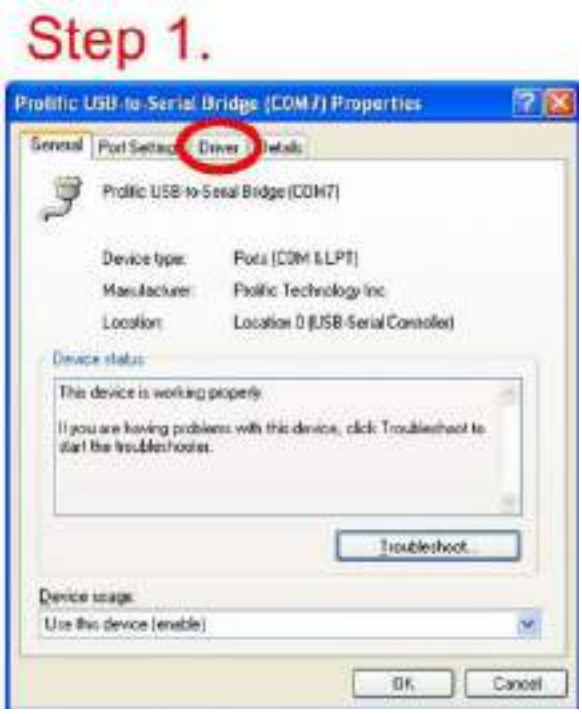


Figure 248: Confirming File Name of USB-Serial Adapter Cable Driver

2. Click on the "Driver Details…" button to open the "Driver File Details" window.

Figure 249: Step 2 Confirming File Name of USB-Serial Adapter Cable Driver

3. In one of the displayed lines, the original driver file name should show up at the end of the following path: "C:\WINDOWS\system32\DRIVERS\..." The example in this case is "ser2pl.sys." It is OK if it does not show a green "digitally signed" checkmark icon to the left of the driver file's path.

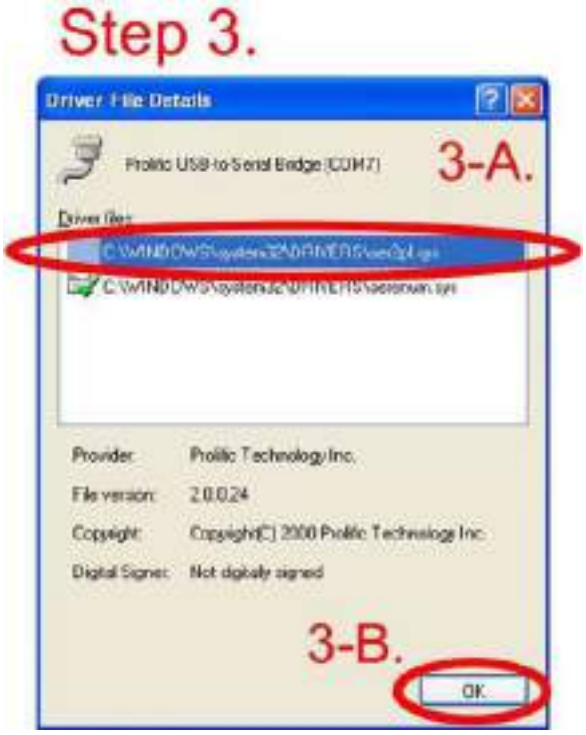


Figure 250: Step 3 Confirming File Name of USB-Serial Adapter Cable Driver

Condition 2. An LXDA 2.0 board is not responding during an address test, or to the correction controls, but all other boards are responding.

If a single LXDA 2.0 board does not respond to OGC commands, whether during an address test or during actual corrections if an address test was not done first, the most likely cause is a problem with addressing. To deal with this, follow these steps:

1. While making sure that all standard safety precautions are complied with, open the LXDA box and check the DIP switch ("SW1") for the correct board address. If the address is correct, then the DIP switch itself may be at fault. Each DIP switch is like an individual jumper, except that they are switched to an "on" position instead of placing a jumper block between pins.
2. Troubleshoot all the individual switches in the DIP component with a continuity check to see if a switch that is supposed to be "on" is open, or a switch that is supposed to be "off" is shorted. It is important in the checks to include the unused sixth switch on the left side of the row.

Condition 3. One energy level (high or low) is not responding beyond a given board number during an address test, or to the correction controls, but the other energy level is responding on all boards. This situation will occur when a communication link is broken on one energy side at a given point in the LXDA chain.

1. While making sure that all standard safety precautions are complied with, open the LXDA box and check the connection of the 10-pin ribbon cable between the last responding board and the first non-responding board in the chain. This needs to be done only on the side of the board (energy level) that is non-responsive.
2. If the 10-pin ribbon cable connections appear good, try a different cable. If the cable is good, there may be a problem with a connector on either of these two boards. Otherwise, some other board-related problem on the non-responsive board may exist. To confirm, remove and replace it with a different LXDA board.

Condition 4. No LXDA boards are responding for either energy level beyond a given board number during an address test, or to the correction controls. This situation will occur when the communication link is stopped for both energy levels at a given point in the LXDA chain.

There are several possible causes for this. If all LXDA boards beyond the point of lost communication are otherwise functional, there may be one or more LXDA 1.0 boards in the system, beginning at that point.

If there is a mixture of boards in the XIS, then all 1.0 boards should be at the end of the chain for best use of the LXDA 2.0 and OGC software's capabilities.

If not only communication is lost on all boards beyond a given board number, but functionality is also lost as seen on a Diode Plot, then there is a problem with the first malfunctioning LXDA in the chain.

1. While making sure that all standard safety precautions are complied with, open the LXDA box.
2. Check the power connection to the failed board.
3. Carefully check the board's +5 and -5 voltages, using test points available on the high-energy side. These points are at "F2" (+5) and "F4" (-5).

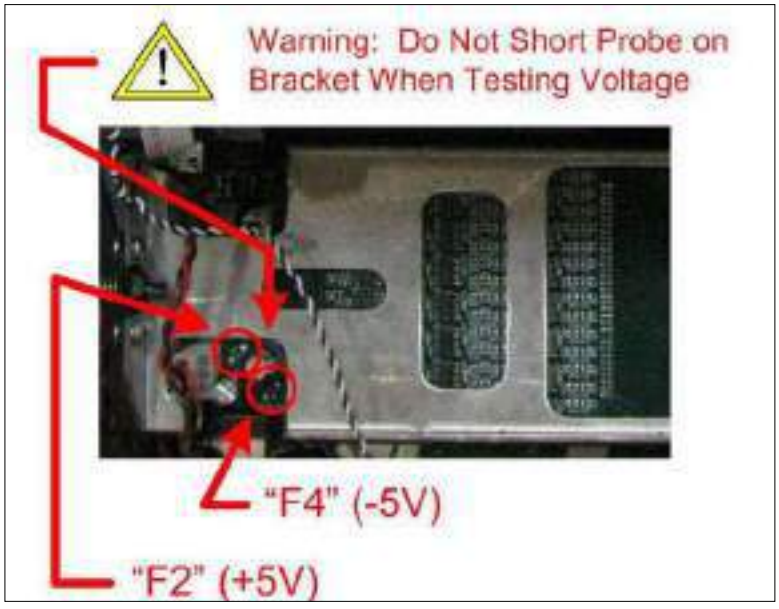


Figure 251: LXDA 2.0 +5V & -5V Test Points and Mounting Bracket

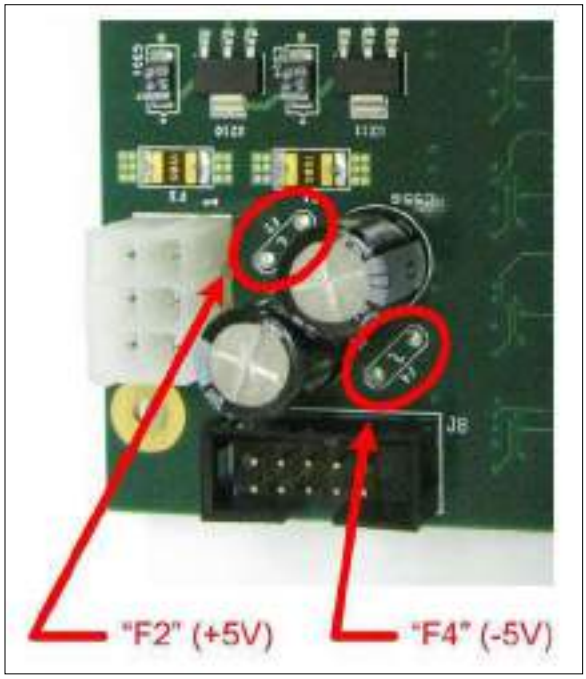


Figure 252: Close-Up of LXDA 2.0 +5V & -5V Test Points

If the board has failed completely, then the 10-pin communication line for both energy levels will be stopped, and all boards beyond that point will not function on the Diode Plot.

CAUTION: To avoid damage, do not short the voltage test probe on the LXDA 2.0 board mounting bracket when testing the voltages at the "F2" and "F4" contact points.

If the board needs to be replaced for any reason, and a spare is not immediately available, then swap the failed board with the last board in the chain to minimize the impact on imaging until it can be replaced.

Radiation Survey

Following are directions for conducting a radiation survey on XIS X-ray machines.

RADIATION SURVEY WORK INSTRUCTIONS

SUMMARY

The instructions below are detailed the work-instructions for performing a comprehensive external radiation survey of the *Astrophysics Inc©.* (Astrophysics) *X-ray Imaging Systems* ™(XIS).

Radiation surveys, performed according to these work-instructions, can be used to evaluate and document compliance to:

- *Health Canada* radiation safety statutes, including but not limited to, the *Consolidated Regulations of Canada (CRC), c. 1370., Radiation Emitting Device (RED) Act, RED Regulations.*
- *United States Food and Drug Administration (FDA), Center for Devices and Radiological Health (CDRH)* statutes for non-medical Cabinet X-ray Systems including but not limited *to United States Code of Federal Regulations (CFR) Title 21, Section 1910.40.*
- *United States Nuclear Regulatory Commission* radiation protection statutes including but not limited to, *United States Code of Federal Regulation (CFR), Title 10, Part 20, Standards for Protection Against Radiation, and*
- *California Department of Public Health* radiation safety codes including but not limited to, *California Code of Regulation (CCR) Title 17 (Public Health), Division 1 (State Department of Health Services), Chapter 5 (Sanitation), Sub-Chapter 4 Radiation.*

Required Resources

Qty	Item	Comments
1	Fluke™ Model Victoreen 451P Pressurized Ion Chamber Radiation meter or other appropriate calibrated radiation measurement meter.	Must have current (unexpired) calibration.
1	Astrophysics Quality Assurance – Radiation Survey Form.	Verify that it is the most current revision.
2	Radiation Scatter-Block	Either a 9” x 12” soft pine block (as described in ASTM F792-01 Section 1) or a wrapped ream of commercial paper (500 sheets), 20 lb basis. For Canadian bound X-ray systems, use a rectangular 4x4 (3.5” x 3.5” x “width of conveyor belt) pine wood “log” block.

Figure 253: Radiation Survey Required Resources

WORK-INSTRUCTIONS

1. Record your name and the date on the Astrophysics Radiation Survey Form (hereinafter referred to as RSF).

2. Record the model number and serial number of the Astrophysics XIS unit in the RSF.

3. Inspect the Radiation Measurement Meter.
   - If you are not familiar with your RMM, read the RMM's operator instructions.

4. Verify that the RMM is ready for use. Record the following information :
   - RMM's manufacturer.
   - RMM's model identification.
   - RMM's serial-number
   - RMM's calibration expiration date.

5. Turn the RMM on.
   - Press the RMM's power ON switch.
   - The RMM auto-starts with its POST (Power-ON Self Test).
   - The (Fluke Model 451P) POST takes approximately 30 seconds.

6. Review all RMM's *Power-On Self Test (*POST) diagnostic messages.
   - Do NOT use the RMM if it fails its POST.
   - If the RMM is defective, notify the Quality Assurance manager and get a replacement.

7. If the RMM has multiple probes, select the appropriate probe.

8. If necessary, set the RMM for "survey" mode.
   - The Fluke 451-P RMM auto-starts in "survey" mode.

9. If necessary, set the units of measurement to R/hr (REMs/hour).
   - The Fluke 451-P RMM auto-starts in "R/hr" units.

10. If necessary, set the "range adjustment" of the RMM so that it accurately measures at <= 0.5 mR/hr with a minimum sensitivity of 0.01 mR/hr.
    - The Fluke 451-P RMM's display is "auto-ranging" and requires no range adjustment.
    - The Fluke 451-P RMM automatically displays the correct units of measurement (uR/hr, mR/hr, R/hr, etc).

11. If necessary, adjust the response time for RMM as necessary.
    - If necessary (and possible), set the RMM's response time to 4 to 6 seconds.
    - The Fluke 451-P requires no response time adjustment.

12. If the RMM has a *check source*, follow the RMM's instructions for performing a *check source* test of the RMM.
    1. Follow the RMM instructions for *check source* test.
    2. Do NOT use the RMM if it fails its *check source* verification test.
    3. If the RMM is defective, notify the Quality Assurance manager and get a replacement.

13. Measure and record the background level of radiation.
    - Record the CORRECT units of measurement on the Radiation Survey Form

14. Perform a complete internal and external inspection of the XIS. Verify that it is safe and ready to use.

    External Inspection
    - Verify that all side panels are securely mounted.
    - Verify that the x-ray inspection tunnel is clear.
    - Verify that all warning labels are present and legible.
    - Verify that all warning lamps are present.
    - Verify that all emergency stop buttons are correctly installed and operational.
    - Verify that the key-switch is correctly installed and operational.
    - Verify that the x-ray curtains are not torn or missing strips.
    - Verify that the x-ray curtains are properly installed (i.e. two layers. The vertical edges of one curtain layer are "staggered".).
    - Verify that the bottom edges of the x-ray curtains are flush with the conveyor/rollers.

    Internal Inspection
    - Verify that all lead shielding on the x-ray funnel assembly is present and correctly installed.
    - Verify that the collimator lead shields are present and properly installed.
    - Verify that the LXDA (Linear X-ray Detector Assembly) box beam-stop lead shielding is correctly installed.
    - Verify that the inner funnel assembly is covered by the "outer" funnel assembly.
    - Verify that the x-ray generator is securely fastened to it base mount.

- Verify that the x-ray generator's base mount is securely fastened into the frame.

15. Start the RMM.
    - Press the RMM's power ON switch.

16. Run the Astrophysics XIS Diode Plot Program.
    - Inspect the Diode Plot graph.

17. Place an approved scatter-block in the inspection tunnel.
    - ASTM F792-01e2, *Standard Practice for Evaluating the Imaging Performance of Security X-ray Systems*, section 3.1.11, defines a security x-ray system scatter-block as a "block of soft wood (for example, pine or similar) that measures at least 300 mm by 300 mm by 75 mm, used as X-ray scattering material to create a difficult case when measuring radiation levels."
    - A block of soft pine wood, 8.5" x 11" x 3", or a wrapped ream (500 sheets) of photocopier paper (20 lb basis) is an acceptable substitute.
    - Verify that the x-ray ON (warning LED) lights are unlit (indicating the x-ray generator is off) before manually placing the scatter-block inside the inspection tunnel.

18. Center the scatter-block in the x-ray window "opening". Align the long axis of the scatter-block to be perpendicular to the direction conveyor travel.

19. Center the scatter-block on the conveyor (or rollers if applicable) bed.

20. Using the Diode Plot program, turn on the x-ray generator.

21. Using RMM slowly survey each zone of each external surfaces.
    - For each measurement point, wait 5 seconds (or the RMM's manufacturer's published response time setting, whichever is longer) to allow the RMM to properly integrate a reading.
    - Slowly move the RMM across each zone.
    - Take several radiation measurements (4 recommended) for each zone.
    - Record the highest measurement on the RSF.

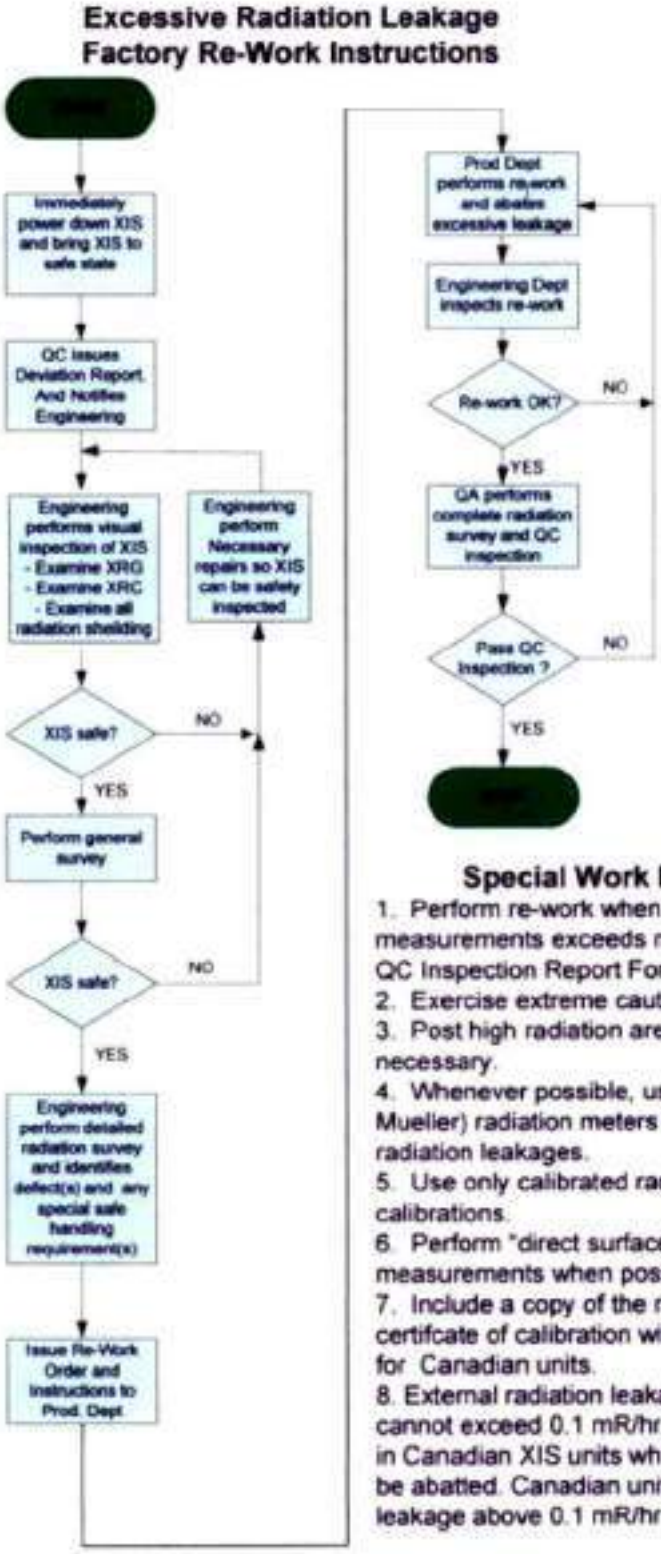
22. Measure the external radiation leakage in each zone on the RSF and answer all questions.

23. When you have completed the survey, turn the x-ray generator off (using the Diode Plot Program – press [9]).
    - Do not leave the x-ray generator on for longer than necessary.
    - Exit the Diode Plot program (press [10]).

24. Sign and date the RSF.

Factory Re-work Instructions for Abating Excessive Radiation Leakage

(For use on the factory floor)



Special Work Instructions

1. Perform re-work when radiation leakage measurements exceeds maximum factory limits (see QC Inspection Report Form for maximum limit).
2. Exercise extreme caution.
3. Post high radiation area hazard signs as necessary.
4. Whenever possible, use fast response GM (Geiger Muelier) radiation meters for spot detection of radiation leakages.
5. Use only calibrated radiation meters with unexpired calibrations.
6. Perform "direct surface contact" radiation measurements when possible.
7. Include a copy of the radiation meter's current certifcate of calibration with the Radiation Survey Form for Canadian units.
8. External radiation leakage for Canadian XIS units cannot exceed 0.1 mR/hr. External radiation leakage in Canadian XIS units which exceeds 0.1 mR/hr must be abatted. Canadian units with external radiation leakage above 0.1 mR/hr cannot be shipped.

Recovering from a Failed Hard Drive

This procedure is written specifically for a dual view XIS 320kV machine.

Introduction:

One benefit of a dual-view system is the recovery options available with the master/slave PC redundancy. Having dual-PCs is a particular advantage in the event of an operating system or hard drive failure because a disk image (clone) of the operational PC may be used to get the other PC functional again. The procedure described in this section outlines the steps and configuration settings necessary to complete the task.

If a hard drive has failed completely and a new one is not immediately available, then the dual-PC design also has the advantage of allowing temporary operation of the machine in single-view mode. In this case it's required to have the master be the running PC, so if the master PC fails then the slave must be configured as the master. That procedure will also be described in this section.

Required Tools & Materials:

- Bootable USB drive with a disk imaging (cloning) utility
- USB keyboard
- USB mouse
- 2 x USB extension cables
- USB hub
- #2 Phillips screwdriver
- Keys for frame panel locks (if applicable)
- Replacement HDD (if applicable; the problem is usually failed software rather than a hardware failure)
- New or reset USB security key possibly required

Procedure:

If disk images have already been saved on an external drive for a master PC and slave PC of the same dual-view unit with the same model PC, recovery is a simple re-imaging of the failed model, and then restoring the original "C:\Program Files\Xray Client\runtime.ini" configuration file. If duplicate disk images are not available, then following are the configuration steps necessary when imaging one hard drive to the other.

The example given is for a master PC hard drive being imaged to a slave PC:

1. Many times it's possible to access files on the corrupt hard drive by booting from an external drive, then copying the original "C:\Program Files\Xray Client\runtime.ini"

configuration file. If not, then please contact service@astrophysicsinc.com with the machine serial number to request a copy.

2. Create a master PC disk image and clone it to the slave PC. Some additional guidelines are given in the document “Creating a Disk Image”.
3. Boot the slave PC on its local hard drive, and immediately close “shutdown.exe” to prevent the PC from shutting down due to the lack of a network connection and therefore no key switch “on” signal. Note that the slave PC will not be accessible from the master PC when the network connection is unavailable. It will only be accessible by keyboard and mouse via direct USB connection.
4. Change the PC name to “Slave”. The multi-PC KVM application uses the machine name when setting the master/slave relationship. Path: “Start” > “Control Panel” > “System” > “Computer Name” > “Change”.
5. Change the last octet of the static IP address from “.250” to “.251”. Note that any valid IP address will work, but the typical setup for master and slave is “192.168.1.250” and “192.168.1.251” respectively, both with a subnet mask of “255.255.255.0”. Path: “Start” > “Control Panel” > “Network Connections” > right-click “Local Area Connection” > “Properties” > select “Internet Protocol (TCP/IP)” > “Properties” > “IP address”. Please see Figure 254 below.

Figure 254: Static IP address settings for the Slave PC

6. Delete the shortcut to Diagnostics from the Startup folder. Diagnostics runs on the master PC only. Path: “Start” > “All Programs” > “Startup” > right-click “AstroDiagnostic” > “Delete”. Please see Figure 255 below.

Figure 255: "AstroDiagnostic" in the Windows Startup folder

7. Copy the original slave PC runtime.ini file to the Xray Client folder.
8.
9. Enable sharing of the Xray Client folder. Note that this is not necessary on the master PC. Path: right-click "Xray Client" folder > "Properties" > "Sharing" > "If you understand the security risks but want to share files without running the wizard, click here." > "Just enable file sharing" > "OK" > select both "Share this folder on the network" and "Allow network users to change my files". Please see Figure 256 below.

Figure 256: Folder sharing property settings for the Slave PC's "Xray Client" folder

10. Create a shortcut to the slave PC's Xray Client folder on the master PC's desktop to simplify maintenance access to the slave's folder. Path: "Start" > "My Network Places" > right-click "Xray Client on Slave" > "Send To" > "Desktop (create shortcut)".
11. Configure the multi-PC KVM application being used, such as "Synergy" or "Input Director". Early units used Synergy, later units used Input Director, and the latest units as of 25OCT2012 are using Synergy again.

Synergy

If it is possible to access files on the corrupt slave PC hard drive from a bootable external drive, then copy the original "C:\Program Files\Synergy\synergy.sgc" configuration file and place in the same folder on the slave PC. If not, then please contact service@astrophysicsinc.com with the machine serial number to request a copy.

Input Director

Double click the "ID" icon on the Windows taskbar to bring up the interface > under "Slave Configuration" > select "Allow any computer to take control", and under "Global Preferences" > select:

- "Input Director is enabled as a Slave"
- "Background slave active for all users and at logon"
- "Run Input Director on Startup"
- "For All Users"

1. Shutdown the slave PC via Windows, then shutdown the complete system with the key switch, and finally do a normal system restart.
2. The slave PC theoretically should not need a new USB security key since the Xray Client software REV and the PC hardware is not changing. However, sometimes a new hard drive requires a new or reset USB security key.

Troubleshooting:

1. If there is no network connection between the PCs after start up, then check that the network speed is set to "Auto Negotiation" on both PCs, and restart both PCs. If this doesn't repair the connection, then force the speed "1.0 Gbps Full Duplex" on both PCs, and restart both PCs. Path: "Start" > "Control Panel" > "System" > "Hardware" > "Device Manager" > expand "Network adapters" > right-click on the network adapter card, will be the only one and something similar to "Intel® 82567LM-3 Gigabit Network Connection" > "Properties" > "Link Speed" tab > "Speed and Duplex:" drop down list > "Auto Negotiation" or "1.0 Gbps Full Duplex" respectively.

Creating a Disk Image

Clean up the target drive by deleting unnecessary files to make the image file as small as possible. Copy these folders on an external drive first so they may be placed back on the unit when finished to return the machine to the condition it was in before taking the

image. Don't permanently delete files without customer permission. Many are required by law to maintain storage images. Folders which may be emptied for a generic disk image include the following:

1. C:\Program Files\Xray Client\Archive Raw
2. C:\Program Files\Xray Client\Archive CBT
3. C:\Program Files\Xray Client\Xray Docs (TEST THAT THE DEFAULT FILES ARE RECREATED ON NEXT LOGIN)
4. C:\Program Files\Xray Client\Exports

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Additional Remove and Replace Procedures

DCI Board Fan Relay Replacement

All DCI boards prior to approximately mid-third quarter 2012 may be susceptible to failure of the surface-mounted fan relay (K1) connected to terminals FAN_IN & FAN_RT on TB3. A new supplier for these relays has been found and are being switched over in production. Both are rated at minimum 10 A / 250 VAC, and activated with 12 VDC. The old and new relays may be identified as below:

	Make	Model
Old	SONG GHUAN	812H-1C-S
New	OMRON	G5LE-1

Replacement of the relay in the field straight-forward when necessary with basic soldering tools (soldering iron, flux-solder, and wicking material). Technicians should carry a small number of these new relays if needed at anytime in the field.

If the new relay, necessary tools, or a replacement DCI board are not immediately available, then there is an alternative to replacement parts as described below.

The FAN_RT terminal is 12 VDC to the fans when the key is on (see Figure 257 below). If the fan is always on as long as the system has power to it and the UPS is on (i.e. key switch is off), then the relay is probably failed and stuck. Move this wire to the PLC's O/5 (which is 12 VDC to the green system lights when the key is on).

NOTE: Do this ONLY for 12 VDC fans; DO NOT do it if AC fans have been fitted on the machine. In this case the relay or the DCI board must be replaced.

Figure 257: FAN_RT Terminal

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