636 Gullwing Van
Mobile Security X-ray System

Maintenance Manual

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1.0 Preface

The heart of the 636 Gullwing Van Mobile Security X-ray System is the 636 baggage type cabinet inspection system.

A baggage type cabinet x-ray inspection system is a machine that is specifically designed to generate x-rays in the low-to-medium keV energy region (50-200 keV) for use in security screening operations. A cabinet x-ray inspection system means the x-ray source (i.e., x-ray tube, x-ray generator, x-ray tank) is installed inside an enclosure or cabinet which, independent of existing architectural structures except the floor on which it may be placed, is intended to contain at least that portion of a material being inspected, provide radiation attenuation and exclude personnel from the cabinet interior during the generation of x-ray radiation.

Baggage type cabinet x-ray inspection systems are regulated by applicable federal and state laws. These systems are equipped with warning lights, warning labels, safety controls, safety interlocks, E-Stops and shielding materials that must be maintained, inspected, and tested routinely.

It is important only trained and qualified individuals operate this x-ray radiation emitting machine. These individuals in turn must ensure the x-ray machine is maintained in excellent condition, that all operators and individual members of the public adhere to and obey all warning labels and that all safety features are maintained operational.

This manual provides safety precautions, basic radiation safety information and operational procedures necessary to safely operate the system and to ensure the risk associated with radiation emitted by the baggage type cabinet x-ray inspection system is maintained below regulatory limits and remains as low as reasonably achievable (ALARA).

1.1 Definitions

1. **ACCESS PANEL** means any barrier or panel which is designed to be removed or opened for maintenance or service purposes, requires tools to open, and permits access to the interior of the cabinet. Any barrier that is designed to be moveable or opened for routine operation is a **door** (defined below), not an access panel.

   Some cabinet x-ray systems have cosmetic covers that conceal electronics but do not allow access to the cabinet when opened. These covers are not access panels unless they are used to prevent access to interior system components that do allow access to the cabinet. Tools can be keys or common tools such as screwdrivers and wrenches.

2. **APERTURE** means any opening in the outside surface of the cabinet, other than a port, which remains open during generation of x radiation. Apertures are usually holes for routing cables, ventilation, or wiring into or out of the cabinet.

3. **CABINET** means the enclosure that contains an x-ray tube and is intended to contain at least that portion of a material being irradiated, provide radiation attenuation, and exclude personnel from its interior during generation of x radiation. The cabinet is the only space within a cabinet x-ray system where radiation exposure greater than the emission limit is permitted.

4. **DOOR** means any barrier which is designed to be movable or opened for routine operation purposes, does not generally require tools to open, and permits access to the interior of the cabinet. Inflexible hardware rigidly affixed to the door shall be considered part of the door. If the barrier is only opened for maintenance and service, then it is an access panel as defined above. However, if the barrier must be moved for the material being irradiated to be placed in or removed from the cabinet as part of routine operations, then the barrier is a door even if tools are needed.

5. **EXTERNAL SURFACE** means the outside surface of the cabinet x-ray system, including the high-voltage generator, doors, access panels, latches, control knobs, and other permanently mounted hardware and including the plane across any aperture or port.

6. **FLOOR** means the underside external surface of the cabinet.

7. **GROUND FAULT** means an accidental electrical grounding of an electrical conductor.

8. **PORT** means any opening in the outside surface of the cabinet which is designed to remain open, during generation of x-rays, for the purpose of conveying material to be irradiated into and out of the cabinet, or for partial insertion for irradiation of an object whose dimensions do not permit complete insertion into the cabinet.

9. **PRIMARY BEAM** means the x radiation emitted directly from the target and passing through the window of the x-ray tube.

10. **SAFETY INTERLOCK** means a device which is intended to prevent the generation of x radiation when access by any part of the human body to the interior of the cabinet x-ray system through a door or access panel is possible.

11. **X-RAY TUBE** means any electron tube which is designed for the conversion of electrical energy into x-ray energy.

2.0 Regulatory Standards and Responsibilities

2.1 Regulatory Standards

2.1.1 Manufacturers of cabinet x-ray systems sold in the United States (U.S.) are responsible **for** complying with the electronic product radiation control provisions of the Federal Food, Drug, and Cosmetic Act (Act), including radiation performance standards [21 U.S.C. 360hh-360ss].

2.1.2 The federal radiation safety performance standard for cabinet x-ray systems (performance standard) is found at 21 CFR 1020.40.

2.1.3 Individual State regulations must also be reviewed for additional registration and Standards for Protection against Radiation requirements. Go ***www.crcpd.org*** and click on Radiation Control Agencies, then locate the applicable State and review the registration requirements, reporting requirements, Standards for Protection Against Radiation and Notice, Reports and Instruction to Worker regulations for non-medical x-ray and/or radiation emitting devices.

2.1.4 Cabinet x-ray systems sold in the U.S. are required to comply with all applicable requirements of the performance standard. Before selling a cabinet x-ray system in the U.S., a manufacturer must certify that its product meets the applicable requirements of the performance standard. This certification must be based on a quality control and testing program that is in accordance with good manufacturing practices. Certification of compliance with a foreign radiation safety standard can not be substituted for certification of compliance with the U.S. performance standard.

2.2 System Owner Responsibilities

2.2.1 The ultimate responsibility for the safe operation, use of trained and qualified operators, radiation safety, routine maintenance, testing and inspection of the 636 Gullwing Van including all of its subsystems including the baggage x-ray inspection system, air conditioner, auxiliary generator, et al., rests with the owner. The system owner must ensure the baggage x-ray inspection system meets all applicable regulatory health and safety standards as well as all regulatory radiation safety standards.

2.2.2 Most facility owners delegate this responsibility to a designated facility Radiation Safety Officer. This individual could also be a senior operator or maintenance worker or the facility health and safety officer.

2.2.3 In every facility where a baggage x-ray inspection system is in use, the system owner or designee is responsible for:

2.2.3.1 Ensuring the baggage x-ray inspection system is positioned for its intended use.

2.2.3.2 Ensuring all operators and maintenance personnel have received training on the proper operation and x-ray hazards relevant to the baggage x-ray system installed prior to using the x-ray inspection system.

2.2.3.3 Ensuring the training program is reviewed and updated as necessary by the appropriate radiation protection regulatory authority.

2.2.3.4 Prescribing radiation safety guidelines, safe operating and emergency procedures, and making readily available a copy of manual for reference by operators and maintenance personnel.

2.2.3.5 Implementing a method of verification, supervision and periodic review to ensure all operators and maintenance personnel have read and understood the relevant operating procedures of this manual, applicable regulation, regulatory guides, including the radiation safety information and guidelines provided within this manual before using a baggage x-ray inspection system.

2.2.3.6 Establishing a maintenance program, taking into account the age and frequency of use of the baggage x-ray inspection system, that ensures all safety devices and components critical to x-ray production and x-ray shielding are routinely checked, and the defective parts replaced or repaired.

2.2.3.7 Ensuring testing and inspection personnel utilize a properly functioning and appropriately calibrated ionization-chamber survey meter or equivalent to perform radiation measurements.

2.2.3.8 Conducting prompt investigations of all radiation accidents and unsafe events, and submitting reports to the system owner, if applicable and to the appropriate radiation protection regulatory authority within 5 calendar days.

2.2.3.9 Ensuring victims of radiation accidents receive specialized medical attention (e.g., consultation with a radiation oncologist, or a physician knowledgeable in the biological effects of ionizing radiation exposure to humans).

2.2.3.10 Determining the appropriate corrective measures following radiation accidents and unsafe events, and ensuring such measures are implemented effectively.

2.2.3.11 The designated facility Radiation Safety Officer, trained maintenance worker or senior operator shall be made available at the x-ray inspection system to assist **or** carry out operational and maintenance system functions unfamiliar to the radiation inspector during a radiation protection survey. A copy of the most recent radiation survey report specific **to** that system, including summaries of corrected measures recommended and instituted, shall be made available to the radiation inspector.

3.0 Safety Features, Controls and Indicators

3.1 Shielding Materials

Shielding materials like stainless steel, carbon steel, lead sheet and lead impregnated curtains or drapes are used throughout the baggage x-ray inspection machine with the primary purpose of reducing the radiation levels on all external surfaces of the baggage x-ray device to as low as reasonably achievable and below the regulations stray radiation leakage limit of 0.5 milli roentgens/hr (5 uSv/hr) measured at 5 cm from all external surfaces of the cabinet, including the imaginary plane at the access port openings.

3.2 Controls and Indicators

A key actuated control is required to insure x-ray generation is not possible with the key removed. When the baggage or cabinet x-ray inspection machine is not in use it is recommended the key be removed and maintained by the facility RSO or designee to prevent unauthorized use.

A control or controls to initiate and terminate the generation of x-rays other than a safety interlock or the main control panel is required. This is typically accomplished by adding Emergency Stop buttons to the machine which are accessible to the operator in the event an individual intentionally or unintentionally reaches inside the access port openings. Emergency Stops are provided on the machine itself and there is one provided on the operator control panel as seen on Figure 2.

Two independent warning indicators which indicate when and only when x-rays are being generated and which are discernible from any point at which initiation of x-ray generation is possible have been provided. At least one indicator is visible from each door, access panel, and/or port, and is legibly labeled "X-RAY ON".

Failure of a single component of the cabinet x-ray system shall not cause failure of both indicators to perform their intended function.

Figure 1: Operator Control Panel

Figure 2: 636sv

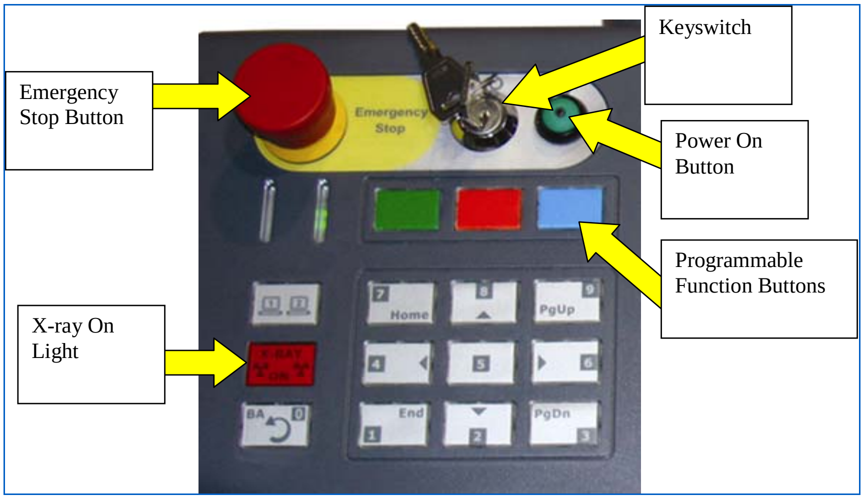


Figure 3: Operator Control Panel

3.3 Warning Labels

Permanently affixed on the x-ray system at the location of the controls which can be used to initiate x-ray generation, there is a clearly legible and visible label bearing the statement:

Caution: X-Rays Produced When Energized

Permanently affixed on the x-ray system adjacent to each port there is a clearly legible and visible label bearing the statement:

Caution: Do Not Insert Any *Part of the Body When System is Energized--X-ray Hazard*

3.4 Safety Interlocks

A safety interlock means a device which is intended to prevent the generation of x-ray radiation when access by any part of the human body to the interior of the baggage x-ray inspection system through a door or access panel is possible.

Each “door” of a baggage x-ray system shall have a minimum of two safety interlocks. One, but not both of the required interlocks shall be such that door opening results in physical disconnection of the energy supply circuit to the high-voltage generator, and such disconnection shall not be dependent upon any moving part other than the door. Each “access panel” of a baggage x-ray inspection system shall have a minimum of one safety interlock. Rapiscan Systems baggage x-ray inspection systems do not have doors as defined. Access panels on critical components located inside the cabinet are provided on the detector housing and on the collimator secured to the x-ray tank.

Following interruption of x-ray generation by the functioning of any safety interlock, use of a control shall be necessary for resumption of x-ray generation. Failure of any single component of the baggage x-ray inspection system shall not cause failure of more than one required safety interlock.

Safety Interlocks are an extremely important part of any x-ray machine. These safety interlocks prevent individuals from reaching into or being exposed to the primary x-ray beam during normal operation and prior to and during maintenance. The primary beam can emit high exposure rates orders of magnitude higher than what is allowed on the external surfaces of the machine.

Maintenance department personnel MUST understand the importance of maintaining the safety interlocks in full working condition at all times. The facility RSO is strongly encouraged to test the safety interlock system and perform a full x-ray machine safety inspection frequently, Rapiscan Systems recommends a quarterly inspection.

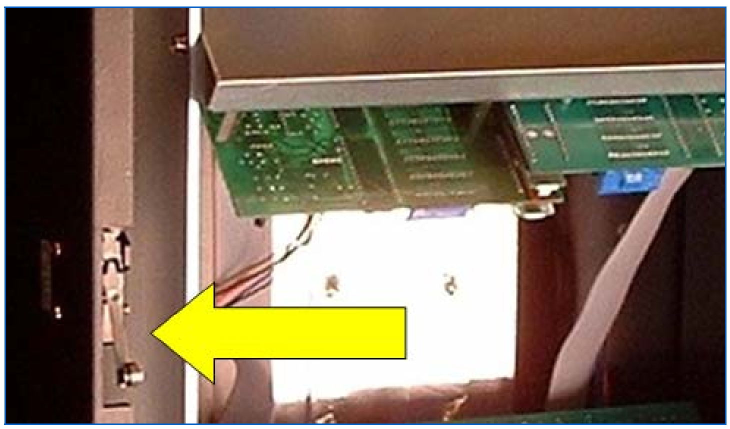


Figure 4: Diode Array Box Interlock

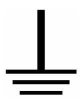
4.0 Safety

1. Every baggage and cabinet x-ray inspection system must be located in such a way that under conditions of use:
    a. Individuals whose baggage (or other belongings) is to be screened with the x-ray inspection system should be more than 0.50 meters away from the access openings of the cabinet chamber while the x-ray beam is on; and
    b. Members of the general public, excluding staff authorized to work with or near the systems and those individuals whose baggage (or belongings) is to be screened, should be more than 2 meters away from the x-ray inspection system.
2. Every baggage x-ray inspection system must be thoroughly tested and verified by trained maintenance personnel to ensure all radiation shielding components and safety devices, including warning lights, are installed and functioning ***before*** the x-ray system is commissioned for use.
3. Even though operational baggage and cabinet x-ray inspection systems may conform to the requirements set out in the regulations and preventive maintenance programs ensure safety and reliability, improper use may lead to unnecessary external x-ray exposures and accidents.
4. To reduce this possibility, the following minimum guidelines should apply to all facilities utilizing baggage and cabinet x-ray inspection systems:
    a. No person must commit any acts that cause unsafe events on an x-ray system when it is in operation. Lifting the lead drapes for any reason when the x-ray beam is on, or exposing any part of the body to the x-ray beam, or covering the x-ray ON lights or x-ray warning signs are examples of unsafe events.

    b. Although an x-ray inspection system may be specifically installed or arranged to prevent ***lifting the lead drapes or to prevent access to the entrance and exit openings of the cabinet chamber, appropriate safety warnings must be legible and in clear view at the point where items are initially presented for x-ray screening.***

    c. No person must create physical or mechanical conditions that ultimately make the x-ray inspection system unsafe to operate. Defeating safety devices, placing liquid-filled containers on an x-ray inspection system, positioning x-ray inspection systems in confined spaces for carrying out routine maintenance and operational test functions, and positioning x-ray inspection systems for use in areas exposed to rain or snow are examples of hazardous conditions.

4.1 Machine Labeling

	Radiation symbol (Optional) This symbol indicates the unit has components capable of emitting X-radiation.
	X-Ray Radiation symbol (Canada Only - Required) This symbol indicates the unit has components capable of emitting X-radiation.
	High Voltage symbol This symbol indicates that hazardous voltages are present.
	Book symbol This symbol indicates the operator manual should be consulted before proceeding.
	Warning symbol This symbol indicates a safety warning or alert.
	Earth symbol This symbol indicates this is the safety earth point for the system or a sub-system.
	Anti-Static symbol This symbol indicates that anti-static electricity precautions should be used to prevent damage occurring to components.
	The CE mark is the official marking required by the European Community for all Electric and Electronic equipment that will be sold, or put into service for the first time, anywhere in the European community.
	The UL mark is a mark showing compliance with the safety standards of Underwriters Laboratories Inc., an independent, not-for-profit product-safety testing and certification organization in the United States of America (USA).

4.2 General Safety Precautions & Instructions

WARNING: Read completely before operating this equipment.

This baggage X-ray inspection system is designed to provide safe and efficient operation. All X-ray inspection systems have inherent dangers and must be operated with safety as a number one priority. Only trained and qualified operators and maintenance personnel should operate or perform maintenance on this equipment.

The following general industrial and radiological safety precautions must be observed:

WARNING: No person must commit any acts that cause unsafe events on an x-ray system when it is in operation. Lifting the lead drapes for any reason when the x-ray beam is on, or exposing any part of the body to the primary x-ray beam, or covering the X-RAY ON lights or x-ray warning labels are examples of unsafe events.

WARNING: Never insert your hands, arms or any other part of the body into the cabinets scanning area when X-RAYS ON. If the operator must be within the cabinets scanning area for a legitimate reason, ensure the X-ray machine is turned OFF while the operator is in this area. The operator MUST caution all material handlers about this requirement.

WARNING: Ensure all safety controls, warning indicators and warning labels are functioning and in good condition before operating the unit. Replace if warning indicators are not functioning or if labels are no longer discernable prior to operation.

WARNING: The baggage x-ray inspection system must be located in such a way that under conditions of use, individuals whose baggage (or other belongings) is to be screened with the x-ray inspection system must be more than 0.50 meters away from the access port openings of the cabinet while the x-ray beam is on.

WARNING: The baggage x-ray inspection system must be located in such a way that under conditions of use, members of the general public, excluding staff authorized to work with or near the system and those individuals whose baggage (or belongings) is to be screened, must be more than 2 meters away from the x-ray inspection system.

WARNING: Moving and/or relocating the baggage x-ray inspection system can affect components critical to safety. If the baggage x-ray inspection system is moved and/or relocated, maintenance personnel and/or other suitably qualified person(s) must test and ensure all safety interlocks are functioning properly as intended by design; examine and ensure all radiation shielding is free from structural damage (i.e., puncture, hole, dent, missing part); examine and ensure the lead clamps that hold the anode and cathode terminals onto the chassis of the x-ray tube housing assembly are positioned correctly; conduct the normal in-beam quality imaging tests and, if discrepancies exist, investigate the x-ray tube assembly, the collimator setting, and the radiation exposure parameters (tube current, high voltage, filters, etc.) for possible causes; and ensure all problems are resolved satisfactorily before the x-ray inspection system is placed into operation.

WARNING: The baggage x-ray inspection system must be thoroughly tested and verified by trained and qualified personnel to ensure all radiation shielding components and safety devices, including warning lights are installed and functioning, *before* the x-ray system is placed into operation.

WARNING: No person must create a physical or mechanical condition that ultimately makes the x-ray inspection system unsafe to operate. Defeating safety devices, placing liquid-filled containers on the x-ray inspection system, positioning x-ray inspection systems in confined spaces for carrying out routine maintenance and operational test functions, and positioning x-ray inspection systems for use in areas exposed to rain or snow are examples of hazardous conditions.

WARNING: Do not remove any conveyor covers or shrouds at any time during x-ray inspection operations. These covers are intended to prevent the insertion of any part of the body into the primary x-ray beam and to maintain radiation levels at or near the entry and exit ports of the cabinet to as low as reasonably achievable and within regulatory radiation leakage limitations.

WARNING: Electric Shock Hazard: DO NOT touch electrical wire terminals by hand or with a conductive tool.

WARNING: Pinch Hazard: DO NOT contact or touch the moving conveyors during operations.

WARNING: The apparatus must have an earth connection. This is normally supplied through the power cord.

WARNING: Do not sit or stand on the conveyor, even when the system is switched off.

WARNING: Do not remove any service panels during x-ray inspection operations. All maintenance must be performed by qualified maintenance or service technicians while the x-ray generator is secured

WARNING: To minimize the risk of fire, an approved type of power connector and cable must be fitted. Since different connectors are used in different countries, the safety approval varies. Following is a list of approval marks that are relevant. Do not fit power connectors that are unmarked or from unknown manufacturers.

4.3 Electrical Rating

636	230V a.c. nominal, 3A	50/60Hz
	115V a.c. nominal, 6A	50/60Hz

The machine is designed to function at 230V or 115V +/-10% to compensate for variations in supply voltage. Supply voltage fluctuations are not to exceed +/-10% of the nominal voltage

WARNING: When dangerous objects such as explosives, guns or other weapons are identified in the X-ray image, follow the procedure established at your facility to safely resolve such events.

WARNING: Modifications to this baggage x-ray inspection system are strictly prohibited. The system owner must contact the manufacturer.

4.4 Additional Safety Equipment

Among the additional safety equipment offered by Rapiscan Systems is a safety footmat. The conveyors and X-rays will shut down within less than a second if the operator removes his or her weight from the footmat.

WARNING: The footmat must not be bypassed by placing heavy objects on it to simulate the presence of an operator. This not only damages the footmat but also, more importantly, allows an operator to keep the X-ray machine operating without an Operator being at the controls. Thus an Operator might place him or herself in danger while the machine is still operating: placing a limb, for example, inside the X-ray machine tunnel or touching the rollers while they are still rolling. Again, never place anything on the footmat other than the Operator's own weight and never do anything to circumvent the footmat.

Figure 5: Footmat

5.0 Introduction

5.1 Scope

This manual covers the basic features, operation and maintenance of the Rapiscan 636 Gullwing Van mobile security X-ray system.

5.2 General System Description

The Rapiscan Gullwing van is a mobile security X-ray system consisting of a van, a full X-ray scanning system, Operator table, computer and monitor, auxiliary battery and power generator, and special gull-wing doors that can be raised to allow access to the X-ray system's exit and entry tunnels so that packages can be placed on the system's conveyor to be moved into the X-ray inspection tunnel and scanned.

5.3 Rapiscan Security 636 X-ray System

The centerpiece of Rapiscan's Gullwing Van is the Rapiscan 636sv security X-ray system.

Figure 6 shows the 636sv.

Figure 6: 636 Security X-ray Machine

Figure 7 shows the Icon Operator Control Panel.

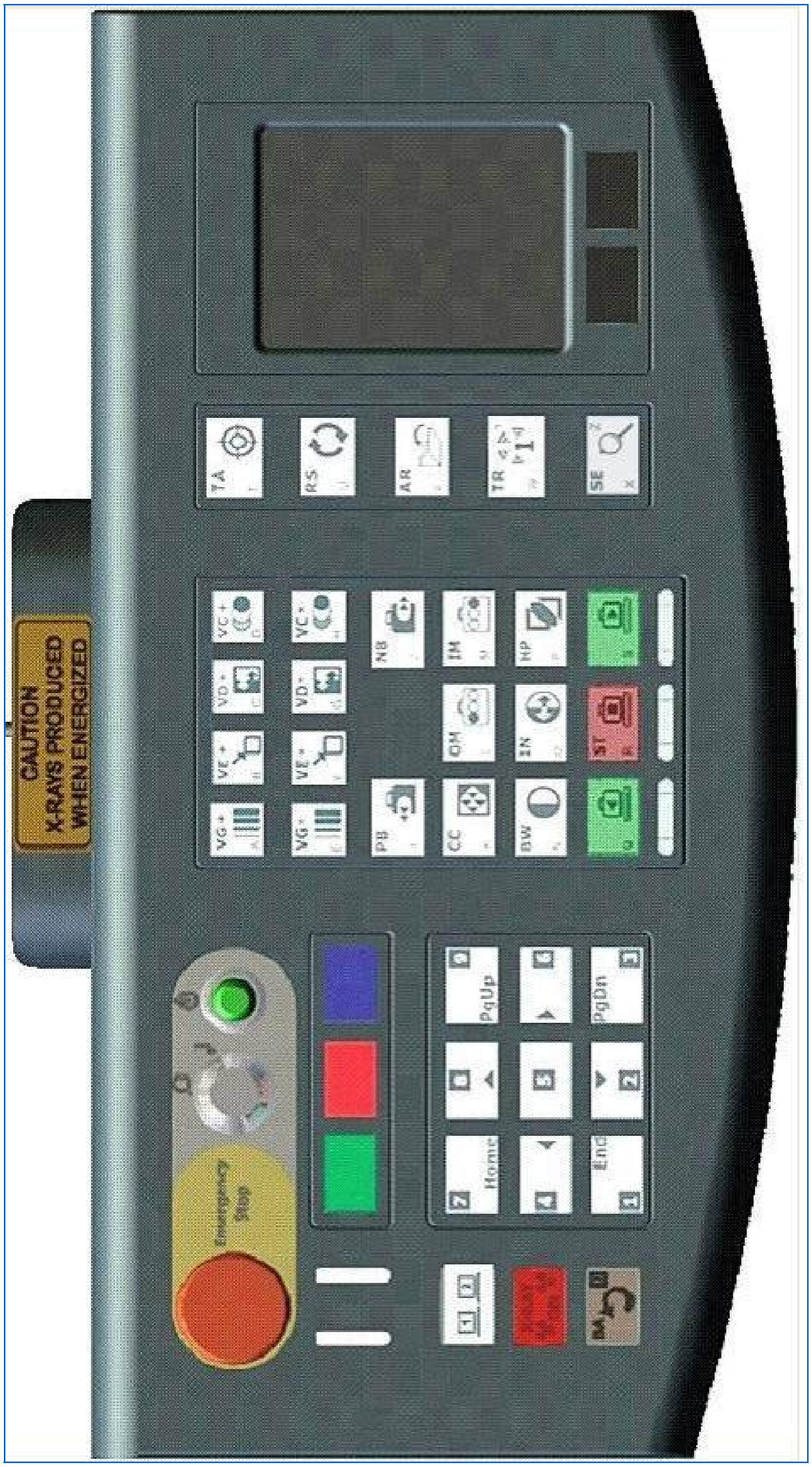


Figure 7: Operator Control Panel

The Rapiscan 636sv consists of:

1. An X-ray generator.
2. A detector system.
3. A frame and tunnel assembly Change Lights to Lights.

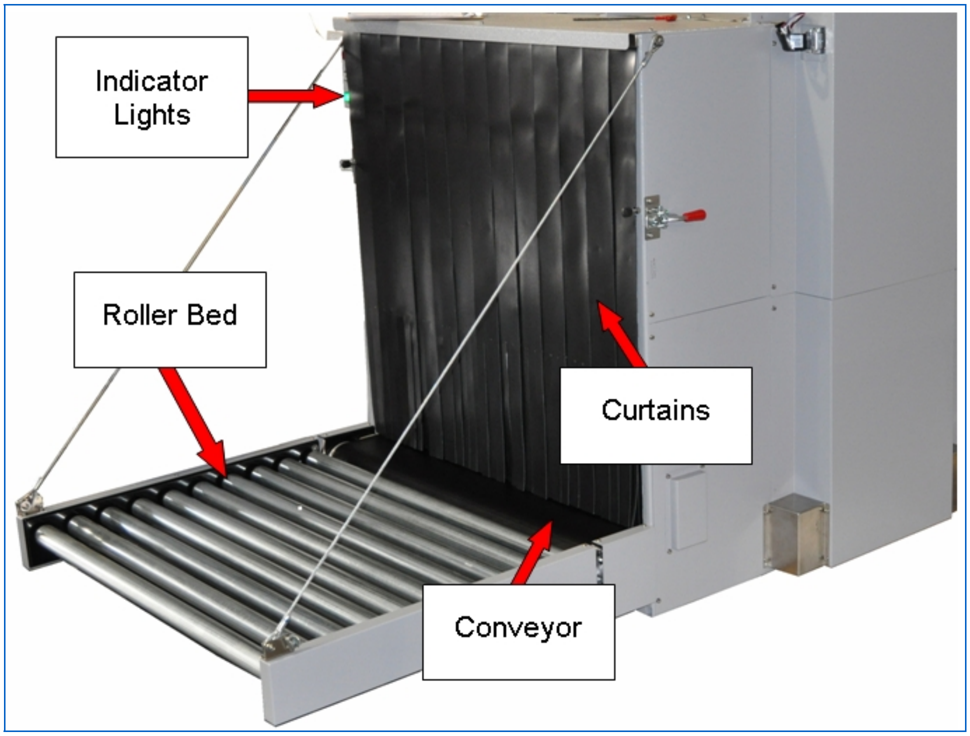


Figure 8: 636, Conveyor, Curtains, Warning Lights, E-Stop

4. Leaded curtains.
5. A conveyor assembly and motor.
6. Photo sensors to detect the presence of baggage.
7. A power distribution system.
8. An Operator Control panel.
9. A computer and monitor.
10. Stringent safety measures including X-ray tunnels covered by conveyor shrouds that prevent passenger access to the tunnel.
11. Advanced detector circuits using minimal X-ray energy to protect photographic film.
12. A dual-energy type machine configured to display images with different colors according to the density and material type of the objects being scanned.
13. Emergency Stops.

14. Proprietary Rapiscan software that controls the entire system and allows the operator to view images in various modes, enhancing the Operator's detection abilities.

Figure 9: Image Processing and Function Keys

See "Control Panel Operation" on page 95 for a full description of each button and function of the control panel.

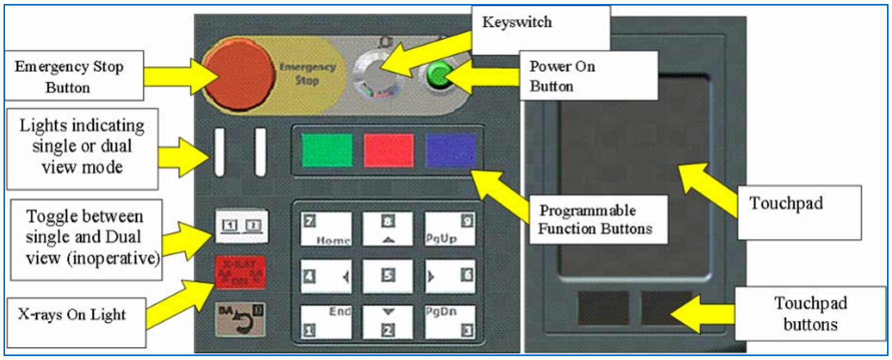


Figure 10: Touchpad, e-stop, key switch, Power-on

Imaging Sequence

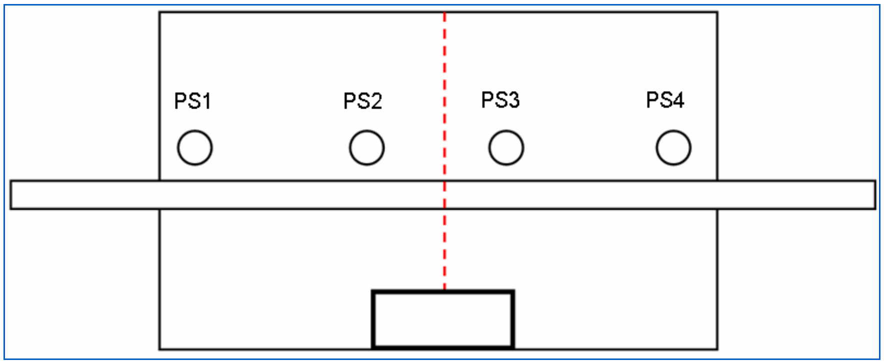


Figure 11: Imaging Sequence

1. While the system is idle, the scan engine is always running and collecting detector signals without X-ray. This signal is called Dark Current.
2. The conveyor moves and brings baggage into the tunnel.
3. The baggage blocks PS1 (photo sensor 1) and the software turns on X-rays.
4. After a delay to ensure that the X-ray generator is fully warmed up, the unit's software begins to collect data for a full-dose signal. This signal is called Light Current.
5. After enough Light Current is collected, the software will calculate the correcting factor for each channel. This whole process of Dark Current, Light Current and correcting factor is called Calibration.
6. When baggage reaches PS2, the system begins to make an image. If Calibration is incomplete, the system will use the results of the previous calibration. The system will then continue the Light Current collection.
7. While the system is creating an image, pressing STOP on the control panel will STOP the conveyor. Clicking FW (Forward) after this will result in a small movement in reverse by the conveyor; the system will then energize the X-rays and move the conveyor forward. This is done to compensate for X-ray and conveyor ramping time in order to create a "cut-free" image.
8. After baggage travels a certain distance past PS2, the software will stop generating an image but will still keep X-rays ON.
9. If, during the time X-rays are still ON, new baggage reaches PS1, the system will continue image processing without re-calibration. This is done to prevent repeatedly turning the X-ray generator ON and OFF, and thus will prolong the life of the generator.
10. After a delay, if no other baggage enters the tunnel, the system turns off X-rays. After further delay, to ensure X-rays are fully off, the system will begin Dark Current collection.

Films

Rapiscan X-ray systems are film safe. A comprehensive range of independent scientific tests was carried out by the British Photographers' Liaison Committee and the B.A.A. on X-ray machines at Heathrow Airport. The test films were subjected to 32 passes through an X-ray machine, then processed and analyzed by Kodak Limited. A news release was issued together with comprehensive data and test descriptions. Copies of these documents are available from Rapiscan Systems.

A short extract from the news release follows:

"A new series of independent scientific tests has revealed that UK airport X-ray machines have no visible effect on the current types of still camera film subjected to routine hand baggage X-ray examination under normal traveling conditions."

"Over 300 films from all the major manufacturers were used in the tests. These films ranged from those typically used by holidaymakers and amateurs, such as ISO100 color negative film for prints, to high speed, high quality professional films. These ranged from ISO64 slide film to black and white film which was push processed to an exposure index of EI 3200."

"To test the effects of multiple exposures to X-rays, several rolls of each type of film were used. Each roll was passed through the X-ray machine a different number of times, ranging from zero to 32."

"The results showed that none of the films suffered any visible effects when viewed on a lightbox, even after multiple exposures to X-rays."

Drugs and Food

There are no known adverse effects of radiation absorbed dose to food or pharmaceuticals which are conveyed and inspected by a cabinet X-ray system used for security screening. The radiation absorbed dose received by objects scanned by most cabinet x-ray systems, including the Rapiscan cabinet x-ray system, is 1 millirad or less. The average dose rate from background radiation is 360 millirad per year.

The minimum radiation dose used in food irradiation for food preservation or destruction of parasites or pathogens is 30,000,000 millirad. For further information on the limits on radiation used for food inspection or food irradiation see Title 21 CFR 179 and/or contact FDA's Center for Food Safety and Nutrition or the United States Department of Agriculture Food Safety Inspection Service.

Diagnostics

Rapiscan's security X-ray systems include extensive diagnostic facilities, commencing with a comprehensive power-on self-test.

Self Test

On power up, a comprehensive self-testing routine is performed before 'System Ready'. Automatic fault indication is displayed on the screen.

Approval for Use

In the United States, all manufacturers of radiation emitting devices like your Rapiscan cabinet x-ray inspection machine are regulated by the Food and Drug Administration or FDA. All manufacturers of cabinet x-ray inspection machines must certify that each machine complies with the standards outlined in FDA regulations 21 CFR 1020.40. CFR stands for Code of Federal Regulations.

For all radiation emitting devices like your Rapiscan cabinet x-ray inspection machine located at **your facility**, the **facility owner** is responsible for “registering” any and all radiation generating equipment with their respective State Radiation Control Agency.

Unless your facility is exclusively operated by the federal government, facility registration with your State Radiation Control Agency is required in all States and it is the responsibility of the facility owner to register the cabinet x-ray inspection machine. It is not the responsibility of the manufacturer or distributor to register your cabinet x-ray inspection machine.

Imaging

Rapiscan’s security X-ray systems provide clear, high-resolution monochrome and color images of inspected items. Images may be enhanced by keyboard selection of High Penetration, 'Inverse' video, toggle to B & W image, Crystal Clear (CC) for computer optimized image, and ‘Zoom’ for 9-sector magnification. Further processing and enhancements include 'Variable Gamma', ‘Variable Zoom', 'Variable Color Stripping' and ‘Variable Edge Enhancement’. On special systems Rapiscan also provides Image Archival (Automatic or Manual) and Remote-Image-Testing (RIT).

In situation where X-rays cannot penetrate an object due to a combination of thickness and/or density, the image color will be black.

Accessories

A wide range of accessories are available for use with Rapiscan X-ray machines to assist airport security staff with baggage handling- from simple off-load devices to fully integrated transfer tables and search bench systems. A customer may choose from standard items available, or contact Rapiscan Systems for custom-designed solutions.

For questions concerning options and accessories, please contact our sales department (below). For questions concerning servicing and maintenance of Rapiscan systems, please contact the Service department nearest you:

5.4 Gullwing Van

Figure 12: Rap 636 Gullwing Van (passenger side)

Figure 13 shows the Van's gullwing door and door latch.

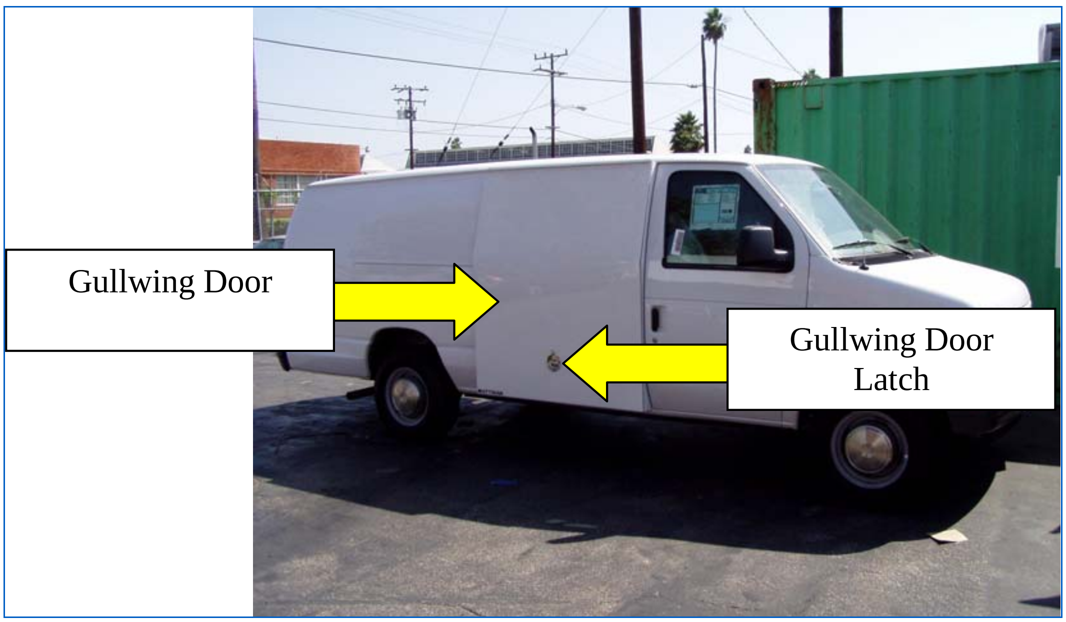


Figure 13: Rap 636 Gullwing Van

Figure 14 shows the gullwing door latch ring and key. Turn the key clockwise and then grab the latch ring and; turn it until the latch opens, then use the ring to pull the door up.

Figure 14: Gullwing Door Latch

Figure 15: Gullwing Door open (Driver Side)

Figure 15 shows the open gullwing door, the lead-impregnated curtains preventing radiation leakage from the X-ray tunnel, and the conveyor that moves packages through the X-ray machine inspection tunnel.

Figure 16: Canopy Holder

Figure 16 shows the canopy holder which stores and dispenses the canopy which protest the operator and equipment from rain. There are two canopy holders, one on either side of the van.

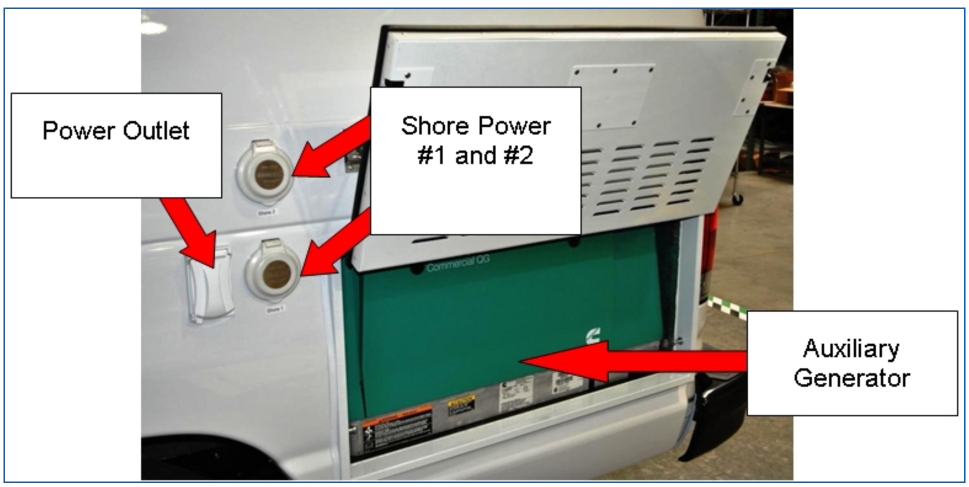


Figure 17: Driver Side of Van

Figure 17 shows the power outlet (one of several outside the van), shore power outlet and auxiliary generator compartment on the driver's side of the van.

Figure 18: Power Outlet and Shore Power (#1 and #2)

Figure 18 shows a close-up of the Power Outlet (on the left) and the two shore power outlets.

Figure 19 shows the opened auxiliary generator.

Figure 19: Generator

In addition to the Honda generator, there is Local Generator Control (Figure 20).

Figure 20: Local Generator Controls

Figure 21: X-ray Unit

The X-ray unit sits inside the back of the van, just behind the van's driver and passenger seats (Figure 21).

Figure 22: Light on Interior of Gullwing Door

There are several lights in the gullwing van, including on the inside of the gullwing doors (Figure 22).

Figure 23: Curtains and Light Indicator Box

Figure 23 shows the lead-impregnated curtains shielding the X-ray tunnel, and the Light Indicator Box (Figure 24) that indicates when X-rays are on, the system energized and when an Operator has spotted a suspect threat and has called for a further search of the suspect bag.

Figure 24: Light Indicator Box

Figure 25 shows the drive roller on the driver's side of the vehicle. Figure 27 shows the end of the roller with the mounting bolts on the end bracket.

Figure 25: Drive Roller and Curtains

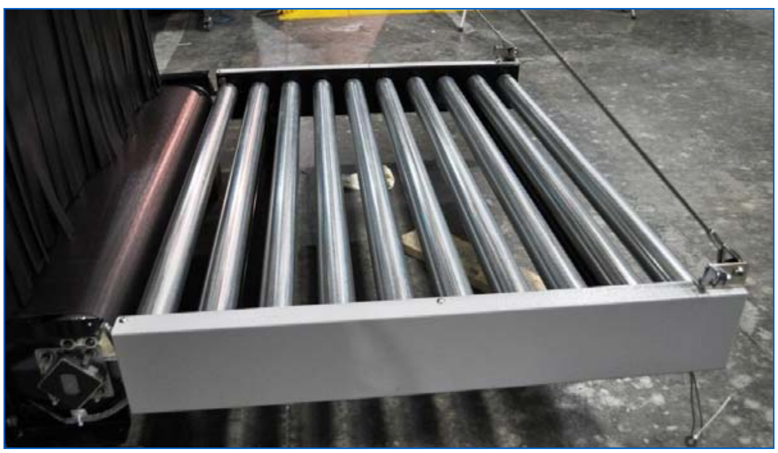


Figure 26: Roller Bed

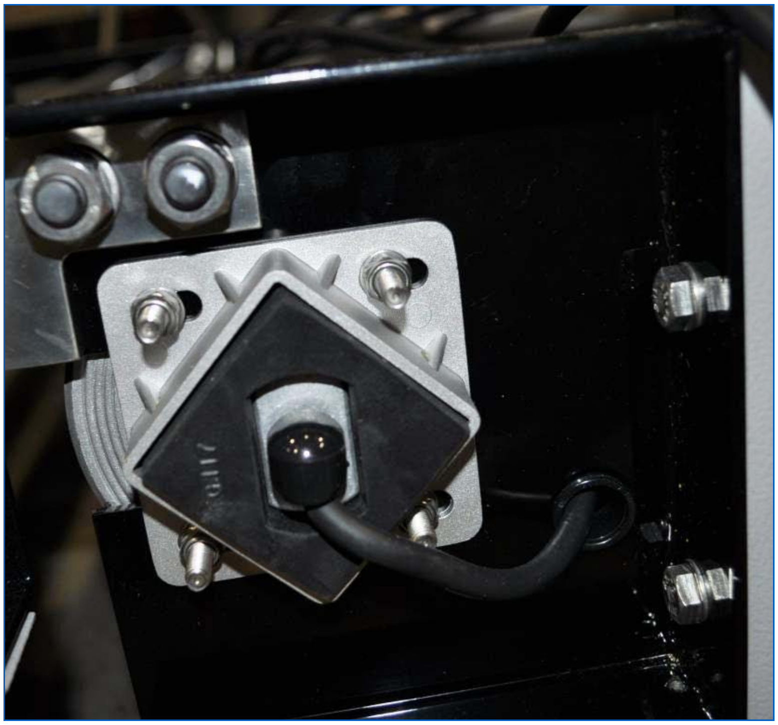


Figure 27: Roller Mount

Figure 28: Tension Bolt

Figure 28 shows the tension adjustment bolt. On this particular X-ray unit, this bolt also acts as the tracking adjustment bolt.

Figure 29: Photosensor Transmitter

Figure 29 shows a photosensor transmitter. These transmitters and corresponding photosensor receivers send signals to the system's computer whenever objects enter and exit the X-ray tunnel.

Figure 30: Cab Interior

Figure 30 shows the cab interior, the only customized controls being the cab light switches shown in Figure 31. The switch labeled “E lts” controls the emergency or Beacon lights. “Dome” controls the cab light in the driver’s compartment. “Bat Sep” is a momentary switch to join both vehicle and auxiliary batter in case either of them is low in charge. “Back Up” is to disable the backup alarm.

Figure 31: Cab Light Switches

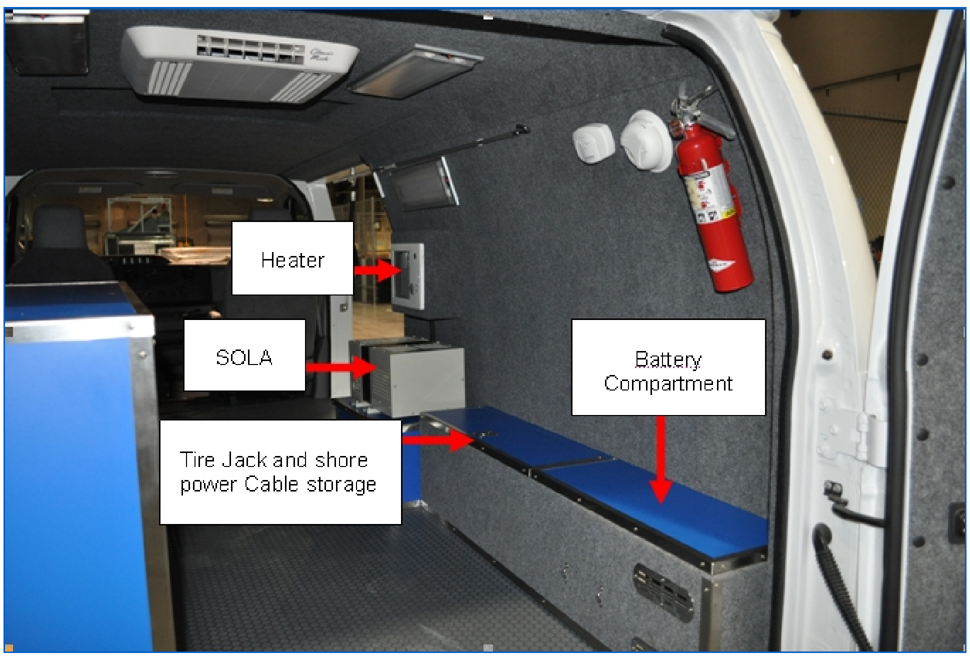


Figure 32: Back of Van Interior

Figure 32 shows the left (driver) side and back of the interior of the gullwing van. This includes the following components: Computer monitor, Operator Control Panel, heater controls, remote generator controls, circuit breaker panel, air conditioner, e-stop/keyswitch/power button, and electronics cabinet.

Figure 33: Door Locking Button and First Aid Kit

Figure 33 shows the inside of the right rear door which contains the first aid kit and a door locking button.

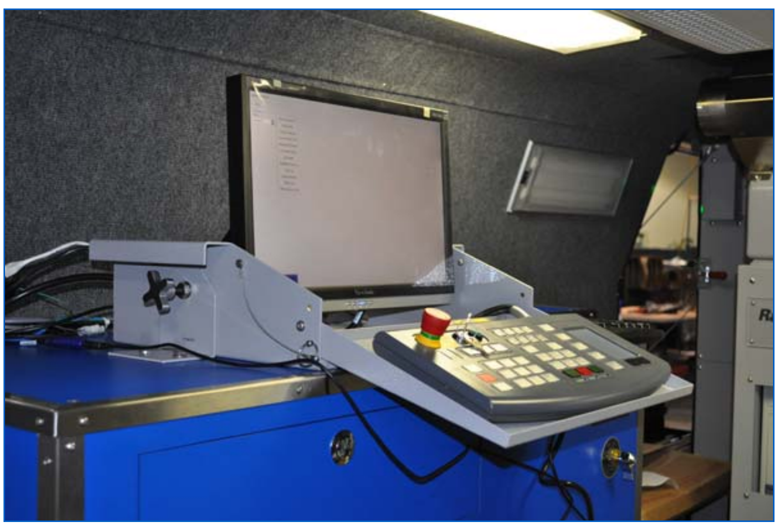


Figure 34: Computer, Operator Control Panel Extended

Note that the operator control panel rests on a moveable tray (Figure 34) that swings up and out of the way, held in place by a retaining pin.

Figure 35: Light Switches, Remote Generator Control and Master Battery Disconnect

Figure 36: Light Switches

There is a panel of light switches at the back of the van that control desk lights, front lights, left and right door lights (Figure 36).

Figure 37: Remote Generator Start Switch

Figure 37 shows the Remote Generator Start Switch that allows the operator to start or stop the auxiliary generator and to monitor how many hours the generator has been operating.

Figure 38: Master Battery Disconnect

Figure 38 shows the Master Battery Disconnect switch.

Figure 39: Heater Control and Electrical Outlet

Figure 39 shows the controls for heater #1 and #2 and an electrical outlet.

Figure 40: Drawer Handle In and out

Figure 40 shows the drawer handles in the “in” and “out” positions. Simply press on the button when in the “in” position and it will “pop” out and can then be used to open the drawer.

Figure 41: Circuit Breaker Panel

Figure 42: Air Conditioner

Figure 43: Air Conditioner

Figure 44: Electronics Cabinet and main circuit breaker

The electronics cabinet consists of: an X-ray generator (that sits atop the cabinet, see Figure 45) that generates X-rays; an electronics chassis that contains power supplies and various electronic boards; power supplies that run the generator and other electronics;, a toroidal transformer; circuit breaker and; a computer that manipulates, enhances and stores the X-ray images.

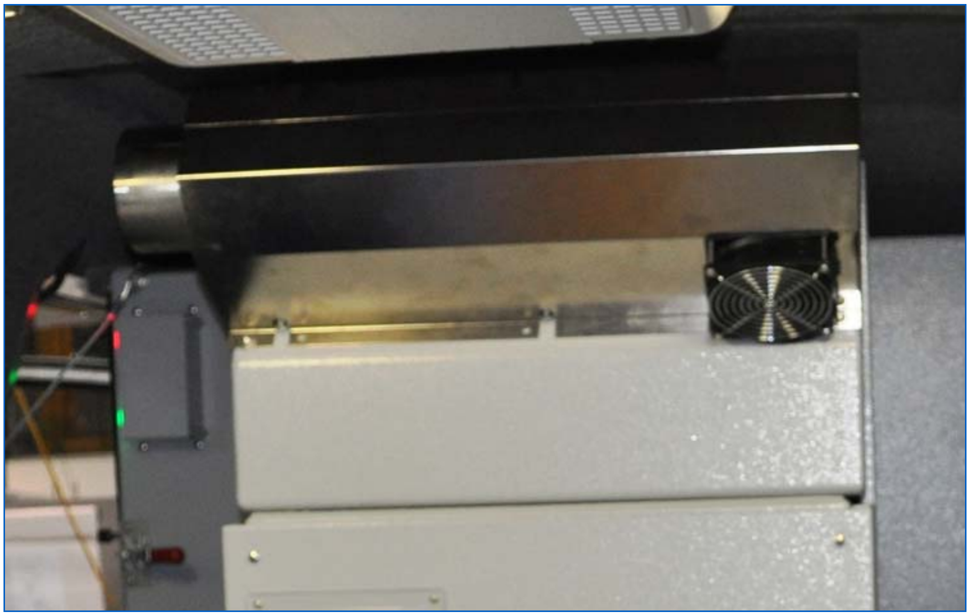


Figure 45: X-ray Generator

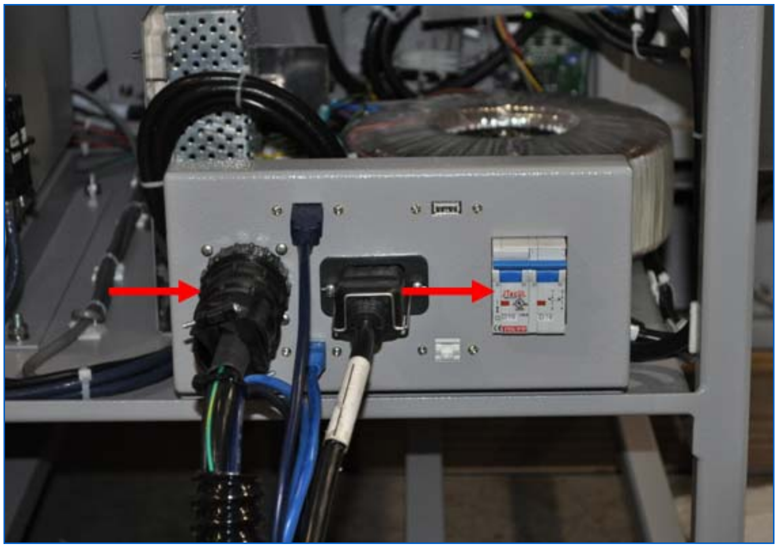


Figure 46: Remote Cable, Main Circuit Breaker

Figure 47:Main Storage Bench

Figure 47 shows one of the storage containers in the back of the van. This is where the shore power cables and tire jack are stored. The arrow shows the auxiliary battery compartment.

The SOLA power conditioner (Figure 48) sits atop another storage cabinet (

Figure 48: SOLA Power Conditioner

Figure 49: Fire Extinguisher, Carbon Monoxide and Smoke Alarms

Figure 50: Chair Bungee Cord

The bungee cord located to the right of the vent on the side of the main storage box, is meant to keep the chair still while the van moves.

Figure 51: Operator Station Support Rack

The 536 Gullwing Van features the ability to move the Operator's station outside the vehicle. This process makes use of the Operator Station Support Rack which is stowed inside the van as shown in Figure 51.

Figure 52: Wall Hook for Operator Station Support Rack

Figure 52 shows how the rack is held to the inside wall of the van with a bungee cord and two mounting hooks.

Figure 53: Support Rack Installed

Position the rack on the outside of the van above the wheel well so that the support arms are parallel to the ground or putting slightly upwards. Lower pads should be resting against the side of the van.

NOTE: The Operator Station Support Rack can be mounted on either side of the vehicle.

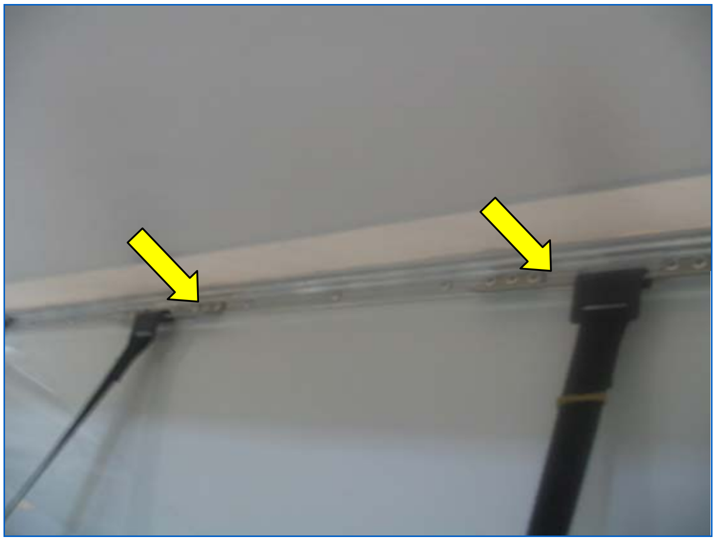


Figure 54: Top Hooks of Support Rack

Attach the two top hooks to the metal plates show in Figure 54. Adjust and tighten the upper strap length by simply pulling on the loose strap on the tab side of the buckle as shown in Figure 55. To loosen the strap, lift the buckle's tab.

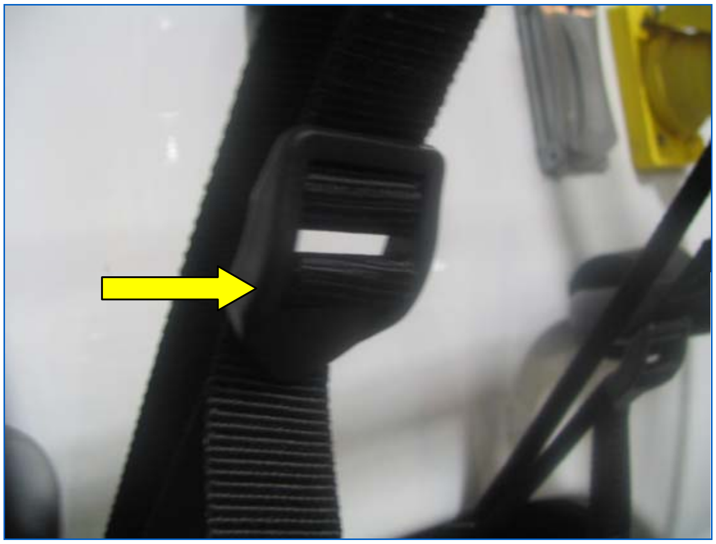


Figure 55: Tab Side of Buckle

Attach to the lower hooks to the top edge of the wheel well and pull the end of the straps until all four straps are tight. Retighten the upper straps if necessary.

Figure 56: Bottom Hook for Support Rack

Figure 56 shows the hooks at the bottom of the rack placed under the wheel well. The straps are then tightened.

Figure 57: Support Rack Installedthis menu all

Figure 57 shows how the rack looks once it is fully attached.

Figure 58: Keyboard in Upright Position

The keyboard rests on a tray that is on a swivel and can be raised to avoid damage to the keyboard during movement. Figure 58 shows the keyboard in an upright position, with a locking pin slid into place to hold the keyboard in that upright position (See Figure 59).

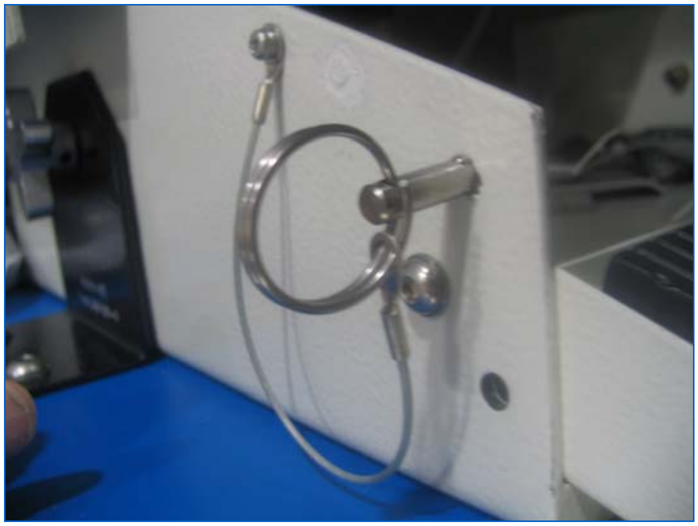


Figure 59; Locking Pin

The Monitor is on a slide mechanism that allows it to be raised or lowered using a button at the back of the monitor to lock and unlock the slide. Unlock the slide, gently push the monitor down into the lowest position, and release the locking button.

Once the keyboard is locked in place, undo the bracket screws that hold the monitor/keyboard assembly to the counter. Remove the bolt and set aside, then remove the bolt from the oppose side of the bracket (Figure 60).

Figure 60: Mounting Bracket for Computer/Monitor Assembly

The computer/Monitor assembly is attached to a cable ("umbilical cord") that attaches to the shore power connection (Figure 61). Remove the umbilical cord.

Figure 61: Umbilical Cord

The monitor/keyboard assembly tray has a lip on either side of the tray that can be used to lift the assembly and move it outside.

Figure 62: Carrying "Lip"

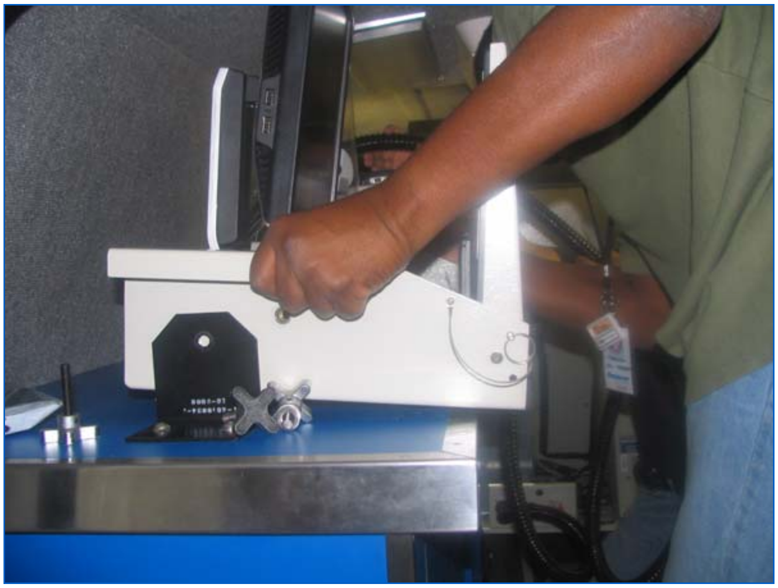


Figure 63: Lifting Monitor/Keyboard Assembly

Place the monitor/keyboard assembly tray carefully onto the rack, slipping the lips of the tray onto the arms of the rack.

Figure 64: Umbilical Cord

Once installed, the tray can have the umbilical cord trailing back into the van through the back doors (Figure 65).

Figure 65: Umbilical Cord Feeding into Back of Van

Figure 66: Conveyor Door Open

Alternatively the cable can be disconnected and run through the conveyor door to the shore power connector.

Figure 67: Umbilical Cord Fed Through Conveyor Door

Figure 68: Installed Monitor/Keyboard Assembly

Figure 68 shows the fully deployed monitor/keyboard assembly on the support bracket outside the van.

6.0 Generator Start-up

NOTE: Thoroughly read the "Onan Commercial Mobile Power Operator's Manual for Models HGJAD, HGJAE and HGJAF" before operating the Onan Generator Set (Genset). Safe operation and top performance can be obtained only when equipment is operated and maintained correctly.

6.1 Generator Heater

The 636 Security X-ray machine has a generator heater unit installed to allow the generator to operate in colder temperatures. The heater will not allow the X-ray generator to operate until it has heated the generator to a safe starting temperature.

There is a warm-up indicator light built into the electronics cabinet panel (see Figure 69). If this light is lit, it indicates that the generator temperature is too low for the machine to start. When temperatures are too low for the machine to operate, the Operator will be able to turn the keyswitch but the power button will not be responsive when he pushes it. Instead the warm-up light will come on and the heater unit will engage, warming the generator. When a safe operating temperature has been reached, the warm-up light will turn off and the Operator will be able to turn the machine on by pushing the power ON button.

If the machine is already operating when the temperature drops below a predetermined limit, the 636 will go into shutdown as if it had been manually shut down by the operator, with the UPS providing a small amount of battery power during the shutdown procedure. The heater unit will then engage, and the warm-up light will come on, and when it the heater has warmed the generator to a safe temperature, the warm-up light will extinguish and the Operator will be able to start the machine.

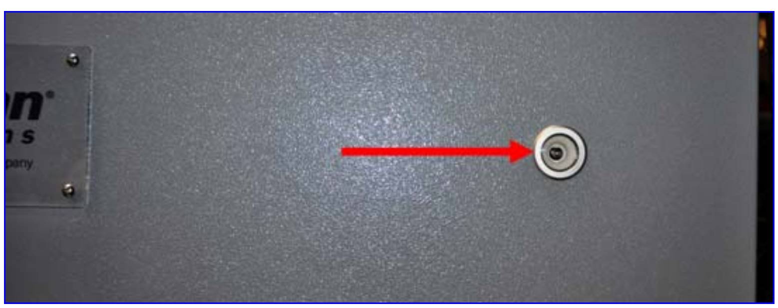


Figure 69: Warm-up Indicator Light

6.2 Generator Operation Procedure

There are two ways to supply electrical power to the X-ray Machine and the Van interior lights:

1. Auxiliary Power Generator (APG) (Figure 71)
2. Land Line or Shore Power Cable (Figure 72)

Pre-Start Checks

Before the first start of the day and after every eight hours of operation, inspect the genset as instructed under CONDUCTING GENERAL INSPECTIONS on page 16 of the Onan Generator Operator's Manual. Keep a log of maintenance and the hours run and perform any maintenance that may be due. See RETURNING THE GENSET TO SERVICE (page 14 of the Onan Generator Operator's Manual) if the vehicle has been in storage.

Before each start:

1. Make sure all vehicle CO detectors are working.
2. Check for signs of fuel and exhaust leaks and for damage to the exhaust system.
3. To prevent overheating and to reduce fouling with dust and debris, make sure the genset's normal ground clearance is not being reduced by sloping ground, curbs, logs or other objects. Repark the vehicle if necessary and/or remove any objects blocking the air inlet or outlet.
4. Turn off air conditioners and other large loads.
5. If the genset is equipped with an hydraulic pump, check and refill the oil reservoir as necessary.

Priming Gasoline Fuel Systems

If a gasoline genset ran out of fuel, prime the fuel system by holding the control switch at STOP/PRIME for 30 seconds. (The Status indicator light will stay on solid while the pump is on.)

Auxiliary Power Generator Start Up

1. Turn on the Master Battery Disconnect Switch to the ON position. The Master Battery should be in the OFF position during shipping.
2. Make sure all circuit breakers are in the OFF position before start up the generator.
3. Push and hold the switch at START until the genset starts. The statue indicator light on the switch flashes while cranking. It will come on solid when the starter disconnects, indicating that the genset is running. (Because the genset control has to "wake up," a slight delay might be noticed before anything seems to happen. On Models with fuel injection, the delay could be up to 3 seconds to pressurize the fuel injectors.)
4. The genset control will discontinue cranking if the genset does not start within 30 seconds and will cause the status indicator light to blink shutdown code No. 4. Wait 5 seconds for the control to reset before trying again. *See Troubleshooting* (page

22) in the Onan Generator Operator's manual if the genset does not start after two or three tries.

CAUTION: Do not risk burning out the starter motor by continued attempts to start. Find out why the genset is not starting and repair as necessary.

6. For top performance and engine life, especially in colder weather, let the engine warm up for two minutes before connecting appliances.
7. Check for fuel and exhaust leaks. Stop the genset immediately if there is a fuel or exhaust leak and have it repaired.
8. See *Troubleshooting* (page 22) in the Onan Generator Operator's manual if the engine shuts down and if the status indicator light blinks.
9. Always secure the access cover after starting the genset at the genset control panel.

CAUTION: Operating the genset with the access cover off can lead to severe burns and overheating of components. Always secure the cover after starting the genset.

10. Switch the circuit breakers to the ON position.
11. Turn the Keyswitch ON.

NOTE: Always turn the circuit breakers OFF before stopping the generator.

CAUTION: Gas is drained out during shipment. Fill only unleaded fuel in the Van's gas tank.

Stopping the Genset

Turn off air conditioners and other large loads and let the genset run for two minutes to cool down before stopping. This reduces backfiring and run-on. Then press the switch to STOP to stop the genset.

Land Line or Shore Power Cable

1. Make sure all circuit breakers are in the OFF position before plugging into the vehicle inlet (Figure 72).
2. Ensure all large loads are off, including the X-ray system (and the conveyor belt) and air conditioner.
3. Open the shore power cable door where the shore power cable is located, pull it out and plug it into the inlet. NOTE: When connecting or disconnecting the Shore Power Cable from the Shore Power Outlet, simultaneously turn and tighten BOTH the

Yellow Shore Power Plug AND the black plastic screw-on tension ring (see Figure 70).

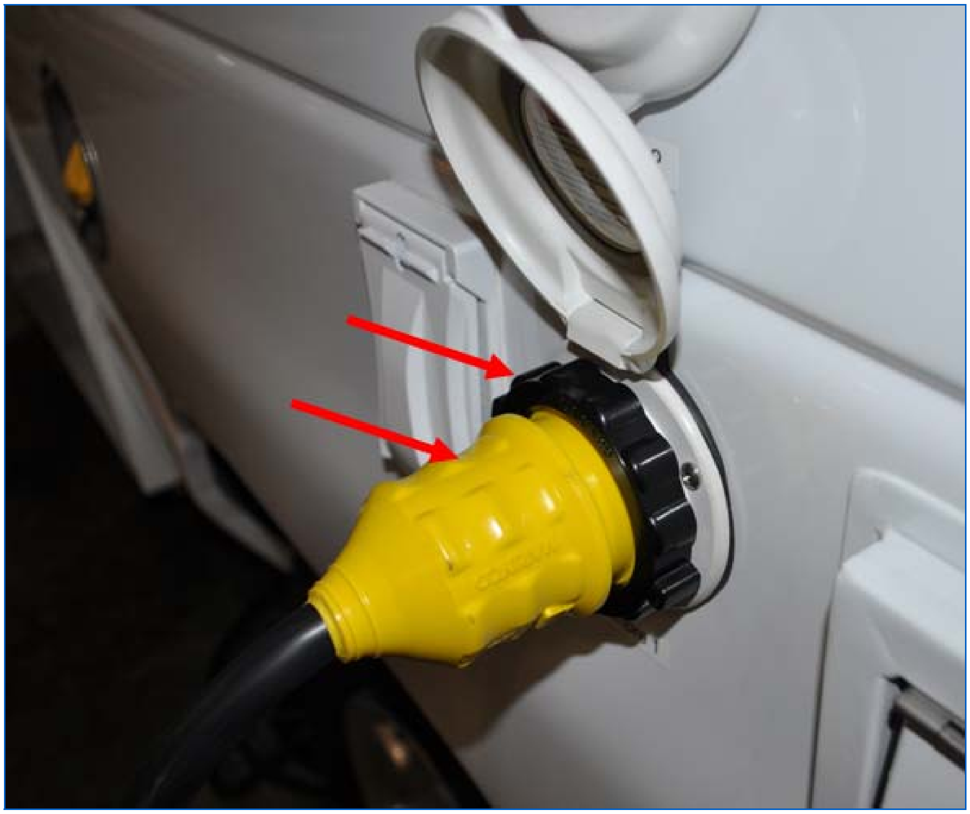


Figure 70: Shore Power Plug In

4. Switch the circuit breakers to the ON.

The X-ray System is READY for the Keyswitch to be turned ON. Always turn the circuit breakers OFF before unplugging.

Figure 71: Auxiliary Power Generator Set (Genset)

Figure 72: Shore Power Cable Inlet

Figure 73: Remote Generator Start-up

Figure 74: Master Battery Disconnect

7.0 Starting the X-ray System

7.1 System Check

Before switch-on:

- Check that the power cord is connected.
- Check that the power switch is activated on the monitor.
- Check the functionality of all warning lights.
- Check that all service panels are closed and locked.
- Check that no lead curtains are torn or missing.
- Check that all emergency switches are in their released or out position.
- Check that there are no objects in the inspection tunnel.
- Check that the circuit breaker switch is set to the ON position (see Figure 44).

7.2 Power Connection

Every Rapiscan X-ray system has a rating plate or label which is located near the power inlet. Ensure the voltage and frequency marked on the plate or label is appropriate for your power supply before connecting (see Figure 46).

Warning: The apparatus must have an earth connection. This is normally supplied through the power cord.

7.3 Switching On

1. Connect the power lead to your supply, and turn the supply on.
2. Rotate the key switch on the power control panel and push the “Power On” button (Figure 75)
3. The X-ray system will begin its power-up sequence. The Power On light at the end of the machine should also light. If no lamps illuminate, check your electricity supply, the power lead and circuit breaker
4. The X-rays will be turned on briefly, to calibrate the system.

NOTE: If there is baggage inside the tunnel, calibration will be performed incorrectly, and errors may be reported. Subsequent images may also be incorrectly displayed. Ensure there is no baggage inside the tunnel before switching on.

If the X-ray lamps turn on, but there is no picture, try adjusting the brightness and contrast controls on the monitors. Check that the connectors on the cables to the monitors are secure.

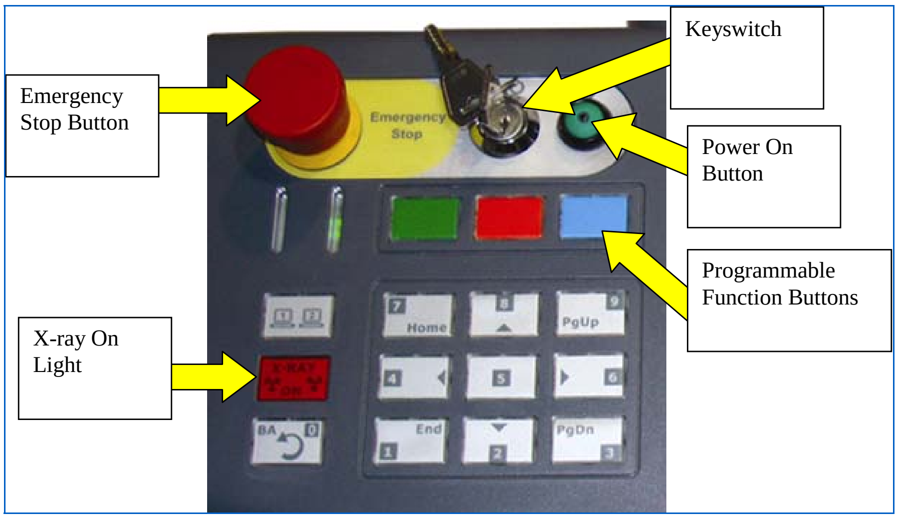


Figure 75: Emergency Stop, Key switch, Indicator Lights and Keypad

7.4 Logging On

After calibration, the log on screen appears (Figure 76).

Figure 76: Log On Screen

The Log-on screen contains fields for User ID and Password, both of which must be correctly filled in order for the operator to access the main operator screen.

The Log-on screen also contains information in the lower right-hand corner about the software version, machine serial number and model number of the Rapiscan X-ray machine that the software is running on.

Finally, the Log-on screen contains two buttons in the lower left hand corner of the left screen, one green, one red. The green button toggles between W and Y on the TR (Transmit) key on the Operator Control Panel, and between X and Z on the SEARCH (SE) key. The red button acts as a backspace key when users are typing in their user ID and passwords. See page 96 for information on these function buttons.

The operator should type in his or her User ID and Password.

7.5 Main Operator’s Screen

Once the Operator has entered his or her ID and Password, the main operation screen will appear as shown in. Notice that the function buttons have changed and now represent HP (High Penetration), BW (Black and White) and Manual Scan.

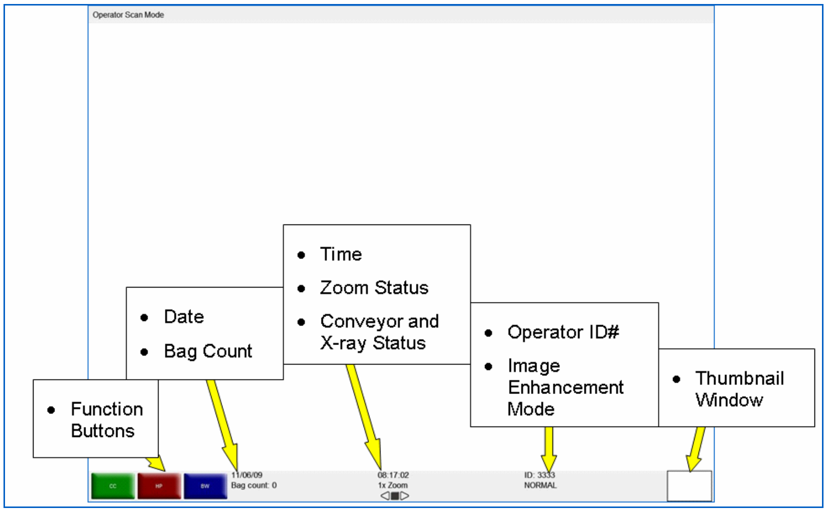


Figure 77: Main Operation Screen

The Main Operator's Screen displays:

- The system's current mode of operation, as indicated at the top left corner of the screen (e.g. "Operator Scan Mode"). The panel at the top of the screen is called the Mode Indicator Panel.
- Three Programmable Function button indicators (in the case of Figure 77 the buttons read CC, HP and BW).
- Date
- Bag count
- Time
- Zoom status (2x, 4x, 8x, 16x, 32x and 64x)
- Operator ID
- Image Enhancement mode (e.g. Normal, Crystal Clear, Black and White, et al)
- Conveyor status, i.e. Stop, Reverse or Forward, (see Figure 78 and Figure 79).
- Thumbnail Window (see empty window in Figure 77 and thumbnail in window on Figure 78)

Figure 78: Forward / Thumbnail Window

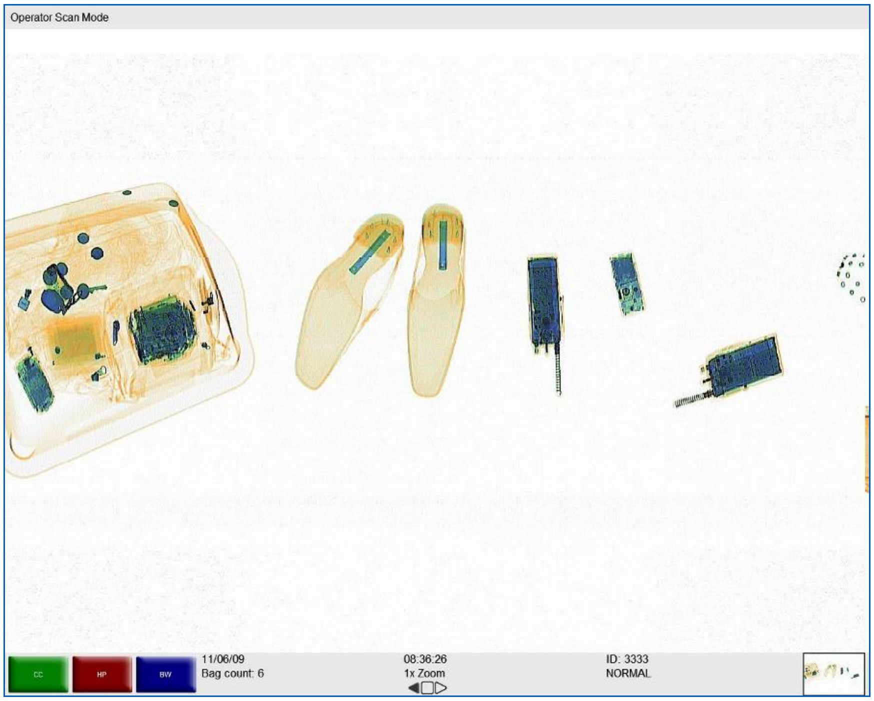


Figure 79: Reverse

7.6 Programmable Function Buttons

The main operation screen contains “Programmable Function Button Indicators.” These consist of three colored on-screen buttons, which are programmable in that any of a number of image processing functions can be assigned to each button.

Figure 80: Programmable Function Buttons close-up

The function of the two programmable buttons will be configured for the User by Rapiscan Systems or by a site supervisor so as to reflect the functions most often used by specific operators. For example, Figure 80 shows the two programmable button functions as:

- Green: Crystal Clear (CC)
- Red: High Penetration (HP)
- Blue: Black and White (BW)

If these are the two most frequently used functions by a particular user, then they are easily available to that user. If another user wanted different functions assigned to those two buttons, a Site Supervisor could reprogram them.

In addition, each button can actually perform multiple functions. For example, the green button can be programmed to perform Crystal Clear, High Penetration and Black and White simultaneously (see Bind Processing Function on page 129). Please note, however, that variable functions (such as Variable Gamma and Variable Edge) cannot be applied together.

7.7 Scanning Baggage

The system is now ready to accept a bag to be scanned. Objects to be scanned should be placed lengthwise on the conveyor belt with all straps and projections underneath (if possible) to achieve the best image.

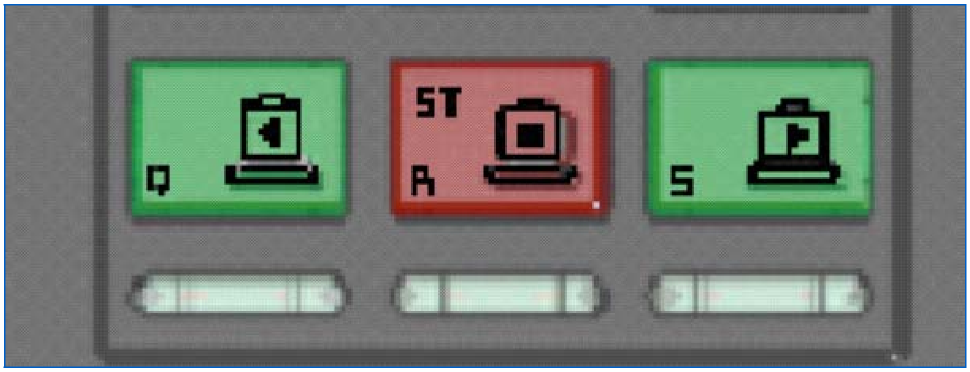


Figure 81: Conveyor Control Buttons

Press the green “S” button (Forward) on the operator control panel (Figure 81). The conveyor will run forward until the R button (Stop, Figure 81) is pressed. When the bag reaches the center of the tunnel, the X-rays will be turned on, and an image of the bag will be displayed on the screen. When the bag has emerged from the output end of the system, you may press the R/ST button to stop the conveyor. A typical image is shown Figure 82.

Figure 82: Typical Scanned Image

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8.0 Control Panel Operation

Figure 83: Operator Control Panel

8.1 General

The Rapiscan Control Panel (keyboard) uses high reliability switches and has a high resistance to liquid spills, and can be cleaned easily by wiping with a damp cloth. Inside the control panel a printed circuit board contains a micro controller that communicates with the X-ray system computer.

NOTE: The Operator Control Panel does not support multiple simultaneous key presses.

8.2 Function Keys

The 600 series operator control panel includes three colored function keys (Figure 84).

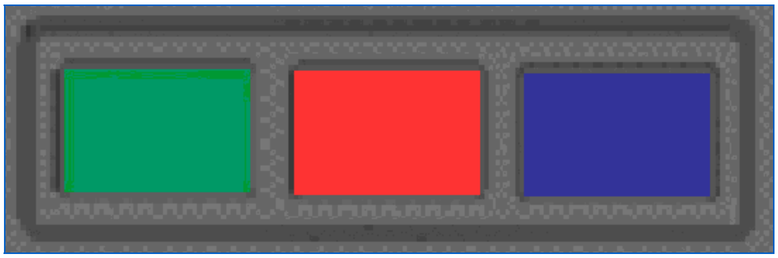


Figure 84: Function Keys

The functions assigned to these three keys vary depending on which screen or mode you are in. During log in, these keys are assigned the following functions:

- The Green Key performs the functions of toggling between W and Y, and X and Z – W and Y are on the same OCP key, as are X and Y.
- The Red Key performs the functions of the backspace key.
- The Blue Key performs the functions of the Shift Key

Before scanning or while scanning has stopped, the green and red keys will be assigned specific image processing functions such as CC (Crystal Clear) and BW (Black and White). The Blue key will be assigned the Toggle Function which allows the operator to remove or reinsert red quadrangles on the screen that highlight potential threats.

While scanning, all three keys will be assigned image processing functions.

8.3 Conveyor Controls

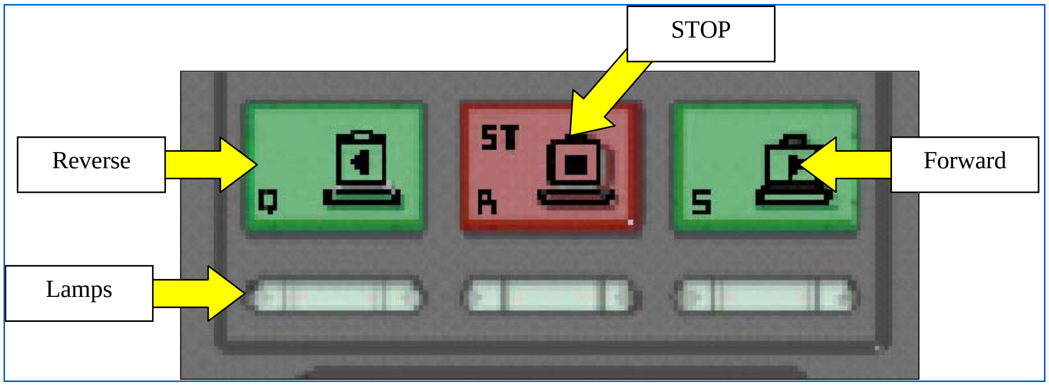
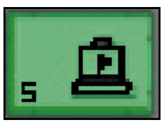


Figure 85: Conveyor Controls

Forward button



When this button is pressed, the conveyor will move objects on the belt to the inspection tunnel for scanning.

Forward lamp

Located beneath the Forward ("S") Button. This lamp lights when the conveyor is traveling in the forward direction.

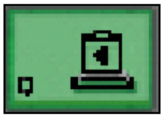
Stop button

When this button is pressed, the conveyor belt will halt. Note: If this button is pressed during scanning of an object, the belt will stop then reverse a few centimeters. This is to ensure that when ‘forward’ is selected again, no part of the object is missing from the image. If the X-rayed image is being viewed with an image processing function, the ST button will cancel the function.

Stop lamp

Located beneath the Stop ("R") Button. This lamp lights when the conveyor belt is stationary.

Reverse button



When this button is pressed, the conveyor belt will travel in the reverse direction. Any objects on the belt will reverse through the tunnel. Depending on the model type, X-ray scanning will or will not take place in reverse. Note: Reverse- scanning X-ray machines are available to special order.

Reverse lamp

Located beneath the Reverse ("Q") Button. This lamp lights when the conveyor is traveling in the reverse direction.

X-ray lamps

These lamps light when X-rays are being produced from the X-ray generator.

Figure 86: X-ray On Lamps

8.4 Image Processing Keypad

Figure 87 shows the image processing keypad on the Operator Control Panel. These keys are described in the following paragraphs.

NOTE: All image processing functions can be applied to images whether the bags have been stopped on the belt and the images are stopped on the operator's screen, or when the bags are still moving through the X-ray tunnel, the images scrolling across the operator's screen.

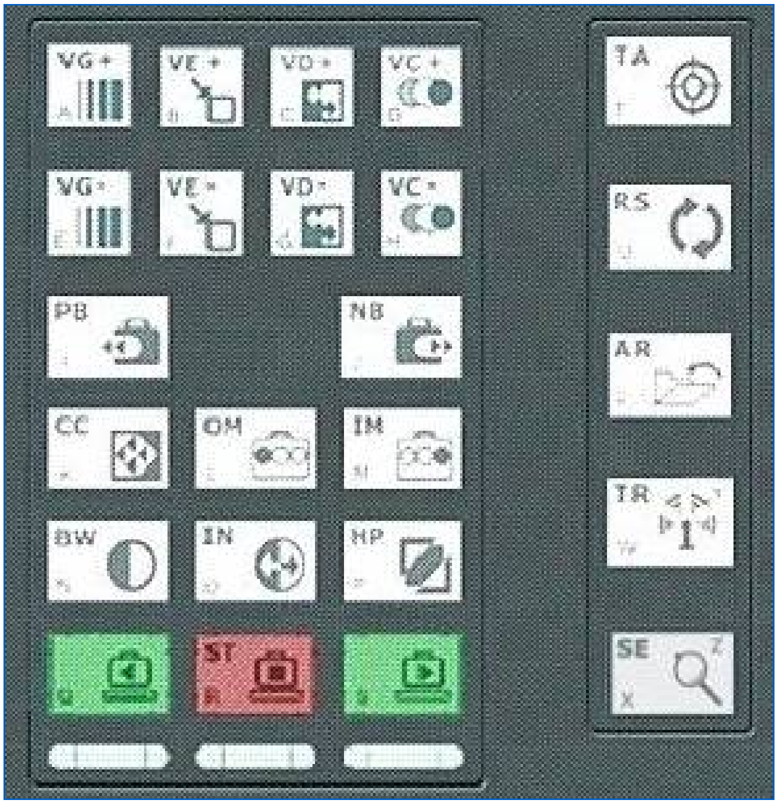


Figure 87: Image Processing Buttons

Material Groups

Organic substances composed of light chemical elements that have an atomic weight of less than ten (irrespective of their molecular structure) are displayed in orange on the operator's screen. The most important elements in this category are hydrogen, carbon, nitrogen and oxygen.

Most explosives are made of a combination of these elements. Explosives like nitro-glycerin and Semite belong to this group.

Materials such as drugs, paper, wood, water and plastics will also be displayed in orange.

Objects composed of a medium heavy element such as aluminum are displayed in green. This also applies to overlapping objects of organic and inorganic substances. This group is termed the ‘mixed’ group.

This group is composed of inorganic substances such as zinc, tin, copper and steel. If a material is too dense to be penetrated by X-rays, it is shown in black.

Organic Material button (OM)

Operation of the Organic Material Stripping button has the effect of removing the color information of all groups except for Group 1 (organic). See “Material Groups” on page 99.

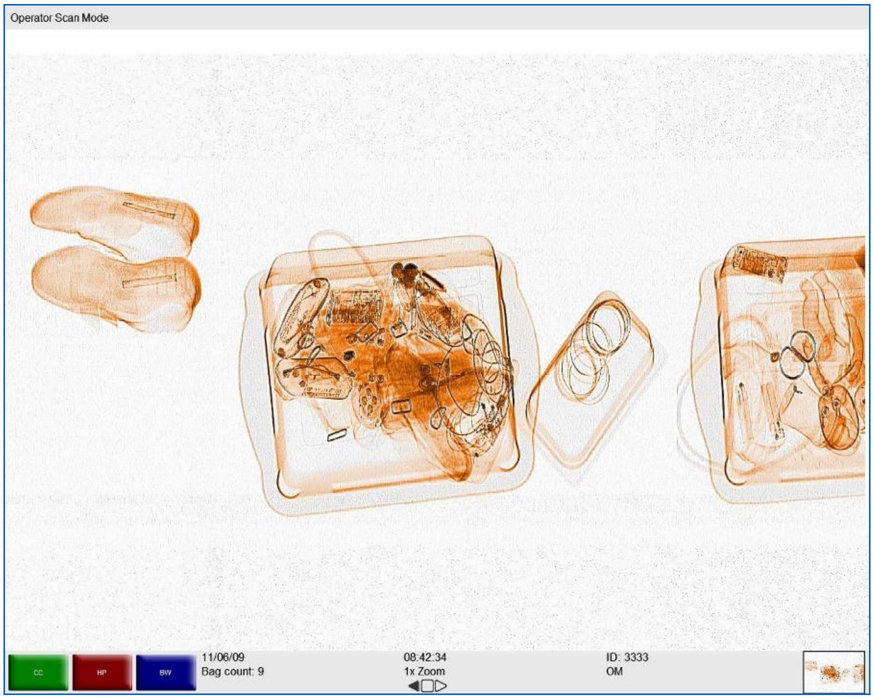
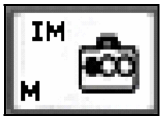


Figure 88: Organic Material

Inorganic Material button (IM)



Operation of the Inorganic Material Stripping button has the effect of removing the color information of all groups except for Group 3 (inorganic). See “Material Groups” on 99.

Figure 89: Inorganic Material (IM)

Crystal Clear button (CC)

Brings out the detail in both light and dark areas simultaneously.

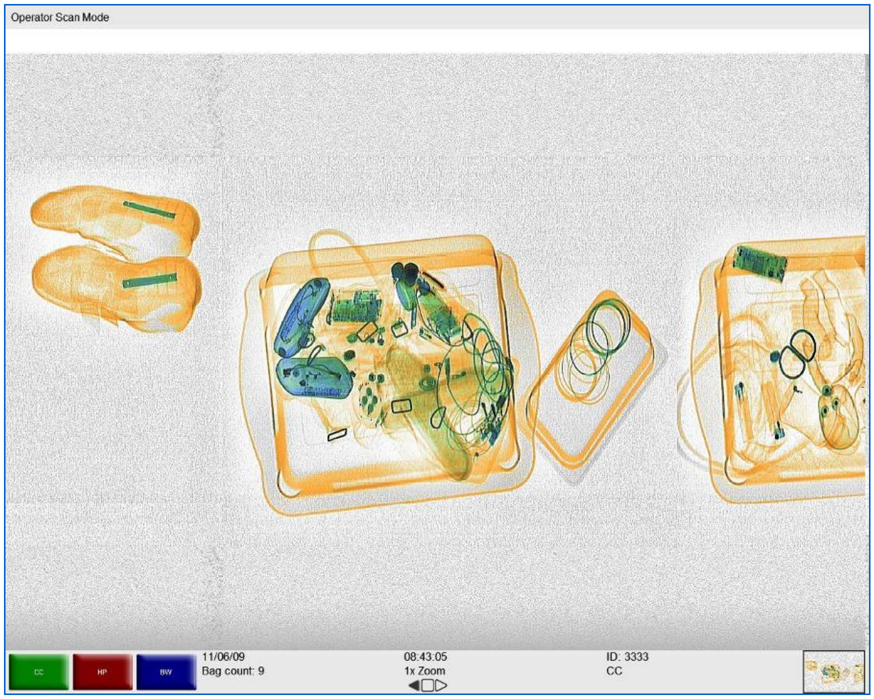
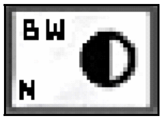


Figure 90: Crystal Clear (CC)

Black and White button (BW)



All color information in the image is removed.

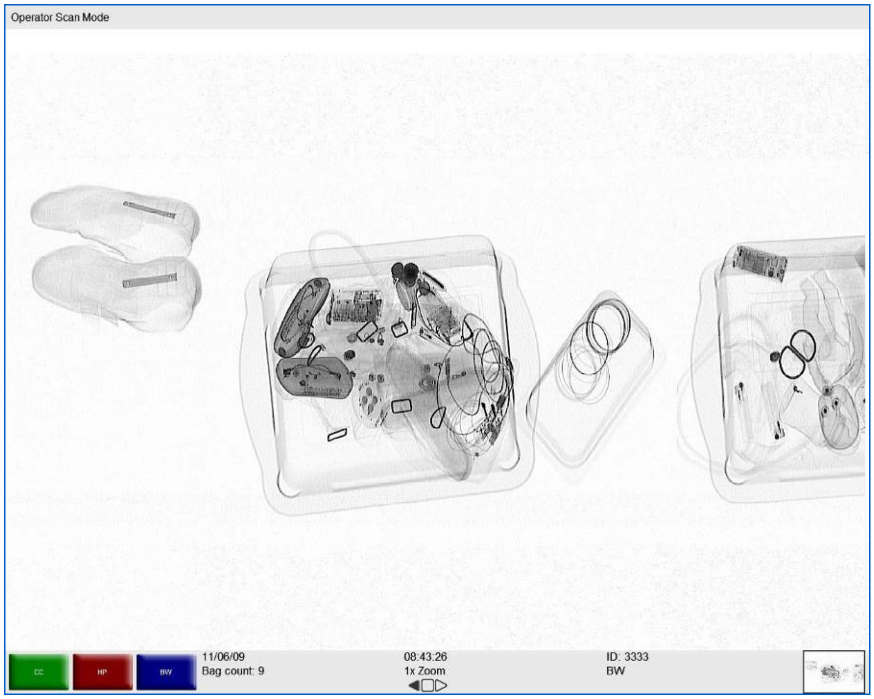


Figure 91: Black and White (BW)

Inverse button (IN)

When this button is pressed, the image is displayed in reverse i.e. black becomes white and vice-versa.

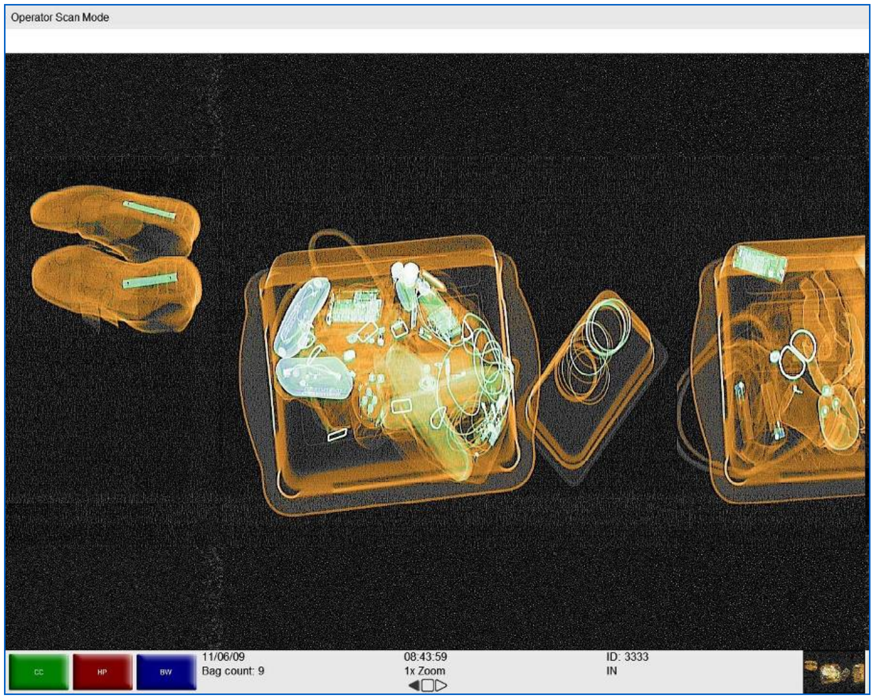
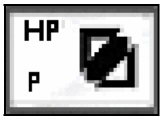


Figure 92: Inverse (IN)

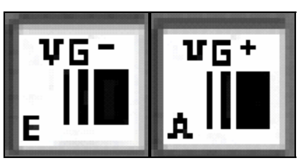
High Penetration button (HP)



When this button is pressed, the presentation of high-density objects is enhanced.

Figure 93: High Penetration (HP)

Variable Gamma (VG)



The Variable Gamma function allows the operator to alter the brightness of the image. Use buttons VG+ and VG-.

Multiple keystrokes on the VG- or VG+ button will either increase or decrease image brightness. Figure 94 shows an image with VG+ applied. Note the variable slider pointed out by the yellow arrow. This indicates that the user pressed the VG+ key several times in order to apply a near-maximum amount of VG+. Figure 95, conversely, shows an image with heavy VG- applied as indicated by the variable slider.

Figure 94: VG+ (variable slider)

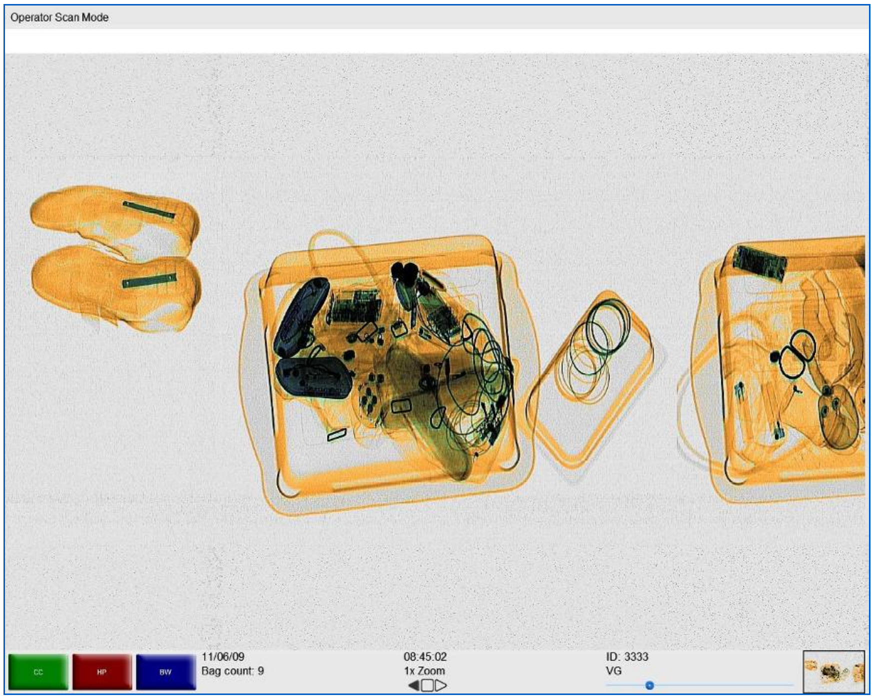
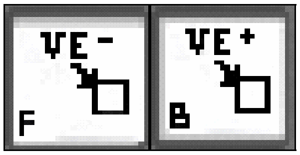


Figure 95: VG-

Variable Edge Enhancement



The Variable Edge Enhancement buttons (VE- and VE+) cause objects' boundaries to become sharper and easier to see.

Multiple keystrokes on the VE- or VE+ button will either increase or decrease the sharpness of different boundaries within the objects being scanned. Figure 96 and Figure 97 show images with heavy VE+ and VE- applied.

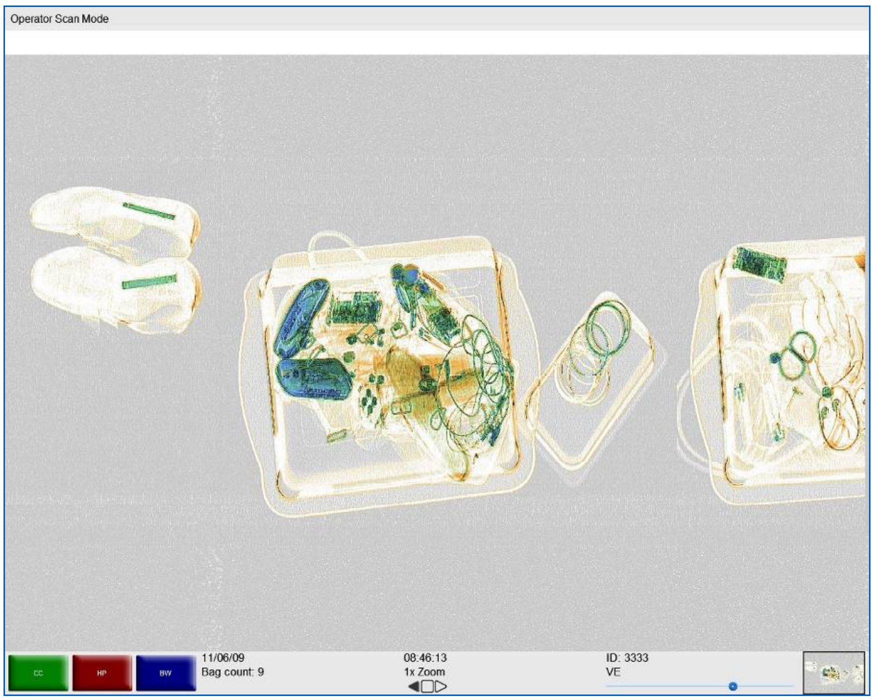


Figure 96: VE+

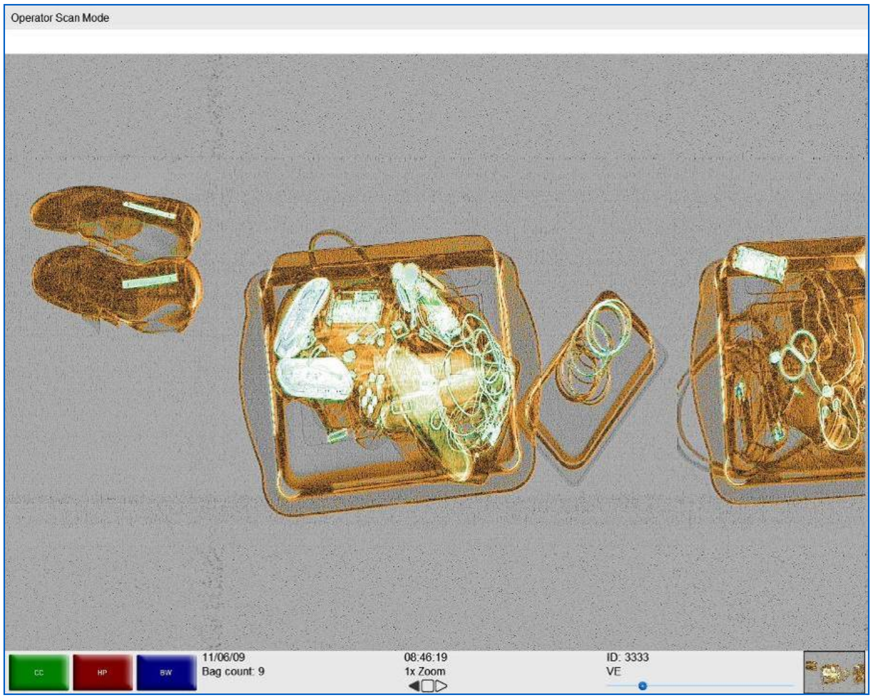
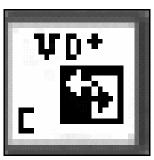


Figure 97: VE-

Variable Density



The Variable Density function allows the operator to exaggerate the difference in color brightness between objects having similar X-ray penetration properties. To adjust this facility, use buttons VD+ and VD.

Multiple keystrokes on the VD+ or VD- button will either increase or decrease the difference in color brightness. Figure 98 and Figure 99 show images with heavy VD+ and VD- applied.

Figure 98: VD+

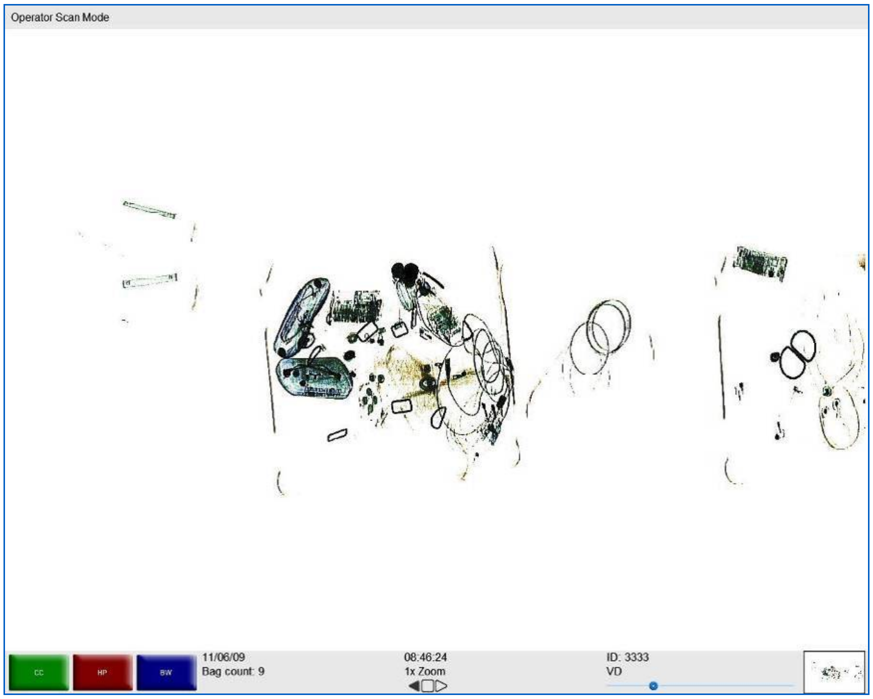
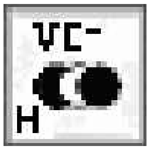
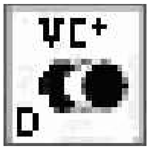


Figure 99: VD-

Variable Color





In this mode, highlighted materials will show in their original colors while the rest of the objects display in grayscale. The VC+ and VC- buttons are used to highlight the differences between the material groups.

Multiple keystrokes on the VC- or VC+ button will highlight different material groups. Figure 100 and Figure 101 show image with heavy VC+ and VC- applied.

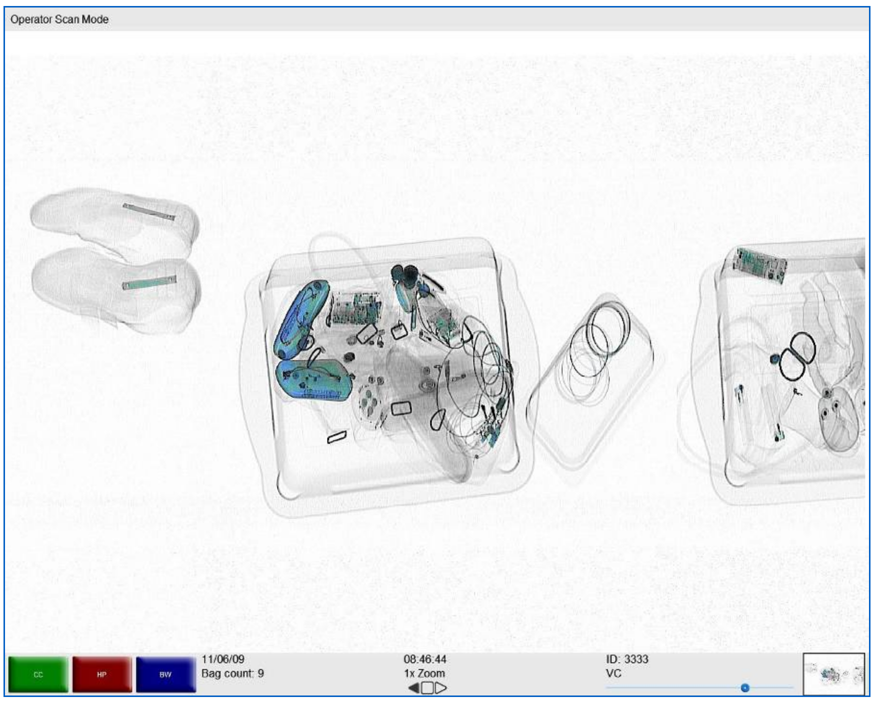


Figure 100: VC+

Figure 101: VC-

Previous Bag and Next Bag

In this mode the operator is able to scroll in reverse to view previous bags or to scroll forward to get back to the latest bag. Note that the Mode Indicator Panel reads: "Scanned Image Review Mode" which is the mode the system enters when allowing review of previous and next bags.

Previous Bag

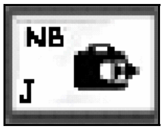
Accessed by the Operator pressing the "PB" (Previous Bag) button. When "PB" is pressed, the Previous bag will scroll back until it is completely on screen. When in reverse mode, "Previous Bag" will operate as "Next Bag" and vice versa.

Figure 102: Previous Bag

Figure 102 shows the screen when in Previous Bag mode. Note that the previous bag is outlined in red once it is chosen, and moves onto the screen from right to left. The Previous bag will be any previous bag's image that is completely or partially on screen.

When the operator reaches the end of the image review buffer in Previous Bag mode, a message will appear, reading: "End of Image Review Buffer. Press the NB/J button to clear this message box. The message will disappear automatically after 5 seconds. The "R" or Stop button can be used to exit the Previous Bag or Next Bag mode and return to the Normal mode.

Next Bag



This mode is accessed by pressing the “NB” key on the Operator Control Panel. When “NB” is pressed, the Next bag will scroll on screen.

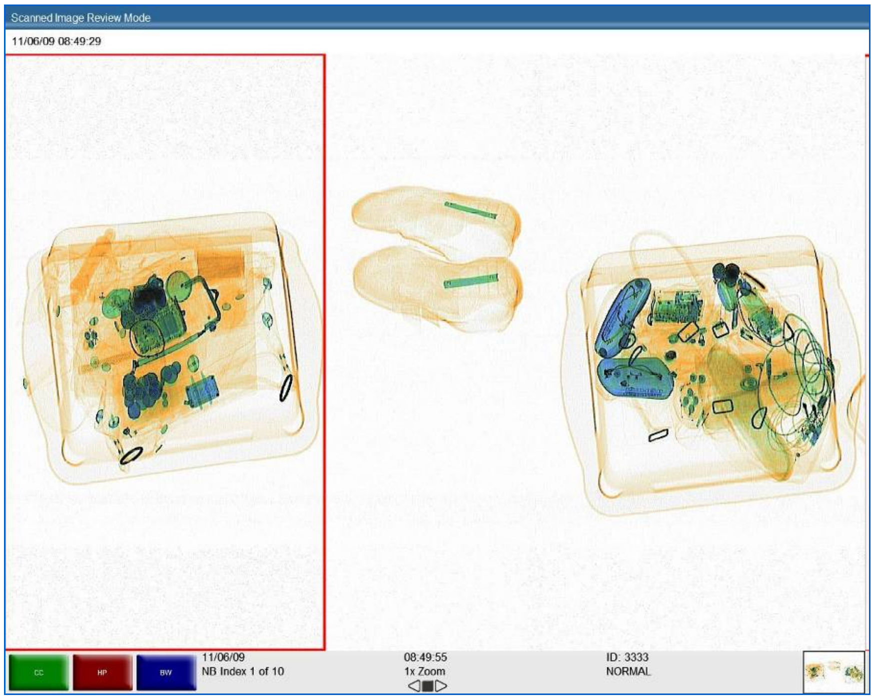


Figure 103: Next Bag

Figure 103 shows how the screen looks when Next Bag key (“NB”) is pressed. Note that the next bag is outlined in red once it is chosen, and moves onto the screen from left to right.

A message reading “End of image review buffer. Press the PJ/I button to clear this message box” will appear on screen once the operator has reached the end of the image review buffer when in Next Bag mode. As indicated in that message, the operator can press the “J” or “NB” key on the operator control board to clear the message, but the message will disappear automatically after 5 seconds. The “R” or Stop button can be used to exit the Previous Bag or Next Bag mode (i.e. the Scanned Image Review Mode) and back to the Normal mode.

NOTE: Each bag in Previous Bag or Next Bag mode has a date/stamp indicator above the bag’s image on screen.

Everything gets reversed, of course, if the conveyor belt is traveling in Reverse. In that case the "previous" bag now becomes the "next" bag and vice versa.

Archive

This function allows one of the most recently scanned bags that are still on-screen to be stored on the hard disk of the computer.

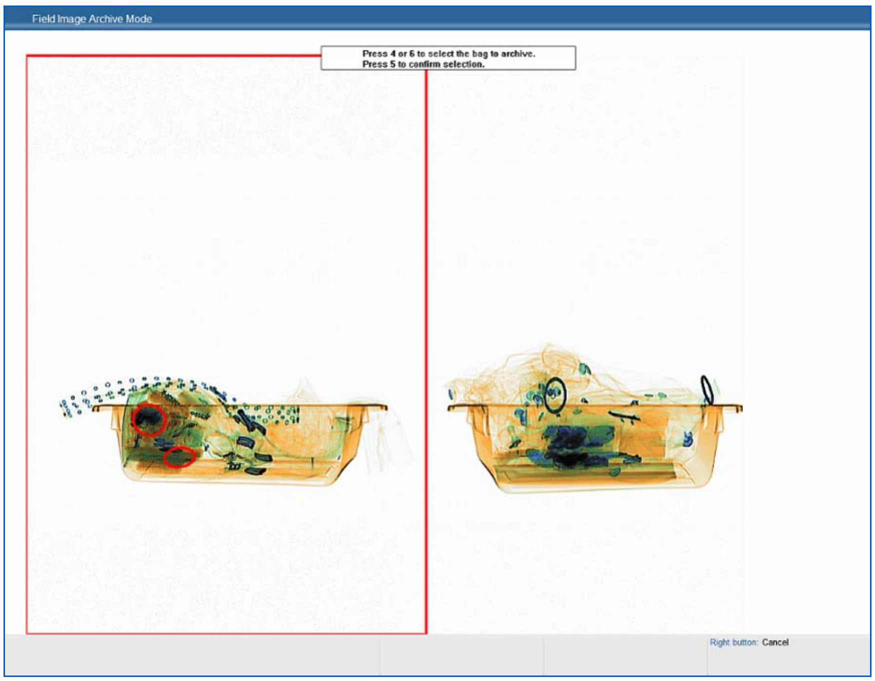


Figure 104: Archive Message

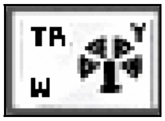
Figure 104 shows what the Operator will see upon pressing the "V" or "AR" key on the operator control panel whenever the system is in stop mode. Note the image to be archived will be outlined in red. In addition, a message appears above the image.

Pressing 4 on the operator control panel numeric keypad causes the red square to move to the left. Pressing 6 will cause the red square to move to the right. The Operator must press 5 in order to confirm the selection of the bag to be archived. A message confirming selection will appear briefly.

This option may not be present in some systems. The number of images that can be archived is limited to hard disk space or to a configurable allowable maximum disk space, whichever is smaller.

It is possible to retrieve archived images but this can only be done in Supervisor mode.

Transmit



This function is applicable when the X-ray machine is part of a network and allows images to be transmitted to other machines in the network.

Reset

This button allows the operator to return to “normal” mode from image enhancement and Zoom modes.

Combined Function

The system software also allows the operator to use more than one image enhancement feature simultaneously. Figure 105, for example, shows an image that is being enhanced with Crystal Clear, Black and White and Organic Material

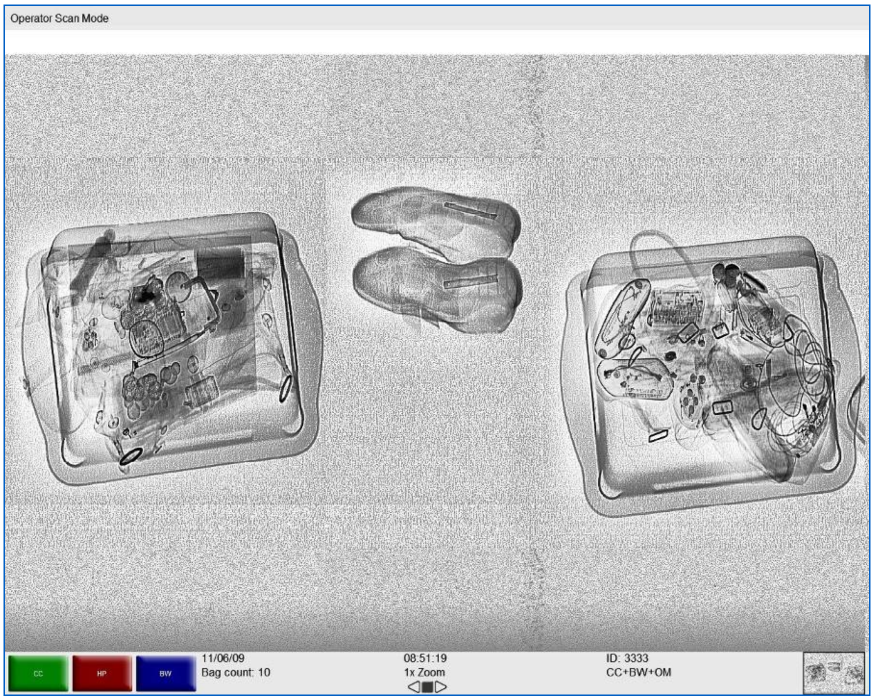


Figure 105: CC+ BW + OM

NOTE: Applying too many image enhancement functions to an image can actually have the opposite effect and distort the image beyond the operator’s ability to spot possible threats

Real Time Mode

One of the' unique abilities of the new Windows-based operating system is being able to use image enhancement on images as they scroll across the screen. Previously images/bags would have to be stopped in order to use image enhancement on them. Thus as an image is scrolling across the screen, the operator can use CC, Black and White, Inverse, etc. on the image without having to stop it.

The new Windows-based software allows the operator to enhance images even when the images are scrolling across the screen in reverse order. Figure 106 shows a screen in forward/scanning mode, with Variable Gamma enabled.

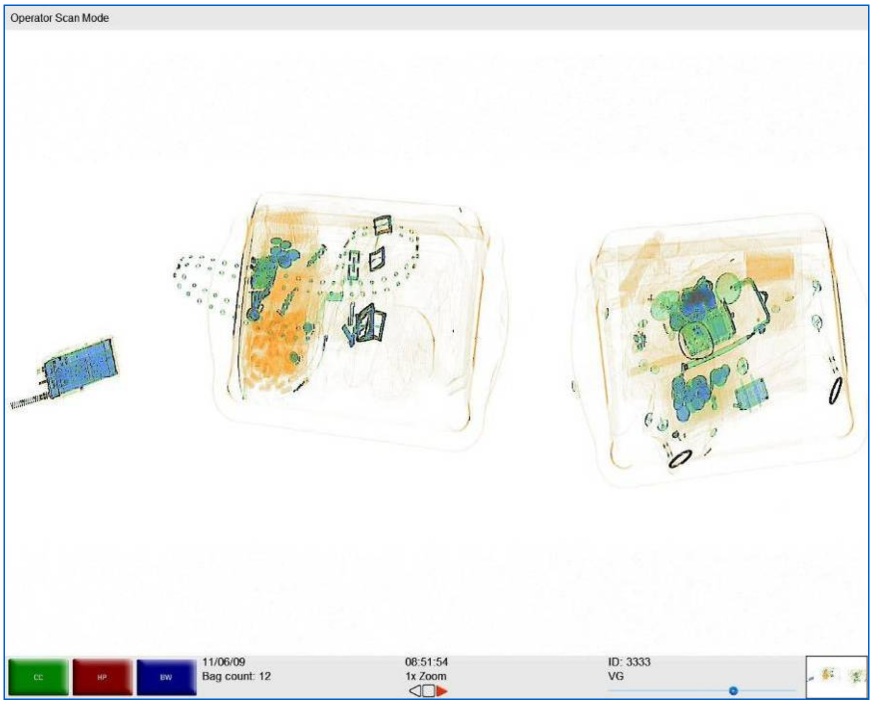


Figure 106: Scanning Mode with VG Enabled

8.5 Zoom Keypad

Figure 107 shows a typical scanned image, which has divided by non-existent dashed lines into nine segments, each corresponding to a button on the Operator Control Panel zoom/numerical keypad (Figure 108).

NOTE: These nine segments actually overlap somewhat rather than being evenly divided. This ensures complete coverage of all the objects on screen.

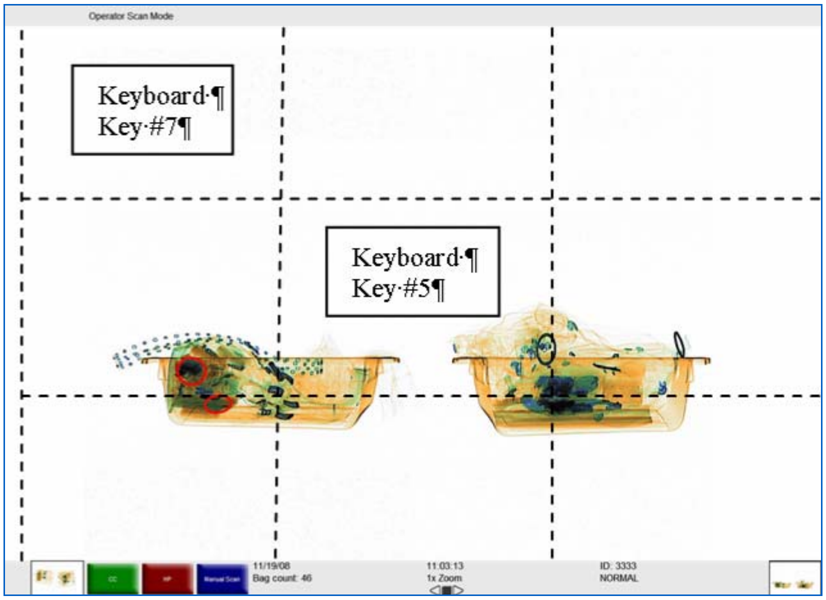


Figure 107: Screen Divided into Nine Segments

For example, the top left corner of the screen corresponds to #7 on the Control Panel Numeric Keypad; the center square corresponds to #5 on the Control Panel Numeric Keypad (Figure 107).

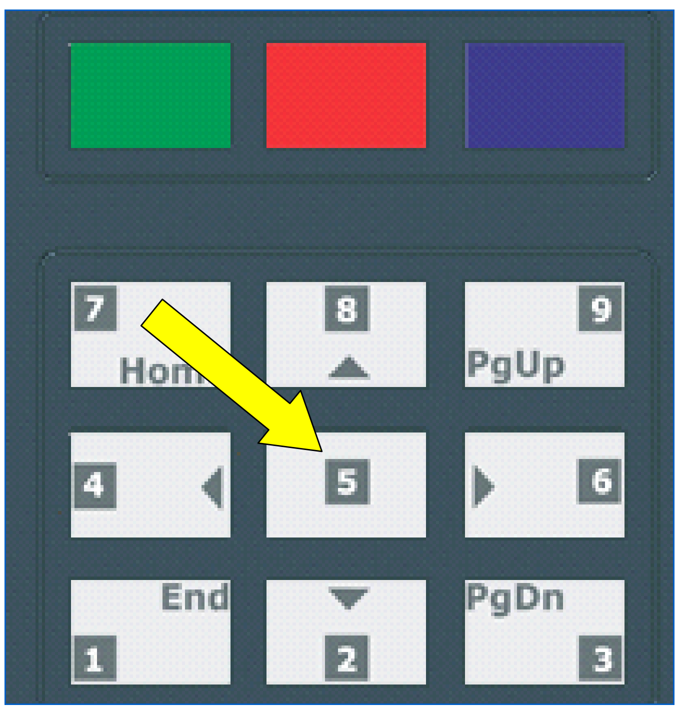


Figure 108: Keyboard Selection

When the #5 button on the zoom keyboard is pressed (Figure 108) it corresponds to the center area of the screen. For example, the image shown in Figure 109 is at normal size (not zoomed). The dotted square highlights the center of the screen, which corresponds to the #5 key on the number keypad on the operator control panel (Figure 108). Pressing that #5 key causes the system to zoom that (center) area of the screen (Figure 110) to a power of 2 (2X Zoom).

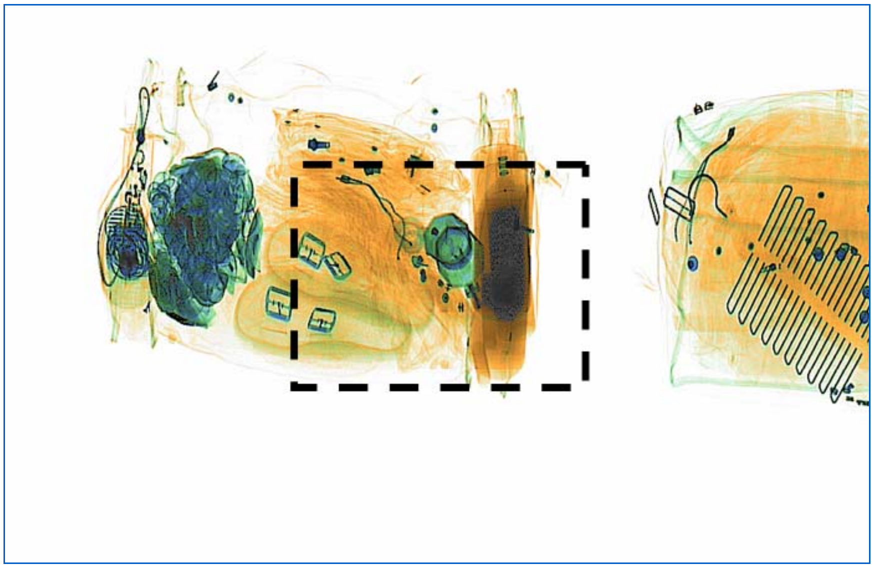


Figure 109: Center Selected (Button #5 on Operator Control Panel)

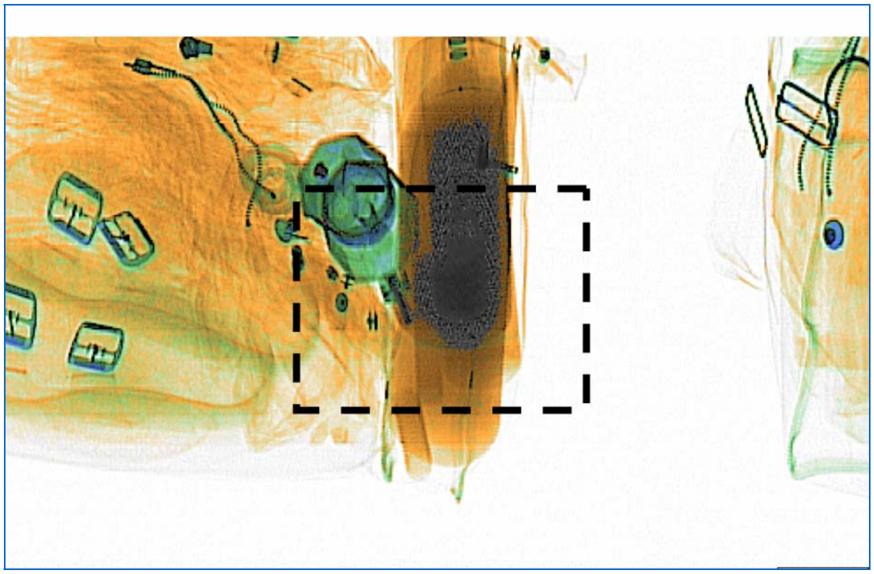


Figure 110: 2 x zoom

Press #5 on the zoom keypad again, the same area of the screen is increased to 4X Zoom (Figure 111).

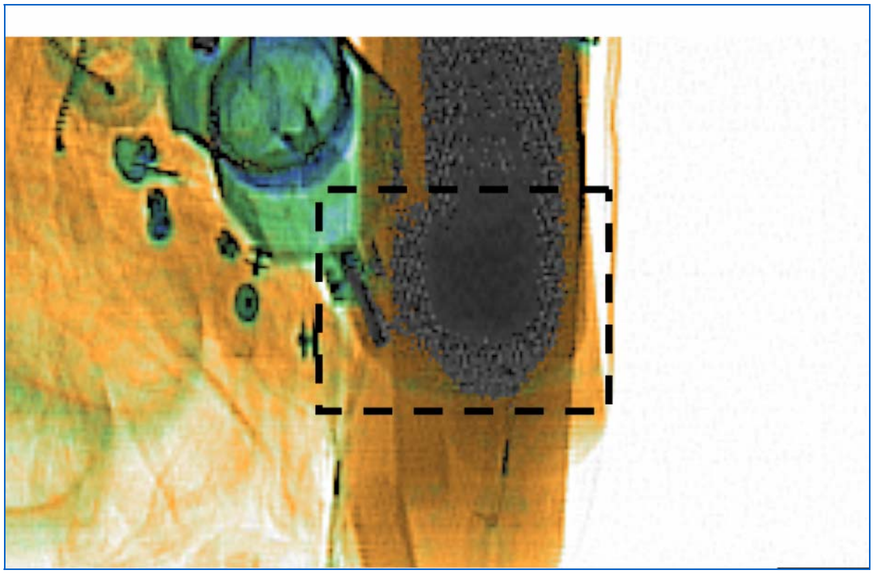


Figure 111: 4 x zoom

Pressing the same button zooms the same area to a power of 8 (Figure 112), and 16 (Figure 113), with a maximum possible zoom of 64X.

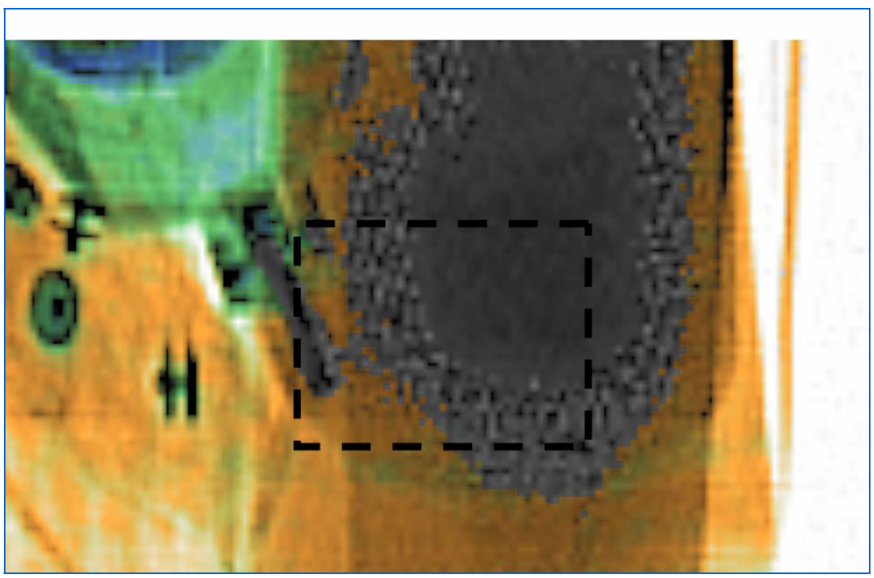


Figure 112: 8 x zoom

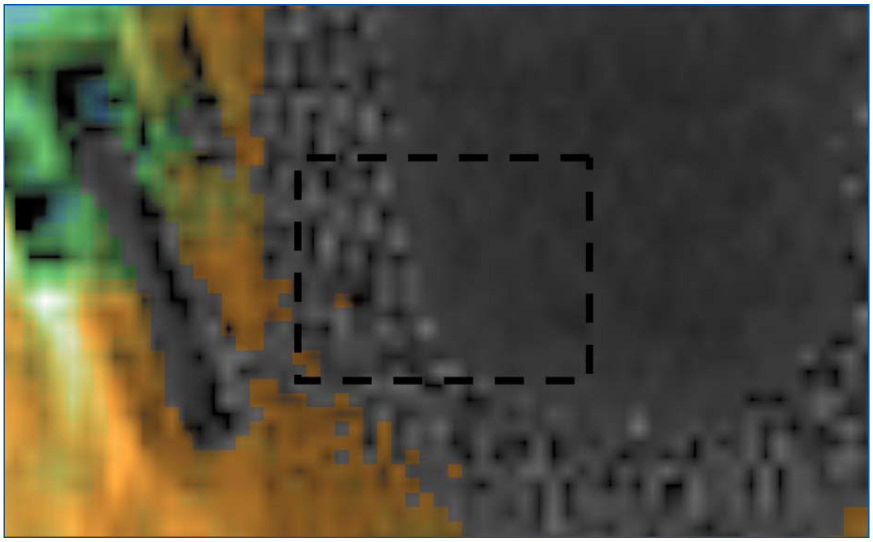


Figure 113: 16 x zoom

The Back to Normal button returns the image to a normal size (Figure 114).

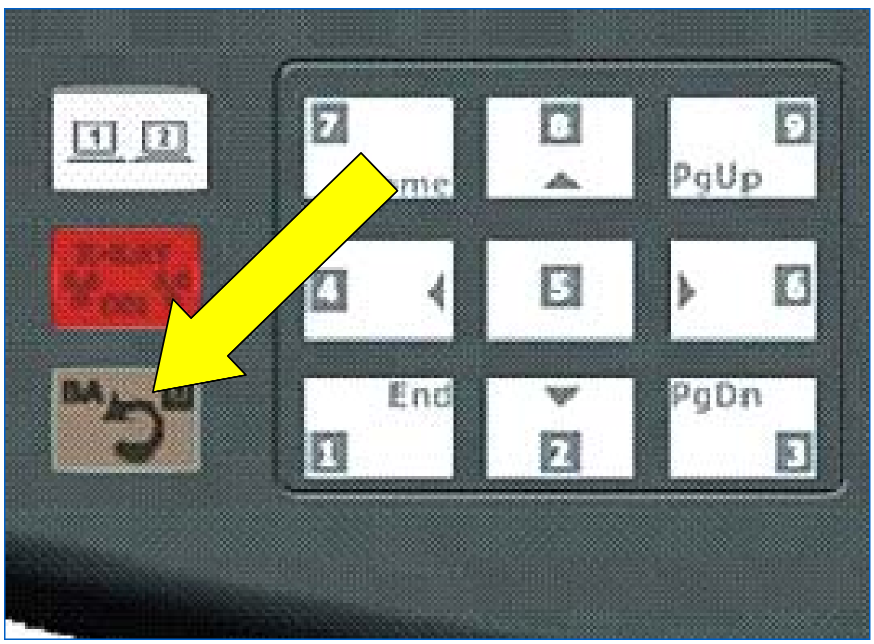


Figure 114: Back-to-Normal and Zero Button

8.6 <u>Other Control Panel Functions</u>

Emergency Stop

As the name implies, this button will immediately stop the unit from generating x-rays or moving the conveyor belt.

Figure 115: Emergency Stop Switch, Key switch and Power Button

When the E-stop is pressed, the following message will appear (see Figure 116).

Figure 116: E-Stop Initial Message

If the STOP button on the Operator Control Panel is pressed before the E-stop is released, the message in Figure 117 will appear.

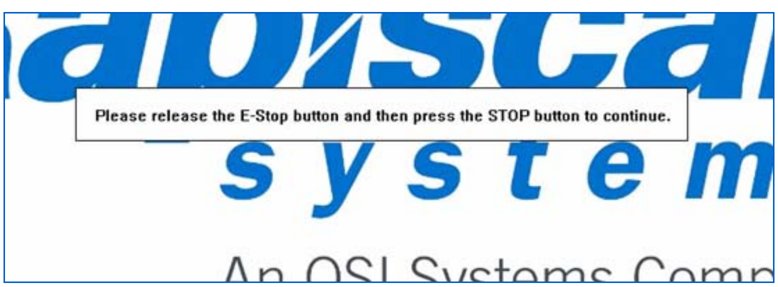


Figure 117: E-Stop Release Message

The operator must release the E-stop and then press the Operator Control Panel STOP button again. At that point the following message will appear:

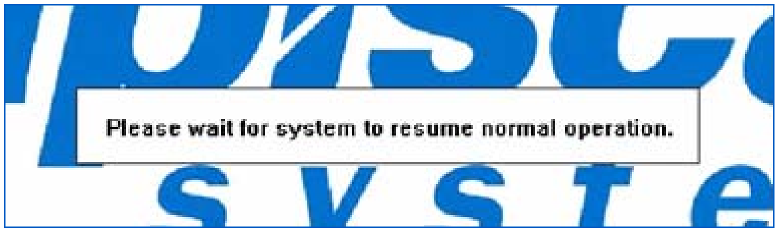


Figure 118: E-Stop "Wait for System" Message

Indicator Lights

The Operator Control Panel features five indicator lights. Figure 119 shows two of those lights: X-rays On and System On. Figure 120 shows the indicator lights at the base of the Image Processing Keypad (NOTE the SE button. These lights are for the Reverse (RE), Stop (ST) and Forward (FW) conveyor buttons and indicate when the respective buttons have been pushed.

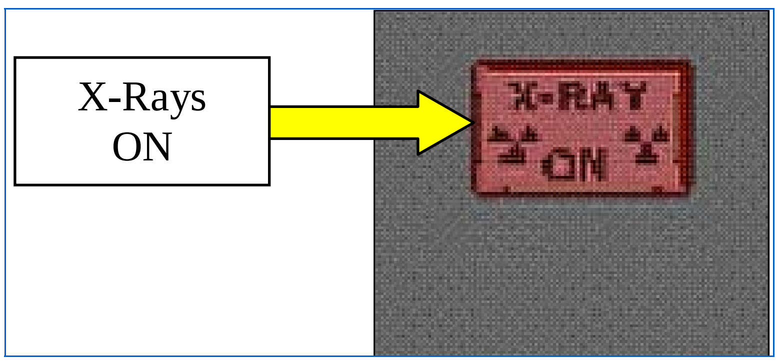


Figure 119: X-rays On Light

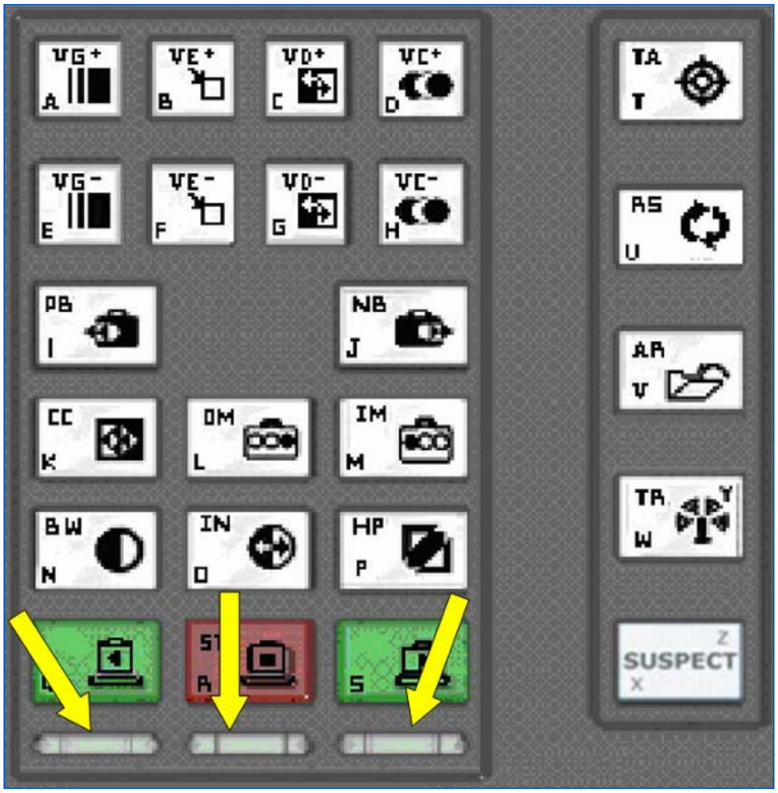


Figure 120: Conveyor Indicator Lights

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9.0 Service Mode

WARNING: The System Service Menu allows access to complex machine configuration details and the performance of the system can be severely affected by improperly altered settings. These settings cannot be restored by removing and restoring the power.

This menu is to be used only by authorized personnel to perform such operations as collimating the X-ray source and mapping out defects on the diode array circuit boards.

NOTE: Rapiscan Systems offers a number of optional functions on its various machines, functions that can be purchased separately and that may or may not appear on your particular X-ray machine software menus. Thus if an option is discussed in this section that does not appear on your unit's menus, it is because that option was not purchased with your X-ray unit. If interested in any option that does not appear on your software menus, please contact Rapiscan Systems.

9.1 <u>Accessing Service mode</u>

To enter Service Mode, go to the Rapiscan Log On screen (Figure 121). Enter your Service User ID and Password.

Figure 121: Rapiscan Log On Screen

The Service Level Main Screen appears (Figure 122).

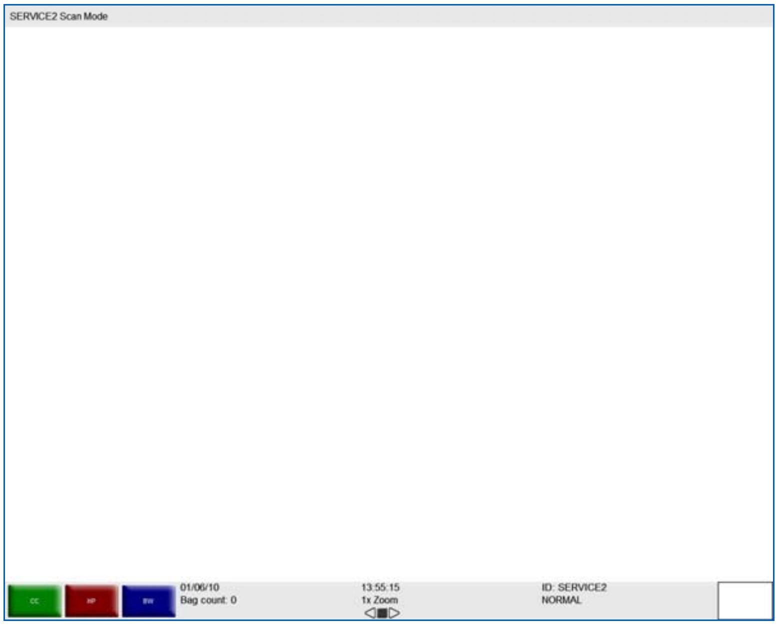

Figure 122: Service Mode Main Screen

Click the left touchpad button (located below the touchpad). This brings up a column of function buttons on the right side of the screen.

NOTE: The length of the menu column makes it impossible to view all the function buttons on one screen. Figure 123 shows the “top” of the menu – notice the arrow at the bottom of the menu, indicating that more menu items are available by selecting the arrow to scroll downward, which shows the “bottom” of the menu (Figure 124).

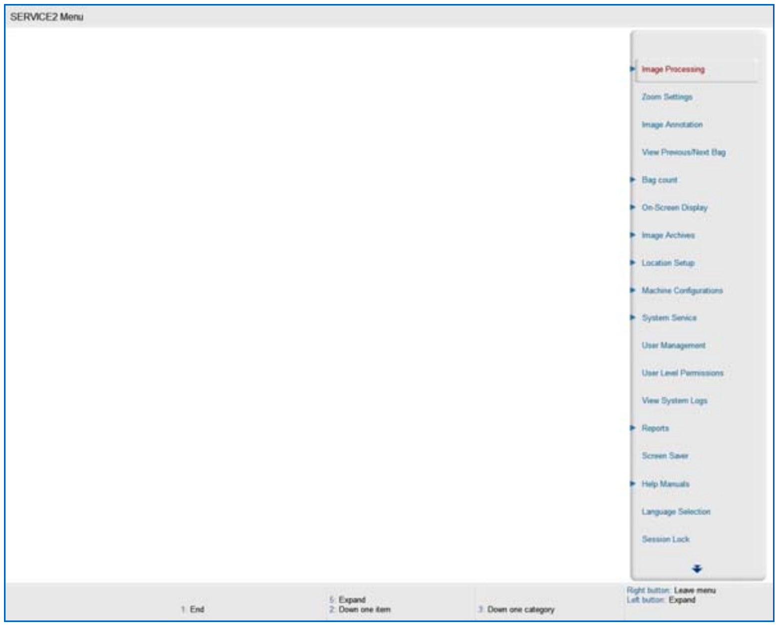

Figure 123: Main menu, top

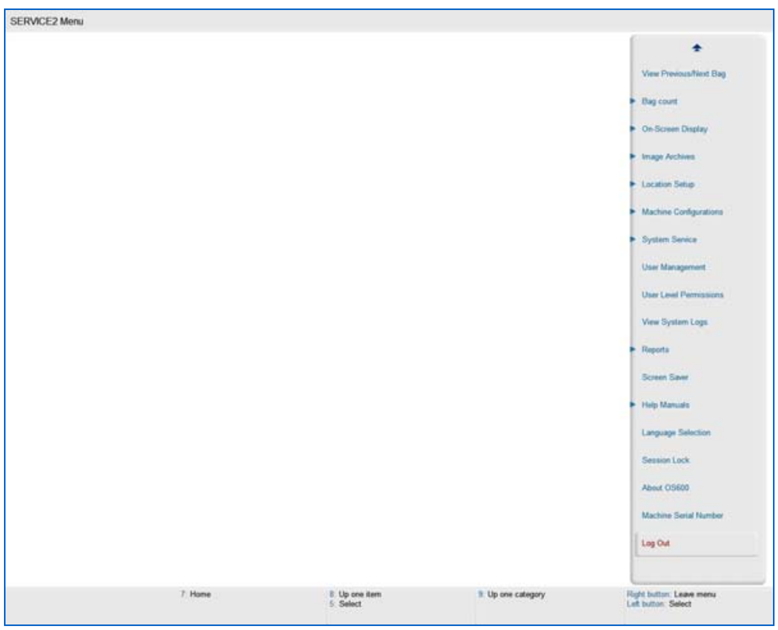

Figure 124: Main Menu, bottom

9.2 Image Processing

Figure 125 shows the first item in the main menu: Image Processing with its various submenu options.

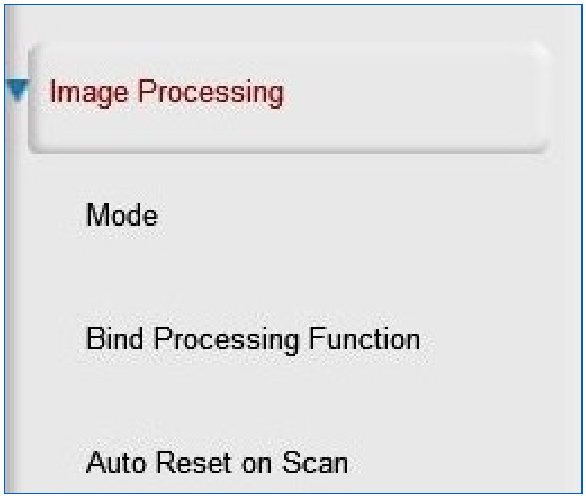

Figure 125: Image Processing

Mode

Selecting “Mode” brings you to the screen shown in Figure 126.

Figure 126: “Mode” menu

“Mode” includes a number of menu items that control the appearance of a scanned image:

- High Penetration
- Crystal Clear
- Inorganic Material
- Organic Material

- Inverse Color
- Edge Enhancement
- Gamma
- Color Stripping
- Density Zoom

Each of these menu items, when selected, offer three choices:

- Stop mode
- Disable/Enable
- Real-Time Mode

This determines whether a particular image enhancement, such as High Penetration, operates only in stop mode or in both stop mode and "real-time" mode and also whether the enhancement is enabled or disabled altogether.

Bind Processing Functions

Figure 127 shows the Bind Processing Functions option on the Service Mode menu under "Image Processing."

Figure 127: Bind Processing Function

The Bind Processing Functions button (Figure 127) allows the Operator to assign multiple image processing functions to individual function keys.

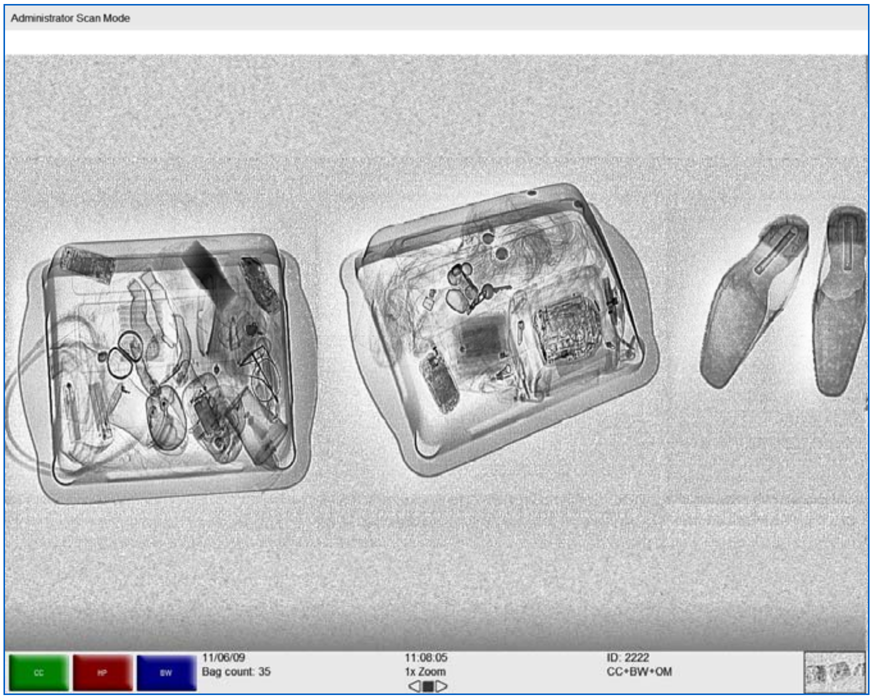

Figure 128: Scanned Image with CC, BW, OM

1. To make use of the Bind Processing Functions function:
2. Obtain a scanned image (Figure 128).
3. Apply one or more image processing functions to the image. For example, CC, BW and OM have been applied to the image shown in Figure 128.
4. Click the left Touchpad button, which brings up the main menu (Figure 129).

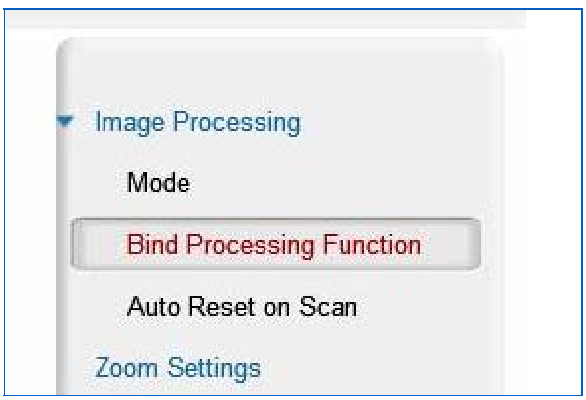

Figure 129: Bind Processing Function

5. Using the touchpad, move the cursor down to highlight Image Processing.

6. Select “Image Processing.” The full Image Processing menu will be revealed, including the Bind Processing Functions button.

7. Using the Touchpad, move down to highlight the Bind Processing Functions button.

8. Select Bind Processing Functions and the drop down menu will appear (Figure 130).

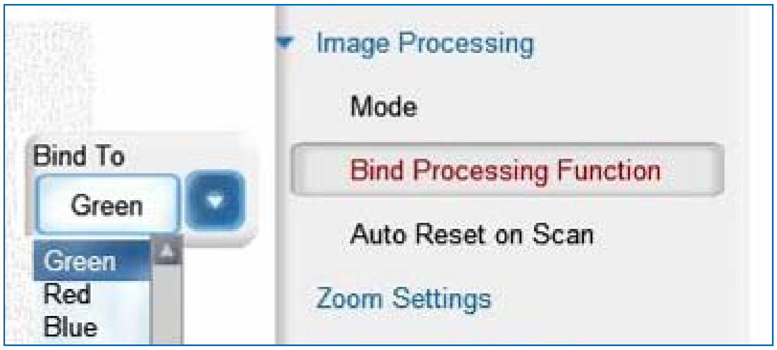

Figure 130: Image Processing – Bind Processing Functions

9. Choose the colored button to which you want to assign the image functions you’ve just applied to the scanned image (Green, Red or Blue).

10. Right-click until you return to the main screen (without the main menu showing) where you’ll see that the functions you chose have been assigned to the function button you selected (Figure 131, note the red function button now reads: CC+BW+OM).

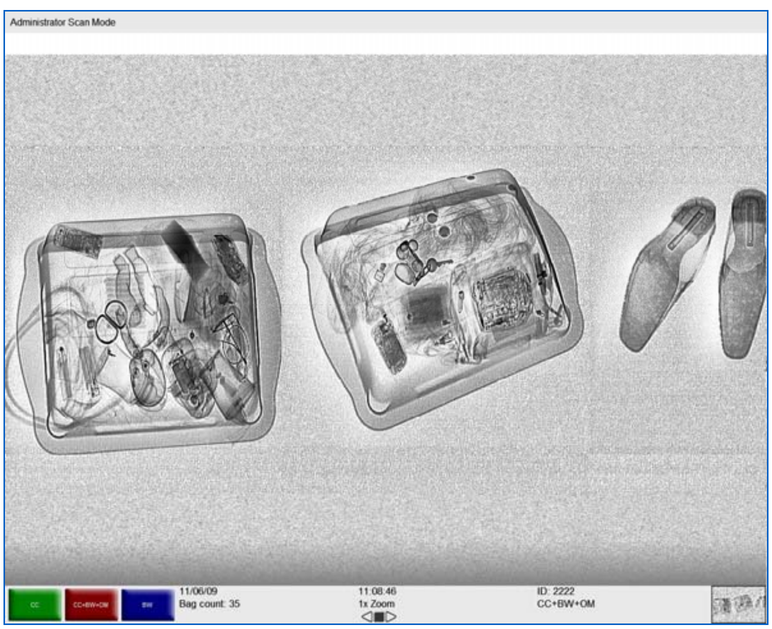

Figure 131: Multiple Image Processing Functions (Target Applied)

To reverse the procedure, press the RS button to remove the image enhancement functions. Return to the Bind Processing Function menu as described above. Select the Green button to apply the Normal function to. Return to the main screen and you will see that the Green Button now has only the Normal function applied to it.

NOTE: Assigning too many functions may prove counterproductive to the quality of the actual image the operator's ability to discern possible threats in the image.

Auto Reset on Scan

Figure 132shows the third and final item under "Image Processing," and that is the "Auto Reset on Scan" function. When enabled, this function resets the image processing functions to normal each time a new item is scanned. Note the Enable and Disable options.

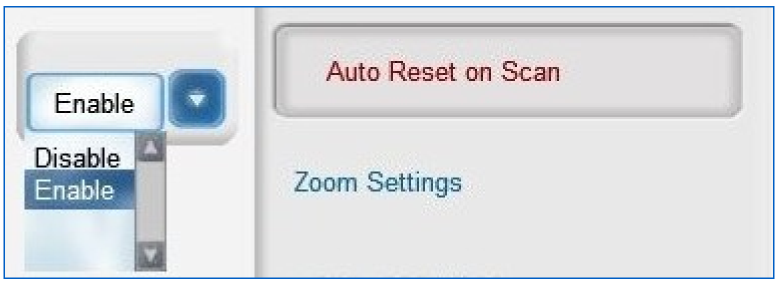

Figure 132: Auto Reset on Scan

9.3 <u>Zoom Settings</u>

Figure 133 shows the Zoom Settings option. When in the "Fixed" zoom mode, clicking a number will take you to that quadrant of the screen (e.g. clicking "5" will take you to the center quadrant of the screen, and clicking "7" will take you to the upper left quadrant of the screen). When in "Smart" mode, if there is only one image on the screen, clicking a number will take you to the corresponding quadrant of that *image* rather than of the whole *screen*.

Figure 133: Zoom Settings

9.4 Image Annotation

Image annotation is an optional feature that allows suspected threats to be highlighted for secondary inspection. The feature can be enabled or disabled.

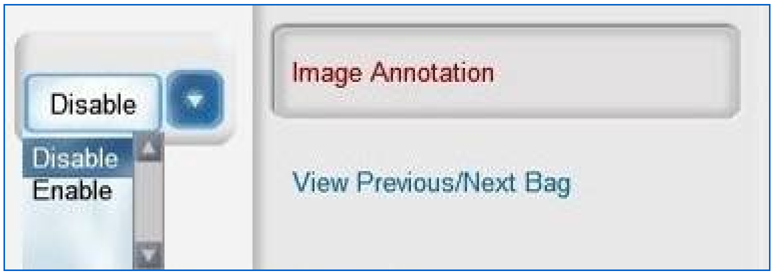

Figure 134: Image Annotation

9.5 View Previous/Next Bag

Figure 135 shows the "View Previous/Next Bag" function which can be enabled or disabled.

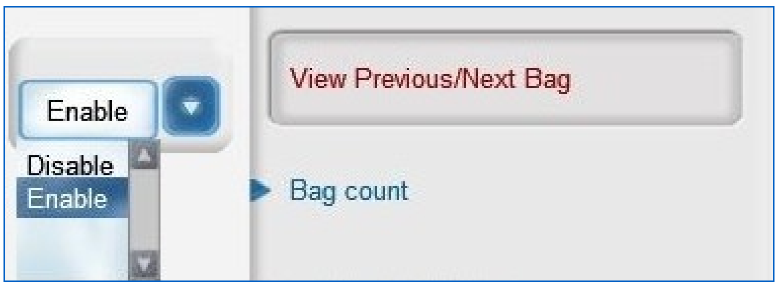

Figure 135: View Previous/Next Bag

9.6 Bag Count

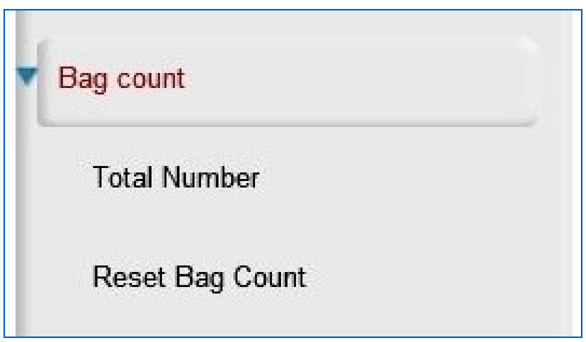

Figure 9-136: Bag Count

Bag Count (Figure 9-136) includes two sub options: Total Number and Reset Bag Total.

Total Number

Total Number displays the number of bags scanned since the Machine first operated at the factory. This number cannot be changed.

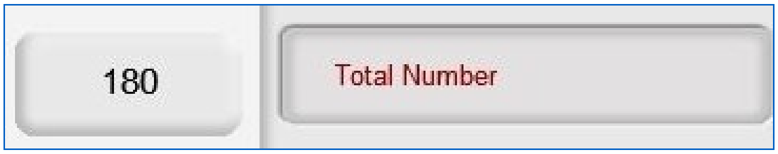

Figure 137: Bag Count: Total Number

Reset Bag Count

Figure 138 shows the "Reset Bag Count" sub-option which allows an Operator to reset the count.

Figure 138: Reset Bag Count

9.7 On-Screen Display

Figure 139 shows the On-Screen Display option and the suboptions for "Date," "Time" and "OSD Status."

Figure 139: On Screen Display

Date

Figure 140 shows the Date readout, which can be displayed on screen in one of three formats.

Figure 140: Date

Time

Figure 141 shows On-Screen Display: Time. The time can be displayed in 12 hour or 24 hour format.

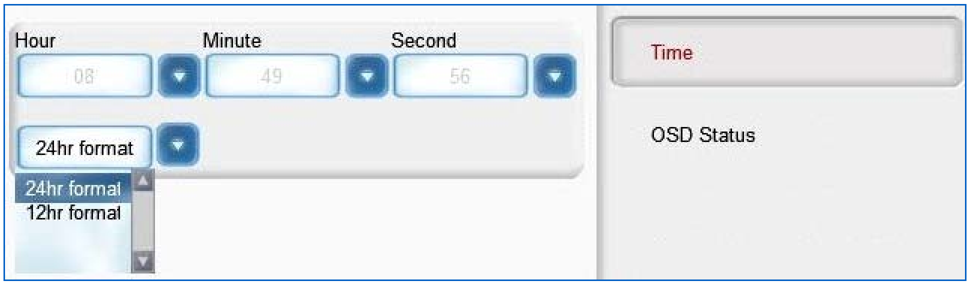

Figure 141: Time

OSD Status

Figure 142 shows the OSD (On Screen Display) Status button which allows control over a number of types of information that can be shown or not shown on screen:

- User Information
- Time
- Date
- Bag Count
- PB/NB Index
- Zoom Factor
- X-Ray Belt Status
- Image Processing Status
- Soft Buttons

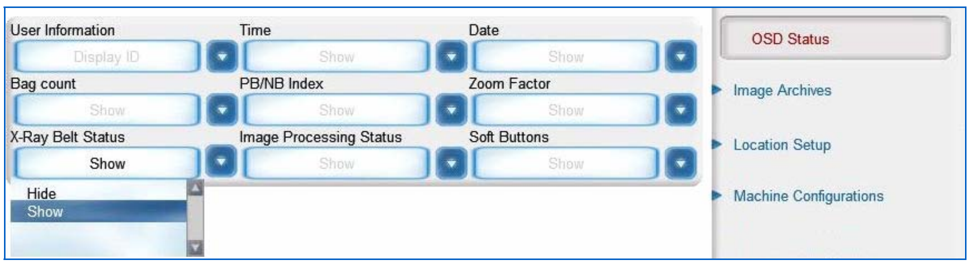

Figure 142: OSD Status

9.8 Image Archives

Figure 143 shows the Image Archives option and the four associated sub-options.

NOTE: Auto Archive is an optional program that automatically archives scanned images, as opposed to Manual Archive which is a standard feature.

Figure 143: Image Archives – Review Manual Archives

Figure 143 shows the Image Archives option along with four sub-options, including Review Manual Archives, Manual Archive Settings, Import Archives and Review Imported Archives.

Review Manual Archives (and optional Review Auto Archives)

Selecting either Review Manual Archives or the optional Review Auto Archives will cause the "Filter Options" screen to appear (Figure 144). The Filter Options screen (Figure 144) allows you to determine the criteria that can be used to search the manually or automatically archived images – such as operator ID, Site and Date options.

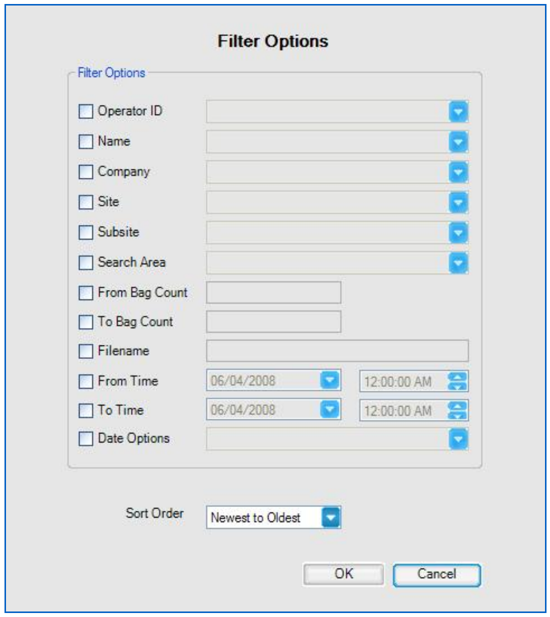

Figure 144: Filter Options

Selecting “OK” on the Filter Options screen brings you to the Archive Reviewer screen shown in Figure 145.

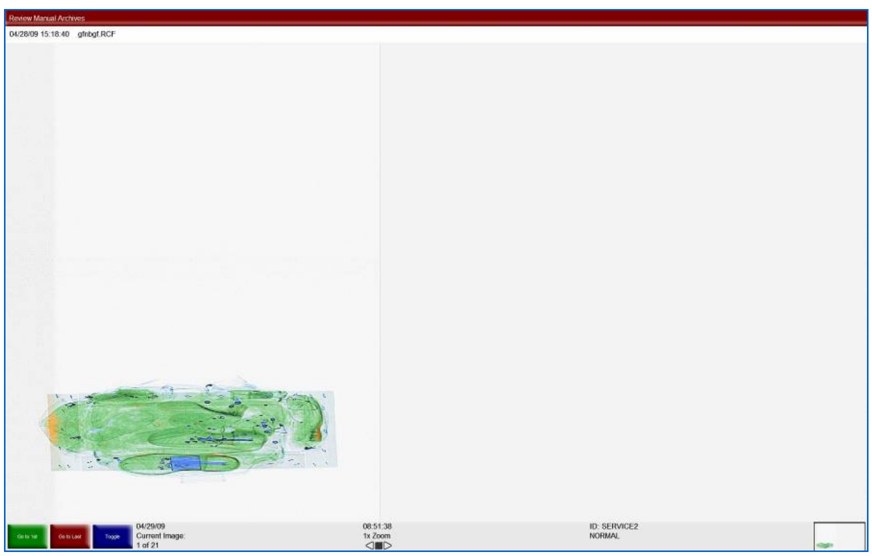

Figure 145: Archive Review screen

Left clicking on the touchpad button brings up the Archive Reviewer menu as shown in Figure 146.

Figure 146: Archive Review mode menu

Figure 147 shows the Help Manuals option which allows access to the electronic copies of the Operator and Service manuals.

Figure 147: Help Manuals

Selecting Image Information brings up the screen shown in Figure 148 which includes Operator ID, name, site, machine serial number, etc.

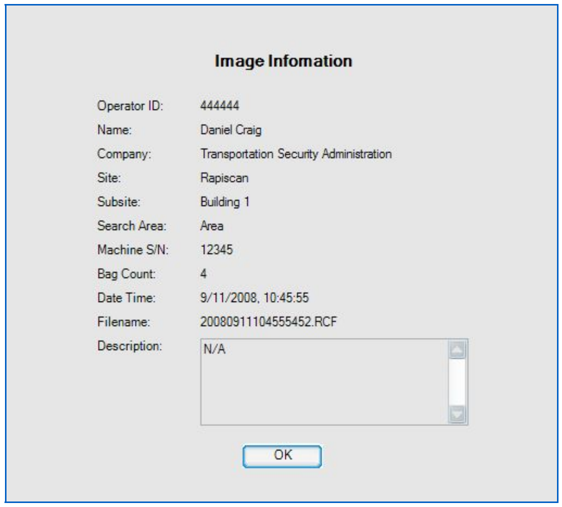

Figure 148: Image Information screen

Figure 149 shows the machine serial number option. Knowing the machine's serial number will allow the technician to look up that specific machine's repair and maintenance history, perhaps shedding light on any current problems the machine might be experiencing.

Figure 149: Machine Serial Number

Selecting Filter Options (Figure 150) brings up the Filter Options screen (Figure 151).

Figure 150: Filter Options

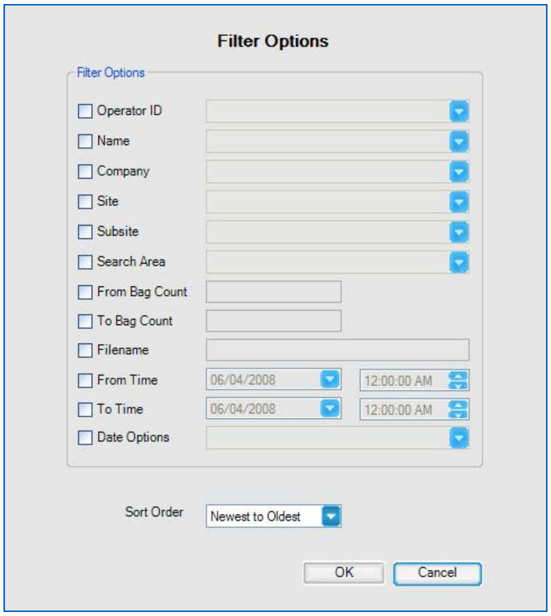

Figure 151: Filter Options screen

Figure 152 shows the Export Images option highlighted. Selecting this option brings you to the Export Images screen shown in Figure 153.

Figure 152: Export Images option

Figure 153 shows the Export Images screen which allows you to choose which images and which types of images you export. Click “Browse” to select the directory or medium to which to export the images.

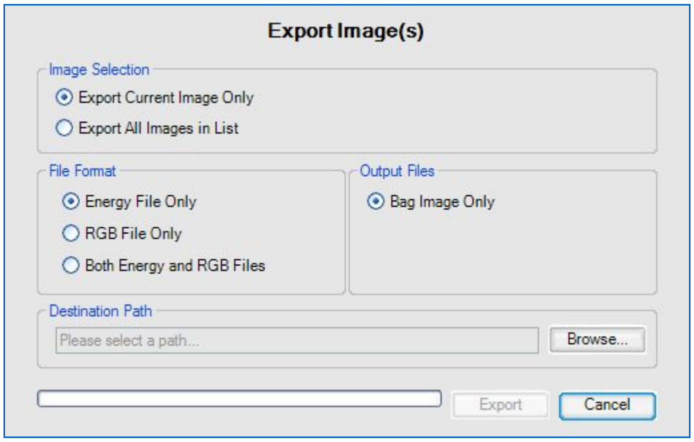

Figure 153: Export Images screen

If there are no archived images, you will see a blank screen in Review Archive mode. Left clicking on that screen will bring up the menu shown in Figure 154.

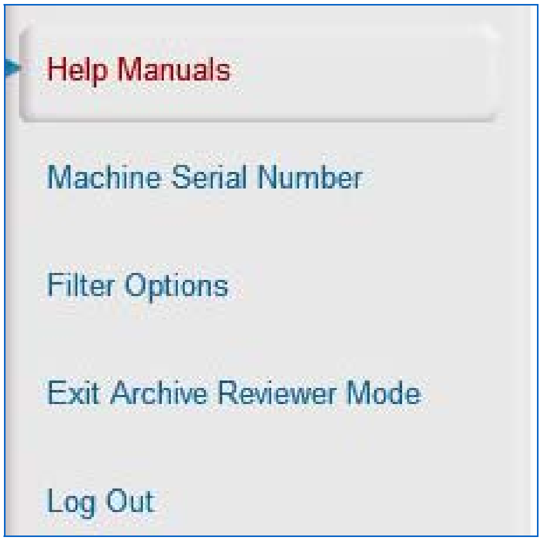

Figure 154: Archive Reviewer Mode

Manual Archives Settings

Figure 155 shows the Manual Archive Settings option. This option allows you to set the default image format to PNG, bitmap or RCF, as well as to simply enable or disable the manual archive setting option.

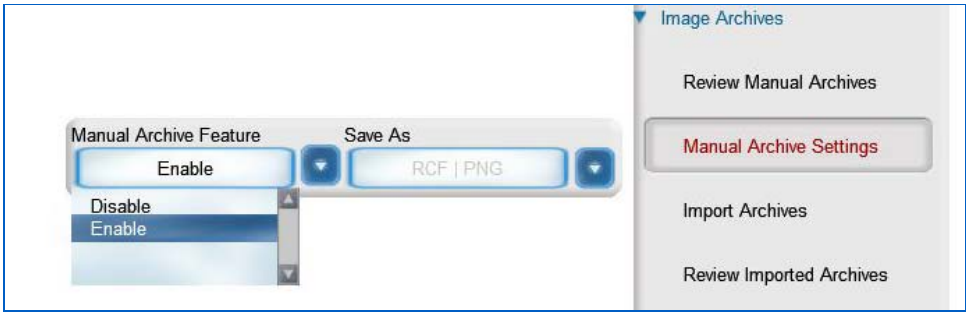

Figure 155: Manual Archives Settings

Import Archives

This function allows you to import archives from other directories or storage media.

Figure 156: Import Archives

Figure 157 shows the browsing window which allows you to access the desired directories or media.

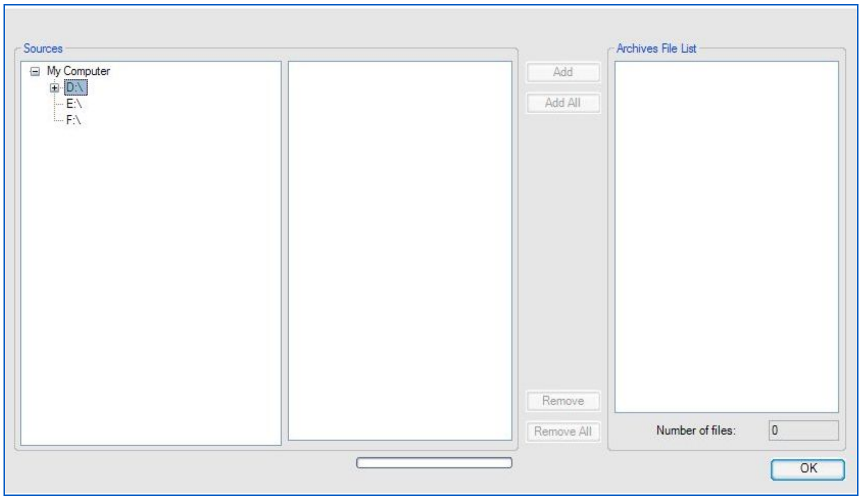

Figure 157: Import Archives Screen

Review Imported Archives

This function allows you to review archives imported using the Import Archives function. Choosing this button brings up the Filter Options screen (Figure 159) and then the Review Imported Archives screen (Figure 160).

Figure 158: Review Imported Archives

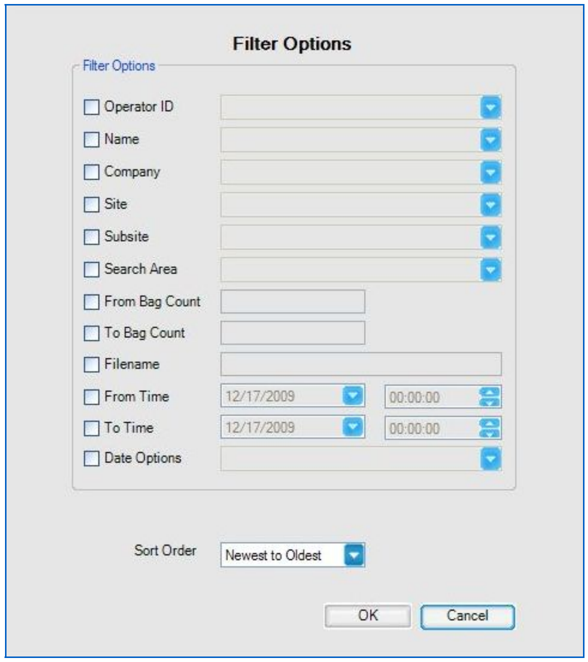

Figure 159: Filter Options

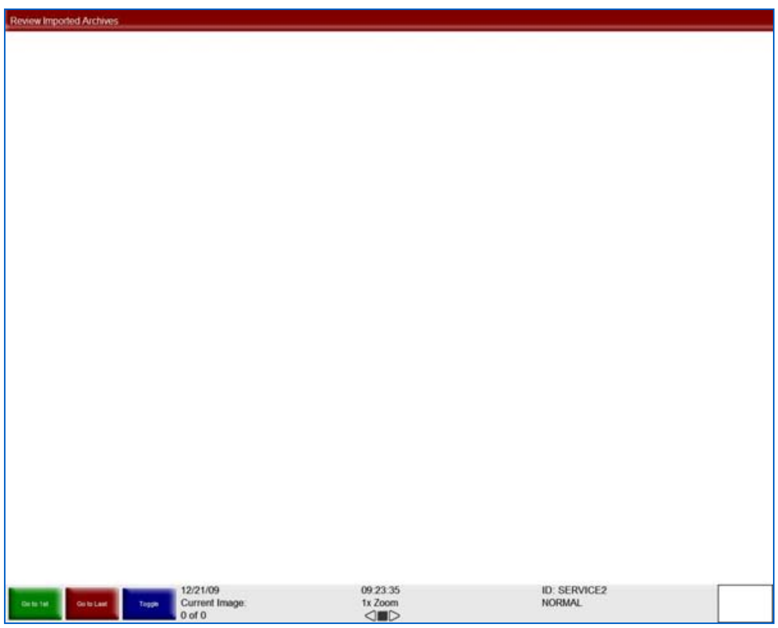

Figure 160: Review Imported Archives screen

If there is an imported archive present, images from that archive will scroll across the screen. Pressing the left mouse button will bring up the following menu:

Figure 161: Review Imported Archives Menu

If no archives have been imported, the following message will appear:

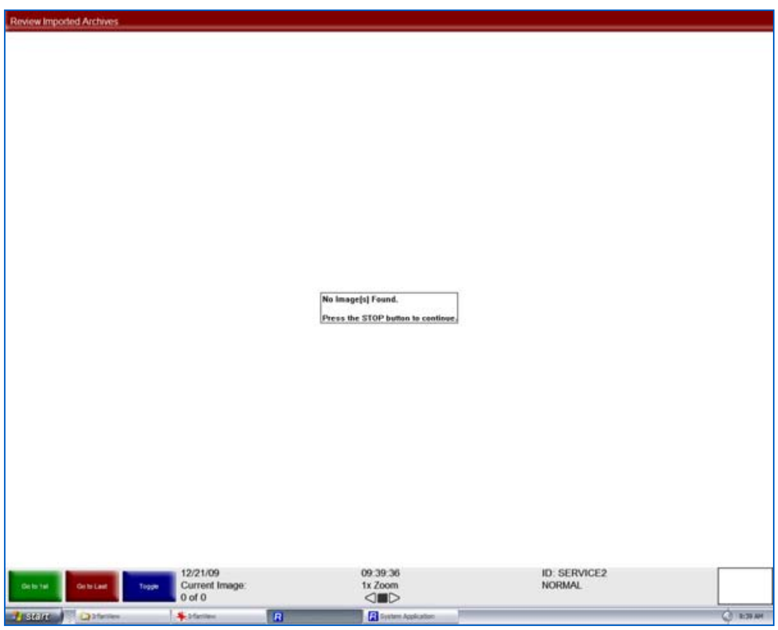

Figure 162: Review Imported Archives "No Images Found" message

When no imported archives are present, pressing the left mouse button will bring up the following menu:

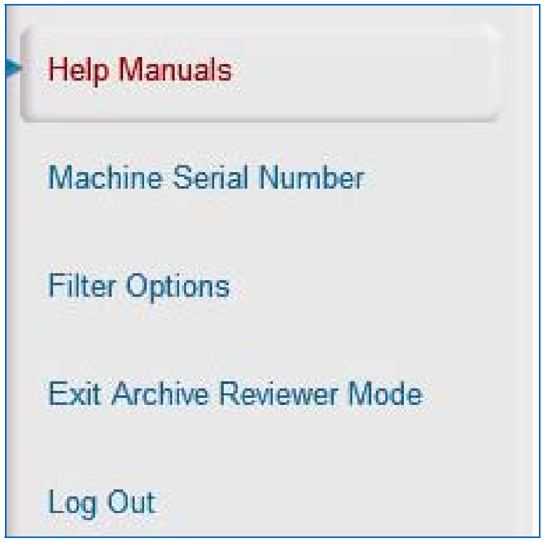

Figure 163: Review Imported Archives Menu (when no archives present)

9.9 Location Setup

Figure 164 shows the Location Setup option and its three associated sub-options: “Site,” “Station” and “Station Settings.”

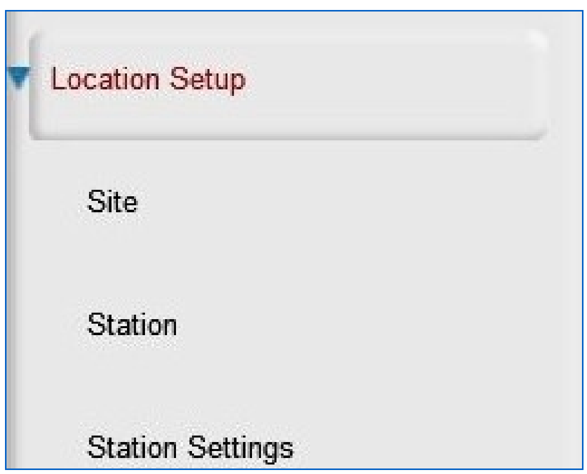

Figure 164: Location Setup

Site

Selecting the “Site” option (Figure 165) brings up the screen shown in Figure 166, where changes can be made to site data.

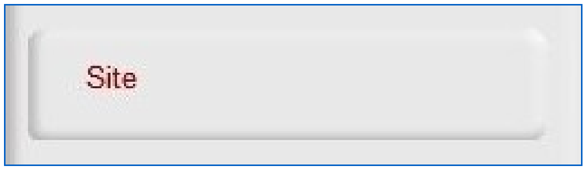

Figure 165: Location Setup – Site

Selecting “modify” on the “Site” screen brings up the “Modify Site” screen shown in Figure 167.

Figure 166: Site

Selecting “Modify” on the “Modify Site” screen shown Figure 167 brings you to Figure 168 where modifications can be made to Site data.

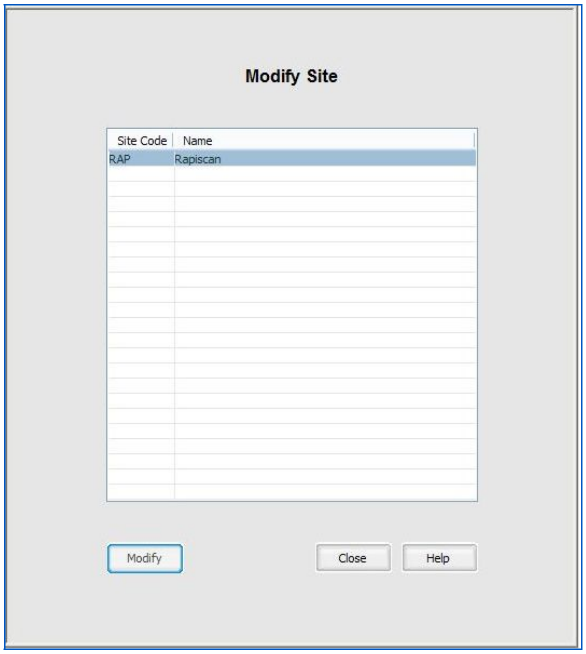

Figure 167: Modify Site

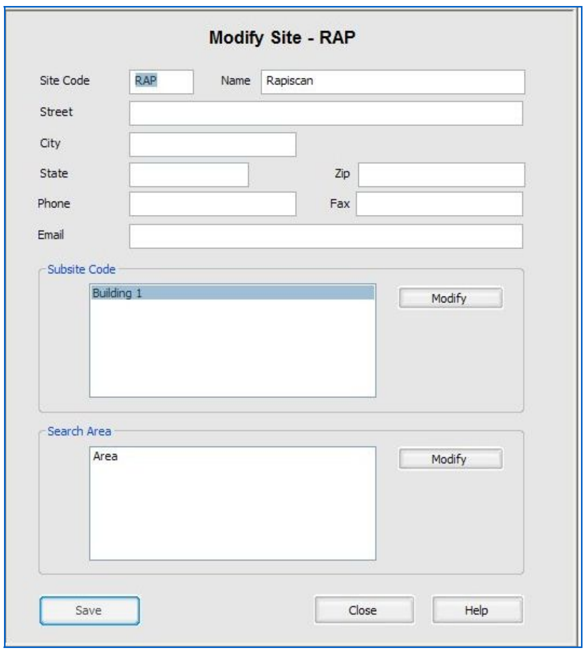

Figure 168: Modify specific site

Selecting “List All” on the “Site” screen shown in Figure 166 brings you to the “List All Sites” screen shown in Figure 169.

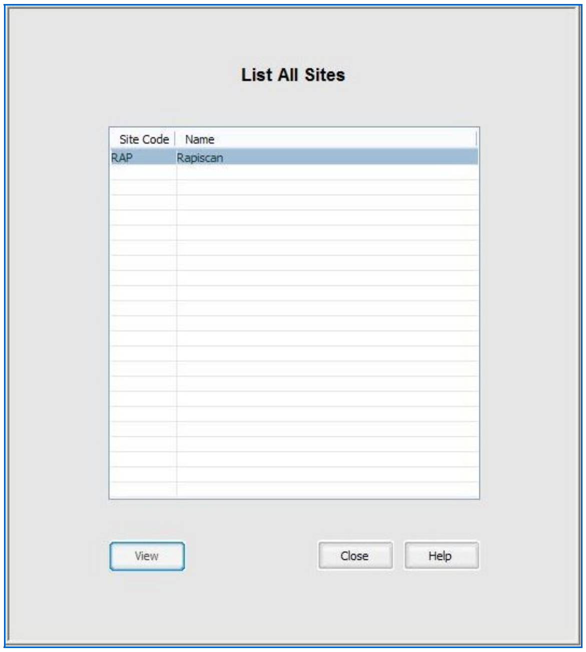

Figure 169: List All Sites

Selecting “View” on the “List All Sites” screen shown in Figure 169 brings you to the screen shown in Figure 170 where you can read the Site Data for that particular site.

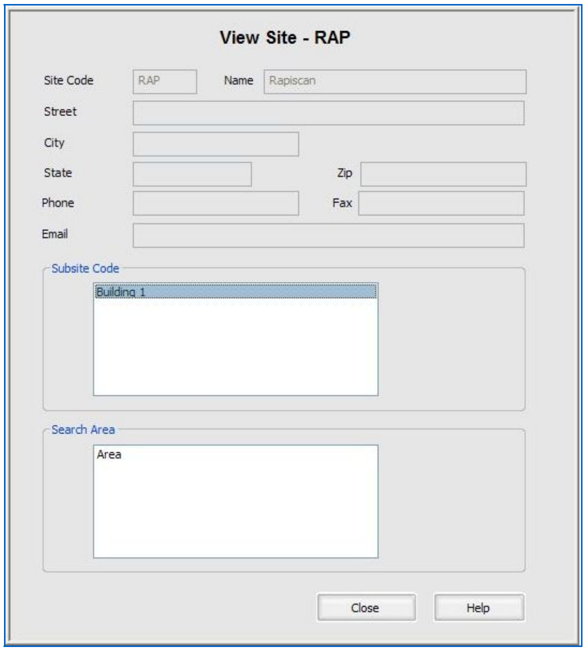

Figure 170: View Site

Station

Figure 171 shows the “Station” option. Selecting this option brings you to the “Station” screen shown in Figure 172.

Figure 171: Station

Figure 172: Station

Selecting “Modify” on the “Station” screen shown in Figure 172 brings you to the Modify Station screen shown in Figure 173.

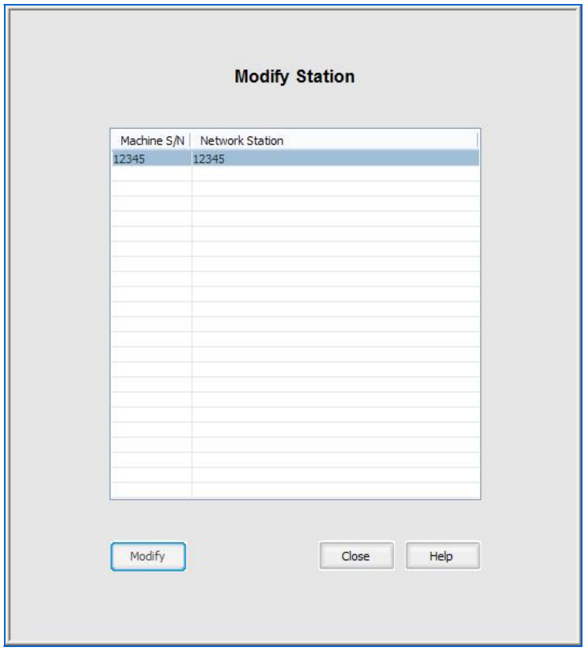

Figure 173: Modify Station

Selecting “Modify” on the “Modify Station” screen (Figure 173) brings up the “Modify Station” screen where data is modified (Figure 174).

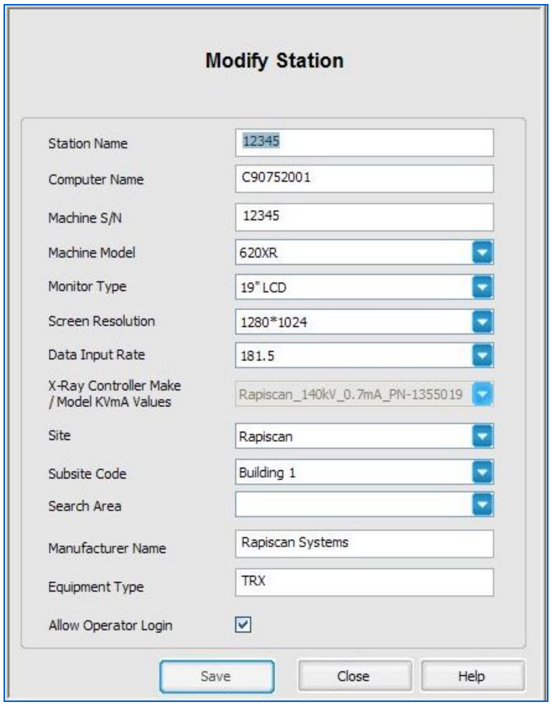

Figure 174: Modify Station data screen

Selecting “List All” on the screen shown in Figure 172 brings you to the “List All Stations” screen shown in Figure 175.

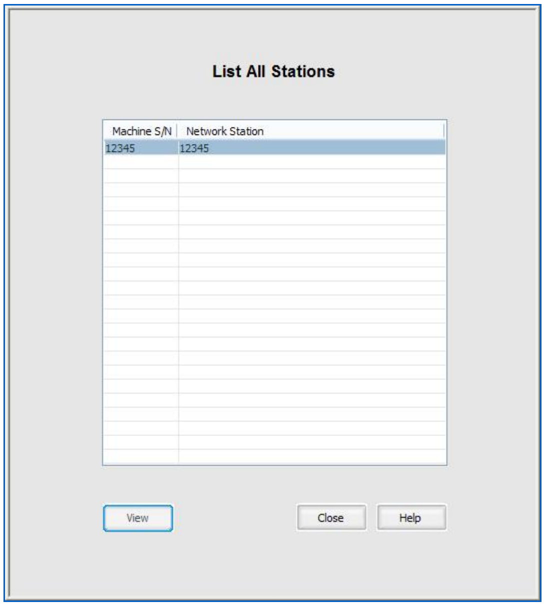

Figure 175: List All Stations

Selecting “View” from the “List All Stations” screen in Figure 175 brings you to the “View Station” screen shown in Figure 176.

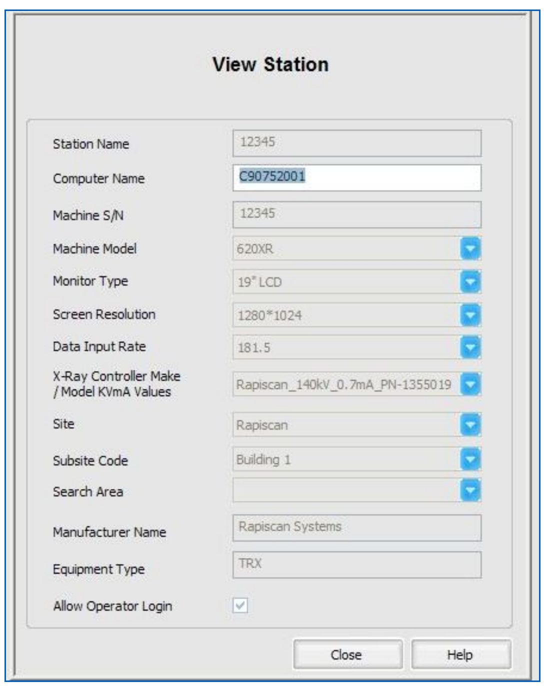

Figure 176: View Station

Station Settings

Selecting “Station Settings” on the Service Menu (Figure 171) brings up the “Station Settings” screen shown in Figure 177. Here the Supervisor can decide whether or not to enable Idle Timers and Session Timers as well as set Session Review Time and User Lockout Periods.

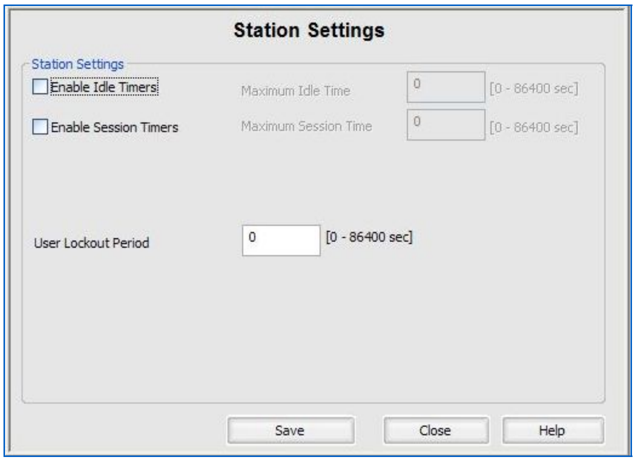

Figure 177: Station Settings

9.10 <u>Machine Configurations</u>

Figure 179 shows the Machine Configurations option.

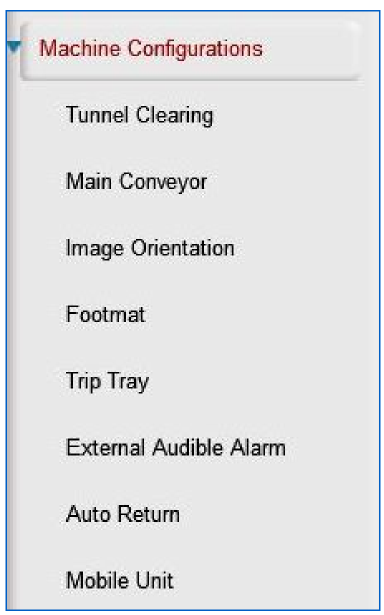

Figure 178: Machine configurations

Tunnel Clearing

The first sub-option, “Tunnel Clearing,” allows a Supervisor to choose whether to enable or disable the tunnel clearing feature, and whether to have the clearing be done when the user presses the S or the Q button on the Operator Control Panel. It also allows the Supervisor to choose the duration of the tunnel clearing.

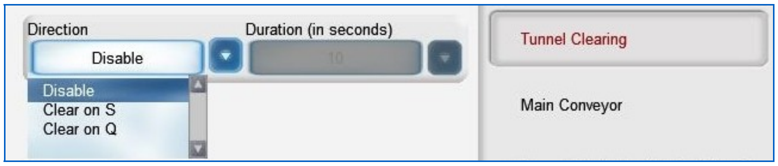

Figure 179: Machine Configurations - Tunnel Clearing

Main Conveyor

Figure 180 shows the Main Conveyor sub-option which controls Swap/Unswap Belt, Scan Direction and Scroll Direction.

Figure 180: Main Conveyor

Image Orientation

Figure 181 shows the Image Orientation sub-option. This determines whether an image is in a normal or vertically flipped orientation (changing orientation can sometimes aid in detecting threats).

Figure 181: Image Orientation

Footmat, Trip Tray and External Audible Alarm

The following figures (Figure 182 to Figure 184) show the enable/disable features for the Footmat, Trip Tray and External Audible Alarm functions.

Figure 182: Footmat

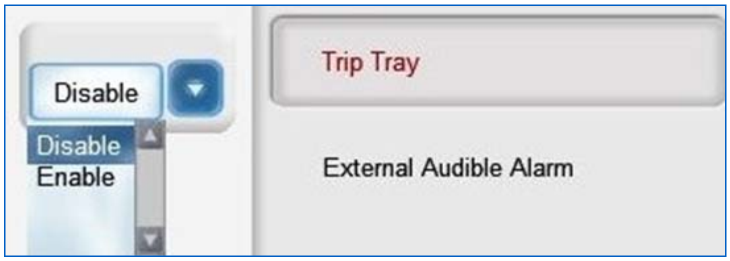

Figure 183: Trip Tray

Figure 184 shows the External Audible Alarm option which is enabled only when an external audible alarm is connected to the system.

Figure 184: External Audible Alarm

Figure 185 shows the Auto Return option which can be enabled or disabled. This allows the scanner to operate so that scanned packages will enter and exit the same side of the machine/van, allowing one of the doors to be kept closed in cold weather.

Figure 185: Auto Return

The next item under Machine Configurations is “Mobile Unit” (see Figure 186). There are two columns under this menu, “Door(s) Deployed” with three options, and “Operator

Position" with varying options depending on which of the "Door(s) Deployed" option has been selected. This gives the Operator the ability to choose which gullwing doors are being deployed (Driver, Passenger or Driver AND Passenger) and which position the Operator will be in during scanning (External – Driver Side, External Passenger Side or Internal).

Figure 186: Mobile Unit

Figure 187 shows the "Driver & Passenger Sides" option chosen in the left column of the "Mobile Unit" option, which then gives the operator the ability to choose "external – driver side," "external – Passenger Side" or "Internal" as the options for the Operator Position.

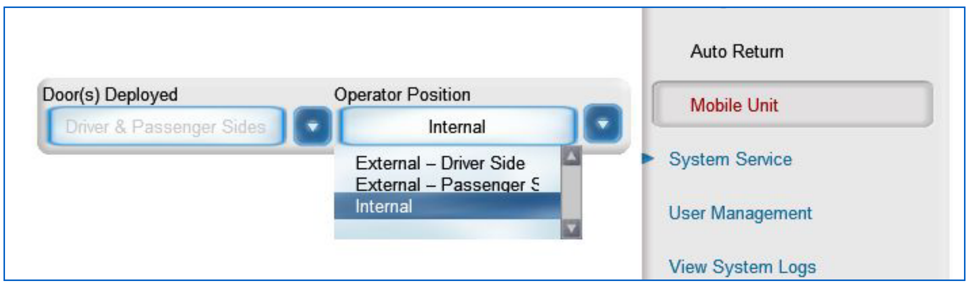

Figure 187: Driver & Passenger Sides

Figure 188 shows the Operator having chosen "Passenger Side Only" under "Door(s) Deployed," which then gives the option of "External – Passenger" or "Internal" as the Operator Position choices.

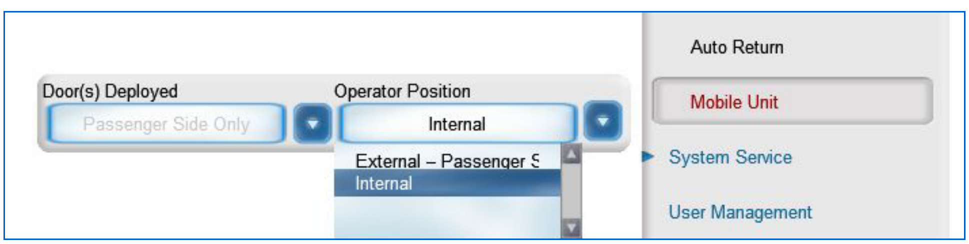

Figure 188: Passenger Side Only

Figure 189 shows the "Driver Side Only" option chosen, which gives the Operator Position options of "External – Driver Side" and "Internal."

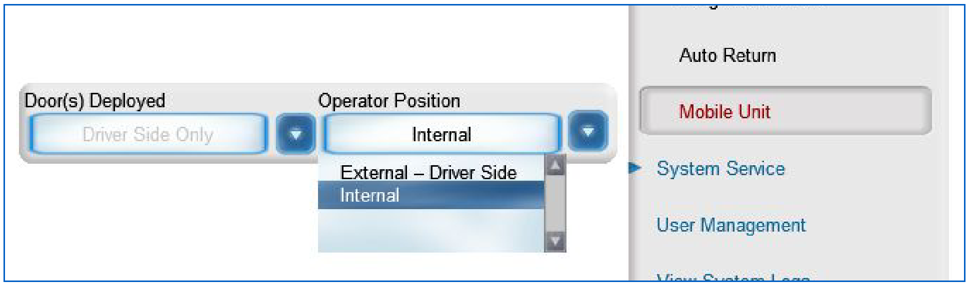

Figure 189: Driver Side Only

9.11 System Service

Figure 190 shows the System Service/Diagnostics & QA/UPS Status option.

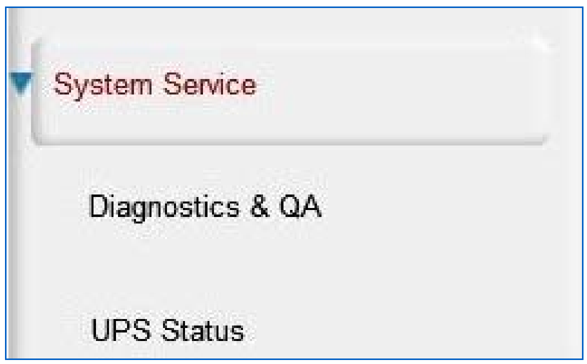

Figure 190: System Service – Diagnostics & QA

Diagnostics and QA

Array Response Screen

Selecting “Diagnostics & QA” brings up the Array Response” screen (Figure 191).

NOTE: The Rapiscan 638 (XR and DV) has a larger tunnel than the 632 (XR and DV) and consequently more boards on the side and the top of the tunnel. Thus there will be more boards shown in the 638 array response screens.

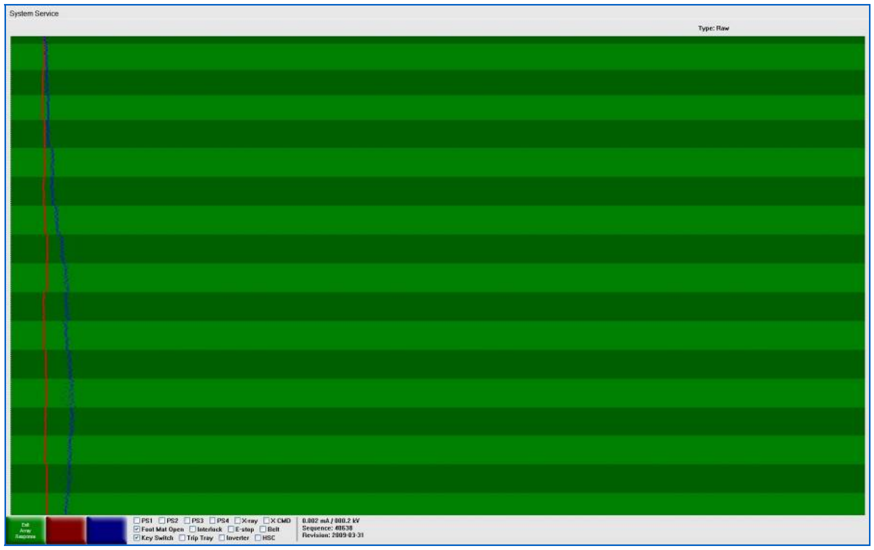

Figure 191: Array Response screen

The reason the "Diagnostics & QA" option defaults to the Array Response screen rather than to the Diagnostics Menu is that the Array Response screen is the most common function accessed through the Diagnostics link in Supervisor Mode. To access the actual Diagnostics menu from the Array Response screen, click on the green "Exit Array Response" button in the lower left-hand corner of the screen.

The Array Response screen is composed of the following elements:

- The RED data line on the Array Response screen representing the signal reading from Low Energy detectors.
- The BLUE data line representing the signal reading from High Energy detectors.

Note that:

- The Signal with X-rays turned off is called Dark data or Offset.
- The signal with X-ray turned on is called Light data or Full Scale.
- None of the signal should touch the left or right side of the image area
- None of the signal should stay in one spot.
- Those out of spec channels should be mapped out (see Channel Mapout on page 162).

Use of this function only helps in setting gain on detector boards and should not be used as guideline for the collimation process.

Diagnostics Menu

Selecting “Exit Array Response” from the Array Response screen (Figure 191) brings you to the Diagnostics Menu shown in Figure 192.

Figure 192: Diagnostics Menu

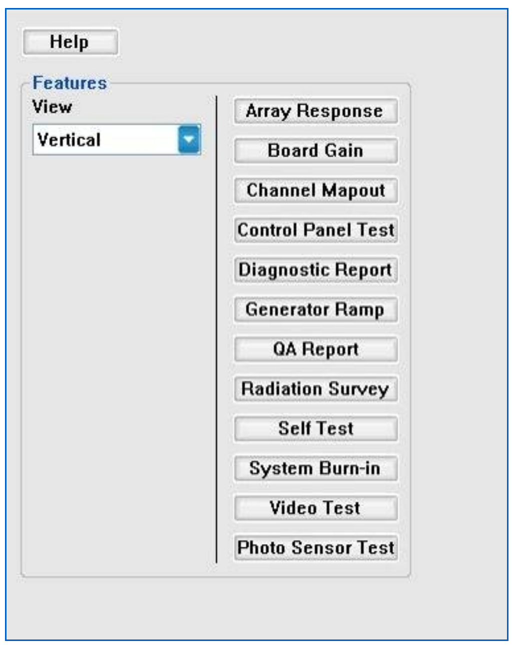

Figure 193: Diagnostics Menu (close-up)

The first option on the Diagnostics menu is “Array Response,” already covered directly above.

Board Gain

The second option on the menu is “Board gain” (Figure 194).

Figure 194: Board Gain

To set gain:

1. Select “board gain” from the top left corner of the Diagnostics Menu (Figure 192).
2. Once in the board gain mode:
   a. Use “P” key on the control panel to select the energy (high or low energy). Only data from the selected energy will be displayed.
   b. Use the “2” or “8” key on the control panel to select the appropriate DAB for gain adjustment. The signal of the selected DAB will be highlighted in light green.
   c. Use the “4” key to lower the gain of the selected DAB.
   d. Use the “6” key to increase the gain of the selected DAB.
   e. Use the “Save Gain” (green) button to save the current setting of the DAB’s gain.
   f. Use “Cancel Gain” (red button) to discard current changes.
   g. It is suggested to set gain of the DAB to shift its signal to the right side without making saturation. The recommended setting is 70-75% of full screen signal.

NOTE: Whatever the gain signal when X-rays are on, the signal must be below the line when X-rays are off.

Channel Mapout

If a line is observed on the screen while scanning an object, this can indicate a faulty channel. It is possible that the auto map-out software does not detect the problem, but a manual map-out can be performed (Figure 195).

Figure 195: Mapout

There is a very thin yellow line at the top of the channel mapout screen (Figure 195).

Manually mapping out a channel involves using the up and down arrow buttons on the operator control panel to move the yellow line one channel at a time or using the Page Up and Page Down buttons to move 64 channels each time.

NOTE: Automatically mapped channels show up in white. Manually mapped channels show up in black.

To manually map out a channel:

1. Use P to select the energy (high or low).
2. Use 2 or 8 to select the channel to be mapped out. A yellow cross will point out the data of selected channel.
3. When only one energy is displayed, the cross hair will be at the data of the selected channel.
4. When both energies are displayed, the cross hair will be in the middle of data of the two energies.
5. Use 5 to map out the channel at the cross hair.

6. The position of the mapped out channel will be highlighted by a black horizontal line (Figure 196 shows both the moved yellow line and two black lines from previously mapped channels).

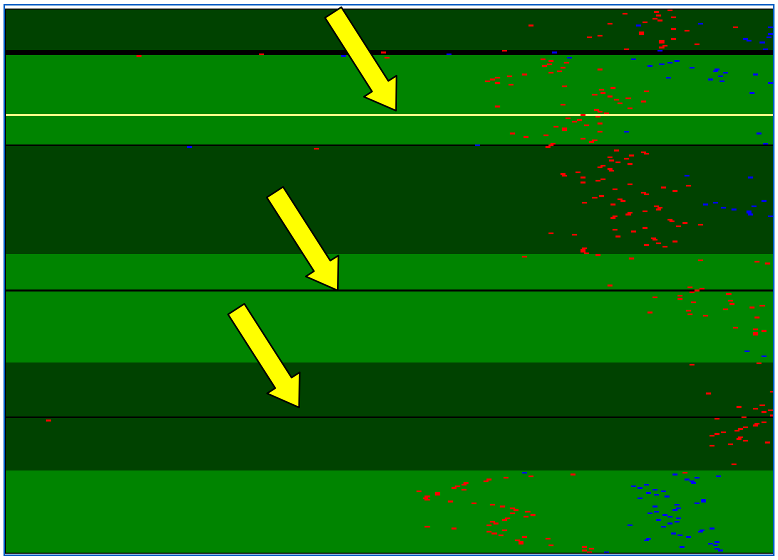

Figure 196: Mapped Channels

7. Use “Save Gain” (green button) to save the current setting of the DAB’s gain.
8. Use “Cancel Gain” (red button) to discard the current changes.

Control Panel Test

Figure 197 shows the control panel test screen. To test the control panel and the panel’s individual keys, press each key on the control panel one at a time, each time checking to see if that key flashes on the control panel test screen. The flashing of the corresponding key on the screen indicates that that key and its associated function are operative.

Figure 197: Control Panel Test Screen

Diagnostics Report

Figure 198 shows the Diagnostic Report screen. This screen gives various measurements including: X-ray kV and mA; minimum, maximum and average output with X-rays on and off; number of detectors either not responding or responding weakly.

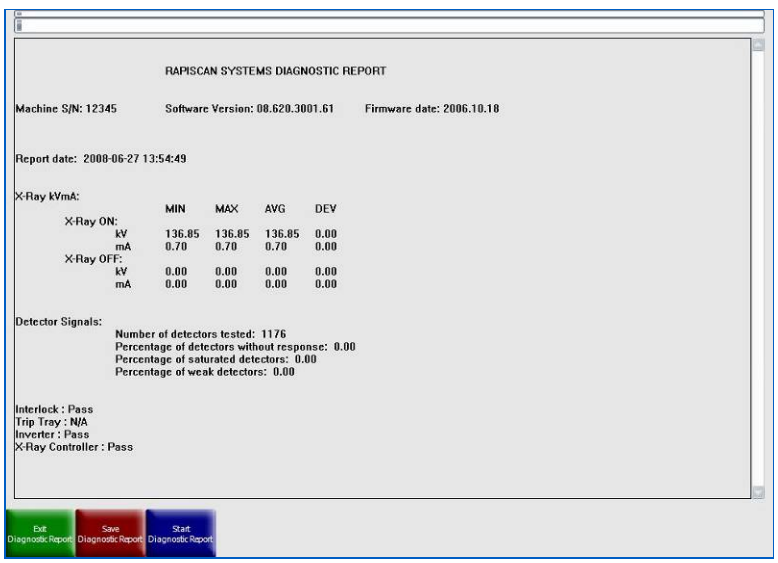

Figure 198: Diagnostics Report

Clicking “Save Diagnostic Report” (red function button lower left corner of the Diagnostics Report” screen) brings up the screen shown in Figure 199 which allows the supervisor to save the diagnostic report to a specific location.

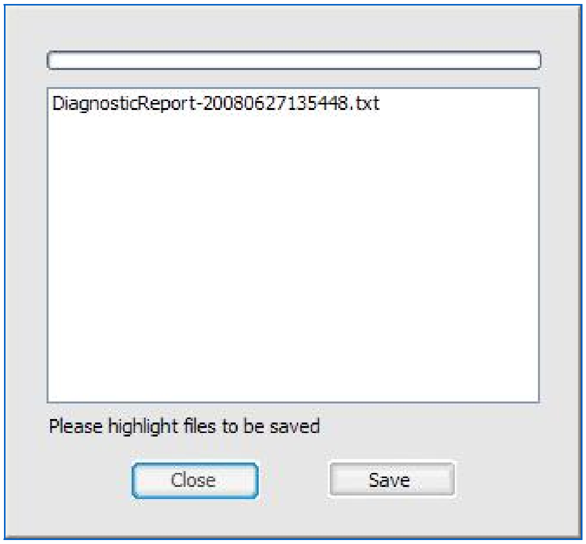

Figure 199: Save Diagnostics Report

Generator Ramp

Figure 200 shows the Generator Ramp screen. This screen measures the ramp up time for the X-ray generator's kV and mA when the generator begins generating X-rays.

Figure 200: Generator Ramp

QA Report

Figure 201 shows the QA Report screen. This report shows the actual and acceptable values for a number of generator functions, including Rise Time, Settle Time, Fall Time and Settle Value.

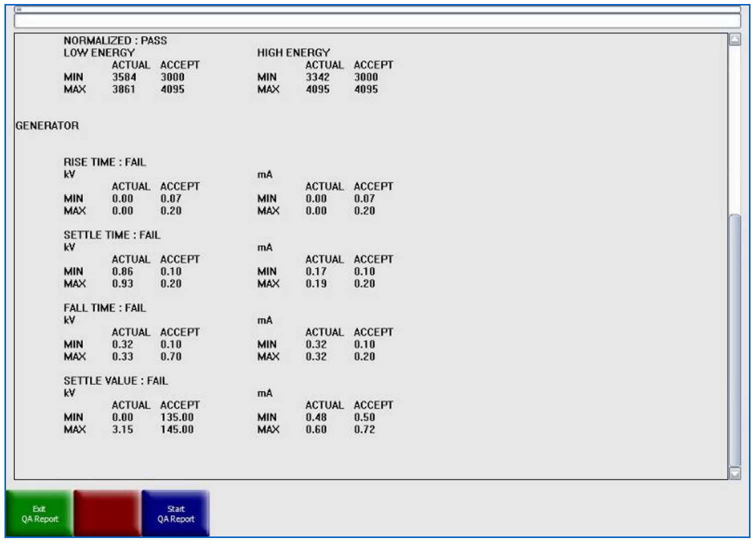

Figure 201: QA Report

Radiation Survey

Figure 202 shows the Radiation Survey which is a simple set of instructions for carrying out such a survey.

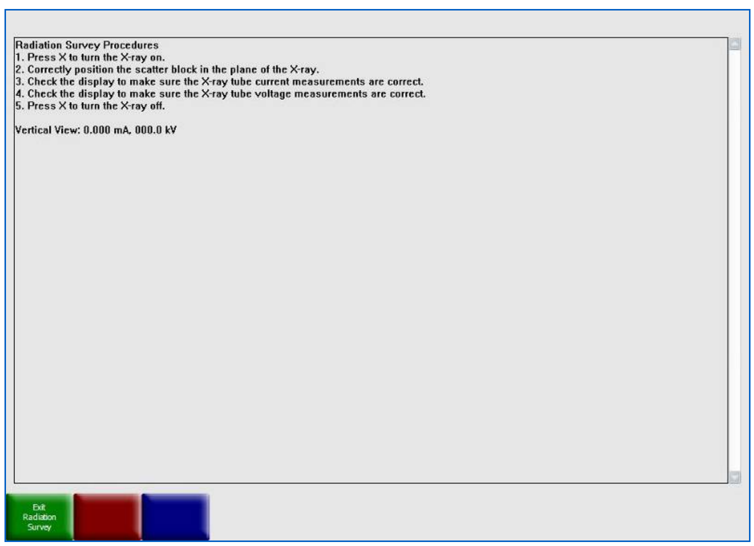

Figure 202: Radiation Survey

Self Test

Figure 203 shows the Self Test screen. This shows the actual and acceptable X-ray Generator kV and ma values while the generator is on and when it's off. It also lists a pass/fail report for various components such as inverter motor, channels (with X-rays off), X-ray controller and conveyor.

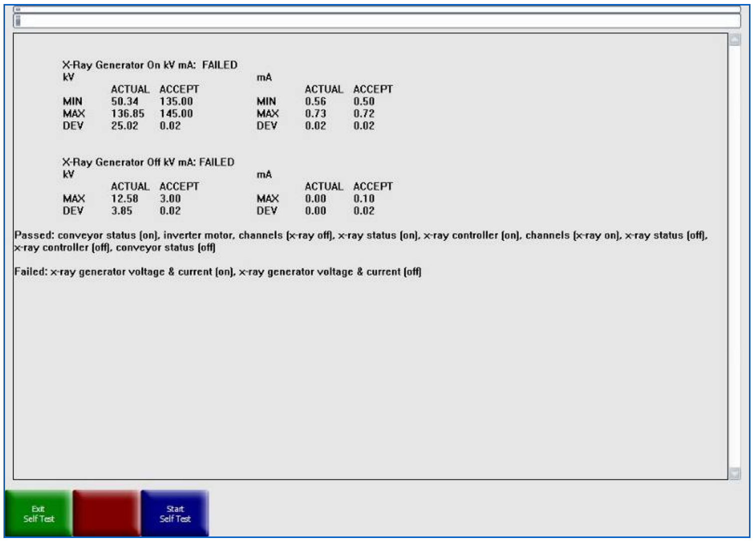

Figure 203: Self Test

System Burn-in

Figure 204 shows the System Burn-in screen. Selecting the “Start Burn-in” button will cause the system to begin the burn-in process. The burn-in process lasts 24 hours once it is started, although it is possible to terminate the burn-in at anytime and obtain a partial burn-in report.

Figure 204: Burn-in Screen

Video Test Screen

Figure 205 shows the Video Test Screen along with instructions on how to adjust your monitor’s image clarity by using the test screen.

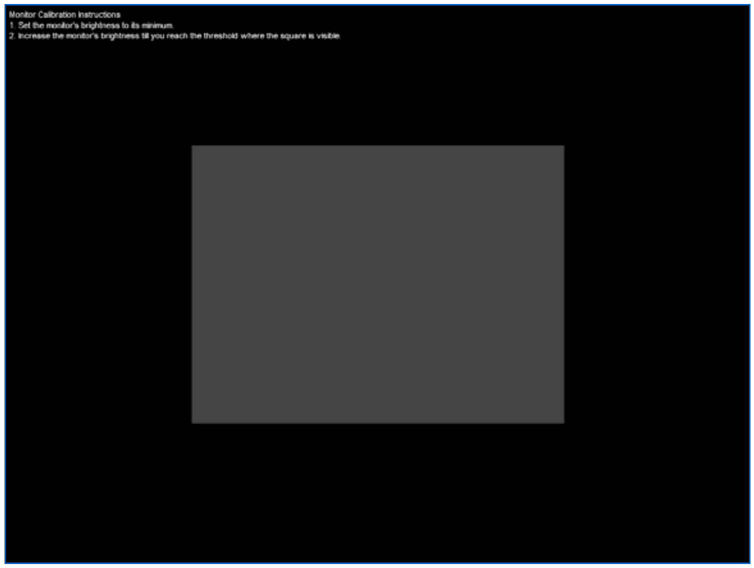

Figure 205: Video Test Screen

Photo Sensor Test

Figure 206 shows the Photo Sensor Test screen which tests the various photosensors and reports the amount of time each photosensor was blocked during the test.

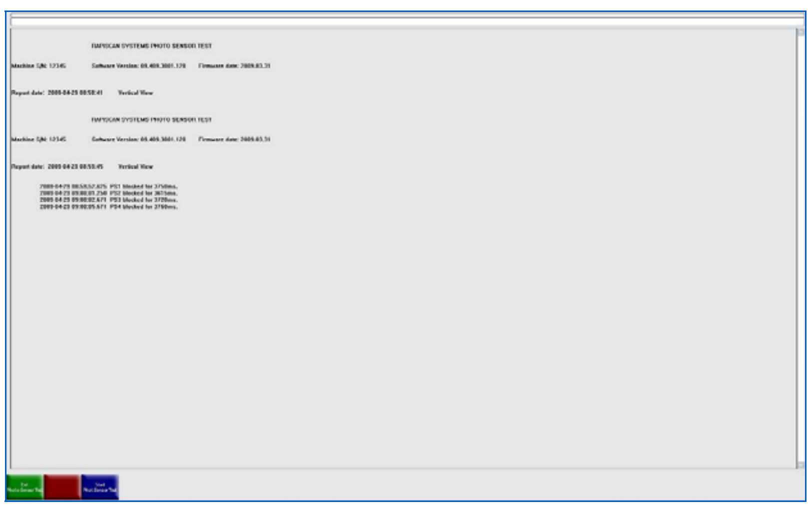

Figure 206: Photosensor Test

UPS Status

The UPS Status, as the name implies, gives a report on the status of the Uninterruptible Power Supply, including the remaining time left on the UPS when it is engaged.

Figure 207: UPS Status

Selecting the UPS Status button brings up the following screen:

Figure 208: UPS Status screen

9.12 User Management

Figure 209 shows the User Management option.

Figure 209: User Management

Selecting the “User Management” option brings you to the “Users” screen shown in Figure 210.

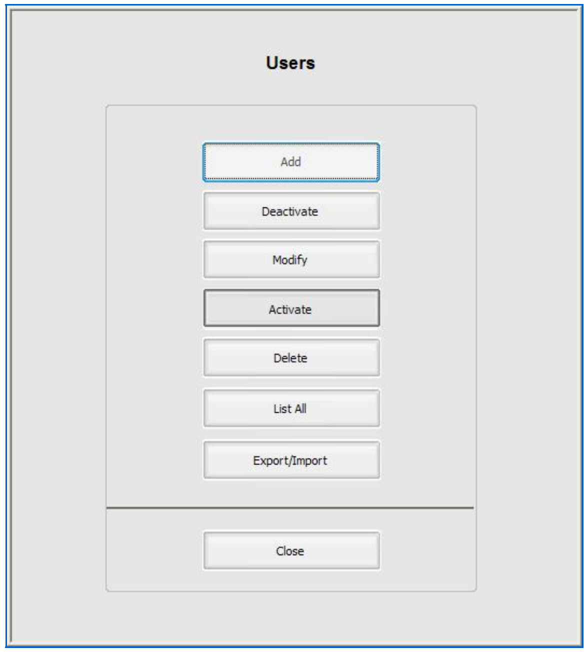

Figure 210: Users

The “Users” Window allows users’ info to be viewed, added, deactivated, modified, activated, deleted, listed, imported and exported (Figure 211 to Figure 216).

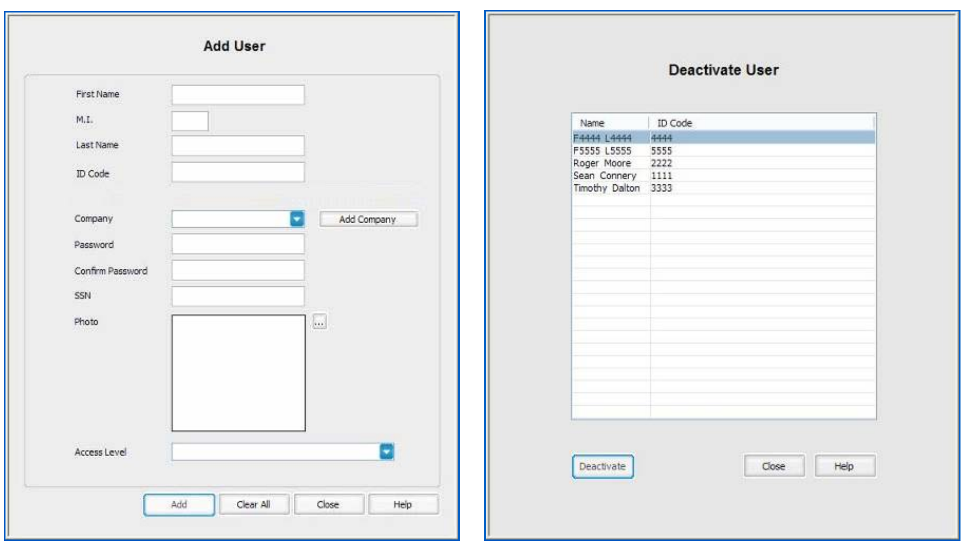

Figure 211: Add / Deactivate User

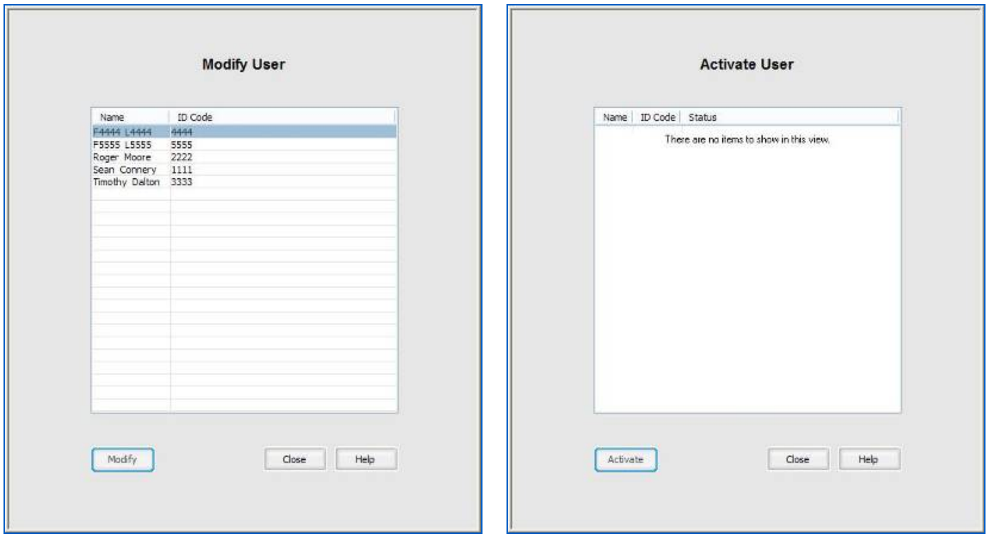

Figure 212: Modify / Activate User

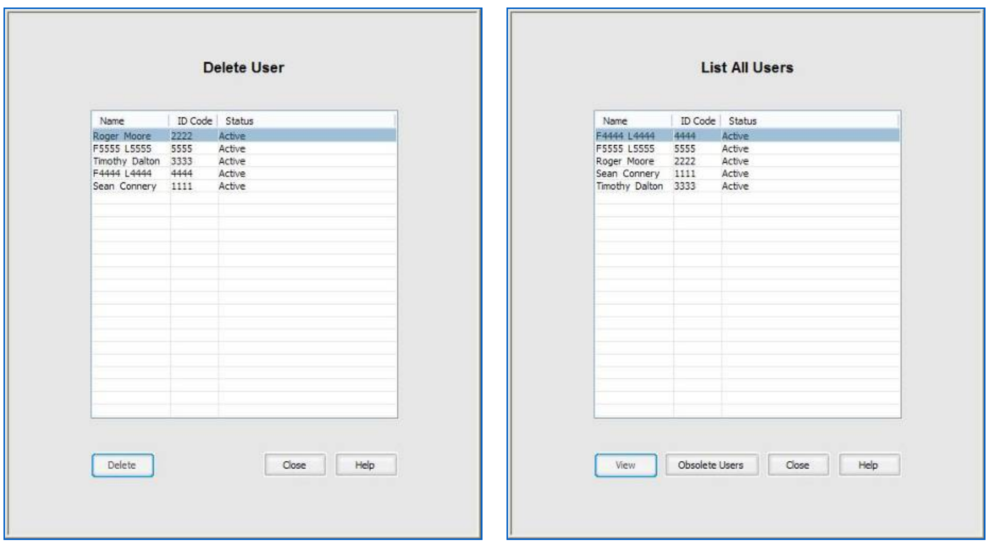

Figure 213: Delete / List All Users

Figure 214: View User Details

Under “List All Users” there is an “Obsolete Users” option which lists obsolete users’ information:

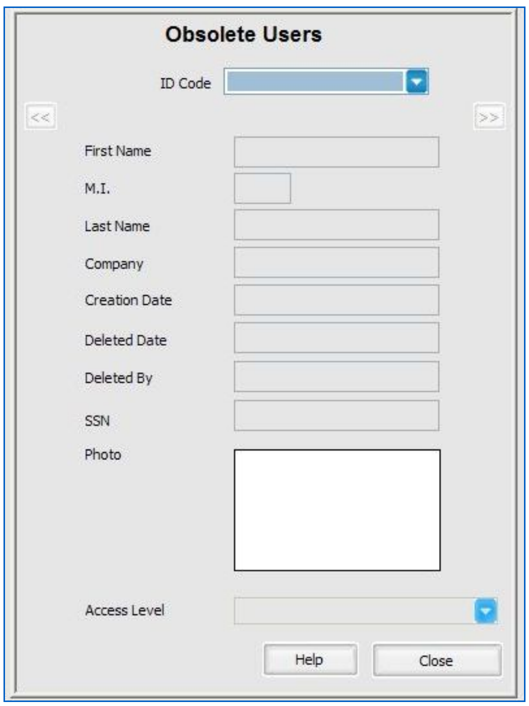

Figure 215: Obsolete Users

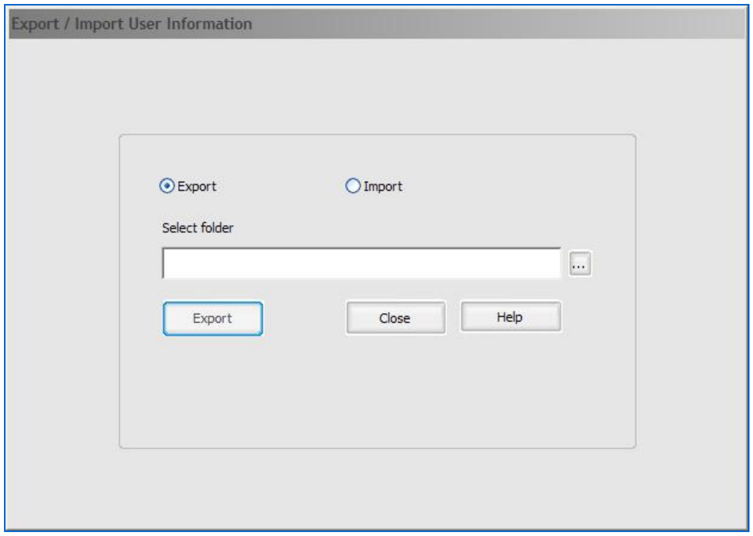

Figure 216: Export/Import User Information

9.13 User Level Permissions

Figure 217 shows the User Level Permissions option. Selecting this brings you to the screen shown in Figure **218**.

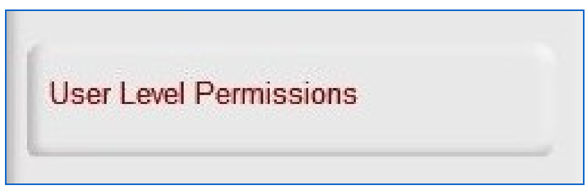

Figure 217: User Level Permissions

Figure 218 shows the User Level Permissions screen that allows a supervisor to enable or disable access to various functions for Technicians, Administrators and Operators (Users).

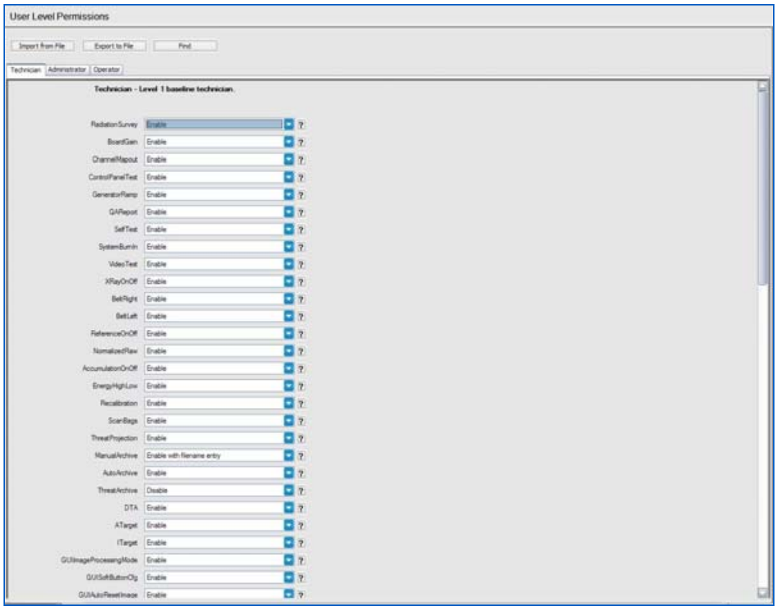

Figure 218: User Level Permissions screen

Create New Level

Selecting "Create New Level" on the User Permissions Screen brings up the screen shown in Figure 219 which allows the Supervisor to create a new level in addition to the Technician, Administrator and Operator Levels. Permissions can then be created for any new levels on the User Level Permissions screen.

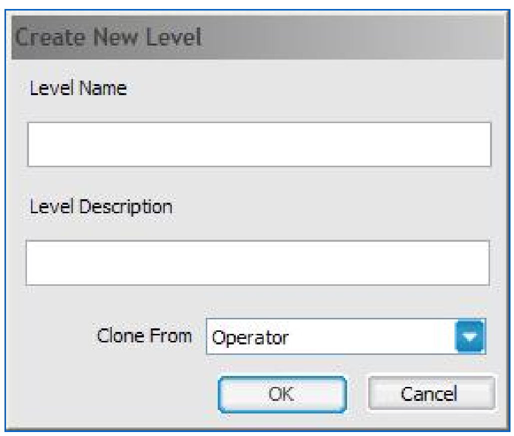

Figure 219: Create New Level

9.14 <u>View System Logs</u>

Figure 220 shows the View System Logs option.

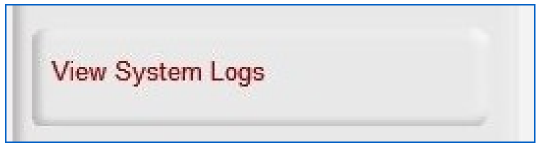

Figure 220: View System Logs

Selecting “View System Logs” (Figure 221) brings you to the System Logs screen shown in Figure 221. To exit this screen, choose “File” then “Exit” in the upper left corner of the screen.

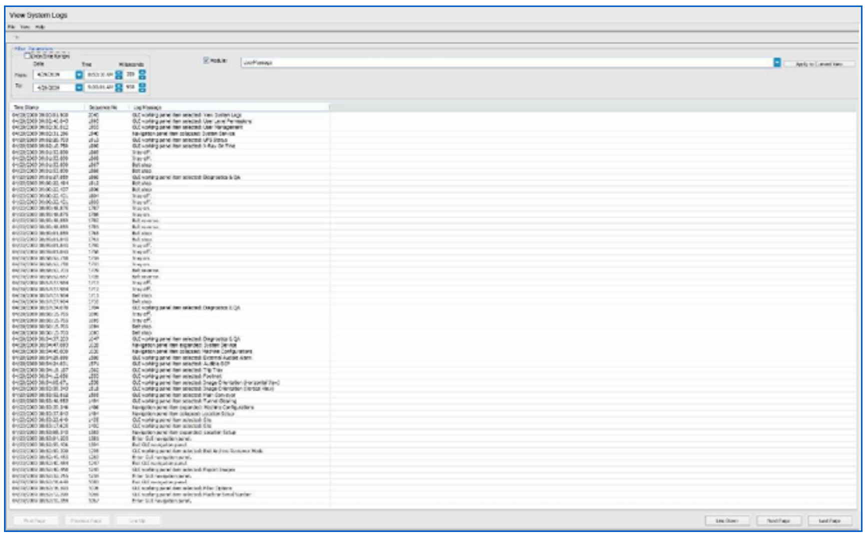

Figure 221: System Logs

9.15 Reports

Figure 222 shows the Reports option and Manage Report Data sub-option.

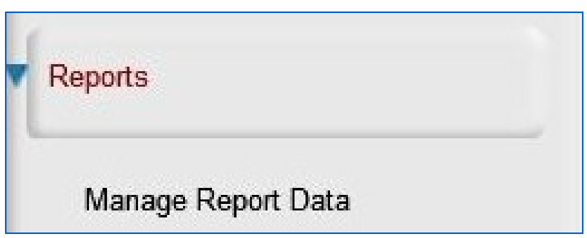

Figure 222: Reports

Manage Report Data

Figure 223 shows the Manage Report Data option which brings up the Report Data screen shown in Figure 224.

Figure 223: Manage Report Data

Figure 224 shows the Report Data Screen which includes “View Reports,” “Download Data Files” and “Purge Data Records.”

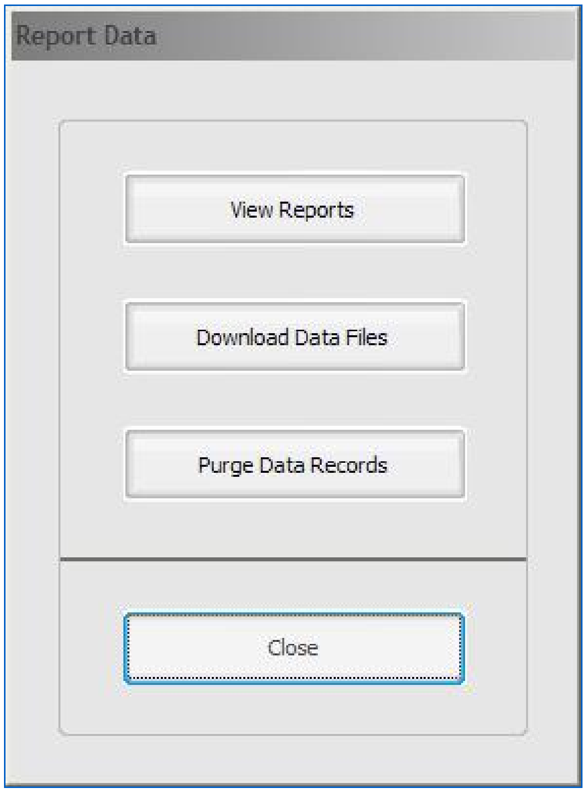

Figure 224: Report Data menu

Selecting “View Reports” from the Report Data screen brings up the following six screens (Figure 225 to Figure 230) which can be viewed and sorted by the various criteria listed on those screens.

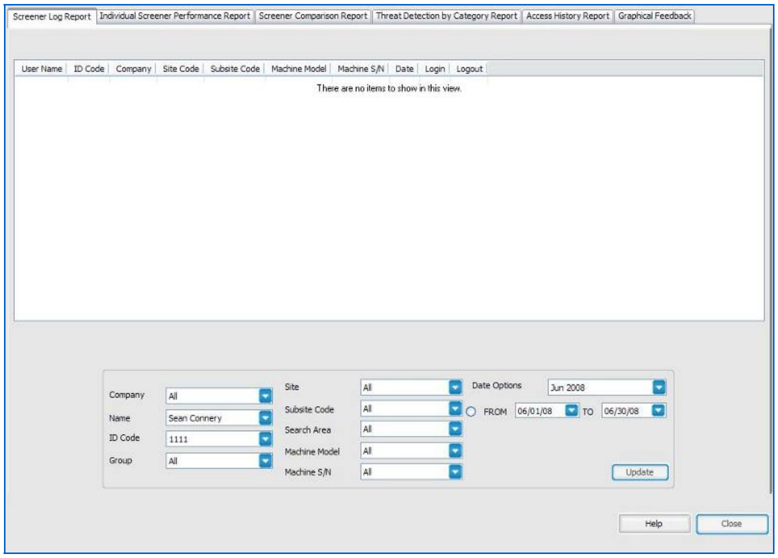

Figure 225: Screener Log Report

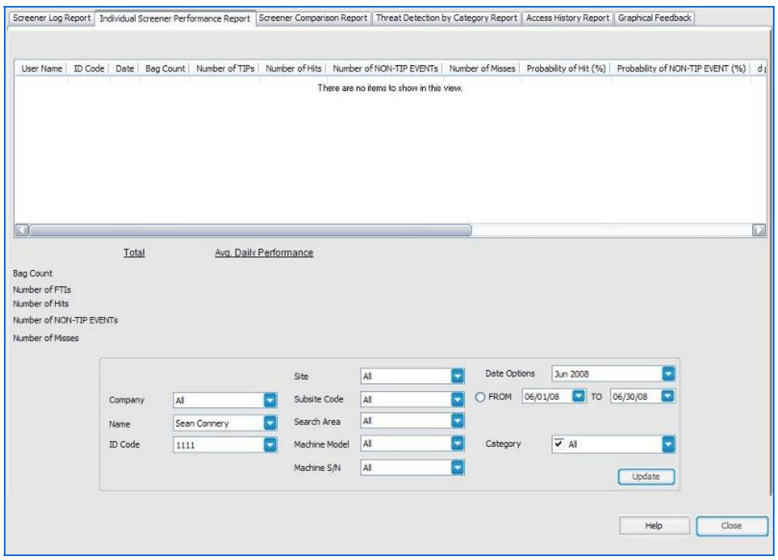

Figure 226: Individual Screener Performance Report

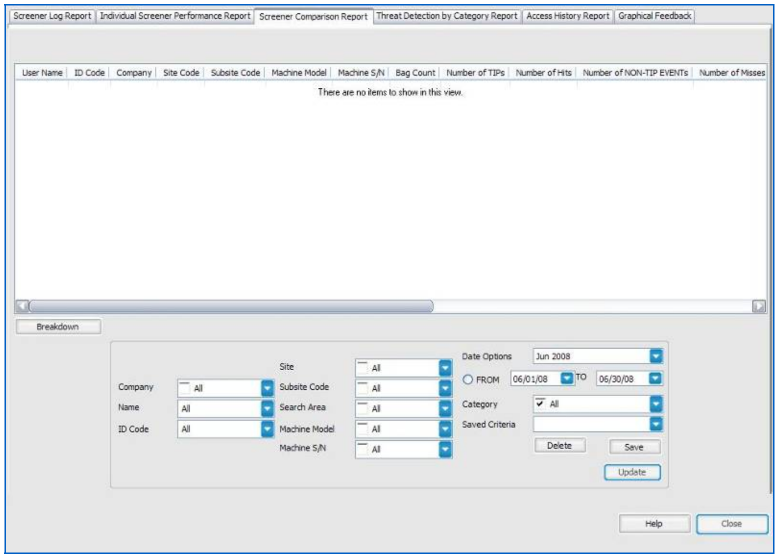

Figure 227: Screener Comparison Report

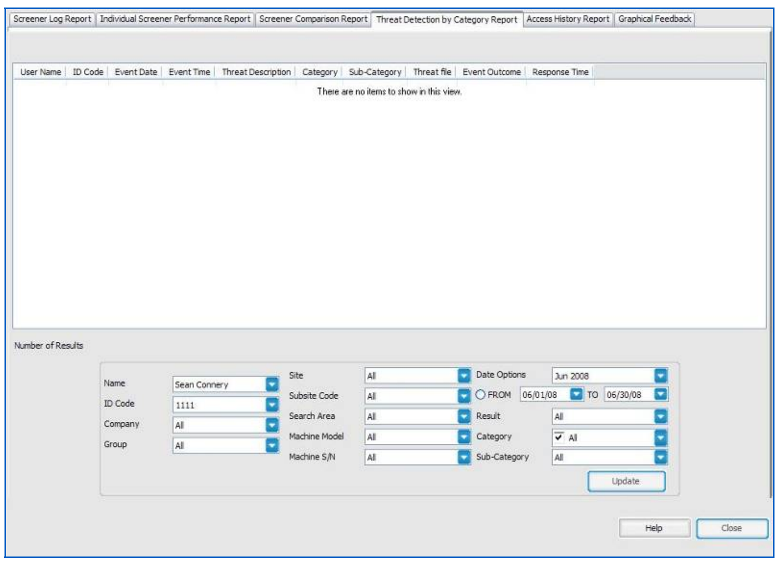

Figure 228: Threat Detection by Category Report

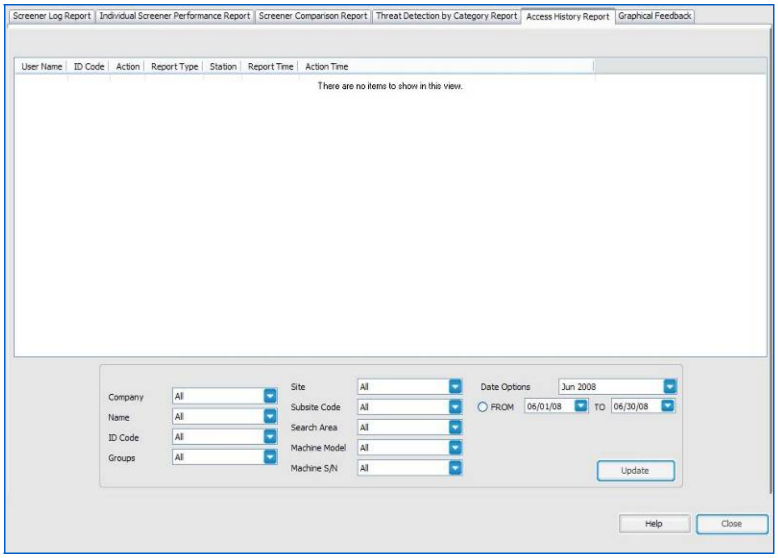

Figure 229: Access History Report

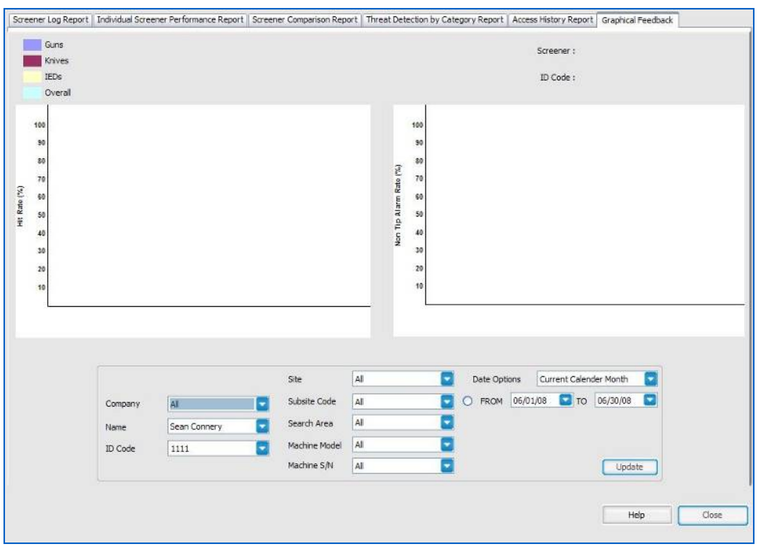

Figure 230: Graphical Feedback

Selecting “Download Data Files” from the “Report Data” screen menu shown in Figure 224 brings up the "Download Reports” screen shown in Figure 231. This screen allows a Supervisor to download reports from:

- Screener log report
- Individual screener performance report
- Screener comparison report

- Threat detection by category report
- Access history report
- All reports

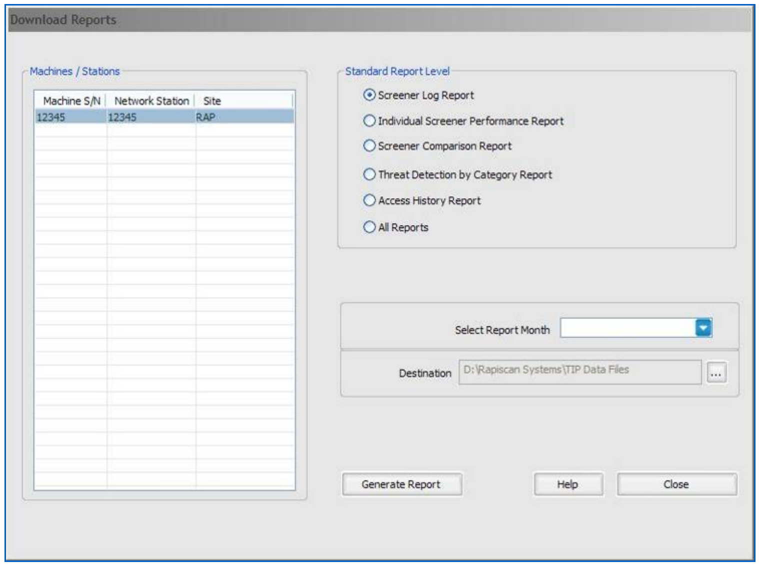

Figure 231: Download Data Files

Selecting “Purge Database” from the “Report Data” screen menu shown in Figure 224 brings up the “Purge Database” screen shown in Figure 232. This screen allows the Supervisor to purge test records based on the age of those records.

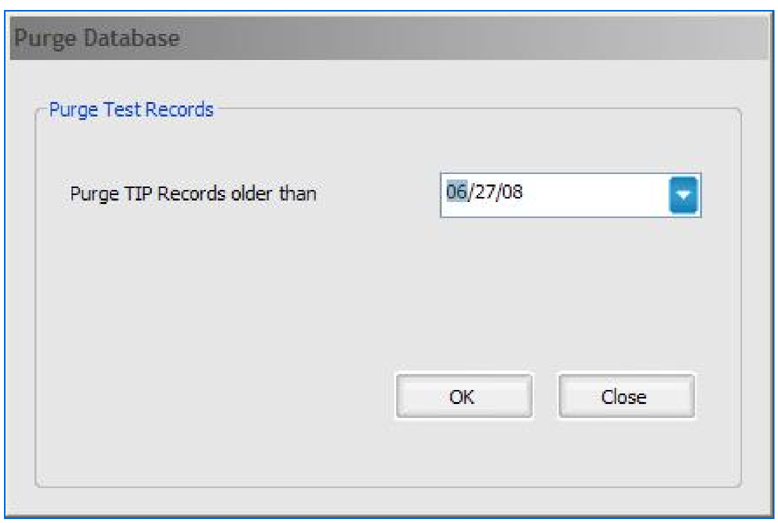

Figure 232: Purge Database

9.16 Screen Saver

Figure 233 shows the Screen Saver menu. The screen saver can be disabled or enabled by setting the timeout value which sets how many minutes of idle time must have passed before the screen saver launches. Idle time is considered the amount of time in which there is no input from the user and the mechanical features of the system are not in motion (i.e. belt moving/scanning).

The "Require Login" option allows the user to determine whether a user is locked out once the screensaver starts running. If the user is locked out, he or she must enter the correct password in order to log back in.

Figure 233: Screen Saver

9.17 Help Manuals

Figure 234 shows the Help Manuals option and both the "Operator and Supervisor Manual" and "Service Manual" sub-options. Selecting either of these will bring you to a browsable e-copy of the respective manual.

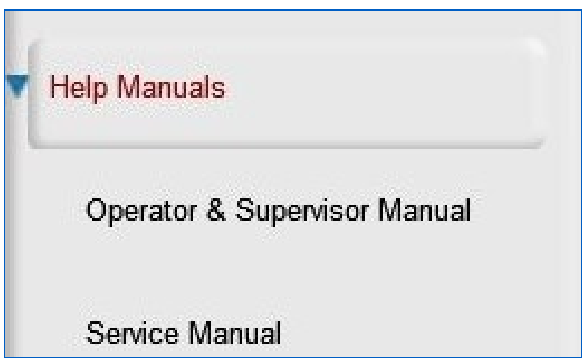

Figure 234: Help Manuals

9.18 Language Selection

Figure 235 shows the Language Selection option and the drop down menu of available languages. Contact Rapiscan for the most current list of available languages.

Figure 235: Language Selection

9.19 Session Lock

Selecting Session Lock allows you to lock the session, a modified version of the Log On screen appearing and necessitating that you input your password to return to the session.

Figure 236: Session Lock

9.20 About OS600

Figure 237 shows the About OS600 option.

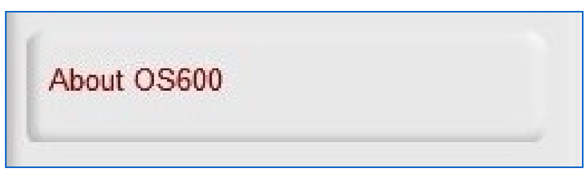

Figure 237: About OS600

Selecting About OS600 brings up the following screen which contains information about the Rapiscan operating system.

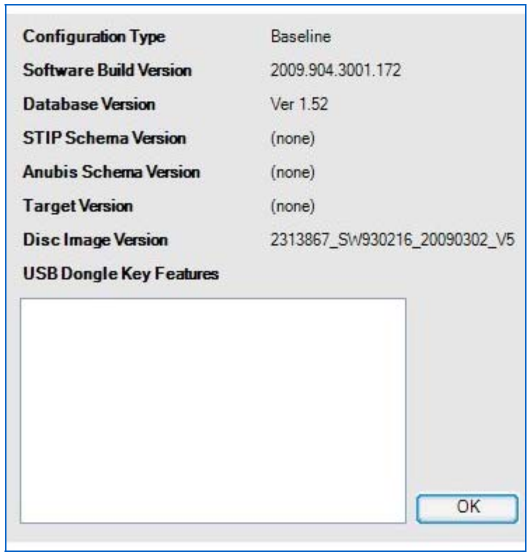

Figure 238: About OS600 screen

9.21 Machine Serial Number

Figure 240 shows the Machine Serial Number option. It is important to know this number for record keeping purposes – it is important to know the service and maintenance history of a machine and the machine's serial number is the best way to be able to match a machine with its service/maintenance history.

Figure 239: Machine Serial Number

9.22 Log Out

Figure 240 shows the Log Out option which logs the user out of Supervisor Mode.

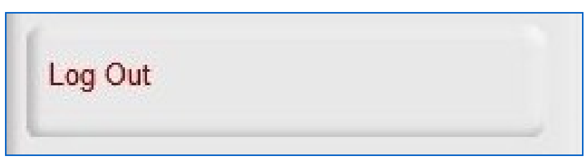

Figure 240: Log Out

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10.0 Icon Control Panel

10.1 General

The Icon Control Panel contains controls for the conveyor, image processing keys and a track-pad. It does not support multiple simultaneous key presses.

Part Numbers

2313749	Icon Control Panel, 600XR Series
2210760	Icon Control Panel PCB
3411287	CAT5 to CAT5 adapter
2313738-BLK	USB to LVDS converter (non-isolated)
2313738-WHT	USB to LVDS converter (isolated)

Figure 241: Icon Control Panel

10.2 Description

The Control Panel consists of a box containing pushbutton switches and LEDs mounted on a PCB, and a cable. Its purpose is to encode key presses and transmit codes to the computer. The computer interprets the codes and acts accordingly. The Control Panel also receives codes from the computer to establish that the communication link is functioning correctly and to instruct the PCB to illuminate the various LED indicators. The Control Panel can be used on dual-view X-ray machines. In this situation, two LVDS cables are used, one going to each of the computers. There is a view select button to establish which computer the control panel is controlling.

Touchpad

The touchpad is used to select a button on the menu. To view the menu, click the left button. The left button also enters the information typed during the log-in procedure. The right button typically exits the current action.

Cabling

There are three cables connected to the Control Panel:

- Power, emergency stop, key-switch, power-on switch
- LVDS first view (black)
- LVDS second view (white)

Both single and dual-view X-ray machines can be operated from this control panel. For single view systems, only the black LVDS cable is used.

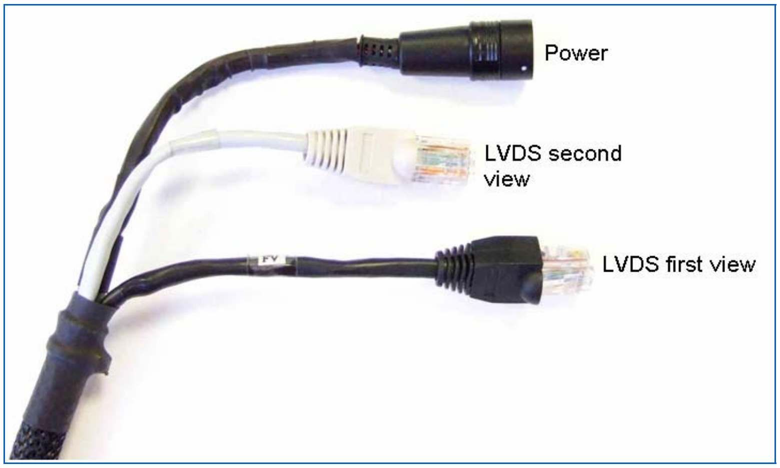


Figure 242: Icon Control Panel Cables

The track-pad is connected to and processed by the Control Panel PCB. The touchpad signals are combined with the control panel button information and sent through CAT5 cable using LVDS (Low Voltage Differential Signal).

NOTE: The CAT5 cable does not contain Ethernet signals and must not be connected to a computer network.

The LVDS signal is converted to USB by the converter at the computer end of the cable.

LVDS to USB converter

Figure 243: LVDS to USB Converter

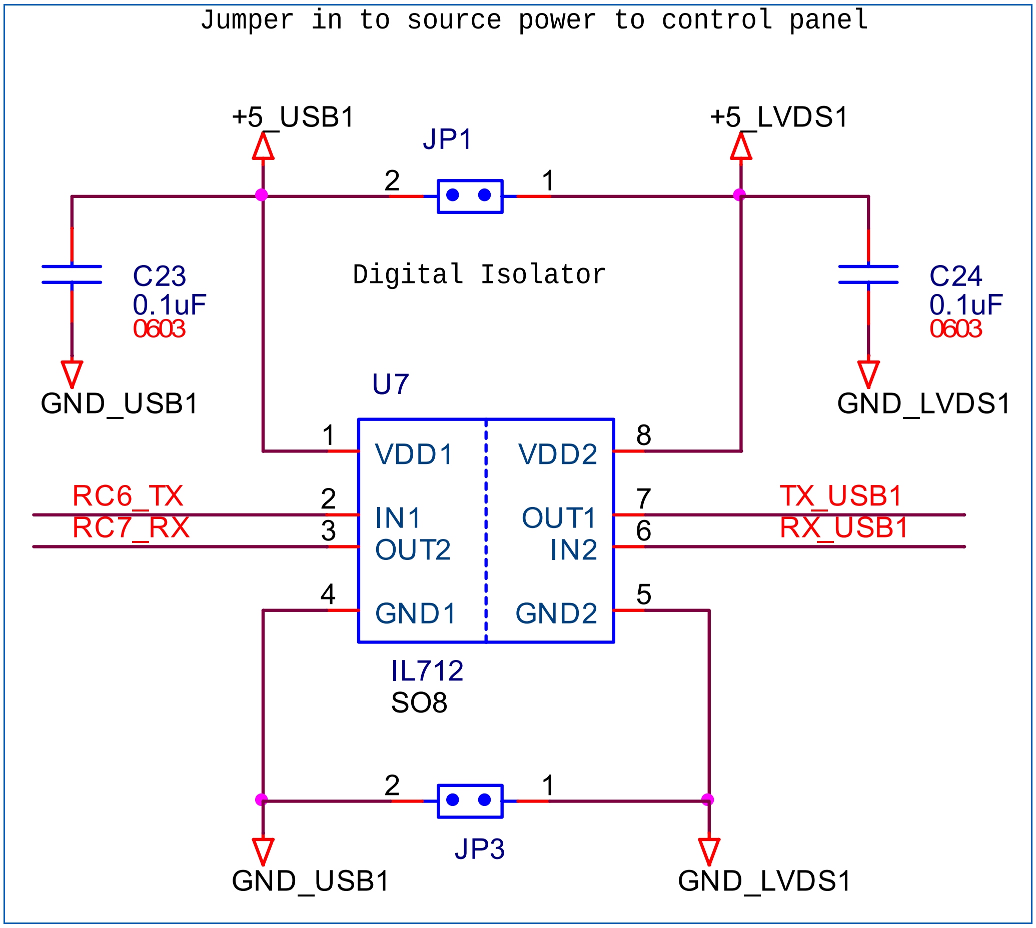


Figure 244: LVDS to USB Converter Schematic

In this box, we have a micro-controller that performs conversion between USB data stream into serial data stream. It also changes the electrical interface to LVDS.

To prevent ground loops when we connect the DVCP to two computers to support a dual view system, the design allows two possible configurations for this box:

1. Non-isolated power and ground. In this configuration, power and ground from USB is connected to the cable on the LVDS side. This allows the system to get power from the computer. The data communication is done via optical isolation device. This part typically is placed in a black housing plastic box. It is used in standard single-view X-ray systems and to control the first view in dual-view systems.

NOTE: When the computer of the first view is not working and you want to use the system in single view mode, move this box to the second view to provide power for the DVCP.

2. Isolated power and ground. This allows us to break the ground loop between sub-systems. This part typically is placed in a white plastic housing. It is used in dual view applications where one wishes to connect to both views.

NOTE: There is no difference between the boxes except the color and internal links JP1 and JP3 (present on the non-isolated version).

2210760 PCB Circuit Description

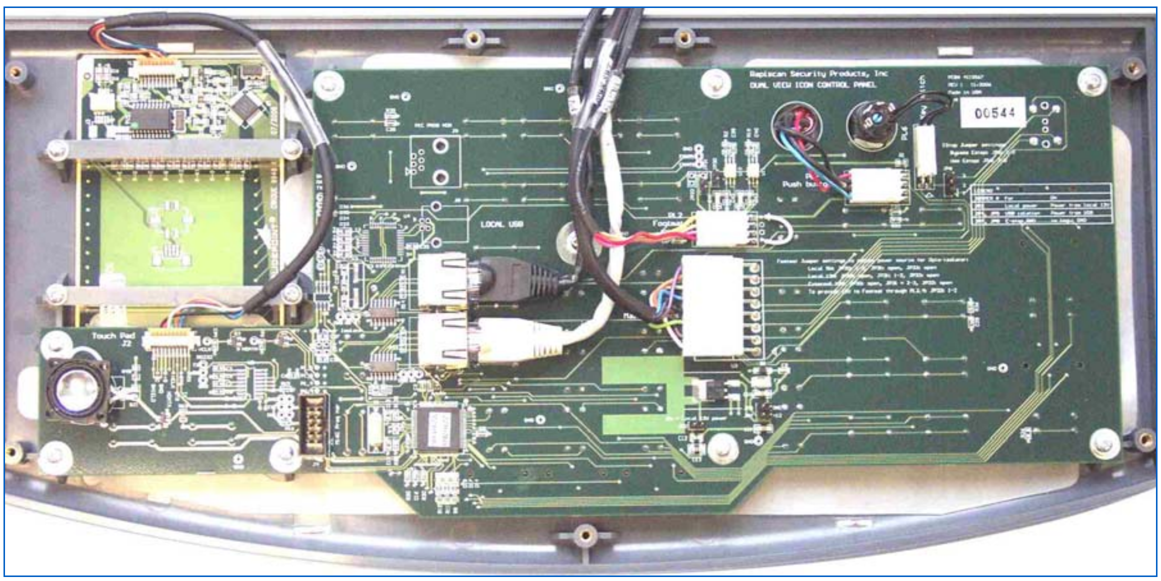


Figure 245: Icon Control Panel Internal View

On this board we have:

- Main Processor
- Key pad and local electronics
- Serial/USB processor. Not populated in normal configuration. Only populated as stand alone DVCP to be connected to computer directly through on board USB interface.
- Local power option

Main processor

This processor performs many tasks:

- Scan the keys and generate the binary code to be sent to the computer.
- Turn on indicators: There are LEDs to signify the X-ray machine status. There is a PWM control sound generator.
- Send commands and read data from the PS/2 touch pad.
- Send data to computer. The main processor has two serial channels. They are called First View (FV) and Second View (SV). Data from each channel is connected to a LVDS interface to drive a CAT-5 cable. This LVDS data will be converted to USB format via a LVDS/USB box for each cable. This is the standard way to connect to the computer. Data from the first channel also could be connected to an on board micro-controller to convert it to USB signal.

Local Power

Normally, the DVCP can get all the power it needs from a USB input. This is done either via the on board USB channel or via a LVDS/USB box.

In extreme cases, where the cable length between computer and DVCP causes the voltage to drop too far, one can provide local power via the connector that is used to connect to the key switch and the emergency switch. In this case, connect the on-board voltage regulator to drop the 12VDC down to 5VDC. Jumpers to connect are JP7, JP8 and JP2.

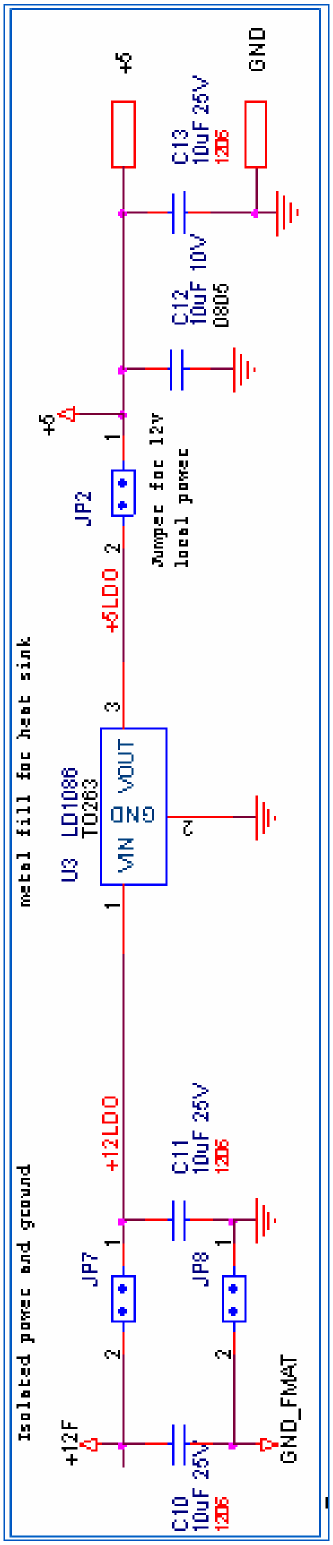


Figure 246: Local Power

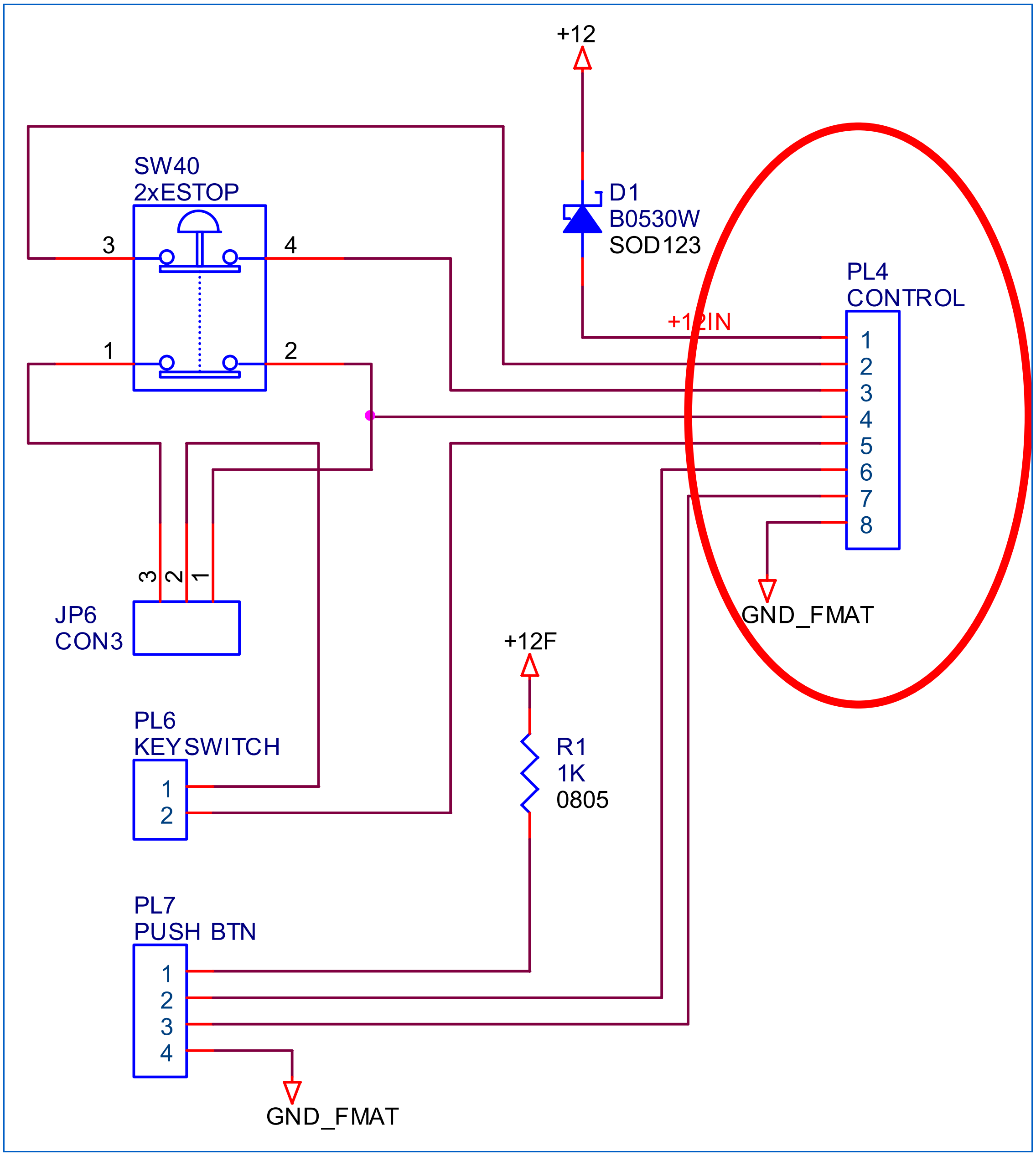


Figure 247: E-stop, Power On

The connector for 12VDC is PL4. A white LVDS/USB box is needed for isolated power and ground configuration.

Jumper Connections

		Link	No Link
JP2	Power +5V	From machine 12V	From USB
JP7	Power +12V	From machine 12V	From USB
JP8	Power 0V	From machine 0V	From USB
		1-2	2-3
JP6	Emergency Stop	Bypassed	Functional

11.0 Machine Cabling

11.1 Power Distribution

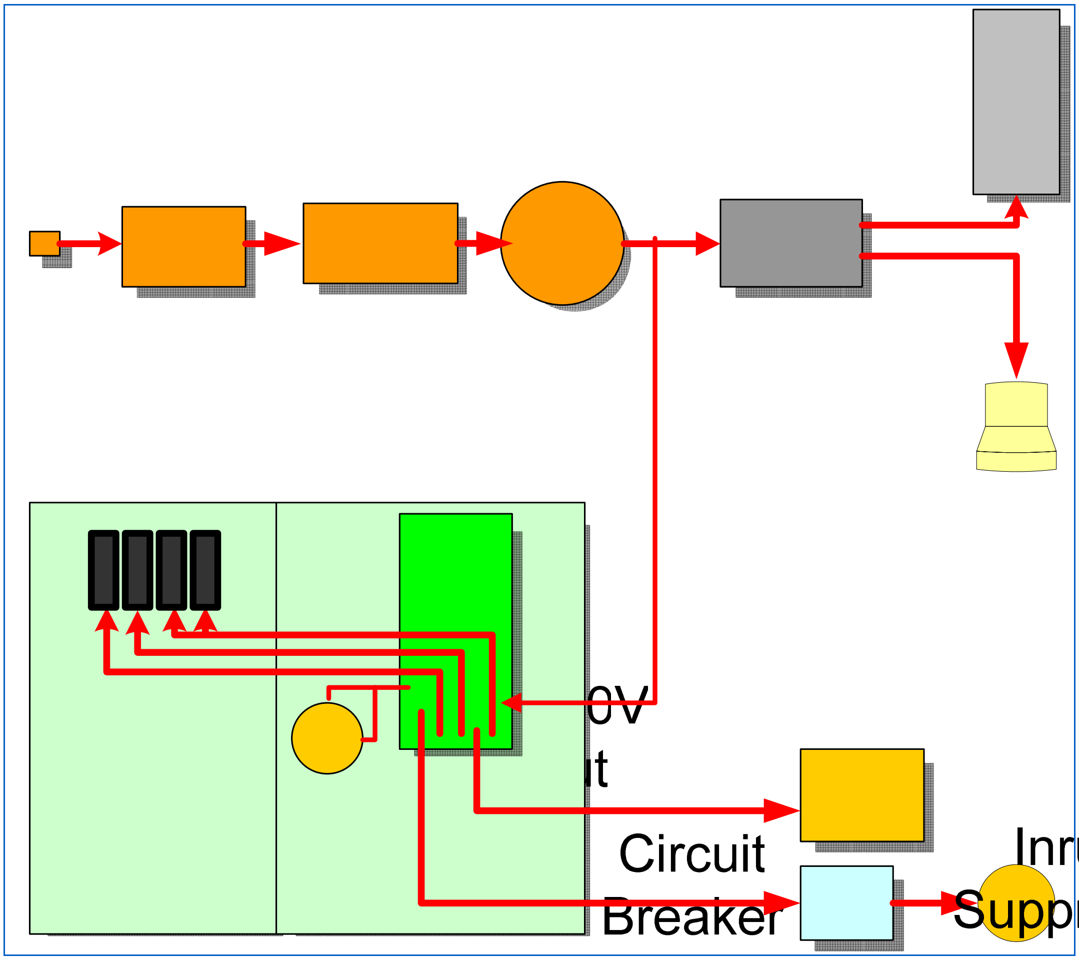


Figure 248: Power Distribution

The supply power for the Rapiscan X-ray system enters the machine via the 3-pin IEC socket on the end panel. From there, it passes through a circuit breaker and inrush current suppressor then proceeds to the transformer.

Isolation/ Step Up Transformer

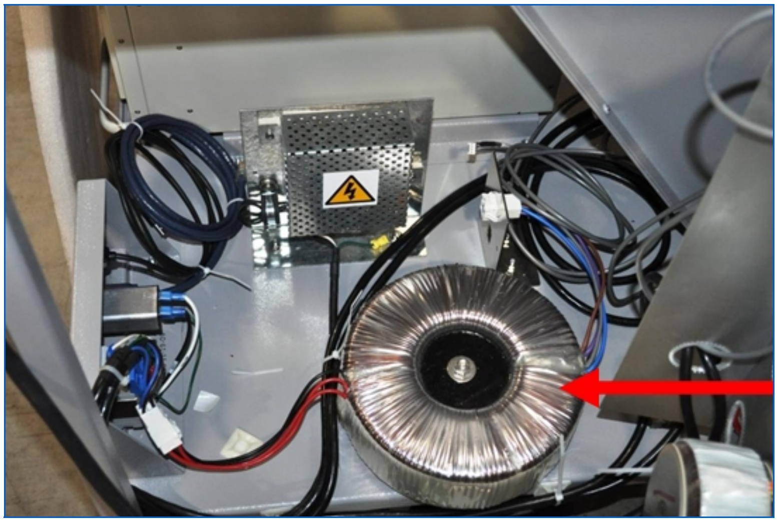


Figure 249: Isolation Transformer

WARNING: The transformer must be configured according to the input voltage. The output of the transformer must always be 230V. All components in the machine run at 230V.

The D.C. power supplies and X-ray head power supply are located on the chassis. Power for the inverter and X-ray generator fan comes from the Power Distribution & Interface (PDI) PCB.

The computer and monitor power comes from a UPS which is connected to the main circuit breaker.

Two power supplies generate +15V, -15V and +5V. These voltages are passed through the A to D PCB to the Diode Array PCBs. The +12V and +5V power supplies are used on the Control Interface PCB and machine lamps and sensors.

The +60V power supply for the X-ray generator is mounted on the PDI board except for the toroidal transformer.

Inrush Suppressor

The function of the inrush suppressor is to reduce the surge of current into the machine and prevent nuisance tripping of the circuit breaker. It contains two thermistors in series on the live connection. The thermistors get hot in operation so they are mounted in a vented metal box.

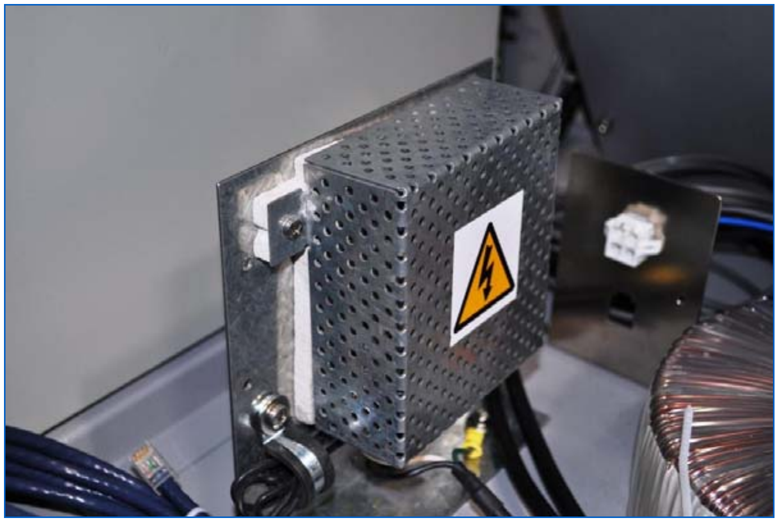


Figure 250: Inrush suppressor

11.2 Diode Array

Signals from the Diode Array PCBs are carried to the Analogue to Digital Converter PCB by a ribbon cable. The A to D converter card then converts the analogue data from the detector diodes to digital. A ribbon cable carries this data to the CI PCB where it is processed and sent to the computer through the National Instruments card. The machine software then processes the signals and produces the image.

11.3 Computer Rack

The Icon Control Panel connects to the computer rack through the LVDS converter. The control panel can be mounted on a console table, which requires an umbilical cable to be fitted.

11.4 Control Interface Board

This board interfaces between the diode array and National Instruments card inside the computer. Signals for the conveyor inverter, X-ray generator and lamps and sensors also flow through this board. For more details read the “Computer,” “Control Interface PCB” and ‘Data Acquisition System’ chapters.

11.5 Foot-mat

The foot-mat is plugged into a connector on the cable going to the Icon Control Panel. Its function is to detect when an operator is not present, and halt the conveyor. When the conveyor is halted, X-rays are also turned off. This option is required only in specific countries.

11.6 Emergency Stop Switches

Operation of an emergency stop switch will remove power from the conveyor circuitry and X-ray generator.

11.7 Machine Cable Numbers

CABLE ASSEMBLIES AND PURCHASE CABLES

Part #	Description
23103120	CABLE ASSY's,
21103100	**CABLE ASSY, JUNC PCB PL1 - FLS1**
21103099	**CABLE ASSY, JUNC PCB PL3 - FLS2**
21103098	**CABLE ASSY, JUNC PCB PL7 - RLS1**
21103097	**CABLE ASSY, JUNC PCB PL9 - RLS2**
21103087	**CABLE ASSY, SENSOR RIBBON**
21103096	**CABLE ASSY, SENSOR RIBBON**
21103104	**CABLE ASSY, Junction PCB to PDI PL16 & CI J18**
21103101	**CABLE ASSY, Estop & Trip to PDI PL4**
21103102	**CABLE ASSY, Search/Power Lamps to PDI PL9**
21103103	**CABLE ASSY, X-Ray Lamps to PDI PL25**
21101514	**CABLE ASSY, Power input MCB to INRUSH**
21103090	**CABLE ASSY, PDI SK5 to Inverter Power**
21103091	**CABLE ASSY, PDI PL26 to Inverter**
21103095	**CABLE ASSY, INRUSH to Transformer 110V/230 V**
21100549	**CABLE ASSY, IEC Socket to Circuit Breaker**
21103105	**CABLE ASSY, PDI PL8 to CI J17,J20,J21,J22 & Inverter**
21101943	**CABLE ASSY, PDI SK6 to X-Ray Head Fan**
21100527	**CABLE ASSY, PDI SK11 to PSU1 Mains**
21100528	**CABLE ASSY, PSU1/PSU2 to PDI PL13**
21100529	**CABLE ASSY, PDI SK8 to PSU2 Mains**
21100530	**CABLE ASSY, PDI SK2 to PSU3/PSU4 Mains**
21100531	**CABLE ASSY, PSU3/PSU4 to PDI PL20**
2145041	**CABLE ASSY, Tip USB 1 & USB 2**
2145042	**CABLE ASSY, Ethernet & LVDS**
21103088	**CABLE ASSY, PSU3/PSU4 to ADC J18**
21100512	**CABLE ASSY, PDI PL17 to CI J25**
21100532	**CABLE ASSY, PDI PL18 to CI P1**
21103086	**CABLE ASSY, PDI SK3 to X-Ray Gen PL2**
21103094	**CABLE ASSY, Transformer to UPS & PDI PL1 Mains In**
21103092	**CABLE ASSY, CI J16 to X-Ray Gen PL1**
21103093	**CABLE ASSY, Umbilical INTERNAL**
21103110	**CABLE ASSY, PDI PL12 to PC**

CABLE ASSEMBLIES AND PURCHASE CABLES

Part #	Description
21100542	**CABLE ASSY, PC Power INSIDE**
2112367	**CABLE ASSY, CI J11 to PC (NI cable)**
21103111	**CABLE ASSY, DIODE ARRAY, SIDE, LE DATA**
21103112	**CABLE ASSY, DIODE ARRAY, SIDE, HE DATA**
21103113	**CABLE ASSY, DIODE ARRAY, BOTTOM, LE DATA**
21101925	**CABLE ASSY, UPS to PC POWER**
3010925	**CABLE ASSY, PC to USB/LVDS Converter**
21101689	**CABLE ASSY, ADC J1 to CI J1**
21103106	**CABLE ASSY, ADC J2 to HE DAB (Data)**
21103108	**CABLE ASSY, ADC J4 to HE/LE DAB (Power)**
21103107	**CABLE ASSY, ADC J3 to LE DAB (Data)**
21103089	**CABLE ASSY, MAIN ROLLER TO INVERTER**
21103114	**CABLE ASSY, DIODE ARRAY, BOTTOM HE DATA**
21103115	**CABLE ASSY, ARRAY BOX SV TO BV, HIGH ENERGY**
21103116	**CABLE ASSY, ARRAY BOX SV TO BV, LOW ENERGY**
21103117	**CABLE ASSY, PWR SIDE BOX HE/LE**
21103118	**CABLE ASSY, PWR BOTTOM BOX HE/LE**
21103119	**CABLE ASSY, DAB POWER SV TO BV**
2112829	CABLE ASSY, 4M EXT UMBILICAL

11.8 Cabling Schematic

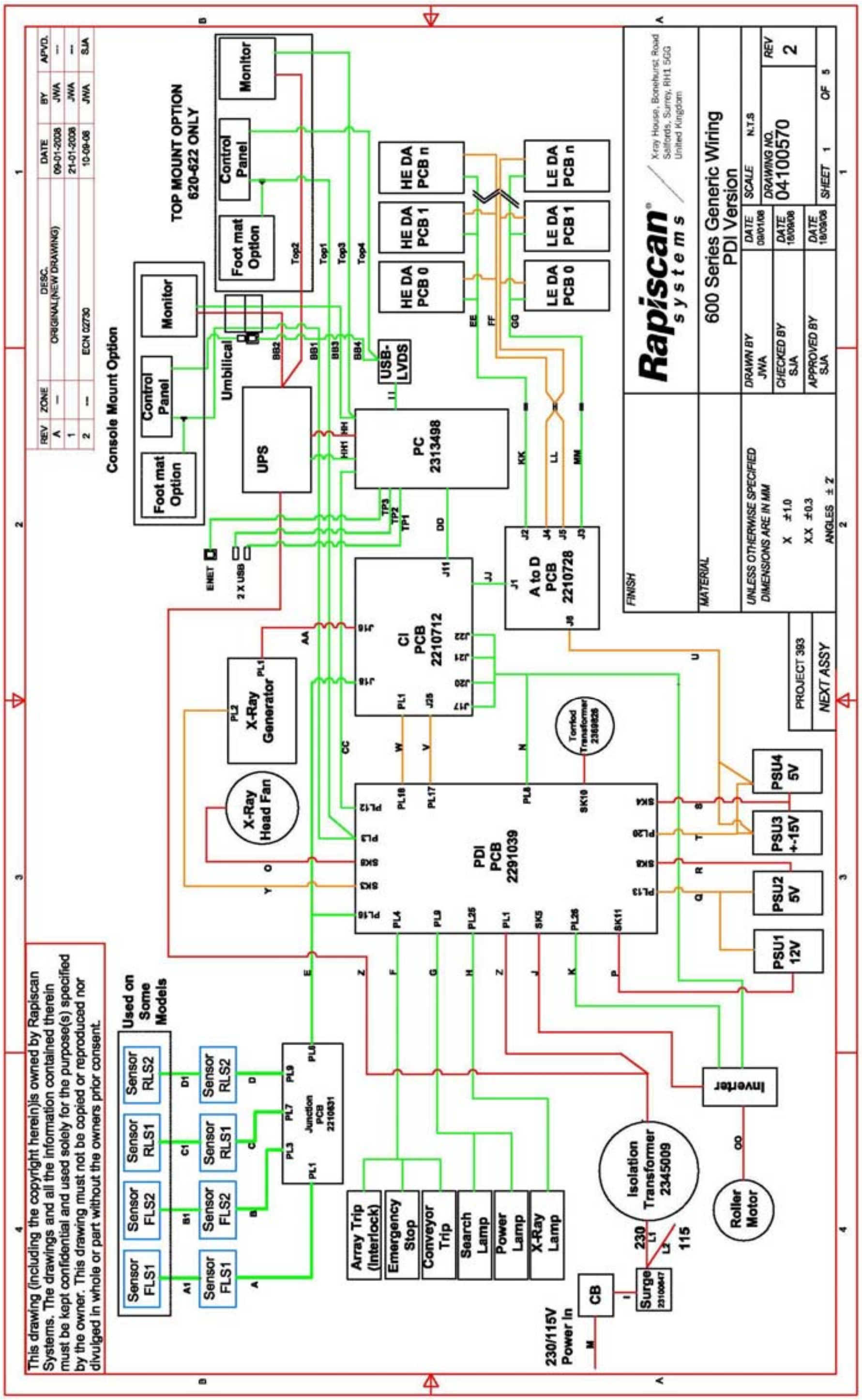


Figure 251: Wiring Schematic

12.0 Power Distribution & Interface PCB

12.1 Part Numbers

2291039 Power Distribution & Interface PCB

Function

This PCB acts as an interface between the computer/ Control Interface (CI) PCB and the conveyor motor, opto-sensors, power-on switch, key-switch, diode array box safety trip, emergency switches and system lamps. It distributes a.c. power to the power supplies for the diode array and CI PCB. The X-ray generator power supply (except the transformer) is incorporated onto the board.

NOTE: The PCB contains a number of useful indicators and test points, and is the first area to observe when checking system malfunctions.

12.2 Operating Voltage

The PDI PCB is designed to work at either 230VAC or 115VAC To change the voltage, set the switches SW1 and SW2 and change the fuses. The value of the fuses depends on the type of machine the board is fitted to.

12.3 Standby Power

When power is applied to the machine, power supply PSU1 is energized. This supplies +12V to the PDI PCB power on circuitry, in preparation for a power-on sequence.

Figure 252: PDI Board on Inside Panel of Electronics Chassis

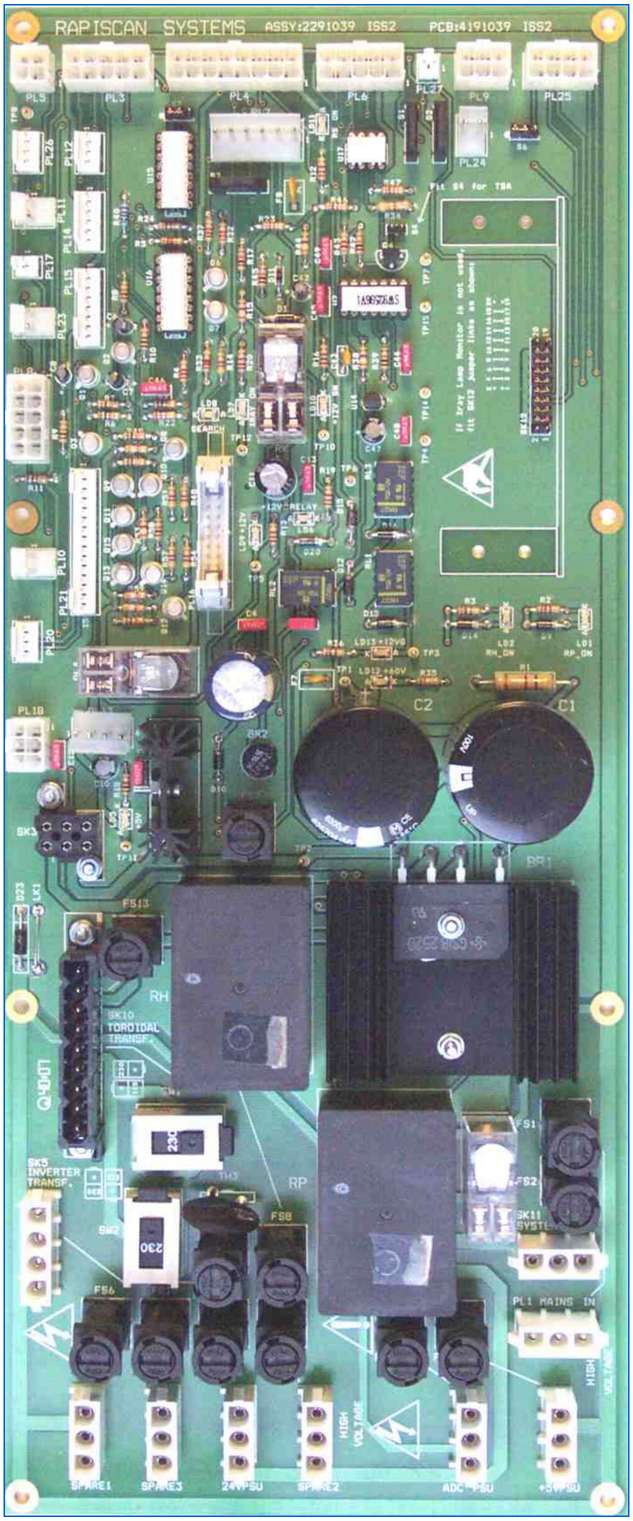


Figure 253: PDI PCB

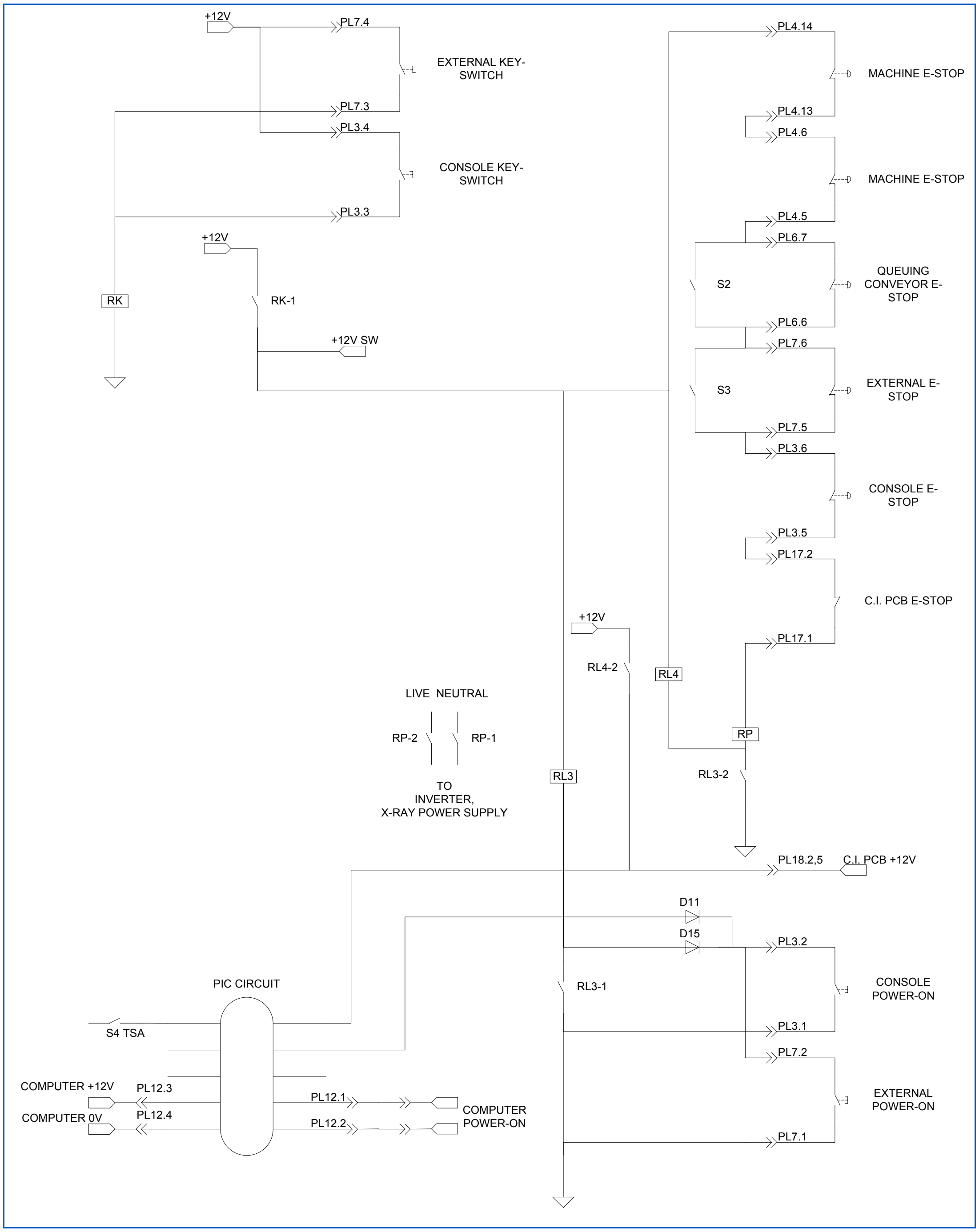


Figure 254: Power On Circuit

When the key-switch is turned on, +12V from PSU1 energizes RK and the +12VSW signal becomes active. When the power-on push-button is pressed, RL3 energizes and is latched on by RL3-1. Provided all of the emergency stop switches are OK, RP will energize, supplying power to the conveyor inverter and X-ray power supply. At the same time, RL4 energizes and supplies power to the CI PCB. The PIC microprocessor detects that the power-on switch has been pressed and turns the computer on.

12.4 PIC microcontroller

A PIC microcontroller on the PDI PCB monitors the state of the X-ray machine and powers-up or powers-down the computer accordingly. The PIC microcontroller can operate in two modes:

PIC Mode 1

The computer and X-ray machine power status is synchronized. When the X-ray machine is turned off, the computer is turned off. When the X-ray machine is turned on, the computer is turned on.

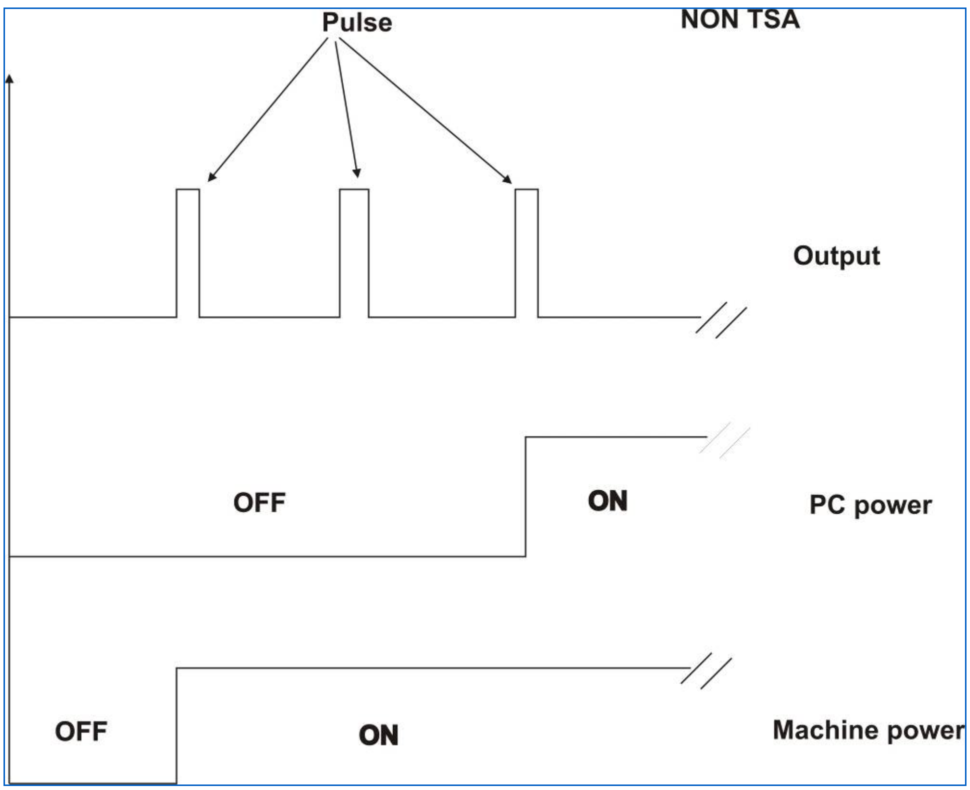


Figure 255: PIC Mode 1

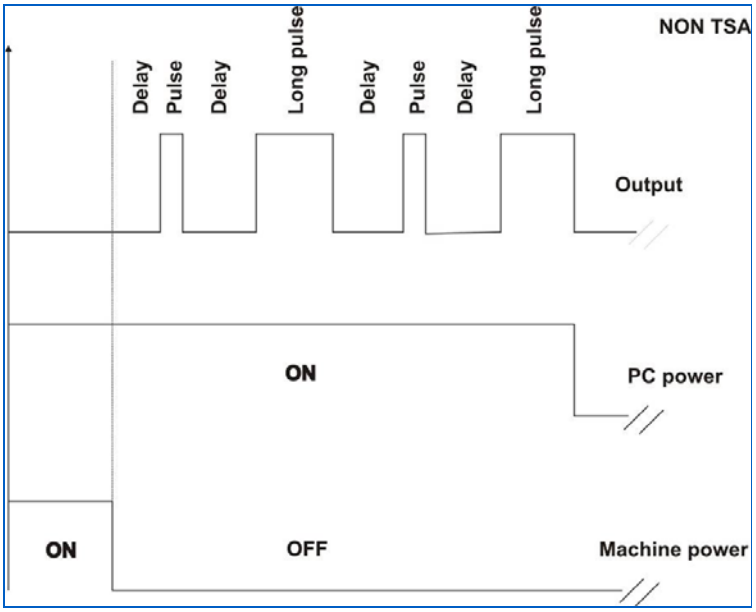


Figure 256: PIC Mode 1

PIC Mode 2

The computer can be powered up independently from the X-ray machine. When the X-ray machine power button is pressed and the key-switch is in the off position, only the computer powers-up. (This is known as TSA mode)

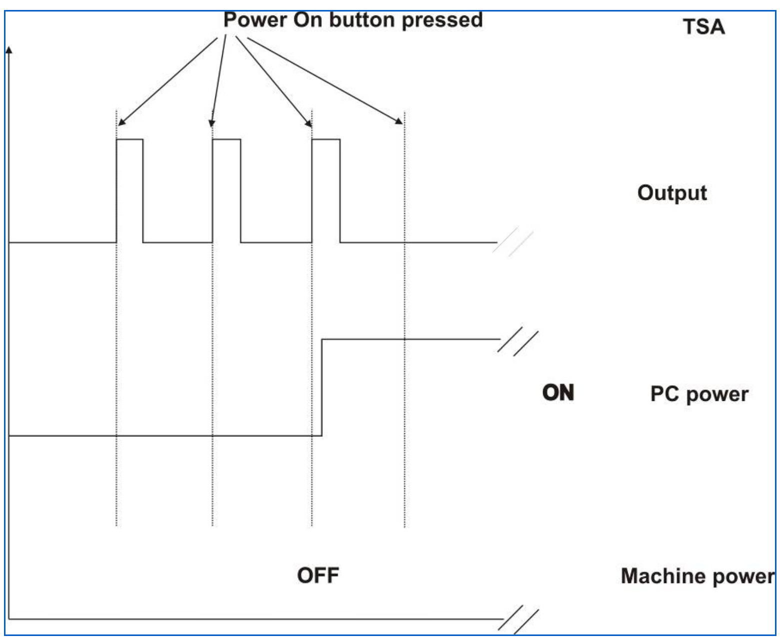


Figure 257: PIC Mode 2

The operating mode of the PIC microprocessor is determined by link S4.

12.5 X-ray Generator Power

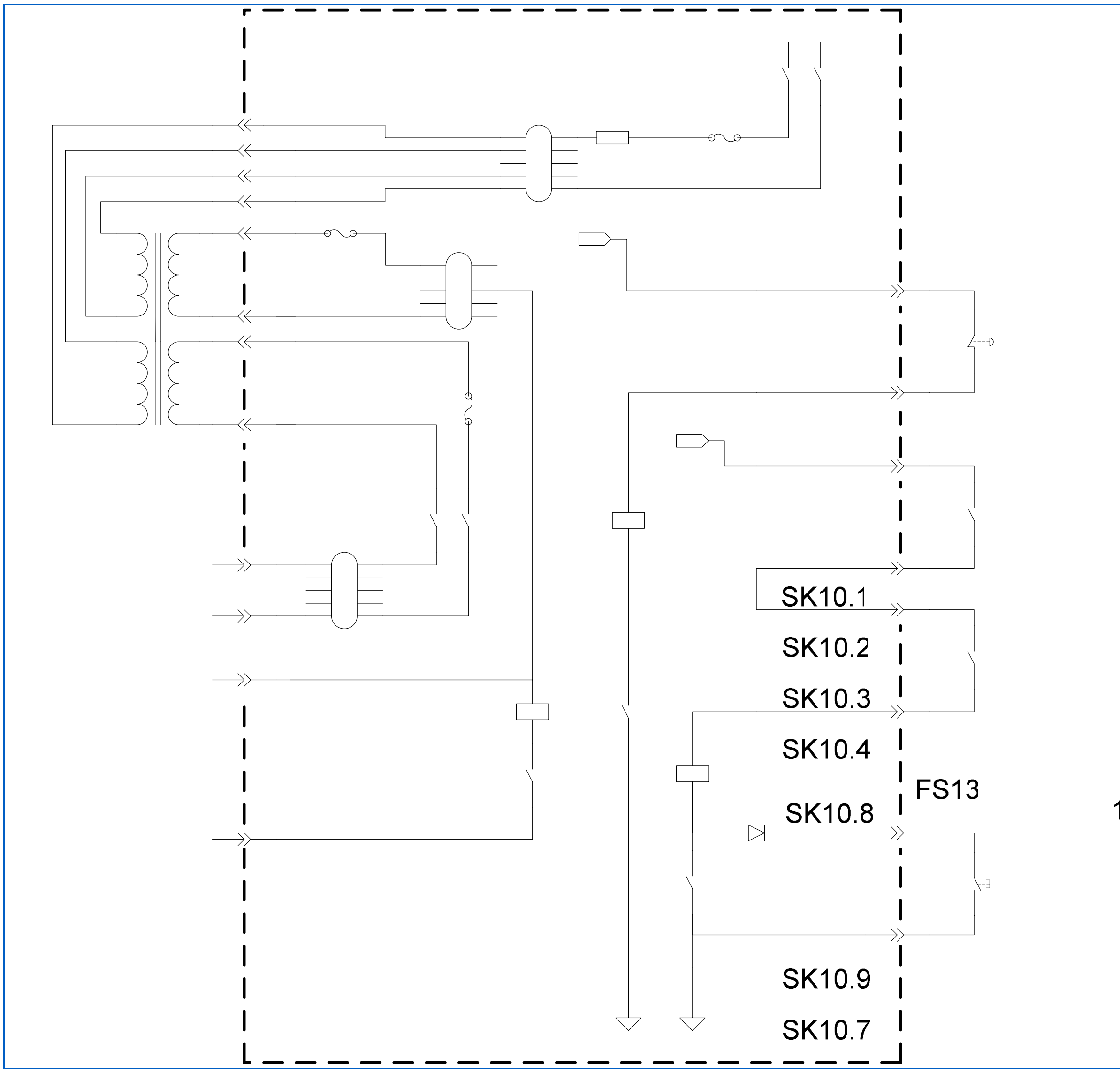


Figure 258: X-ray Generator Power

When relay RP is energized (see power on circuit description), power is applied to the toroidal transformer. There are two secondaries on the transformer; the first supplies power to the +12V regulator, the second provides 60V unregulated. Both the +12V and +60V are used on the X-ray generator control PCB.

If the X-ray generator control PCB has no error, RL1 will energize and RH will turn on. If the array trip safety switches are all OK then RL2 will turn on and 60V (unregulated) will be applied to the X-ray generator control PCB.

If an array box door has been opened and closed with the power on, then the power-on switch must be pressed to re-energize the X-ray relays RL1 and RH.

12.6 Control Interface PCB Signals

The CI PCB receives signals through PL8 to inform the machine software of the status of the array trip safety switches, emergency stop switches, and trip tray. The X-ray machine search lamp, conveyor run and X-ray on are controlled by the machine software through the CI board.

12.7 Conveyor Control

The machine software turns the conveyor on through the CI PCB. The forward and reverse signals enter the PDI PCB through PL8 and pass through opto-isolators to the inverter. If the machine trip tray is activated, the opto-isolators are non-functional and this prevents the conveyor from starting.

NOTE: If trip-trays are not fitted, move link S5 to position 1-2.

12.8 X-ray On Lamps

The X-ray on signals to the generator do not pass through the PDI PCB, this connection is direct. However, when X-rays are turned on, the CI PCB passes this signal through the PDI board to turn on the machine lamps. In some countries it is necessary to monitor the X-ray lamp current to detect if a lamp has failed. A lamp current monitor PCB can be plugged in to SK12 to perform this function. Connectors are provided to monitor the lamps on the control panel if necessary. These lamps can be powered by the PDI board or by the Icon Control Panel.

12.9 Links, Indicators and Test Points

Links

S1 QUEUING CONVEYOR TRIP	OPEN	CLOSED
QC TRIP NOT FITTED		X
QC TRIP FITTED	X	

S2 QUEUING CONVEYOR E-STOP	OPEN	CLOSED
QC E-STOP NOT FITTED		X
QC E-STOP FITTED	X	

S3 EXTERNAL E-STOP	OPEN	CLOSED
EXTERNAL E-STOP NOT FITTED		X
EXTERNAL E-STOP FITTED	X	

S4 PIC MODE	OPEN	CLOSED
PIC MODE 2 (TSA)		X
PIC MODE 1	X	

S5 TRIP TRAY	1-2	2-3
TRIP TRAY FITTED		X
TRIP TRAY NOT FITTED	X	

S6 POWER FOR ICON CONTROL PANEL X-RAY LED	1-2	2-3
PDI BOARD		X (DEFAULT)
ICON CONTROL PANEL	X	

Indicators

LD1	relay RP on
LD2	RH relay on
LD5	+5V
LD6	+12V relay
LD7	X-ray on
LD8	Search
LD9	+12V
LD10	+12V SW
LD11	RS relay on
LD12	+60V unregulated (X-ray generator)
LD13	+12V (X-ray generator)

Test Points

TP1	+60V (Positive)
TP2	+60V (Negative)
TP3	+12V (X-ray generator)
TP4	0V
TP5	+12V
TP6	0V
TP7	0V
TP8	0V
TP10	+12V SW
TP11	+5V
TP12	X-ray on
TP14	+5V PIC
TP15	PIC CLOCK

12.10 Machine Status Monitor Signals

A Machine Status Monitor PCB can be connected to PL21. This PCB is designed to monitor voltages from the power supplies and opto-sensors, conveyor commands, X-ray on and search signals.

12.11 Auto-Reject Unit and PLC

The PDI board provides an interface to accessories such as Queuing Conveyors. Baggage Handling Systems often require a PLC (Programmable Logic Controller) interface and this is provided on PL14.

12.12 Fuses

The fuses are documented in the section on spare parts.

13.0 X-ray Generator

13.1 Description

The X-ray generator consists of an X-ray tube, filament transformer and HV multiplier stack on a PCB with transformers giving +90kV and -90kV. All connectors to the generator electronics are through a connector on the top of the generator. The generator internal components are immersed in mineral transformer oil. There are bellows at one end of the generator to allow for expansion of the oil. There are no user serviceable parts inside the generator.

The primary collimator is adjusted to provide a thin fan beam of X-rays. Adjustment of the collimator is done at the factory and should not need altering. When a replacement generator is being fitted, it may be necessary to re-orient the collimator or adjust the gap to suit the X-ray machine. See the following diagrams for further information.

The collimator is matched to each generator during manufacture. Do not exchange them with those from other units. If they are exchanged or the orientation has to be changed, it cannot be guaranteed that the collimator is set directly above the center of the X-ray beam.

The X-ray Control PCB 91001 is matched to the X-ray head and should not be replaced separately. If replacement is attempted, the tuning procedure WI-0012 needs to be carried out (see Generator Frequency and Pulse Width Tuning on page 218).

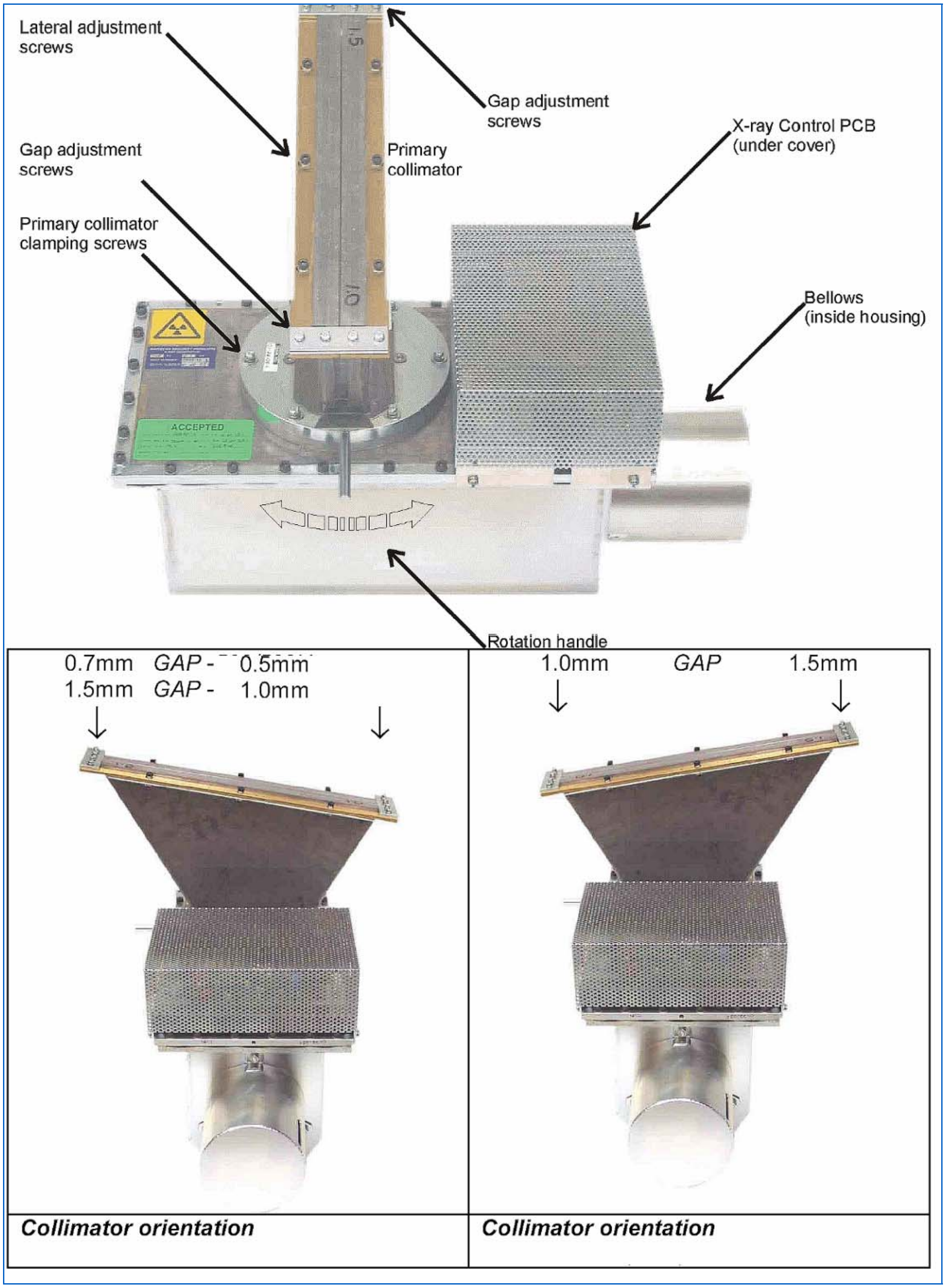


Figure 259: Generator Specifications

13.2 Field Maintenance / Removal and Replacement

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the “Limitation on Liability” section, including the section on voiding the Rapiscan Systems warranty.

WARNING: The X-ray generator is quite heavy and requires two service people to move it out and back into place. Because of the location of the 636 generator (higher off the ground) it is more difficult to move and it is important to remove the collimator funnel from the generator before moving the generator out and down to the floor.

1. The first step to replacing the 636 generator is to disconnect the power going to the 636.

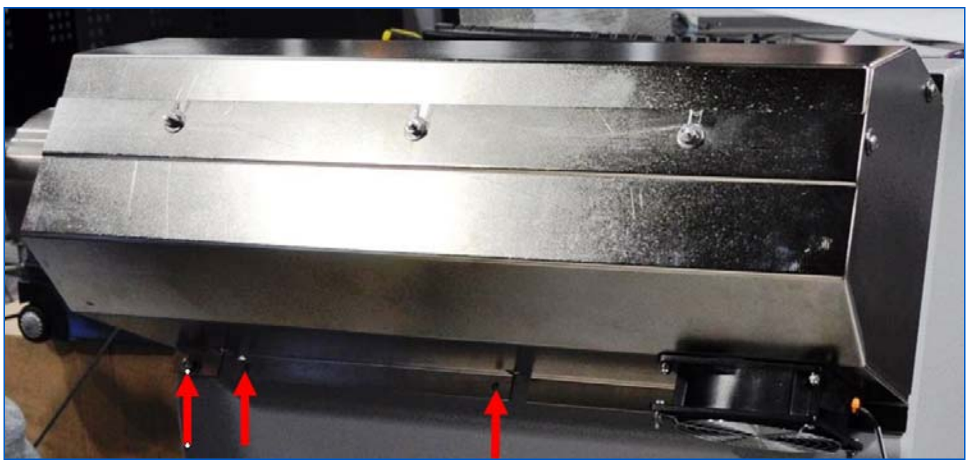


Figure 260: Generator Cowling and Lower Mounting Screws

2. Figure 260 shows the generator without its panels, but with its protective cowling still in place. Note the mounting screws pointed out by the red arrows. The generator’s protective cowling actually consists of two pieces; one top, one bottom.

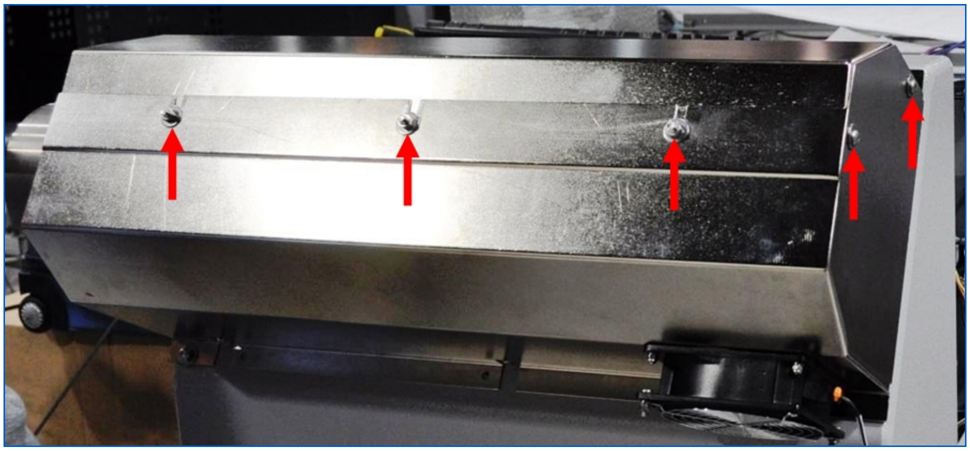


Figure 261: Bolts Joining Top and Bottom Cowling

3. To remove the cowling, remove the lower mounting screws (Figure 260), then the two screws on the right end of the bottom cowling (Figure 261). Finally, loosen the nuts on the three bolts joining the top and bottom cowling. The bottom cowling should slide easily out and away. This will leave the top half of the cowling as shown in Figure 262.

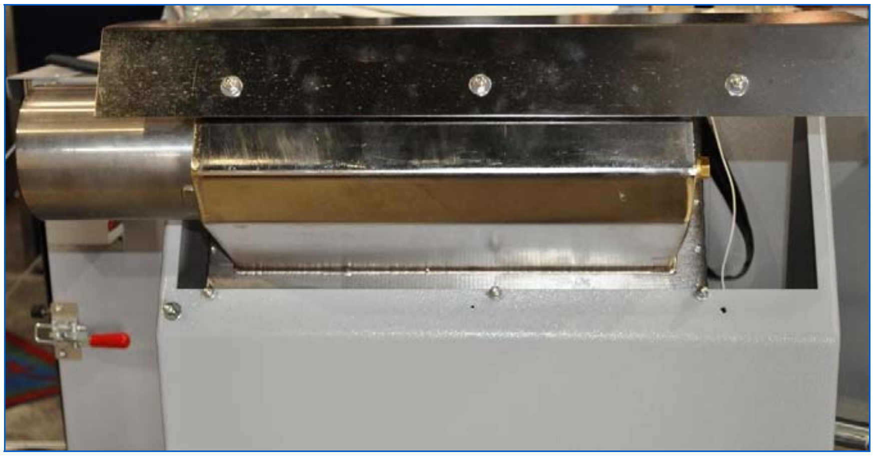


Figure 262: Top Half of the Generator Cowling

The top half of the cowling is held in place by the screws shown in Figure 263.

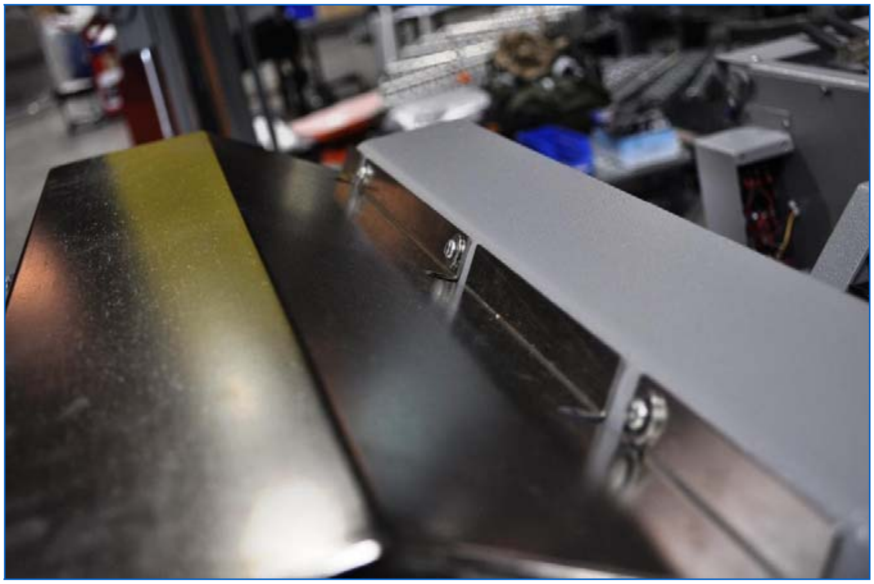


Figure 263: Mounting Screws for Top Half of the Generator Cowling

With the panels and cowling now removed, the generator is now exposed.

Generator Replacement Procedure

To remove the X-ray generator:

1. Remove the collimator end panel cover, removing the mounting screws (Figure 264).

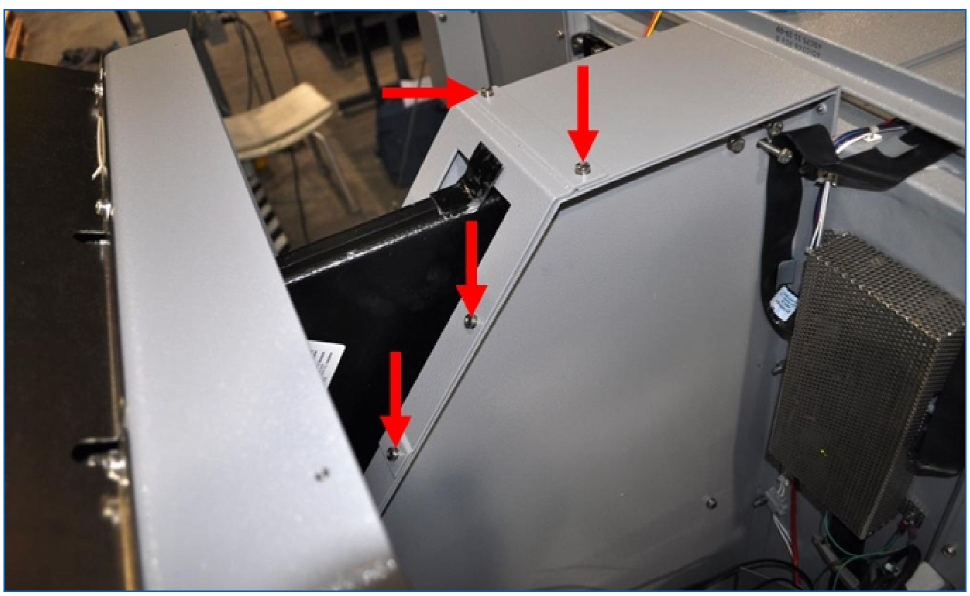


Figure 264: Collimator End Panel Cover Mounting Screws

2. Disconnect the cables from the generator including the earth lead.

3. Remove the mesh cover on the X-ray Controller by undoing the mounting bolts for that cover (Figure 265).

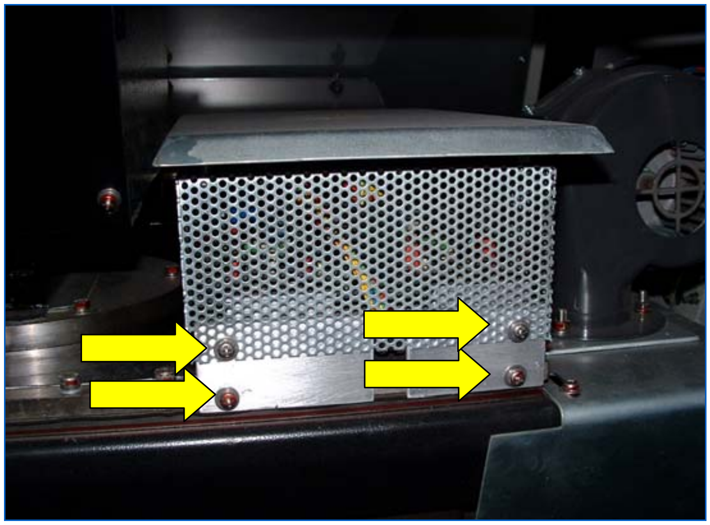


Figure 265: Controller Cover Mounting Screws

4. Remove the three leads connecting the X-ray Controller Board to the machine: The Power Cable, Ground wire and; Communication Ribbon Cable (Figure 266).

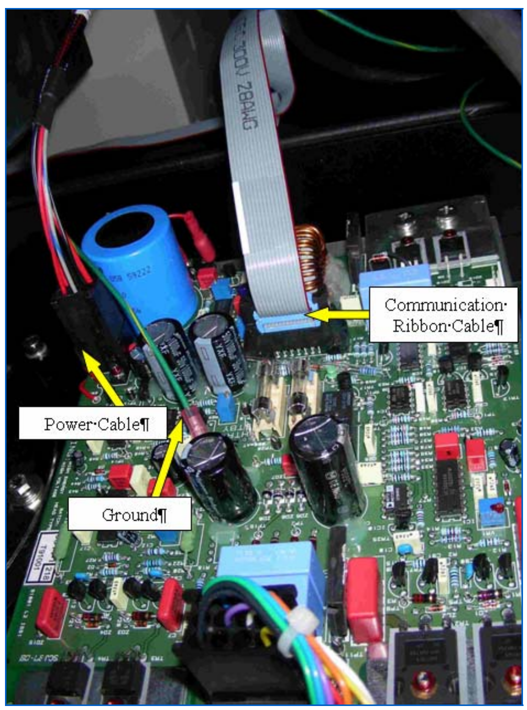


Figure 266: X-ray Generator Controller Board

5. Remove the controller from atop the generator by undoing the controller mounting bolts (Figure 267).

Figure 267: Controller Mounting Bolts

Disconnecting the Primary Collimator Funnel

The combined weight of the collimator funnel and generator is considerable and could cause injury to those trying to move both components together, thus it is advisable to disconnect the primary collimator funnel at this time. Figure 268 shows the collimator funnel and the mounting bolts.

6. Remove the bolts and remove the collimator funnel.

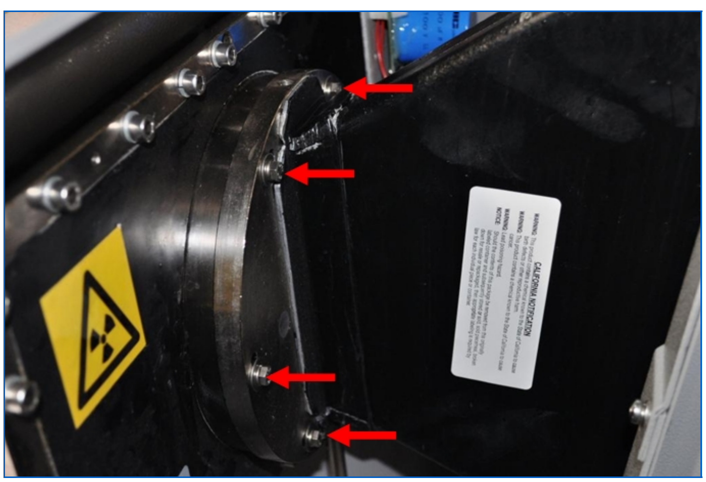


Figure 268: Collimator Mounting Bolts

7. Undo the bolts holding the generator frame to the frame of the X-ray unit (Figure 269).

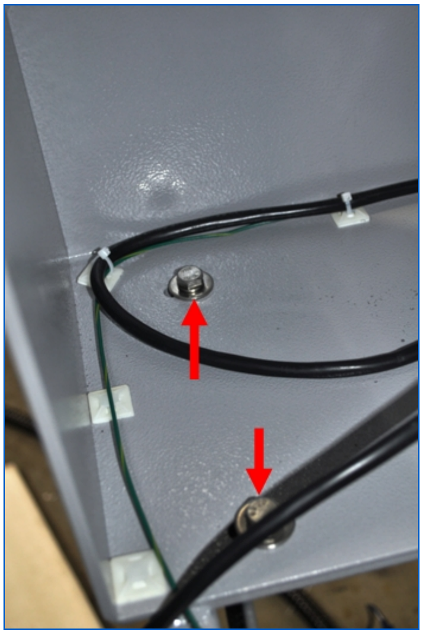


Figure 269: Generator Frame Mounting Bolts

8. Using two people, carefully lift the generator and frame and place on the floor. Take care not to damage the bellows during this procedure.
9. Remove the generator mounting bolts and take the generator out of its frame (Figure 270).

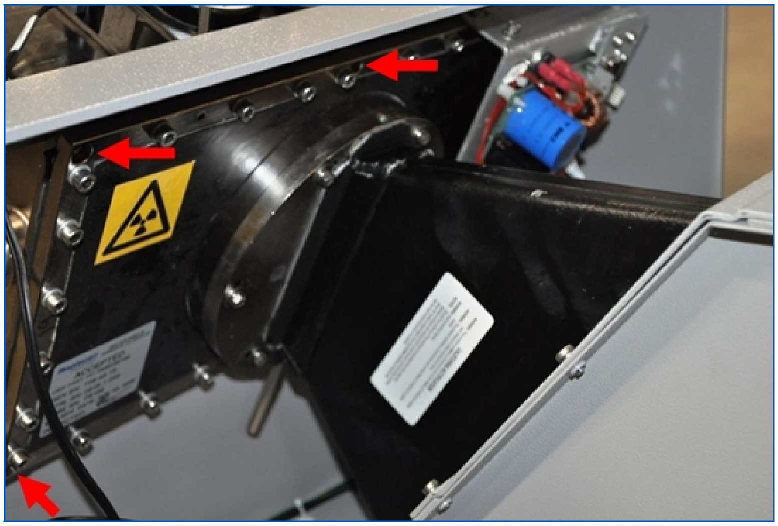


Figure 270: Generator Mounting Bolts Close-up

Replacement of the Generator

Replacement of the generator is a reversal of removal:

1. Fit the mounting bolts to a maximum torque of 5Nm.
2. Lift the generator in with the collimator supplied with the replacement unit, and fit the frame bolts hand tight.
3. Fit the collimator cover, and refit the cables including the earth.
4. Switch on, and switch to maintenance mode voltage monitoring screen.

CAUTION: The primary collimator funnel is matched to the X-ray generator. Use only the new funnel with the new generator.

WARNING: Do not attempt to turn X-rays on if the collimator cover or any lead shielding is missing. Check X-rays with a meter immediately after changing the X-ray generator.

5. Switch on, log in as a service person, and enter System Service – Diagnostics and QA.
6. Turn X-rays on and check the voltage and current on the screen.

The system will now need to be collimated to align the X-ray beam with the diode array. Refer to the section on collimation for instructions (see page 225).

It should not be necessary to adjust the voltage and current, these values are set at the factory. However, there are potentiometers marked kV and mA on the X-ray control PCB for this purpose. Use the ‘qualify generator’ screen in ‘Maintenance Mode’ to set the standby current - see procedure in the X-ray Control PCB section. The system will now need to be collimated to align the X-ray beam with the diode array. Refer to the section on collimation for instructions ((see page 225).

WARNING: If an X-ray head or Head Control PCB has been changed or adjusted, then the unit must be checked with an X-ray monitor such as the Minimonitor type D. These instruments must contain a compensated G.M. tube, and be calibrated in µSv/hr or mRem/hr - not counts/sec. They must have a valid calibration certificate. If the measurements are outside those permitted by the regulations in force in the country of installation, the X-ray generator current must be reduced or other measures taken to ensure compliance.

13.3 Generator Frequency and Pulse Width Tuning

NOTE: Extracted from WI-0012.

Purpose:

To set the correct frequency, pulse width, and wave form on the 140 kV generator.

Scope:

Applies to all 140 kV generators.

Responsibility:

The Generator Lab Technician and Field Service Engineer are responsible for tuning generators.

Reference Documents:

- Form R-0048 Generator Repair Specification Form
- Service Manual

Definitions:

None.

Tools required:

• Tektronix Oscilloscope TDS210	1
• Scope probes	2
• Tektronix current probe A622 with digital meter adapter	1 Set
• Digital meter such as Wavetek 27XT or Fluke II 70	2 (labeled as 1 and 2)
• Screw driver for setting potentiometers	1

Procedure:

1. Verify that R29, R31, and R74 have been replaced according to Generator Repair Specification Form R-0048.
2 Turn kV (VR4) and mA (VR2) POT down (counterclockwise all the way).
3 Turn on scope. Hook up channel 1 of scope to test point TP5 or TP6. Ground of scope should be either on TP23 or TP27.
4 Hook up current probe (on channel 2) to ‘+KV IN’ (line SK3 pin 3 going into generator). Make sure that the arrow sign (current flow direction) on current probe points into the generator. Set the current probe to 100mV/A scale.

NOTE: Current probe has to be calibrated before use. Refer to manual of current probe for calibration. Make sure there is working battery inside the probe.

5 Hook up digital meters on TP15 (anode current reading) and TP2 (kV reading) respectively. Set for proper voltage reading scale on digital meter that it can at least read 0 to 5 volts. Before x-ray is turned on, the reading at both test points should be zero.

6 Temporarily disconnect SK3 from the generator tank to the controller board. Connect power to the x-ray PSU board. Turn on x-ray from machine or test hand switch.

7 Press 'Measure' on scope, there should be frequency reading on CH1 or CH2. Select CH1 and the frequency should be between 17.5 kHz to 22.0 kHz on CH 1. If the scope does not provide measurement, use visual measurement to determine the driving frequency. Turn R74 POT and set the frequency to 18.5 kHz temporarily. The purpose is to set the initial frequency safely so that no component can be damaged due to frequency mismatch.

8 Adjust VR1 to set the initial pulse width duty cycle to between 20% to 25%.

9 Turn off the x-ray and PSU power. Reconnect the head to controller board (SK3).

10 Turn on the PSU power. Turn on x-ray from machine or test hand switch. There should be some waveforms on scope screen. They may be out of trigger at this point.

11 (For TDS210) Press 'AUTOSET' on scope, the scope will automatically set trigger on the two channels. Channel 1 on TP5 shows the MOSFET gate drive waveform, and Channel 2 shows the driving current waveform. Voltage scale on channel 1 or channel 2 can be adjusted for easier viewing. If the scope does not have automatic setting, try to set the most reasonable viewing parameters.

12 Check channel 1 where the gate driving square wave shows up: the 'on' time should be between 20 to 25% of the whole period (='on' time plus 'off' time).

NOTE: It is very important that the definition of 'duty cycle' is correctly understood and the duty cycle is set between 20% and 25%.

13 Check CH1 frequency and it should be around 18.5 kHz as set previously.

14 With kV, mA and Heater Standby pots all the way down, measure TP26 and across both Fuse 1 and Fuse 2. The voltage reading should be 10 volts or so on TP26 at the beginning.

15 Bring up kV and mA according to the following procedure:

i First turn up VR4 (10–turn kV POT) slowly. The reading on TP2 should be 1.0 volt or so initially when the POT is counterclockwise all the way. The reading will start to increase after one or two turns to the clockwise direction.

ii When the reading on TP2 reaches between 2.0 volts to 2.5 volts, check the reading on TP15. At this time the reading on TP15 should be around 2.5 volts or so.

iii Continue to bring VR4 up such that TP2 reading is 3.5 volts.

Iv Turn VR2 (mA) POT up slowly and monitor TP15 reading. Stop at reading of 2.8 volts. *

NOTE: The mA value is 0.56 (mA) and the kV value is 140 (kV) at this (3.5 volts) reading. If mA or kV is specified differently (such as 0.7 mA or 0.85 mA), the test point readings should be scaled and set accordingly.

16 Look at CH2 current waveform while adjusting (frequency turning) VR5 (in series with R74). Try to bring the waveform close to that in figure 1. Note that there should be two peaks (‘A’ and ‘B’ in figure 1) showing up, and the one to the right is 60 to 80% in height to the one at left. 10µs / div.

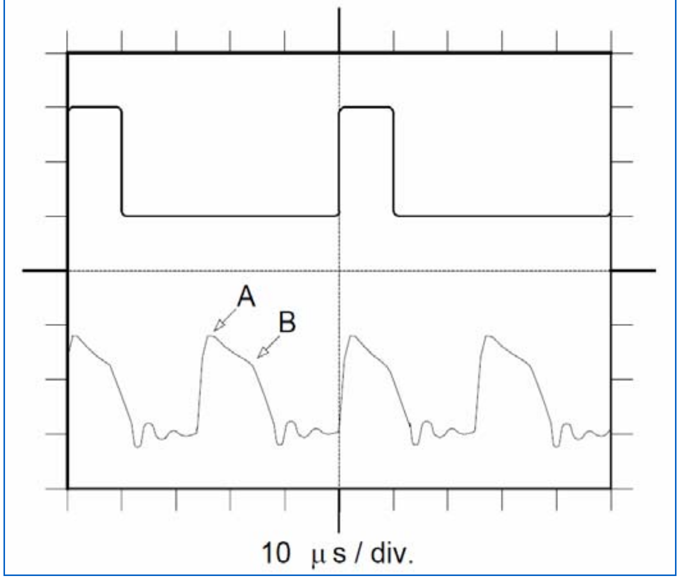


Figure 271: Waveforms

17 Look at CH2 current waveform while further adjusting VR1 such that that waveform approximates that in figure 1. (Note that there are two main peaks on the current waveform when frequency is close to 18.0 kHz. The one marked ‘A’ in figure 1 will become large and leans towards left when driving frequency increases. The peak marked ‘B’ in figure 1 comes from the higher harmonics and will lean towards right when frequency decreases. Adjusting the pulse width will affect the ‘sharpness’ of this peak ‘B’. The task of tuning frequency (VR5) and pulse width (VR1) is such that neither peak ‘A’ or ‘B’ is higher than 10 amp peak value. Peak ‘B’ is about 60 to 80% of peak ‘A’, with the peak shape as smooth as possible.)

18 Measure TP26 with digital meter, the reading should be at least 36.0 volts and not exceeding 41 volts.

19 To measure RMS current, hook up the BNC adapter plug to DVM and current probe. Attach current probe to number 3 wire of the controller board assembly, Orange for

UK, Red for US. Turn the probe on and write down the VDC value in the test checklist. Value should not exceed 0.32 volts.

20 Set rise time according to Service Manual.

Records:

None

13.4 Generator Storage and Reconditioning ("Seasoning Procedure")

Purpose

The purpose of this procedure is to test and condition ("season") new and refurbished X-ray generators on the MVXR5000, in order to provide maximum reliability.

CAUTION: If the MVXR5000 X-Ray Scanner unit has been idle, in storage or in-transit for more than 90 days, then this procedure must be performed on each of the X-Ray generators on the MVXR5000, before the Scanner can be used for testing or live operation.

If there is any doubt, perform this procedure regardless.

Definitions

X-ray Duty Cycle

The percentage of the cycle during which the X-rays are on.

The formula for calculating X-ray duty cycle is: **ON / (ON+OFF)**

X-ray on time

divided by

the sum of X-ray on time and off time.

Tools

- X-ray Generator Power Supply Set
- Generator Hand Switch
- Current Probe
- Digital Multi Meter (DMM)
- 555 timer circuit switch

- Oscilloscope and Probes (Scope) -- [**Optional**]

Step-by-Step

Setup

1. Clean generator exterior.
2. Clean oil off all connectors.
3. Connect head, controller board and power lines.
4. Make sure controller ground, power supply ground and generator tank are connected and secured.
5. Make sure kV (VR4) and mA (VR2) potentiometers are all turned down (fully counterclockwise) to lowest value.
6. [**Optional**] If you have an oscilloscope, hook up scope probe (channel 1) to TP5.
7. Hook up current probe from (channel 2) to SK3 pin 3.
8. Make sure hand switch is in "OFF" position, and plug in hand switch.

"Seasoning" Procedure

1. Turn on generator power supply.

   Green LED should be on. Leave the hand switch in the OFF position.

2. First check TP26 reading. Also check the voltage reading at both ends of the fuses.

   All readings should be the same and be around 36 volts (±2 volts).

   If the reading is too low, such as only a few volts, or too high, such as 60 volts, the controller board may be defective.

3. Turn the hand switch to "ON".

   At this moment, TP2 reading should be around 1.0 Volt.

   TP15 should read around zero at this point.

   - kV Scaling: 1 Volt on TP2 = 50 kV across x-ray tube
   - mA Scaling: 1 Volt on TP15 = 0.4 mA emission current

NOTE: Trip-offs due to over-kV or over-mA protection are only allowed while performing **Step 8** through **Step 10** (initial seasoning of x-ray tube).

Restart from **Step 8** after each trip-off. Only **two retrials** are allowed.

The generator should be rejected for tripping off the third time during the initial seasoning.

4. Every 20 minutes, turn up VR4 such that the TP2 reading increases by 0.4 volts.

   This will increase the voltage across the tube by 20 kV every 20 minutes. Continue until voltage at TP2 reaches 3.4 volts.

5. While following **Step 9**, when the voltage reading reaches 3.4 volts (170 kV), then wait for 20 minutes.

6. Measure the TP15 reading. The reading should be around 1.0 volts.

   Increase the TP15 reading to 2.5 volts by turning VR2 clockwise.

   Wait for 30 minutes.

7. Check the TP2 reading.

   If the TP2 still reads 3.4 Volts, stop and go to **Step 14**.

   If the reading drops to lower than 3.4 Volts, turn down VR2, so that TP15 reading is reduced by 0.1 Volts.

8. Try turning VR4 so that TP2 reads 3.4 volts.

   If this can be done, stop at this mA reading and go to **Step 14**.

   Otherwise, repeat these checking steps by lowering the mA (TP15) reading by 0.1 Volt and try to increase the TP2 reading, until TP2 can read 3.4 Volts.

9. If **any** trip-offs have occurred after Step 10, the generator must be **rejected**.

   Otherwise the procedure is complete and the generator is a “pass”.

Records:

The Rapiscan X-Ray Generator Test Check List is maintained by the QA Engineer according to BSP-1601, Quality Records.

Figure 272: 180 kV Generator X-ray Control PCB (P/N: 91001)

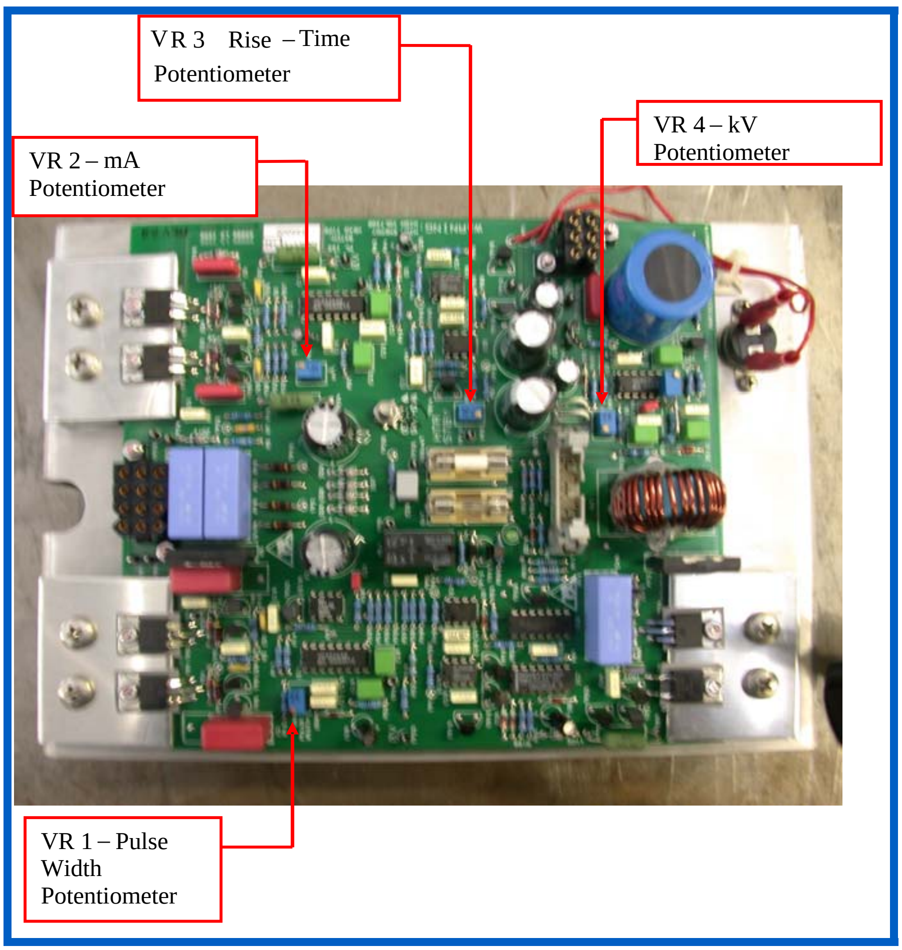


Figure 273: 180 kV Generator X-ray Control PCB (P/N: 91001)

14.0 Collimation

WARNING: If an X-ray generator or X-ray Control PCB has been changed or the collimation has been adjusted, then the unit must be checked with an X-ray monitor such as the Victoreen 450p/ 451p or Mini Instruments Mini Monitor 900 type D.

These instruments must contain a compensated G.M. tube, and be calibrated in µSv/hr or mRem/hr - not counts/sec. They must have a valid calibration certificate.

If the measurements are outside those permitted by the regulations in force in the country of installation, the X-ray generator current must be reduced or other measures taken to ensure compliance..

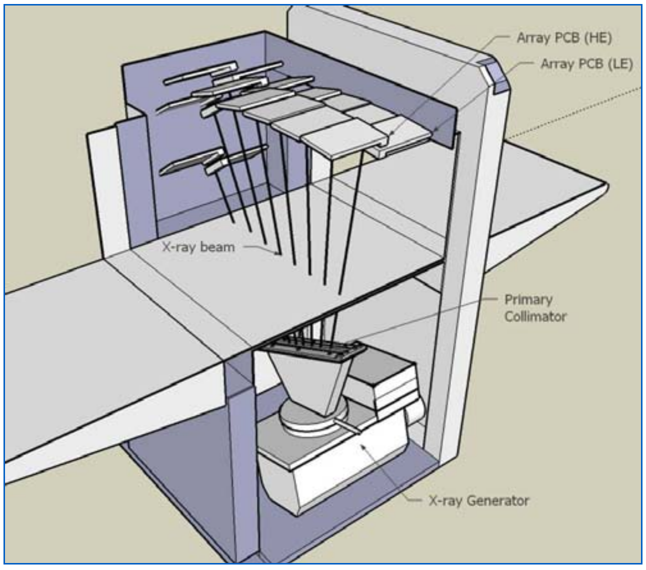


Figure 274: Components adjusted during collimation

The Rapiscan X-ray system must be collimated for a good X-ray image to be generated. The components to be adjusted include:

- The position of the generator focal point.
- The primary collimator sitting on the generator.
- The secondary collimator below the conveyor.
- Array PCB carrier rails.

Good collimation and minimal X-ray leakage is achieved when all four components sit on the same plane.

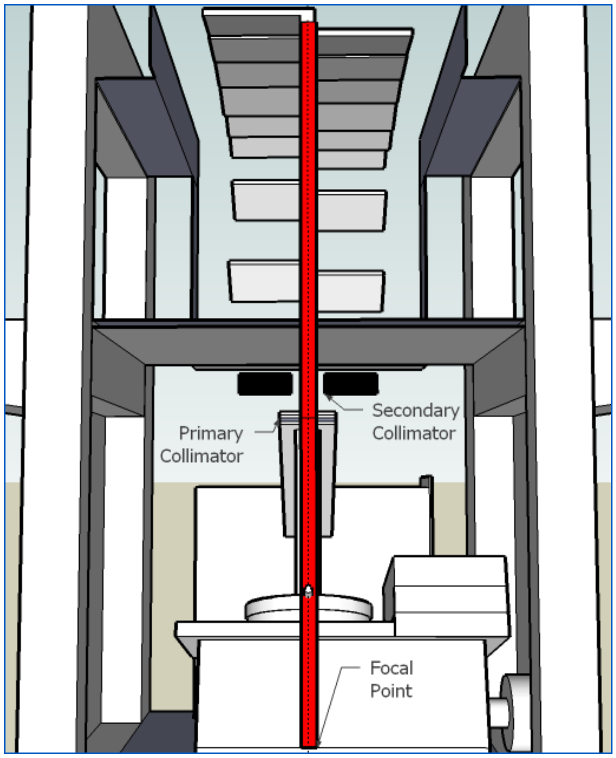


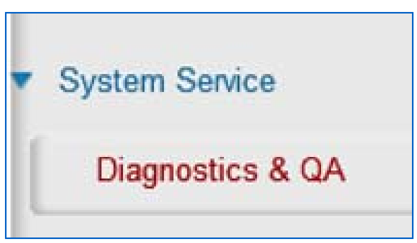
Figure 275: Collimation

14.1 X-ray Generator Alignment

The diode array will not normally need adjustment since it will have been set centrally in the factory. If you cannot achieve collimation then check that the array rails are centered in the array box. Loosen the array rail locking nuts before adjusting the array rail position.

The primary collimator should have gap opening of 1mm to 1.5mm. This allows the beam to be wide enough when it reaches the secondary collimator but also small enough to limit the scatter in the funnel back to the generator area.

System Service



1. Switch the X-ray machine on and enter System Service mode by logging in as SERVICE2.

2. Select the System Service button.
3. Select ‘Diagnostics and QA’. This option allows one to view the signal from the detectors as well as to recalibrate, edit gain, normalize data, and do channel analysis.

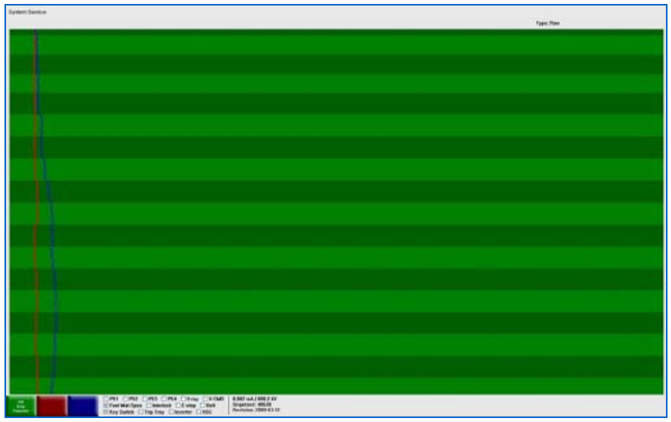


Figure 276: System Service Screen

Each horizontal green band represents a diode array board. The number of boards varies between machine types.

Board Gain

The gain of the array boards is normally set in the factory and should not need adjustment. However, if a board gain has been set incorrectly, this is how to correct it. The board gain should not be used to compensate for a poorly collimated system.

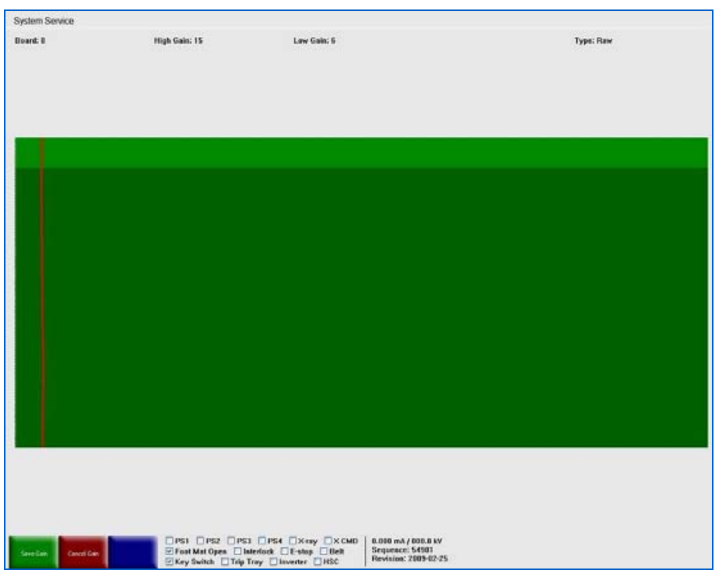


Figure 277: Incorrectly adjusted array board gain

1. Highlight Board Gain from the system service menu by using the up/down keys 2 and 8. Select using key 5.
2. Select high energy (blue) or low energy (red) using the P key.
3. Use keys 2 and 8 to select the board to be adjusted.
4. Use keys 4 and 6 to decrease or increase the gain of the array board.
5. Use the green button to save the gain, or red to cancel.

Primary Collimator Adjustment

1. Loosen the four screws holding the generator to the frame and all 6 screws holding the primary collimator assembly. Rotate the collimator fully clockwise using the handle.

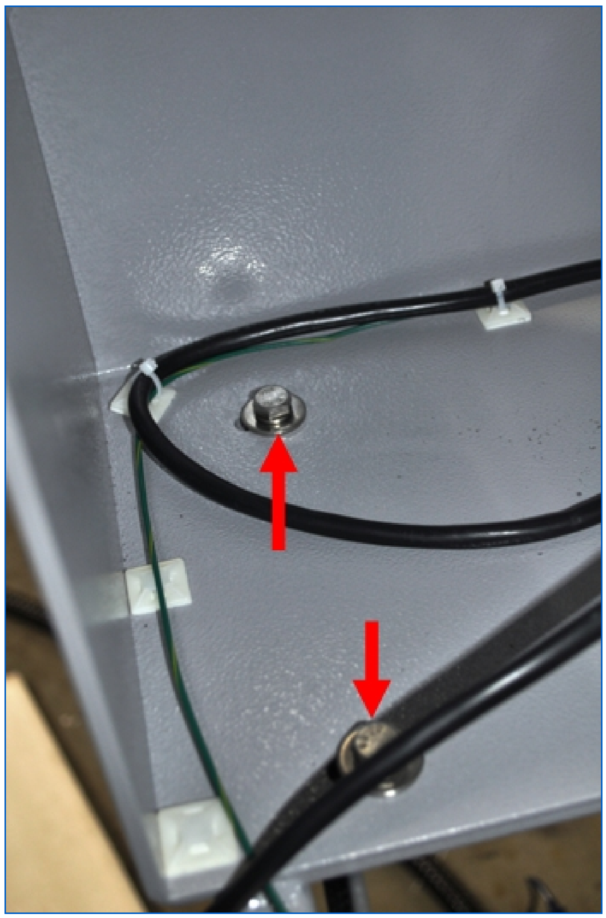


Figure 278: X-ray Generator Mounting Screws

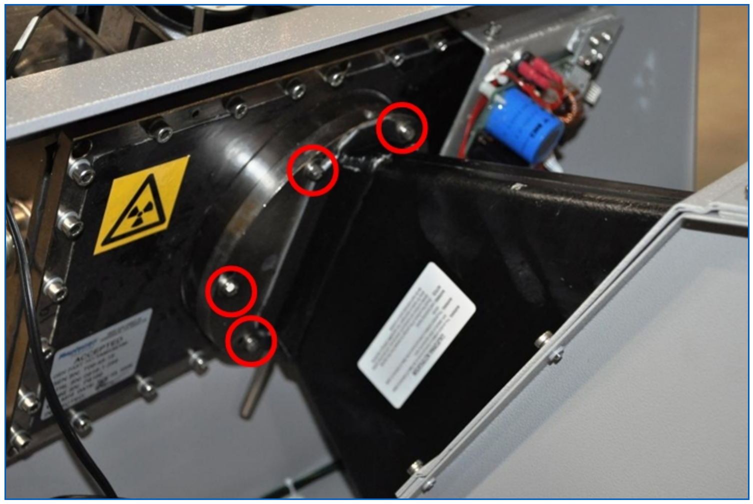


Figure 279: Primary Collimator Assembly Screws

2. Switch on the X-rays (Press X). The signal will show up as a line in middle of the screen with a peak pointing to the right.
3. Rotate the primary collimator assembly in the opposite direction. If the peak position does not change vertically, the generator is in the correct position laterally. (See the diagrams later in this chapter.)
4. If the peak position moves, readjust the generator position (left or right) to make the peaks on the screen come closer together as the collimator is rotated. This is repeated until the position of the peak does not change when the collimator is rotated. Rotate the primary collimator until the response is even across the screen.

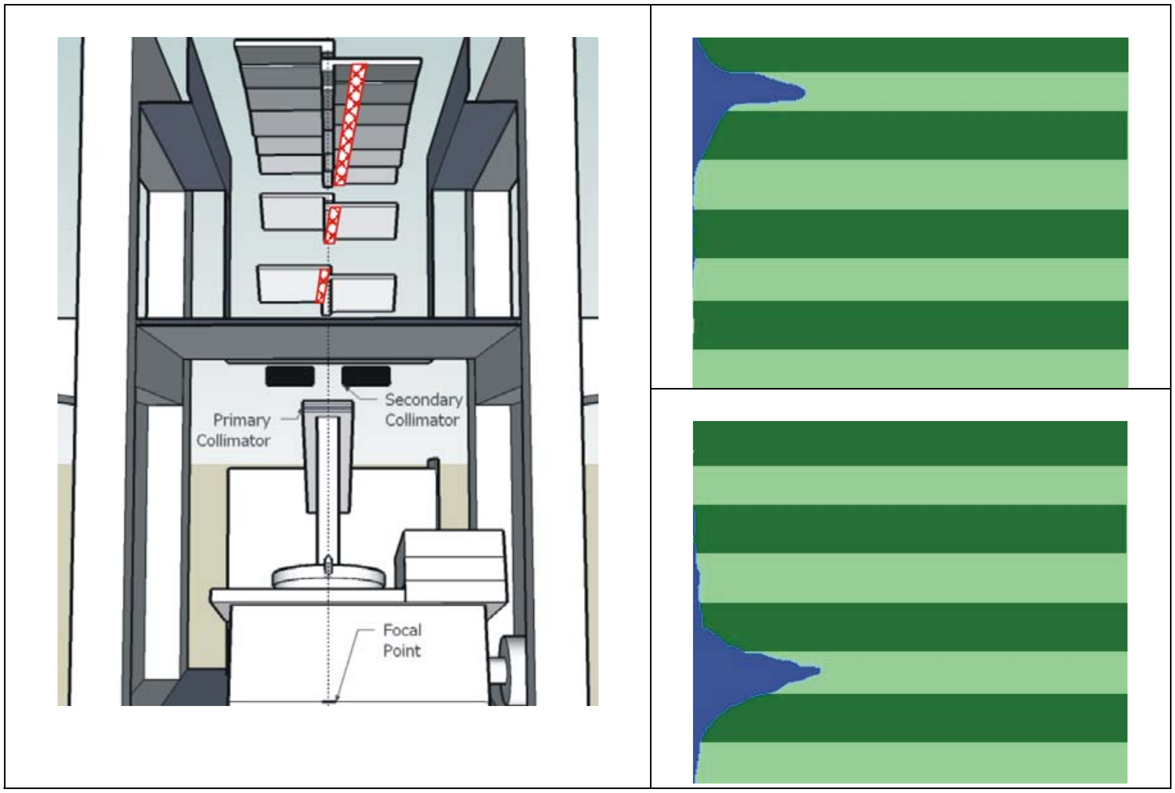


Figure 280: Primary Collimator Not Properly Centered

Turning the primary collimator will allow the X-ray fan beam to cross the detector array. Since this crossing is only a small area, the signal shows only as a localized peak. Turn the primary collimator to the opposite position. If the peak shifts, this indicates that the centre of rotation is not on the detector array. Slide the X-ray generator so that the centre of rotation shifts onto the array.

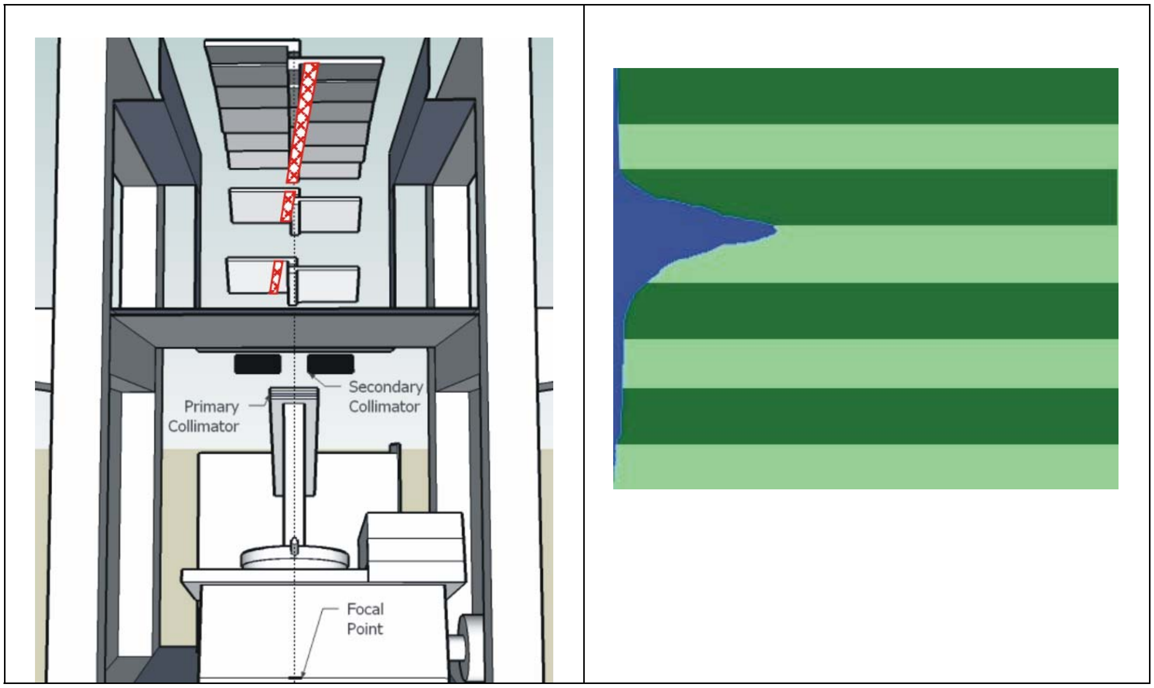


Figure 281: Primary Collimator Properly Centered

When the centre of rotation is on the detector array, turning the primary collimator will not shift the centre of the peak in array response. The general shape of peak will change but the peak should be at the same place vertically. The X-ray generator is now in the correct place laterally. Rotate the primary collimator to get a good response across the whole array.

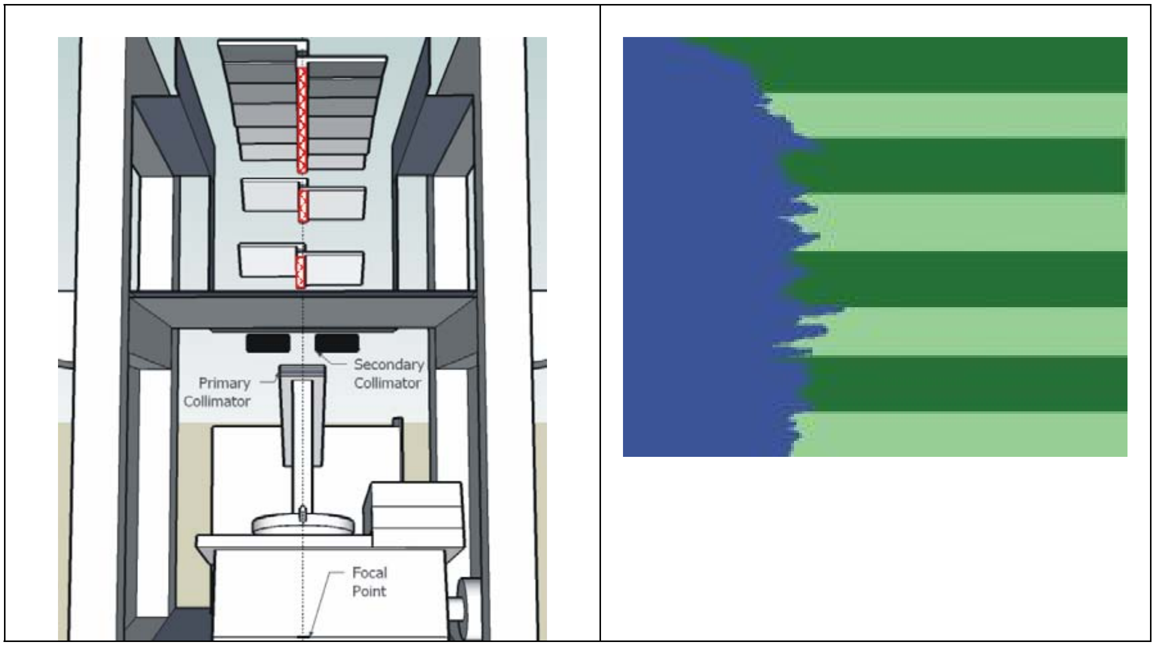


Figure 282: Primary Collimator Rotate for Maximum Response

14.2 Secondary Collimator Adjustment

If problems are encountered with getting a good X-ray response, the secondary collimator must be adjusted, by adjusting gap and position.

Gap and position are adjusted using the Gap and Position screws (Figure 283). The Gap screw will open or close the gap between the two collimator bars above the generator. The Position screw will move the collimator from side to side. Combining the two adjustments will allow a precise alignment of the generator with the diode array.

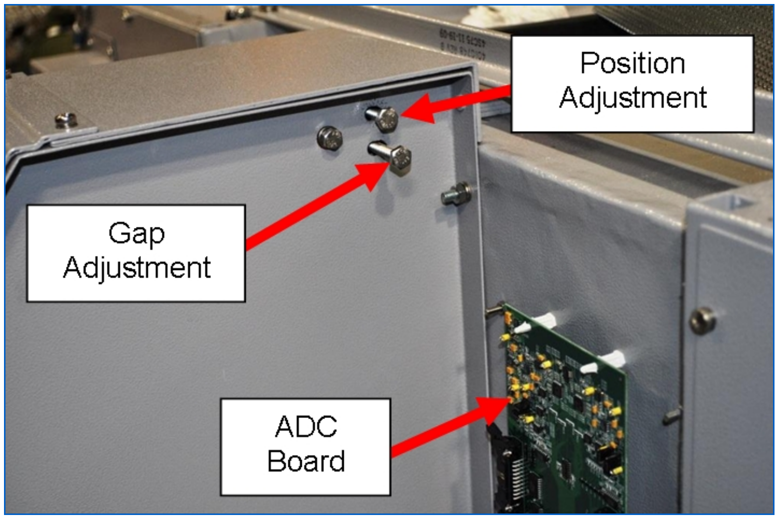


Figure 283: Gap and Position Adjustments

Procedure

1. Adjust the Gap screw to reduce the gap, narrowing the X-ray beam in the tunnel. The system should be in Diagnostics and QA mode, displaying raw data with Low Energy being displayed (toggle “P” on the operator control panel until only low energy is showing on the array response screen). To track the change, noise accumulation mode should be on (toggle the “O” button on the operator control panel to turn accumulation on and off).
2. Continue to reduce the gap until the signal intensity just begins to diminish.
3. Using the Position screw, slide the Collimator to the left or the right, in order to regain signal intensity.
4. Continue closing the gap whilst moving the Collimator from left to right to the point at which any further adjustment will reduce the signal intensity.
5. If the peak intensity is too high, i.e. falls to the right of the second blue line on the array response screen, verify that the gain setting of the board is not too high.
6. Once the optimal setting has been achieved, save the screen using buttons J and 3.
7. Check that the signal has not drifted. This is done by turning on X-rays and restoring the saved screen (button D to turn on X-ray, and button 0 to restore saved screen). The current data will wiggle while that of saved screen will not.
8. Adjust the diode array carriers if necessary by turning the screws at the side of the diode array box, until a maximum signal is achieved within the vertical lines and that the signal is uniform i.e. follows a straight line with no reduction in signal intensity at the edges.
9. Bolt down the Diode Array and check that the signal has not drifted.

WARNING: Always have the cover fitted when X-rays are on.

10. When the collimation is complete, the secondary collimator must be closed up to reduce X-ray leakage from the lead curtains. Close the secondary collimator as far as possible without affecting the array response.

14.3 Beam Profile

The X-ray generator has a target made of metal that expands when it heats up. This causes the X-ray beam to deflect slightly.

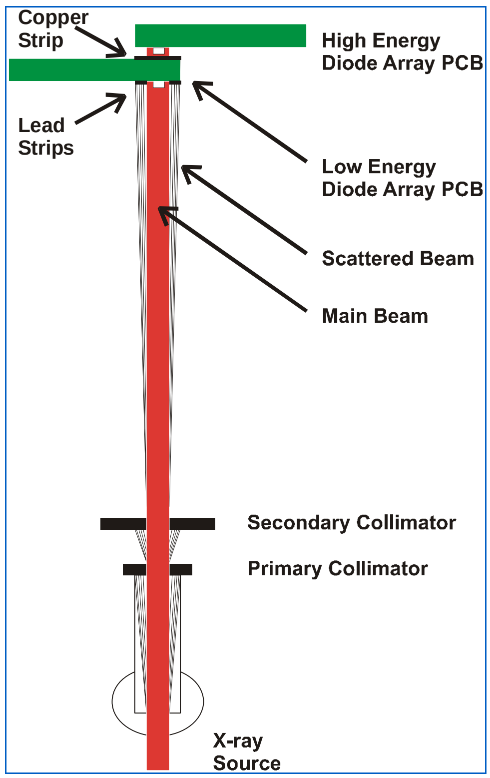


Figure 284: Correct Alignment

This beam profile shows the centre of the main beam going through both the high energy and low energy diodes. The lead strips on the low energy diode array PCB are stopping the scattered beam.

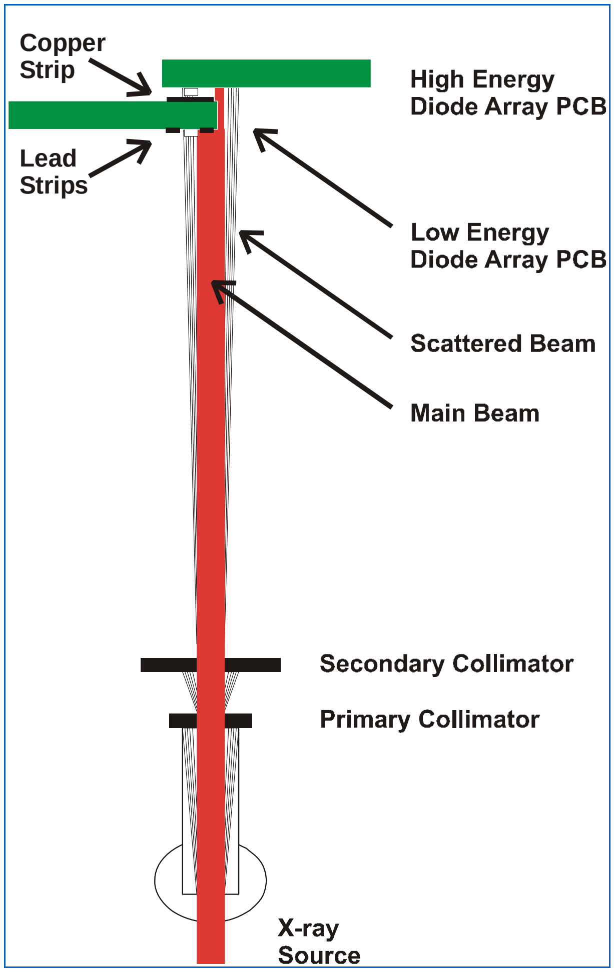


Figure 285: Incorrect Alignment

This beam profile shows the main beam is missing the diodes. The scattered beam is striking the diodes giving a poor signal.

14.4 Final Check

Validate the quality of your collimation as follows:

1. Turn the system off for an extended period, 15 minutes or more. This allows time for the generator to cool down. Turn on the system and enter System Service.
2. Check the array response has not deteriorated from when the X-ray generator was warm.
3. Tighten the four nuts securing the generator cradle and the six nuts on the primary collimator. Check that the array response does not worsen when these screws are tightened. Perform a complete X-ray radiation check.

14.5 Additional Notes On Signal Drift.

Drifting to the right indicates that the centre of the beam has moved into the detector.

Drifting to the left indicates that the centre of the beam has moved away from the detector. The drift observed on screen is magnified by the gain setting on the Diode Array Board. If any single Diode Array Board setting is incorrect in comparison with its neighbors, the drift of that Diode Array Board will be out of line with its neighbors.

If the drift on one end of the system is significantly higher than the other, the detectors on the high drift end are not aligned with the X-ray beam.

If the drift of the system goes up on one side and down on the other, the detector rail is diagonal to the beam.

If the drift of one board shows one end going up while the other goes down, this single board is crossing the beam.

If drift on one end of a board is more than the other end, the board is not lined up with the beam

If drift on one LE scintillator module (16 channels) differ from next module, it could be caused by displacement of the scintillator module relative to other on the same DAB

If all boards on the same rail show similar alignment problem, it could be that the rail is twisted

Another possible cause for all boards on the same rail to have a similar alignment problem is the X-ray beam being at an oblique angle to the detector box. This is a strong possibility when the symptoms appear on the side box of the system

15.0 X-ray Control PCB

15.1 Description

Please refer to the schematic diagram while reading this section.

The X-ray controller is fed from the X-ray power supply on the main chassis assembly. It is supplied with two voltages, one 60V D.C. unregulated and one at +12V D.C. regulated. There is also a relay that controls the supply. This supply is enabled by the relay if the thermal trip is closed and the main trip on the X-ray control PCB is on (LP1 ON). The main trip is reset when the 'X-ray on' signal is turned off.

The X-ray controller runs in two states, namely 'standby' and 'X-rays On'. In standby mode, RL1 is off and IC2 and associated components put a fixed power (set by VR3) into the X-ray filament with the high voltage off. The purpose of this is to keep the filament warm ready for the 'X-rays on' transition (see Standby Current Adjustment). In ‘X-rays On’ state, RL1 is on, and IC9 controls the voltage at FS1, FS2 that in turn controls the anode and cathode high voltage in the X-ray head via IC1 and associated components. IC1 works at a fixed duty cycle of 25% (after tuning) and it is the voltage at +v KVIN that determines the output voltage. This voltage is controlled by IC9 and has an upper limit of about 44V D.C., limited by ZD13.

Figure 286: 180 kV Generator X-ray Control PCB (P/N: 91001)

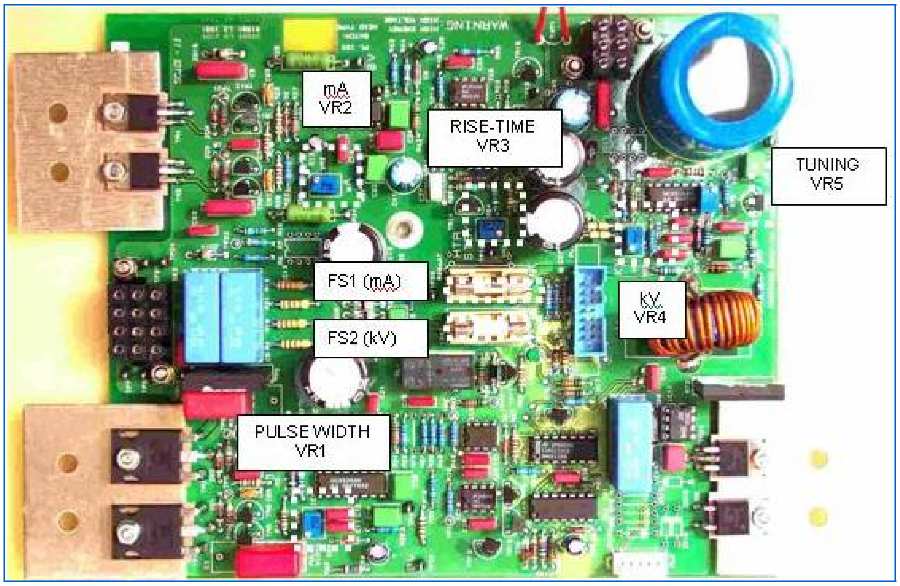


Figure 287: 91001 X-ray Control PCB

The output driving frequency for IC 1,2 and 9 are all synchronized via LK1 and LK2. IC3 and IC6 are serial A/D converters and are used to measure the beam current and +kV respectively; these signals route via PL1 to the Main Control PCB. TP12 is a test point for measuring the –kV supply and is typically 4.21V for 150kV output. IC4 and IC5 are comparators for measuring over voltage, over current and X-ray on signals. An over voltage or over current situation will ‘set’ IC7 pin 2 and turn lamp LP1 off and disable the X-rays. VR4 (marked kV) is used to set the voltage to e.g. 150kV, and VR2 (marked mA) to set the current to 1.8mA +/-0.01mA. In both cases, turning the potentiometer clockwise will increase the value. IC12 and IC13 can be used to replace VR4 and VR2. This will enable the kV and mA to be set by the computer software.

NOTE: VR1 is set at the factory and must not be adjusted in the field.

15.2 Specifications

Output voltage: 160kV +/-2kV

Output current: 1mA +/-0.05mA

NOTE: The output voltage and current may be set differently according to the type of X-ray machine the X-ray generator is installed into. The recommended setting is documented on the product test record, which is located in the document wallet inside the X-ray machine.

WARNING: If an X-ray head or Head Control PCB has been changed or adjusted, then the unit must be checked with an X-ray monitor such as the Minimonitor type D. These instruments must contain a compensated G.M. tube, and be calibrated in µSv/hr or mRem/hr - not counts/sec. They must have a valid calibration certificate. If the measurements are outside those permitted by the regulations in force in the country of installation, the X-ray generator current must be reduced or other measures taken to ensure compliance.

15.3 Standby Filament Current Adjustment

It is not normally necessary to adjust any controls on the X-ray control PCB. This PCB is matched to its generator and should be changed with the generator if suspected to be faulty.

Before making adjustment to the standby filament current, the voltage and current should be set to 140kV and 0.7mA respectively, using the ‘kV’ and ‘mA’ potentiometers.

The following figures demonstrate the adjustment of the potentiometer VR3 on the X-ray Control PCB to set up the filament current. An oscilloscope or the Generator Ramp screen in Service Mode can be used to set up the X-ray head.

Incorrect Adjustment

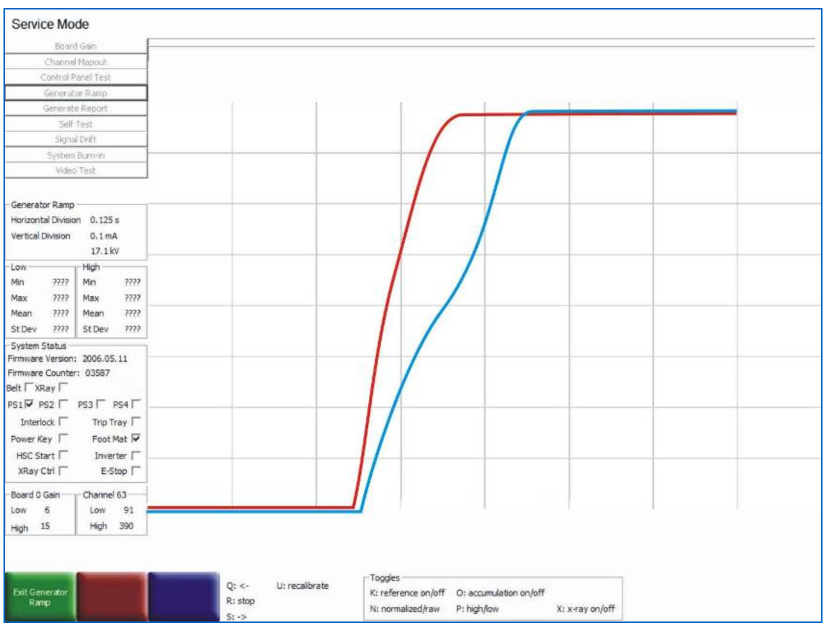


Figure 288: Voltage Rising Too Rapidly, Current Too Slowly

The voltage is rising too rapidly, and the current rising too slowly. Red trace: Voltage feedback. Blue trace: Current feedback (This screen is simulated).

Incorrect Adjustment

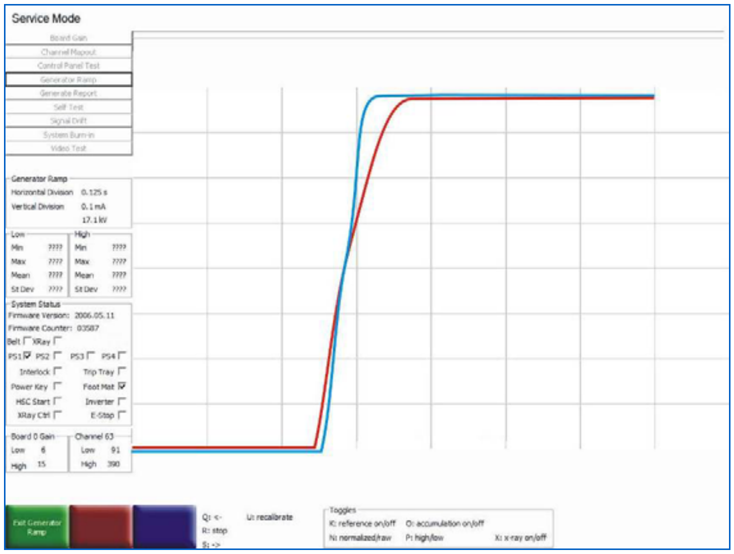


Figure 289: Voltage Rising Too Slowly, Current Too Quickly

The voltage is rising too slowly, and the current rising too quickly. A setting such as this is liable to cause a trip. Red trace: Voltage feedback. Blue trace: Current feedback (This screen is simulated).

Correct Adjustment

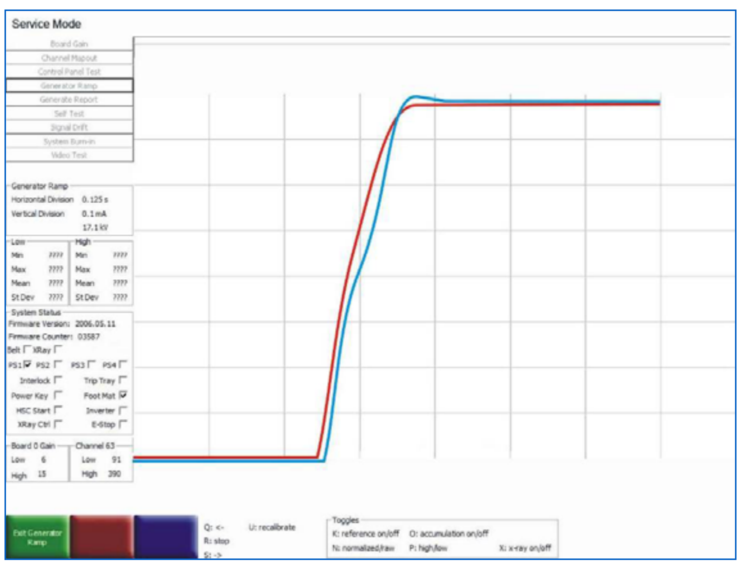


Figure 290: Voltage and Current Rise in Synch

The voltage and the current rise times are similar. This is an ideal setting. Red trace: Voltage feedback. Blue trace: Current feedback (This screen is simulated).

15.4 Fuses

FS1	T1.6A
FS2	T15A

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16.0 Data Acquisition System

16.1 Detector System Architecture

The Data Acquisition system comprises the computer, Control Interface PCB, Analog to Digital Converter PCB and Diode Array PCBs.

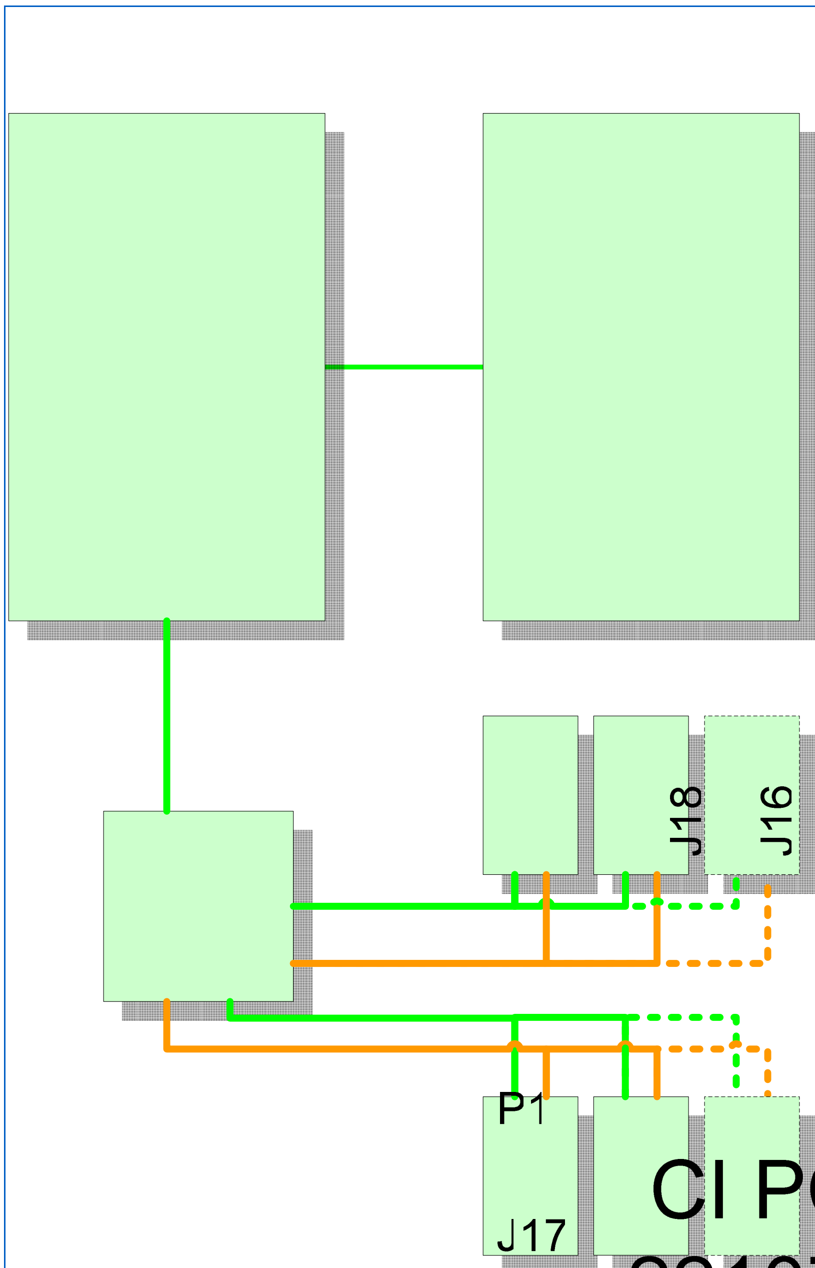

Figure 291: Data Acquisition System Block Diagram

Control Interface PCB

The C.I. board is used to control timing, store uploaded parameters, collect array board data from the A to D PCB and send it to the scan engine software on the computer through the National Instruments DIO card PCI-653x. For more details see the section on the C.I. PCB.

Analog to Digital Converter PCB

The function of the 16 bit Analog to Digital Converter PCB is to pass the address signals from the C.I. board to the diode array PCBs. The diode array boards then present analog data to the A to D PCB which is converted to digital data and presented to the C.I. PCB. For more details see the section on the A to D PCB.

Diode Array PCB

A bank of Diode Array boards are used to convert the beam of X-rays into an electrical signal which is converted to digital data by the A to D Converter PCB, and is then interpreted by the computer to produce an image. Two banks (High Energy and Low Energy) of boards are used. The same base board is used, and this is configured to be a high or low energy board.

Different machine sizes use a different number of diode array boards and there are two sizes.

17.0 Diode Array

WARNING: Handle the diode array PCBs only by their edges. The PCB will malfunction if a finger mark or other contamination is present.

17.1 Part Numbers

2278506	Diode Array PCB Assy, large with 2.5mm low energy detectors
2278507	Diode Array PCB Assy, large with 2.5mm high energy detectors

17.2 Diode Array PCB Description

A bank of Diode Array boards are used to convert the beam of X-rays into an electrical signal which is converted to digital data by the A to D Converter PCB, and is then interpreted by the computer to produce an image. Two banks (High Energy and Low Energy) of boards are used. The same base board is used, and this is configured to be a high or low energy board.

Different machine sizes use a different number of diode array boards and there are two sizes.

NOTE: These diode array boards are not interchangeable.

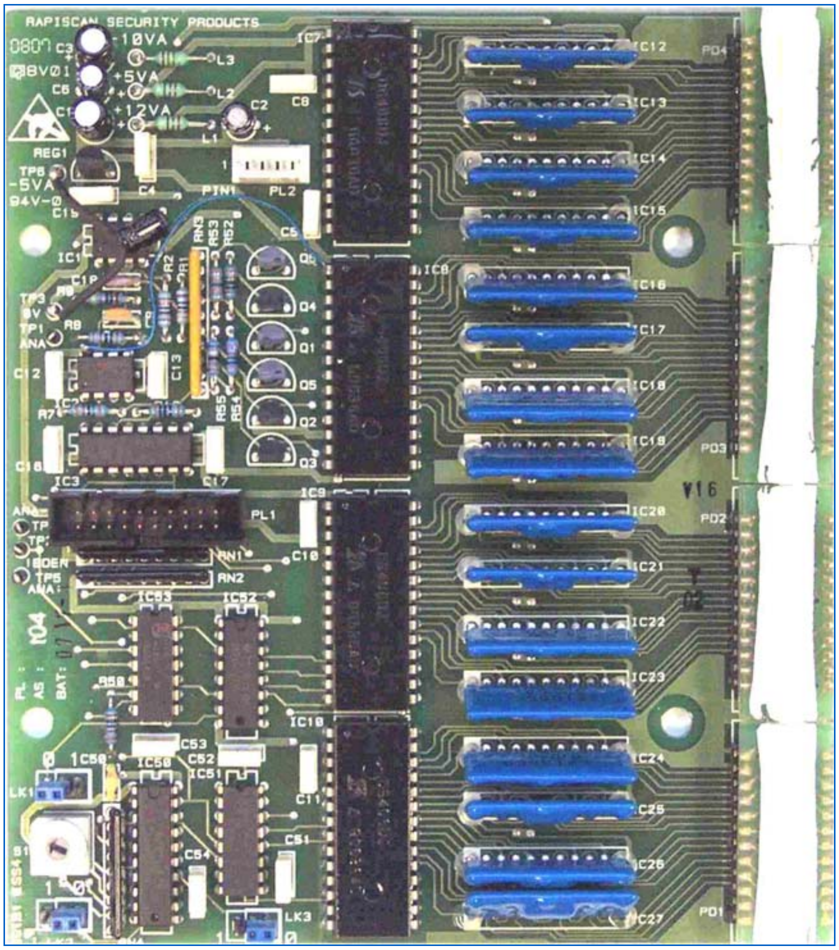

Figure 292: Large Diode Array PCB

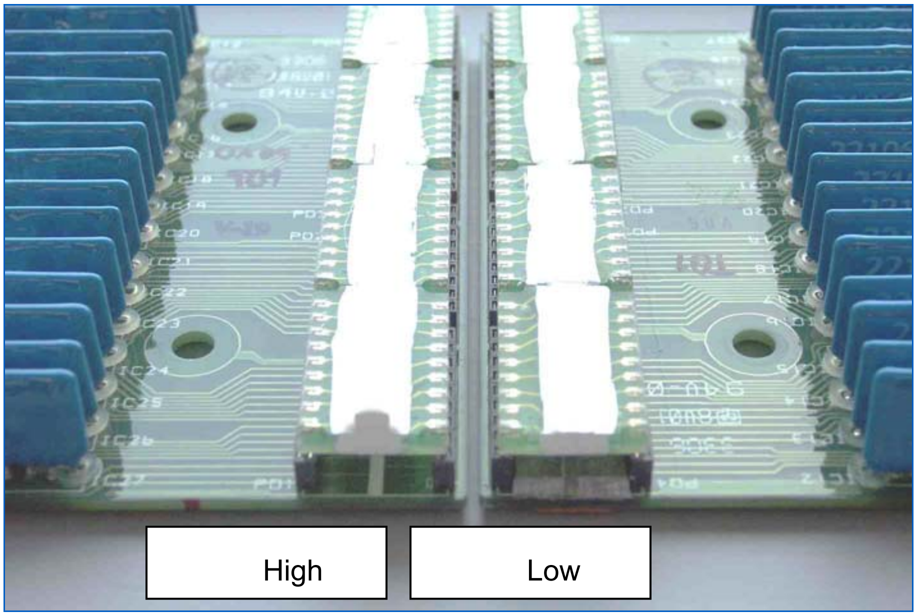

Figure 293: High Energy / Low Energy comparison

The low energy diode array PCB is fitted with lead strips to help stop scattered X-rays from reaching the high energy PCB.

Analogue Circuitry

There are sixty-four detector diodes on the Diode Array PCB (each package contains sixteen diodes). The diodes are used in photo-voltaic mode; there are 64 virtual-earth amplifiers to achieve this. The amplifiers are hybrid circuits to prevent the ingress of moisture affecting their operation. The output from the hybrid passes through an R-C filter network and enters the multiplexer device (DG406). The outputs from the four DG406 devices are connected together and proceed to IC1 which is used as a buffer. The amplitude of the signal from the diodes is adjusted by IC2-A, Q1 to Q6 and associated circuitry. The MOSFET transistors switch gain resistors in or out of circuit to alter the gain of IC2-A. After IC2-B (buffer) the signal enters a DG201 analogue switch. This device only passes the signal to the A to D PCB when the Diode Array board is selected. The analogue signals from the inner and outer boards appear simultaneously at the A to D board.

Digital Circuitry

The bank of Diode Array boards in an X-ray machine is controlled by the Control Interface board. The CI board sends out an address to select one pair of diodes (one on an inner board, one on an outer) in the bank. The analogue data from these diodes passes through the ribbon cables to the A to D PCB where it is converted to twelve-bit digital data. For more information about this subject see the section on the A to D PCB. On the Diode Array PCB, the board recognizes that it has been selected when the data on address lines A6-A9 matches the board address set by the hexadecimal switch. IC50 (HC688) performs this function by comparing its P and Q inputs; when the data matches, BDEN goes low on both the inner and outer board. When BDEN goes low and A11 is high, IC 51 is selected and decodes address lines A4 and A5. This selects one of the four DG406 devices, and address lines A0-A3 select one diode from this channel.

Gain Latch

The board gain latch data is held in an EEPROM device on the CI board. This information is retained if the machine is switched off. During power-up, the CI board writes the gain latch data to the Diode Array PCBs. This is achieved by putting the data onto address lines A0 to A5 and pulsing address line A11 low. To allow the gain latch on the inner and outer boards to be accessed independently, link LK1 is used. If position 1 is linked, then the inner board gain latch is selected. A link in position 0 causes the outer board latch to be selected. Address line A10 is the inner/outer board select signal from the CI board. The gain data on address lines A0 to A5 is latched into IC52 (HC174) when BDEN is low, A10 is selecting the current (inner or outer) array, and A11 is pulsed low. Components R50 and C50 prevent corruption of the gain latch by spikes.

17.3 Switch Settings and Links

Each pair of diode array PCBs has the same board address, which is selected by rotary switch S1. This switch is set to zero on the boards nearest the cable exit from the array box. The addresses are then set sequentially in ascending order away from position zero.

Address	
0	Side Small
1	Side Small
2	Side Small
3	Top Small
4	Top Small
5	Top Small
6	Top Small
7	Top Small
8	Top Small
9	Top Small
A (10)	
B (11)	
C (12)	
D (13)	
E (14)	
F (15)	
0 (16)	

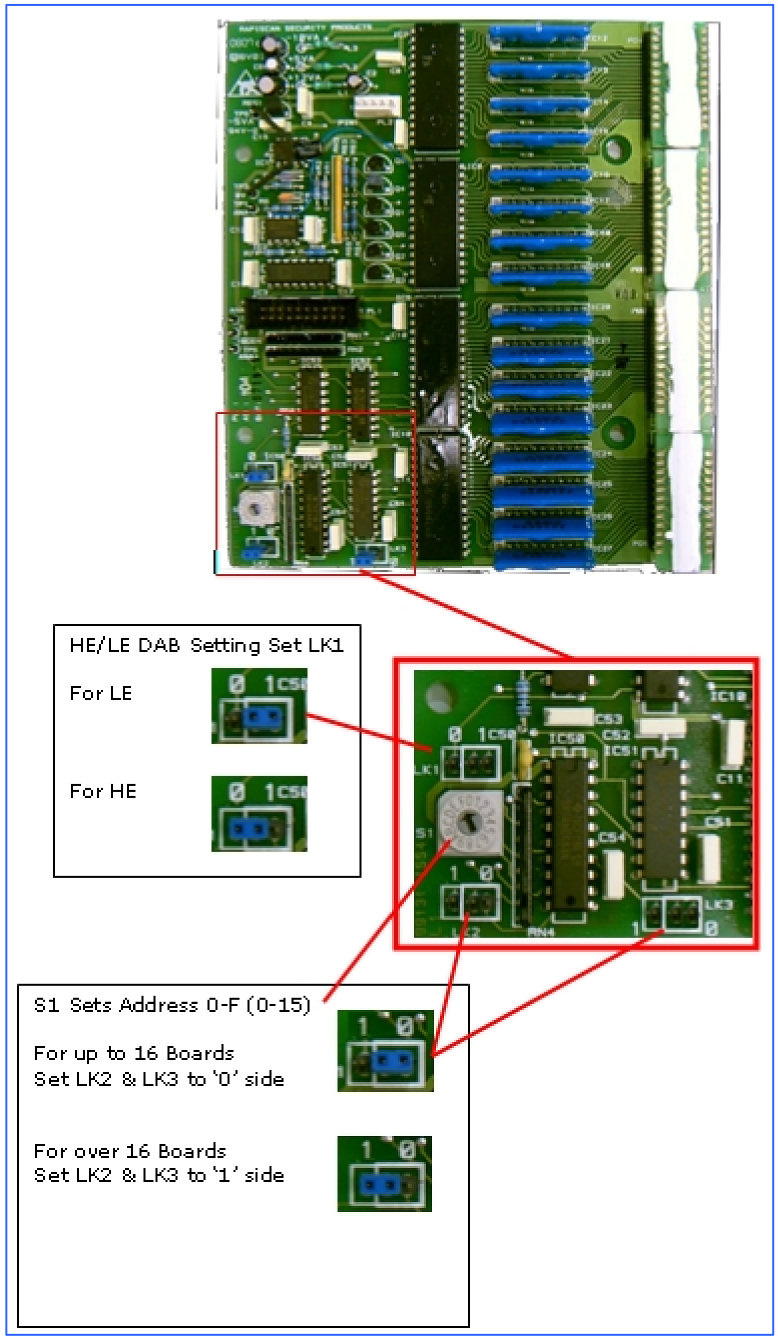

Figure 294: Switch and Jumper Settings and Links

17.4 Replacing a Diode Array Board

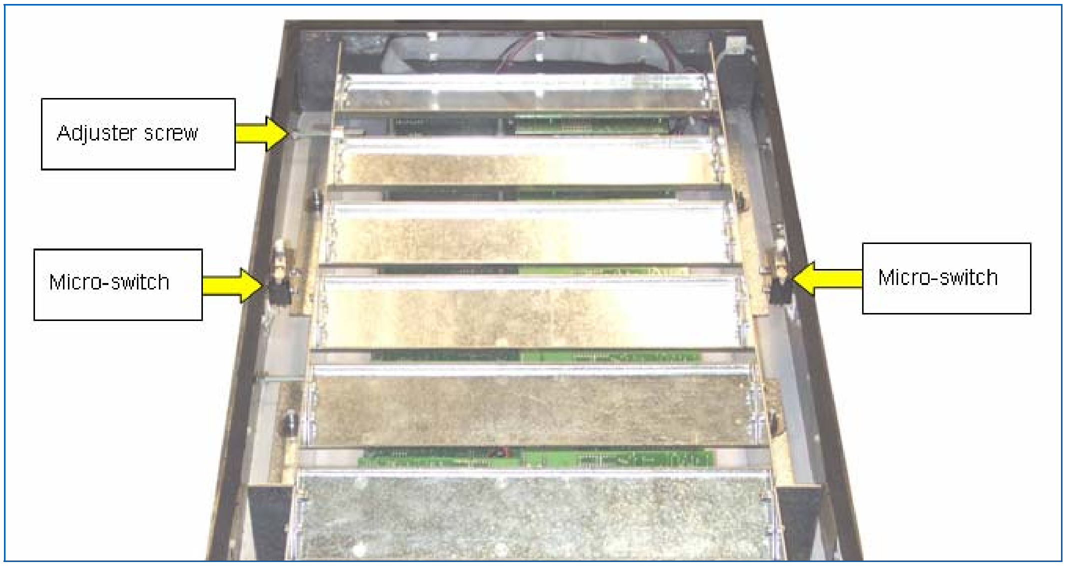

Figure 295: Diode Array Box

1. Switch the X-ray machine on and enter System Service mode by logging in as SERVICE2.
2. Select the System Service button (Figure 296).
3. Select 'Diagnostics and QA'. This option allows one to view the signal from the detectors as well as to recalibrate, edit gain, normalize data, and do channel analysis.

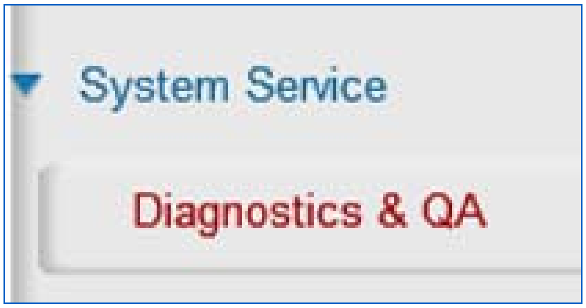

Figure 296: Diagnostics & QA

4. Select 'Diagnostics and QA'. This option allows one to view the signal from the detectors as well as to recalibrate, edit gain, normalize data, and do channel analysis.
5. Using the '2' and '8' keys on the control panel, select 'Board Gain' from the menu by pressing '5'.

Figure 297: Board Gain Screen

6. Move the green stripe down to the faulty section by using the ‘2’ and ‘8’ keys. The board number will be displayed in the box at bottom left.
7. Press the green button to exit service mode and turn the machine off.

FOR THE SIDE DIODE ARRAY BOX:

1. Remove the side panel to gain access to the side diode array box.
2. Remove the screws holding the lid of the box, and remove the lid (Figure 298).

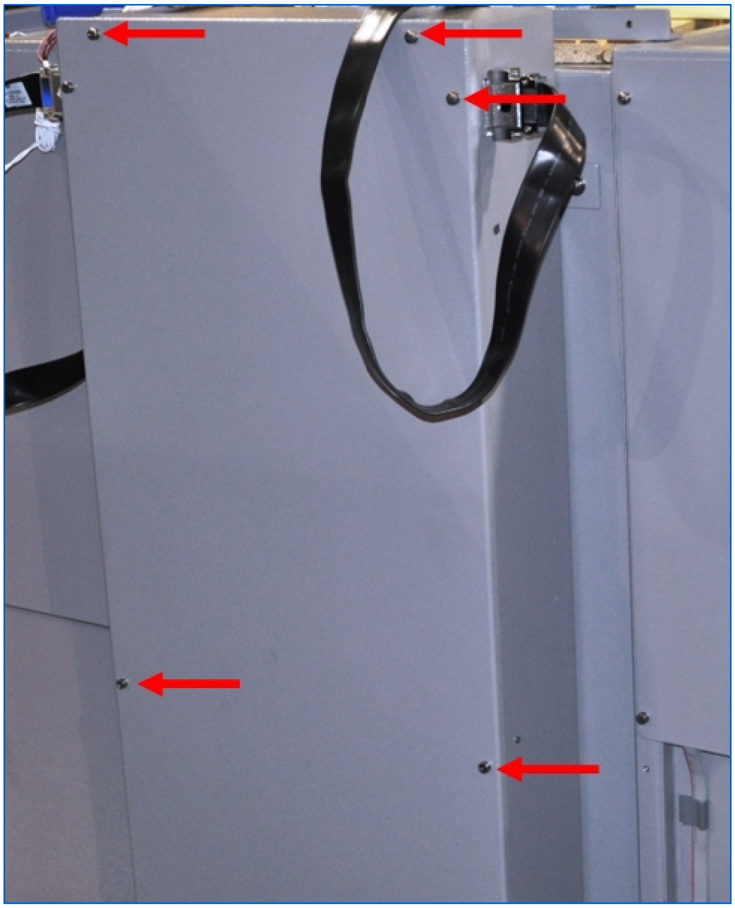

Figure 298: Side Diode Array Box Lid and Mounting Screws

FOR THE BOTTOM DIODE ARRAY BOX:

1. Remove the mounting bolts for the bottom Diode Array Box – there are two mounting bolts on the back of the bottom Diode Array Box (Figure 299) and two on the front of the Diode Array Box (Figure 300).
2. Unplug the Signal Cables from the back of the Diode Array Box (Figure 299).
3. Grab the handle on the front of the Diode Array Box beneath the Electronics Cabinet (Figure 300) and carefully pull the lower Diode Array Box out from under the X-ray machine.

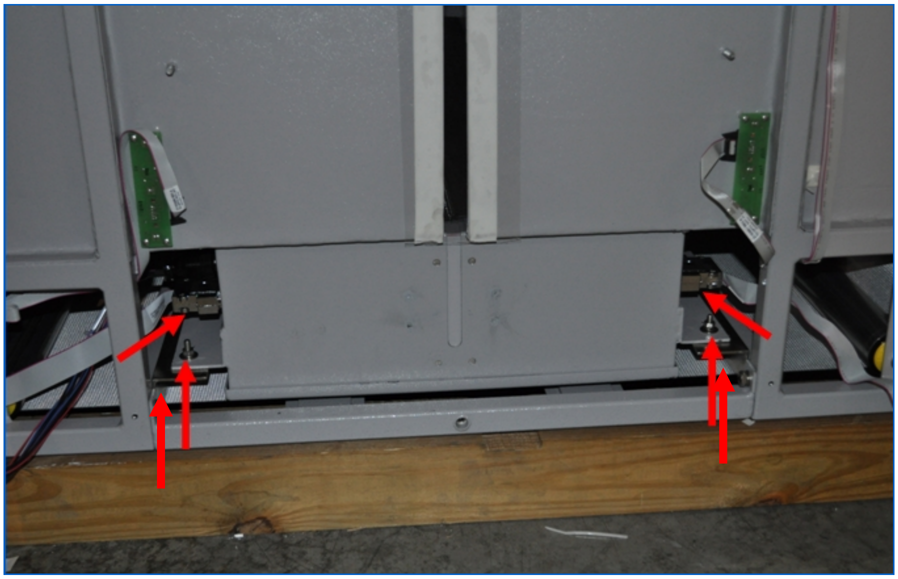

Figure 299: Back of Bottom Diode Array Box, Mounting Bolts an Signal Cables

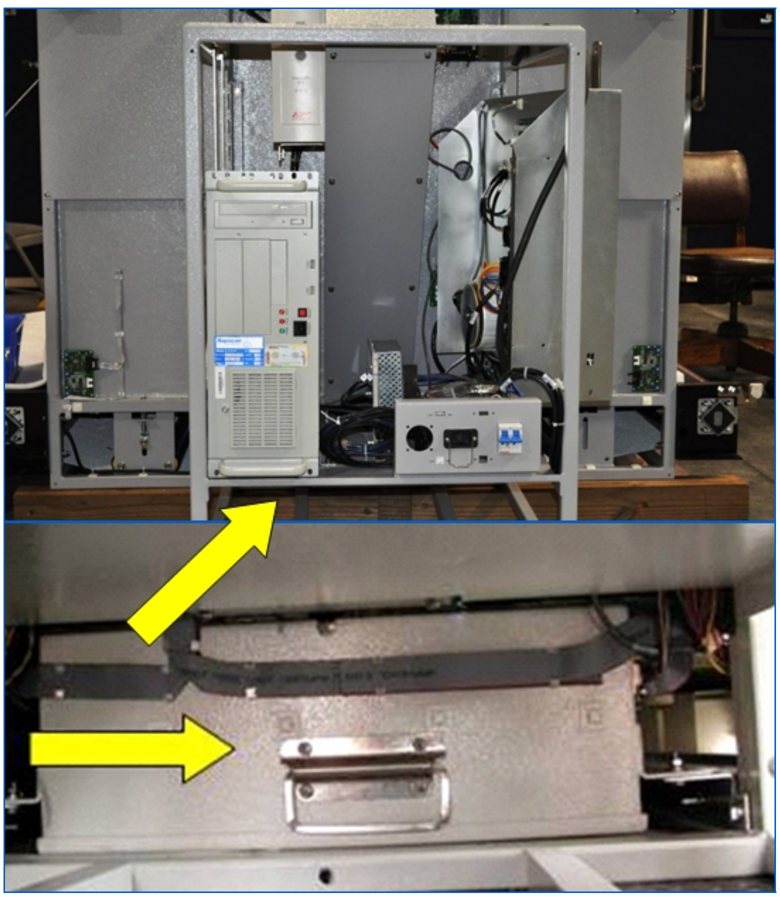

Figure 300: Front of Bottom Diode Array Box (with handle)

For Both Side and Bottom Diode Array Boxes:

1. Locate the suspect diode array board, and remove its carrier screws. A right angled screwdriver is useful here.

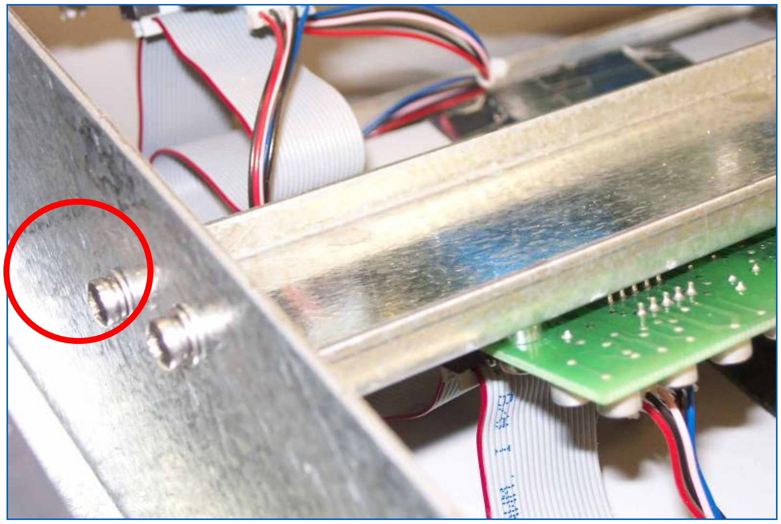

Figure 301: Array Board Carrier screw

2. The diode array board is held on by four screws. Remove the screws and pull the cables off. Hold the diode array board by its edges only.

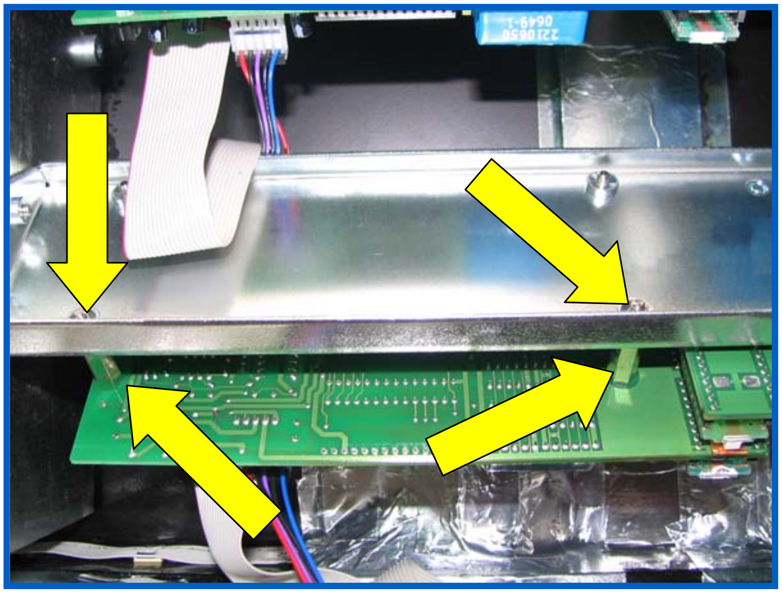

Figure 302: Diode Array Board Mounting Screws

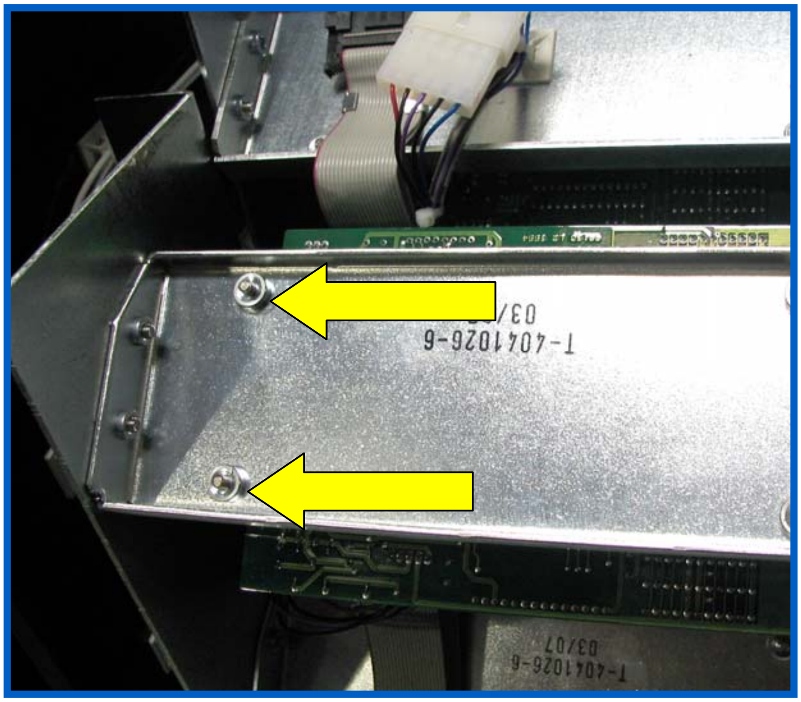

Figure 303: Diode Array Board Mounting Bolts (close-up)

3. Take the new diode array board from its anti-static bag, and install it in position.
4. Ensure the switches and links are set in the same manner as the old board, and that the correct (high energy or low energy) type is fitted.
5. Connect the cables up to the new board, and replace the carrier in the same position.
6. Replace the lid, turn the machine on and enter service mode to check the problem is cured.

17.5 Manually Mapping Out a Diode

If two array boards overlap (one board is in front of another at the edge) then the diode that is in the shadow will cause a line on the image. The image processing software can be told to ignore the diode by ‘mapping out’. You might also want to map out a diode if it has gone faulty, but don’t want to replace the whole array board.

1. Switch the X-ray machine on and enter System Service mode by logging in as SERVICE2.
2. Select the System Service button.

Figure 304: Diagnostics & QA

3. Select ‘Diagnostics and QA’. This option allows one to view the signal from the detectors as well as to recalibrate, edit gain, normalize data, and do channel analysis.
4. Using the ‘2’ and ‘8’ keys on the control panel, select ‘Channel Mapout’ from the menu by pressing ‘5’.

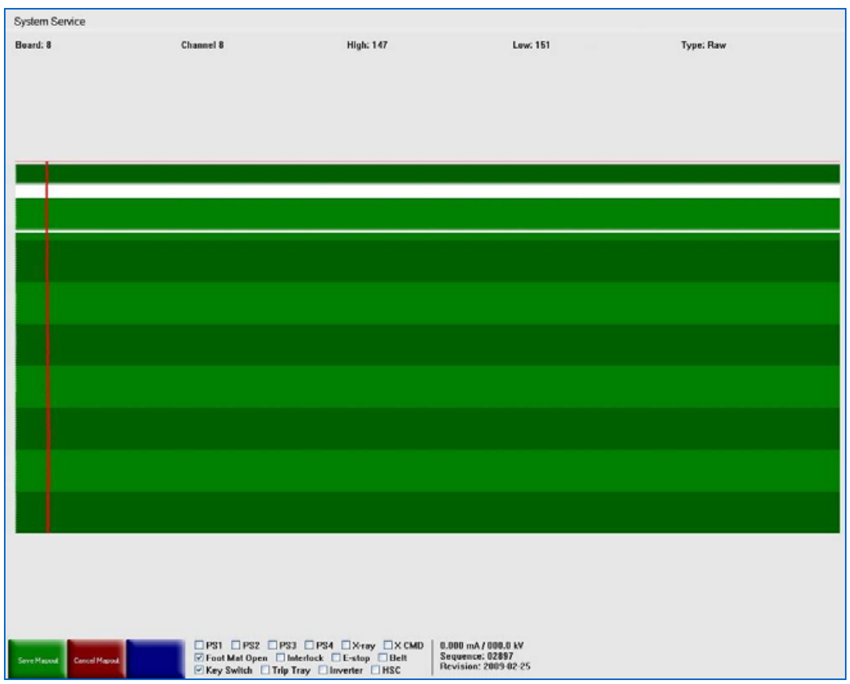

Figure 305: Channel Map-out

5. Switch on X-rays and locate the faulty diode. Move the yellow line down to the diode by using the ‘2’ and ‘8’ keys (use ‘3’ and ‘9’ to jump a board).

6. Press ‘5’ to map out the diode. The diode will be marked black to show it is mapped out.

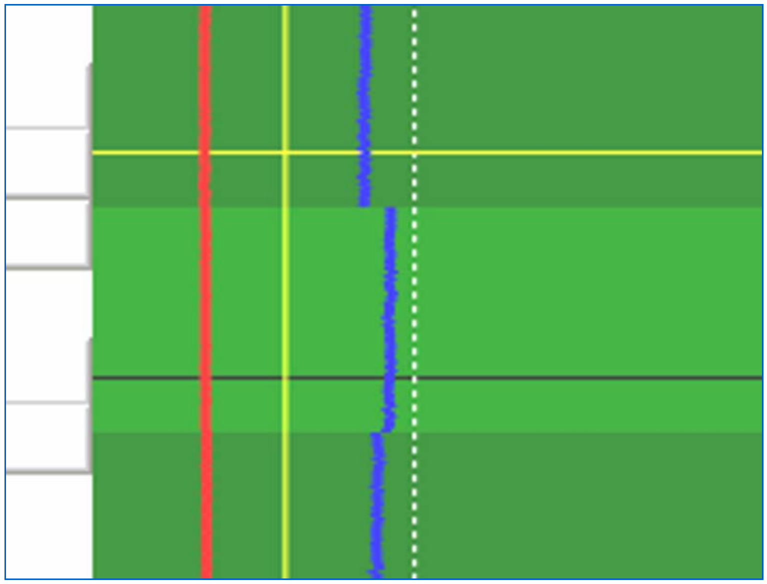

Figure 306: Map-out Detail

7. To save the map-out information, press the green button.
8. To remove a map-out, position the yellow line in the same position and press ‘5’. The yellow line will turn red when highlighting a mapped-out diode.

NOTE: Auto map-outs are shown in white.

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18.0 Control Interface PCB

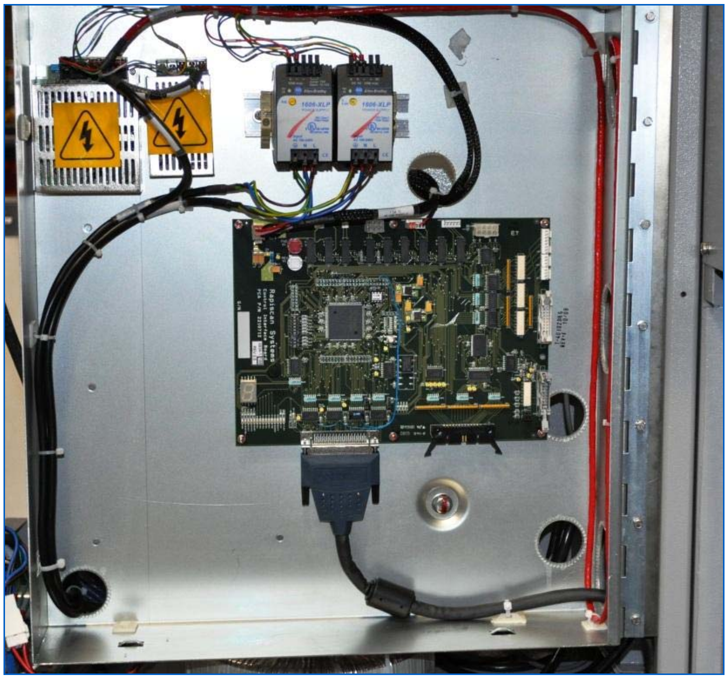

Figure 307: Control Interface (CI) Board

The Control Interface Board (part number 2210712) is located on the Electronics Chassis (Figure 307). This PCB (Figure 312) has circuitry connected to the ‘Power On’ switch, Diode Array door microswitches and emergency stop switches.

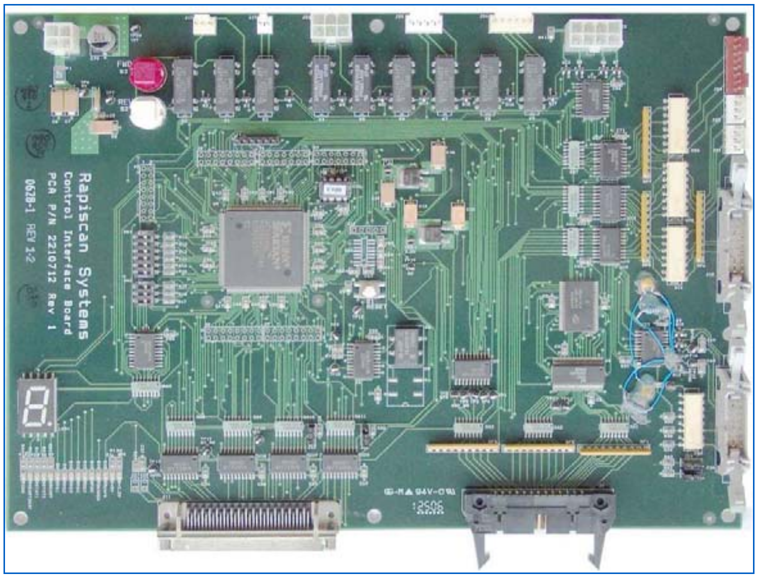

Figure 308: Control Interface PCB

18.1 Part Number

2210712 Control Interface PCB

18.2 Description

The C.I. board is used in the data acquisition system to control timing, store parameters, collect detector data from the analogue to digital converter board and communicate with the scan-engine software on the computer through the National Instruments card. It consists of five sub-modules which are ADC Interface, RS232 Serial Interface, Scan-engine PC Interface, I/O module interface, and on-board switches interface. These five modules are synchronized to each other by 15MHz master clock (MCLK).

18.3 CI Board Theory of Operation

At the start-up, the ScanEngine software is waiting for CI board ready, indicated by ci_ready signal goes high. After Scan Engine receives a ci_ready signal, it will send to the CI board the ni_wr_rd, ni_ram_wr, DAB board Addresses, and DAB Gain & Offset. The below timing waveforms diagram describe the relationship between these signals:

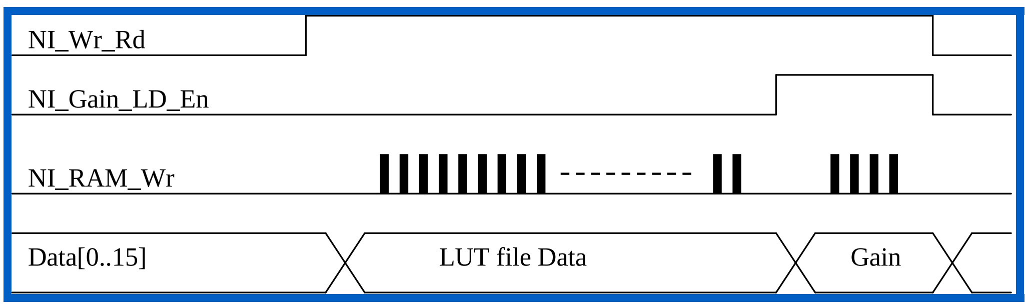

Figure 309: System Start-up Timing Diagram

The ScanEngine software will send 4 words of data to CI for each channel via NI DIO PCI-653x card. The first words are for Low Energy Channel Addresses, the second word is for High Energy Channel Addresses, the third word is for Low Energy Channel Gain & Offset, and the forth word is for High Energy Channel Gain & Offset. The third & forth words are divided into low byte and high byte. The low byte [0..7] is for Offset control and high byte [8..15] is for Gain control.

After finishing upload data to CI, the ScanEngine software will turn both NI_Wr_Rd and NI_Gain_LD_En signals to low and ready to read data from CI board.

When the data from ADC is ready, then the CI will send data to ScanEngine via NI card. Assuming the NI_Wr_Rd & NI_Gain_LD_En signals are already switched to low and ScanEngine is ready to receive data in; there is a control signal associates to this event, which is the ni_dval signal. The ni_dval signal indicates the data is ready for NI to pick-up. The ni_dval is tied up to Req1 signal of NI card.

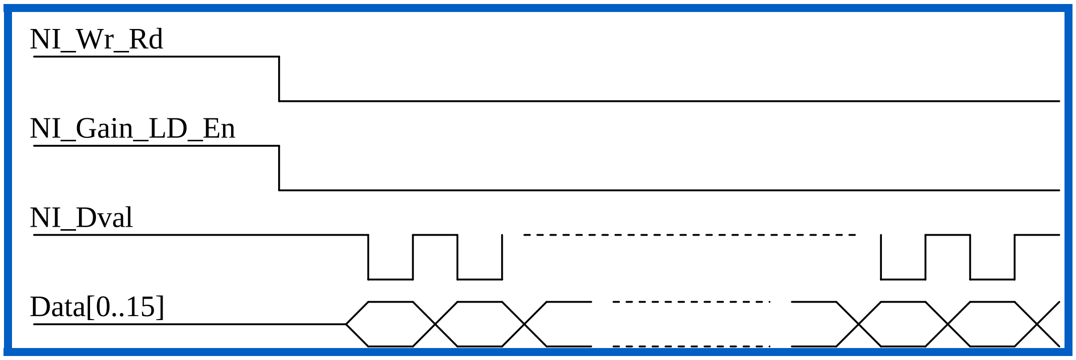

Figure 310 - Data Transfer Waveform

18.4 ADC Interface

The CI board interfaces with the ADC through a 26-pin connector. All the signals which interface between the ADC and C.I. boards are 5V TTL.

Signal Name	Dir	#	Function Description
Data[0..16]	IO	16	Bi-directional Data bus (Low Byte). Output direction happens when CI board uploads the constraint parameters up to ADC board. Input direction happens when CI reads detector data from ADC
Sel[0..2]	O	3	Operation Mode Selection. These are control signals from CI board to ADC to specify the operation mode of data transaction. 000 Address B Clock 001 Address A Clock 010 Gain & Offset A Clock 011 Gain & Offset B Clock 100 Convert A Clock 101 Convert B Clock 110 Read A Clock 111 Read B Clock
ADCWR	O	1	ADC Write & Read signal. 1 = CI write parameters to ADC 0 = CI read detector data from ADC
ADCSTB	O	1	ADC Strobe signal. This signal is used to strobe data into the buffer.

Pin No.	Function	Pin No.	Function	Pin No.	Function	Pin No.	Function
1	GND	8	Data6	15	Data13	22	GND
2	Data0	9	Data7	16	Data14	23	ADCWR
3	Data1	10	Data8	17	Data15	24	GND
4	Data2	11	Data9	18	GND	25	ADCSTB
5	Data3	12	Data10	19	Sel0	26	GND
6	Data4	13	Data11	20	Sel1		
7	Data5	14	Data12	21	Sel2		

18.5 RS232 Serial Interface

The RS232 Serial interface connects to third party devices through a 5-pin header connector.

Pin	Signal Name	Dir	Functional Description
1	Rx	I	Receiving Data
2	CTS	I	Clear to send
3	Tx	O	Transmitting Data
4	RTS	O	Ready to send
5	GND	N/A	0V

18.6 Scan-engine PC Interface:

The CI board interfaces with Scan-engine PC via the NI DIO card PCI-653x. There is a 32-bit digital interface between NI PCI-653x card and the C.I. board. This DIO bus is divided into four groups, which are group A (DIOA), group B (DIOB), group C (DIOC) and group D (DIOD). Some of the signals (marked 'cargo') are not used on 600 series machines.

Signal Name	Dir	#	Description
DIOA	IO	8	Bi-directional Data bus (Low Byte). Output direction happens when NI card upload the constraint parameters up to CI board. Input direction happens when CI send DAB data to NI
DIOB	IO	8	Bi-directional Data bus (High Byte). Output direction happens when NI card upload the constraint parameters up to CI board. Input direction happens when CI send DAB data to NI
DIOC	I	8	Control signal from CI to NI DIOC[0] = xray_on 1 = X-Ray on 0 = X-Ray off DIOC[2] & DIOC[1] = CI_belt_status 00 = belt_fwd_stop 01 = belt_fwd 11 = belt_rev 10 = belt_rev_stop DIOC[3] = PS1 1 = PS1 is active 0 = PS1 is off DIOC[4] = ni_dval. (For cargo system only) This is pulse signal used to clock DAB data to NI card. DIOD[5] = ni_bclk. (For cargo system only)This is pulse signal indicate DAB board number in the array. DIOC[6] = ni_strtln. (For cargo system only)This is pulse signal indicate start of new scan line. DIOC[7] = Power_KeySwitch 1 = Power Key is on 0 = Power Key is off

Signal Name	Dir	#	Description
DIOD	O	8	Control signal from NI to CI DIOD[0] = ni_wr_rd & DIOD[5] = NI_Gain_LD_En DIOD[0] DIOD[5] (Mode selection) 10 = Upload LUT file from NI to CI 11 = Upload default DAB Gain Value from NI to CI 00 = Normal Operation (Scanning mode) 01 = Setting DAB Gain DIOD[1] = ni_ram_wr. This is pulse signal used to clock parameters from NI into CI board. The minimum pulse width is two mclk (140ns). DIOD[2] = xray_on_off 1 = X-Ray is on 0 = X-Ray is off DIOD[4] & DIOD[3] = ni_belt_status. 00 = belt_fwd_stop 01 = belt_fwd 11 = belt_rev 10 = belt_rev_stop DIOD[6] = Search. 1 = Search active 0 = No Search DIOD[7] = HiSpeed_Conveyor 1 = Run 0 = Stop

Pin No.	Function	Pin No.	Function	Pin No.	Function	Pin No.	Function
1	+5V	18	GND	35	GND	52	DIOB[3]
2	REQ1	19	GND	36	GND	53	DIOB[4]
3	ACK1	20	GND	37	GND	54	DIOB[5]
4	STOPTRIG1	21	DIOB[6]	38	DPULL	55	GND
5	PCLK1	22	DIOB[7]	39	GND	56	GND
6	PCLK2	23	DIOC[0]	40	CPULL	57	DIOC[1]
7	STOPTRIG2	24	GND	41	GND	58	DIOC[2]
8	ACK2	25	DIOC[3]	42	GND	59	GND
9	REQ2	26	DIOC[4]	43	GND	60	DIOC[5]
10	DIOA[0]	27	GND	44	DIOA[1]	61	DIOC[6]
11	GND	28	DIOC[7]	45	DIOA[2]	62	GND
12	DIOA[3]	29	DIOD[0]	46	GND	63	DIOD[1]
13	DIOA[4]	30	GND	47	DIOA[5]	64	DIOD[2]
14	GND	31	DIOD[3]	48	DIOA[6]	65	GND
15	DIOA[7]	32	DIOD[4]	49	GND	66	DIOD[5]
16	DIOB[0]	33	GND	50	GND	67	DIOD[6]
17	DIOB[1]	34	DIOD[7]	51	DIOB[2]	68	GND

18.7 On-Board Switches

The CI board has several DIP switches and links to configure the board according to the system it is used on.

Setting Table		
J4	Open	Jtag connector
J12	1-2*	Control Signals Direction sets for conventional systems
	2-3	Control Signals Direction sets for cargo systems
J13	2-3*	Control Signals Direction sets for conventional systems
	1-2	Control Signals Direction sets for cargo systems
J29	1-2*	D0 X-ray Control PCB internal pull-up
	2-3	D0 X-ray Control PCB external pull-up
J30	1-2*	X-RAY ON X-ray Control PCB internal pull-up
	2-3	X-RAY ON X-ray Control PCB external pull-up
SW1	111111*	Not Used
SW2	111*	FPGA Configuration Mode

* = Default setting

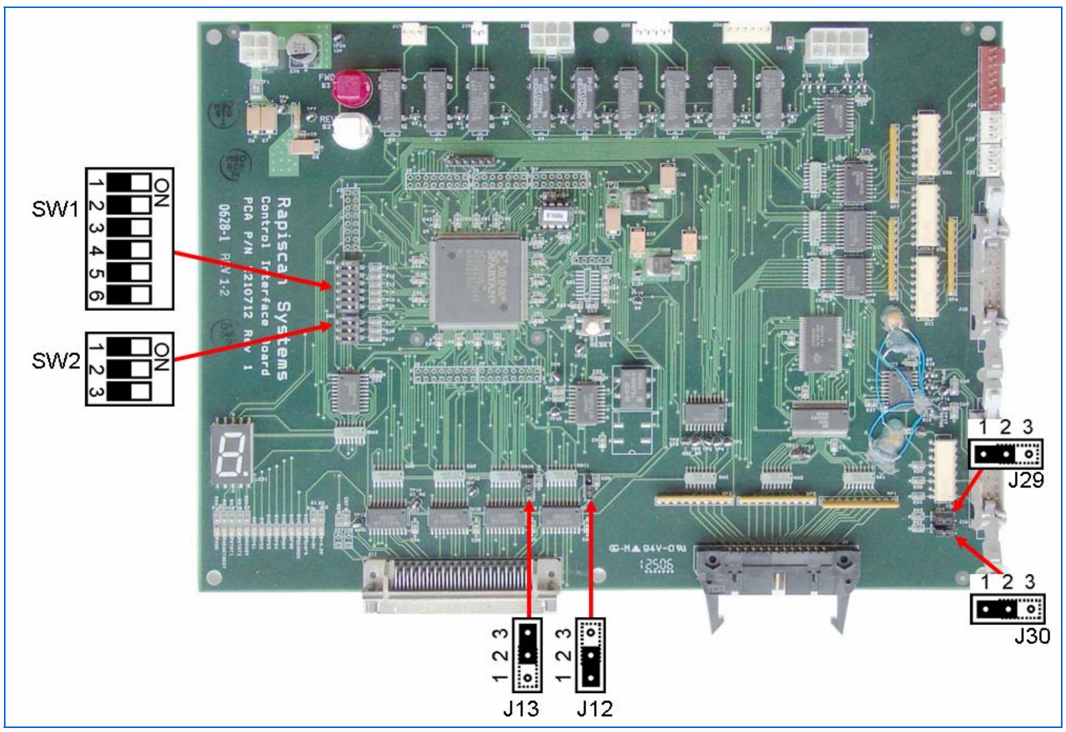

Figure 311: Control Interface PCB Links

18.8 I/O Module Interface

The CI board has 12 inputs and 12 outputs to control signals in the system such as photo-sensors, conveyor belt, interlocks, emergency stop etc.

18.9 Electrical & Environmental Specification

Power requirement:

- The CI board requires one power supply unit rating at +5V ± 0.25V @ 2Amps and +12V ± 0.25V @ 2Amps.

Power Connector

There are two 4-way header Molex connectors PN 39-28-1043, the pin allocation is as follows:

Pin No.	Function
1	+12V
2	0V
3	+5V
4	0V

Environmental Specification

Operating temperature:	0° C to 55°C
Relative humidity:	15 to 95 % non-condensing

18.10 Indicators

There are several LED indicators and one 7-segment LED on the CI board. The 7-segment LED can display only one error at a time. If there is more than one error, when the first is cured, the second will be displayed and so on.

Single LEDs

D1	+5V
D2	+3.3V
D4	Heartbeat (should be flashing)
D5	Upload from scan-engine in progress
D6	Upload has been successful
D7	Ready
D8	PS1 photo-sensor
D9	PS2 photo-sensor
D10	PS3 photo-sensor
D11	PS4 photo-sensor

D12	Conveyor is moving in reverse direction
D13	Conveyor is moving forwards.
D14	Search buzzer/ lamp is active
D15	Spare
D16	X-rays are on

7-Segment LED:

0 = System operating normally

1 = Power key-switch is off

2 = Trip-tray is active

3 = Diode array box interlock is active

4 = Inverter faulty

5 = Emergency Stop Active

18.11 Test points

Test points are provided to allow the user to place an oscilloscope probe or logic analyzer on critical signals.

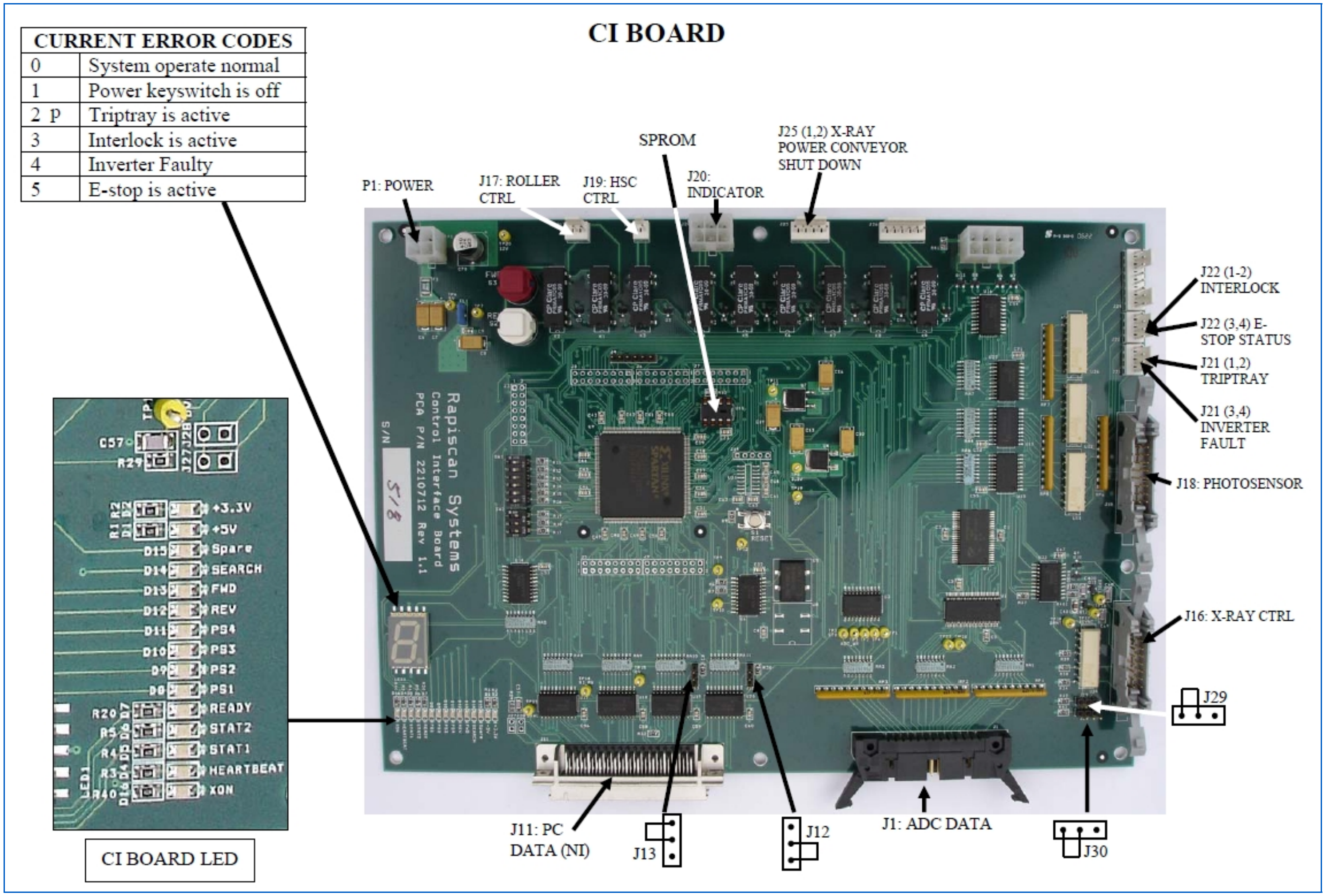

Figure 312: CI Board with Jumper Settings and Error Codes

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18.12 Replacing the Controller Interface Board

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the “Limitation on Liability” section, including the section on voiding the Rapiscan Systems warranty.

Note the arrows in Figure 313 that point to the mounting screws for this PCB.

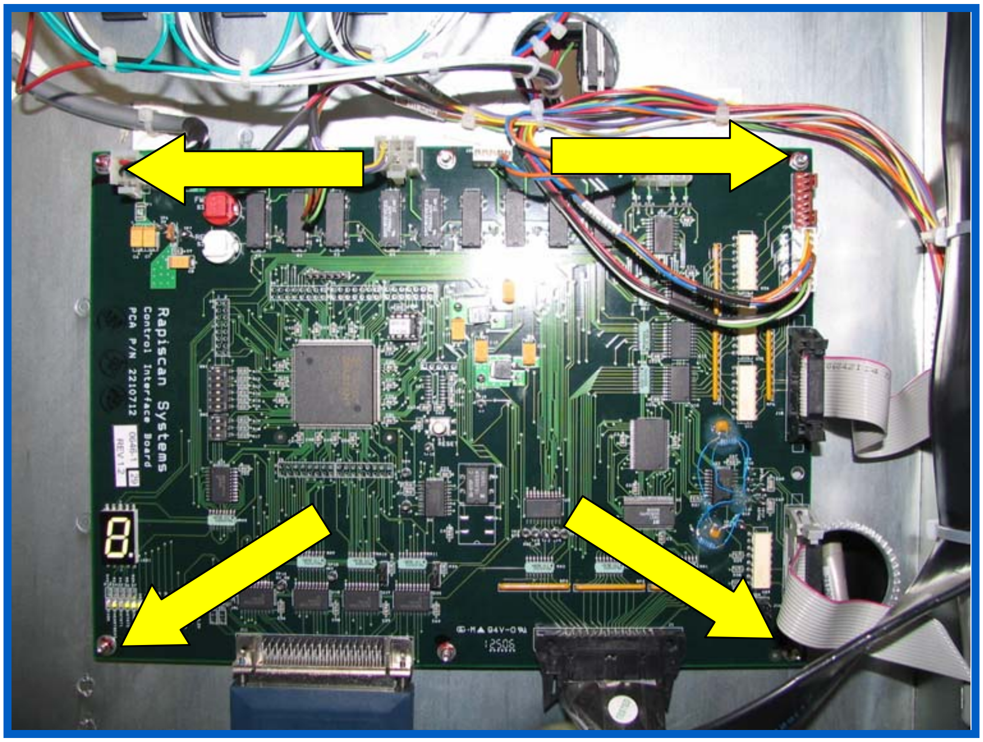

Figure 313: Controller Interface Board

Note also that the CI board has wires, cables and connectors plugged into it. The standard procedure for removing and replacing the CI board calls for disconnecting each of the connectors, dismounting the board itself and then re-plugging all the items onto the new board.

When unplugging the various connectors, etc., make note (on a piece of paper if handy) of the position of each item to facilitate plugging them back into the new board.

WARNING: Handle these boards only by its edges. The board may malfunction if a fingerprint or other contamination is present. Observe anti-static precautions at all times i.e. do not touch components unless your hand is grounded.

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19.0 Analog to Digital Converter PCB

19.1 General

The 16 bit Analog Digital Conversion Board (ADC) is intended to provide a full 16 bits dynamic range. It has two A/D converter devices with 16 bits of dynamic range.

Figure 314: Analog to Digital Conversion board (ADC)

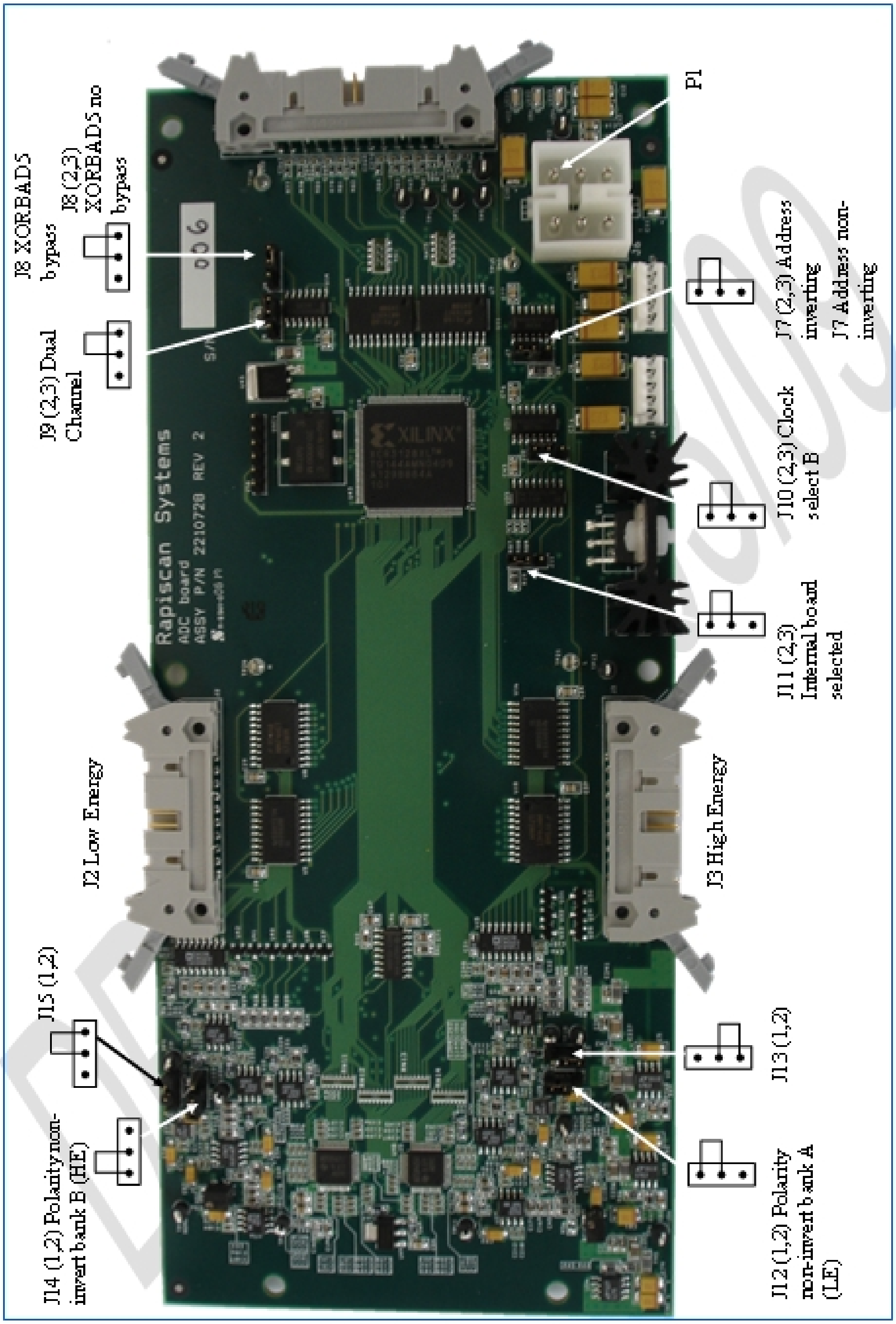

Figure 315: ADC Board with Jumper Settings

NOTE: Pin 1 is identified by the square solder pad on the rear of the PCB.

	Function	Setting	Setting
J7	Non-invert/ invert addresses	1-2 Non-invert	2-3* Invert address
J8	Address bypass	1-2 BAD5 used	2-3* XORBAD5 used
J9	Dual/Single channel	1-2 Single Channel	2-3* Dual Channel
J10	Clock select	1-2 Clock Y1	2-3* Clock Y0
J11	Board select	1-2 External board select enabled	2-3* Board always selected
J12	Non-invert and invert polarity, low energy	1-2* Non-inverted	2-3 Inverted
J13	Non-invert and invert polarity, low energy	1-2* Non-inverted	2-3 Inverted
J14	Non-invert and invert polarity, high energy	1-2* Non-inverted	2-3 Inverted
J15	Non-invert and invert polarity, high energy	1-2* Non-inverted	2-3 Inverted

* Default setting

19.2 Part Number

2210728 Analog to Digital PCB

19.3 Diode Array Interface

The analog input to the electronic circuits is current from a photodiode array. The minimum input corresponds to the system X-ray being turned off, i.e. leakage current and noise from the photodiode. The maximum input corresponds to the system X-ray generator being turned on to maximum output with the tunnel empty.

19.4 Inputs

The digital input to the electronic circuit is 16-bit from T2SXI (CI board) board. This input is used for addressing and controlling the offset and gain for each of the photodiodes. All interface digital inputs are 5V TTL signals.

19.5 Outputs

The output from the ADC is 16-bit data to the CI board and 16-bit for addressing and gain control to the diode array PCBs. All interface digital outputs are 5V TTL signals.

19.6 Address Decoder

This device takes the three address lines and uses them to select the data that is required to be written or read.

RD/WR	CA2	CA1	CA0	Function
WR	0	0	0	Address Bank A
WR	0	0	1	Address Bank B
WR	0	1	0	Gain/ Offset A
WR	0	1	1	Gain/ Offset B
RD	1	0	0	A/D Converter A
RD	1	0	1	A/D Converter B
RD	1	1	0	A/D Data Output A
RD	1	1	1	A/D Data Output B

19.7 System Calibration

In order to achieve maximum performance it is necessary to ensure that the output from each diode channel, when presented to the input of the A/D converter, utilizes the full dynamic range of the converter. Since the performance of the diodes varies considerably from one to the next, the effective gain and offset of the amplifier chain must be adjusted for each diode. During start up, system will read pre-stored data from the computer and use them if there is any reason that prevents the system from performing full calibration. During the System Calibration phase, the computer will acquire data with X-ray off and with X-ray on to establish the offset and gain required for each diode channel.

19.8 Gain & Offset Adjust

On the ADC board, there are separate data latches for Gain & Offset with values for each X-ray diode stored after the calibration sequence.

Offset:

This can be adjusted any time the X-ray is off. This should have a target value that is above zero. (Say 5 – 10% of 16-bit data value – corrected in software later.)

Gain:

This has to be adjusted when X-ray is on. This should have a target value less than full scale. (Say 90% of 16-Bit data value – corrected in software later.)

Data Word:

The value from AD0 to AD15 is written into a data latch for each of the two ADC. The format of the data is as follows:

- AD0 – AD7: Offset
- AD8 – AD15: Gain

19.9 Image Acquisition

During this phase the A to D converter will provide all of the control signals identical to the calibration process. This time, the computer will use the Offset and Gain calculated from the calibration step to make the image.

19.10 Connectors

Power-In Connector

J6	6W AMP
Pin No	Function
1	+15V
2	0V
3	+5V
4	0V
5	-15V
6	N/C

Power-Out connector

J4, J5	5W Molex 22-27-2051
Pin No	Function
1	+15V
2	0V
3	+5V
4	0V
5	-15V

Data Bus Connector to CI board

J1	26W IDC
Pin No	Function
1	GND
2 – 17	AD0 – AD15
18	GND
19	CA0
20	CA1
21	CA2
22	BS
23	RD/WR
24	GND
25	STRB
26	GND

Data Bus Connectors to Diode Array

J2 (HE) J3 (LE)	20W IDC
Pin No	Function
1 – 16	BAD0 – BAD15
17	GND
18	ANA-
19	GND
20	ANA+

19.11 Jumper Configuration

	Function	Setting	Setting
J7	Non-invert/ invert addresses	1-2 Non-invert	2-3* Invert address
J8	Address bypass	1-2 BAD5 used	2-3* XORBAD5 used
J9	Dual/Single channel	1-2 Single Channel	2-3* Dual Channel
J10	Clock select	1-2 Clock Y1	2-3* Clock Y0
J11	Board select	1-2 External board select enabled	2-3* Board always selected
J12	Non-invert and invert polarity, low energy	1-2* Non-inverted	2-3 Inverted
J13	Non-invert and invert polarity, low energy	1-2* Non-inverted	2-3 Inverted
J14	Non-invert and invert polarity, high energy	1-2* Non-inverted	2-3 Inverted
J15	Non-invert and invert polarity, high energy	1-2* Non-inverted	2-3 Inverted

- Default setting

19.12 Replacing the ADC Board

Figure 316 shows the ADC board with the standoffs which hold the board in place. To remove the board, remove all wiring, being careful to remember where each wire is attached (it is best to write down the wiring placement on a sheet of paper), then gently squeeze the standoffs and pull the board free. To replace the board, simply reverse these instructions.

Figure 316: ADC Board Standoffs

20.0 Electronics Chassis

20.1 General

The electronics chassis contains four boxed power supplies, the X-ray head power supply, Control Interface (CI) PCB and the Power Distribution & Interface (PDI) PCB.

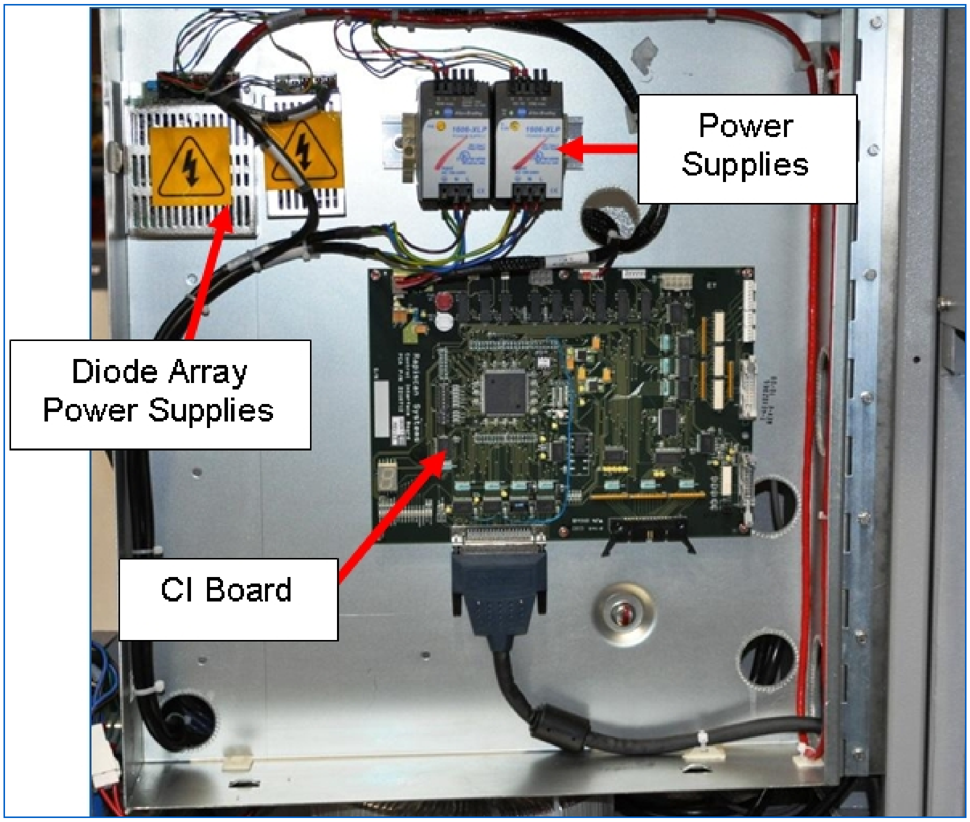

Figure 317: Electronics Chassis Front

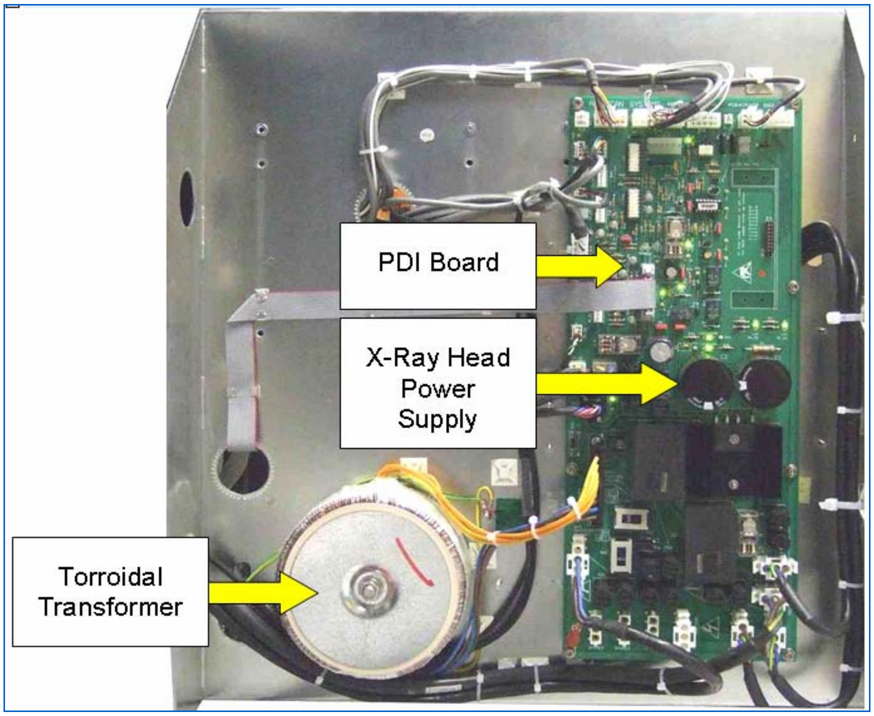

Figure 318: Electronics Chassis Rear

Part Numbers

23100573 Electronics Chassis

Cabling

Please see the section on Machine Cabling for details of how cables are connected to the electronics chassis.

20.2 Power Supplies

X-ray Head Power Supply

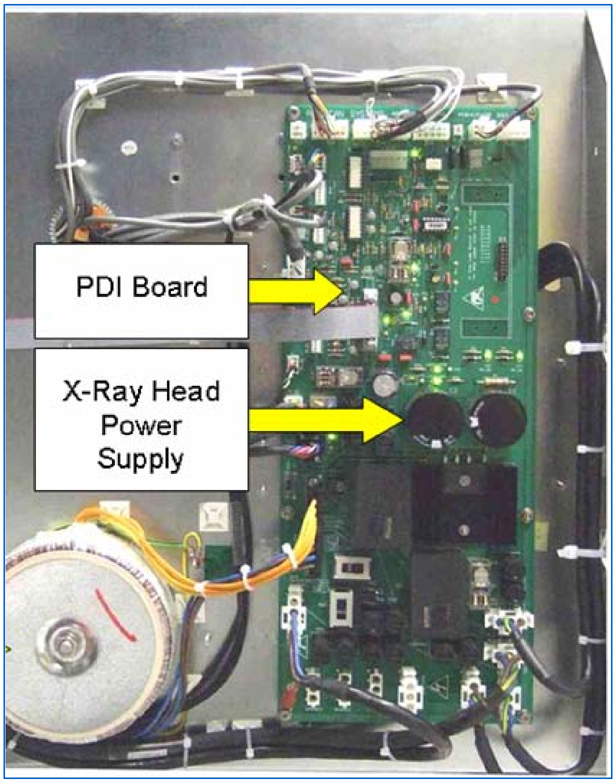

Figure 319: X-ray Head Power Supply on PDI Board

The X-ray head power supply is built onto the PDI PCB except for the toroidal transformer T55016. The transformer is connected as follows:

Connector	Colour	Function
Pin 1	Brown/ White	Primary A 115V
Pin 2	Blue/ White	Primary A 0V
Pin 3	Brown	Primary B 115V
Pin 4	Blue	Primary B 0V
Pin 5	No Connection	-
Pin 6	Orange	Secondary A 60V
Pin 7	Orange	Secondary A 0V
Pin 8	Yellow	Secondary B 12V
Pin 9	Yellow	Secondary B 0V

Boxed Power Supplies

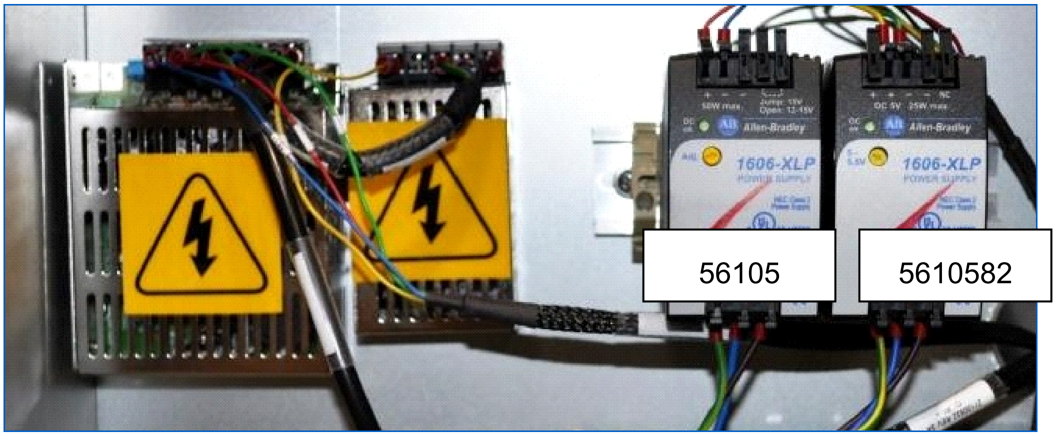

Figure 320: Power Supplies

Part Numbers

5610582 Power Supply, 1606-XLP, 5V 25W

5610594 Power Supply, 1606-XLP, 12V to 15V, 50W

20.3 Computer

The computer contains a power supply, fed by the Control Interface Board. The supply provides +5v, +12v and -12v, which drive the motherboard, computer keyboard, fans, disk drives, and expansion boards.

20.4 Fuse Values

The 636 series has two fuses, with the following values:

PART #	DESCRIPTION	FUSE
5800042	FUSE, 5A, TYPE-T, 5 X 20MM	F2
5810691	FUSE, 10A, TYPE-T, 5 X 20MM	F1

The 636's Control Interface board controls the drive motor and mains power distribution circuitry. It also has circuitry connected to the "Power On" switch, diode array door microswitches and E-stop switches. The main control PCB for the 636 machine is the 2210712, 230V a.c. board.

The power must be disconnected before attempting to change any fuse. Always fit the correct rating and type of fuse. All fuses are 250V 20mm type T, which indicates an anti-surge fuse. The most up-to-date rating information for the fuses is documented on the Product Test Record that is located in the document wallet provided inside the X-ray machine. This document also takes into account any special features and options that the machine might have.

X-ray Control PCB

All machines

FS1 1.6A

FS2 5A

X-ray Head PSU PCB Fuse

All machines FS1 1A

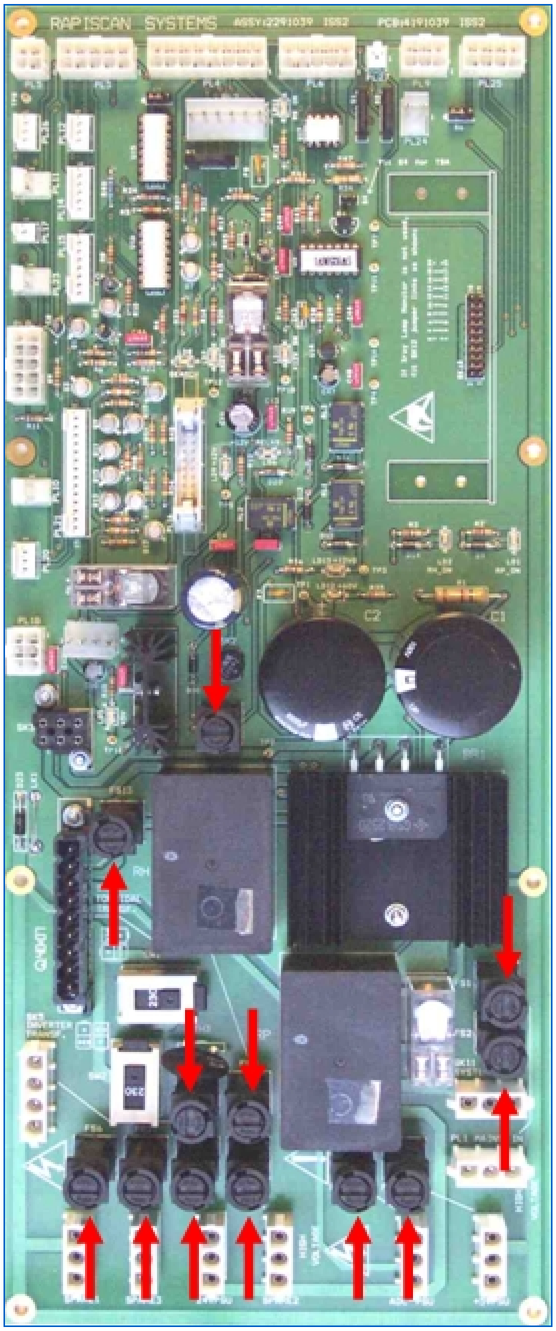

Figure 321: Fuses

FUSE	***SOCKET (SK)***	***Component***
F2	SK1	FV XRAY BLOWER
F3	SK2	FV XRAY FAN
F4	SK3	SV XRAY BLOWER
F5	SK4	SV SRAY FAN
F6	SK5	MAIN FAN
F7	SK6	CABINET FAN
F8	SK7	MAIN CONVEYOR
F9	SK8	HIGH SPEED CONVEYOR
F10	SK14	SPARE 2
F11	SK15	SPARE 3

Figure 322: Power Distribution Board Connections

Figure 322 shows the connections between the fuses and sockets on the Power Distribution Board. In addition to the fuses shown in Figure 321, there is a master fuse (F1) that connects to the mains inlet/plug that acts like a master fuse, leading to all the fuses listed in Figure 322, as well as directly to Sockets SK9, SK10, SK11 and SK13. Finally, F1 connects via the U1 Power Supply to SK12.

20.5 Replacing the Power Supplies

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the “Limitation on Liability” section, including the section on voiding the Rapiscan Systems warranty.

WARNING: Always shut down all power to the X-ray machine and unplug all power cords before doing any work on the power supplies.

The 636’s power supplies are located on the Electronics Chassis.

The power supplies are fixed to a DIN rail (Figure 323).

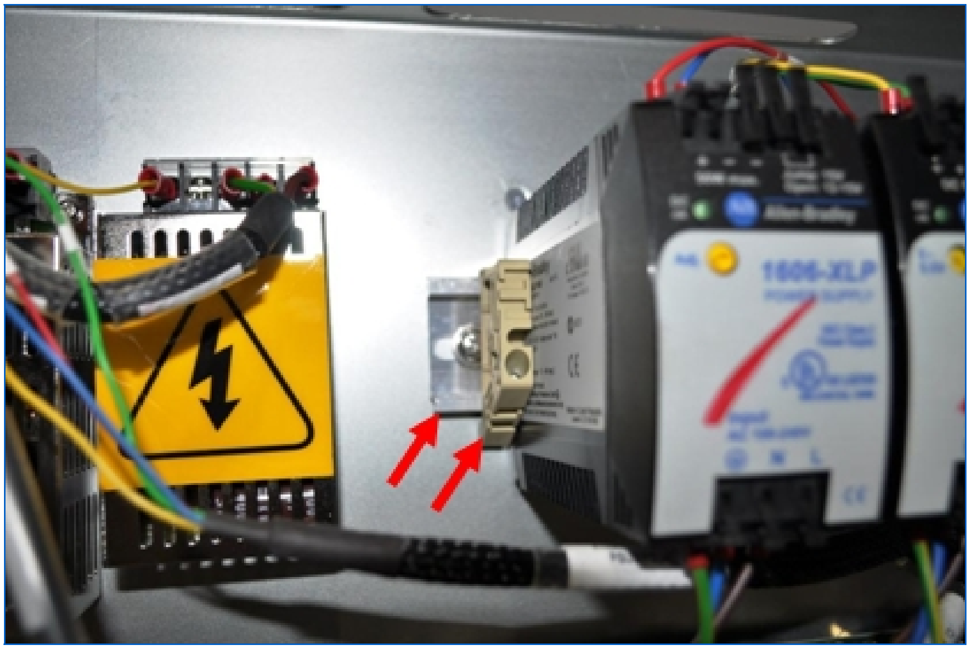

Figure 323: Electronics Chassis DIN Rail and Clamp

Most of the components on the rail have to be slid off the rail in order to be removed. The power supplies, however, have a tab at the bottom of the supply that, when pushed, allow the power supply to snap directly off the rail without having to be slid off.

Remove all wires from the power supplies. If the wires are soldered to the power supply, follow the wire to its end connector and disconnect it. Unscrew the cap on the end of the rail. Press the release tabs and pull the Power Supply or Supplies off the railing. Reverse these directions when replacing the power supply.

21.0 Computer

21.1 General

The computer rack contains a complete PC ATX computer, which runs the 636 software. Because of technological innovation, parts inside the rack are occasionally upgraded.

When ordering a replacement computer rack, be sure to order the correct type. If a new type is to be fitted to an older X-ray machine, other parts such as cables and the NI or video cards (Figure 326) may also need to be replaced.

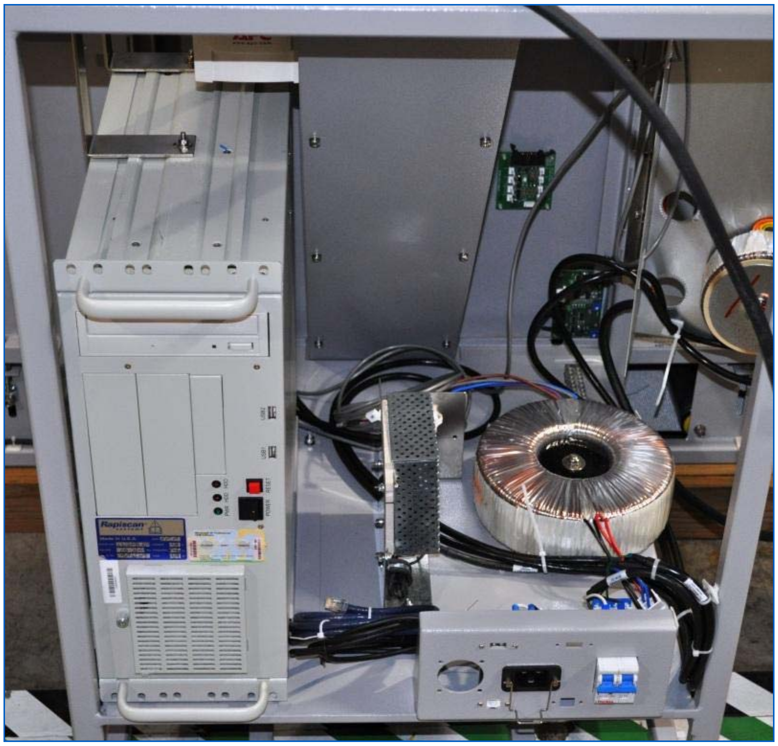

Figure 324: PC

Figure 325: Computer, internal

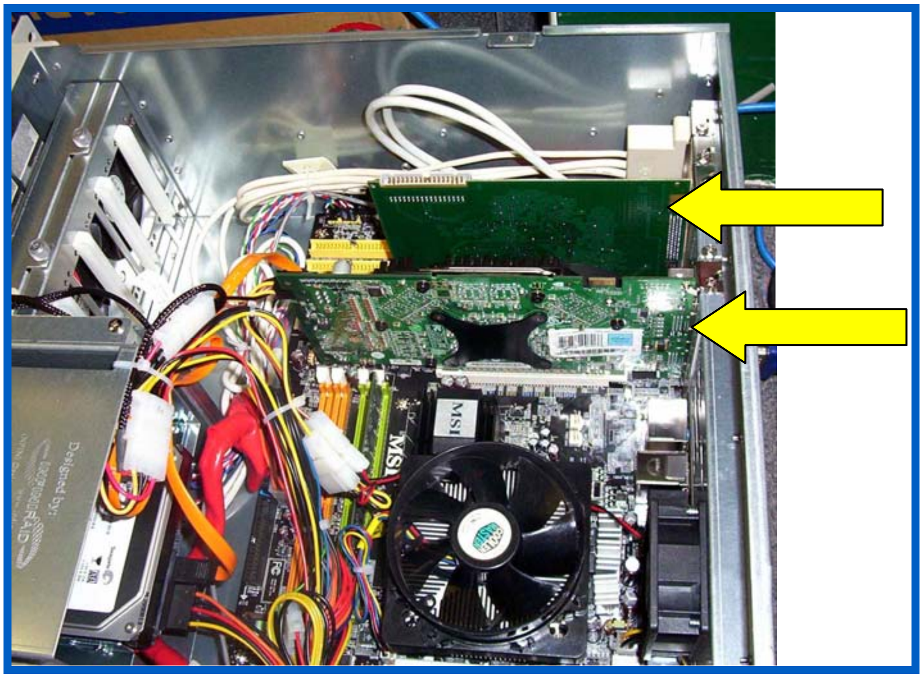

Figure 326: NI (top) and Video Cards (bottom)

21.2 Motherboard

General

The motherboard in the computer contains the central processing unit, DVD and hard disk drive interface, RS232 ports, parallel port and sockets for expansion cards and memory modules.

If it is necessary to replace the motherboard at any time, then the new motherboard must be configured according to the manufacturer's instruction book and the Rapiscan BIOS setup procedure following. Not all motherboards are compatible with Rapiscan's Windows-based system software. For replacement, seek advice from the Rapiscan Systems service department.

Memory Module

The memory module must be inserted into the correct socket for the computer to function. There is usually one module fitted, inserted into the socket usually marked 'SIMM 1'.

21.3 Digital I/O Card

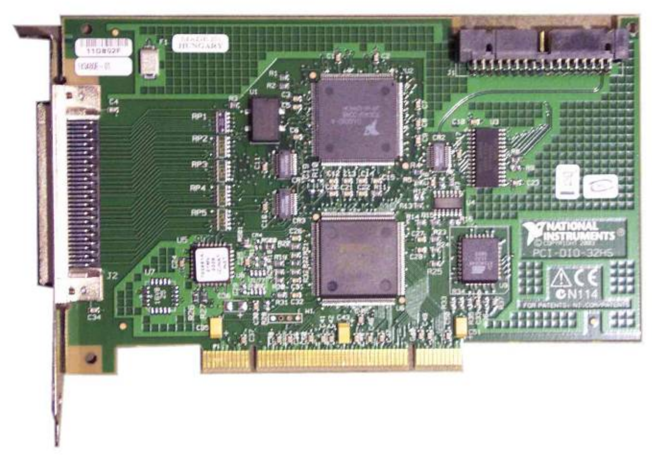

Figure 327: National Instruments PCI-DIO-32HS

The National Instruments PCI-6533 (DIO-32HS) is a high-speed, 32-bit, parallel digital I/O interface for PCI. The NI PCI-6533 incorporates the NI DAQ-DIO ASIC, a 32-bit general-purpose digital I/O interface specifically designed to deliver high performance on plug-in digital I/O boards. This device performs single-point I/O, pattern I/O, and high-speed data transfer using a wide range of handshaking protocols at speeds up to 76 MB/s. You can operate the 32 lines as individually configurable single-line I/O, or as 8, 16, or 32-bit ports for pattern I/O and handshaking.

In the Rapiscan data acquisition system, this board provides the digital interface between the Control Interface PCB and the computer. The software installed for this card provides a useful tool for troubleshooting.

21.4 Graphics Card

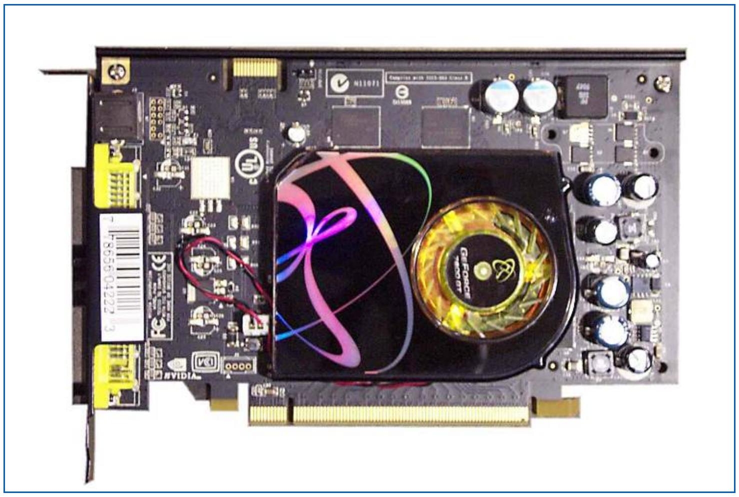

Figure 328: XFX GF7600GT 256MB DDR3 DUAL DVI TV(3)

The video card plugs into the PCI Express 16x slot on the motherboard. The function of the card is to transfer the contents of its memory to a video display. The memory is fed with information by the OS600 software.

21.5 Power Supply

The computer power supply provides +12v and +5v for the disk drives, and a range of voltages for the motherboard. Also present is a 'power good' signal, which informs the motherboard that the supplies are stable. There is no power switch on the computer rack.

21.6 Video Card

The video card plugs into a PCI slot on the motherboard. The function of the card is to transfer the contents of its memory to a video display. The memory is fed with information by the Rapiscan system software. At least ninety megabytes of video memory is required to display the image required on the display. Configuration of the video card is not normally necessary. The graphic card used must be approved by a Rapiscan Systems representative.

21.7 Hard Disk Drive

Currently a hard disk drive of at least 100 gigabytes is fitted in the machine. The hard disk is a fragile item and must not be subjected to shocks or vibration, especially when the machine is running. For this reason, the drive is fitted in a bay that has rubber shock mounts. If damage occurs to the drive through shock, the computer may display error messages when starting up.

21.8 DVD-RW Drive

A DVD-R drive is fitted to allow the loading of the operating system and X-ray machine software.

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22.0 Lamps and Sensors

22.1 Lamps

The Rapiscan 636 machines have two lamps located on the panels at each end of the tunnel (Figure 331). The lamps are wired to the Power /CI Board via the Machine Loom. The lamps are designed for long life, but should one fail, it must be replaced as soon as possible, particularly those for the X-ray lamps.

Part Numbers

Part #	Description
5100005	INDICATOR
5100006	LENS, RED, X-RAYS ON
5100016	LENS, WHITE, SEARCH
5100062	LENS, GREEN, SYSTEM ENERGIZED
7700027	LED CLUSTER, 12VDC T6.8, RED
7700028	LED CLUSTER, 12VDC T6.8, GREEN
7700029	LED CLUSTER, 12VDC T6.8, YELLOW

Power On Lamps

These lamps light when the system is switched on; this does not necessarily mean that there is no mains power inside the system, since mains may still be present on the +12v power supply.

X-ray On Lamps

These lamps light when X-rays are being generated.

Search Lamp

This lamp will light shortly after the operator presses the Suspect button on the console, during scanning. The function of this lamp is to alert the person performing a search of the luggage that the operator of the X-ray system has located for example, a potential threat object, and requires the bag to be searched. A sounder is also connected to the lamp circuit to provide audible warning.

Figure 329: X-ray On, Search and Power Lamps

The search and power lamps are wired to the Control Interface PCB via the Machine Loom. The lamps are LED cluster type (see Figure 329 with “Search” light cover off, showing the LED cluster). The lamps are designed for long life, but should one fail, it must be replaced as soon as possible.

WARNING: The power lamps light when the system is switched on; this does not necessarily mean that there is no power inside the system. Power may still be present. See the section on the cabling for more details of the power distribution.

Even when the power cable is disconnected from the machine, power may be present inside due to the uninterruptible power supply.

The search lamp will light shortly after the operator presses the search key on the Icon Control Panel, during scanning. The function of this lamp is to alert the person performing a search of the luggage that the operator of the X-ray system has located an area of concern and requires the bag to be searched. A sounder is also connected to the lamp circuit to provide audible warning.

22.2 Replacing the Lamps

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the “Limitation on Liability” section, including the section on voiding the Rapiscan Systems warranty.

Figure 330 shows the back of the Indicator Light Box with the cover still on. The first step to replacing a faulty indicator light/led is to remove the screws on the back of the indicator light box.

Figure 330: Back Cover of Indicator Lights Box

Figure 331 shows the Indicator light box, with the back removed, exposing the back of the indictor lights with the mounting screws as indicated by the arrows.

Figure 331: Back of Indicator Lights

Remove the wires from the defective indictor light, and remove the indictor light mounting screws (Figure 331).

22.3 Through Beam Sensors

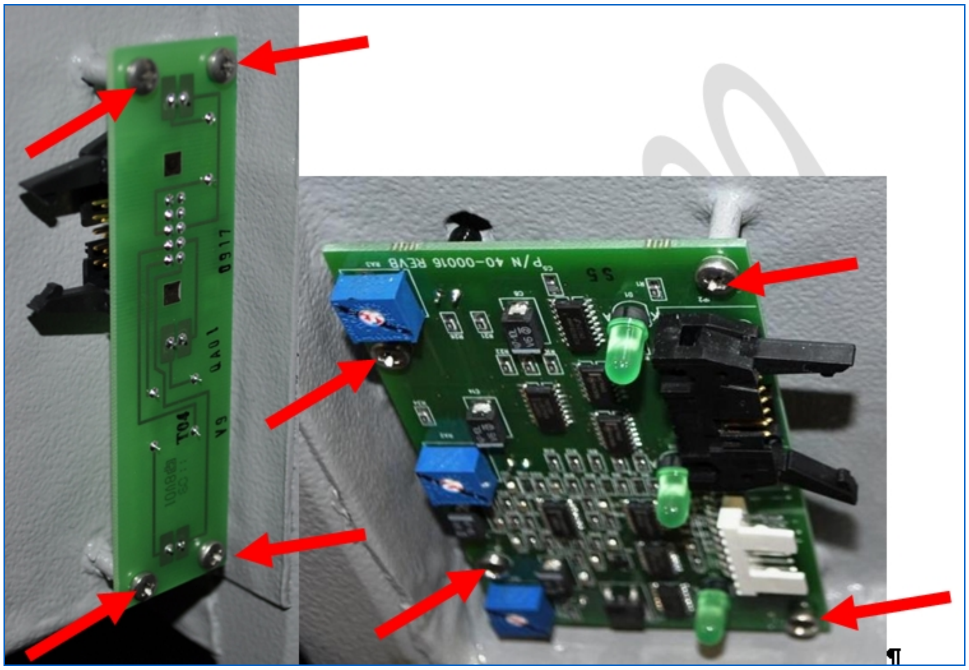

Figure 332: Through Beam Sensors (transmitter left, receiver right) and Mounting Screws

NOTE: Some models have standoffs instead of screws for mounting the position sensor boards.

The through beam sensor consists of two PCB assemblies (Figure 332), one of which contains a row of three infrared transmitters, and the other a row of receivers and associated circuitry. The PCBs are linked by a ribbon cable to power the transmitter LEDs (the LEDs are multiplexed to eliminate cross-talk).

The alignment of the sensors is critical. If the sensors are out of alignment or need cleaning, then false triggering of the sensor may cause the computer to start calibration, and turn X-rays on.

The Rapiscan 3-channel opto sensor has three potentiometers that are normally adjusted for maximum sensitivity. The sensors are multiplexed to give immunity to false triggering.

The function of the FPS1 sensor is to alert the computer that an object has entered the tunnel; the computer then performs a calibration of the diode array response. When FPS2 is interrupted, the computer begins collecting data from the diode array and displaying the processed image on the monitor.

Bi-Directional Scanning

The X-ray machine can perform bi-directional scanning because an extra pair of sensors (RPS1, RPS2) is fitted to the output end of the system. Bi-directional scanning needs to be enabled in the X-ray machine software 'User Setup Parameters' screen.

22.4 Replacing the Opto Sensors

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the "Limitation on Liability" section, including the section on voiding the Rapiscan Systems warranty.

Figure 332 shows the mounting screws for both the transmitter and receiver. Remove the cable from the Opto Sensor, then the mounting screws and finally the Opto Sensor itself. Reverse the procedure for replacing the Opto Sensor.

23.0 Curtains

23.1 Replacing the Curtains

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the “Limitation on Liability” section, including the section on voiding the Rapiscan Systems warranty.

The lead-impregnated curtains at each end of the 636 tunnel (Figure 333) are held in place by a metal strip fixed to the top of the tunnel entry (Figure 334) with fixed, protruding threaded posts. The curtains are held together by a matching metal strip with holes that fit over the fixed threaded posts. The curtains are then held in place by nuts screwed onto the threaded posts. To remove the curtains, remove the nuts and carefully pull the curtains from the threaded posts. Reverse the procedure for replacing the curtains.

CAUTION: The curtains are heavy. Be careful when removing the nuts to prevent the curtains from falling.

Figure 333: Curtains

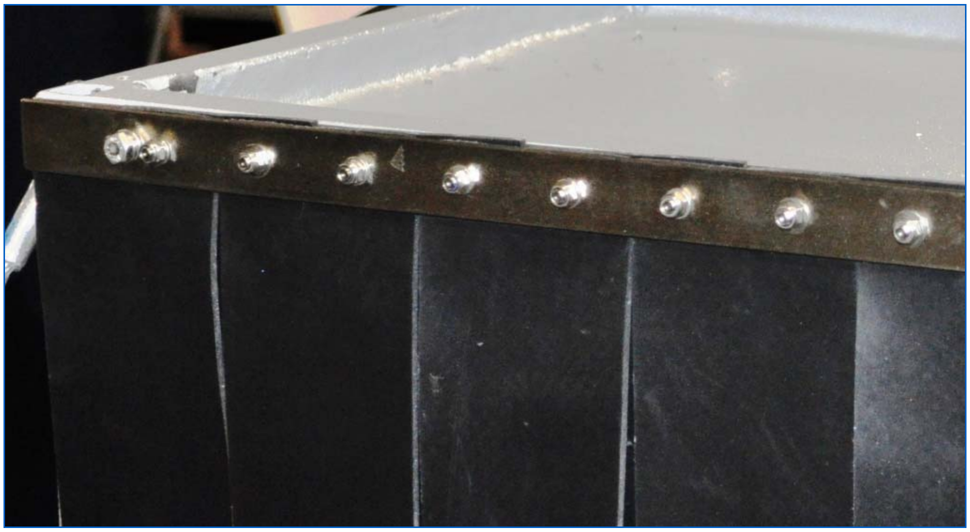

Figure 334: Curtain Mounting Screws

24.0 Conveyor Assembly

The 636 conveyor assembly consists of the conveyor itself and two foldable roller beds attached to the ends of the conveyor.

Figure 335: Roller Bed in Extended Position

The roller bed locks in the upright position through the use of a latch as shown in Figure 336.

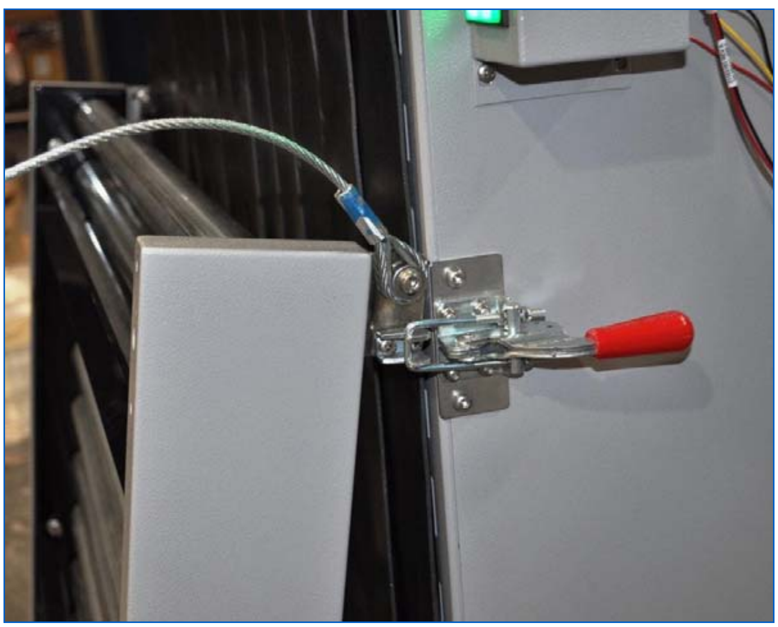

Figure 336: Conveyor Bed in Upright, Locked Position

Figure 337: Conveyor Cable Bolt

CAUTION: Care must be taken in lifting and lowering the conveyor bed. DO NOT allow the roller bed to drop, do not slam it into locked position, and ensure that the conveyor cable bolts are tight and secure.

25.0 Drive Roller

25.1 General

Rapiscan X-ray machines have a flexible conveyor belt driven by a drive roller in the centre of the conveyor bed. The conveyor belt is either welded in a continuous length or wire jointed. When replacing the belt, it is possible to use a wire-jointed type, although the join will show up on the X-ray image.

The drive roller contains a motor that rotates a drum in the centre of the conveyor belt. The motor is driven by the inverter. It is essential to connect the drive roller correctly. The roller may have no torque, run in the wrong direction, blow a fuse, overheat, or simply not run if the wiring is incorrect.

25.2 Part Numbers

Rollers

Part#	Rev	Vendor	Description	
4010801	A	INTERROLL #1.702.R81.M73-39.94RL	ROLLER, TRACKING, 1.90D, 39.94RL	4
4010802	A	INTERROLL # 6.145.000.012-39.00" W	ROLLER, IDLER, 4.5DIA, 39.00" W	1
40102985	A	INTERROLL # 6018U-39.90	Roller, Drive, 39.90" RL, .30HP, 3x230V, 60HZ,51fpm	1
4010805	A	INTERROLL P.No 6.009	BRKT,ROLLER MOUNT,ISOLATION	4
4010821	A	VENDOR: SEIGLING E8/2 U0/V2H BLK W/KS FSTNR	BELT, CONV, 38W X 11.73FT LG, RAP X36	1

25.3 Drive roller wiring

The drive roller is wired to the inverter as follows:

- Black T1/U
- White T2/V
- Red T3/W
- Green Earth
- Screen Earth

If the drive roller rotates in the wrong direction, swap two of the phase wires.

25.4 Replacing the Drive Roller

When replacing a drive roller, be sure to order an identical drive roller for the Rapiscan system involved.

WARNING: Remove the power cable and turn the UPS off before starting work.

1. Remove both side panels from the machine.
2. Trace the motor cable and disconnect it from the inverter. Remove any cable ties and reduce the belt tension by lifting a conveyor bed.
3. Carefully remove the drive roller from the conveyor by removing the four bolts on each clamp (Figure 338). The clamp has a rubber mount.

Figure 338: Drive Roller Clamp

5. Install the replacement drive roller including rubber mount.
6. Set the belt tension by following the procedure.
7. Connect the replacement drive roller to the inverter and install cable ties as required.
8. The conveyor belt must now be adjusted according to the tracking procedure.

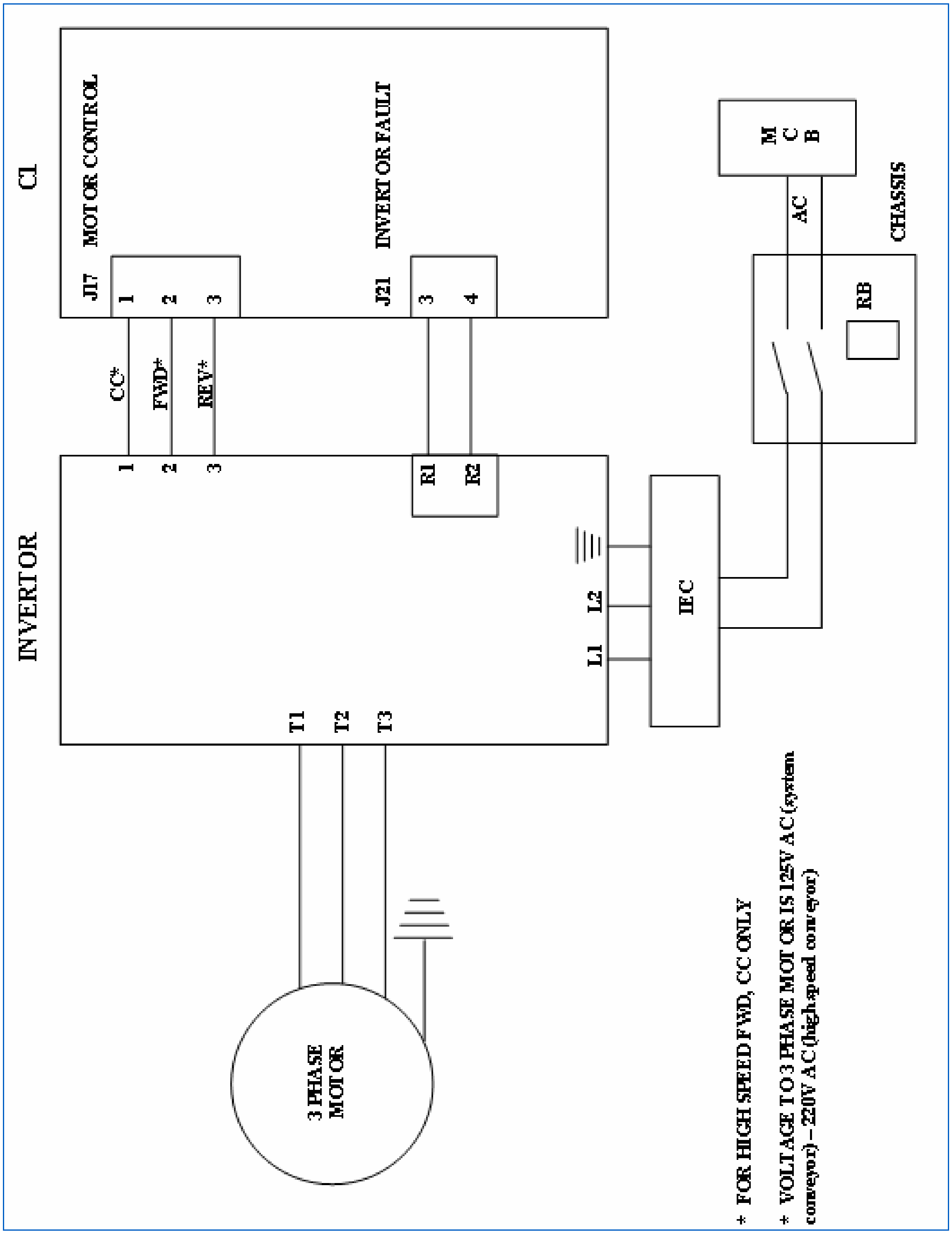

Figure 339: Three Phase Motor Block Diagram

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26.0 Inverter

The inverter is single-phase 115V input and 230V three-phase output to the drive roller. If it needs to be replaced, the new inverter must be programmed before it is used. The inverter is located inside a box.

Part Numbers

5300058	INVERTER, 0.37kW, 230V INPUT, 230V OUTPUT

WARNING: The three-phase output on the inverter may continue to be live for a while after the input power is removed.

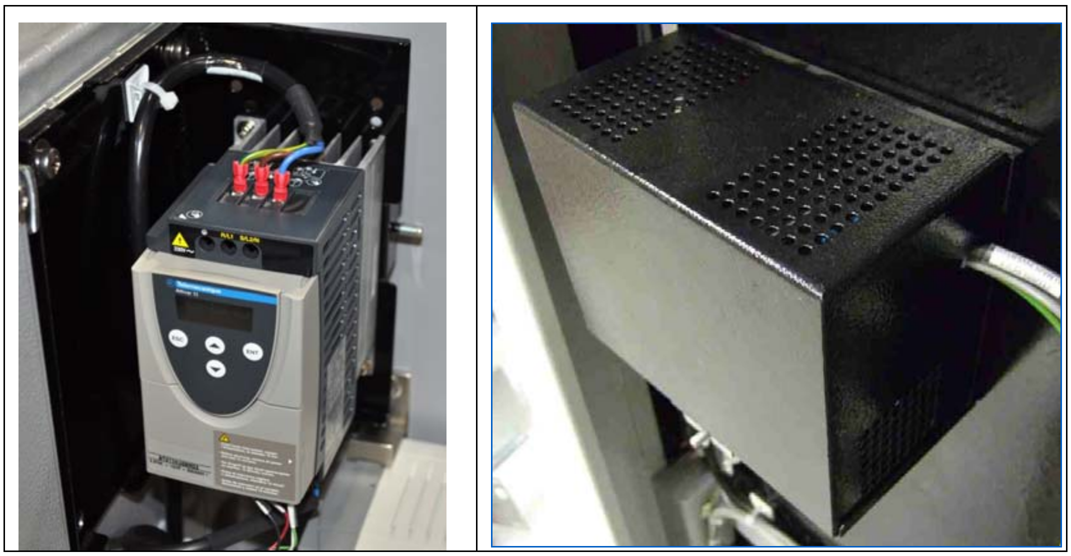

Figure 340: Telemecanique Inverter and Cover

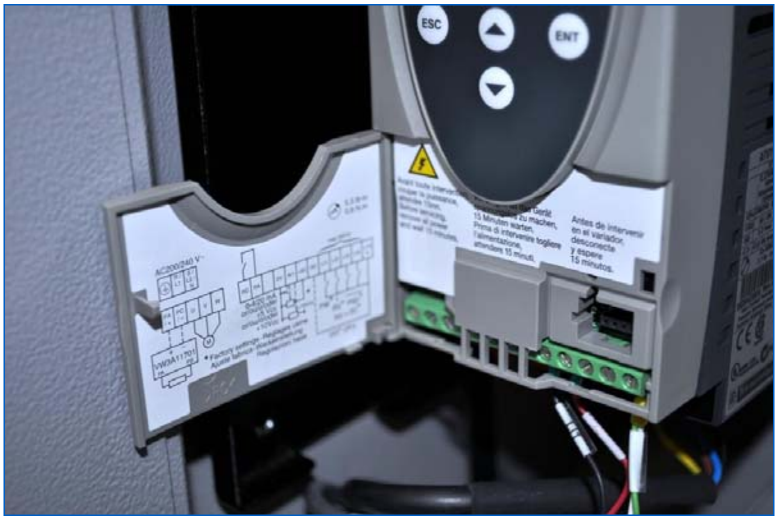

Figure 341: Inverter Terminals

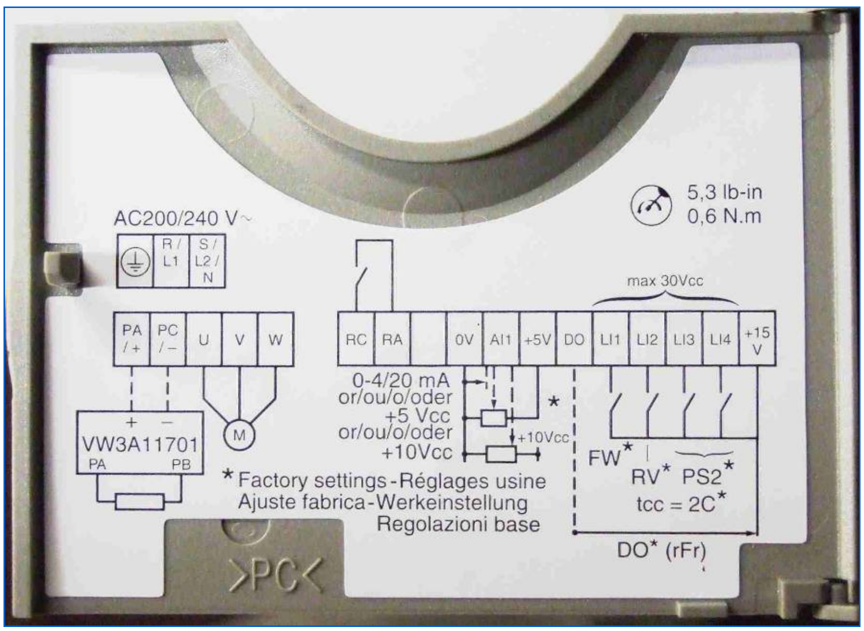

Figure 342: Inverter Terminals (close-up)

Programming

REV.	ZONE	DESC.	DATE	BY	APVD.
1	None	Production release Per ECN 01925	07/21/06	TT	TTRAN
2	None	Revised per ECN 02006	10/10/06	TT	TTRAN
3	None	Revised per ECN 02132	02/16/07	PTRUONG	TTRAN
4	None	Updated per ECN 02267	06/28/07	PTRUONG	TTRAN

Parameter Settings & Programming Instructions for Telemecanique Inverter, 6xx- XR WBS

(Model: Telemecanique ATV11HU09F1U)

Rapiscan systems
An OSI Systems Company
3232 W. El Segundo Blvd.
Hawthorne, CA 90250

Title:
Parameter Settings and Programming instructions for Telemecanique Inverter, 6xx-XR WBS

		DRAWN BY T. Tran	DATE 07/21/06	ECN No. 02267
		CHECKED BY E. Vaysburd	DATE 02-16-07	DRAWING NO. 0411507 / REV. 4
USED ON 6xx-WBS	NEXT ASSY	APPROVED BY Thien Tran	DATE 02-16-07	SHEET 1 OF 2

0411507, Rev4 Page 1 of 2

Telemecanique Inverter ATV11HU09F1U Parameters Setting

No.	Title	Function	Setting	Description	Notes
1	ACC	Acceleration ramp time	0.1	ACC	Acceleration ramp time
2	dEC	Deceleration ramp time	0.5		
3	LSP	Low Speed	Vary	Normal Speed	See Note below
4	HSP	High Speed	60.0	Factory Setting	
5	drC → StA	Frequency loop stability	20		
6	drC → FLG	Frequency loop gain	20	Factory Setting	
7	drC → UFr	IR Compensation	50	Factory Setting	
8	drC → SLP	Slip compensation	100	Factory Setting	
9	FUn→tCC→ACt	Start Source	2C	Factory Setting	2-wire control
10	FUn → rrS	Reverse	L12	Factory Setting	Change to n0 for HSC
11	FUn→AdC→ACt	Automatic DC Injection	YES	Factory Setting	
12	FUn→AdC→tdC	Injection time on stopping	0.5	Factory Setting	
13	FUn→AdC→SdC	Injection current	0.7	Factory Setting	
14	FUn→SFt→SFr	Switching frequency	4	Factory Setting	
15	FUn→bFr	Motor Frequency	60Hz	Factory Setting	Change to 50Hz for 50Hz motor

Note:

1. For 6xx-XR systems, Set LSP to 30
2. For 620DV system, Set LSP to 55
3. For High Speed Conveyor, Set LSP to 60

The ScanProcCfg.xml Parameters Setting

No.	Function Name	Telemecanique Setting	Allen Bradley Setting	Notes
1	BackBeltForwardTime	398	360	
2	BackBeltReverseTime	393	365	

Programming Instruction for Telemecanique Inverter:

1. To program the inverter, press the Up and Down Arrow to get into the parameter setting
2. Press “ENT” to get into screen to edit the value
3. Using the Up and Down Arrow to change the setting value
4. Press “ENT” to save the value
5. Change all the parameters according to the above table
6. Press “ESC” to get out until seeing the “RDY” appear on the screen

0411507, Rev4 Page 2 of 2

Programming Instruction for Telemecanique Inverter:

1. To program the inverter, press the Up and Down Arrow to get into the parameter setting
2. Press "ENT" to get into screen to edit the value
3. Using the Up and Down Arrow to change the setting value
4. Press "ENT" to save the value
5. Change all the parameters according to the above table
6. Press "ESC" to get out until seeing the "RDY" appear on the screen

Remove and Replace

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the "Limitation on Liability" section, including the section on voiding the Rapiscan Systems warranty.

The inverter as it sits on a mounting plate. Bolts hold the inverter to the plate and the plate to the chassis. To remove and replace, disconnect all cables from the inverter and remove the mounting bolts holding the inverter to the mounting plate, then reverse the directions to replace with a new inverter.

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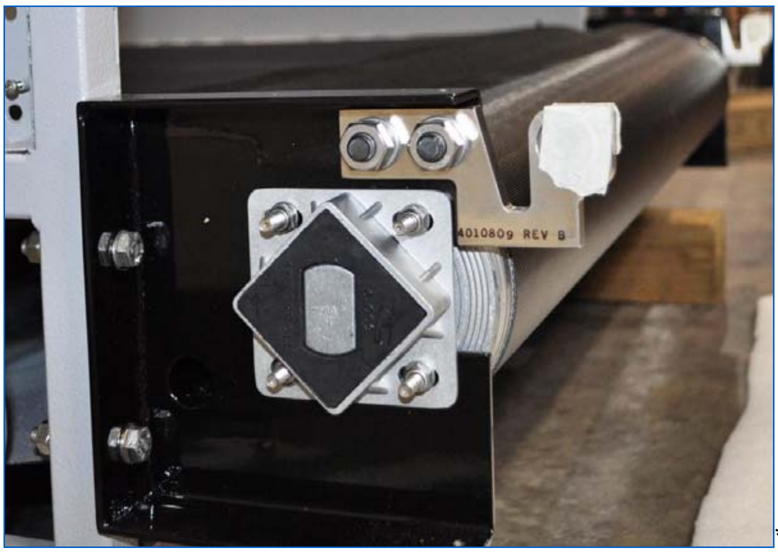
27.0 Idler Roller

27.1 Replacing the Idler Roller

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the “Limitation on Liability” section, including the section on voiding the Rapiscan Systems warranty.

The 636 has a drive roller at the exit end of the machine, and an idler roller at the entrance end of the machine. (Figure 343). The mounting assembly for the idler roller consists of a bolt at each end of the roller.



**

Figure 343: Idler Roller

To remove and replace the idler roller, loosen the conveyor belt to allow enough slack to pull the idler roller out from the belt. To loosen the conveyor belt, release the tension on the tension bolt. It may be necessary to loosen and remove the snub roller in order to gain enough slack in the belt to remove the idler roller.

Once the conveyor belt has been slackened, undo the idler roller clamp on either side of the idler roller by removing the four nuts and slip the roller out of its mount.

To replace the roller, reverse these directions.

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28.0 Conveyor Belt

28.1 General

Rapiscan 636 machines have a flexible conveyor belt driven by a drive roller at the center of the conveyor bed. The belt is joined by a seam or "zipper" that allows for easy removal and replacement.

28.2 Part

Part#	Rev	Vendor	Description	Qty
4010821	A	VENDOR: SEIGLING E8/2 U0/V2H BLK W/KS FSTNR	BELT, CONV, 38W X 11.73FT LG, RAP X36	1

28.3 Conveyor Belt Routing

Figure 344 shows the belt routing for the 636 X-ray machine. Note that the belt is tensioned only on the driver roller side (left side of drawing).

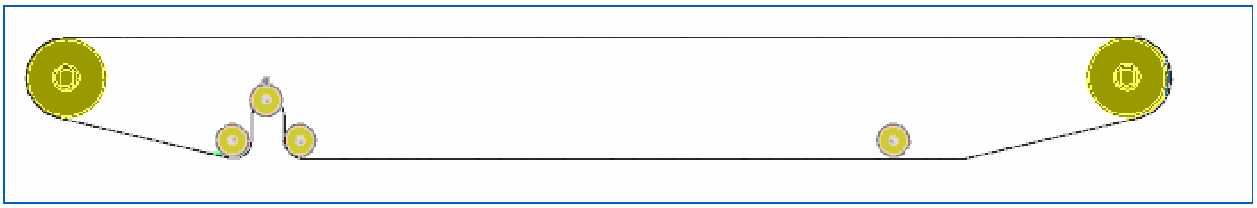


Figure 344: Belt Routing

28.4 Replacing the Conveyor Belt

WARNING: Remove the power cable and turn the UPS off before starting work.

1. Bring the conveyor belt "zipper" to the end of the roller where it is easily accessible (Figure 345).

Figure 345: Conveyor Belt Zipper

2. Reduce the belt tension by loosening the tension adjuster (Figure 346).

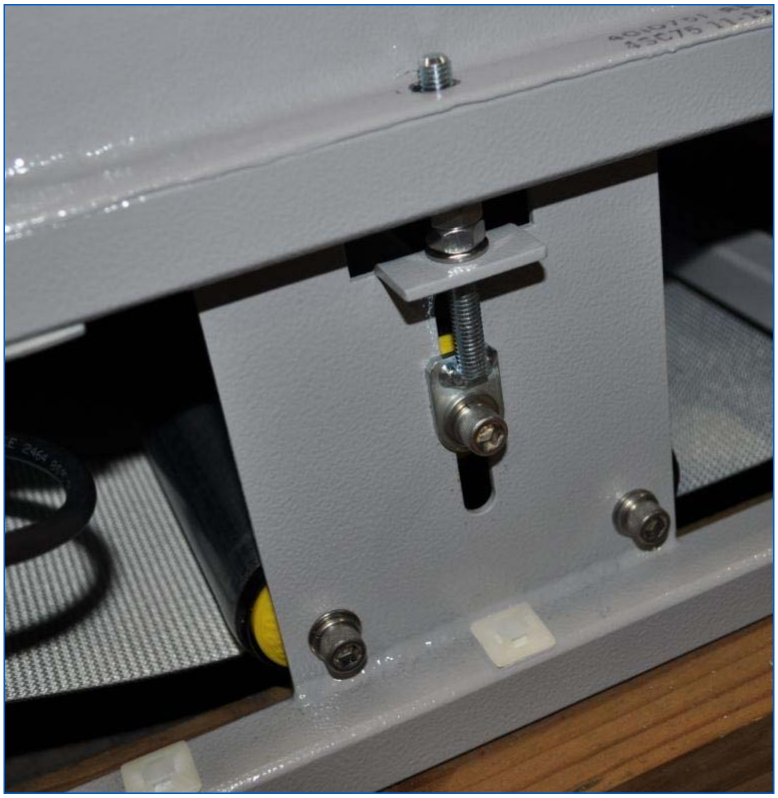


Figure 346: Belt Tension Adjuster

3. Pull the plastic strip Figure 347) from the zipper (using needle nosed pliers), undoing the belt.

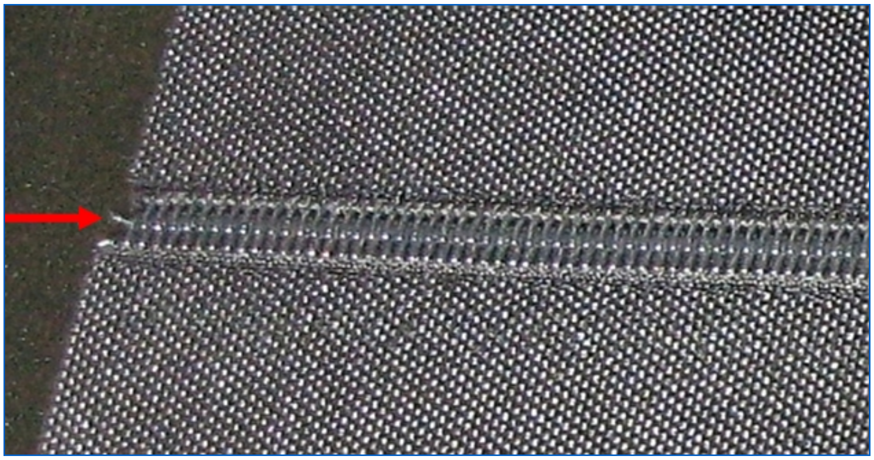


Figure 347: Zipper Strip

4. Attach the new conveyor belt to the old conveyor belt using the zipper, inserting the zipper strip to connect the two belts.
5. Manually pull the old belt out of the machine, thus pulling the new belt through the machine, between rollers, etc. so that it follows the same routing as the old belt.
6. Disconnect the old belt from the new belt.
7. Zipper the new belt shut, inserting the plastic strip.
8. Replace the catch tray and side guards.
9. Replace the power cable and turn the U.P.S. back on and replace the side panels.
10. Adjust the belt tension and tracking per the instructions below.
11. Run the conveyor for 30 minutes to ensure that tracking and tensioning are correct.

28.5 Conveyor belt tracking

Ensure that the Idler and driver rollers are parallel to each other, and perpendicular to the bed of the system. If these rollers are not positioned correctly, it may be impossible to track the conveyor belt, and the belt may not reach its correct speed if it is rubbing excessively on the bed.

Release conveyor belt tension by loosening the nut on the tension adjustment bolt (Figure 346).

Adjust the belt tensioning bolts measuring the distance on the bolts to keep it even. Since the idler rollers are crowned, the belt will become fully tensioned over the center one third but the edge of the belt will remain slack. When feeling across the underside of the conveyor belt the center of the belt should be tight and the edges slack.

Under-tensioning will make tracking almost impossible.

Over-tensioning of the conveyor belt will distort the tracking rollers and damage bearings.

To track the conveyor belt start the conveyor in the forward direction, run the belt until you can determine the “error” direction the belt is moving in, and begin adjusting the tension bolts one at a time until you determine which tension bolt adjustment is causing the belt to track correctly. Adjustments should be small and constantly monitored.

Start the conveyor in the reverse direction, run the belt until you can determine the “error” direction the belt is moving toward, and begin adjusting the tension bolts one at a time until you determine which tension bolt adjustment is causing the belt to track correctly. Adjustments should be small and constantly monitored.

On completion of tracking the conveyor should be run for a minimum of 30 minutes in forward and 30 minutes in reverse. If the belt tracking runs out of line it must be adjusted and run for a further 30 minutes in both directions. The belt deviation should not be more than 20mm.

29.0 Machine Software

29.1 General

The Rapiscan X-ray machine is under direct control of the OS600 software running on the computer rack. All of the functions of the machine such as conveyor control, image processing, X-rays on/off, diode array addressing etc. are controlled by the software. (Safety interlocks such as emergency stop switches and diode array box micro-switches can override the computer.) The machine software is fully described in the operator's manual.

WARNING: Do not attempt file operations unless you are trained in the use of the Windows operating system. The X-ray machine may malfunction if Rapiscan system files are altered or deleted. The system files cannot easily be repaired or reloaded.

29.2 Software Protection Key (Dongle

The dongle protection works on the following features:

- - TIP (Threat Image Projection)
- - Auto Archive
- - DTA (Density Threat Alert)
- - Manual scan
- - Target
- - Interactive Target
- OTP (Operator Training Program)
- NDS (Network Display Station)
- TIPNET
- TMAS
- Smart Card

The dongle is checked once the main OS600 software is running. If the dongle is not installed on the machine the computer shuts down immediately. If the dongle is installed the protected features are loaded in the software.

The OS600 software does not inform you which features are allowed on the dongle. For example if all settings for TIP are set correctly in the configuration files and TIP is not working, this means that the dongle is stopping this feature.

To confirm the feature is included in your dongle, check the details of the order for the X-ray machine.

If you want to install a new feature which is protected, you must send the dongle back to Rapiscan for reprogramming. Certain features may require a license in future releases.

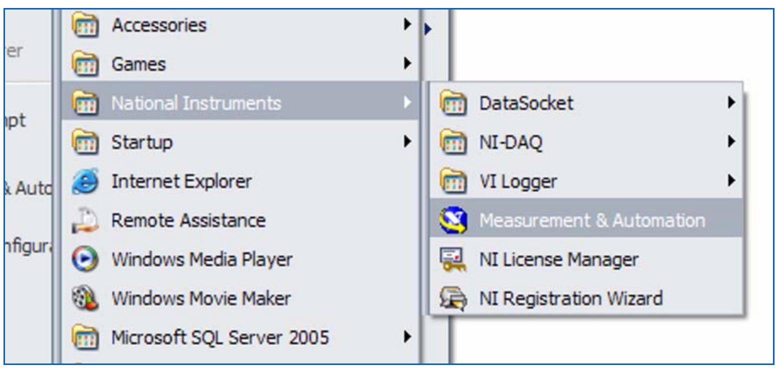
29.3 Testing the Hardware

You can directly access some parts of the X-ray machine without entering the OS600 X-ray machine software. This can be useful if you wish to eliminate the X-ray machine software during fault-finding.

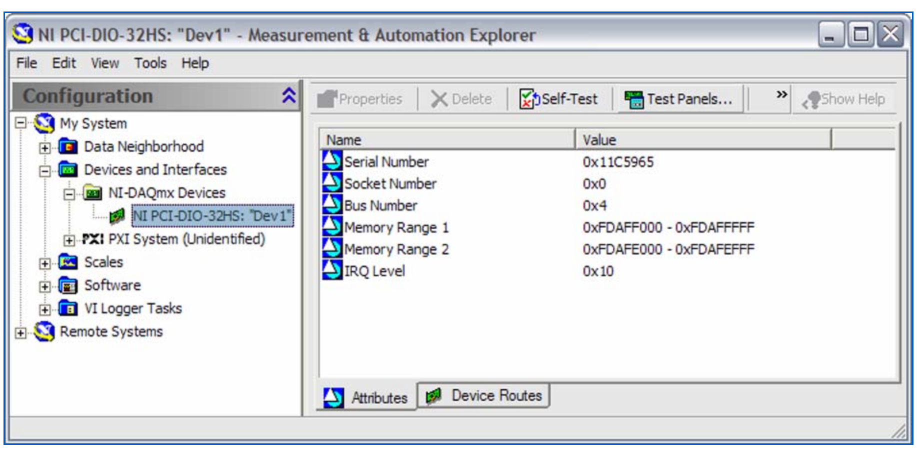
1. Exit the machine software by pressing CTRL-F4 then type the password.

Start Windows Task Manager by pressing CTRL-ALT-DEL and select task manager.

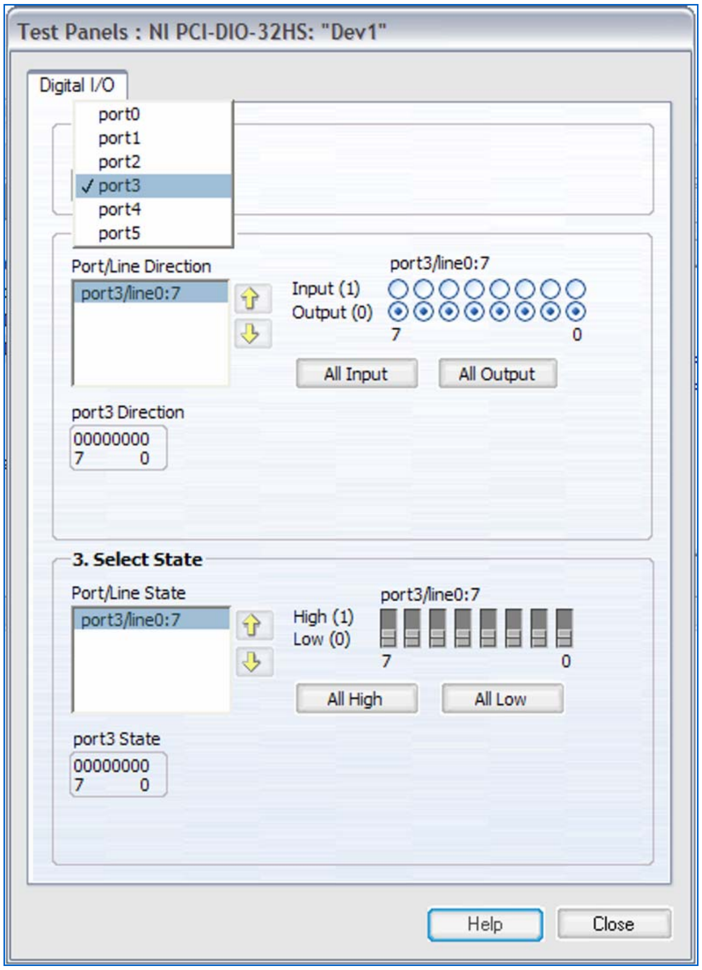
2. Click the New Task button and enter explorer.exe. The Windows desktop will be displayed.
3. Select Measurement and Automation from the National Instruments menu:



4. Select NI-PCI-DIO-32HS: "DEV1" from the menu on the left.



5. Click the Test Panels button.



6. Select port3 and click ‘All Output’. In Select State, the switches can now be operated to turn devices on as follows:

Bit 2	Turn X-rays On
Bit 3	Turn conveyor on
Bit 4	Conveyor direction
Bit 6	Turn search lamp/ buzzer on

7. Do not operate the other switches.
8. Select port2 and click ‘All Input’. The status of the devices will be shown as follows:

Bit 0	X-rays are on
Bit 1	Conveyor is running
Bit 2	Conveyor direction

29.4 Creating a Bitmap File

Sometimes it is useful to capture the image on the screen so it can be imported into other software packages.

1. Connect a computer keyboard to the computer and press the 'Print Screen' key. The image will save to Windows clipboard.
2. Exit the machine software by pressing CTRL-F4 then type the password.
3. Start Windows Task Manager by pressing CTRL-ALT-DEL and select task manager.
4. Click the New Task button and enter explorer.exe. The Windows desktop will be displayed. Click Start, All Programs, Accessories, Paint.
5. Click Edit-Paste and the captured image will be displayed.

The bitmap file created cannot be subsequently processed by X-ray functions, such as Crystal Clear. To store images that can be later processed by the X-ray software, use the 'Archive' function.

29.5 USB ports

USB ports are provided on the outside of the machine to allow data from the computer to be transferred to or from a flash drive (see Figure 348).

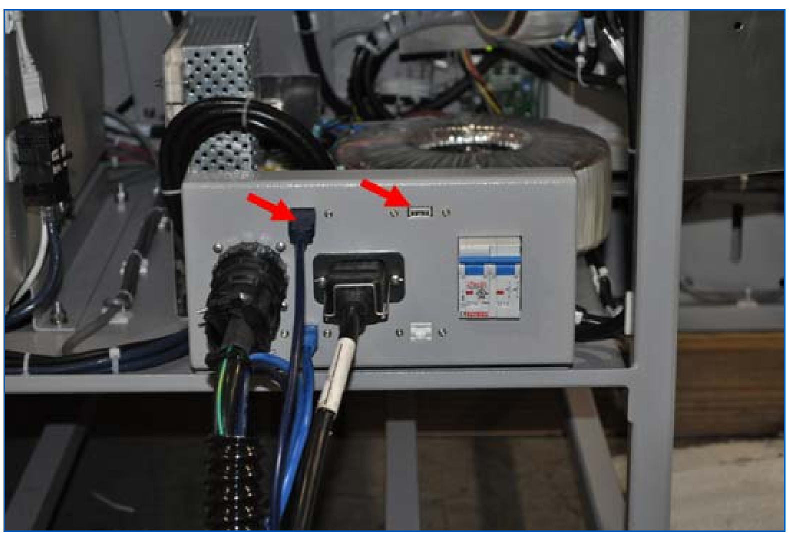


Figure 348: USB Ports on End Panel

30.0 Auxiliary Generator Troubleshooting and Maintenance

NOTE: Thoroughly read the “Onan Commercial Mobile Power Operator’s Manual for Models HGJAD, HGJAE and HGJAF” before operating the Onan Generator Set (Genset). Safe operation and top performance can be obtained only when equipment is operated and maintained correctly.

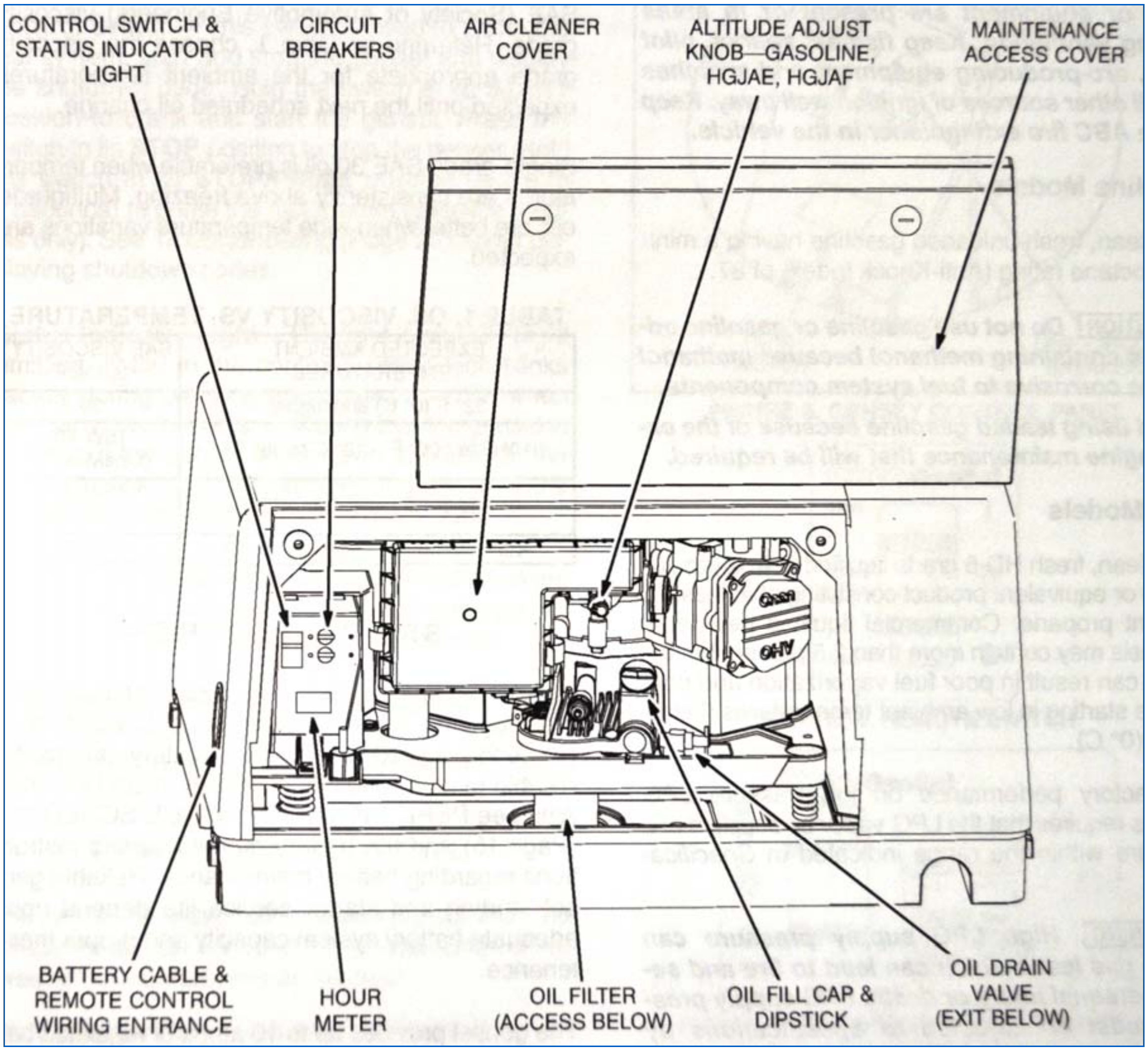


Figure 349: Auxiliary Generator Component Drawing

Figure 350: Auxiliary Generator

30.1 Resetting Circuit Breakers

If a circuit breaker in the main power distribution panel of the vehicle or on the genset trips, either a circuit shorted or too many loads were running. Note that the may continue to run after a circuit breaker trips.

If a circuit breaker trips, disconnect or turn off as many loads as possible and reset the circuit breaker. (Push the circuit breaker to OFF to reset it and then to ON to reconnect the circuit.). If the circuit breaker trips right away, either the electrical distribution system has a short circuit or the circuit breaker is faulty. Call a qualified electrician.

If the circuit breaker does not trip, reconnect the loads one by one up to a total that does not overload the genset or cause the circuit breaker to trip. If a circuit breaker trips right away when an appliance is connected, the appliance probably has a short.

Electrical appliances and tools must be used and maintenance properly and be properly grounded to cause the line circuit breakers to trip when short circuits occur.

30.2 Periodic Maintenance

See “Periodic Maintenance” in the Onan Operator’s manual for a full Preventive Maintenance schedule and descriptions.

WARNING: Hot engine parts can cause severe burns. Always allow the engine time to cool before performing any maintenance or service.

MAINTENANCE PROCEDURE	MAINTENANCE FREQUENCY						
	Every Day or Every 8 Hours	After First 20 Hours	Every Month	Every 50 Hours	Every 150 Hours	Every 450 Hours	Page
General Inspections	X						16
Check Engine Oil Level	X						17
Clean and Check Battery			X[3]				19
Clean Spark Arrestor				X			21
Change Engine Oil & Oil Filter		X[1]			X[2, 3, 4]		18
Replace Air Filter Element					X[2]		19
Replace Spark Plugs						X[5]	20
Clean Engine Cooling Fins						X[2]	–
Replace Fuel Filter						X[5, 6]	–
Adjust Valve Lash						X[6]	–
Clean or Replace Cylinder Heads						X[6]	–

1 – As a part of engine break-in, change the engine oil after the first 20 hours of operation.
2 – Perform more often when operating in dusty environments.
3 – Perform more often when operating in hot weather.
4 – Perform at least once a year.
5 – Perform sooner if engine performance deteriorates.
6 – Must be performed by a qualified mechanic (authorized Onan dealer).

Figure 351: Preventive Maintenance Schedule

General Inspections

1. Inspect the genset before the start of the day and after every eight hours of operation.

Oil Level

1. Check engine old level.

Exhaust System

1. Look and listen for exhaust system leaks while the genset is running.
2. Look for openings or holes between the genset compartment and vehicle cab or living space if the genset engine sounds louder than usual.

3. Replace dented, bent or severely rusted sections of the tailpipe and make sure the tailpipe extends at least 1 inch (25.4mm) beyond the perimeter of the vehicle.
4. Park the vehicle so that the genset exhaust gases disperse away from the vehicle.
5. Do not operate power ventilators or exhaust fans while the vehicle is standing with the genset running.
6. Check all CO monitors to assure proper operation.

Fuel System

1. Check for leaks at the hose, tube and pipe fittings in the fuel supply and return systems while the genset if running and while it is stopped. DO NOT USE A FLAME TO CHECK FOR LPG LEAKS.
2. If you smell gas, close the LPG container shutoff valve and have the genset serviced before using again.

Battery Connections

1. Check the battery terminals for clean, tight connections.

Mechanical

1. Look for mechanical damage. Start the genset and look, listen and feel for any unusual noises and vibrations.
2. Check the genset mounting bolts to make sure they are secure.
3. Check to see that the genset air inlet and outlet openings are not clogged with debris or blocked.
4. Clean accumulated dust and dirt from the genset.

Checking Engine Oil Level

1. Park the vehicle on level ground and shut off the genset before checking the engine oil level.
2. Unscrew the oil fill cap and wipe oil off the dipstick. Screw the cap back on, remove it and check the oil level on the dip stick.
3. Add or drain oil as necessary.
4. Screw the oil fill cap back on securely.

Changing Engine Oil and Oil Filter

Refer to Figure 351 for scheduled engine oil change. Change oil more often in hot or dusty environments. Refer to page 18 of the Onan Operator's Manual for oil changing procedure.

Maintaining Battery and Battery Connections

Refer to Figure 351 for scheduled battery maintenance. Refer to page 19 of the Onan Operator's Manual for battery maintenance procedure.

Replacing the Air Filter Element

Refer to Figure 351 for scheduled air filter element replacement. Refer to page 19 of the Onan Operator's Manual for air filter replacement procedure.

Replacing the Spark Plugs

Refer to Figure 351 for scheduled spark plug replacement. Refer to page 20 of the Onan Operator's Manual for spark plug replacement procedure.

Cleaning the spark Arrestor

Refer to Figure 351 for scheduled cleaning of the spark arrestor muffler. Refer to page 21 of the Onan Operator's Manual for spark arrestor muffler cleaning procedure.

30.3 Troubleshooting

WARNING: Hot engine parts can cause severe burns. Always allow the engine time to cool before performing any maintenance or service.

See Table 4 in the Onan Operator's manual included with this vehicle. This table lists the shutdown codes in numerical order along with step-by-step corrective actions. If you are unable to resolve the problem after taking the corrective actions suggested, contact an authorized Onan dealer. See "How to Obtain Service" on page 32 of the Onan Operator's manual.

Maintaining engine oil level, keeping battery connections clean and tight, watching the fuel gauge, not overloading the genset, keeping the air inlet and outlet openings clear, etc. will prevent most shutdowns.

When the genset and vehicle engine share a common fuel tank the fuel dip tubes are usually arranged so that the genset will run out of fuel first. Marking the genset empty point on the fuel gauge will make it easier to tell when to stop the genset before running it out of fuel.

Shutdown Codes

The genset controller provides extensive diagnostics by causing the status indicator light on the control Switch to blink in a coded fashion. Following a fault shutdown, the indicator light will repeatedly blink 2, 3 or 4 blinks at a time.

- TWO BLINKS indicates a low oil pressure fault.
- THREE BLINKS indicates a service fault. Press STOP once to cause the two-digit, second level shutdown code to blink. (Pressing STOP again will stop the blinking.) The two-digit code consists of 1,2,3,4, or 5 blinks, a brief pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks the units digit of the shut down code number. For example, shutdown code no. 36 appears as:

  Blink-blink-blink—pause—blink-blink-blink-blink-blink-blink—long pause—repeat
- FOUR BLINKS indicates that cranking exceeded 30 seconds without the engine starting.

RESTORING shutdown code Blinking – the shutdown code stops blinking after five minutes (15 minutes, Series HGJAD). Press STOP three times within five seconds to restore blinking. Note that the last fault logged will blink, even after the condition that caused the shutdown has been corrected.

31.0 Battery Separator

Figure 352: Battery Separator

The Battery Separator is designed for use in multi-battery applications as a solenoid priority system to protect the chassis charging system from excessive loading while allowing auxiliary batteries to be charged. The Battery Separator has two basic operational characteristics:

31.1 Assist in Engine Starting

When the starter is activated the Battery Separator compares the voltage of both battery banks. If the chassis' battery is lower than the auxiliary battery bank, the Battery Separator will engage allowing the auxiliary battery bank to aid in vehicle starting. The start signal must be at least three volts for the operation to occur.

31.2 Protect the Charging System

The Battery Separator monitors the battery system to determine if the batteries are being charged. When the engine or auxiliary batteries (if 1315-200 is used), or the engine batteries (if 1314-200 is used) reach 13.2 volts*, indicating charging is taking place, the Battery Separator will engage, joining the two battery banks. If the drain on the charging system by the auxiliary or main battery bank reduces the system voltage below 12.9 volts, the Battery Separator will disconnect the battery banks from each other, thus protecting the respective battery banks from excessive drain.

A delay function has been incorporated in the control circuitry to prevent the Battery Separator from reacting to momentary voltage fluctuations and chattering.

The priories are to assist in engine starting, if required, and to protect the charging system from excessive power drain.

32.0 9000 Series Roof Top Air Conditioner

For more information on the Air Conditioner, please see the “Operation and Maintenance instructions For 9000 Series Roof Top Air Conditioners and Ceiling Plenums” included with this vehicle.

Figure 353: Air Conditioner

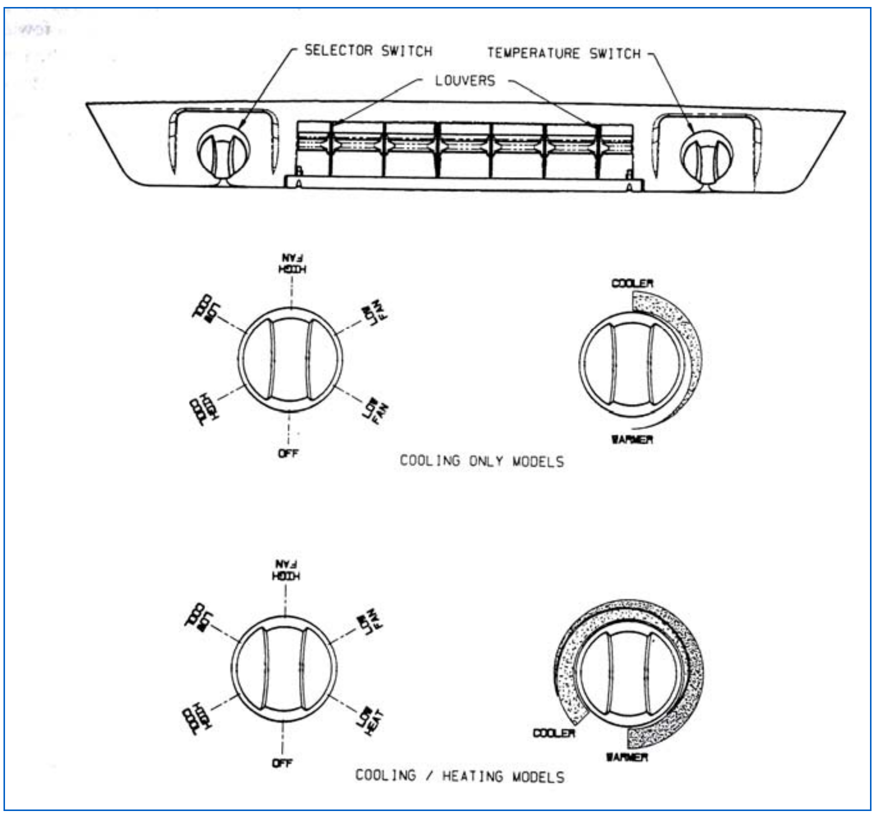


Figure 354: Air Conditioning Controls

There are three controls on the ceiling assembly that help you control the air conditioner. They are as follows:

A. The Selector Switch – The selector switch determines which mode of operation the air conditioner will be in. By rotating the selector switch, the operator can obtain any system function desired. System functions vary upon options of both the roof top unit and ceiling assembly. Figure 354 shows selector switch location and lists available functions by model.

B. The Thermostat (temperature control) – In the cooling mode, the thermostat regulates the "ON" and "OFF" temperature setting at which the compressor will operate.

   For "Heat/Cool" models, the thermostat also controls the "ON" and "OFF" temperature settings of the heater assembly. See Figure 354.

C. Louvers – The louvers are located at both ends of the ceiling assembly shroud and are used in directing the discharge air from the unit.

For a more detailed explanation of the operation of the Air Conditioner, see the "OPERATION" section of the "Operation and Maintenance instructions For 9000 Series Roof Top Air Conditioners and Ceiling Plenums" included with this vehicle.

32.1 Cleaning or Replacing Filters

Do not operate your air conditioner for extended periods of time without the filter installed. This can lead to lint, dirt, grease, etc. normally stopped by the filter now accumulating in the cooling coil. This not only leads to a loss of air volume and a possible icing-up of the cooling coil, but could also result in serious damage to the operating components of the air conditioner.

It is recommended that the filters be cleaned and changed at least every two weeks when the air conditioner is in operation.

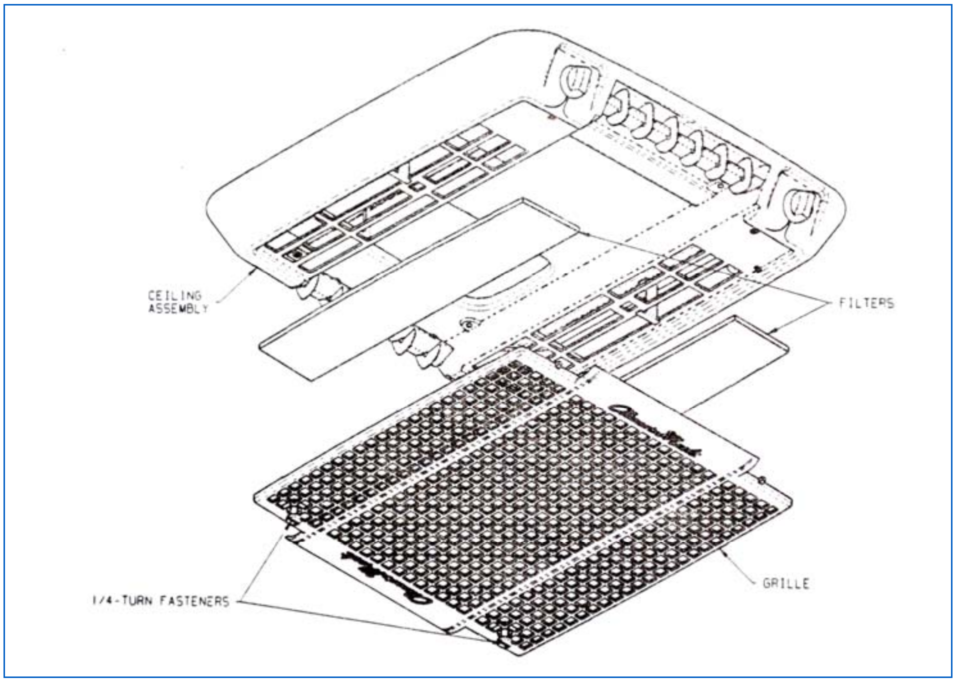


Figure 355: Removing the Air Conditioning Filters

1. Disengage the two ¼-turn fasteners that secure the ceiling assembly grille to the ceiling assembly (see Figure 355).
2. Lower the grille and filters from the ceiling assembly.
3. Take filters out and either clean or exchange with other filters (see Figure 355).
4. if the vehicle is equipped with a flush mount ceiling assembly, remove the four return air grill screws. Remove filter from grill and either clean or exchange with new filters.

32.2 Electrical Maintenance

All electrical work and/or inspection should be performed only by accredited service personnel. Contact your nearest Authorized Service Center if electrical problems should arise.

For more information on electrical maintenance of the air conditioning unit, please see “Section IV – Maintenance” in the “Operation and Maintenance instructions For 9000 Series Roof Top Air Conditioners and Ceiling Plenums” included with this vehicle.

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33.0 Power Control Center (Breaker Box)

For information about the PD4500 Series Power Control Center, please see the “Installation and Operation Guide for PD4500 Series Power Control Center” included with this vehicle.

Figure 356: The Power Control Center (Circuit Breaker Box)

TROUBLESHOOTING GUIDE

PROBLEM	**POSSIBLE CAUSES**	**ACTION**
No Output	120 VAC supply not connected	Connect Power Supply
		Check AC distribution panel for proper operation
	Reverse Battery fuses blown	Check for Reverse Battery connection
		Replace fuses with same type and rating
	Short Circuit	Trace RV Circuits for possible fault
	Unit has shutdown due to overheating	Check air flow
		Allow unit to cool
	Unit has shutdown due to over voltage	Check input voltage
		Converter will shut down if the input voltage exceeds 132 Volts
		Correct input voltage
Low Output	Compartment gets too hot	Check air flow to the converter
		Improve Ventilation to the compartment
	Excessive Load for Converter	Reduce load requirements or Install Larger Converter
	Input Voltage not between 105-130 VAC	Correct input supply voltage
	Bad Battery Cell(s)	Replace Battery
Intermittent or no Output on Generator, works on Shore Power	Unit has shutdown due to overvoltage	Add another load to the generator, this may reduce the "spikes" to an acceptable level
	Some generators exhibit excessive voltage spikes on the AC power output, this may cause the over voltage protection to shut the unit down	Contact generator manufacturer for possible defect in the generator
Open Fuse Indicator	Fuse open	Replace fuse with same type and rating

34.0 Awnings

34.1 Operation

For more information on operating the awnings on the 636 Gullwing Van, please see the “FIAMMA Installation and Operations Instructions” included with this vehicle.

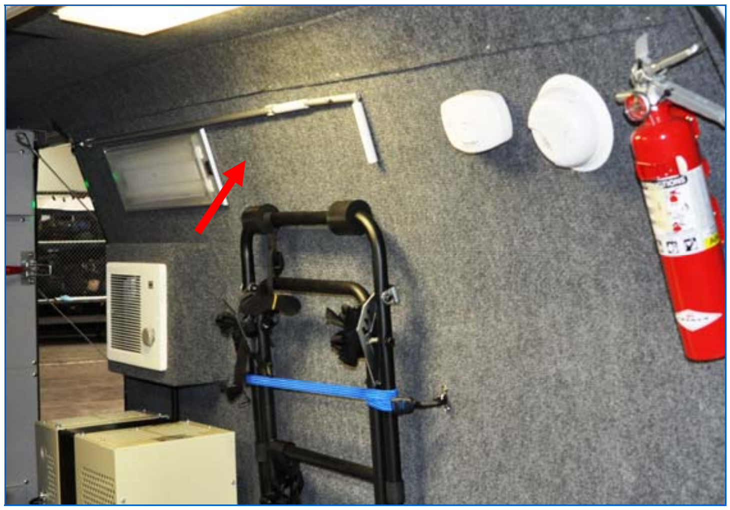

Figure 357: Crank Handle on Interior Van Wall

The awning crank handle is stored on the inside wall of the van as shown in Figure 357. To extend/deploy the awning:

1. Place the crank handle into the loop of the awning (Figure 358).

Figure 358: Crank Handle

2. Turn the crank handle to extend the awning open approximately 1 meter (3 feet) as shown in Figure 359.

Figure 359: Turning the Crank Handle

The awning will support itself but it is recommended that the legs be positioned to the ground after extending the awning 1 meter to reduce any strain on the awning and vehicle wall.

It is possible to break the leg if it is forced out in the wrong direction. To position the support legs properly, unscrew the knob on the leg to loosen the leg (Figure 360).

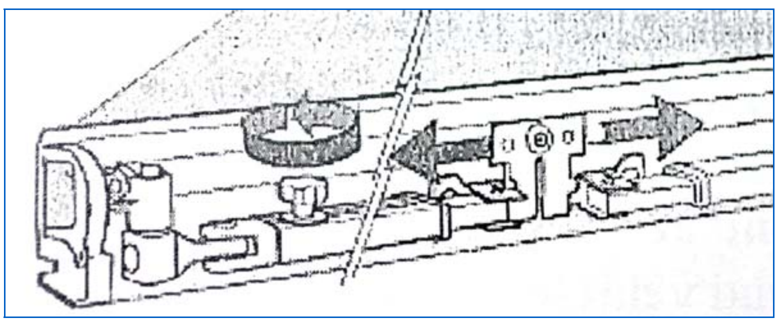

Figure 360: Loosening the Leg

Hold the leg near its swivel joint and pull straight out. This action pulls the joint out, allowing the leg to pivot to the ground and also removes the foot of the leg from behind the plastic holding brackets (Figure 375).

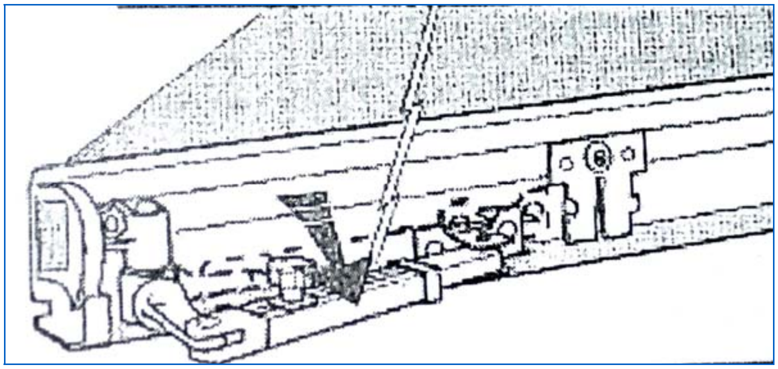

Figure 361: Pulling the Leg Out

With the joint pulled completely out and the foot no longer behind the holding bracket, swing the leg down to the ground, set the leg height and tighten the knob (Figure 362). Repeat on opposite side.

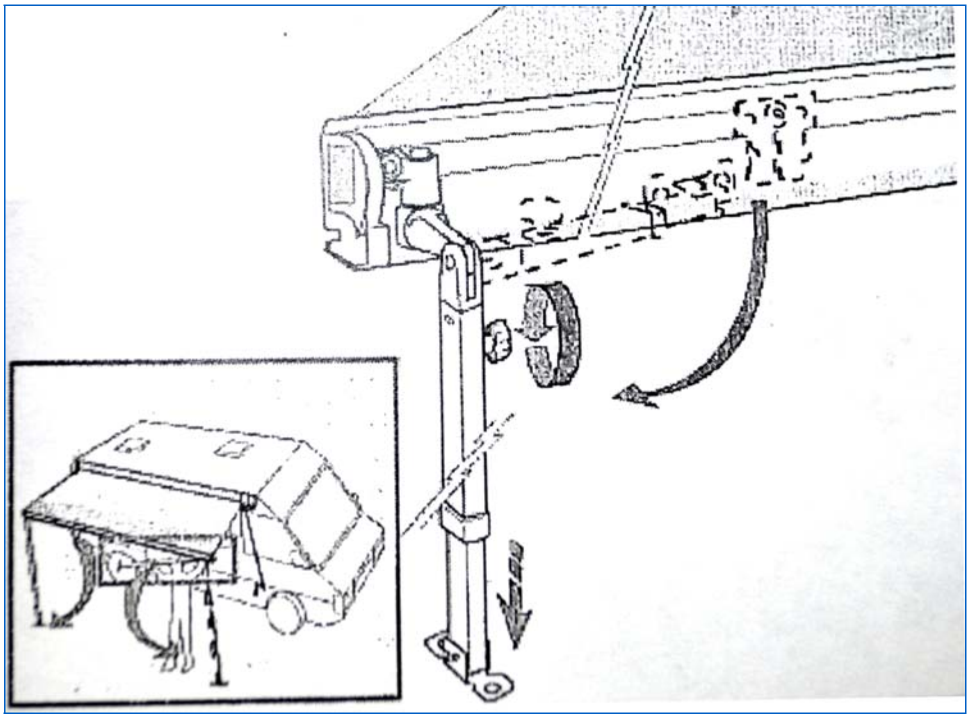

Figure 362: Swinging the Leg Down

Angle the legs away from the vehicle and extend the awning the rest of the way out. If you extend the awning completely to the end and th4e fabric becomes loose, crank the awning back in enough to tighten up the fabric (Figure 363).

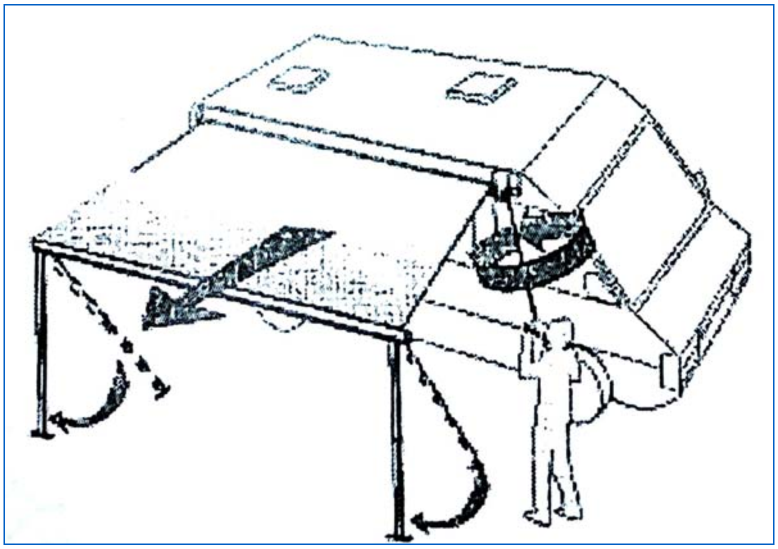

Figure 363: Angling the legs away from the Vehicle

NOTE: The lateral arms are designed to have a slight bend in them. Do not try to straighten.

Stakes are provided to hold the legs down in light winds; however, it is strongly recommended, as added security, that you use a tie-down kit or similar kit designed to help hold the awning down.

CAUTION: For stronger winds, rain or snow, close the awning! Wind, rain or snow can damage your awning and possibly result in damage to your vehicle.

34.2 Troubleshooting and Maintenance

Please see the "FIAMMA Installation and Operations Instructions" included with this vehicle for detailed troubleshooting and maintenance procedures.

The awning is manufactured following high quality control standards. The fabric has high resistance to UV rays, does not fade, is resistant to tearing, is flame-retardant, rot-proof, light-resistant, waterproof and washable. It can also be rewound damp; however it should be opened within 12 hours to dry completely.

To maximize the life of the awning, it is recommended that you follow the simple maintenance instructions below.

Before Closing Your Awning

Make sure that your awning is clean, free of any debris and completely dry before closing. Any residual moisture could cause stains. If however you

have no choice but to close the awning when it is still wet, make sure to open it within 12 hours maximum to dry completely.

Basic Guidelines to Clean the Fabric

Most dirt is superficial and can be removed with clean water and a cloth or brush. If the fabric has become excessively soiled, a mild dishwashing solution can be applied. Do not use any aggressive chemical solutions on the fabric or high pressure machines.

Lubrication

It is recommended lubricating all of the moving parts such as the elbows of the lateral arms and swivel joints at the top of the legs with a spray lubricant about ever six months to allow your awning to operate smoothly.

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35.0 Carbon Monoxide Detector and Radiation Detector

35.1 Radiation Detector

The 636 Gullwing Van security X-ray system includes a gamma/neutron radiation detection system. Please see the Rapiscan 636 Gullwing Van Gamma/Neutron Radiation Detection System manual, part #92103479/ included with the van and also available from Rapiscan Customer Service.

NOTE: Thoroughly read the First Alert CO400 User Manual before operating the First Alert CO400 battery powered carbon monoxide detector. Safe operation and top performance can be obtained only when equipment is operated and maintained correctly.

The Van features an electrochemical CO400 carbon monoxide detector on the rear passenger side of the van (see Figure 364 and Figure 365)

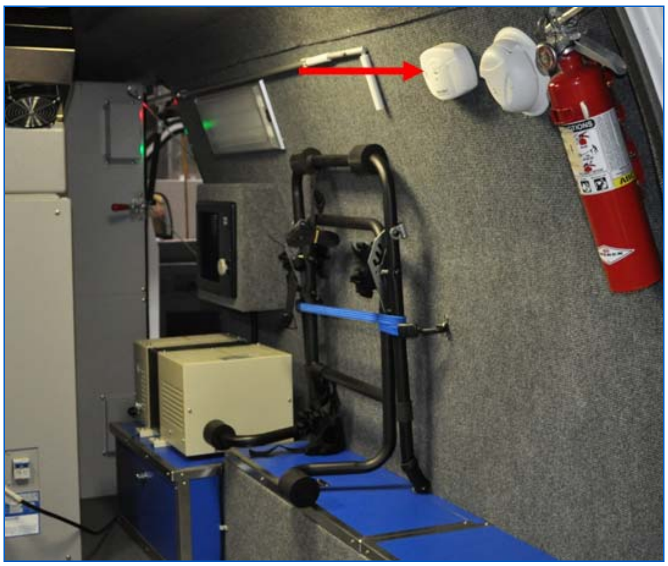


Figure 364: Carbon Monoxide Detector in rear of van

Figure 365: Carbon Monoxide Detector close-up

The alarm features a mute button to silence any nuisance alarms. The same button also tests alarm functions. The unit is powered by two AA batteries which are accessible from the front of the unit. There is also a light/indicator which, when lit, indicates that anyone inside the van should move to the outside.

35.2 Basic Safety Information

WARNING: This is not a smoke alarm. This CO Alarm is designed to detect carbon monoxide from ANY source of combustion. It is NOT designed to detect smoke, fire or other gas.

This CO alarm will only indicate the presence of carbon monoxide gas at the sensor. Carbon monoxide gas may be present in other areas.

The Silence Feature is for your convenience only and will not correct a CO problem. Always check your area for a potential problem after any alarm. Failure to do so can result in injury or death.

NEVER ignore your Carbon Monoxide Alarm if it alarms. Refer to “If Your CO Alarm Sounds” for more information. Failure to do so can result in injury or death.

Test the CO Alarm once a week. If the CO Alarm ever fails to test correctly, have it replaced immediately! If the CO Alarm is not working properly, it cannot alert you to a problem.

This product is intended for use in ordinary indoor locations. It is not designed to measure CO levels in compliance with Occupational Safety and Health Administration (OSHA) commercial or industrial standards. Individuals with medical conditions that may make them more sensitive to carbon monoxide may consider using warning devices which provide audible and visual signals for carbon monoxide concentrations under 30 ppm. For additional information on carbon monoxide and your medical condition contact your physician.

35.3 How Your Alarm Works

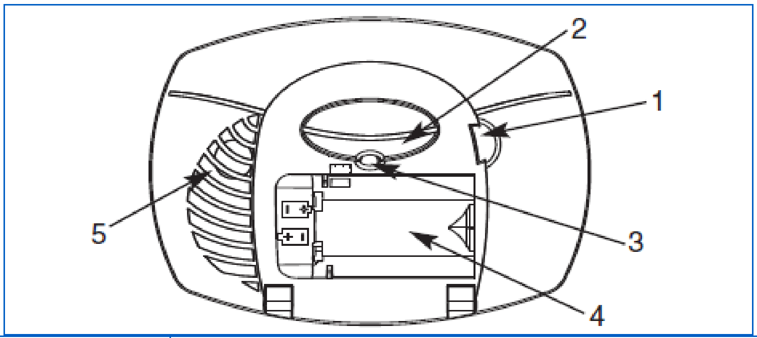
General Information

WARNING: This CO Alarm does not operate without working batteries. Removing the batteries, or failure to replace them at the end of their service life, removes your protection.

A CO Alarm measures the CO levels in the air. It will alarm if CO levels rise quickly or if CO is consistently present (a slow CO leak on a fuel-burning appliance).

This Carbon Monoxide Alarm features a permanently installed sensor and an 85 dB alarm horn. It also has a silence feature to temporarily quiet the alarm horn.

The Parts of your CO Alarm



1. Open door here	4. Battery Compartment
2. Test/Silence Button	5. (Behind Cover) Alarm Horn: 85dB audible alarm for test, alarm, and unit malfunction warning
3. POWER/ALARM Light (RED)	

Figure 366: The Parts of Your CO Alarm

35.4 Understanding Your Alarm

Welcome Chirp

Horn chirps and light blinks once when batteries are first connected.

Alarm Receiving Battery Power

Light flashes every minute. Horn is silent.

Low Battery Warning

The light continues to flash (RED) and the horn also “chirps” once every minute. This warning should last for up to 30 days, but you should replace the batteries as soon as possible.

During Testing

Light flashes Red in sync with the horn pattern (4 beeps, pause, 4 beeps), simulating a CO Alarm condition.

CO Alarm

Sensor has detected enough CO to trigger an alarm. Light flashes rapidly and horn sounds loudly (repeating 4 beeps, pause). See “If Your CO Alarm Sounds” for details. **During an alarm, move everyone to a source of fresh air. DO NOT move the CO Alarm!**

CO Alarm Requires Service (Malfunction Signal)

The light flashes (RED) and the horn sounds 3 quick “chirps” every minute. CO Alarm needs to be replaced.

35.5 If Your Co Alarm Sounds

WARNING: Actuation of your CO Alarm indicates the presence of carbon monoxide (CO) which can kill you. In other words, when your CO Alarm sounds, you must not ignore it!

If the Alarm Signal Sounds:

1. Operate the Test/Silence button.
2. Call your emergency services, fire department or 911. Write down the number of your local emergency service.
3. Immediately move to fresh air—outdoors or by an open door or window. Do a head count to check that all persons are accounted for. Do not reenter the premises, or move away from the open door or window until the emergency services responder has arrived, the premises have been aired out, and your CO Alarm remains in its normal condition.
4. After following steps 1-3, if your CO Alarm reactivates within a 24-hour period, repeat steps 1-3 and call a qualified appliance technician to investigate for sources of CO from fuel-burning equipment and appliances, and inspect for proper operation of this equipment. If problems are identified during this inspection have the equipment serviced immediately. Note any combustion equipment not inspected by the technician, and consult the manufacturers’ instructions, or contact the manufacturers directly, for more information about CO safety and this equipment. Make sure that motor vehicles are not, and have not, been operating in an attached garage or adjacent to the residence. Write down the number of a qualified appliance technician.

“ALARM-MOVE TO FRESH AIR”
If you hear the alarm horn and the Red light is flashing, move everyone to a source of fresh air.
DO NOT disconnect the batteries from the CO Alarm!

WARNING: Alarms have various limitations. See "General Limitations of CO Alarms" for details.

35.6 Using the Silence Feature

- **The Silence Feature is for your convenience only and will not correct a CO problem. Always check your home for a potential problem after any alarm. Failure to do so can result in injury or death.**

- **NEVER remove the batteries from your CO Alarm to silence the horn. Use the silence feature. Removing the batteries removes your protection! See "If Your CO Alarm Sounds" for details on responding to an alarm.**

The Silence Feature is intended to temporarily silence your CO Alarm's alarm horn while you correct the problem—it will not correct a CO problem. While the alarm is silenced it will continue to monitor the air for CO.

When CO reaches alarm levels the alarm will sound— repeating horn pattern: 4 beeps, a pause, 4 beeps, etc. Press and hold the Test/Silence button until the horn is silent. The initial Silence cycle will last approximately 4 minutes.

NOTE: After initial 4-minute Silence cycle, the CO Alarm re-evaluates present CO levels and responds accordingly. If CO levels remain potentially dangerous—or start rising higher—the horn will start sounding again.

While the detector is silenced:

If the CO Alarm...	This means...
Is silent for only 4 minutes, then starts sounding loudly—4 beeps, pause, 4 beeps, pause	CO levels are still potentially dangerous.
If the CO Alarm...	**This means...**
Remains silent after you pressed the Test/Silence button	CO levels are dropping.

Silencing the Low Battery Warning

This silence feature can temporarily quiet the low battery warning "chirp" for up to 8 hours. You can silence the low battery warning "chirp" by pressing the Test/Silence button. The LED will flash twice, acknowledging that the low battery silence feature has been activated.

After 8 hours, the low battery "chirp" will resume. **Replace the batteries as soon as possible; this unit will not operate without battery power!**

To deactivate this feature: Press the Test/Silence button again. The unit will go into Test Mode and the low battery warning will resume (LED flashes and unit sounds "chirp" once a minute.)

If you cannot silence the low battery warning, replace the batteries immediately.

35.7 Testing & Maintenance

WARNING:

• Test the CO Alarm once a week. If the CO Alarm ever fails to test correctly, have it replaced immediately! If the CO Alarm is not working properly, it cannot alert you to a problem.

• DO NOT stand close to the Alarm when the horn is sounding. Exposure at close range may be harmful to your hearing. When testing, step away when horn starts sounding.

Push and hold the Test/Silence button on the cover until the LED flashes. The alarm horn will sound 4 beeps, a pause, then 4 beeps. The ALARM (RED) light will flash.

The alarm sequence should last 5-6 seconds. If it does not alarm, make sure fresh batteries are correctly installed, and test it again. If the unit still does not alarm, replace it immediately.

If the alarm does not test properly:

1. Make sure that fresh batteries are installed correctly.
2. Be sure the Alarm is clean and dust-free.
3. Install fresh AA batteries***** and test the Alarm again.

WARNING:

• DO NOT try fixing the Alarm yourself – this will void your warranty! If the CO Alarm is still not operating properly, and it is still under warranty, please see "How to Obtain Warranty Service" in the Limited Warranty. Install a new CO Alarm immediately.

• The Test/Silence button is the only proper way to test the CO Alarm. NEVER use vehicle exhaust! Exhaust may cause permanent damage and voids your warranty.

* For a list of acceptable replacement batteries, see “Regular Maintenance.”

Regular Maintenance

To keep the CO Alarm in good working order:

- Test it every week using the Test/Silence button.
- Vacuum the CO Alarm cover once a month, using the soft brush attachment. Never use water, cleaners, or solvents, since these may damage the unit. Test the CO Alarm again after vacuuming.
- Replace the batteries when the CO Alarm “chirps” about every minute (the low battery warning).

The low battery warning should last for 30 days, but you should replace the battery immediately to continue your protection.

Choosing a replacement battery:

This CO Alarm requires two standard AA batteries. The following batteries are acceptable as replacements: Energizer E91. These replacement batteries are commonly available at local retail stores.

IMPORTANT!

Use only the replacement batteries listed. The unit may not operate properly with other batteries. Never use rechargeable batteries since they may not provide a constant charge.

CAUTION: DO NOT spray cleaning chemicals or insect sprays directly on or near the CO Alarm. DO NOT paint over the CO Alarm. Doing so may cause permanent damage.

Important!

Household cleaners, aerosol chemicals, and other contaminants can affect the sensor. When using any of these materials near the CO Alarm, make sure the room is well ventilated.

35.8 What You Need to Know About CO

What Is CO?

CO is an invisible, odorless, tasteless gas produced when fossil fuels do not burn completely, or are exposed to heat (usually fire). Electrical appliances typically do not produce CO.

These fuels include: Wood, coal, charcoal, oil, natural gas, gasoline, kerosene, and propane.

Common appliances are often sources of CO. If they are not properly maintained, are improperly ventilated, or malfunction, CO levels can rise quickly. CO is a real danger now that homes are more energy efficient. “Air-tight” homes with added insulation, sealed windows, and other weatherproofing can “trap” CO inside.

Symptoms of CO Poisoning

These symptoms are related to CO POISONING and should be discussed with ALL household members.

Mild Exposure: Slight headache, nausea, vomiting, fatigue (“flu-like” symptoms).

Medium Exposure: Throbbing headache, drowsiness, confusion, fast heart rate.

Extreme Exposure: Convulsions, unconsciousness, heart and lung failure. Exposure to carbon monoxide can cause brain damage, death.

WARNING: Some individuals are more sensitive to CO than others, including people with cardiac or respiratory problems, infants, unborn babies, pregnant mothers, or elderly people can be more quickly and severely affected by CO. Members of sensitive populations should consult their doctors for advice on taking additional precautions.

Finding the Source of CO After an Alarm

Carbon monoxide is an odorless, invisible gas, which often makes it difficult to locate the source of CO after an alarm. These are a few of the factors that can make it difficult to locate sources of CO:

- House well ventilated before the investigator arrives.
- Problem caused by “backdrafting.”
- Transient CO problem caused by special circumstances.

Because CO may dissipate by the time an investigator arrives, it may be difficult to locate the source of CO.

How Can I Protect Myself?

A CO Alarm is an excellent means of protection. It monitors the air and sounds a loud alarm before carbon monoxide levels become threatening for average, healthy adults.

A CO Alarm is not a substitute for proper maintenance of home appliances.

To help prevent CO problems and reduce the risk of CO poisoning:

- Test and maintain all fuel-burning equipment regularly.
- Check equipment for excessive rust and scaling. Use vents or fans when they are available. Make sure fuel-burning equipment is vented to the outside.
- Check for exhaust backflow from CO sources.

In addition, familiarize yourself with all enclosed materials. Read this manual in its entirety, and make sure you understand what to do if your CO Alarm sounds.

35.9 Regulatory Information for CO Alarms

What Levels of CO Cause an Alarm?

Underwriters Laboratories Inc. Standard UL2034 requires residential CO Alarms to sound when exposed to levels of CO and exposure times as described below. They are measured in parts per million (ppm) of CO over time (in minutes).

UL2034 Required Alarm Points*:

- If the alarm is exposed to 400 ppm of CO, IT MUST ALARM BETWEEN 4 and 15 MINUTES.
- If the alarm is exposed to 150 ppm of CO, IT MUST ALARM BETWEEN 10 and 50 MINUTES.
- If the alarm is exposed to 70 ppm of CO, IT MUST ALARM BETWEEN 60 and 240 MINUTES.

* Approximately 10% COHb exposure at levels of 10% to 95% Relative Humidity (RH).

The unit is designed not to alarm when exposed to a constant level of 30 ppm for 30 days.

Important!

CO Alarms are designed to alarm before there is an immediate life threat. Since you cannot see or smell CO, never assume it's not present.

- An exposure to 100 ppm of CO for 20 minutes may not affect average, healthy adults, but after 4 hours the same level may cause headaches.
- An exposure to 400 ppm of CO may cause headaches in average, healthy adults after 35 minutes, but can cause death after 2 hours.

This CO Alarm measures exposure to CO over time. It alarms if CO levels are extremely high in a short period of time, or if CO levels reach a certain minimum over a long period of time. The CO Alarm generally sounds an alarm before the onset of symptoms in average, healthy adults.

Why is this important? Because you need to be warned of a potential CO problem while you can still react in time. In many reported cases of CO exposure, victims may be aware that they are not feeling well, but become disoriented and can no longer react well enough to exit the building or get help. Also, young children and pets may be the first affected. The average healthy adult might not feel any symptoms when the CO Alarm sounds.

However, people with cardiac or respiratory problems, infants, unborn babies, pregnant mothers, or elderly people can be more quickly and severely affected by CO. If you experience even mild symptoms of CO poisoning, consult your doctor immediately!

Standards: Underwriters Laboratories Inc. Single and Multiple Station carbon monoxide alarms UL2034.

According to Underwriters Laboratories Inc. UL2034, Section 1-1.2: "Carbon monoxide alarms covered by these requirements are intended to respond to the presence of carbon monoxide from sources such as, but not limited to, exhaust from internal-combustion engines, abnormal operation of fuel-fired appliances, and fireplaces. CO Alarms are intended to alarm at carbon monoxide levels below those that could cause a loss of ability to react to the dangers of Carbon Monoxide exposure." This CO Alarm monitors the air at the Alarm, and is designed to alarm before CO levels become life threatening. This allows you precious time to leave the house and correct the problem. This is only possible if Alarms are located, installed, and maintained as described in this manual.

Gas Detection at Typical Temperature and Humidity Ranges: The CO Alarm is not formulated to detect CO levels below 30 ppm typically. UL tested for false alarm resistance to Methane (500 ppm), Butane (300 ppm), Heptane (500 ppm), Ethyl Acetate (200 ppm), Isopropyl Alcohol (200 ppm) and Carbon Dioxide (5000 ppm). Values measure gas and vapor concentrations in parts per million.

Audible Alarm: 85 dB minimum at 10 feet (3 meters).

35.10 General Limitations of CO Alarms

- This CO Alarm is not intended to meet Occupational Safety and Health Administration (OSHA) requirements for carbon monoxide detectors.
- CO Alarms may not waken all individuals.
- CO Alarms will not work without power.
- CO Alarms for Solar or Wind Energy users and battery backup power systems: AC powered CO Alarms should only be operated with true or pure sine wave inverters. Operating this Alarm with most battery-powered UPS (uninterruptible power supply) products or square wave or "quasi sine wave" inverters will damage the Alarm. If you are not sure about your inverter or UPS type, please consult with the manufacturer to verify.
- This CO Alarm will not sense carbon monoxide that does not reach the sensor.
- CO Alarms may not be heard.
- CO Alarms are not a substitute for a smoke alarm.
- CO Alarms are not a substitute for life insurance.
- CA Alarms have a limited life.

- CO Alarms are not foolproof.

PROBLEM...	**THIS MEANS...**	**YOU SHOULD...**
The light continues to flash (RED) and the horn "chirps" once every minute.	Low battery warning.	Install 2 new AA batteries*.
The light flashes (RED) and the horn sounds 3 quick "chirps" every minute.	**MALFUNCTION SIGNAL.** CO Alarm needs to be replaced.	CO Alarms under warranty should be returned to manufacturer for replacement. See "Limited Warranty" for details.
CO Alarm goes back into alarm 4 minutes after you press the Test/Silence button.	CO levels indicate a potentially dangerous situation.	IF YOU ARE FEELING SYMPTOMS OF CO POISONING, EVACUATE your home and call 911 or the Fire Department. If not, press the Test/Silence button again and **keep ventilating your home.**
CO Alarm sounds frequently even though no high levels of CO are revealed in an investigation.	The CO Alarm may be improperly located. Refer to "Where to Install CO Alarms."	Relocate your alarm. If frequent alarms continue, have home rechecked for potential CO problems. You may be experiencing an intermittent CO problem.

*For a list of acceptable replacement batteries, see "Page 4: Regular Maintenance."

Figure 367: Troubleshooting Guide

36.0 Planned Preventive Maintenance

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the "Limitation on Liability" section, including the section on voiding the Rapiscan Systems warranty.

WARNING: Care must be taken to prevent water or any other liquid entering the system. Make sure any cleaning cloth is wrung out before use.

If the system is to be dismantled in any way, or if an internal inspection of the tunnel is necessary, then the system must be switched off and disconnected from the mains supply. The keyboard key is to be in the possession of the maintenance engineer.

Some parts of the X-ray system are heavy and require two persons during removal.

36.1 Shore Power

NOTE: Shore line power should be kept ON during non-used time such as overnight and during the weekends. If the system is not plugged in for 2 to 3 days, the UPS should be shut down. Turn the UPS back ON when putting the van back into use.

36.2 Weekly Maintenance

The weekly maintenance routines are mainly concerned with visual inspection and cleanliness of the system; they are detailed in sequential order. If the operating environment warrants it, they should be performed more regularly.

Preparation

- Read the warnings at the beginning of this chapter before proceeding.
- Switch off the system and remove the keyboard key.
- Remove the mains supply to the system.

CAUTION: Care must be taken to prevent water or any other liquid entering the system. Make sure any cleaning cloth is wrung out before use.

Visual Inspection

Visually inspect all the covers and panels for damage and security- damaged covers and panels and any missing fasteners must be replaced.

Conveyor Belt and Video Monitor casing

Using a damp lint-free cloth (soap suds may be used if required) wipe clean the surface of the conveyor belt and the casing of the monitor. Dry all surfaces that have been cleaned with a dry lint free cloth.

Video Monitor Screens

Clean the screen with an anti-static spray or liquid and a lint-free cloth.

36.3 Three Month Maintenance

Preparation

Read the warnings at the beginning of this chapter before proceeding. Switch off the system and remove the keyboard key. Remove the mains supply to the system.

CAUTION: Care must be taken to prevent water or any other liquid entering the system. Make sure any cleaning cloth is wrung out before use.

System housing

Using a damp lint-free cloth (soap suds may be used if required) wipe clean the surface of the system housing. Dry all surfaces that have been cleaned with a dry lint free cloth.

Lead Curtains

Visually inspect the lead curtains screening at the entrance and exit of the inspection tunnel for damage. Replace any strips found to be damaged.

Conveyor Visual Inspection

Visually inspect the conveyor belt for tears and holes, replace the belt if excessive damage is found.

Visually inspect the rollers of the discharge conveyor (if fitted) for signs of damage.

Conveyor Motion Checks

1. This requires that the machine be operated during the checks, so reconnect the main supply to the system and switch the system back on.
2. Press the forward button (“S”) on the operator control panel, and observe that the associated indicator is lit and the conveyor moves in the forward direction.
3. Check for excessive noise from each roller bearing- this will indicate that the bearing is defective.
4. Check the conveyor belt deviation from center at each end. The maximum deviation allowable is 20mm.
5. Press the STOP button (“R”) on the operator control panel.
6. Press the reverse button (“Q”) on the operator control panel, and observe that the associated indicator is lit and the conveyor moves in the reverse direction.
7. Check the conveyor belt deviation from center at each end. The maximum deviation allowable is 20mm.

Radiation Leakage Survey

Radiation surveys must be performed routinely or as needed to evaluate the radiation hazards. All personnel responsible for the maintenance of baggage and cabinet x-ray inspection systems must use a properly functioning and appropriately calibrated survey meter to monitor radiation levels before and after maintenance activities, especially after the replacement of an x-ray tube (or its shielded housing) or the relocation of an x-ray inspection system and for other radiation safety checks when warranted.

A radiation protection survey is intended to establish the x-ray inspection system functions according to applicable performance standards and that it is used and maintained to provide maximum radiation safety to all individuals.

Baggage and cabinet x-ray inspection systems must be surveyed regularly. While the frequency of surveys depends on the conditions of use, performance history and type of x-ray system, the appropriate radiation protection regulatory authority defines the required or recommended survey frequency.

Rapiscan Systems recommends a quarterly radiation leakage survey; however, the minimum survey frequency is **ANNUALLY**.

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37.0 Troubleshooting

CAUTION: Before installing, repairing or troubleshooting any Rapiscan Systems equipment, read the "Limitation on Liability" section, including the section on voiding the Rapiscan Systems warranty.

37.1 General

The Rapiscan X-ray System has been designed for a long service life and reliable operation. Some reasons for malfunction can be checked and rectified by on-site maintenance personnel without the need to call for a service engineer.

The X-ray system contains numerous safety features and interlocks that prevent hazardous generation of X-rays. If a fault occurs and X-rays are not being switched on, proceed with extreme caution when troubleshooting.

Rapiscan X-ray machines perform an extensive power-on self-test that will report problems on the monitor if any are found. The system software provides a testing facility called 'Maintenance Mode' which can be used to exercise parts of the system to aid in fault diagnosis.

Before attempting to replace or repair parts, the Rapiscan Systems Service Department should be contacted since they can help with complex issues and have the most up-to-date knowledge regarding common problems.

37.2 Electrical Warning

The following checks are to be carried out by a trained and qualified maintenance technician only. Hazardous voltages exist on circuit boards and other places inside the system. Take precautions to prevent electric shocks if it is necessary to operate the system with the panels removed. Remove the power lead from the wall socket before opening any panel if you are unfamiliar with the system.

37.3 X-Ray Warning

Never insert an arm or any other part of the body into the tunnel area if the X-rays are on, or if they can be switched on by another person at the keyboard.

Do not operate the machine with the lead curtains removed or displaced over the top of the machine. The lead curtains must be in good order, with no gaps.

Do not disable safety interlocks, such as the microswitches on the Diode Array box.

Do not remove any lead shielding from any part of the machine.

The X-ray generator is not a user-serviceable part. Faulty units must be returned for refurbishment to a Rapiscan Systems Service center.

37.4 System Does Not Switch On

Check:

1. Power-On key on the keyboard is turned clockwise.
2. Mains cable is connected firmly to power inlet, and other end is connected to a live mains socket.
3. Trip indicator on circuit breaker is set correctly, and power switch is turned on.
4. The fuse in the mains plug is OK.
5. All emergency stop switches (if fitted) are not activated i.e. rotated to the 'out' position.
6. Remove the power cable from the mains supply, and unlock the access panels to reveal the electronics chassis.
7. Check that the voltage selector is set correctly.

Warning: If this switch is set incorrectly, check your serial number plate to make sure you have the appropriate voltage and frequency machine for your main supply!

Interlock release sequence

1. On power ON sequence, pressing power ON button provides power to the self-sustaining circuit or relay RL.
2. Release power ON button, and this RL is still energized. The voltage of this circuit is used to energize coil RX that provides AC power to X-ray PSU
3. When an interlock is opened, it breaks this self-sustain relay power. Power will be interrupted. This brings lost power to the coil of RX and stops X-ray generator by cutting its AC source.
4. After closing the interlock, one has to press the Power ON button to restart the self-sustaining relay RL.

E-STOP system

1. E-Stop chain connects 12V to coil of RE and to connector J25 of CI
2. Interrupting this chain de-energizes RE, thus opening the loop of signal connect to CI at connector J22. This gives CI indication of Emergency button activation.

3. Interrupting power in this chain also interrupts power to J25 of CI. This power goes through a contact of relay on CI board to reach the coil of RB. Losing power to the coil, RB releases the contact that supplies AC to IEC bar. IEC bar is used to supply power to motor and X-ray generator. Cutting this power results in stop motion of conveyor and stops X-ray generator output.

37.5 Interaction with X-ray controller

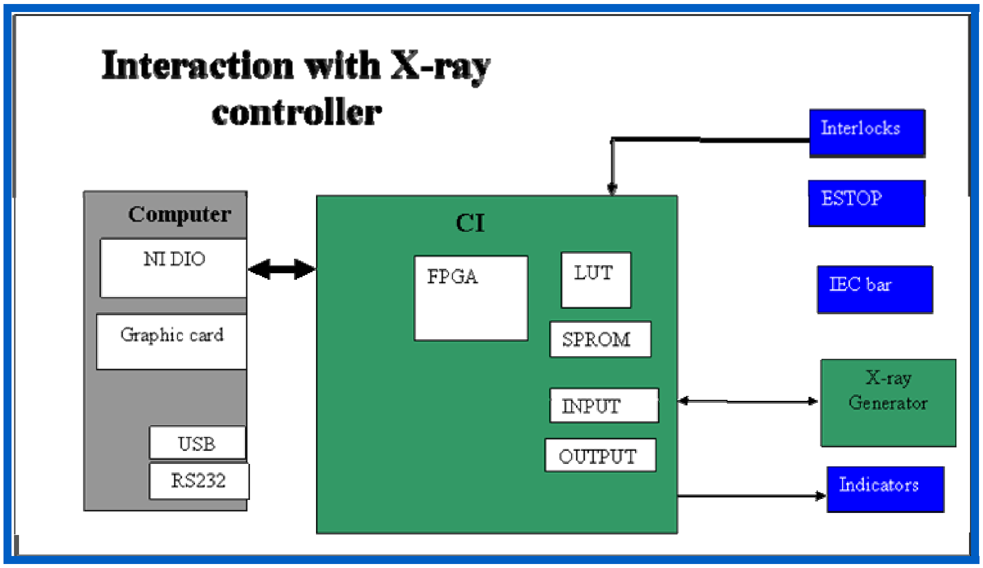

Figure 368: Interaction with X-ray Controller

Turn ON X-ray output

Computer turns on X-ray by send a single signal via NI to CI. FPGA make this into differential signal pair DVay_Ctrl0 and DVay_Ctrl1 and pass it to X-ray generator

X-ray generator must see proper level of differential pair to turn on.

DVay_ON command signals from FPGA sent out as X-ray_Ctrl0. /DVay_ON command signal from FPGA sent out as X-ray_Ctrl1. This is buffered up by U23 and used to turn on Q9 and Q10. When input to FET Q9 or Q10 is high, they go into conductive mode and allow signal on XON or /XON to be connected to 0V. These two signals are generated by X-ray Controller and typically have 12V.

Reading KV and mA value

System read KV and mA via CI. Between CI and X-ray controller, we need 3 signals: DPOLL, XSYNC and D0RTN.

DPOLL is used to select reading of KV or mA. A stuck DPOLL will not allow the system to read correct data out from X-ray controller.

XSYNC is used to clock data out from X-ray controller. A stuck XSYNC will disable data flow from X-ray controller to CI.

D0RTN is the data return from X-ray controller to CI. A stuck D0RTN will give wrong reading from X-ray controller.

Note that these signals typically swing between 0V and 12V at high rate. With X-ray ON, a volt meter on these signals should get reading between 12V and 0V but not at any of the two extremes.

37.6 'System Ready' does not appear

This indicates a lack of communication in the data acquisition system (National Instruments card, cable adapter board and ribbon cables). Any of these devices could be faulty, also check the motherboard BIOS set-up. It is important the IRQ settings are correct on the PNP - PCI page. For more details, see the Data Acquisition and Computer Rack sections.

37.7 X-ray System Does Not Switch On

1. Check:

- Power supply to the system is turned on.
- Power on key-switch is turned clockwise.
- Power cable is connected firmly to X-ray machine power inlet.
- Circuit breaker near the power inlet is switched on.
- All emergency stop switches in the zone are not activated i.e. rotated to the 'out' position.

2. If all the above conditions are O.K., open the access panels to reveal the electronics chassis.
3. Check the fuses FS1 and FS2 on the PDI board are O.K. If they are good, detailed faultfinding on the PDI board is required. Please refer to the section on the PDI board.

37.8 Conveyor Does Not Operate

The X-ray machine software should display an error message if the conveyor does not run. Please see the 'Inverter Fault' error above.

37.9 Machine Does Not Calibrate

The opto-sensors on the tunnel entry initiate the diode array calibration procedure. If the sensor is blocked or faulty this will prevent calibration. The image quality may deteriorate over time if calibration is not performed.

37.10 X-rays Do Not Turn Off

Opto sensors PS1 (and PS4 in the other direction) detect objects entering the tunnel and cause X-rays to turn on. When the object has left the tunnel, X-rays should turn off. If the sensor is misaligned or dirty, the X-rays will remain on even though all objects have left the tunnel.

37.11 Bags Do Not Stay On the Screen

Normally, bags scroll on from the side of the screen and stop there until the next item enters the tunnel. If they do not stay on the screen, check the opto-sensor inside the tunnel near the X-ray beam to see if it is blocked.

37.12 Interaction with X-ray controller

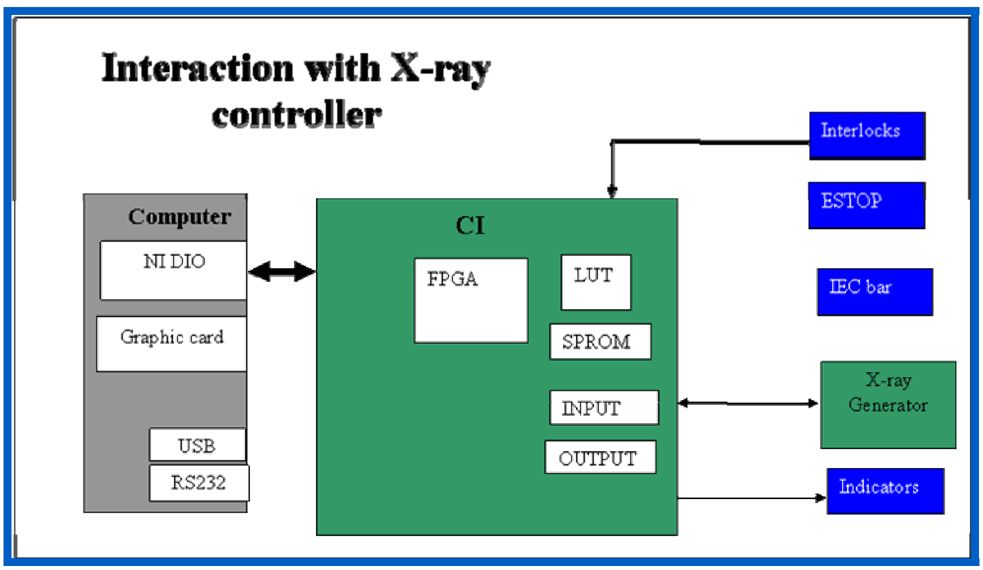

Figure 369: Interaction with X-ray Controller

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Note that these signals typically swing between 0V and 12V at high rate. With X-ray ON, a volt meter on these signals should get reading between 12V and 0V but not at any of the two extremes.

37.13 Image Problems

Please see the section on the diode array for troubleshooting poor image quality. The system may need collimating if the image quality is poor.

Check the Data Acquisition Boards and ADC jumper settings (see Figure 293Figure 294 and Jumper Configuration on page 279).

Interaction with Position Sensors:

There are two conventions for naming Position Sensor in Rapiscan software.

- Electrical: The Position sensor is numbered in order from the Front to the Rear of the machine, from PS1 to PS4.

- Software: Position sensors in Rapiscan software are numbered relative to the direction of the belt movement. The first one would be encountered by the bag as it moves through the tunnel is called PS1 in software. Note that in Maintenance mode, no matter which direction you run the conveyor, the order of sensor blocked always in sequence from PS1 to PS4.

The critical point is not at the position of the Position Sensor but in which connector of Junction Board you connect signal from Position Sensor to.

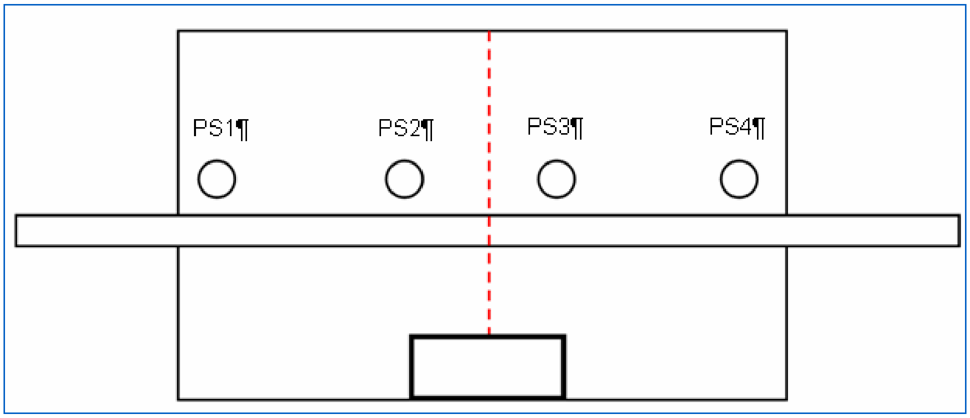

Figure 370: Position Sensors

- In the direction of conveyor movement, position sensors are named in sequence of PS1, PS2, PS3, PS4.
- When the leading edge of a bag crosses PS1, system software will turn on X-ray and perform calibration
- When the leading edge of the bag crosses PS2, system will make image.

NOTE: When X-rays are not already ON, the leading edge of the bag crossing PS2 will tell the software to turn on X-rays then wait for full signal before starting to make an image. For this reason the following special cases may happen.

1. PS1 is dead, not providing signal: System does not detect bag entry thus turn on X-ray and make image solely depending on PS2. Since this is too close to X-ray beam, the image forming will be late and leading edge of bag image will be cut off.
2. PS2 and PS1 swapped: This could be a problem due to miss wiring or putting cables into wrong position on junction board.
   a. Since the bag's leading edge cross PS2 as the first sensor, system will try to make image early. Because the bag is not near the x-ray beam, the leading blank in the image will be long. One will see the image start to scroll early.
   b. Since the system stop generating image also based on PS2, it may turn off too soon and resulting in image cut off at the trailing edge.

37.14 Conveyor Problems

See Figure 376.

37.15 Emergency switch interface

AC power to Conveyor and X-ray PSU is coming from an IEC bar. As a part of safety system, there is a double pole relay **RB** in the AC power chain to this IEC bar with the coil is controlled by CI board via connector **J25**. CI control power to this coil via a reef relay, **K6**. The connection to this relay, K6, is on it Normally Closed end. By this, it means that without power, the contact through K6 is closed and conducted electric.

At all time, the 12V chain is also monitored by CI board through connector **J22** which feed signal to CI through an opto-isolator **U12**. Note that the 12V from emergency chain power the coil of RE whose contact provides the translation into 5V signal used by opto-isolator.

When CI detect emergency button engaged, it will cut of power to reef relay **K6** which in turn shut off power to the coil of double pole relay **RB**. This will result in shut down AC to IEC power bar and keep conveyor/X-ray PSU in power off state even user restore Emergency button to normal position. User then must activate command from software to set CI to re-engage the reef relay **K6**

37.16 Interlock Interface

Interlocks are in normal closed position.

- In power up sequence, when Power Button is pressed, it allows 12V to go through the coil of RI.
- RI closes its contact and allows following actions:
- 12V goes through interlock switches as the first leg.
- 12 V goes through coil of RX. This allows AC power from IEC bar to reach X-ray PSU.
- 12V goes through the coil of RL as the second leg. This closes the contact and brings 12V directly through the switches before reaches back at the coil.
- Release Power Button, 12V is disconnected from coil of RI. This opens contact of RI and disconnects the first leg of 12 V from getting into the circuit.
- The interlock circuit is still powered through the second leg.
- Open the cover of system with interlock will break the loop back supply from the second leg.
- This stops energizing the coil of RL, opens the contact on RL and shuts the loop back supply.
- Without 12V from either leg, RX coil is de-energized and release the contact that allow AC to get to X-ray PSU.

37.17 Error Messages

Error Message: 'Bad signals or X-Ray is blocked. Press R to ignore or S/Q to clear the tunnel'

Some or all of the X-ray sensors are not detecting any X-rays.

There might be something blocking the X-ray beam inside the machine. Run the conveyor to try and remove the blockage. If this does not cure the fault, switch the machine off and wait for it to shut down. Remove the power cord from the machine then look inside the tunnel for an obstruction. Press R and log in as SERVICE2. Enter System Service and turn X-rays on. If the diode array shows no signals, check the cables to the diode array and the power supplies located next to the array box. Check the analog to digital converter card cables.

Error Message: 'Interlock Violation'

There is a problem with the X-ray interlock switches inside the machine.

Remove the side panel and locate the electronics chassis. Check cable F and N (refer to table of cable numbers). Switch the machine off and remove the diode array box lids. Check the micro-switches operate correctly.

Error Message: 'Trip Tray Violation'

Check Trip-tray or trip-bar, if this option is fitted.

There might be an obstruction in the trip-tray at the end of the conveyor. Turn the machine off, remove the obstruction and check that the trip-tray is free to move. The trip-tray operates micro-switches that should click when they activate. If the trip-tray is not fitted, check the Machine Configurations menu trip tray option, which should be disabled. Check cable F and N (refer to table of cable numbers).

Error Message: 'Foot Mat Violation'

The conveyor has been asked to run when the foot-mat is not being activated.

Check whether the foot-mat is plugged in correctly and the cable is not damaged. If the foot-mat is not fitted, check the Machine Configurations menu foot-mat option, which should be disabled.

Error Message: 'Inverter Fault'

There is a problem with the conveyor drive inside the machine.

1. Try turning the machine off, (wait for it to power down) remove the power cord, then reapply the power.
2. Check cable N (refer to table of cable numbers) from the inverter to the CI board J21.
3. Check whether the inverter has power from the PDI PCB.
4. Check the drive roller and cable.

Error Message: ‘X-Ray Control Fault’

There is possibly a problem with the X-ray generator inside the machine.

1. Try turning the machine off, (wait for it to power down) remove the power cord, then reapply the power.
2. Check the cables Y and AA (refer to table of cable numbers).
3. Check fuses FS7 and FS8 on the PDI PCB.

37.18 Master Battery Disconnect

One of the main causes of power problems with the 536 Gullwing Van is the Master Battery Disconnect Figure 38 being in the “off” position without the operator’s knowledge. So the first step in troubleshooting any power-related problem is to check the status of the Master Battery Disconnect.

37.19 Generator Fails to Operate

The auxiliary generator operates on the van’s fuel, taken from the van’s gas tank through a fuel line. That line sits at the quarter-full level of the tank. That means that when the van’s gas tank gets below a quarter full, the fuel will no longer flow into the fuel line supplying the auxiliary generator, even though the van’s fuel gage will show that there is fuel and even though the van itself has fuel to start and operate.

If the generator stops operating or refuses to start, check the gas gauge to see if the level is at a quarter tank or less. If so, fill the tank.

Another possible cause of the generator not operating properly is that the generator might be flooded, just as a car engine can be flooded. If this happens, wait five minutes then try the generator again.

37.20 Replacing Light Bulbs

There are several lights on the interior of the Rap 536 Gullwing Van. These include lights on the inside of the gullwing door, and inside the back of the van (Figure 371).

Note that there is a master light switch but also individual switches on each of the lights themselves. This means that if a particular light stops operating, it may be that the switch is in the "off" position rather than being burned out.

Figure 371: Interior Lights

The lights are covered by a rectangular piece of hard plastic. To remove this cover, press on either side of the plastic until the edges slip out from behind the metal lip.

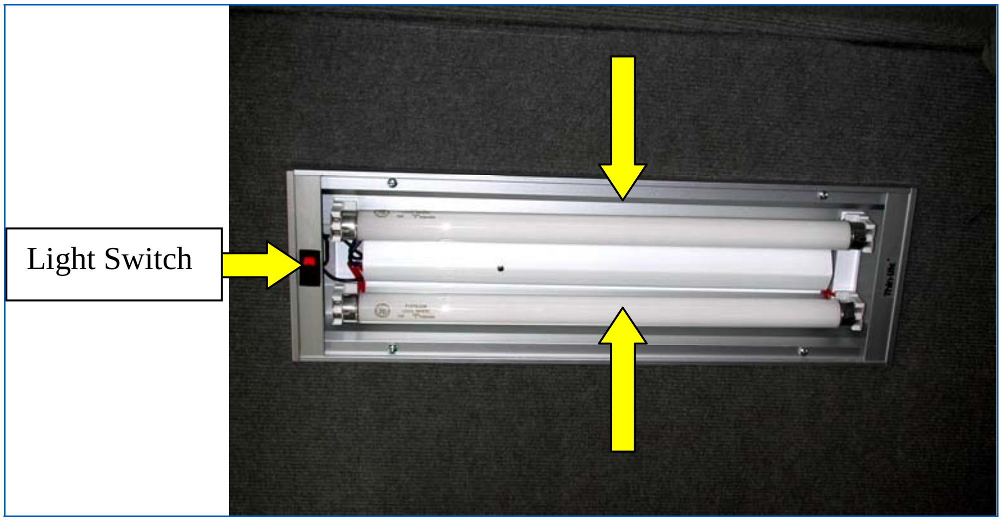

Figure 372: Light with Plastic Cover Removed

Once the plastic cover has been removed, you can either remove or insert a fluorescent tube into the appropriate slots as shown in Figure 373

Figure 373: Fluorescent Tubes Inserted

37.21 Tire Jack and Shore Power Cable

Figure 374 shows the location of the tire jack, beneath the bench on which the SOLA sits in the back of the van.

Figure 374: Tire Jack compartment

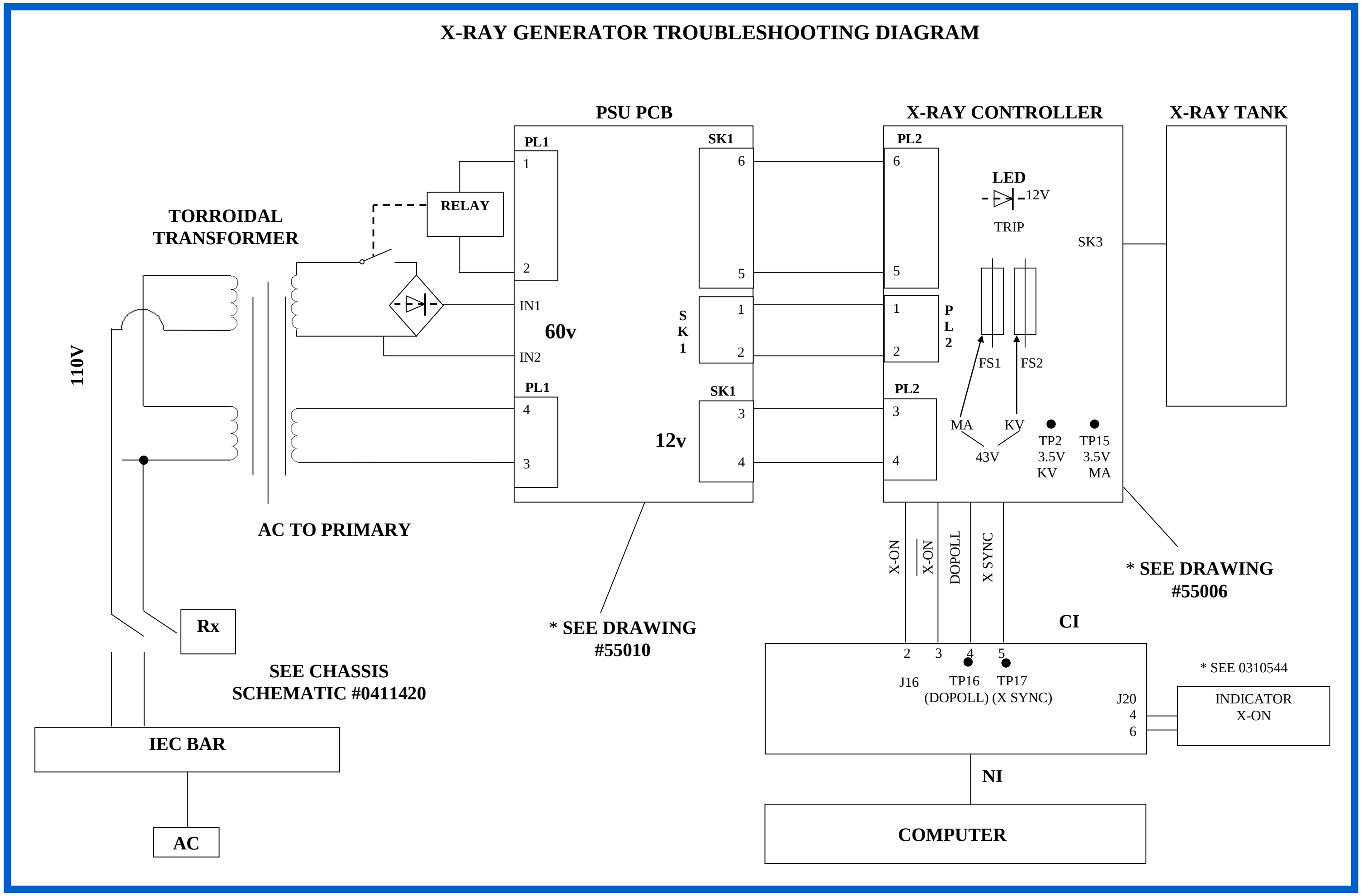

Figure 375: Troubleshooting Diagram

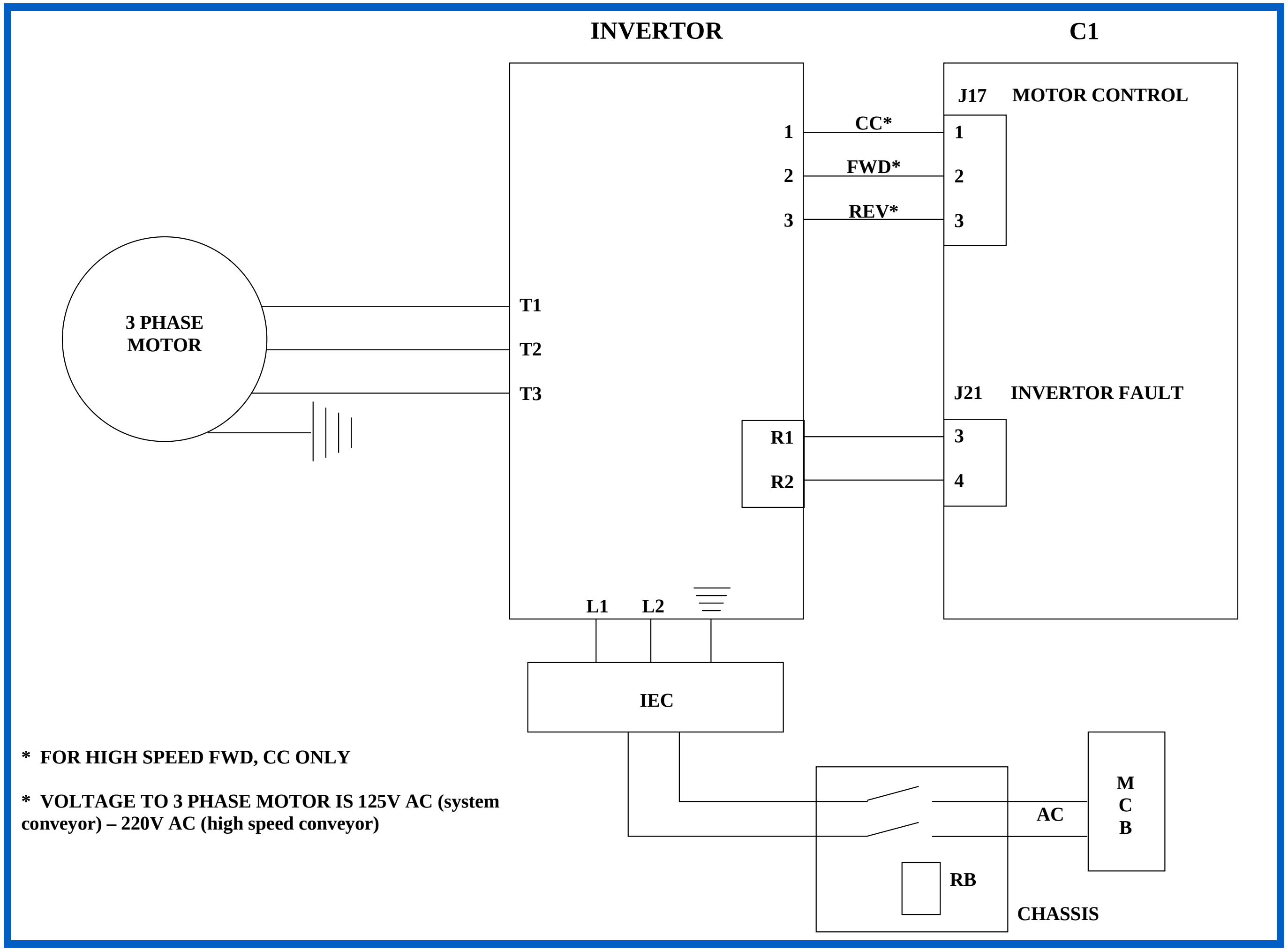

Figure 376: Three Phase Motor Block Diagram

38.0 Glossary and Acronyms

Collimation	The process of lining up the X-ray beam with the diode array.
Multiplier Stack	An assembly of diodes and capacitors configured to generate a high voltage.
Thermal Trip	A device that goes electrically open-circuit (or short-circuit) when its trip temperature is reached.
Contactor	A device similar to a relay, which switches a heavy load on when its coil is energized.
Interlock	A safety circuit that prevents users from performing dangerous acts
RS232, RS485	Standards defining a method of serial communication between two electrical devices, for example a computer and printer.
Console	A trolley that typically contains the system monitor, Control Panel and touchpad.
Watchdog	A device that monitors a signal and reports when the signal falls outside of the correct operating condition.
Multiplexing	Combining several signals for transmission on some shared medium, often by time division.

38.1 List of Acronyms

Computer

NI National Instruments

CPU Central Processing Unit (Processor)

SIMM Single In-line Memory Module

CMOS Complementary Metal Oxide Semiconductor

IRQ Interrupt Request

PnP Plug ‘n’ Play

PCI	Peripheral Component Interconnect
AGP	Accelerated Graphics Port
RAM	Random Access Memory
SDRAM	Synchronous Dynamic Random Access Memory
IDE	Integrated Drive Electronics

General

EPX	Enhanced Performance X-ray
ADX	Assisted Detection X-ray
TIP	Threat Image Projection
FTI	Fictional Threat Item
CTI	Combined Threat Item
LED	Light Emitting Diode

39.0 List of Spare Parts

39.1 General

Rapiscan X-ray machines use many common parts across the range with regard to electrical and electronic items. A table is provided to show the variations in the replaceable parts for different sized machines.

NOTE: Due to component obsolescence and equipment upgrade, the components used may change from time to time. For replacement parts, please contact a Rapiscan Systems service department to verify the correct Rapiscan part number before ordering. These lists document the most recently supplied systems.

Part No.	Description	QTY
2210631	PBA, T2 JUNCTION BOARD	1
2210728	PBA 16 BIT A/D CONVERTER	1
2313498	COMPUTER P4 3.2GHRZ,4U,6XX WINDOWS	1
2313749	LOCAL ICON CONTROL PANEL DUAL VIEW MOLDED	1
5610592	UPS ASSY 230V 800VA	1
2313738-BLK	USB-LVDS CONVERTER BLACK BOX NON ISOLATED	1
TA55130/180	X-RAY GENERATOR 180Kv	1
3411287	RJ45 coupler	1
23102106	Chassis Assy Vanilla Systems	1
2278506	Diode Array Board, LE 2.5mm	1
2278507	Diode Array Board, HE 2.5mm	1
5700071	SPACER, 25MM R40-3002502	1
1310851	COMPUTER KEYBOARD USB	1
1310991	MONITOR, WIDESCREEN LCD, 17"	1
23103005	COOLING FAN ASSY FOR X-RAY GEN	1
5300058	INVERTER, 0.37KW, 230V TELEMECANIQUE ATV11	1
5500013	BUZZER	
2345009	2KVA ISOLATION TRANSFORMER	
23100647	INRUSH ASSY	
5210506	COOLING FAN	
5700032	CONDUIT CLIP	1
5610500	POWER CONDITIONER, 3.0KVA, 60HZ, HARDWIRED	1
7910640	FILTER, AC-LINE, 20A, IEC SOCKET	1
5710506	SPRING, COMP, 3/8OD, 1.5LG, .045 DIA	1
8410500	WEATHER STRIPPING, 3/4W,1/4T, CLSD CELL	1

5710519	HANDLE, DETECTOR/COVER, GOI-MOD	
5710502	BUSHING, SNAP, 3/4 OD, 5/8 ID	
7900033	3-CH SWITCH ASSY TRANSMITTER & RECEIVER	1
8800005	LABEL EMERGENCY STOP LABEL	
8800009	LABEL, EARTH	11
8800010	LABEL, EARTH	11
8800015	LABEL, HIGH VOLTAGE WARNING	
8800017	LABEL, DANGER RADIATION LOGO	44
8806658	DANGER RADIATION	1
8810560	E-STOP, LEGEND PLATE	1
5500003	TERMINAL, 8W, 3D20	1
5100033	SWITCH INTERLOCK, SHORT ROLLER	1
5110531	SWITCH INTERLOCK, LONG ROLLER	1
5110540	SWITCH, E-STOP, EN418	1
5110541	CONTACT BLOCK, 1-POLE NORM.CLOSED	2
5100005	INDICATOR	
5100006	LENS, RED, X-RAYS ON	
5100016	LENS, WHITE, SEARCH	2
5100062	LENS, GREEN, SYSTEM ENERGIZED	1
7700027	LED CLUSTER, 12VDC T6.8, RED	1
7700028	LED CLUSTER, 12VDC T6.8, GREEN	2
7700029	LED CLUSTER, 12VDC T6.8, YELLOW	0
8770163	TOOL PCB REMOVAL TOOL	1
3400560	USB CONNECTOR, A to B, PANEL MOUNTING	2
7900040	MCB 2 POLE 16AMP D CURVE	4
8910527	DESSICANT, SILICA GEL (BLUE/WHITE)	4
4010801	ROLLER, TRACKING, 1.90D, 39.94RL	1
4010802	ROLLER, IDLER, 4.5DIA, 39.00" W	1
40102985	Roller, Drive, 39.90" RL, .30HP, 3x230V, 60HZ,51fpm	1
4010805	BRKT,ROLLER MOUNT,ISOLATION	2
4010821	BELT, CONV, 38W X 11.73FT LG, RAP X36	2
0411507	REF DWG, INVERTER PARAMETER ADJUSTMENTS	1
0480139	SILKSCREEN RAPISCAN SYSTEMS LOGO	2
4062226-2	PLATE, RAPISCAN LOGO	6
40102310	SERIAL NUMBER & RATING PLATE, UK	2
40102311	SERIAL NUMBER & RATING PLATE, USA	2
40102312	SERIAL NUMEBR & RATING PLATE, MALAYSIA	2
88103002	LABEL MACHINE IDENTIFICATION RAP 636SV	4

39.2 OEM Parts List

Component Description	Manufacturer	Part #
Master Disconnect Switch	Cole Hearse	M-0284-01-BP
Battery		
House Battery, Deep Cycle, Marine	Life Line	GPL-4DLT
Battery Separator	Sure Power Industries Inc	1315-200
Battery 150Amp Circuit Breaker	Copper Bussman	BP/CB185-150
Automatic Transfer Switch,120VAC,30Amp	Progressive Dynamics	PD5110-10
AC/DC Distribution Panel with Charger	Progressive Dynamics	PD 4560K12LV
Thin light- 30watt	Thin Lite	716XL
Thin lite replacement bulb 15 watt	Thin Lite	F15T8/CW
Auxiliary Generator		
Generator 5.5KW	Cummins Onan	QG 5500
		HGJAE-2131
Control panel	Cummins Onan	300-5332
Harness adapter remote	Cummins Onan	338-3489-01
Air Conditioner		
Air Conditioner	RV products Inc(Coleman)	Coleman Polar Cub
		9201A776
Electric heat kit	RV products Inc(Coleman)	9233-4551
Air Distribution Assy	RV products Inc(Coleman)	9330E715

Heater		
Heater, 500 Watts w/ Thermostat	Broan heater	165FT
Heater Housing	Broan heater	171H
Awnings		
Awnings	Fiamma Inc.,	F45006-Deluxe Grey
Awning Multi brackets- F45 1.5-5.0m	Fiamma Inc	98655-011
Gull Wing Door Gas Struts	Mcmaster Carr	9416K52

Door Handle		
SS handle w/ bent ring	Austin Hardware	ALH 279S SS 1250
Rotary, 2 PT.W/ tapped mtg holes	Austin Hardware	TM 11656-16 RH
Rotary, 2 PT.W/ tapped mtg holes	Austin Hardware	TM 11657-16 LH
1/2" Diam. Striker stud	Austin Hardware	TM 10335-16 ZN
Gasket for 279S	Austin Hardware	G 8

Lock Kit 36" rods, nylon guides	Austin Hardware	AH 5612 ZN ADJ
Rod kit	Austin Hardware	RLK-DB-5612-48-2N
Small rotary latches	Austin Hardware	240R 240L
Strike plate	Austin Hardware	240-52
Generator door holder	Austin Hardware	29-4

Misc		
Two Part Foam	Foam Direct	II-205 Handi-Foam
Carpet	Beaulieu Group Inc	Surfaces
		ST103 Stratos
Drawer Latch	Southco	M1-2A-11-1
Handle Rear door	Austin Hardware	AH4303
Cabinet flush ring pull	Seachoice	36641
Weather tight electrical covers white	TayMac	MX1000
Weather Strip Gull wing Doors	Trimlok	X-119HT
Drawer Slides	Accuride	C3884-C20P

Chair Task	North Safety Products	#NS109532
Adapter 30F-15m DLX round	Amerex Corp.	B417
Extension cord 30 amp 25 ft	James King & Co.	1005
Detachable power cover 30 amp	Orion	3153
	Streamlite Poly Stinger	#76501
Safety	Marathon	OPT1013
First Aid Kit	Perko	0550DP0CHR
Fire Extinguisher 2.5lb ABC	Seadog	420201-1
3 Hazard triangles kit	Cole Hearse	M-58031-C20P
3 flare kit	First Alert	CO400
Flash Light, Blk w/ AC charger	First Alert	SA303CN
Carbon Monoxide Detector	Pass & Seymour	TM 811-BK-CC6
Smoke Detector	Cole Hearse	420292-1
Switches	Cole Hearse	420291-1
DC loads desk and dash switches	Blue Sea Systems	5025
Dash Momentary switch for separator	Battista	OM01801
Switch Heater	Arcon	AD-004
Switch Bezel, center	Arcon	0055976A250
Switch Bezel, ends		30ARVKIT
6 circuit fuse block under dash		
Emergency Lighting		
400 series surface mount light head	Whelan	40B-02ZBR
4500 series 6 inch beacon	Sound off	ELB45BCH0BB