Verifier

Model: FSX-080

Portable X-Ray Inspection System

Operation and Maintenance Manual

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Revision History

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1.0	B	X-Ray Ctrl Panel Update	Oct. 2006
1.0	C	Text & Tables Edits	April 2007

Chapter 1

Introduction

System Components
User Responsibility
Receiving and Inspection
Potential, Current, and Duty Cycle Rating
X-Ray Warning Label
Radiation Safety Regulation Reference
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Installation Note

Introduction

FocalSpot's Verifier, model number FSX-080, X-ray System is used for microfocus real-time inspection of electronic components, cables, multi-layer circuit boards, sealed components, and electronic SMT assemblies.

System Components

The standard Verifier system consists of the following:

- Lead Lined cabinet that houses the x-ray tube, detector, and positioner.
- 80 kV, 33 micron x-ray tube with integrated power supply
- Image Intensifier with Zoom Lens and CCD Camera
- Control Panel with Adjustment controls, Key switch, E-Stop and indicators for x-ray generation and detection.
- X-Y manual positioner including: adjustable board width fixture and variable board height positioning.
- Standard PC with Microsoft Operating System
- 15 inch Flat Panel Monitor
- Printer
- Verifier Imaging Software.

User Responsibility

Your Verifier X-Ray System will perform in conformity with the description contained in this operating manual and the accompanying labels and/or inserts when assembled, operated, maintained, and repaired in accordance with the instruction provided.

The system must be checked periodically. A defective system should not be used. Parts that are broken, missing, plainly worn, distorted, or contaminated should be replaced immediately. Should such repair or replacement become necessary, FocalSpot Inc. recommends that you telephone, email, or Fax a request for service from FocalSpot Inc. or its nearest affiliates.

Your Verifier system or any of its parts should not be repaired other than in accordance with written instructions provided by FocalSpot Inc., and FocalSpot Inc. trained personnel.

The system must not be altered without the prior written approval of FocalSpot, Inc.
The user of this product shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, improper repair, damage, or alternation by anyone other than FocalSpot, Inc.

You are required to register the use of this X-Ray System with the state in which the product is installed. Contact FocalSpot Inc for additional information if required.

Receiving & Inspection

The Verifier system is carefully inspected mechanically, electrically, and for radiation safety before shipment and should be free from damage. As a normal part of receiving, please do the following:

- When the system is delivered by commercial carrier, check it for damage with the carrier. Contact the carrier's office and FocalSpot Customer Service if any damage is found.
- When unloading from commercial carrier, DO NOT use any hooks.
- Following the uncrating instructions attached to the shipping crate. If you have any questions, contact FocalSpot, Inc. Customer Service at the number provided on the inside title page of this manual.
- Compare the packing list with your order invoice. If you find any discrepancies, contact FocalSpot, Inc or local affiliates.
- Save all packing material for the system in case it should ever have to be moved or shipped again.

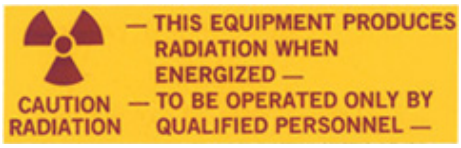
Potential, Current, and Duty Cycle Rating

Your FocalSpot FSX-080 is designed such that:

- The x-ray source potential does not exceed 80 kV.
- The x-ray beam current does not exceed .250 milliamps
- No combination of x-ray source voltage and current exceeds 20 Watts.
- The FSX-080 has a 100% duty cycle when the x-rays are on.

X-Ray Warning Label

The Verifier X-ray system is properly identified according to the label below or its equivalent.



Radiation Safety Regulation Reference

- Food and Drug Administration 21 CFR Ch I (4-1-91 Edition), Subchapter J – Radiological Health, Part 1000 – General, paragraph 1020.40, Cabinet X-Ray Systems.
- U.S. Department of Commerce/National Bureau of Standards NBS Handbook 114, General Safety Standards for Installations Using Non-medical X-Ray and Sealed Gamma Ray Sources, Energies up to 10MeV.

Safety Precautions

Specific notations are used in this manual to call attention to conditions which could result in injury, damage to the system, or require special attention.

WARNING A Warning notation is used to describe an operating or maintenance procedure, practice, condition, or statement which, if not strictly observed, could result in injury or loss of life.

CAUTION A Caution notation is used to describe an operating or maintenance procedure, practice, condition, or statement which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE A Note is used to describe an essential operating or maintenance procedure, condition, or statement which requires special attention.

Terms Used in this Manual

The terms operation, maintenance, and service, have specific and important meanings throughout this manual. They are defined as follows:

- **Operation:** Means the use of the FSX-080 system over the full range of its functions.
- **Maintenance:** Means the performance of those adjustments or procedures specified in this manual which are to be performed by you.
- **Service:** Means the performance of those adjustments or procedures which are to be performed only by individuals certified by FocalSpot, Inc.

Installation Note

The installation procedures described in ***Chapter 2*** of this manual are provided for ***informational purposes only***. Your system must be installed by a qualified FocalSpot Service Representative, x-ray certified and documented prior to use.

Chapter 2

Before You Begin

Installation
System Requirements
Safety
Inspection
Cabling
Initial Setup

Installation

The installation procedures described in this chapter are provided for information purposes only. Your FSX-080 FocalSpot X-Ray Imaging System must be installed by a FocalSpot, Inc. Service Representative or Authorized Affiliate.

System Requirements

AC Power

Your FSX-080 system is equipped with a three-conductor line cord in accordance with NEMA requirements. When plugged into the appropriate receptacle, the power cord is designed to ground the equipment cabinet.

Clearance

- Allow at least 30 inches in front of the cabinet for operating the system
- Allow at least 4 inches between the rear of the system and wall for air circulation.

Environment

The environment for your FSX-080 system should be free from excess dust and dirt, and the floor should not vibrate. The system is designed to tolerate the following temperatures and humidity ranges:

Temperature: 0-35 C (32-95 F)
Humidity: 70% maximum to 20% minimum at 35C with no condensation.

Safety

This system is designed to conform to Federal Regulations (CFR) 21, subchapter J, paragraph 1020.40, “Cabinet X-Ray Systems.” Various localities may have different rules and regulations that must be complied with prior to installation. Make an inquiry as to these rules and regulations with the installation facility’s Safety Department and with the local Department of Health. Notify these officials the installation is taking place and inquire about any special plant requirements that may apply. Requirements may involve wiring, notices, or special safety procedures unique to that particular company. Take whatever steps necessary to comply with these requirements.

Inspection

Carefully inspect the FSX-080 for any physical damage. Look for:

- Dislodged components
- Loose cables
- Dents, Broken Glass, Damaged casters, bent frame members.

NOTE: Do not discard the packing material. If you find damage, the carrier may want to examine the material. Also, in the event the system needs to be returned to FocalSpot, it should be shipped in the original containers.

Record the system serial number on the Service Installation form. The serial number appears on the back of the cabinet.

Compare the shipped items to those listed on the packing slip.

Report any discrepancies to FocalSpot Customer Service. Contact FocalSpot Customer Service directly at: **1-858-536-5050**.

Cabling

These instructions tell you how to route and connect all cables for the system and its components. Before you begin, locate all cables.

Main Power Line Cord

1. Plug the main power line cord into the line cord receptacle on the back of the machine. Plug the line cord male end into the appropriate wall socket (US: 110V 60Hz, Asia: 110V or 220V 50Hz, Europe 230V 50Hz). For Domestic shipments within North America, the FocalSpot X-ray system is equipped with the appropriate line cords. For Export shipments, the agent/representative/distributor is responsible for supplying the appropriate line cords.

Computer, Monitor, and Printer

2. Set the Computer Chassis into position on the lower frame shelf. Plug the computer line cord into the appropriate wall socket. Check the back of the computer for the appropriate power selection (115V or 220V). Plug the mouse cable into its position. Plug the keyboard cable into its position.
3. Place the Monitor on top of the cabinet. Plug the monitor line cord into the monitor and the male end into the AC receptacle on the rear of the machine.
4. Plug the SVGA cable from the monitor into the back of the Computer.
5. Place the Printer into position on above the computer on the printer shelf. Plug the printer line cord into the end into the AC receptacle on the rear of the machine.
6. Plug the printer parallel cable into the back of the computer.

Initial Setup

Familiarize yourself with the Rear Machine and Front Control panels. (see attached figures).

The Rear Machine Panel

The main machine power switch and fuse block is located on the rear machine panel. The man power switch provides AC power to the machine and internal AC distribution blocks. Additionally, the main power switch, upon activation, starts the cooling fan and turns on the light in the interior of the machine.

Front Control Panel

The front control panel is located on the front of the machine to the left of the load door. The front control panel has the key activated ON / OFF switch, Emergency Stop Switch, X-ray On/Off indicators,

X-ray On/Off pushbuttons, and analog controls for X-ray Voltage (kV), X-ray Current (mA), Camera Gain, Camera Lens Focus, and Camera Lens Zoom control.

Before you begin, perform the following steps before turning on the system:

1. Set the x-ray voltages (X-ray Voltage, kilovoltage, kV) to the lowest setting by turning the kV adjust knob all the way to the left (counter clockwise)
2. Set the x-ray current (X-ray current, milliamp, mA) to the lowest setting by turning the mA adjust knob all the way to the left (counter clockwise)
3. Turn the Computer On, Turn the Monitor On.
4. Insert the key into the Power key switch on the front control panel.

Chapter 3

Starting the System

Before you Begin
Major Machine Component Locations
Front Panel Controls

Before You Begin

Take the time to become familiar with the FSX-system, its components, and any options and accessories on your system. Be aware of and pay attention to all safety precautions set by your operating site, this manual, or other regulations.

WARNING **Never operate this system if either of these conditions exists. The viewing glass window is cracked or broken; the lead lining is separating from the inside of the sample compartment**

WARNING **This equipment produces x-rays when energized. Follow all safety procedures set by the installation site.**

Major Machine Components

- Rear Panel
- Front Panel
- Sample Compartment
- Upper Electronics Compartment / Access Panel
- Lower Electronics Compartment / Access Panel
- Computer, Monitor and Printer.

Rear Panel

The main machine power switch and fuse block is located on the rear machine panel. The man power switch provides AC power to the machine and internal AC distribution blocks. Additionally, the main power switch, upon activation, starts the cooling fan and turns on the light in the interior of the machine.

Removing the rear panel will provide partial access to the upper electronics controls and the motion components (pulley and belt, tensioner) of the x-y table in the sample compartment. Rear panel access is interlocked with a low voltage (24V DC) switch to disable x-ray generation.

Key Items:

1. Main AC Power Switch with Integrated Fuse Block
2. Machine Nameplate, including Serial Number
3. Warning Labels
4. Fan Guard

Note: Always refer to the machine serial number when contacting FocalSpot Customer Service.

Major Machine Components Location, Description, and Key Items

- Rear Panel
- Front Panel
- Sample Compartment
- Upper Electronics Compartment / Access Panel
- Lower Electronics Compartment / Access Panel
- Computer, Monitor and Printer

Front Panel

The front control panel is located on the front of the machine to the left of the load door. The front panel is the main location for control over the x-ray and image generation process.

Key Items

1. Main Power ON / OFF key-switch
2. Emergency Stop button
3. Power, X-ray On/Off, and Interlock LED indicators
4. X-ray On/Off buttons
5. X-ray Voltage (kV) control knob
6. X-ray Current (mA) control knob
7. Camera Gain control knob
8. I.I. (2" / 4") rocker switch
9. Camera Lens Zoom control rocker switch
10. ESD Ground terminal

System Controls and Indicators

Controls and Indicators	Description
Main Power On / Off Key-Switch	The **Key Activated ON/OFF Switch,** in the **ON** position, energizes power to the x-ray control board and x-ray tube. This key operated switch is an FDA/CDRH requirement and cannot be removed in the **ON** position.
Emergency Stop Button	The **Emergency Stop** button is a safety device. Upon activation of the Emergency Stop Switch all power is de-energized to the x-ray tube and control board. This immediately removes all system power and stops the production of x-rays. **Warning**: Do **NOT** use this as the standard power OFF button as repeated use may cause damage to the system and/or Image Processor computer.
X-Ray **ON** Push Button	The **X-Ray ON (RED) Button** enables x-ray production if all interlocks are satisfied.
X-Ray **OFF** Push Button	The **X-Ray OFF (GREEN) Button** disables x-ray production
X-Ray Voltage (kV) Knob	The **X-Ray (kV) Voltage Knob** controls x-ray voltage (penetration). Increase for detection of *Voids* and decrease for detection of *Shorts*.
X-Ray Current (mA) Knob	The **X-Ray Current Knob** controls x-ray current (intensity). Provides contrast control of the x-ray image.
Camera Gain Knob	A **Camera Gain Knob** is used to increase or decrease the gain of the CCD camera. Increasing the gain of the CCD camera increases camera sensitivity (brightness). This is most often used when viewing very dense

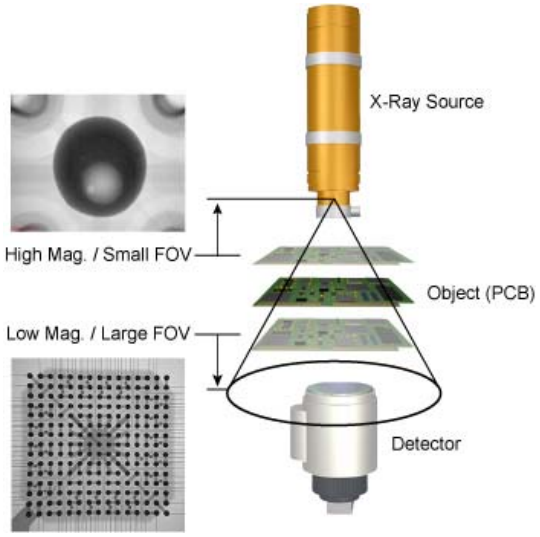
	materials. However, increasing camera gain too much can introduce noise making the image appear grainy and overly contrasted.
Peripheral Controls	** Located to the right and/or left side of the keyboard tray*
I.I. (2" / 4") rocker switch	The **I.I. (2" / 4")** rocker switch is used to select either 2" or 4" mode operation of the dual-mode image intensifier. 2" Mode — Small FOV mode (High Magnification) 4" Mode — large FOV mode (Low Magnification)
Camera Lens Zoom rocker switch	The **Camera Control (Zoom)** rocker switch is used to adjust the camera lens optical magnification (zoom-in / zoom-out). Pressing either the plus side of the rocker switch will increase optical magnification making the object larger to provide improved diagnostic capabilities. Pressing the minus side of the rocker switch will decrease magnification thus providing a larger overall view of the entire assembly. Lower magnification provides QuickCheck capability to quickly and easily locate bridging, missing solder, or other gross solder defects.
Indicators	
Main Power **ON** LED Indicator	The **GREEN LED Power Indicator** signifies that both AC and DC power are energized
X-Ray **ON** LED Indicator	The **RED LED X-Ray ON Indicator** signifies production of x-ray radiation
Interlocks **OK** LED Indicator	The **YELLOW LED Interlock Indicator** signifies that all High Voltage and Low Voltage interlock safety switches are satisfied. Interlocks are located on every access panel or door.

Image Intensifier (I.I.)

Definition: An X-ray Image Intensifier converts low intensity x-rays into light. Through this process, several thousand light photons are produced for each x-ray photon, which are captured by a CCD Video Camera. This process produces a visible real-time image and the resulting video signal is then interfaced with an Image Processor for enhancement, display and analysis.

A 2"/4" or "Dual-Mode" Image Intensifier offer two settings:

- **2" Mode:** Low Magnification, Large Field-of-View (FOV), this is used to display as much of the inspection area at one time to facilitate fast inspection.
- **4" Mode:** High Magnification, Small Field-of-View (FOV), this is used to provide greater detail and presents more information to reveal subtle abnormalities.

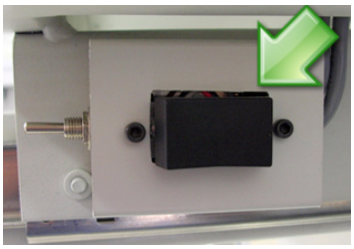


Function of 4/2 II Switch

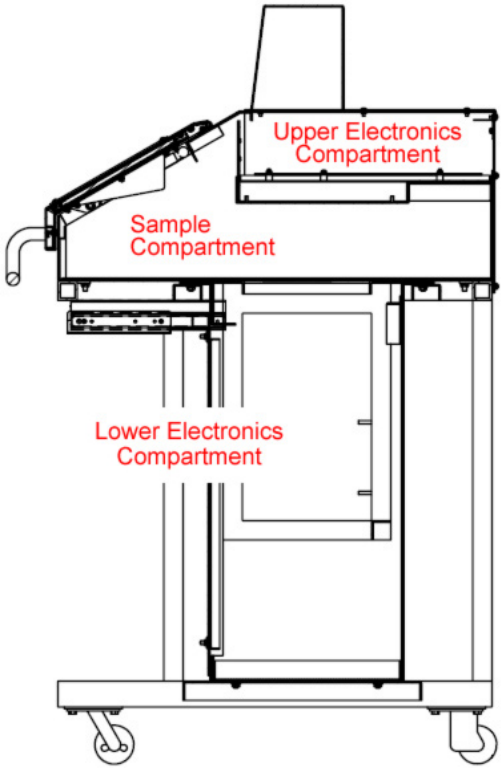
As a general rule, a good balance between sufficient magnification (inspection detail) and sufficient FOV (to view as much of the inspection area at one time to facilitate fast inspection). With high-magnification, the field-of-view (FOV) becomes smaller thereby reducing the speed at which a board can be completely inspected. Therefore, throughput and magnification are opposing objectives and the best balance of each depends upon your application.

The 2/4" toggle has been added to the Verifier X-Ray Control Panel to provide the end-user with this capability and convenient access to this control.

Imaging Control Switches

Switch Functions	Description	
 ***Switch Locations***	 ***Micro Switches***	 ***Rocker "Toggle" Switches***
Left Rocker Switch (Magnification) **[optional add-on]**	The **Left Rocker Switch** controls the movement of the x-ray source (up/down), custom option. Moving the x-ray source down will increase magnification while decreasing the Field-of-View. Conversely, moving the x-ray source up (away from the sample) will decrease magnification and increase the field-of-view. See the Image Intensifier image (Function of 4/2 II Switch - above) for reference.	
Left Micro Switch (Focus)	The **Left Micro Switch** adjusts the focus of the displayed image.	
Right Rocker Switch (Rotation Fixture control) **[Optional add-on]**	The **Right Rocker Switch** controls the (optional) rotation fixture and provides off-axis (tilt /rotate) of the sample between the source and detector.	
Right Micro Switch (Aperture)	The **Right Micro Switch** is used to adjust the lens opening (aperture) of the camera lens and control the amount of light reaching the CCD Camera's digital sensor causing the image to display darker or lighter images.	

Chassis Compartments

Chassis Diagram	Compartment	Description
	Upper Electronics Compartment	The **upper electronics compartment** houses the major electronic components, including the x-ray tube, power supplies, relays, AC power distribution, and a x-ray control / safety PCB.
	Sample Compartment	The **sample compartment** contains the manual x-y table. Samples (boards, trays, cables, etc) can be loaded onto the x-y table at several different height positions. To accommodate variable board sizes, the width of the fixture can be adjusted by unlocking the key lock mechanism and sliding the board holder apart.
	Lower Electronics Compartment	The **lower electronics compartment** houses the Image intensifier, zoom lens, and camera assembly.

Chapter 4

X-Ray Operation

Starting the System
Cold Start Procedures
X-ray Source Warm-up
Turning X-ray production ON
Turning X-ray production OFF

Starting the System

1. Provide AC Power to the machine by turning the Main Power Switch to the ON Position. Validate that the Cooling Fan and Internal Cabinet Light are audible and visible. (See Section for Trouble-shooting, if the fan and light fail to turn on).

WARNING The fan is energized when the power is turned on.

2. Provide DC Power to the machine by turning on the Power ON/OFF switch, located on the Front Panel.

Indicators The main power indicator (green) will be ON.

Cold Start Procedures

CAUTION All System Operators must read this section for Important Operational Information affecting x-ray source life.

Your x-ray tube has been fully processed during manufacturing. As such, it does not require any special start-up procedures. However, as the generation of x-rays involves high voltages, it is recommended that you follow a stepped pattern to reach the full power rating. This will ensure the maximum life of your x-ray tube. Below is an example of a common stepped pattern procedure.

- Turn kV on to 40% of maximum rating
- Turn mA on to 50% of maximum rating (wait 30 seconds)

- Increase kV to 60% of maximum rating
- Increase ma to 100% of maximum rating (wait 30 seconds)

- Increase kV to 80% of maximum rating (wait 30 seconds)
- Increase kV to 100% of maximum rating

X-Ray Source Warm-Up

A burn-in period must always be implemented when making a cold start (power up of a machine after power has been removed). The Verifier FSX-080 is equipped with the latest integrated x-ray tube and power supply and does not require special attention. Follow the cold start procedures outlined above.

Turning X-Ray Production ON

The x-ray tube can be activated as long as the safety interlocks are satisfied (**YELLOW** INDICATOR LED) is **ON**. To activate x-ray energy; depress the **RED** x-ray ON Button (A buzzer will sound). If the system has not been warmed-up, and to ensure a long lasting tube, follow the warm up procedure. When the x-ray tube has been warmed up, increase the kV slowly. **Note:** Upon initial power up, the x-ray on button will not activate for 10 seconds.

Turning X-Ray Production OFF

The x-ray tube can be de-activated by depressing the **GREEN** X-ray **OFF** button. Prior to shutting OFF the x-ray system, turn the x-ray kV and mA control knobs fully counterclockwise to the minimum kV and minimum mA positions.

Chapter 5

Applications

X-Ray Generating Operation
Controlling the Image
Loading the Board
Adjusting the Board Width
Positioning the Board for Magnification
Position the Board for Oblique Viewing
Manipulating the Board
Inspecting the Board
Verifier Software

X-Ray Generating Operation

1. To generate x-rays, verify that the system is in ready condition. Check that the power and interlock indicators are on.
2. Depress the x-ray <**ON** Button> to turn **ON** the x-ray source.
3. Depress the x-ray <**OFF** button> to turn **OFF** the x-ray source.

NOTE: The Emergency Power OFF (EPO) button should not be used to turn the system OFF other than in emergency situations. Using the EPO button for other than emergency shut off may shorten the life of critical hardware components, including the Image Processor.

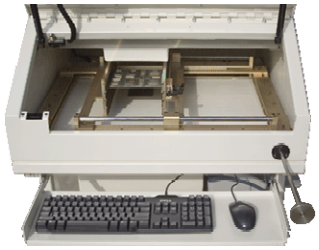
Controlling the Image

The real-time x-ray image display can be controlled in several ways.

#	Image Adjustments	Description
1	kV (X-ray Tube Voltage)	The **kV adjustment** potentiometer is used to increase or decrease x-ray voltage. kV is used to control penetration through an object. The knob indicates the proper penetration level for finding bridges (lower energy / darker image), while the voiding range (higher voltage / lighter image).
2	mA (X-ray Tube Current)	The **mA adjustment** potentiometer is used to increase or decrease the x-ray current (milliamperage). mA is used to provide intensity and control contrast.
3	Camera Gain	The **camera gain** is used to adjust the internal gain of the camera allow the camera signal to be amplified. The gain is used together with the kV, mA, and camera aperture to lighten, darken, and control contrast of the object and the surrounding area.
4	Camera Focus	The **camera focus** rocker switch is used to focus the image and is most useful when the camera zoom is used to magnify the image.
5	Camera Zoom	The **camera zoom** rocker switch control the zoom lens of the camera. The zoom lens is used to provide magnification without moving the object.
6	Camera Aperture	The **camera aperture** toggle switch is used to control the camera aperture. The aperture is used to open or close the camera lens aperture. When the aperture is complete open, the camera gathers the most light. In the fully open position, it also will make the image to appear noisy or grainy.
7	Dual 2” / 4” Image Intensifier Settings	The **image intensifier** switch is used to change from 4” to 2” intensifier output screen. This change over increases/decreases overall image magnification by 2x fold, depending on the current settings. This feature provides additional magnification when needed by the operator/user.

Sample Handling

Loading the Board



The Verifier has a unique sample loading fixture to allow the PCBA to be held on rails and therefore ensure it is flat. This fixture is adjustable in width to accommodate small to large boards. And, by using the adjustable width feature, a board can be loaded at an angle to the x-ray imaging system.

Adjusting the Board Width

The PCBA sample fixture can be adjusted by unlocking the lock down knob. Turn the knob counterclockwise to disengage the key locking mechanism. This allows the fixture to slide to allow for different sides boards to be held

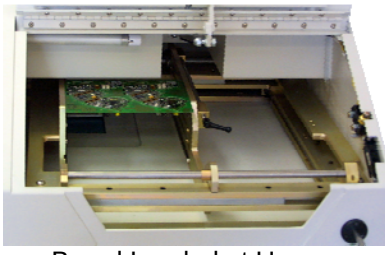
Adjusted to Minimum Width

Load the Board onto the Fixture and into the Imaging Zone

Load the sample with the object of interest toward the left hand side of the fixture. The Verifier was designed to accommodate a 16 x 18 inch sample with a scan area of greater than 8 x 9. Therefore, review the board and object you wish to inspect and load the sample such that the area of interest is toward the left hand side and to the rear. You may need to rotate or flip the board to position the board into the inspection area of interest & imaging zone.

Adjusted to Maximum Width

Position the Board for Magnification



Board Loaded at Upper Position for High Magnification

The fixture has rails which can be secured into 5 different positions. If the rails are placed in the highest slots, this will deliver the maximum magnification. Conversely, if the rails are placed into the lowest slots, this will deliver the lowest magnification and largest viewing area.

To move the rails from one slot to another, use the hex key to unscrew the mounting screws. Place the rail into the appropriate position. Secure the rail by tightening the mounting screw.

Manipulating the Sample

Use the motion control knob to move the board from front to back and right to left (x-y). Pull the handle out to translate the board toward the front of the machine (y). Push the handle in to translate the board toward the back of the machine. Rotate the handle counterclockwise to move the board to the left and clockwise to move the board to the right.

Inspecting the Board

Use the x-ray and Imaging Controls to darken, brighten or magnify the inspection object.

Bridge Detection

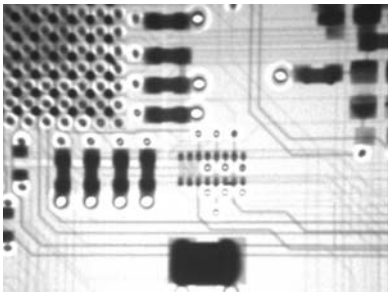
Use lower kV and mA to find bridges or shorts. Using the kV control knob, turn the knob slightly clockwise and maintain it in the “bridge” zone.

Void Detection

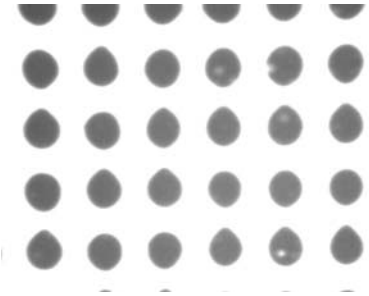
Use higher kV and mA to find voids inside the soldered connection. Use the kV control knob and turn the knob clockwise into the “void” zone.

Metal Lids

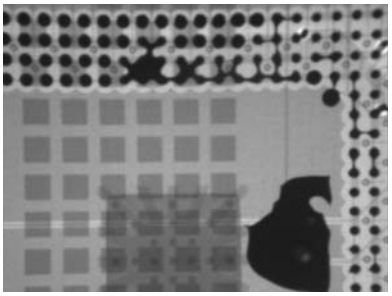
Use higher kV and mA to properly penetrate BGA devices with metal or ceramic lids. Use the kV control knob and turn the knob clockwise into the “void” zone.



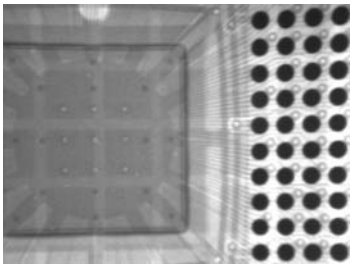
Shorted IC



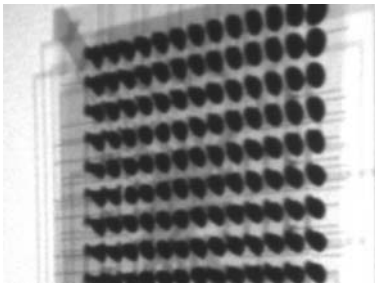
BGA Voiding



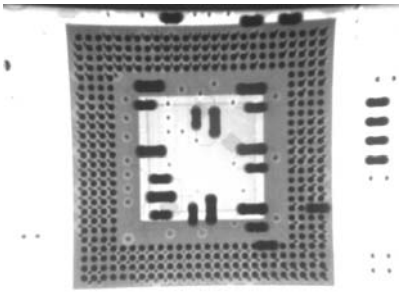
Shorted BGA / Poor Reflow / Poor Shape



Good BGA connection



Oblique BGA View

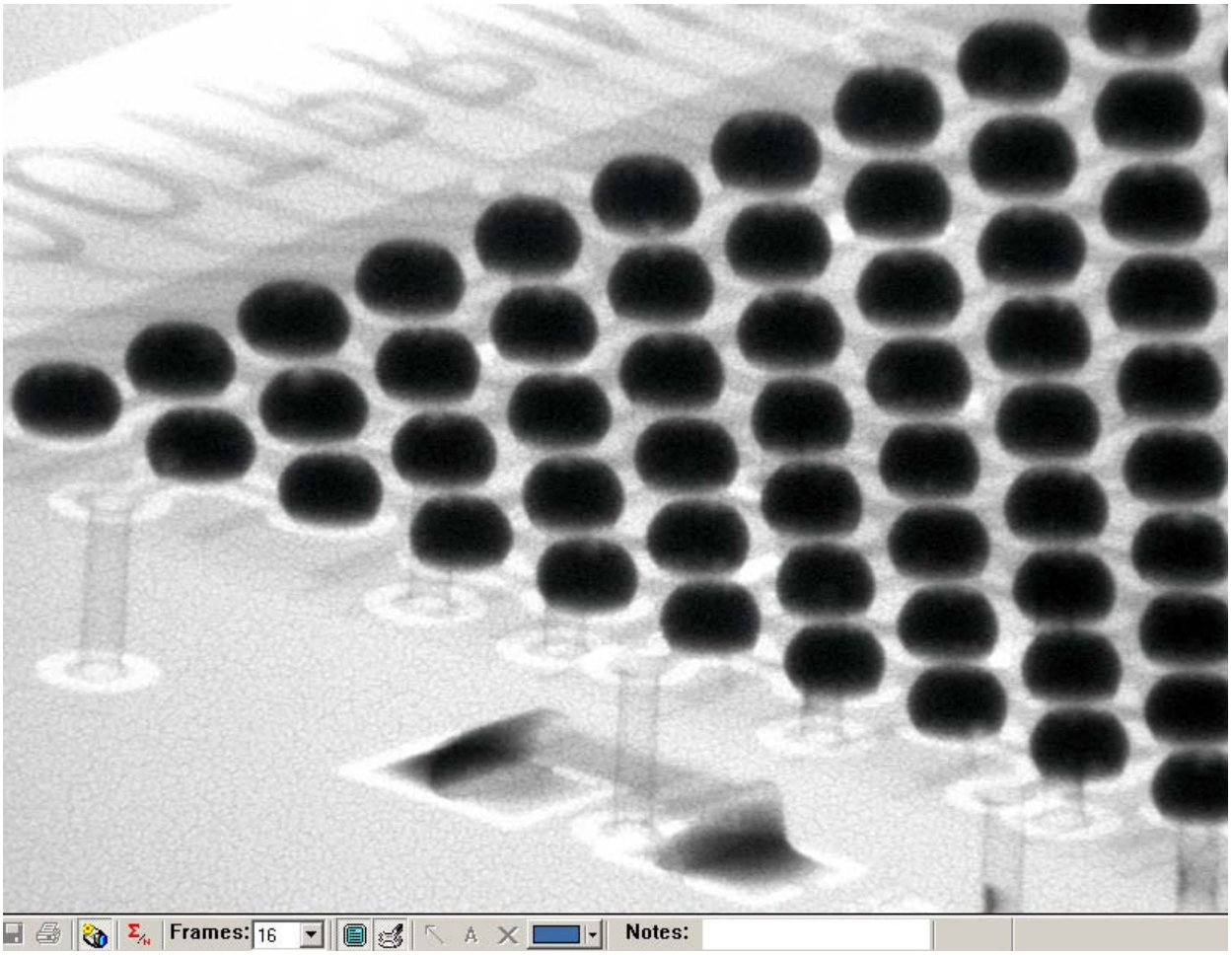


Metal Lid

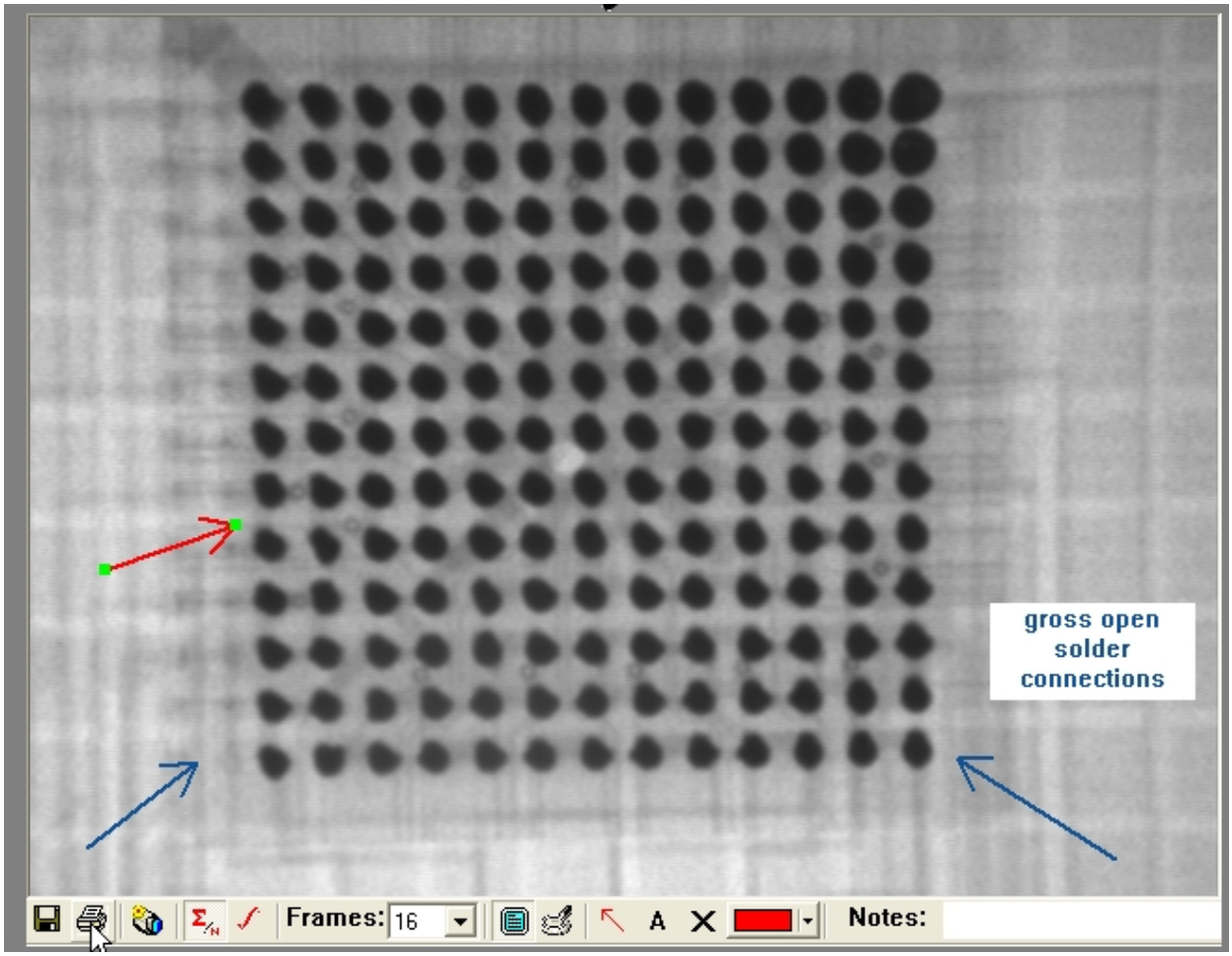
Verifier HR Software

The Verifier comes complete with Standard x-ray imaging software which is most frequently used by x-ray inspection operators.

Software Functions	Description
Save File	Saves captured image in different file formats, including (jpeg, bmp, tif)
Print File	Prints the captured image, including text annotation and notes
Live Image (ON/OFF)	Toggles between live and captured (still) image
Frame Average	The Verifier software can frame average up to 64 frames. Frame averaging reduces the noise in the system by taking a collection of frames and averaging them together and dividing by the number of frames. The Verifier software allows for “live” averaging, thus providing the best image possible during real-time motion.
Frame Integration	The Verifier software provides up to 64 frames of integration. Integration is similar to opening the camera lens. It allows more light to be captured. To use integration effectively, turn down kV and mA.



Software Functions	Description
Full Screen Viewing	Provides the full monitor screen for viewing. Toggle this button to switch between normal and full screen viewing.
2X Zoom View	Provides a digital 2X zoom of the image.
Text Annotation	A text box can be selected to make comments or notes about the board and or defects. Arrows can be selected to pinpoint areas of concern or proper joint formation.
Notes	The board can be named in the Notes section of the software. During printing of the image the information contained in the notes field will appear.



Chapter 6

Maintenance

Introduction
Recommended Intervals
Ordering Information
Warranty

Maintenance

Introduction

In order to keep this FocalSpot unit operating properly, it must be inspected and checked in accordance with the recommended intervals depending on the age and use of the equipment. If there is a problem, call an authorized serviceman.

Warning

DO NOT OPERATE THE EQUIPMENT UNTIL REPAIRS ARE COMPLETED.

Recommended Intervals

Periodic preventive maintenance includes cleaning, and electrical testing, and any necessary calibration adjustments. These maintenance procedures are to be at intervals not to exceed 12 months. The maintenance schedule is required to keep the unit in proper and accurate working condition.

Ordering Information

To order replacement parts contact the FocalSpot service department at:
(858) 536-5050 between the hours of 6:30 AM and 6:00 PM Monday through Friday.

When ordering replacement parts, be prepared to submit the following information:

- Purchase Order No. (as applicable)
- FocalSpot Part No.
- Part Description
- Quantity Required
- Shipping Instructions

If replacement parts are for a unit still under warranty, be prepared to submit model numbers and serial numbers to expedite your order.

Warranty

FocalSpot, Inc.
9915 Businesspark Ave, Suite A
San Diego, CA 92131
Tel: (858) 536-5050 or FAX: (858) 536-5054

Equipment Warranties

All warranties are against manufacturing defects only. Warranties exclude consequential damage or damage resulting from normal wear, accident, mishandling or modification. (Customer will be advised of charges for such repairs). Liability is limited to repair or replacement of any parts, which prove to be defective. Parts proving defective will be replaced free of charge FOB Laurel, Maryland, USA if defective equipment is returned to FocalSpot for inspection. Freight charges prepaid.

X-Ray Inspection Systems

Parts only: 12 months from date of delivery. Part will be repaired or replaced at our option provided it is returned to us, or a location designated by us, by prepaid transportation and that inspection indicates defective part. Shipments from us will be on a freight collect basis. Labor charges for on site work will include travel, expenses and hourly rate. These prices will be quoted separately as they are subject to change. The guarantee applies only if the equipment has been operated in accordance with the instruction manual. It does not apply to defects resulting from accidents, alterations abuse, or misuse.

Do not return your instrument without return authorization from the factory or authorized service center. Always include the serial number, which is located at the rear of the instrument.