Basic Guide of FireCR Scanner

❖ Training Contents

- Install FireCR+.
- Explain the function of each part.
- Disassembly and assembly of FireCR+.
- Explain how to calibrate
- Explain Quantor software.
- Common Issues.

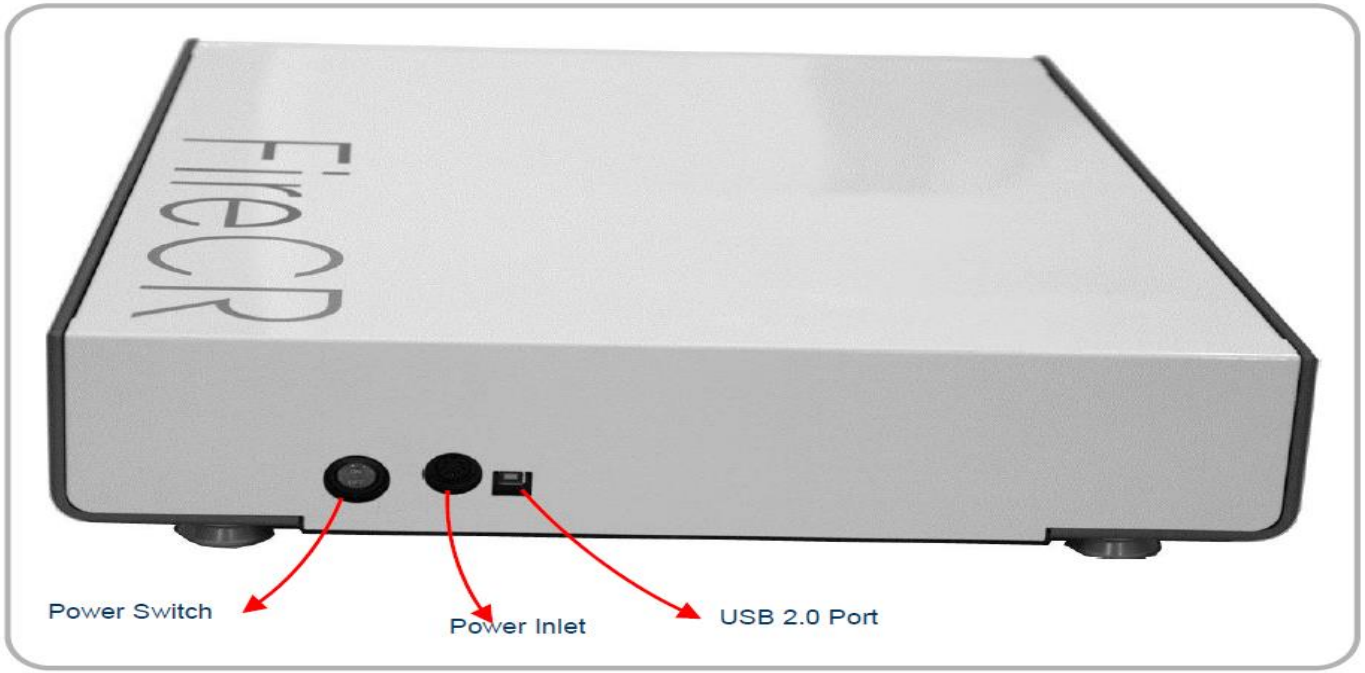
❖ FireCR+ installation

1. Take out a FireCR+ scanner and accessories in the box.
   - Components

Item	Quantity
FireCR Plus Scanner	1
Power Cord	1
Power Adaptor	1
Dust Cover	1
USB 2.0 Interface Cable	1
Cassette 14 x 17” containing IP size 14 x 17”	1
Cassette 10 x 12” containing IP size 10 x 12”	1
Extractor	1
Dongle (Option)	1
Speed Plate (Option)	1

2. Check all components that are in the box.
3. Take out FireCR+ scanner.
4. The FireCR+ scanner must be placed on the flat desk with at least 50 cm free space on the front side.
   Free space of 20 cm back side.

4. Connect power and USB cable on the back of FireCR+ scanner.
   • Connection



Note: You must connect USB cable to USB port 2.0 of PC.

5. Connect a dongle to PC. (Q dongle is needed.)
6. Download and install Quantor software. Please refer to the below website

Rebuilding now. Announcement due later.

Installation files

Please find Quantor Imaging Software and documentation in the list below.

File	Download
IMAGING SOFTWARE	
QuantorMed+	Download
QuantorVet+	Download
QuantorDent	Download
QuantorDentVet	Download
Free DICOM Viewer	Download
USER MANUALS	
FireCR Flash	Download
FireCR Dental	Download
FireCR	Download
QuantorMed+	Download
QuantorVet+	Download
QuantorDent	Download
QuantorDentVet	Download
Cassette & IP Maintenance Guide	Download
EXPOSURE GUIDES	
Exposure Guide - Veterinary - HF/3 Phase Generators	Low / High
Exposure Guide - Veterinary - Single Phase Generators	Low / High
Exposure Guide - Human - HF/3 Phase Generators	Low / High
Exposure Guide - Human - Single Phase Generators	Low / High

- for Quantor software download
- for User manual download

DIGIRAY

7. Quantor software installation

- Log on a PC with an administrator account.
- Connect the USB dongle to a USB port
  - You should connect USB cable to USB 2.0 port.
- Launch software file, “QuantorMed 2.x.x Setup.exe”
- Click the “Next” button as shown in Figure 2.1

Figure 2.1 Welcome Dialog Box

- Choose all components and click the “Next” button as shown in Figure 2.2

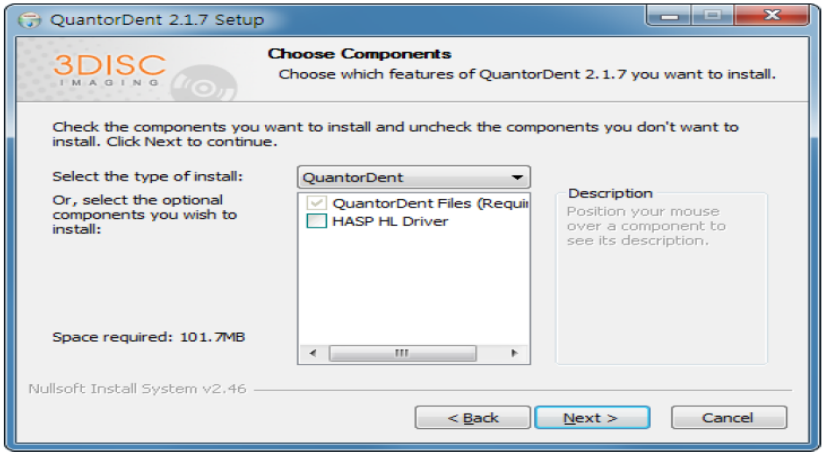


Figure 2.2 Components Dialog Box

• Choose your language and click “Next” button as shown in Figure 2.3

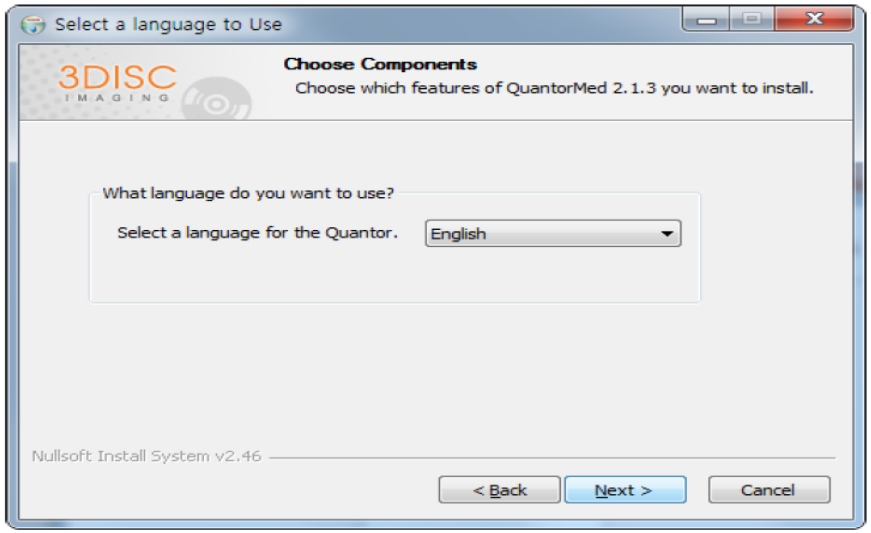


Figure 2.3. Components Dialog Box

• Choose FireCR model and click the “Next” button as shown in Figure 2.4

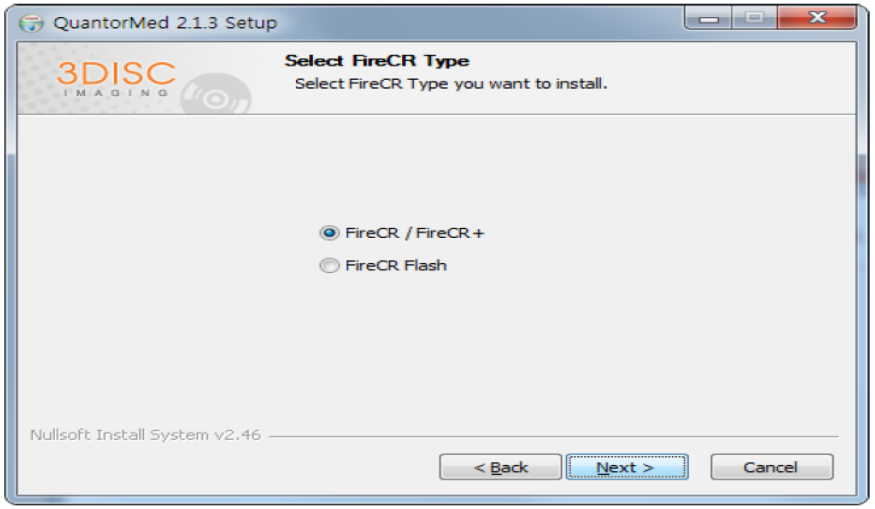


Figure 2.4 *FireCR* Model Selection Dialog Box

• Choose the destination folder and click the “Install” button as shown in Figure 2.6

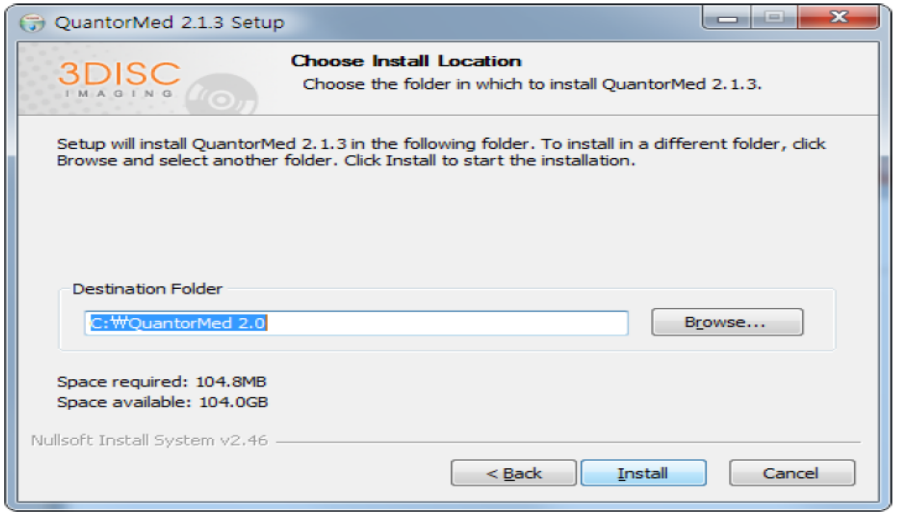
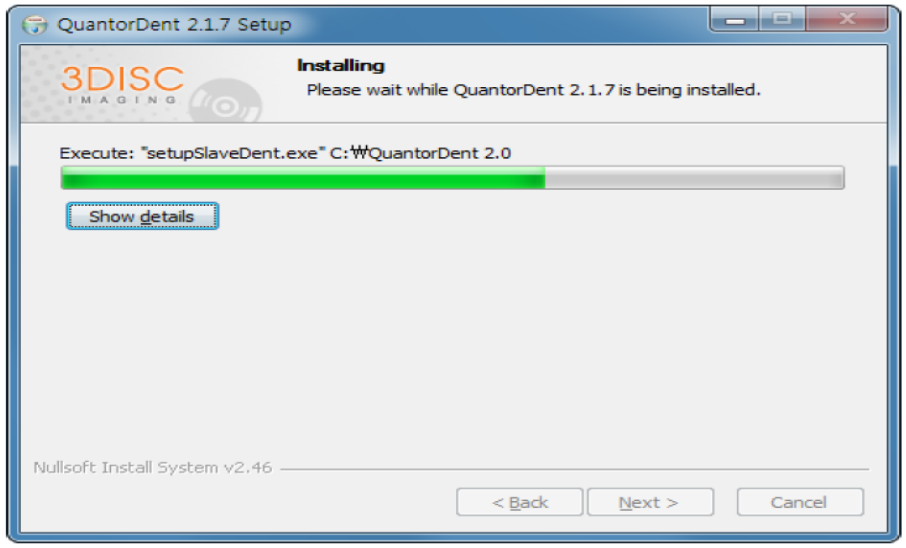
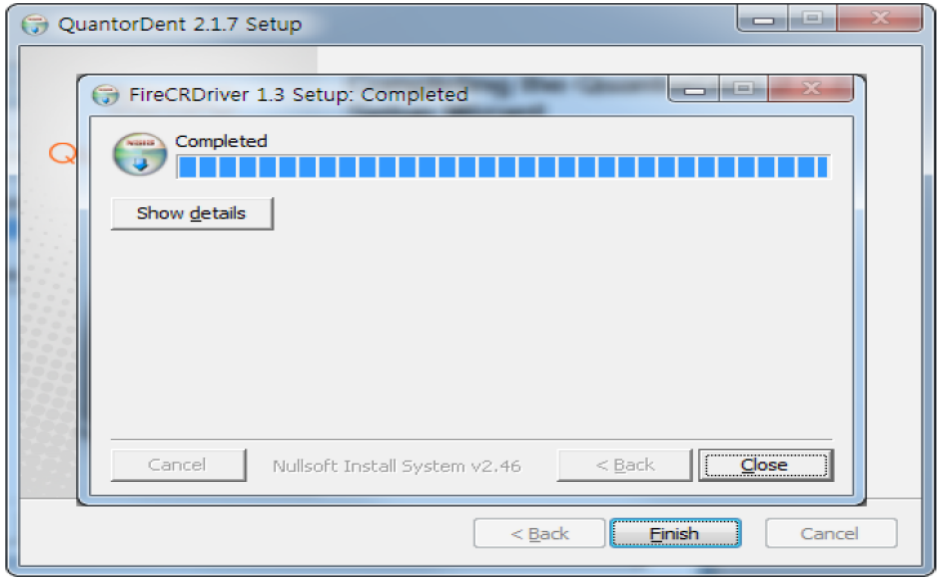


Figure 2.6 Installation Location Dialog Box

• Installation status will be displayed.



• Installation status of the FireCR USB driver will be displayed as shown in Figure 2.7.



• Installation is successful, Figure 2.8 will show up.
• Click “Finish to finish the installation.

Figure 2.10 Installation Finish Dialog Box

• the Windows Security Dialog Box pops up after installation, click [Allow access].

Figure 2.9 Windows Security Dialog Box

7. PC requirement

• Recommended PC requirement

Operating System	Microsoft Windows 7, 8
CPU	Intel CORE i5
Memory	RAM 4 GB or more
Hard Disk	500 GB Free Hard Disk Space
Network	1 Gbps Ethernet
Video	32-bit Color Display
Video Resolution	1920 x 1080, 1440 x 900

• Minimum PC requirement

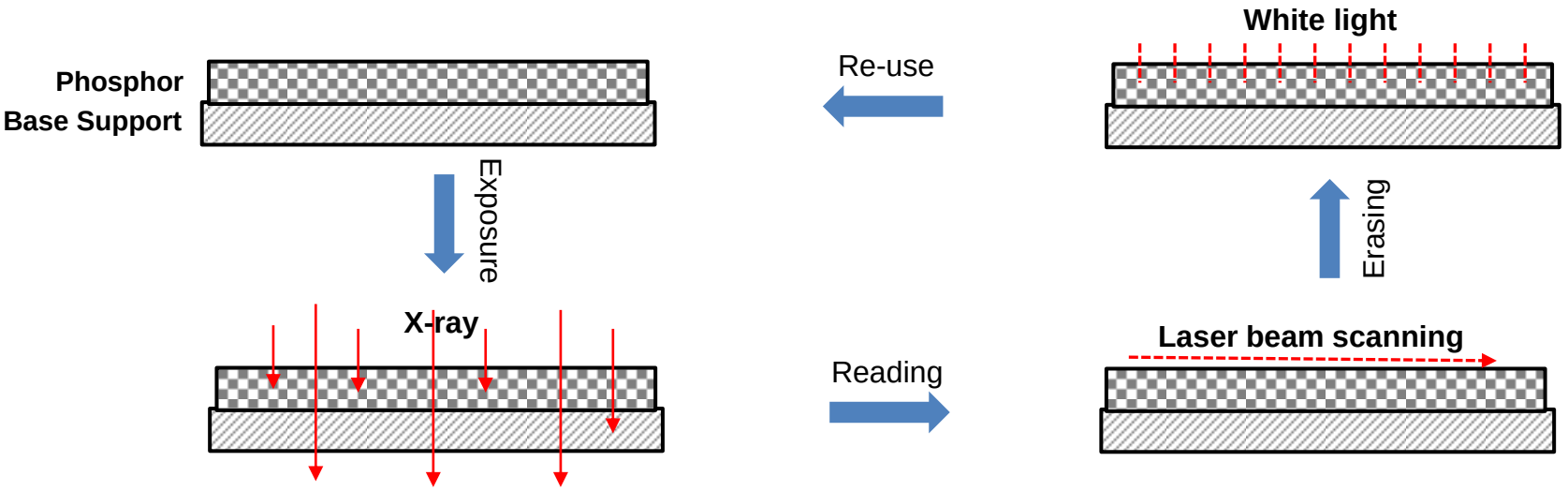
Operating System	Microsoft Windows 7
CPU	Intel Processor
Memory	RAM 2 GB or more
Hard Disk	80 GB Free Hard Disk Space
Network	1 Gbps Ethernet
Video	32-bit Color Display
Video Resolution	1366 x 768, 1280 x 800, 1600 x 900, 1280 x 1024

❖ Basic configuration of CR (=Computed Radiography) system

- Developed and used a , called **“Imaging Plate”**
  - The function of “**Imaging Plate”**
    1) Imaging plate is a flexible plate of 1mm or less thickness coated with fine photostimulable phosphorus crystal.
    2) Temporarily stores the X-ray energy image in portion to the X-ray intensity it receives.
    3) The stored energy is released as visible light when a laser in the CR Reader scans the IP. This phenomenon is generally called “photostimulable luminescence” (PSL)
    4) The image on the imaging plate is erased when exposing excessive light.

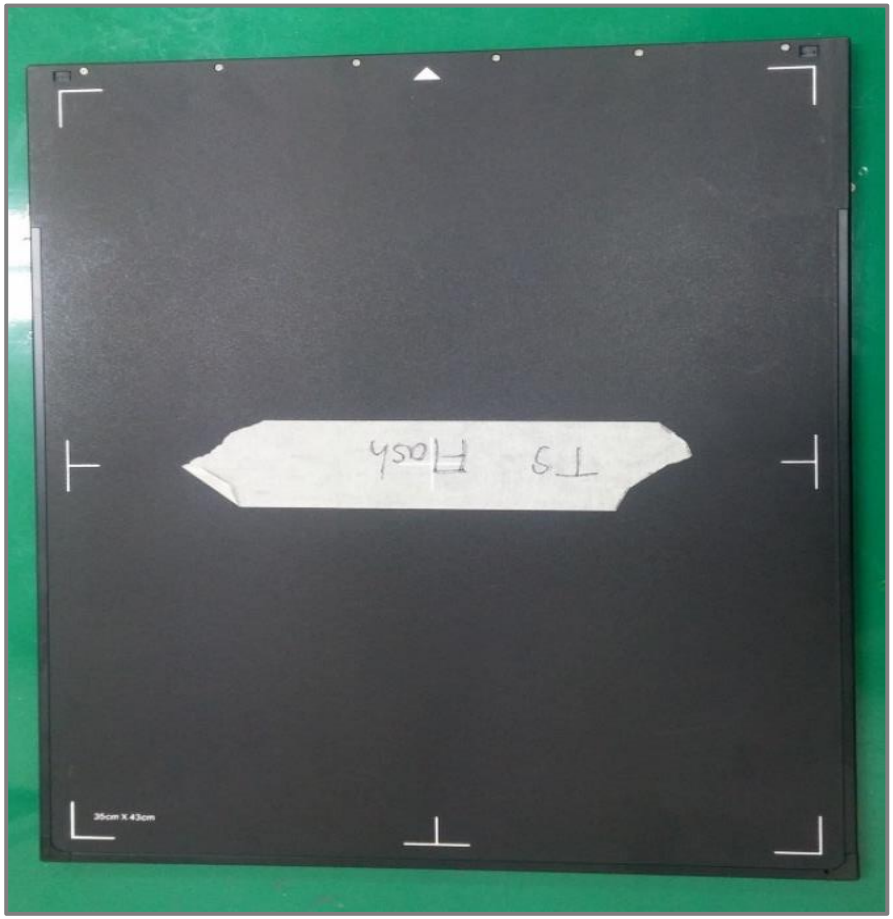
- Emit the blue light by laser beam scanning.

- The image reader (= FireCR flash) converts the latent image on the imaging plate into digital signal.



❖Basic configuration of CR (=Computed Radiography) system

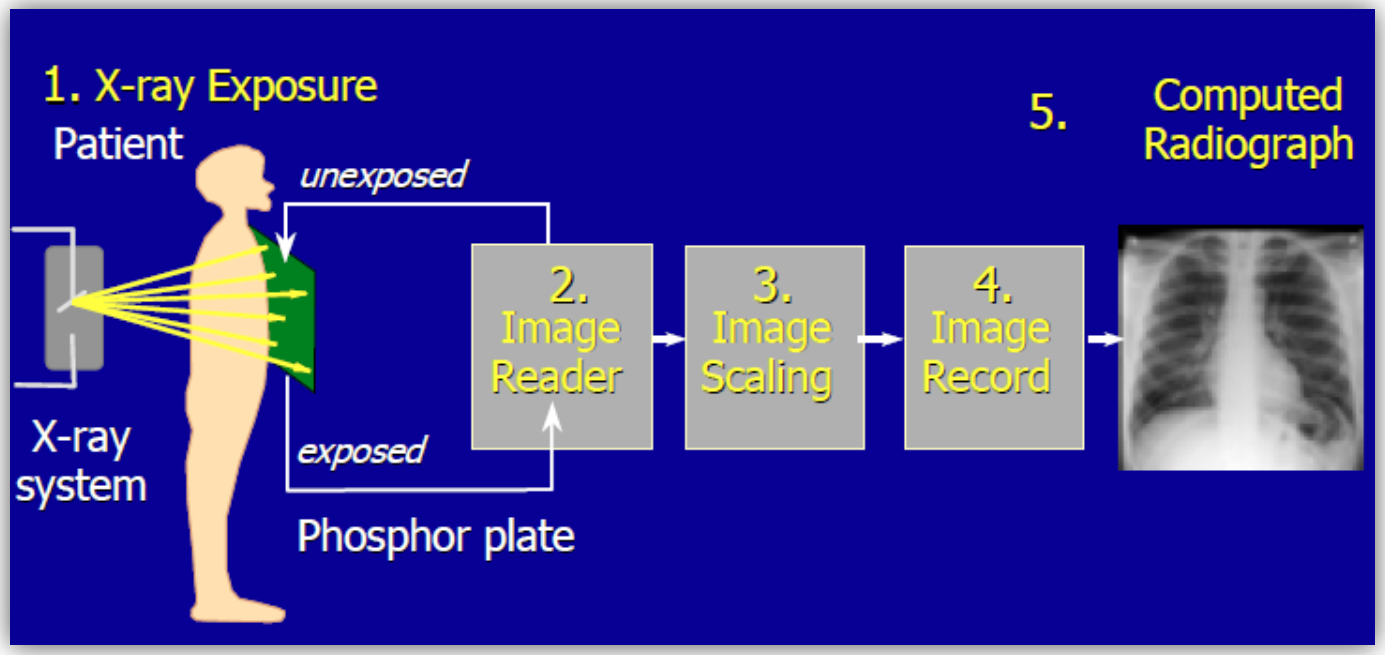
[Imaging Plate]



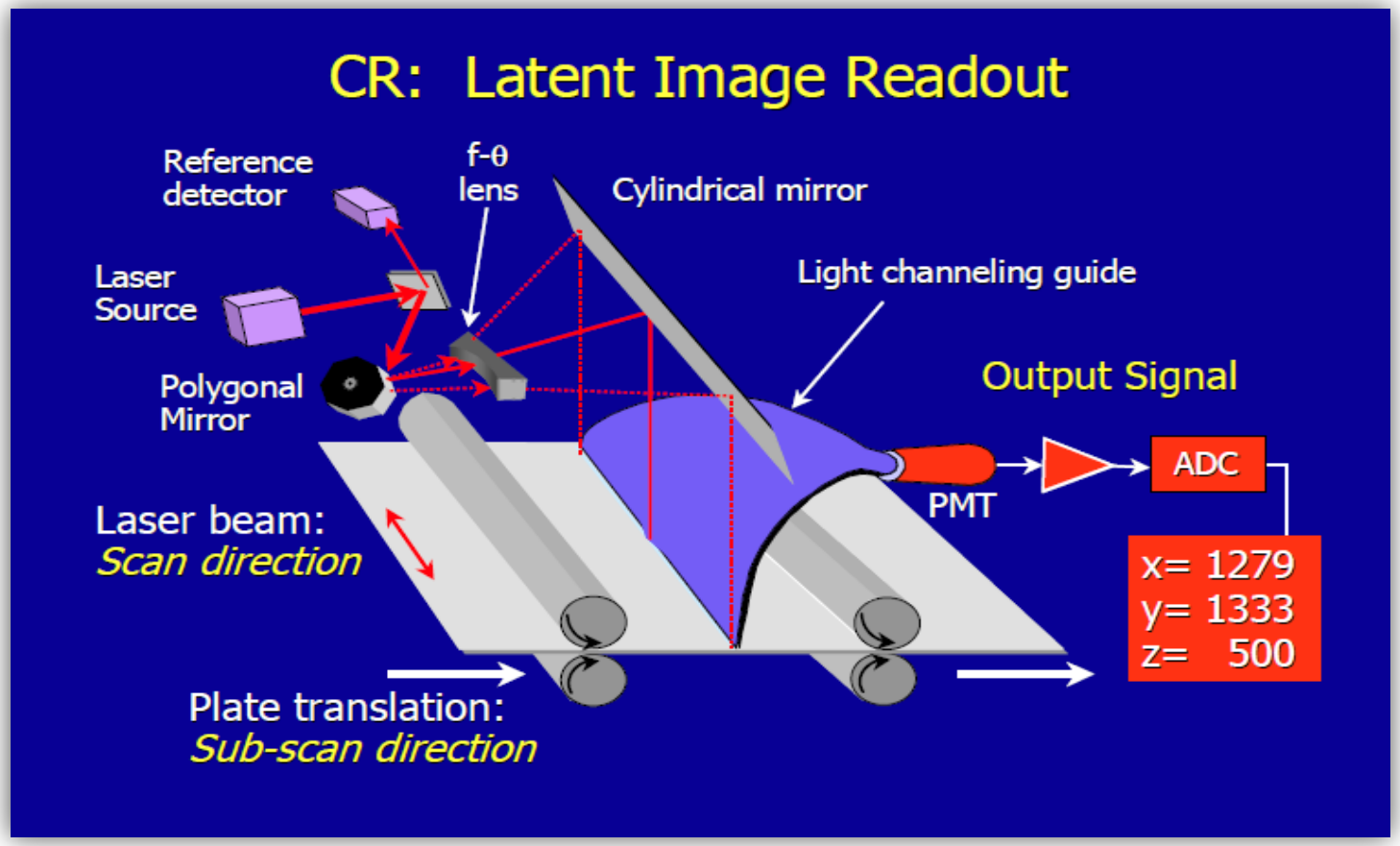
[Cassette Housing]

❖ Basic configuration of CR (=Computed Radiography) system

1. X-ray image is stored on IP.
2. It is scanned with a 650 nanometer (nm) laser beam to produce PSL radiation corresponding to the absorbed x-ray energy.
3. The luminescence radiation stimulated by laser scanning is collected through a light guide into photomuliplier tube(PMT) which converts it into electric signals.
4. The signal output from the detector is an analog signal and the output from the analog to digital convertor is time-series digital signal that is being processed.
5. The residual image is erased when exposing excessive light.



❖ FireCR+ Overview



- Fast scan axis:
  1. Beam Flow: Steering laser unit → Secondary mirror assembly → IP → Fiber bundle → PMT

- Slow scan axis
  1. Y-axis motor
     - HD mode: 100 [um] resolution
     - SD mode: 200 [um] resolution

❖ FireCR+ Scanner Video on how to use.

https://www.youtube.com/watch?v=xVkq_-slabc

❖ FireCR Scanner Specification

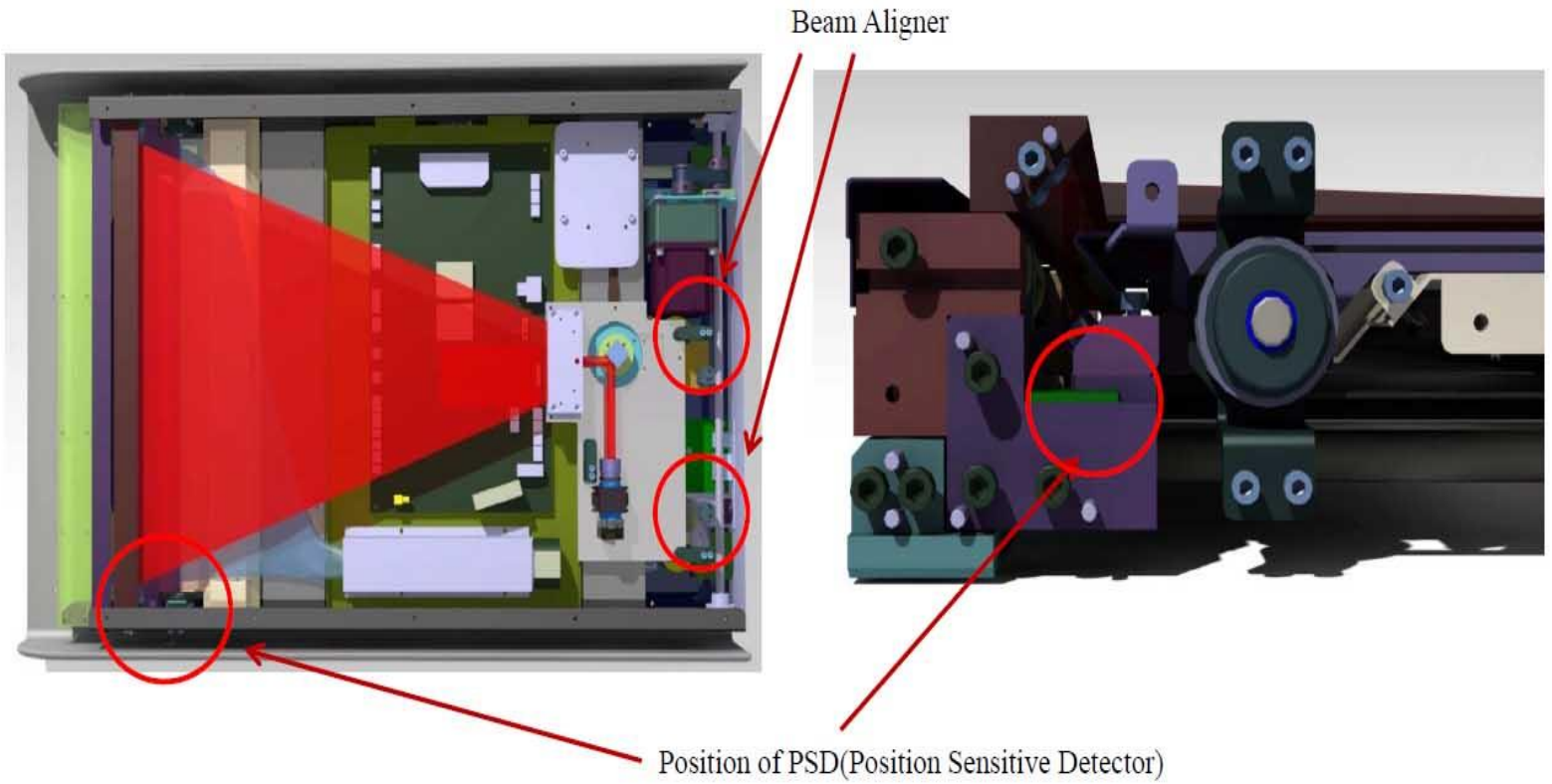
▪ FireCR Plus Scanner

- High throughput – up to 70 plates per hour.
- Resolution, 100 micron meter [um]
- Ultra light, 30 kg
- Accomodates two standard cassettes sizes,
  17 x 14 [Inch], 10 x 12 [Inch]
- Wall mount option for minimum space occupancy.
- One step integrated scanning and erasing

▪ FireCR Flash Scanner

- High throughput – up to 70 plates per hour.
- Resolution, 100 micron meter [um]
- Ultra light, 19.5 kg
- Accomodates three standard cassette sizes.
  35 x 43[cm], 24 x30[cm], 18 x 24[cm]
- Wall mount option for minimum space occupancy.
- One step integrated scanning and erasing.

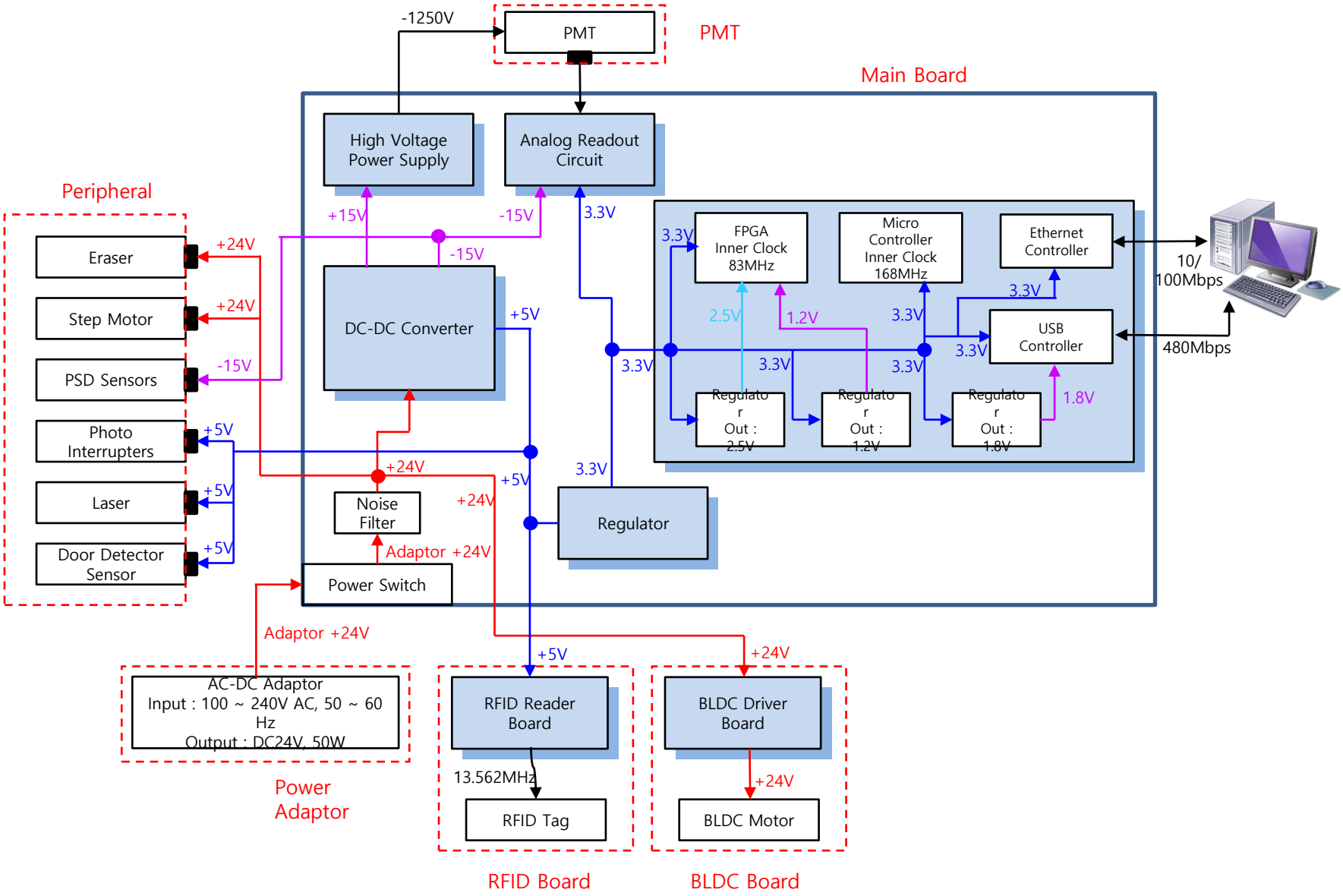
❖ FireCR Plus Overview



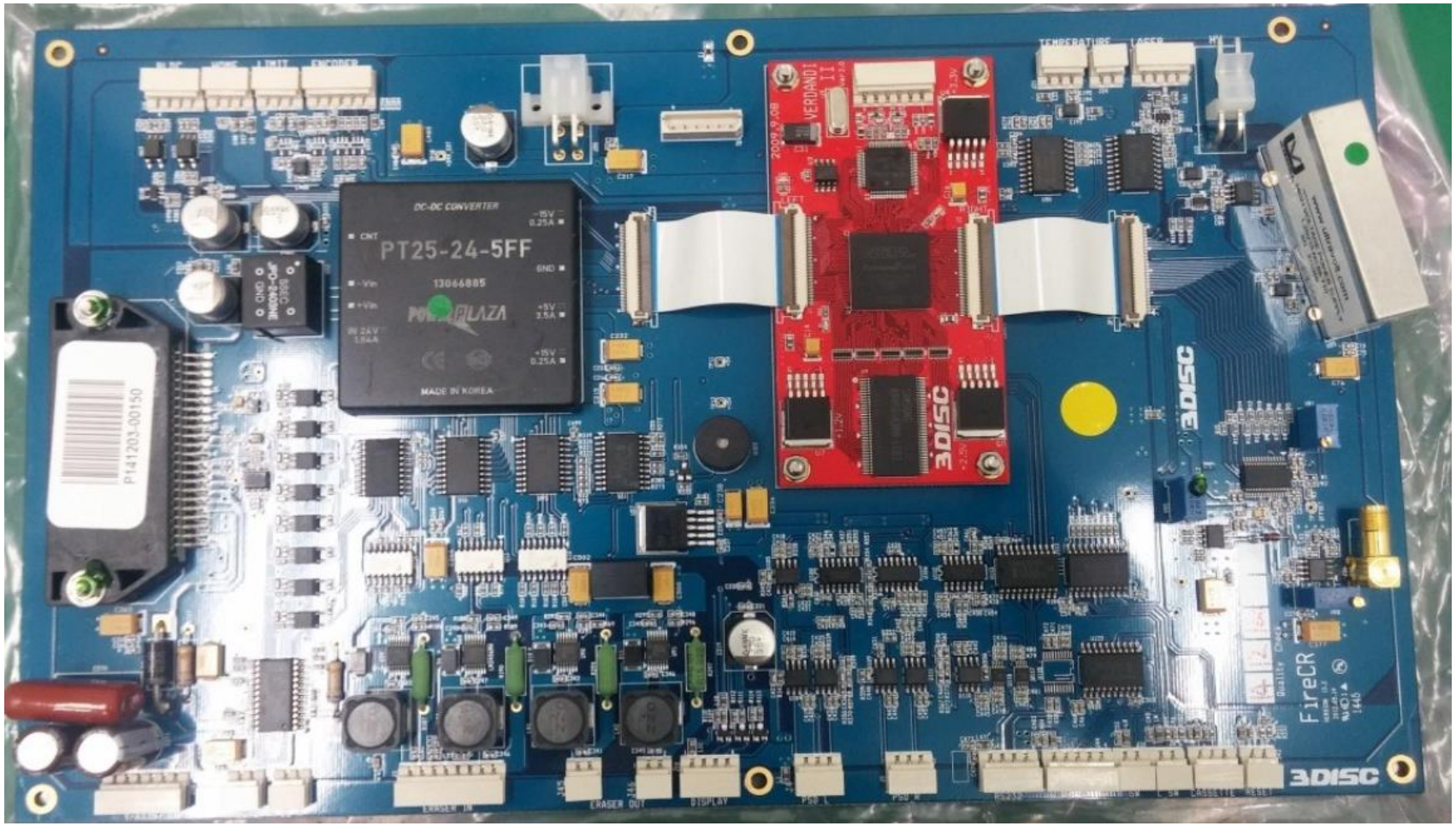
- Fast scan axis:
  1. Beam Flow: Steering laser assembly → Secondary mirror assembly → IP → Fiber bundle → PMT
     → PSD

- Slow scan axis
  1. Y-axis motor
     - HD mode: 100 [um] resolution
     - SD mode: 200 [um] resolution

❖ FireCR+ Function Diagram



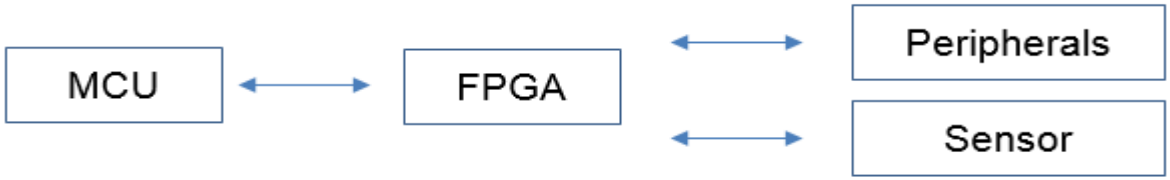
❖Main Board & Core Board



❖Main Board & Core Board

• Function

1. Control all peripherals of for acquisition of image data using FPGA and MCU.



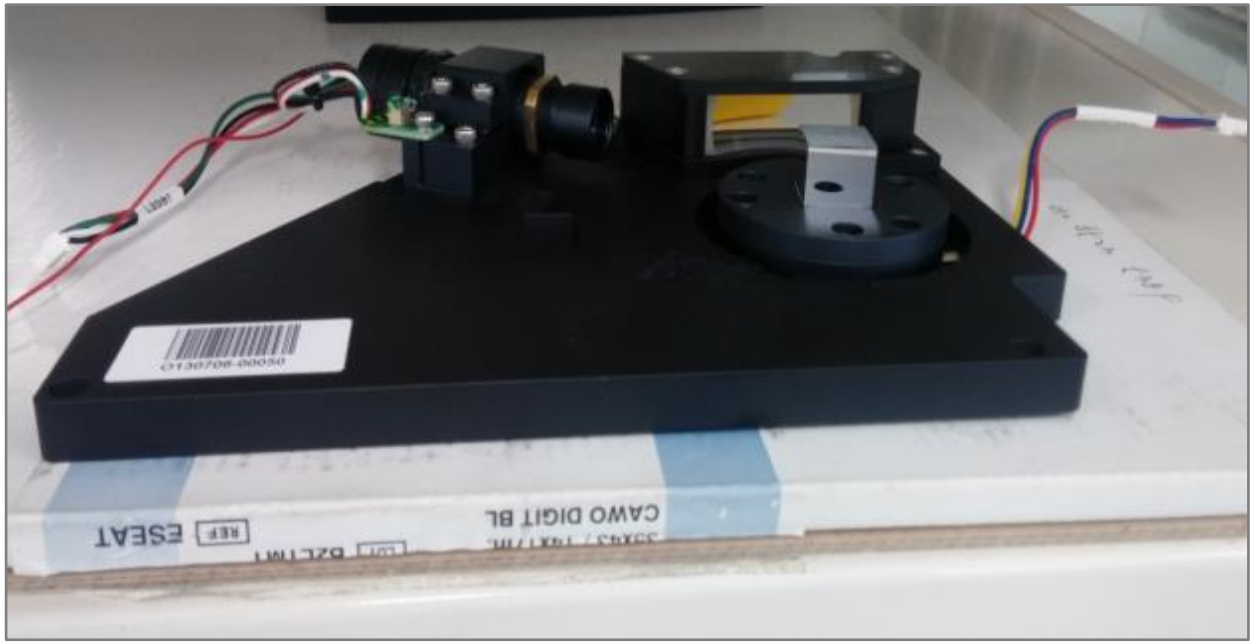
- MCU and FPGA always communicate each other.
- Sensor reading status is transferred to the FPGA and to MCU.
- MCU and FPGA give a command to some peripherals such as Y-axis motor and Eraser unit etc.

2. All sensors on/off reading.
3. Convert analog signal to digital.
4. Provide Power to PMT, laser module, RFID board & some peripherals..
5. Transmit image data to PC using USB communication.

• Main board Issue

1. Stop during mid-scan. – main board
2. Wavy noise. – main board
3. ScanLow value is abnormal.(White image) – main board
4. Partial horizontal lines on image. – main board
5. Booting fail. – core board

❖ Laser Steering Unit



• Function

1.Laser module:

- Transmit 650 [nm] ± ∂ wavelength Red light
- Laser power is within 60 ± 2mW.
- Laser spot size is less than 70um.

2. Square mirror:

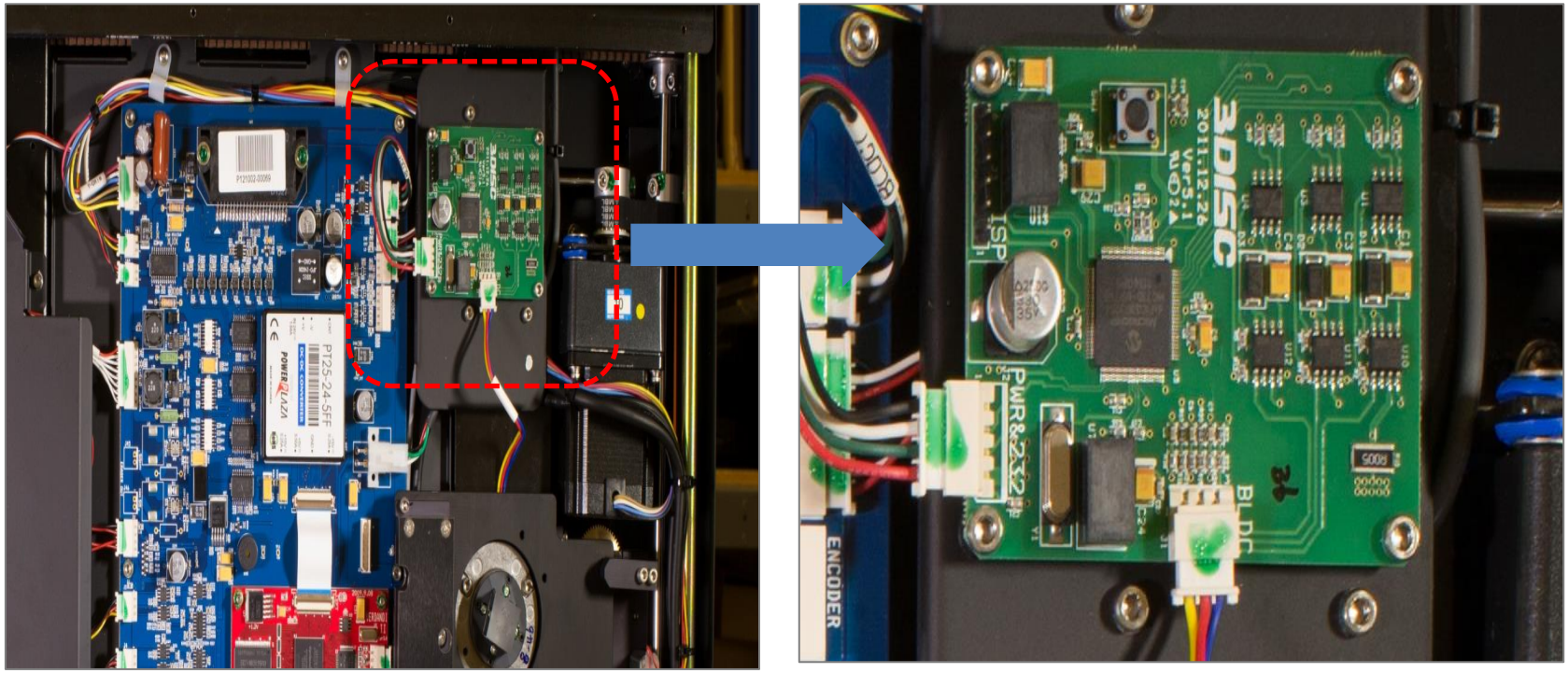
- it rotates 1800 rotation per 1 minute 1800[rpm]. It is allowed to scan whole moving plate.

3. F-theta lens : It helps beam focus on the moving plate.

• Laser Steering Unit Issue

1. There could be no light because of dead diode.
2. There could be very fine horizontal lines on the whole image because of misalignment.
3. RPM is abnormal. It should be near 1800 +/-2[rpm].

❖ BLDC board



• Function
1. BLDC motor driver.
2. Control BLDC motor to maintain same stable speed.

• BLDC Issue
1. Bad RPM

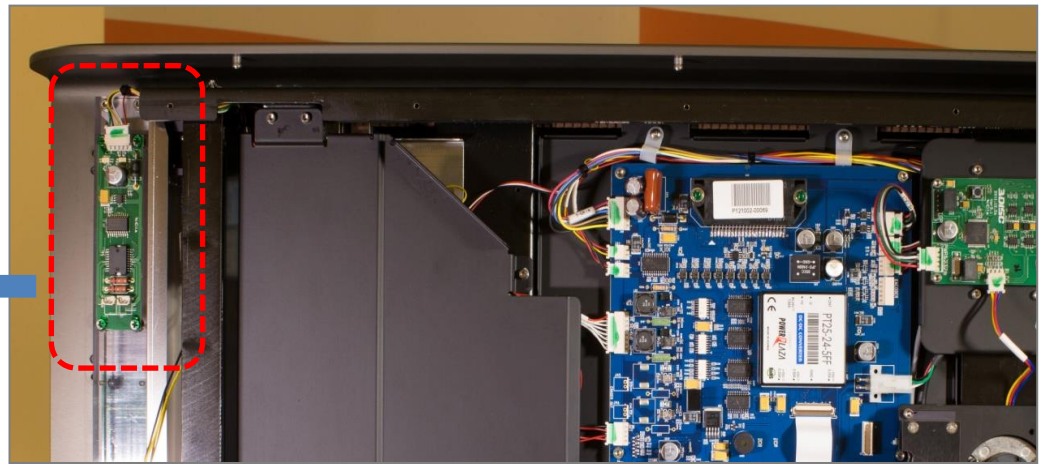
❖ The Compatibility between BLDC Board and Optic Plate

Optic Ver.	BLDC Ver.	F/W Ver.	Cable	Switch			
				SW1	SW2	SW3	SW4
				ON/OFF	Product		Motor Type
1 ~ 6	V6.1.2	V1.0.1.5	BLDC 3	0	0	0	0
7~	V6.1.2a	V1.0.1.9		0	0	0	1

- BLDC V6.1.2 / Firmware V1.0.1.5 : This version is compatible to Optic version 1~6.
- BLDC V6.1.2a / Firmware V1.0.1.9 : This version is compatible from Optic version 7~.
- In case of Optic Plate version 7 ~ , the dip switch of BLDC board is 0001.
- In case of Optic board version 1~6, the dip switch of BLDC board is 0000.

❖ Cassette Motor Lock Board

[Cassette Lock Board]

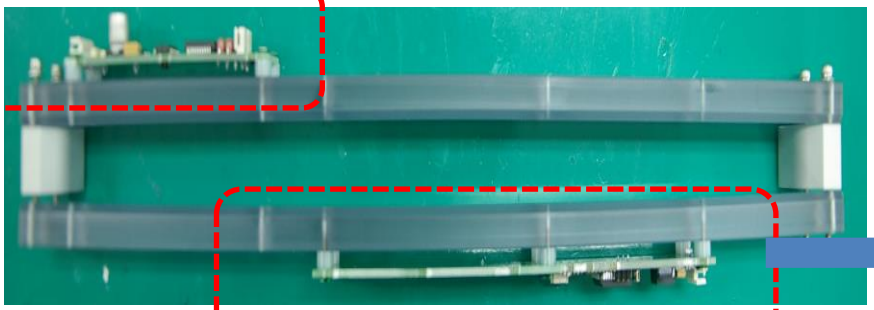


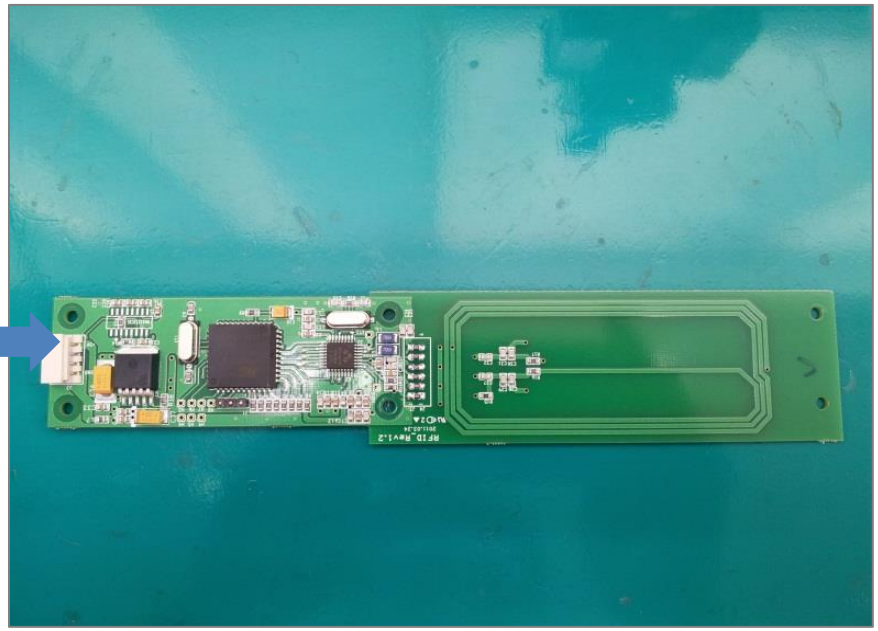
- Function
  1. Control cassette lock & unlock

- Cassette Motor Lock Board Issue
  1. Cassette lock motor doesn't work.

❖ RFID Board & Cassette Lock Board

[Cassette Lock Board]



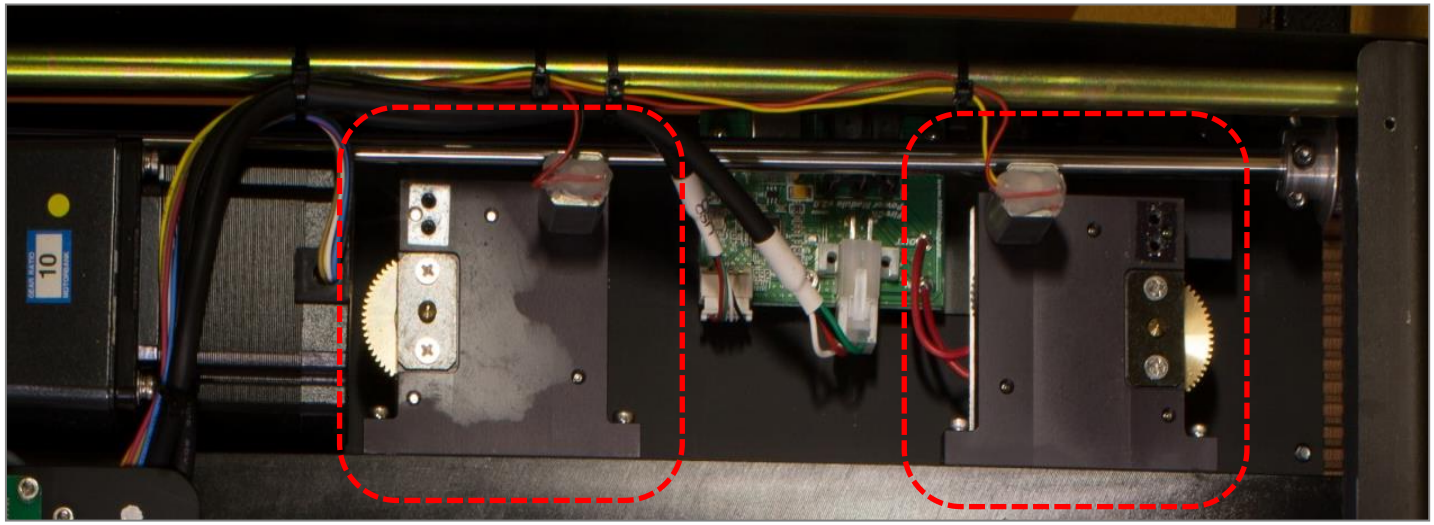


[RFID Board]

• Function
[RFID Board]
1. Read the information of cassette.
2. Read the information of unit identity
3. Transmit the information to Core Board.

• RFID Issue
1. It can’t recognize cassette itself or cassette size.
2. It can’t recognize the scanner type ex) 20, 40, 60, 80
3. It takes time to become “ready to scan” from “warming-up”.

❖ Alignment motor

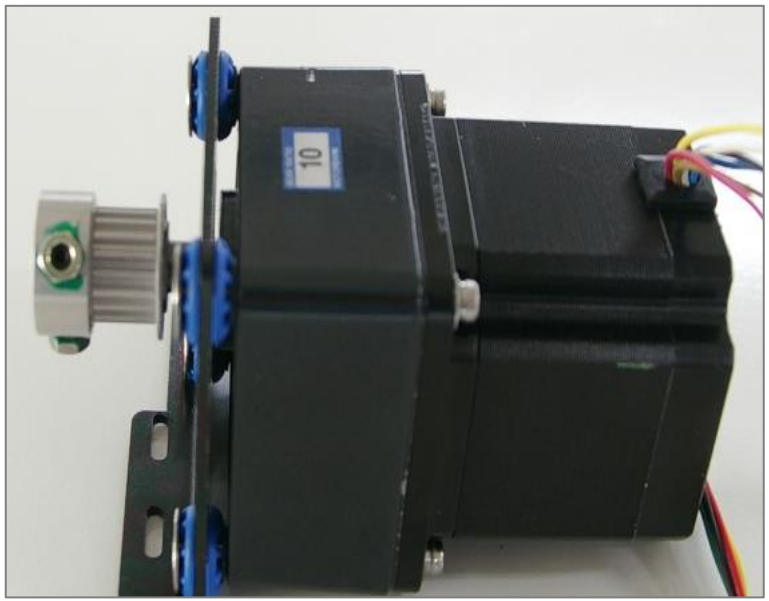


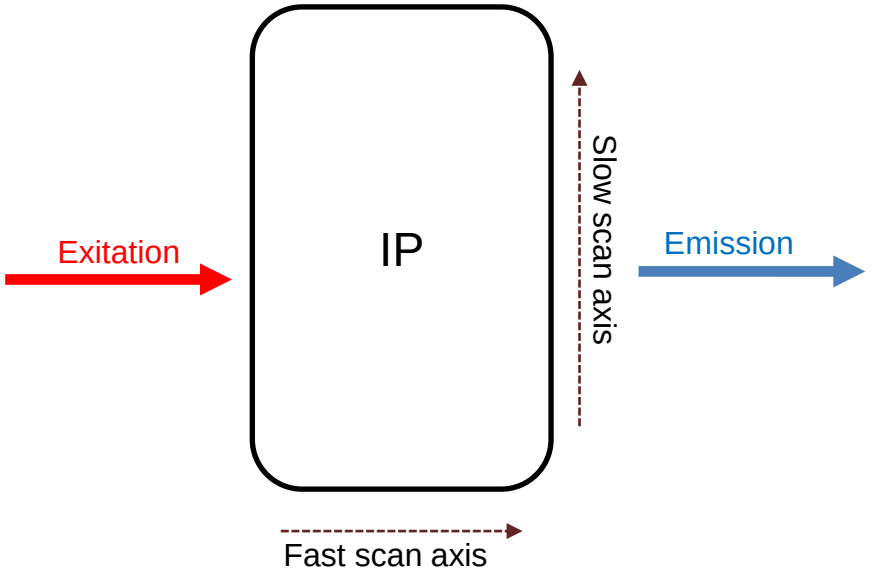
[Right alignment motor] [Left alignment motor]

• Function
1. It makes the laser steering unit move up and down.
2. It continuously move up and down to find out best PSD position when you press “auto alignment” button.

• Laser Steering Unit Issue
1. Auto alignment fail

❖ Y-axis Motor

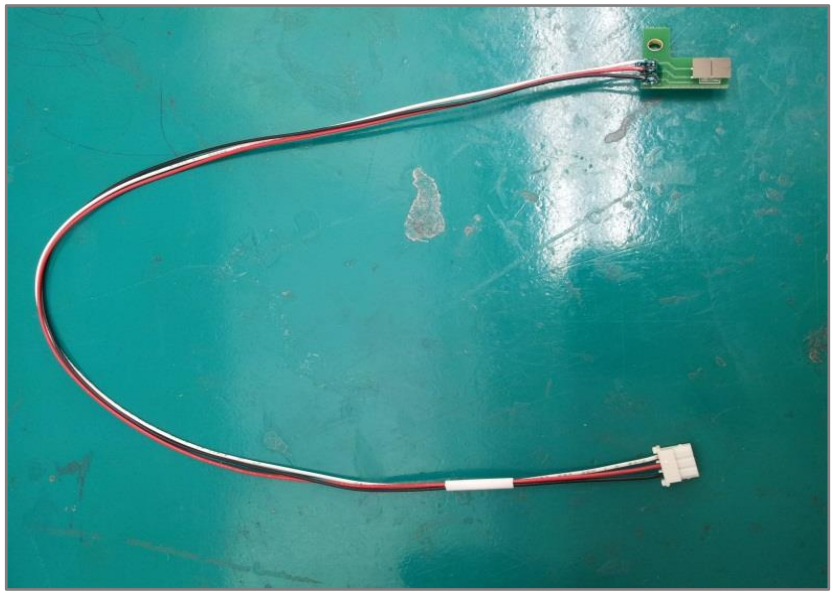




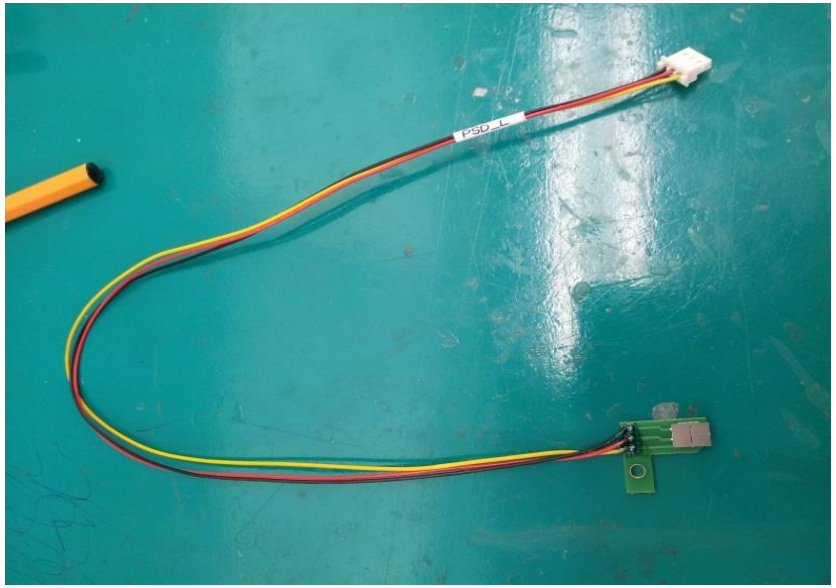
- Function
  1. Y-axis motor works on it as the slow axis scan.
  2. Separate SD mode with HD mode as the slow scan speed.
  3. Laser steering unit works on it as the fast scan axis.

- Y-axis Motor Issue
  1. It happens the regular horizontal lines.
  2. It can't pull out the moving plate from the cassette housing when it starts to scan.

❖ PSD (Position Sensitive Detector)



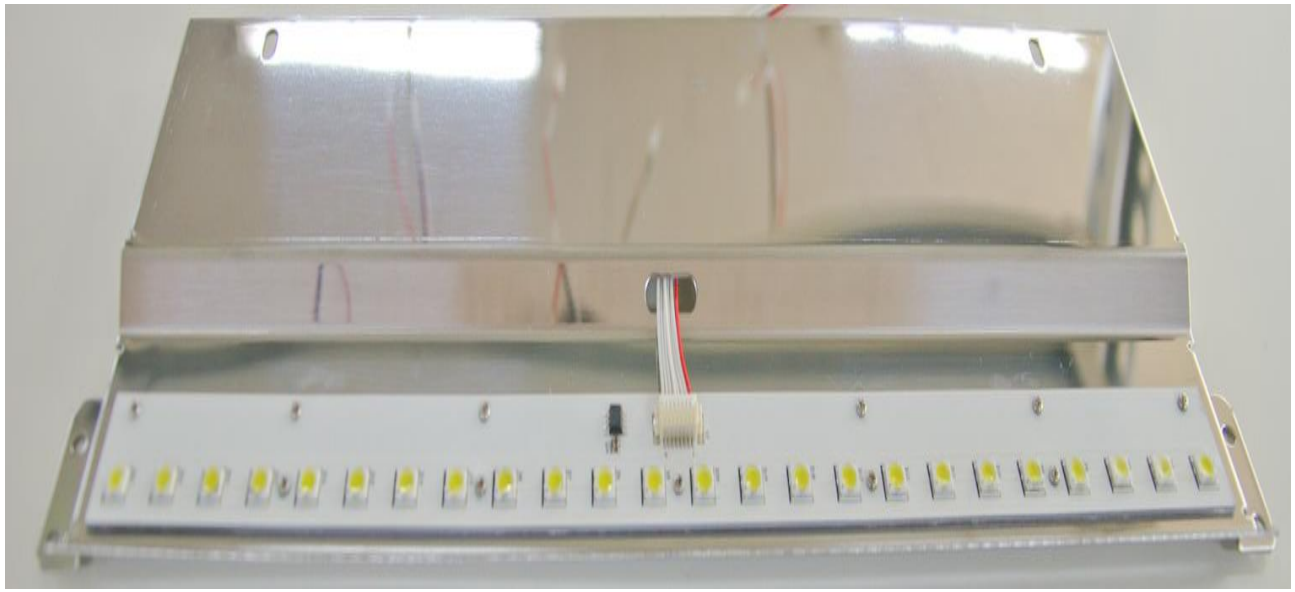
[PSD Right Sensor]



[PSD Left Sensor]

- PSD means Position Sensitive Detector
- Amplify the signal.
- It recognizes exact position using ADC converted voltage.
- It can determine scan start position and scan end position

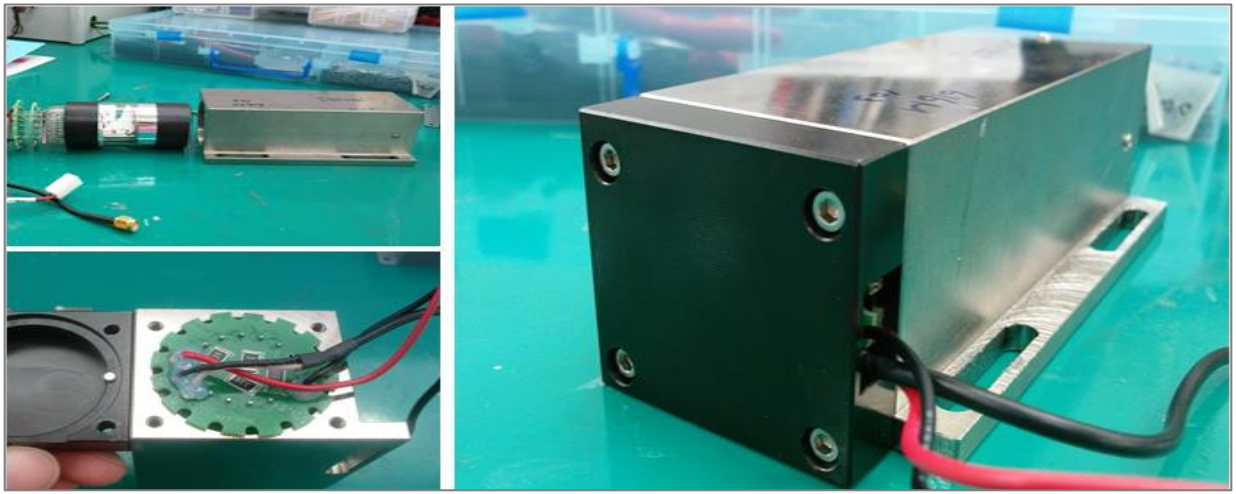
❖ Eraser Unit



• Function
1. Erase the image on the moving plate
2. Eraser works after scanning.

• Eraser Issue
1. Still exist image residual even though erasing.
2. Don't forget to erase twice in case you use high dose x-ray.

❖ PMT (Photo Multiplier Tube)

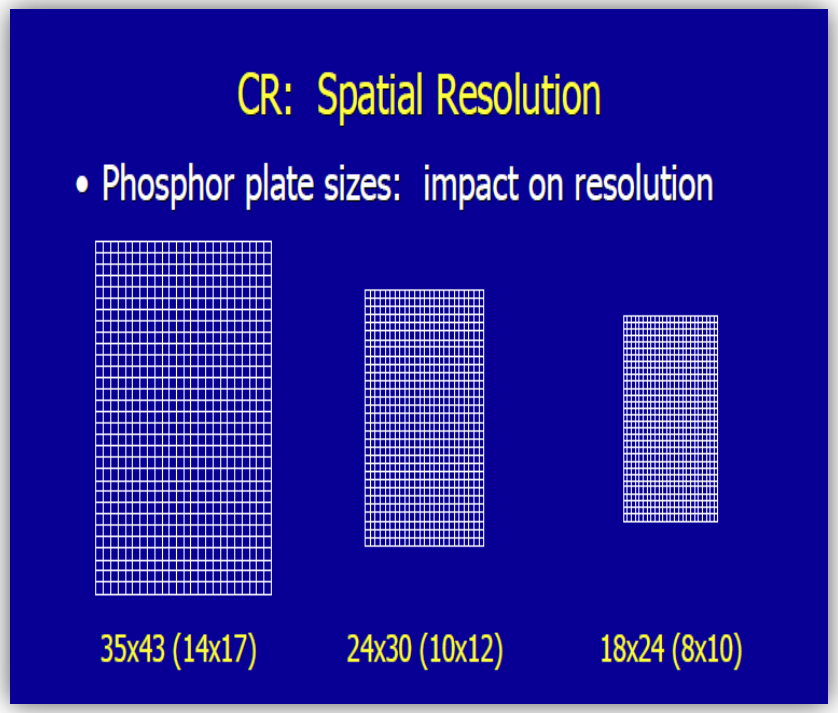


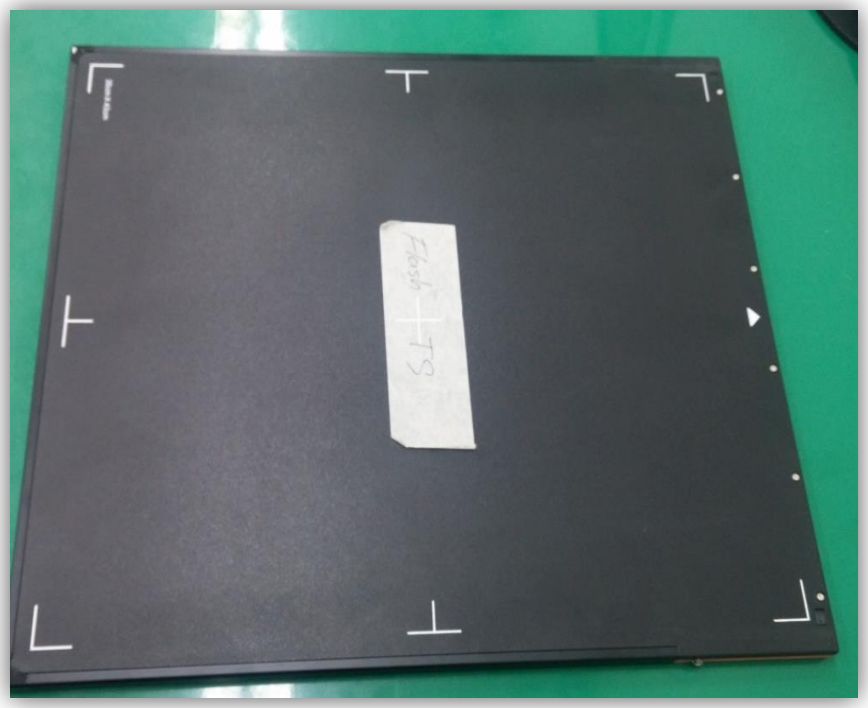
- Function
  1. It is a sensor to detect how much light goes through the sensor.
  2. It converts light into the electric signal..
  3. High sensitivity – It can detect the signal even though using less light.

- Flow
  : Light → Photocathode → Electons → Anode

  - Photocathode: Emit electron when receiving above specific frequency.
  - Electrons: Amplify electrons
  - Anode: It converts light into the electric signal.

1. Moving Plate



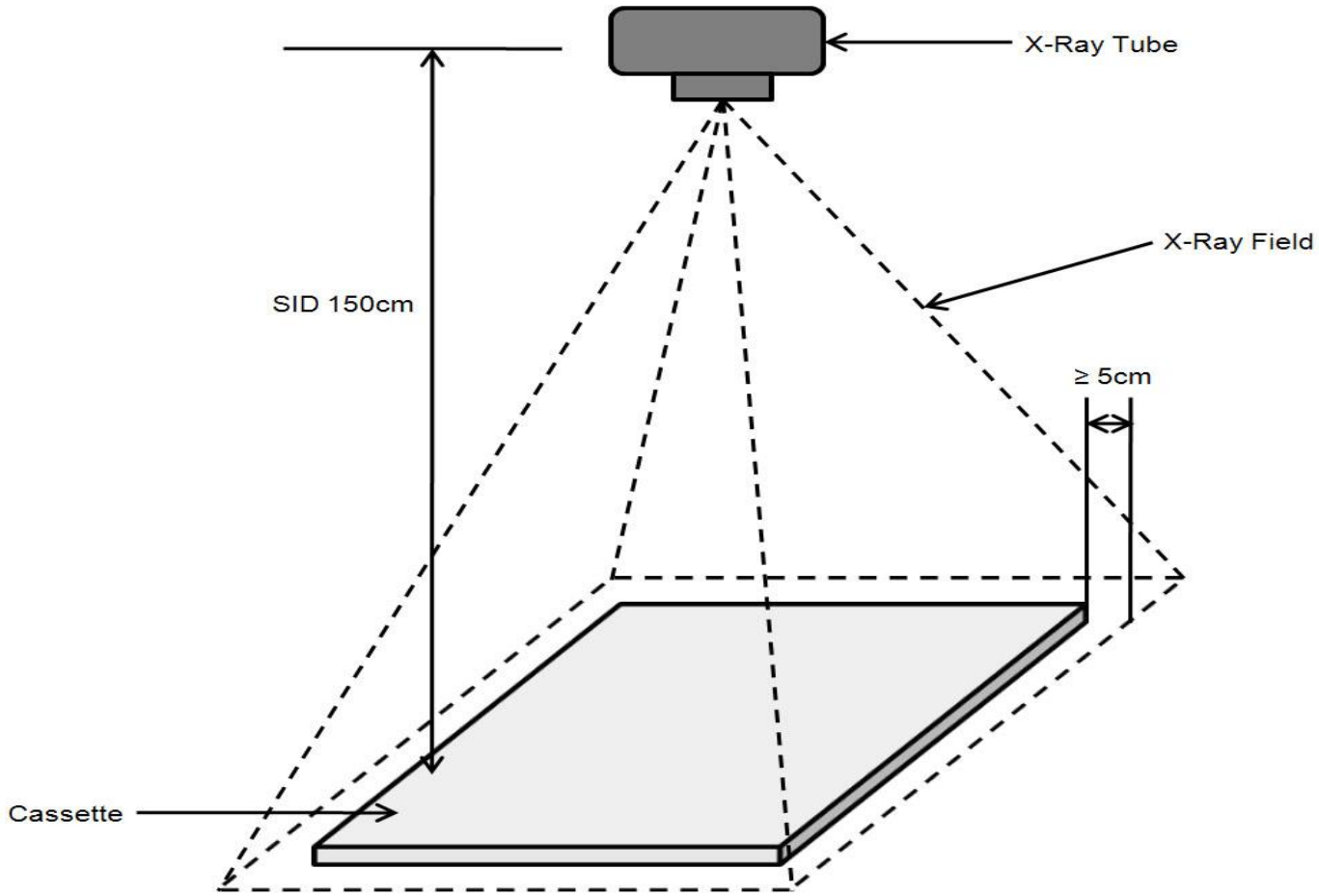


• IP
1. Imaging plate or Moving plate
2. FireCR+ has two types of cassettes and IPs: 14 x17 [Inch], 14 x12 [Inch]

• IP Features
1. The moving plate stores X – ray image.
2. White light : Erase the image on the moving plate when exposing excessive light.

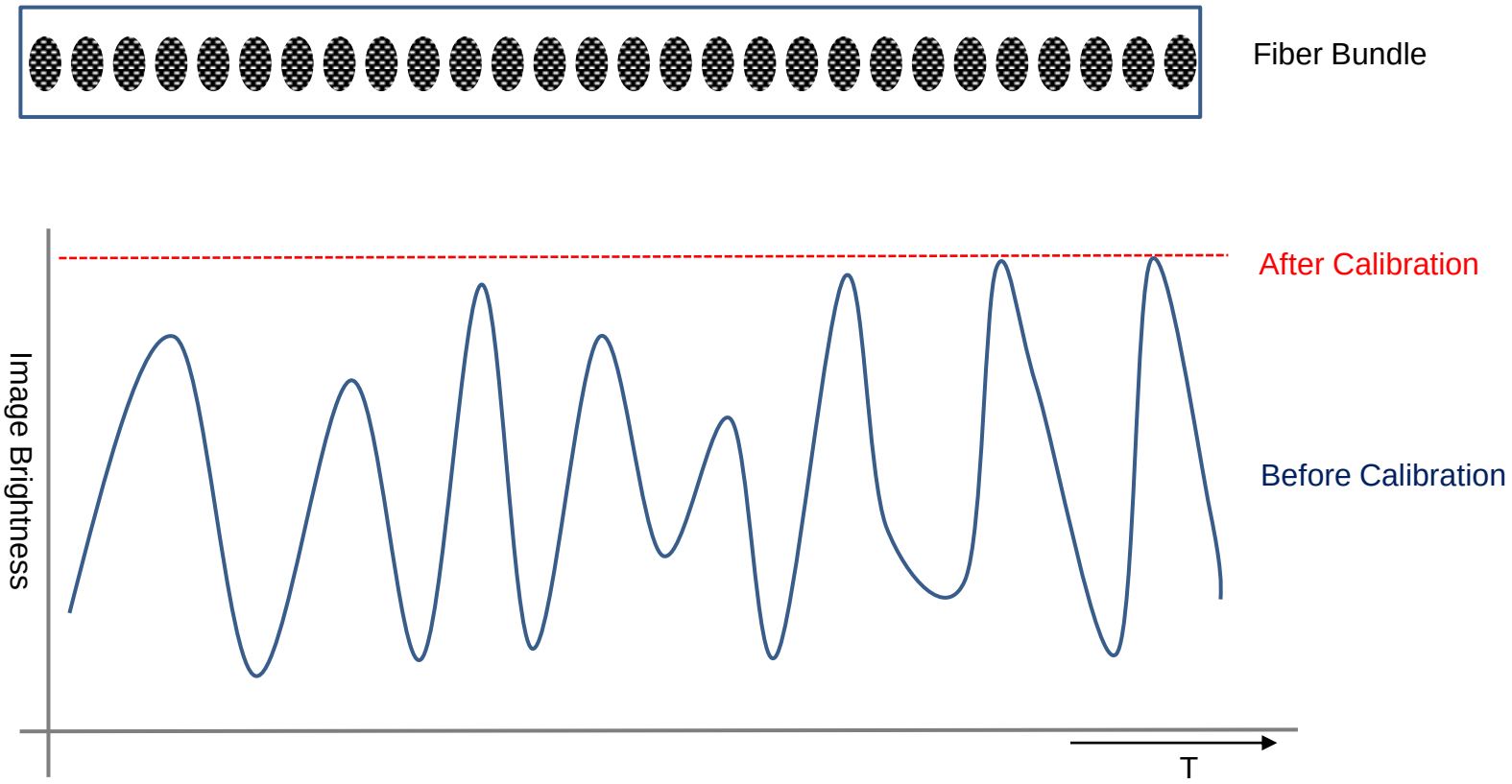
❖ Understanding FireCR Flash; Calibration

Note: X-ray exposure must cover entire cassette.

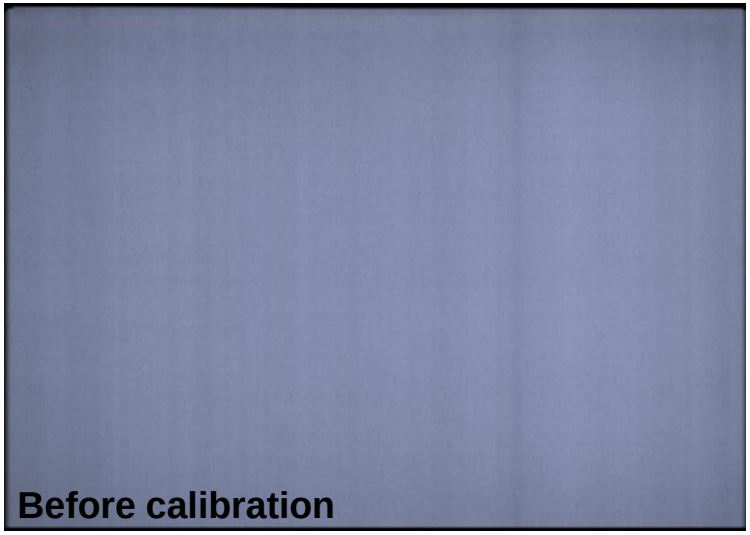


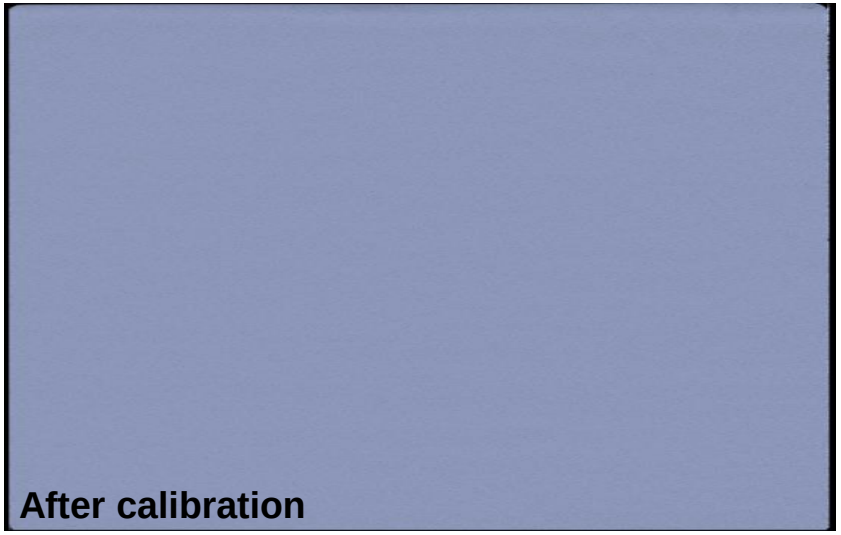
❖ Understanding FireCR Flash; Calibration

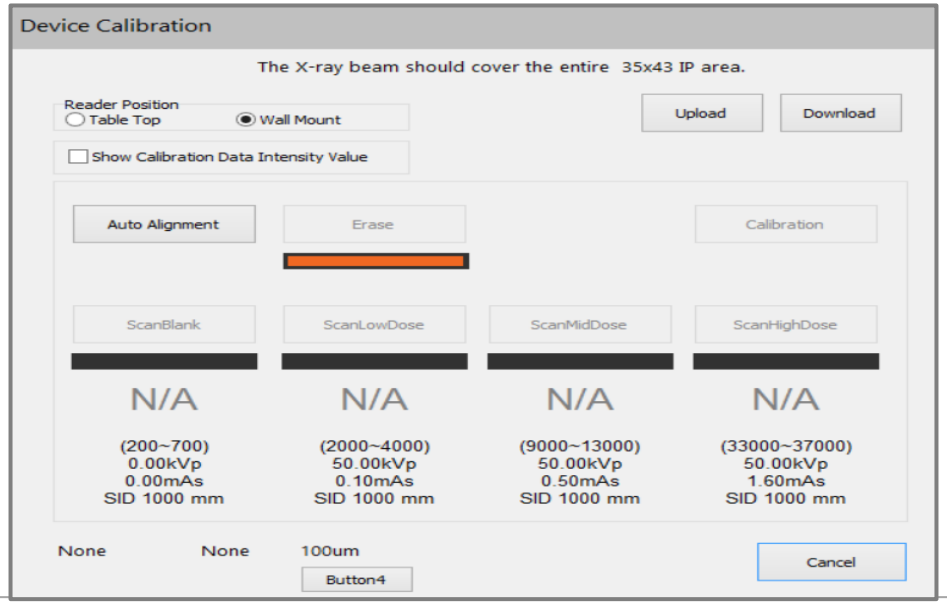
- Every scanner has a different "**Fiber Bundle Condition"**. Fiber bundle collectors have different light sensitivity. Image is optimized using calibration. It means that brightness of image is uniform.



❖ Understanding FireCR Flash; Calibration



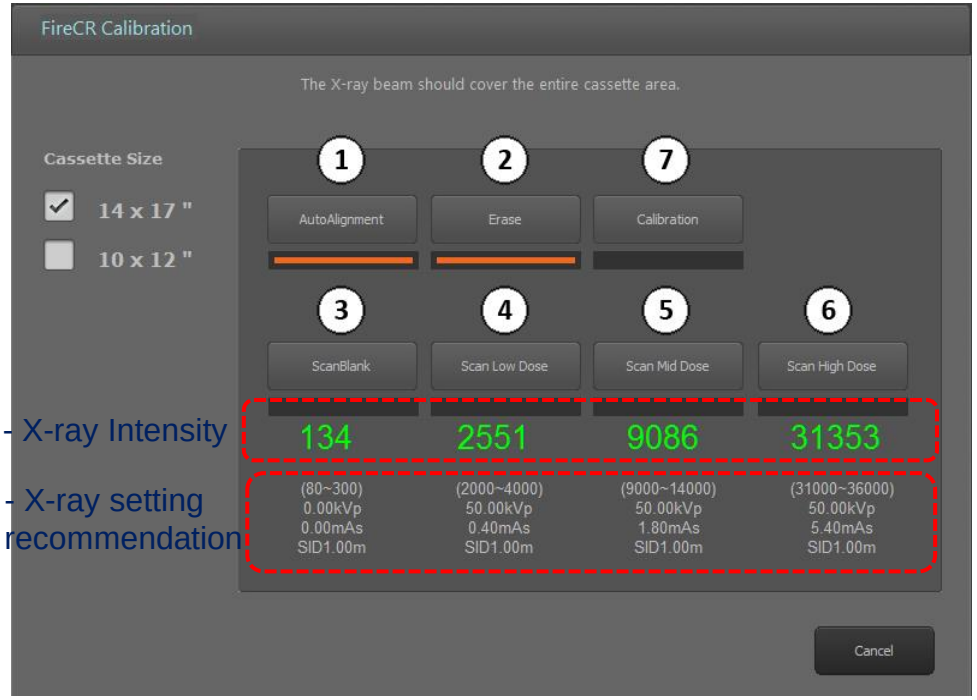




1. Auto Alignment
2. Erasing
3. We expose four images with different dose.
   - ScanBlank, SacnLowDose, ScanMidDose, ScanHighDose
4. Calibration

❖ Calibration and Images

- Calibration Procedure
  - **This screen will appear:**



Step 1: Auto alignment

Step 2: Erase

Run an erase cycle to remove any residual radiation that may be left on the phosphor.

Step 3: Scan Blank

Without exposing the cassette, insert it into the reader and press the “Scan Blank” button. ***Note: Use the same cassette for the entire calibration.***

Step 4, 5, & 6: Scan Low, Medium, & High Dose

Expose the entire cassette at the recommended values and if the value is out of range adjust mAs until the numbers are green. ***Note: mAs and calibration values are directly proportional, so a 5% increase in mAs will equal a 5% increase in calibration value, etc.***

Step 7: Calibration!

Press and wait until the software confirms that the calibration was successful. ***Note: Cancelling the calibration before completion will force you to start over.***

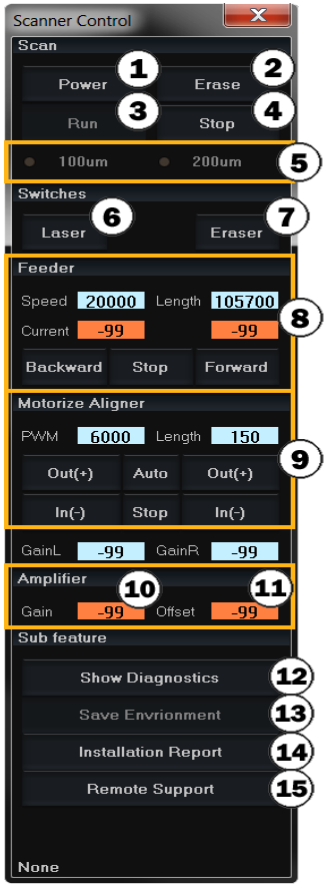
❖ Calibration and Images

- ## Understanding the Cal-files:
  - Calibration files can be found in the software folder. Windows Photo Viewer can view the Cal-files. We recommend that you open the “High Dose” calibration of each cassette size to verify an artifact free calibration.

14 x 17 Cassette Calibration		10 x 12 Cassette Calibration	
File	**Description**	**File**	**Description**
Cal0.tif	Scan Blank	Cal4.tif	Scan Blank
Cal1.tif	Scan Low Dose	Cal5.tif	Scan Low Dose
Cal2.tif	Scan Mid Dose	Cal6.tif	Scan Mid Dose
Cal3.tif	Scan High Dose	Cal7.tif	Scan High Dose
Section.dat	Cal0 - Cal3 compressed together	Section2.dat	Cal4 - Cal7 compressed together

5. Scanner Control and diagnostics

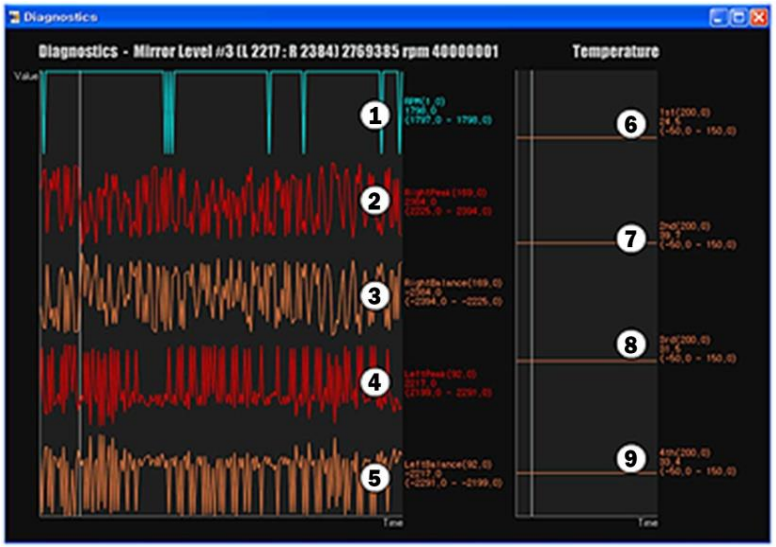
- Scanner Control



1. Software on/off
2. Run manual erasing
3. Run scan
4. Stop scan
5. Select the resolution of scan
6. Laser on/off
7. Eraser on/off
8. Stage control *(current should be “40 & “40”)
9. Beam aligner control
10. PMT(Photo Multiplier Tube) gain
11. ADC(Analog to Digital Converter) offset
12. Diagnostics window on/off
13. Save values highlighted in orange
14. Send a report to technical support
15. Connect to remote support.

5. Scanner Control and diagnostics

- Diagnostics window



Gauge 1: Rotating mirror RPM (1840RPM +/- 10)
Gauge 2: Right PSD peak
Gauge 3: Right PSD balance
Gauge 4: Left PSD peak
Gauge 5: Left PSD balance
Gauge 6: Internal frame temperature
Gauge 7: Mainboard temperature
Gauge 8: Eraser temperature
Gauge 9: Laser module temperature

2. Disassembly

- Top Cover

1. Turn the power off
2. Unplug the USB cable and power cord
3. Remove 4 front screws and 3 rear screws from the base plate(2.5mm hex)

2. Disassembly

- Top Cover

  1. Pull back cover

2. Disassembly

- Top Cover

1. Slowly lift cover from the back.

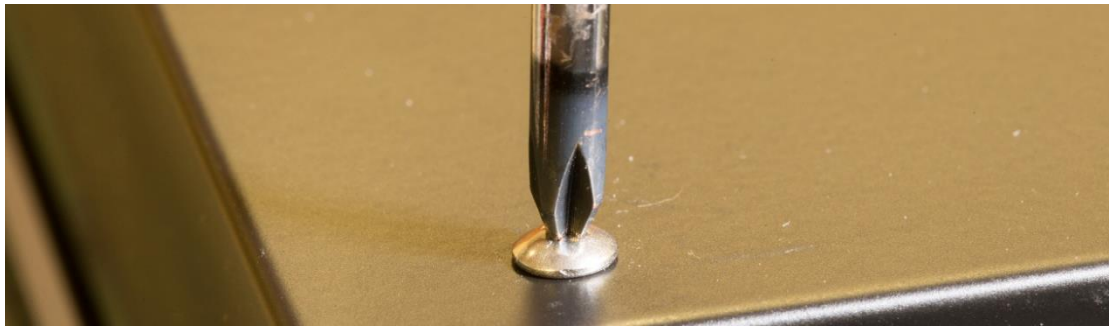
Note: Before removing the cover, disconnect the LED connector underneath.

2. Disassembly

- Internal Cover

1. Remove the 6 screws on the top of the internal cover(#2 Philips).

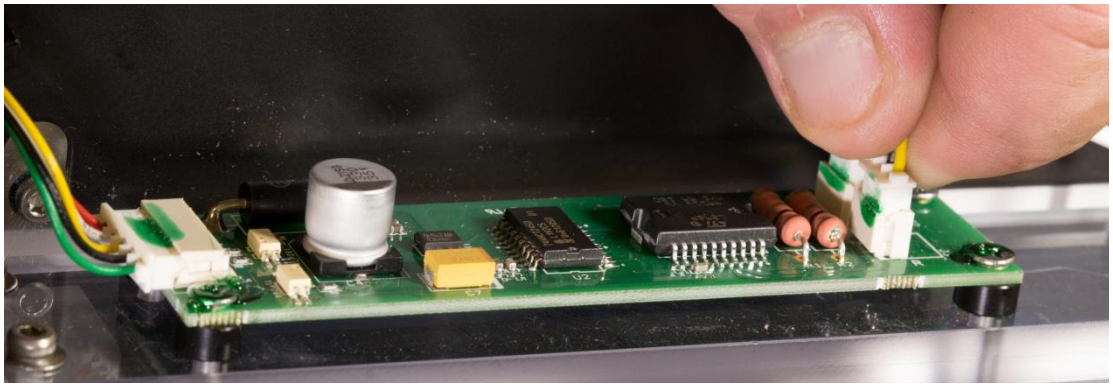
Note: Some scanners have 10 screws



2. Disassembly

- Internal Frame

2. Disconnect the cassette lock cables from the cassette lock board and feed them through the hole in the middle of the internal cover).



2. Disassembly

- Internal Cover

3. Lift off internal Cover

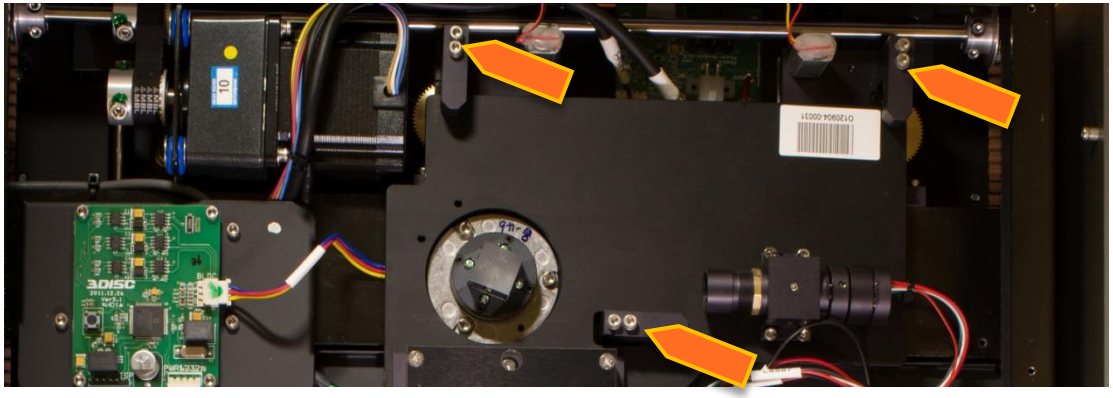
Note: There are two grooves on each side of the Internal Cover front. When refitting the Internal Cover, make sure that the cables on both sides go through the upper grooves. Refit it from front to back and make sure that the end of the Internal Cover goes over the entire internal frame and not into the space between the internal frame and the back cover.

2. Disassembly

- ## Optic Plate

1. Remove Top Cover.
2. Remove Internal Cover.
3. Remove 2 screws from each of the three spring loaded brackets (2.5mm hex).
4. Unplug the 3 wire connectors (1 to BLDC, 2 to Main Board)
5. Lift out Optic Plate.
6. Reinstall in reverse order.

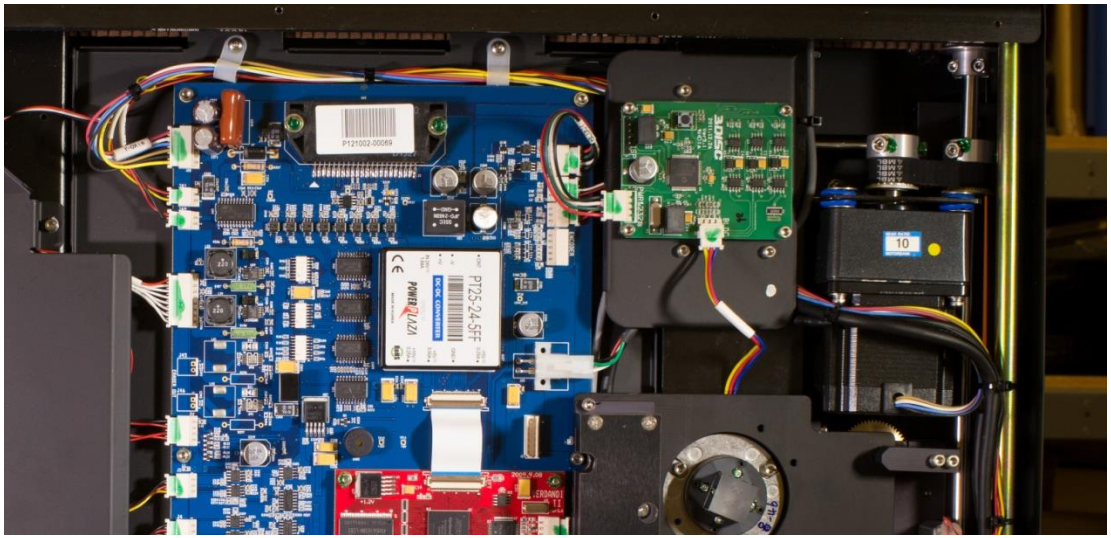
Note: Keep pressure over the spring while removing and re-installing screws.



2. Disassembly

- BLDC Board

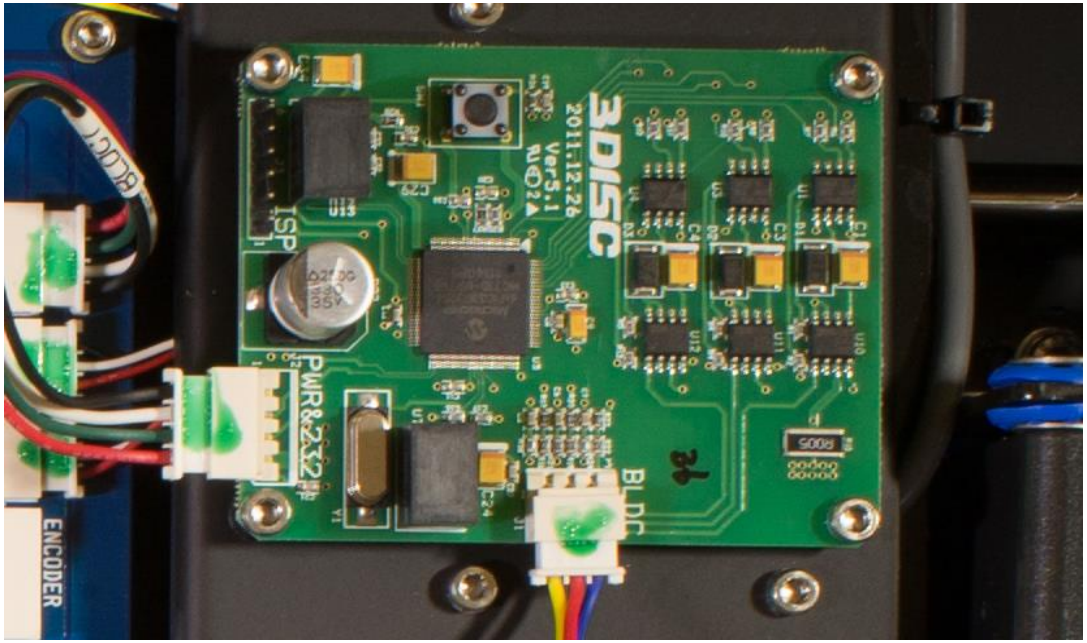
1. Remove Top Cover.
2. Remove Internal Cover.
3. Unplug 2 wire connectors from BLDC Board.



2. Disassembly

- BLDC Board

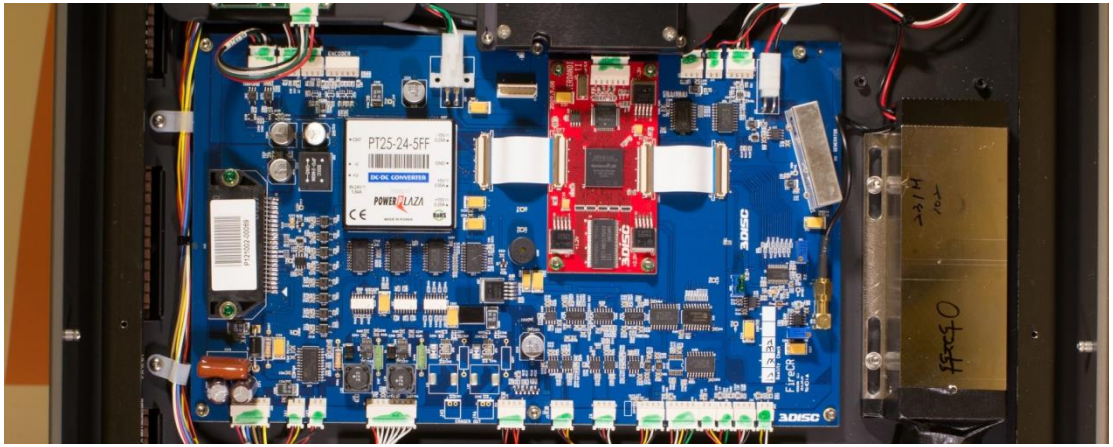
4. Remove 4 screws (2.5mm hex).
5. Reinstall in reverse order.



2. Disassembly

- Main Board

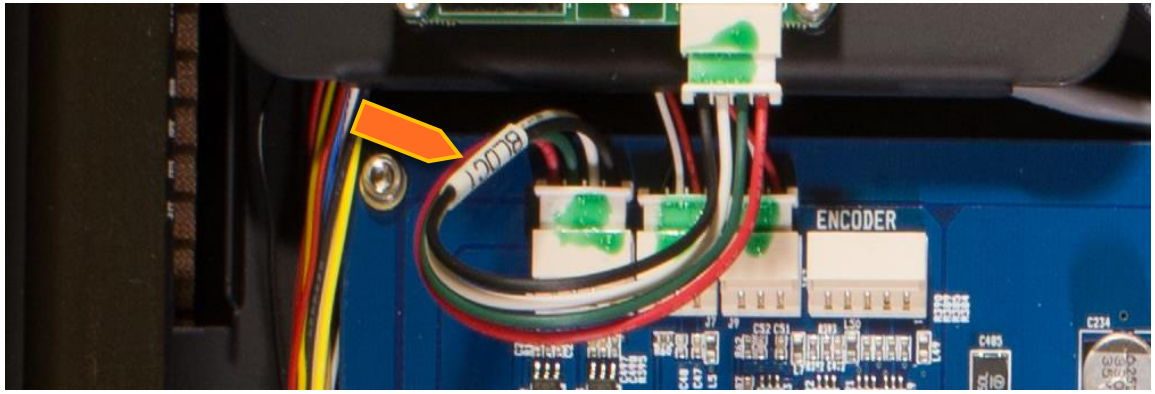
1. Unscrew the 6 screws that hold down the board and replace (2.5mm hex).



2. Disassembly

- Main Board

Note. **Make sure to connect the cables correctly when reassembling. The cables all have tags corresponding to descriptions on the connectors.**



2. Disassembly

- Core Board

1. Remove Top Cover
2. Remove Internal Cover
3. Remove the Loctite on the nuts.
4. Unscrew the 4 nuts on the core board.

2. Disassembly

- Core Board

5. Disconnect the 2 ribbon cables and wire connector.
6. Replace the old core board with a new core board.
7. Reinstall the nuts to secure the core board.
8. Connect the 2 ribbon cables and wire connector.
9. Put Loctite on the nuts.

2. Disassembly

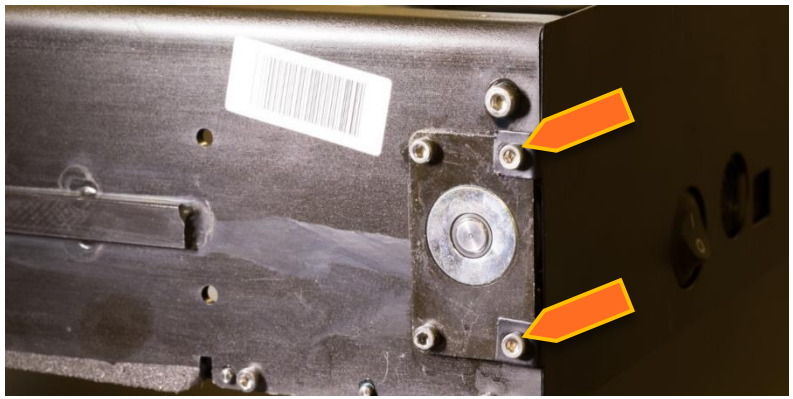
- Cassette Lock Motor Board

1. Remove Top Cover.
2. Remove Internal Cover.
3. The Cassette Lock Motor Board is located front section of the Fire CR+.

2. Disassembly

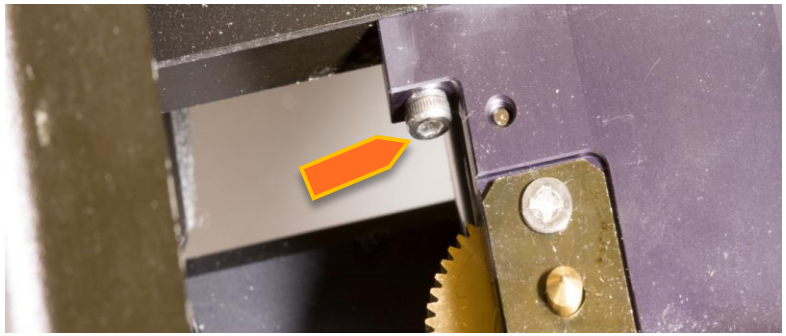
- Aligner Motor

1. Remover back over



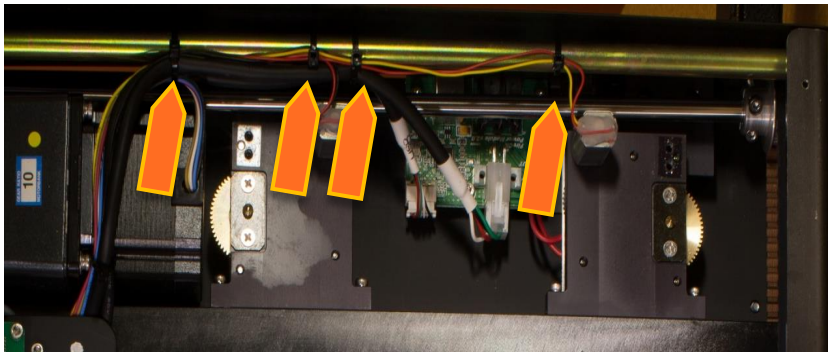
2. Disassembly

- Aligner Motor



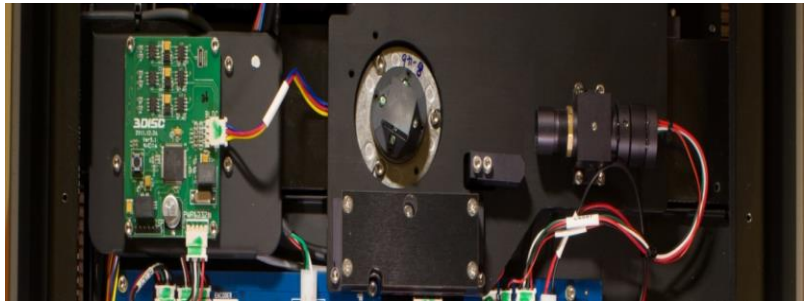
2. Remove 2 screws from aligner motor

3. Cut cable ties holding wiring harness to cross bar.



2. Disassembly

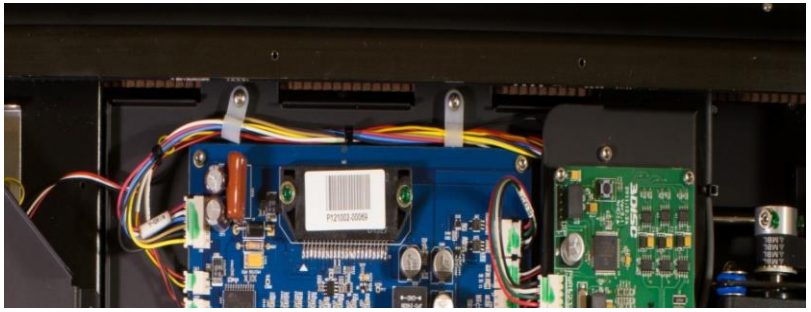
- Aligner Motor



4. Remove 3 BLDC bracket screws(2.5mm hex).

Note: Wiring harness routes under BLDC bracket and along the side of scanner.

5. Remove 2 cable along the side of scanner

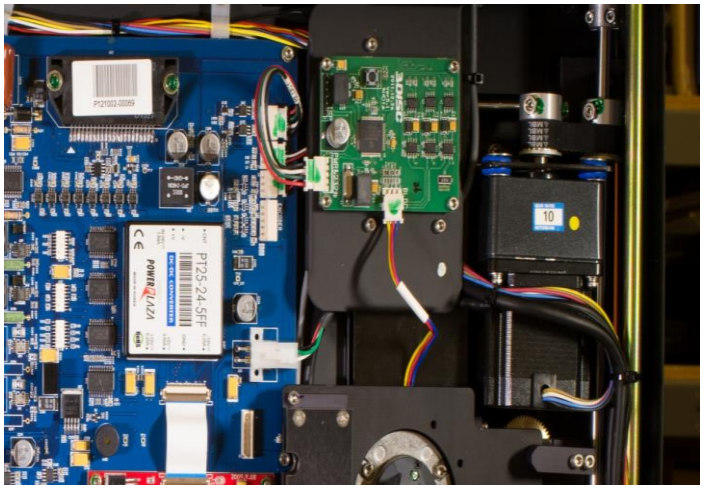


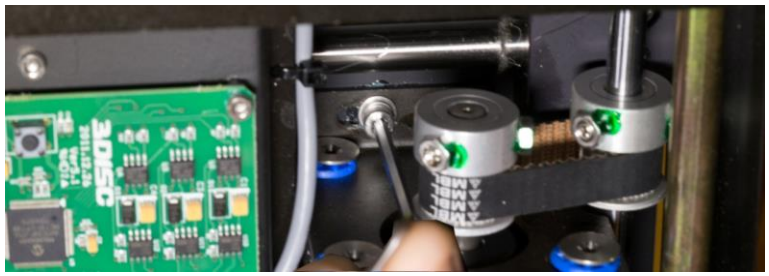
2. Disassembly

- Y-Axis Motor(Step motor)

1. Remove BLDC Bracket (2.5mm hex)Take note of wiring harness routing under BLDC bracket.
2. Remove 2 cable clamps along the side of the scanner.
3. Unplug wire connector from Main Board.

4. Loosen set screws on belt pulley on motor and axle.
5. Slide both pulleys toward side of scanner until motor pulley slips off end of shaft.
6. Remove 2 screws from Y-Axis bracket (3mm hex).
7. Lift out Y-axis motor.
8. Reinstall in opposite order.



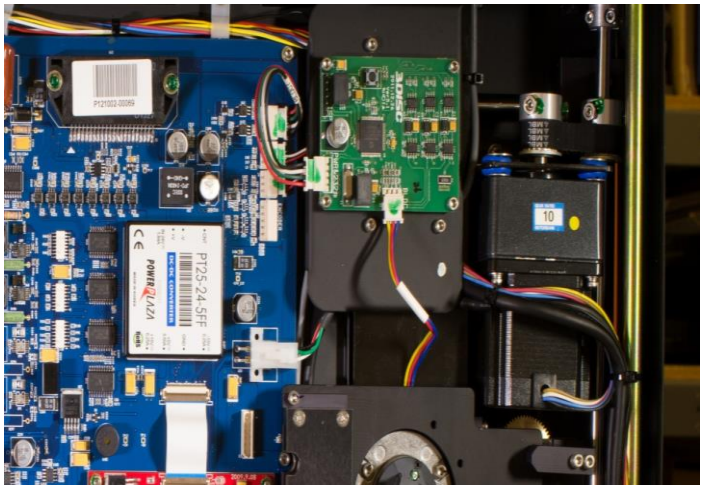


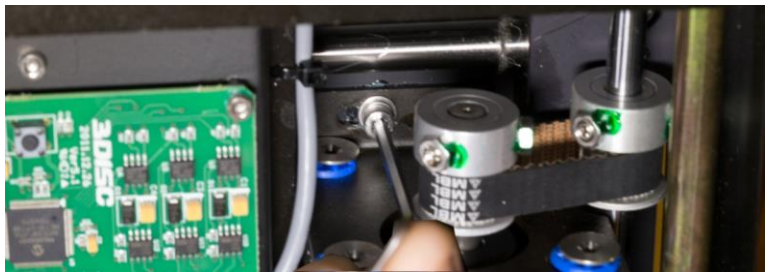
2. Disassembly

- Y-Axis Motor(Step motor)

1. Remove BLDC Bracket (2.5mm hex)Take note of wiring harness routing under BLDC bracket.
2. Remove 2 cable clamps along the side of the scanner.
3. Unplug wire connector from Main Board.

4. Loosen set screws on belt pulley on motor and axle.
5. Slide both pulleys toward side of scanner until motor pulley slips off end of shaft.
6. Remove 2 screws from Y-Axis bracket (3mm hex).
7. Lift out Y-axis motor.
8. Reinstall in opposite order.





2. Disassembly

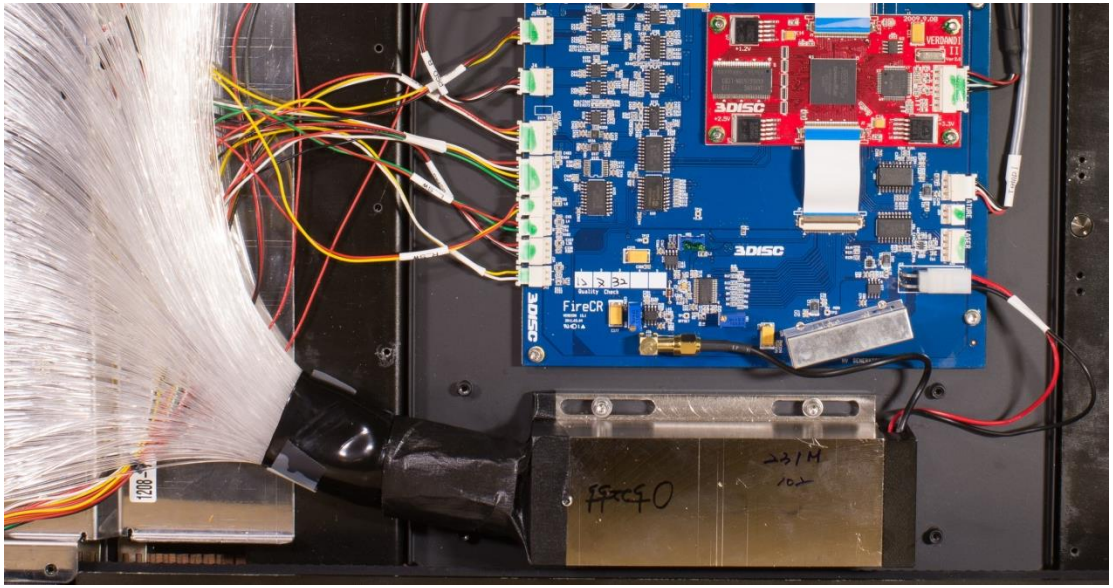
- Fiber Bundle

1. Remove the 6 screws for from the fiber bundle cover.
2. Lift off cover

2. Disassembly

- Fiber Bundle

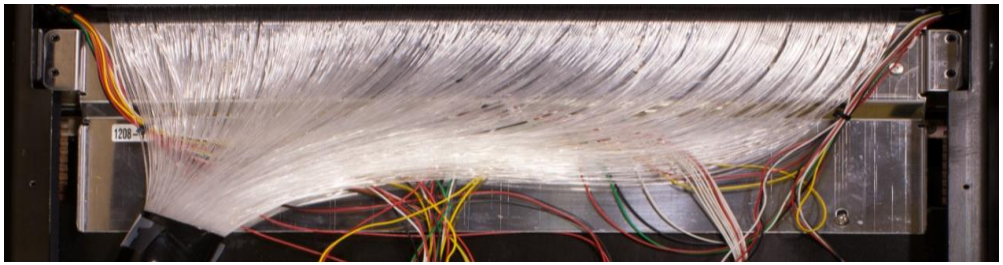
3. Remove the two screws from the PMT housing.
4. Loosen PMT connectors.



2. Disassembly

- Fiber Bundle

5. Remove the two screws at the edge of the eraser.
6. Pull back eraer.



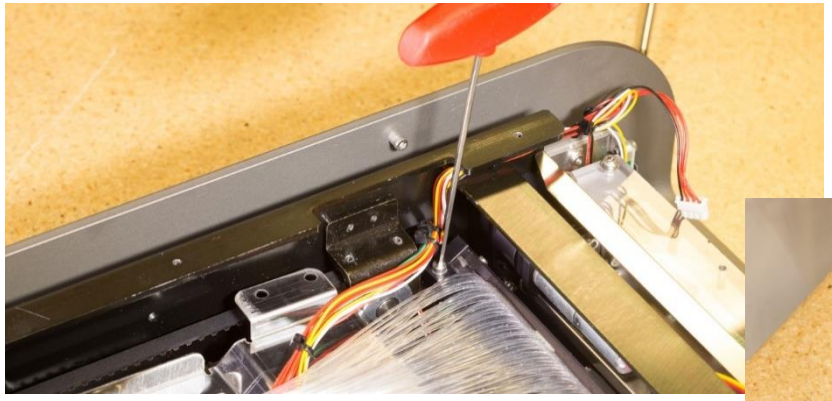
2. Disassembly

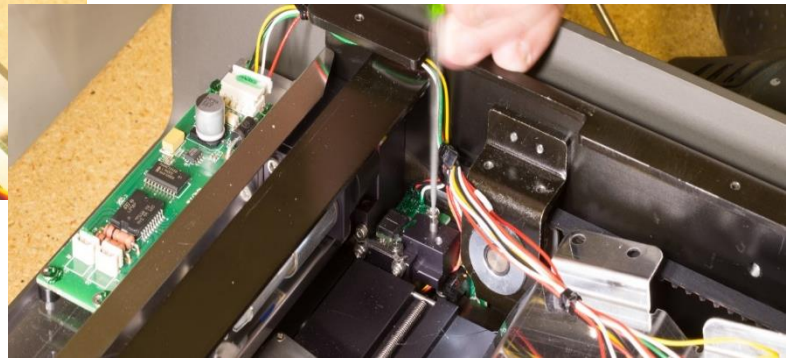
- Fiber Bundle

9. Remove the screw on each side of the fiber bundle.

10. Lift out fiber bundle.

Note: Be careful not to scratch the fibers while pulling out the fiber bundle and note the location of the dowel pin on ea ch side.

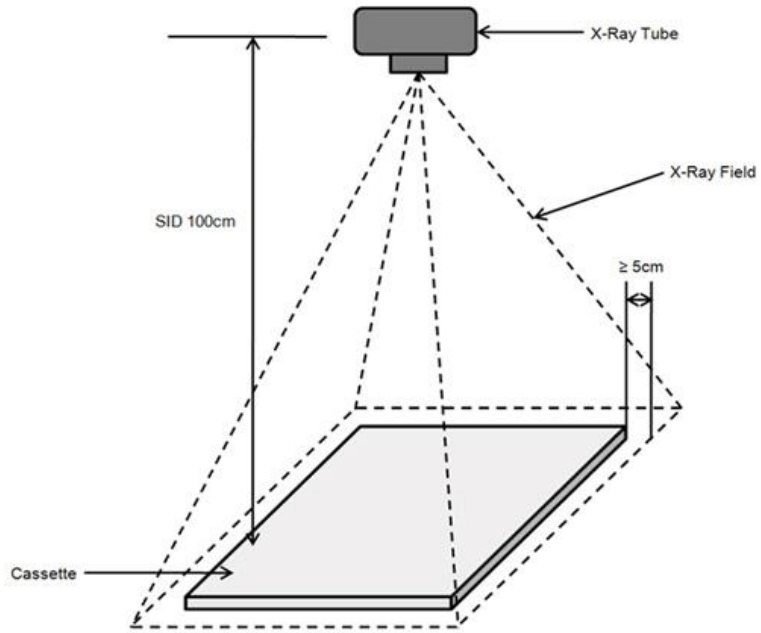




❖ Calibration and Images

- Calibration Geometry

Note: Exposure must always cover the entire cassette

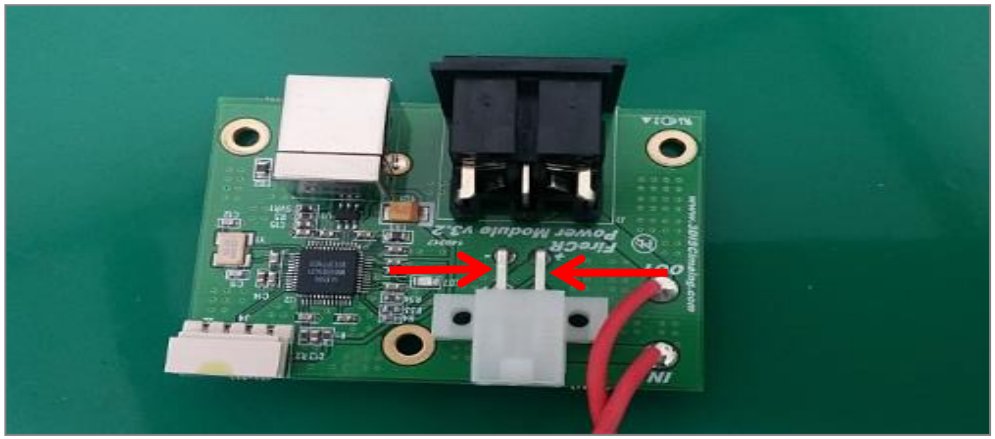


❖ Common Issue

1. No Power

1.1 Check to see if power supply is in working order by swapping with a working one.

1.2 Remove top cover and internal cover.



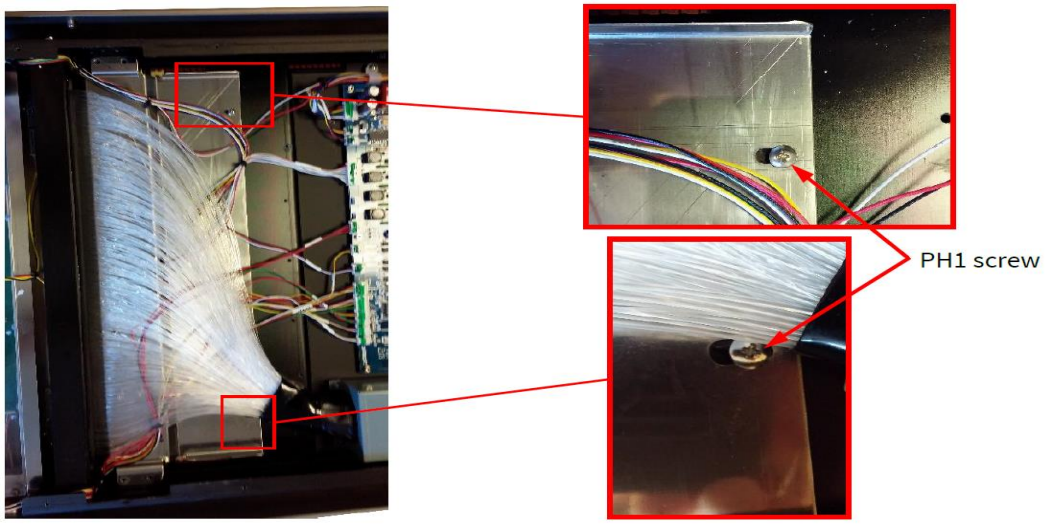
7.3 Check the voltage.
7.4 Make sure that voltage reads 24V (Scanner must turned on).
7.5 If not, disconnect the power cable on the main board
7.6 Make sure that voltage reads 24V
7.7 If not, replace power board or power switch.

- Refer to the FireCR+ Service Manual p.33 for power board replacement

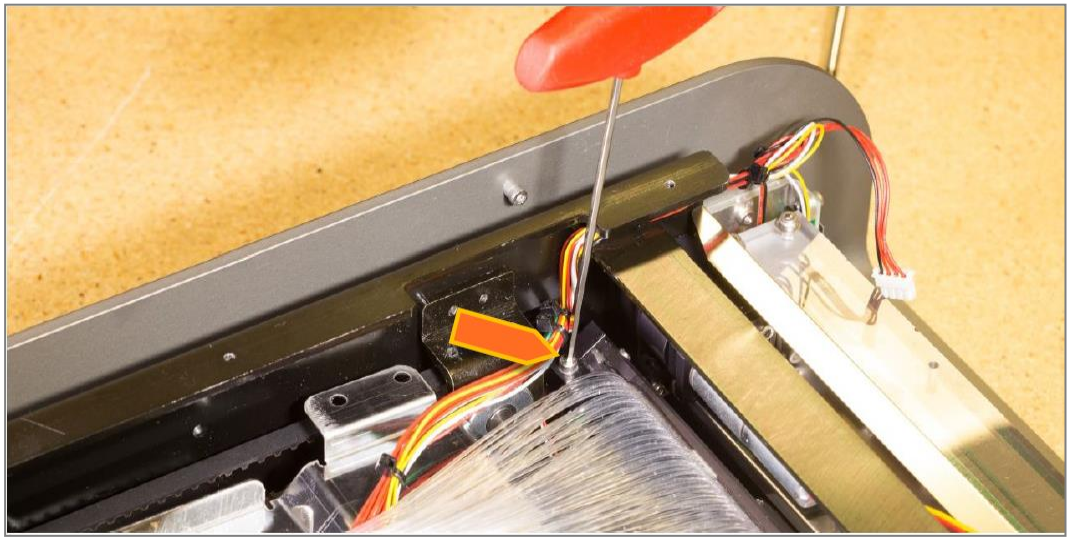
2. Fiber bundle cleaning

2.1 Turn off the power and disconnect the power cable and USB cable.
2.2 Remove the top cover and internal cover.

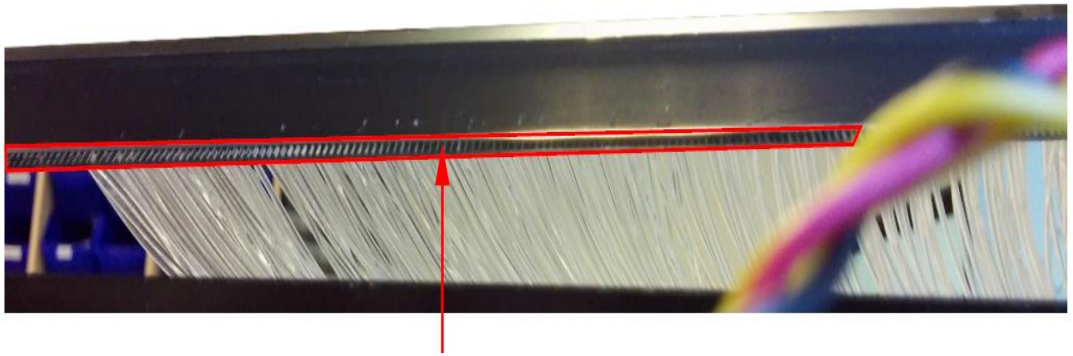
2.3 Remove 6 screws holding fiber bundle guide in position using 2.5mm hex key and remove the fiber guide.



2.4 Remove the two screws holding the eraser assembly and slide the eraser towards the back of the reader.



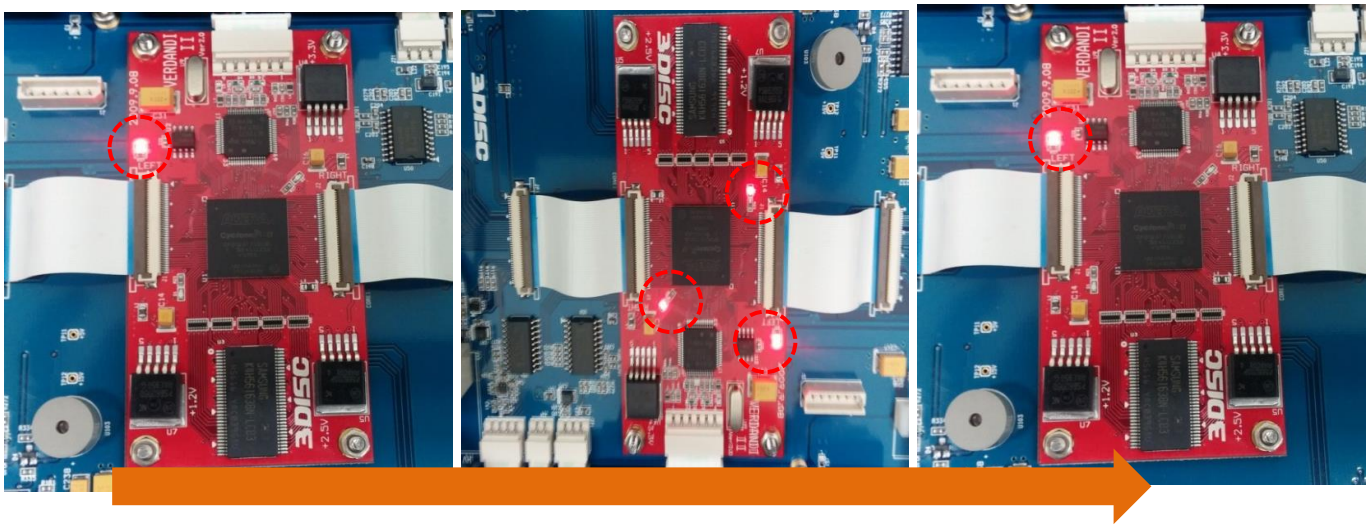
2.5 Remove the screw on each side of the fiber bundle in place using a 2.5mm hex key.



2.6 Lift up the fiber bundle and clean the end using either an antistatic screen wipe, or a microfiber cloth and technical alcohol.
2.7 Ensure that the two guides for the fiber bundle is in position and reinstall in reverse order.

3. Booting issue trouble-shooting

3.1 Connect USB cable in the another port of the computer.
3.2 Check to see if another USB is in working order by swapping with a working one.
4.3 Remove the top cover and internal cover.



4.4 Check the core board led status
4.5 When you turn on the power, one led of the core board is on.
(One led is on → Three led is on → One led is on.)
4.6 If the led of the core board is something wrong, replace the core board.
4.7 Check the power board

4. Not recognize the cassette housing

4.1 Scan it with another cassette housing to check cassette working well.
4.2 Check the RFID board.
- Refer to the FireCR+ Service Manual p.32 for RFID board replacement.

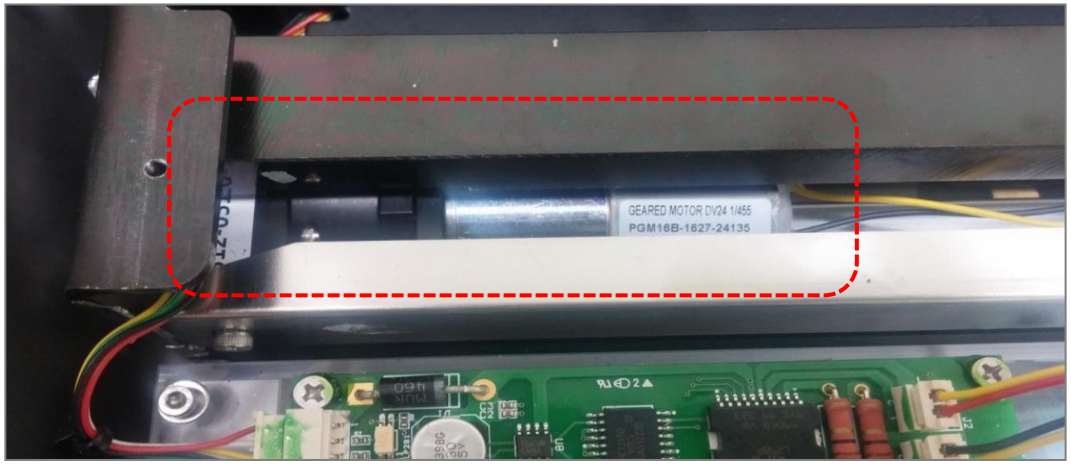
5. Knocking sound

5.1 With cassette

5.1.1 Scan it with another cassette housing to check cassette working well

5.1.2 Remove the top cover and internal cover.

5.1.3 Scan it with pushing both locks on the side of the cassette housing.



5.1.4 Check it if the cassette lock motors hold the cassette housing firmly.

5.2 Without cassette

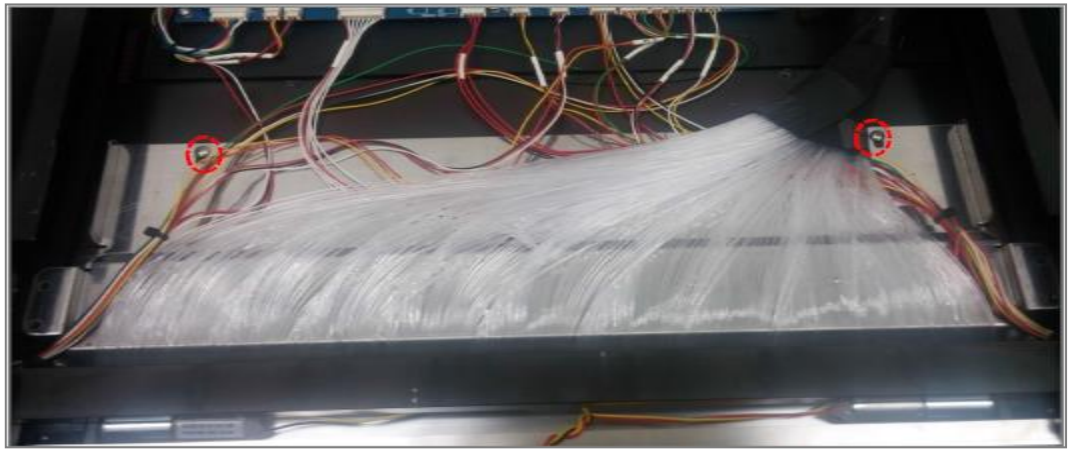
5.2.1 Check the home sensor

1) Turn off the power.

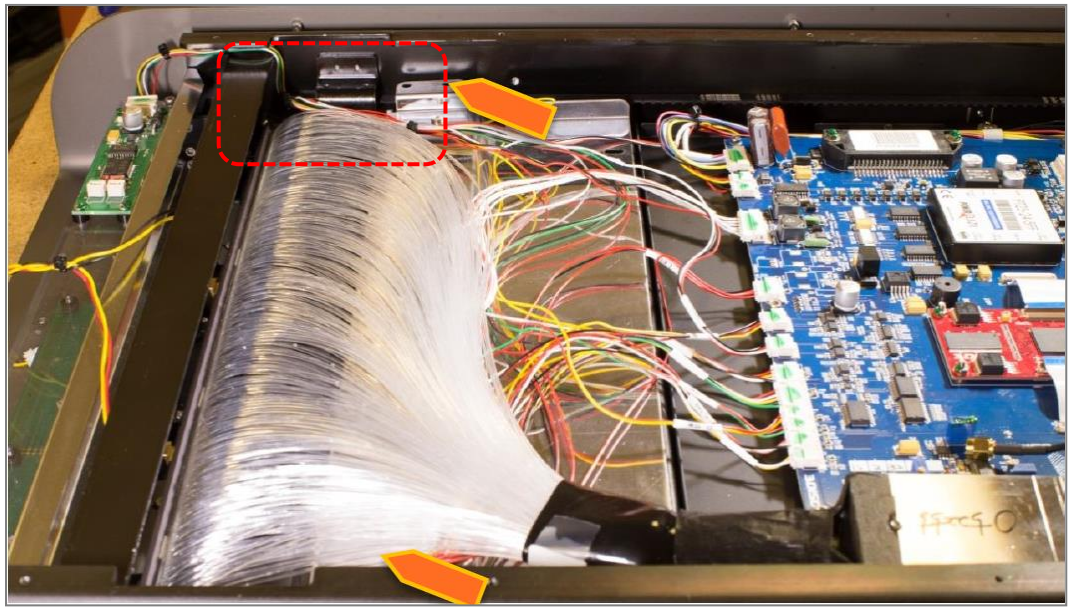
2) Remove the top cover and internal cover.

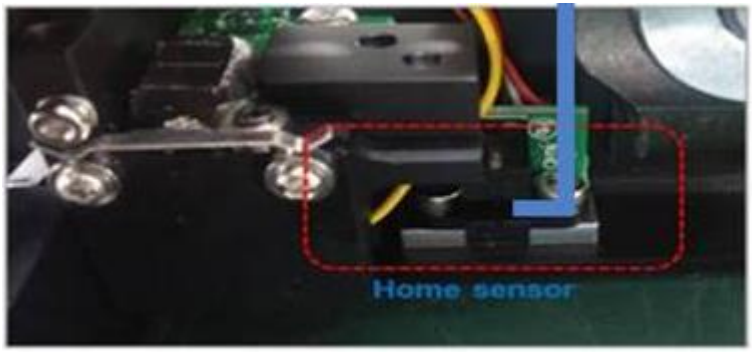
3) Move the stage forward and backward manually.

4) Remove 6 bolts and remove the black fiber guide.



5) Remove 2 bolts
6) slide the eraser assembly
7) Turn on the power



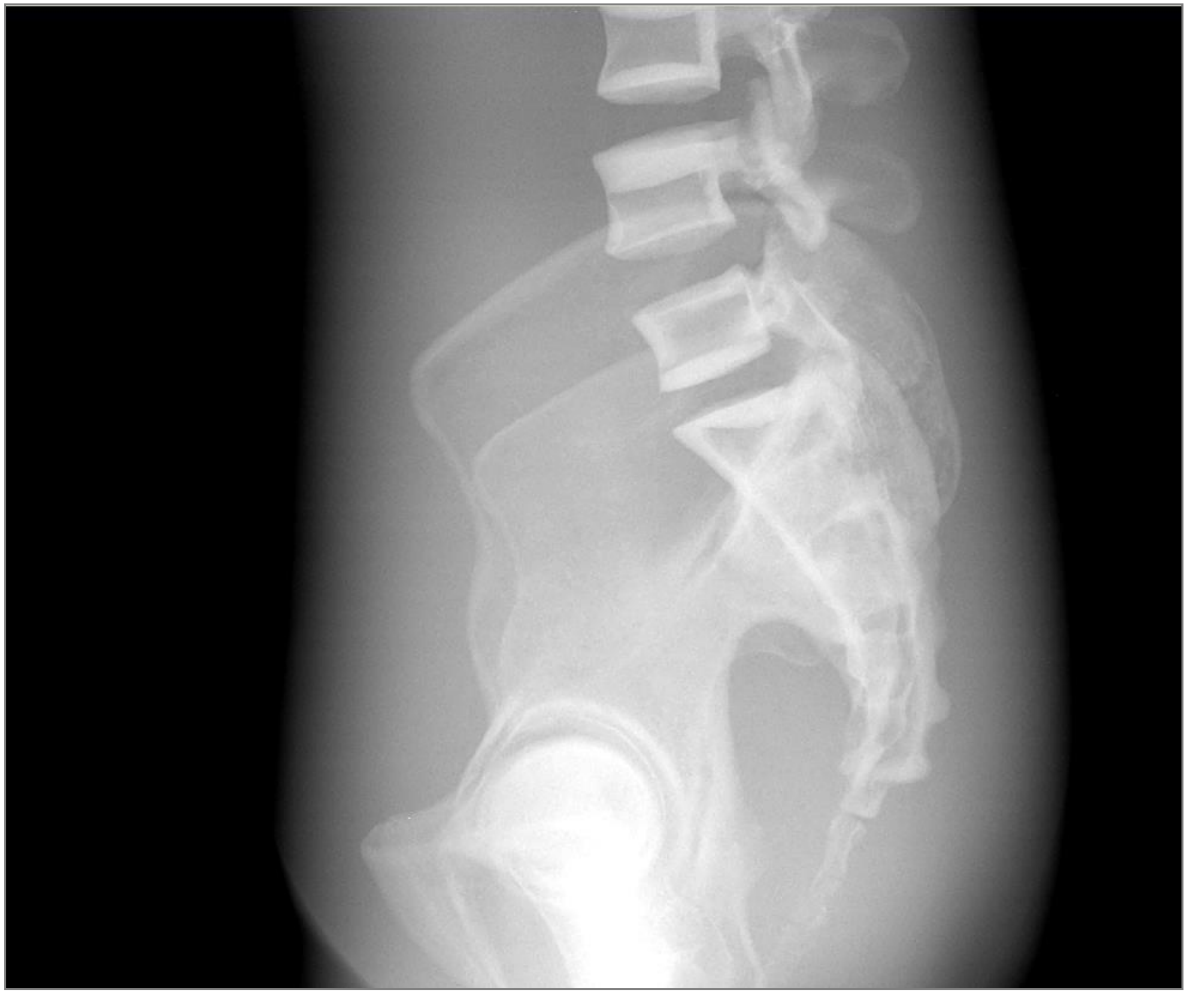


8) Manually sense the home sensor with a small wrench.
9) If the stage dose not stop, need to replace the home sensor.
10) Stage stop, need to align the stage.
11) If it doesn't help, need to adjust belt tension

6. Auto align fail

6.1 Check laser is on.
6.2 Check both auto alignment motors work well.
6.3 When you auto aligns, beam must cover whole area of PSD.
6.4 Check PSD itself.

7. The case of artifact



• There are horizontal lines on the image.
  In case of these horizontal lines, replace the defective Y-axis motor.

8. The case of artifact

- There are vertical lines on the image.
  In case of these horizontal lines, clean the fiber bundle or replace the defective fiber bundle.

In case of these wavy noise, replace the defective main board.