World's Best Dental Imaging Company

PaX-Duo3D

Service Manual

for the expert

Caring Insight

VATECH

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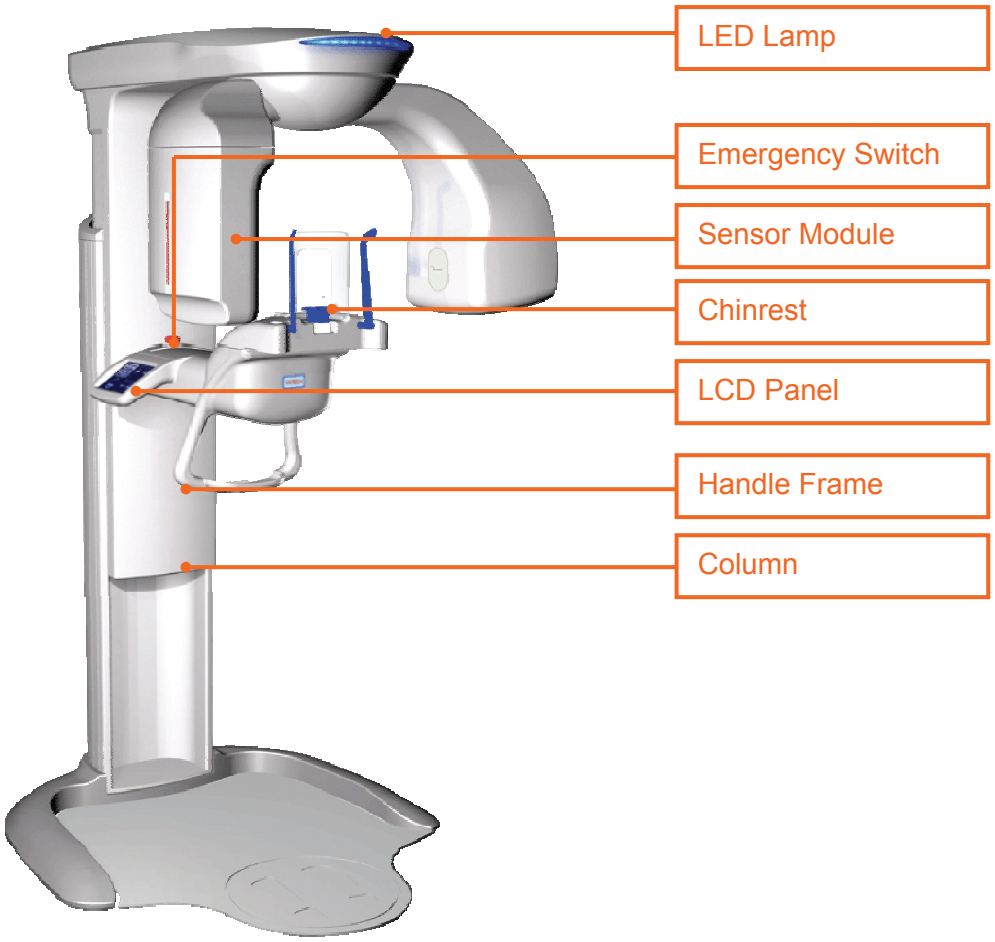
Chapter 1 PaX-Duo3D Equipment Overview

1.1 Equipment Composition unit



- **LED Lamp:** Indicating the current X-Ray emission activity of unit. While it stays green when the unit is idle, led lamp turns orange when the unit is in operation

- **Emergency switch:** stop the movement of the unit when it abnormally operates.

- **Sensor Module:** Digital X-ray image sensor module for Panoramic and Dental CT imaging units. With its Auto-Switching sensor technology, there is no need to change sensors when imaging mode changed

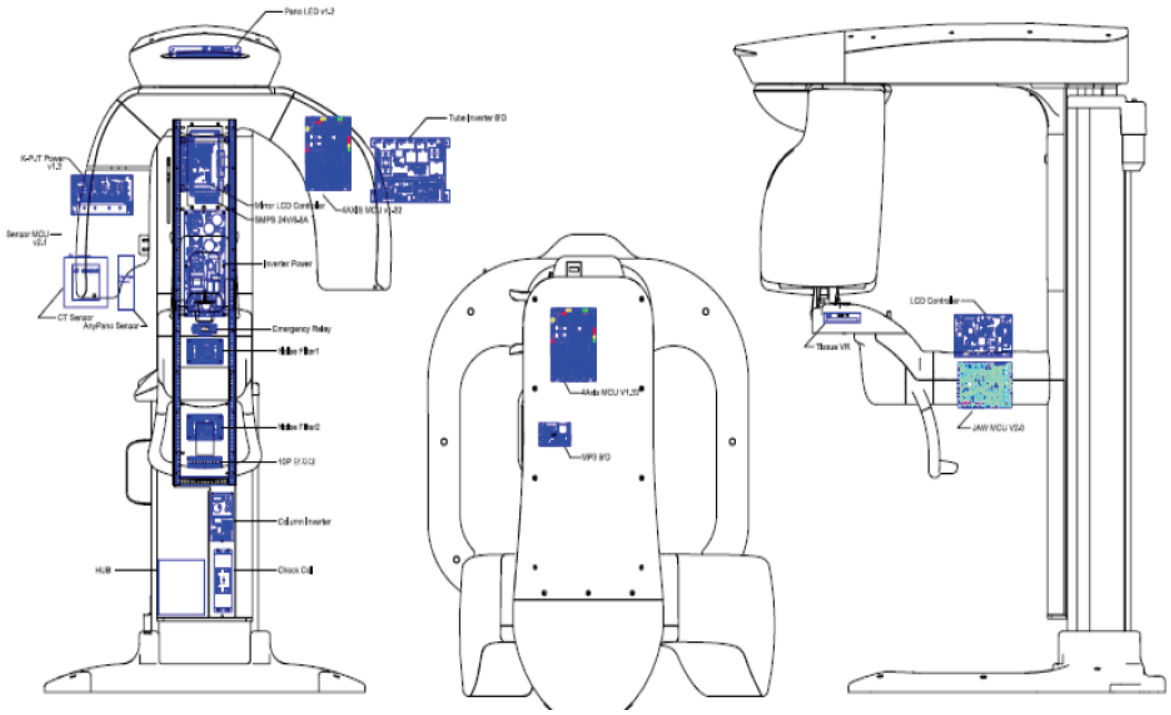
- **Chinrest:** provide the patient comfort and rest while imaging, thus producing better image

- **LCD panel:** the supporting device to monitor and control the Unit activity
- **Handle frame:** is used for the patient to hold firmly while imaging to stabilize his or her position
- **Column:** is used to adjust the unit height according to the height of patient.

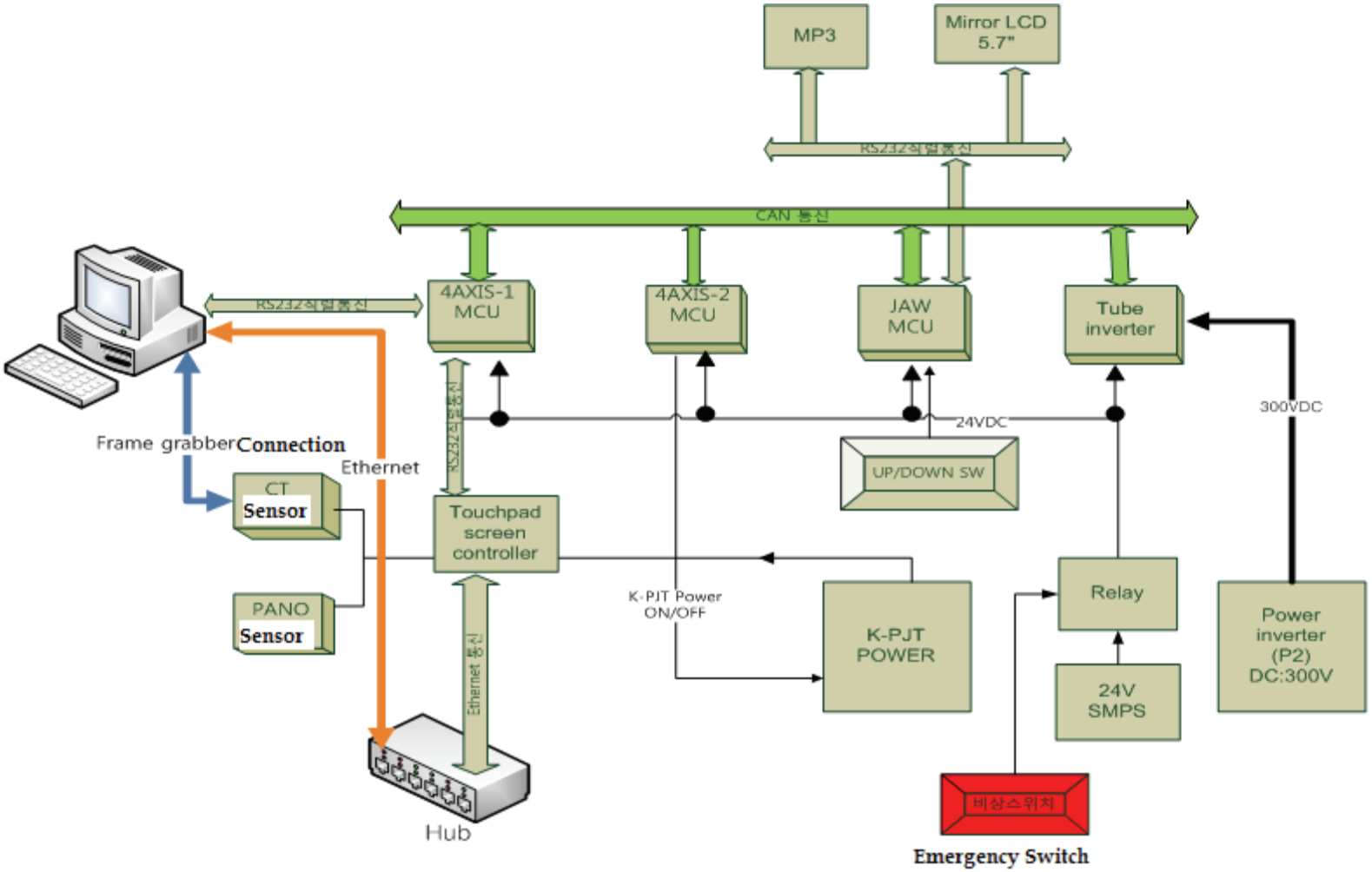
NOTE

This configuration may differ depending on the specification of your product.

1.2 Positions of Various Boards



1.3 System Configuration Block Diagram



1.4 Roles of Each Boards

1. **4axis-1 MCU Board**
   - Controls with S/W between the sensor and the Rotator to ensure the rotation does not exceed the initial value when the rotator spins
   - Tube inverter board X-ray Examination On/Off control
   - Vertical Beam Laser Generation for Patient Alignment
   - Horizontal Beam Laser Generation for Patient Alignment
   - A motor to drive the equipment suitable to various arch loci. X-axial Motor moves with variable speed to correspond to the applicable arch during scanning
   - Makes the Rotator to spin
   - Drive the Motor to let the Sensor Rotator spin
   - CAN Communication with JAW MCU
   - CAN Communication with 4AXIS-2 MCU Board
   - Serial communication with Touch pad screen
   - Serial communication with PC

2. **4axis-2 MCU Board (Collimator)**
   - Power supply or cut off to Pano and CT sensor
   - Vertical Beam Laser Generating Laser for Patient Alignment
   - Horizontal Beam Laser Generating Laser for Patient Alignment
   - Supply the voltage to drive Collimator servo motor
   - CAN Communication with 4AXIS-1 Board
   - CAN Communication with Tube inverter Board
   - Driving Motor that moves Collimator to the left/ the right

3. **4axis-2 MCU Board (Collimator)**
   - Connecting the Switch to make the Column Up or Down
   - Limiting Sensing Switch to prevent moving out of the minimum point and the maximum point of the Column section
   - Control the motor suspension force when moving the Column up/down
   - Functions as On/Off switch of Laser for Patient Alignment and in addition, functions to move to the position of lamp
   - Moving the Chinrest to the left/ the right
   - Moving the Chinrest up/down
   - CAN Communication

- Serial communication with MP3 Board via RS-232 communication
- Serial communication with Mirror LCD Board

4. P2 power Board (Inverter power)

- Supply 300V to Tube inverter Board
- Supply 24V to Tube inverter Board
- Supply ±15V to Tube inverter Board

5. K-PJT power Board

- Supply power to CT sensor
- Supply power to Pano sensor

6. Inverter Board

- Generates Tube Voltage and Tube Current
- CAN Communication with 4AXIS-2 Board
- Functions for On/Off by receiving Exposure switching signal from 4AXIS-1 Board

7. Touch LCD controller Board

- Serial communication with 4AXIS-1 Board (for Firmware upgrade and etc)
- Exchange data with Touch LCD(6.4”)
- Exchange data with PC by having Ethernet communication with external Hub

8. MP3 Board

- Serial communication with JAW MCU Board
- Drive the external stereo speaker for voice guidance during operation of equipment

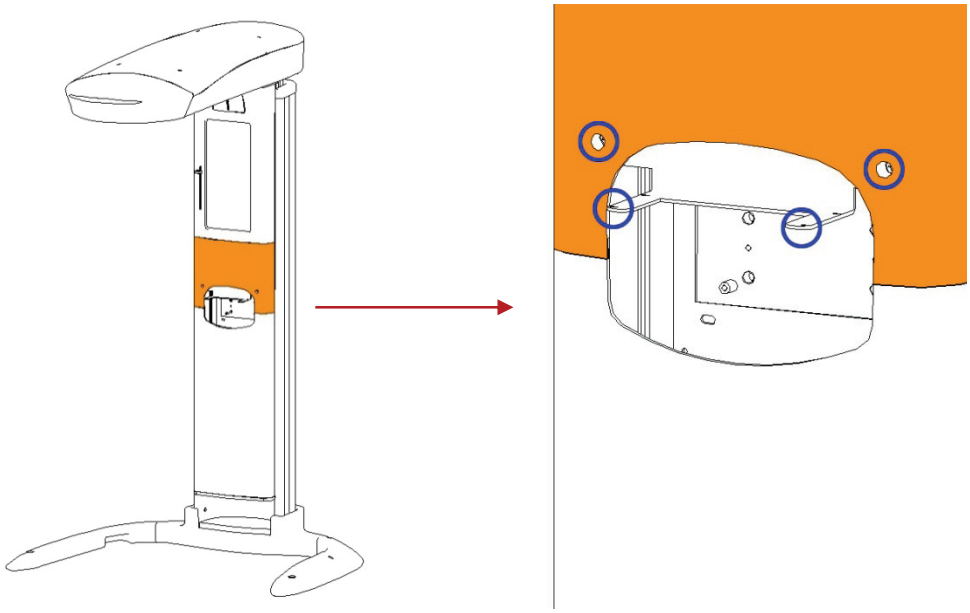
9. Mirror LCD control Board

- Serial communication with JAW Board
- Exchange data with Mirror LCD(5.7”)

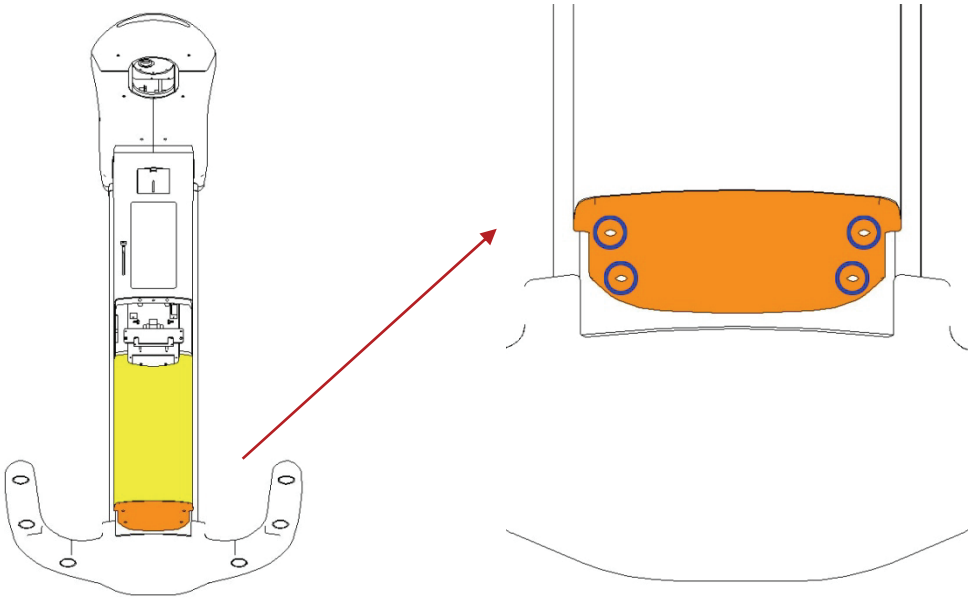
Chapter 2 PaX-Duo3D Disassembly

2.1 Vertical Frame and Column Disassembly

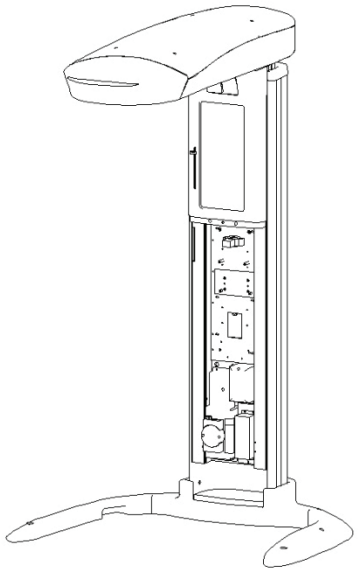
1. Remove 4 bolts, and then disassemble Case A.



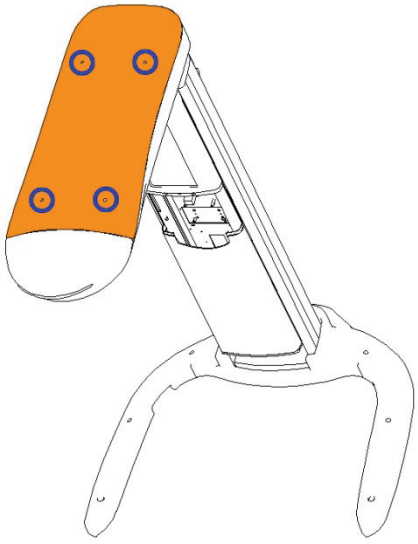
2. Remove 4 bolts, and then disassemble Case B and C.



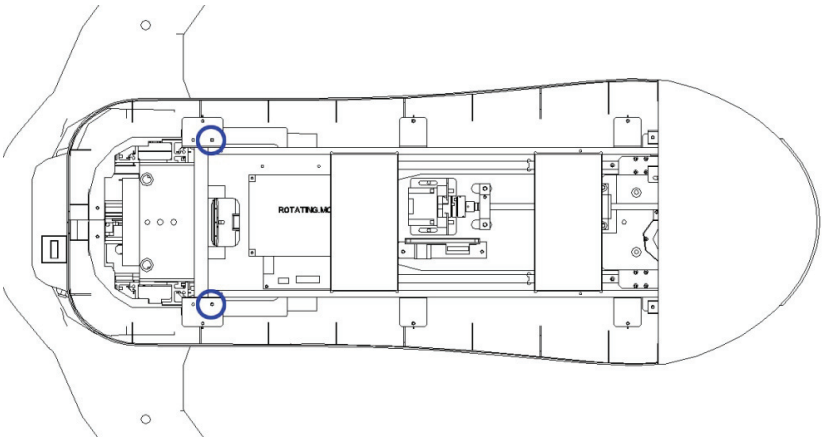
3. Figure shown after disassembling the lower casing.



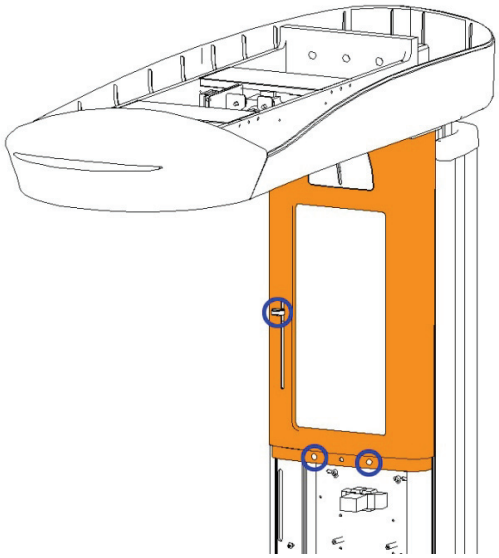
4. Remove 4 bolts, and then disassemble Case E.



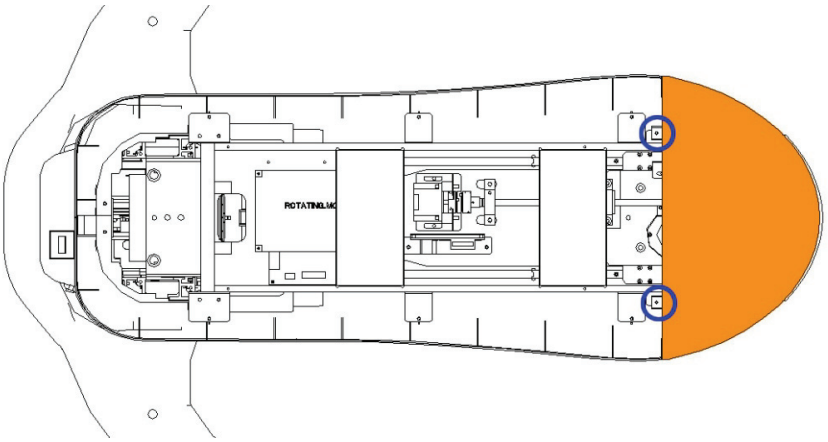
5. Remove 2 bolts.



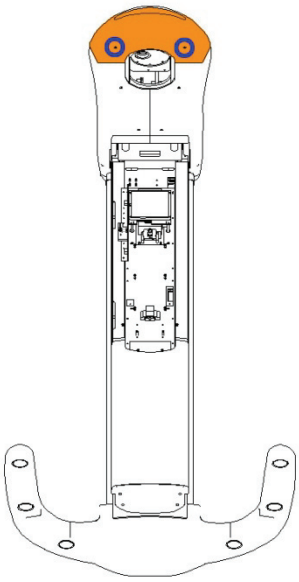
6. Turn 2 bolts and the horizontal beam adjustment bar to remove them, and then disassemble Case F.



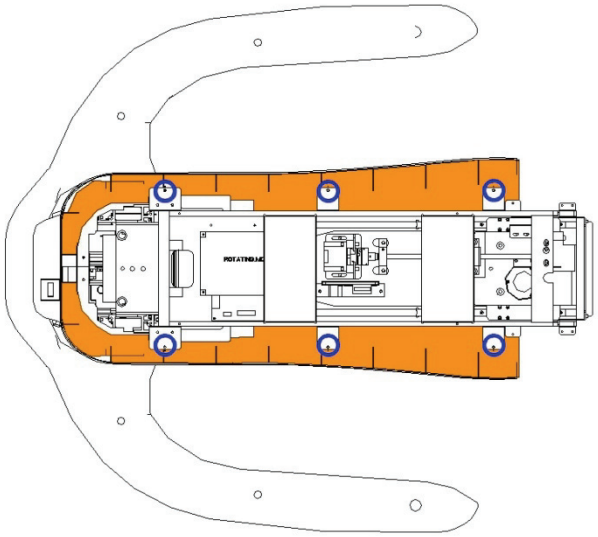
7. Remove 2 bolts



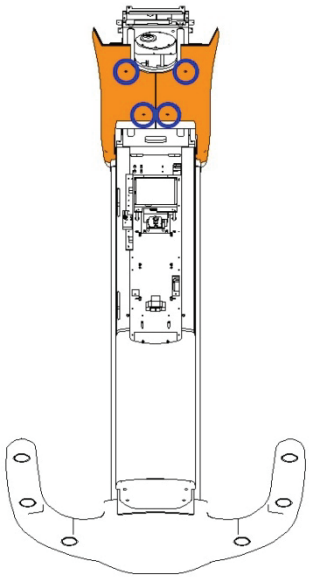
8. After removing 2 bolts, disassemble case G.



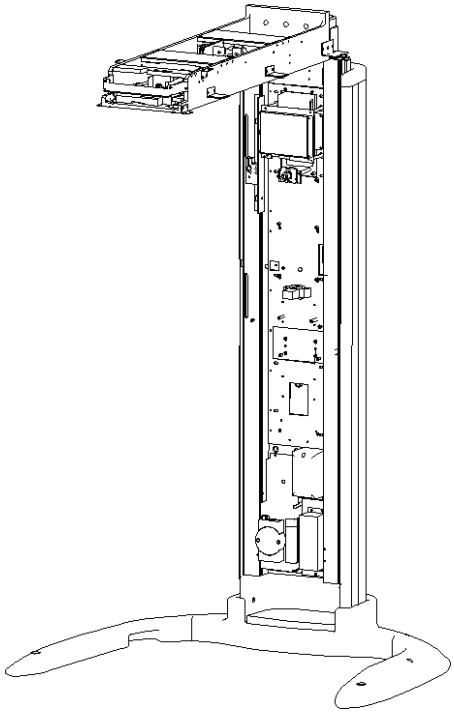
9. Remove 6 bolts.



10. Remove 4 bolts, and then disassemble Case G.

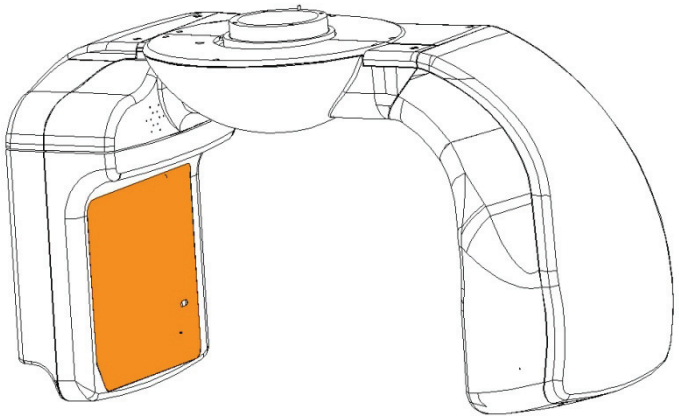


11. Figure shown after completion of disassembling the column and the vertical casing.

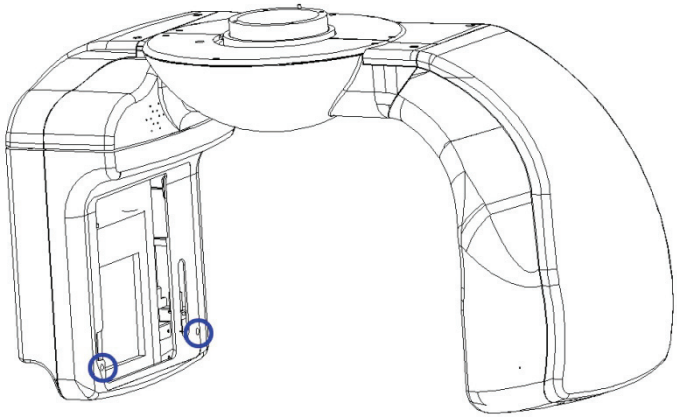


2.2 Rotating Unit Disassembly

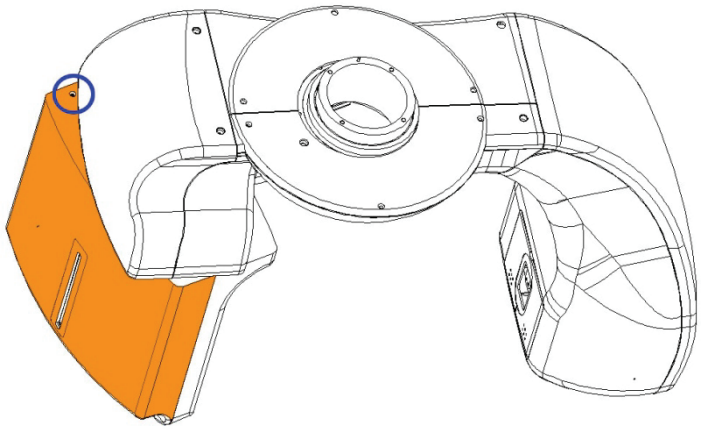
1. Separate and remove the sensor cover.



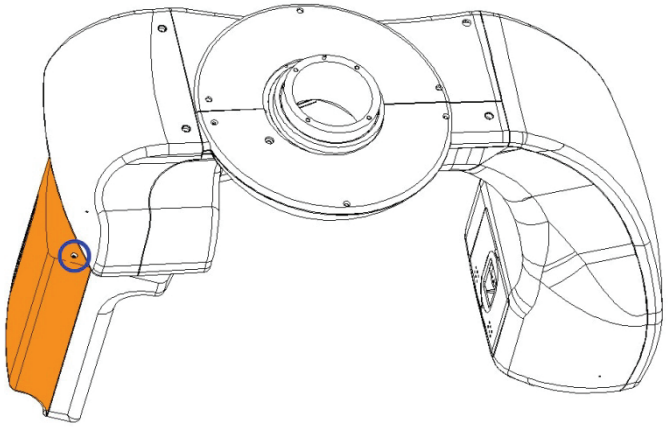
2. Remove 2 bolts.



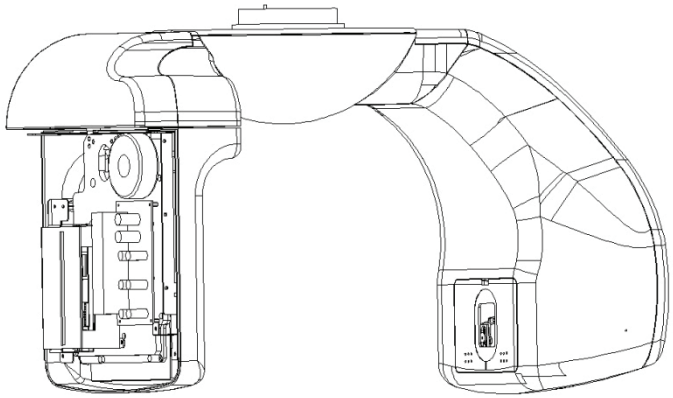
3. Turn the sensor part slightly and remove 1 bolt that is hidden.



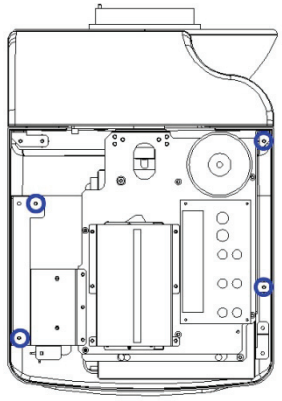
4. Turn the sensor part slightly and remove another 1 bolt that is hidden.



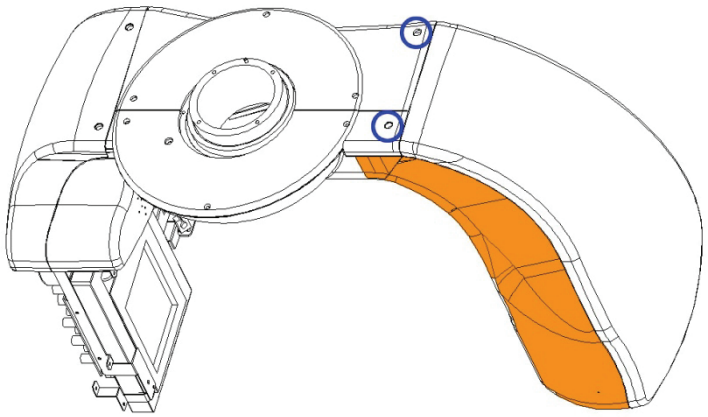
5. Figure shown after disassembling so far.



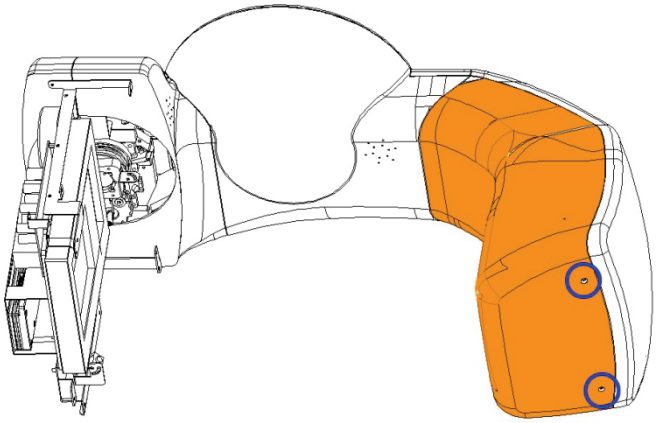
6. Remove 4 bolts, and then separate Cover B as shown in the following Figure.



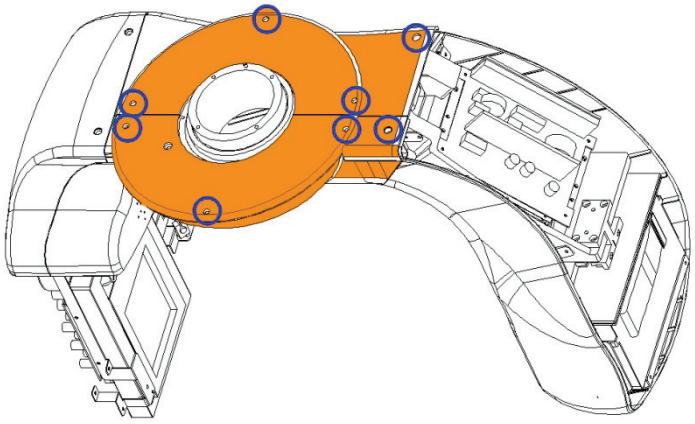
7. Remove 2 bolts as shown the following Figure.



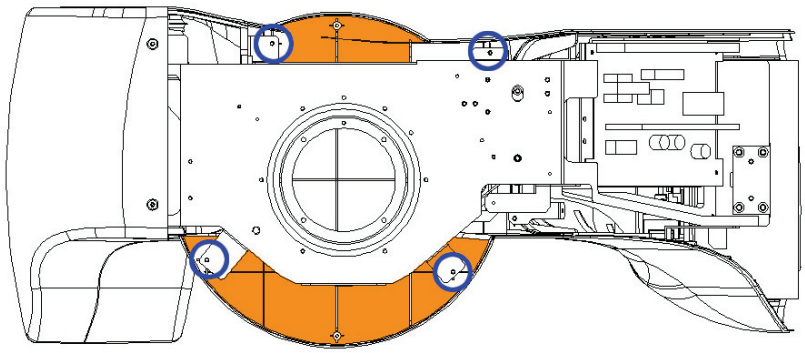
8. Remove 2 bolts, and then disassemble Case C.



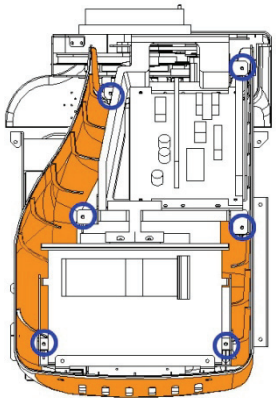
9. Remove 4 bolts of each direction respectively, in total of 8 bolts.



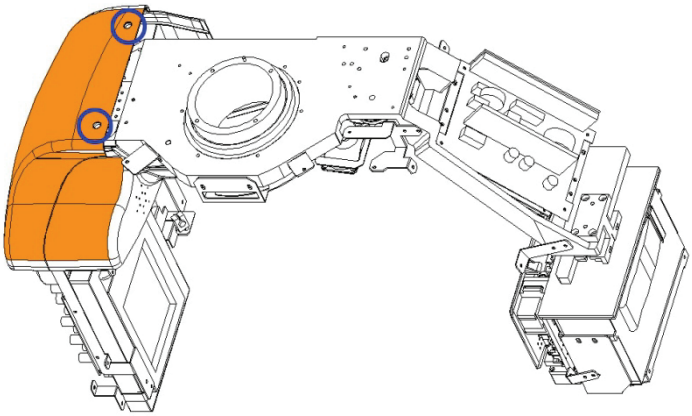
10. Remove 2 bolts of each direction respectively, in total of 4 bolts, and then disassemble Cases D and E.



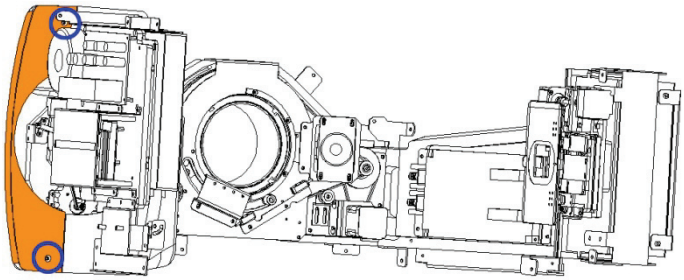
11. Remove 6 bolts, and then disassemble Case F.



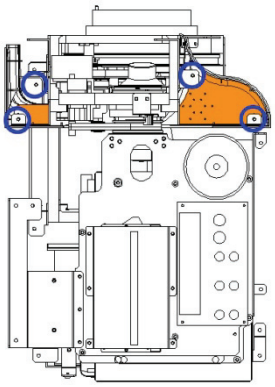
12. Remove 2 bolts.



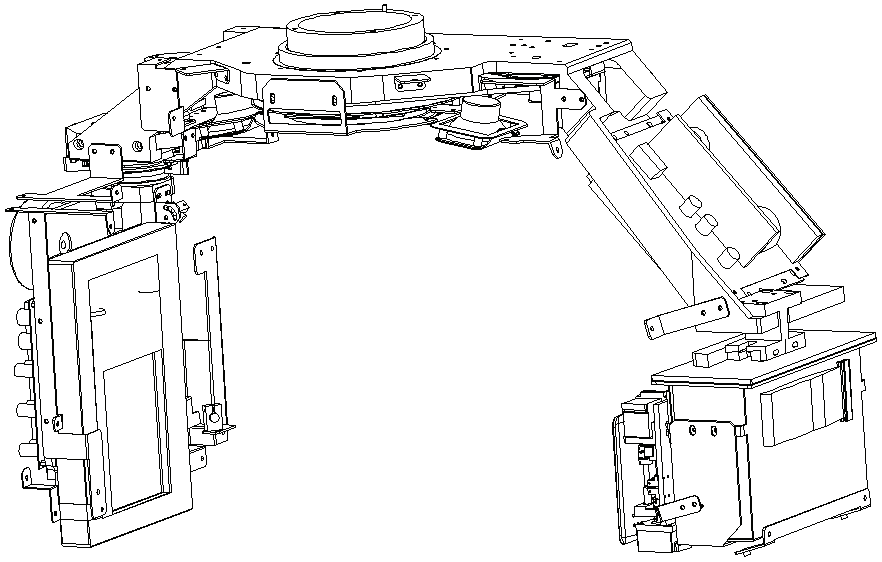
13. Remove 2 bolts, and then disassemble Case G.



14. Remove 4 bolts, and then disassemble Case H.

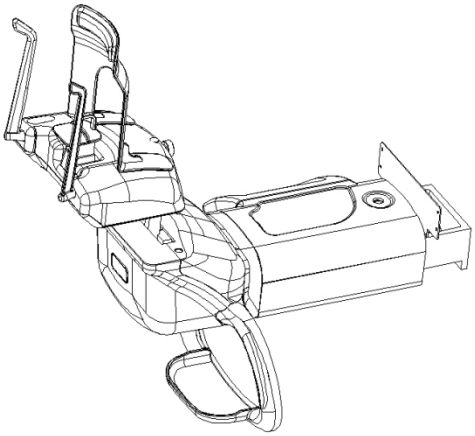


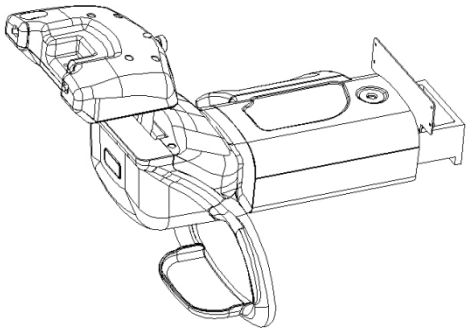
15. The final figure shown after completion of disassembling the rotating unit casing.



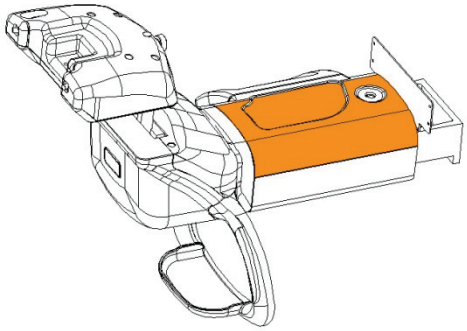
2.3 Handle frame Disassembly

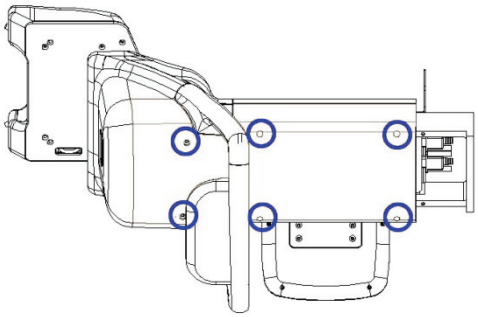
1. Remove the accessories pinned in the hand frame.



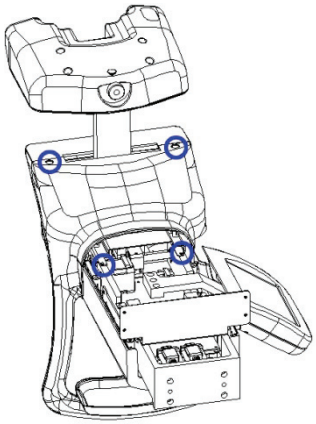


2. Remove 6 bolts, and then disassemble Case A.

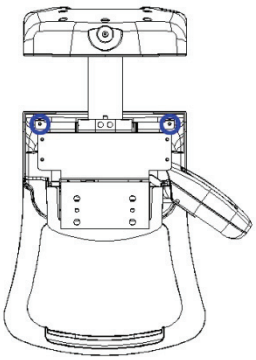




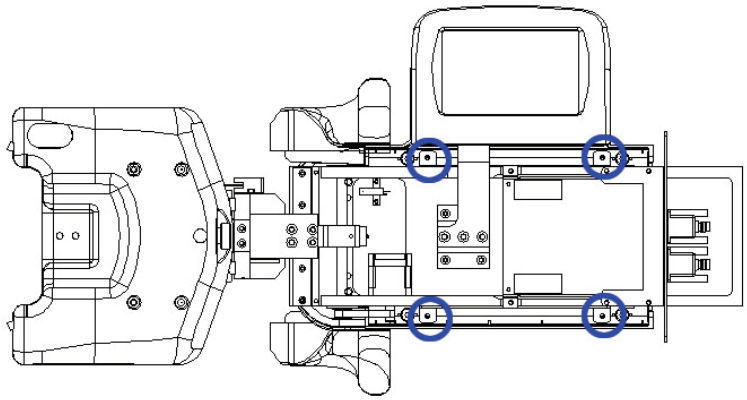
3. Remove 4 bolts, and then disassemble Case B.



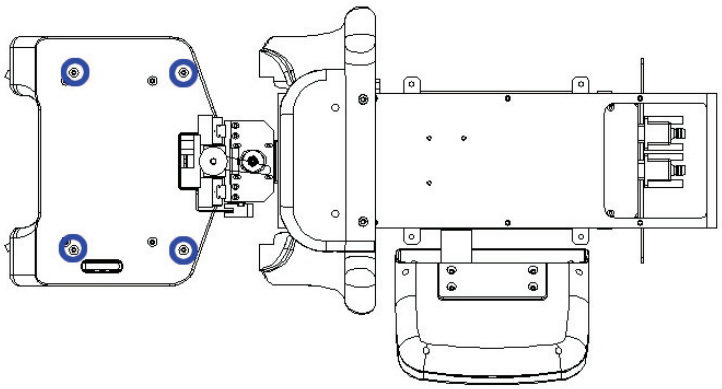
4. Remove 2 bolts, and then disassemble Case C.



5. Remove 4 bolts, and then disassemble Case D.



6. Remove 4 bolts, and then disassemble Case F.



Chapter 3 Replacement Methods of Various Boards

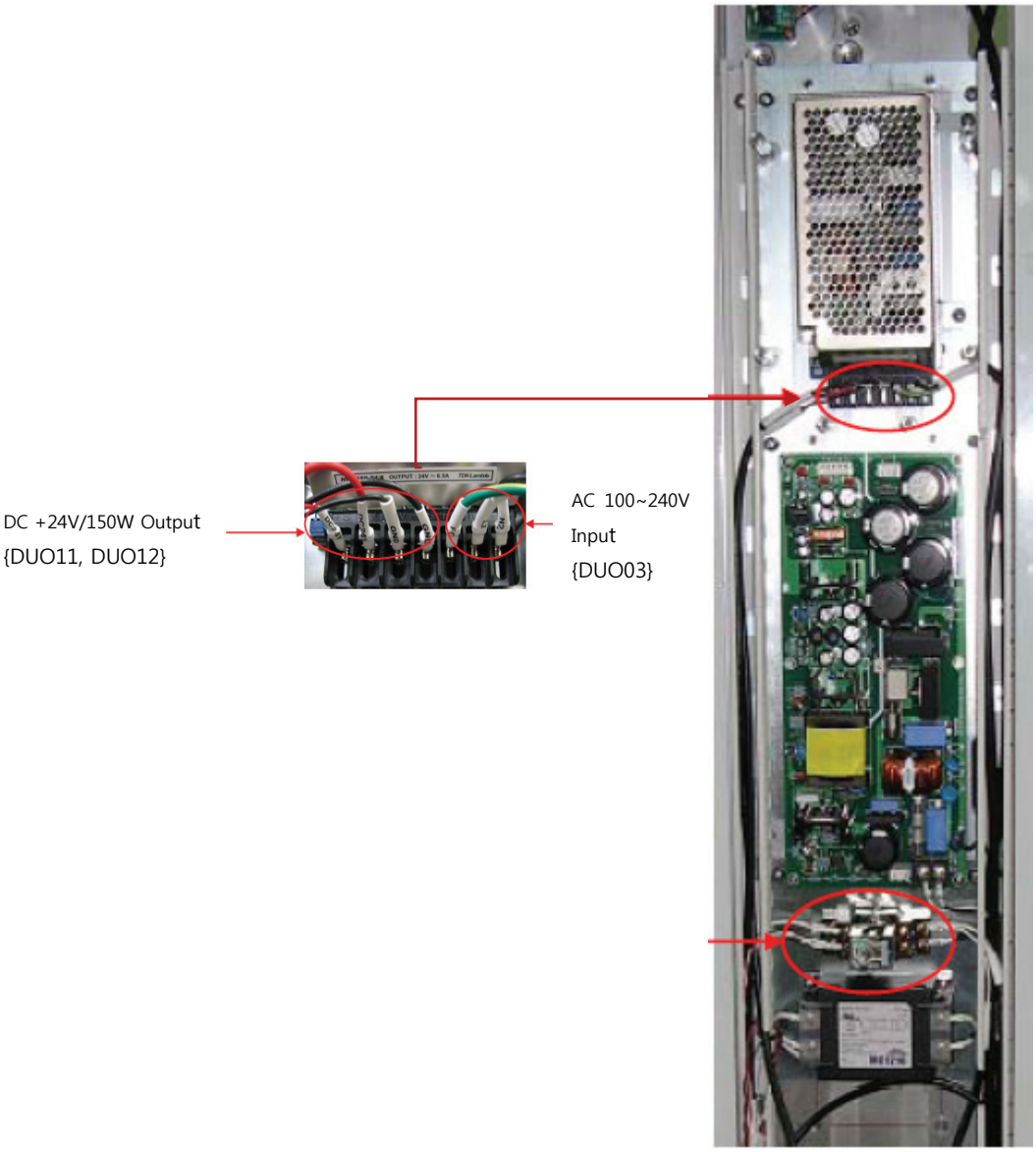
3.1 Power Board Replacement

1. +24V SMPS Replacement

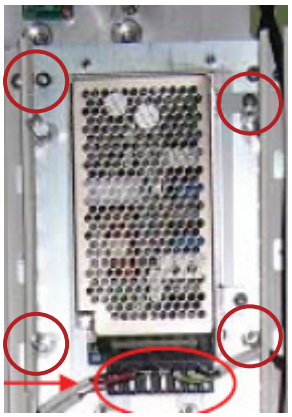
① First, separate the power supply cord that is connected to the equipment completely from the wall.

② Separate the cover of the column's front side. Then the inside of electric field is revealed as shown in the following figure.

③ (Refer to the Column Unit Disassembly).



④ Remove 4 screws as shown in the following figure.



2. P2 Power Board Replacement

WARNING

This power board employs large capacity condenser, therefore, even in the state that the power supply is cut off; it is possible to feel large shock when touching the static electricity that is saved in the condenser. So, extra cautions should be taken for handling this board.

① First, separate the power cable completely from the wall.

② Disconnect cables that are connected to the board

③ Then, remove 4 screws

④ After finishing replacement, reassemble in reverse sequence. At this point, be careful for the polarity of wires not to be changed.

3. Relay Board Replacement

Fixed Bracket

① It is possible that Emergency Relay is slipped out by vibration, so the relay should be fixed by attaching the bracket for relay fixing.

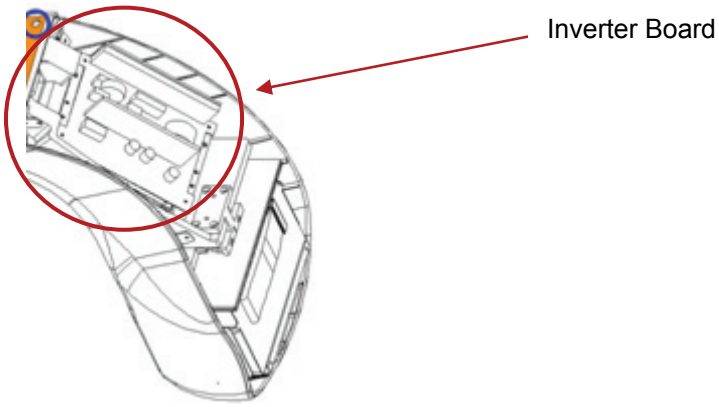
② When wiring the relay, perform the wiring after checking on the polarity (7 - , 8 +) and the contact (NO).

③ Check on whether the Relay LED is illuminated when switched on the power supply.

3.2 Tube inverter Board Replacement

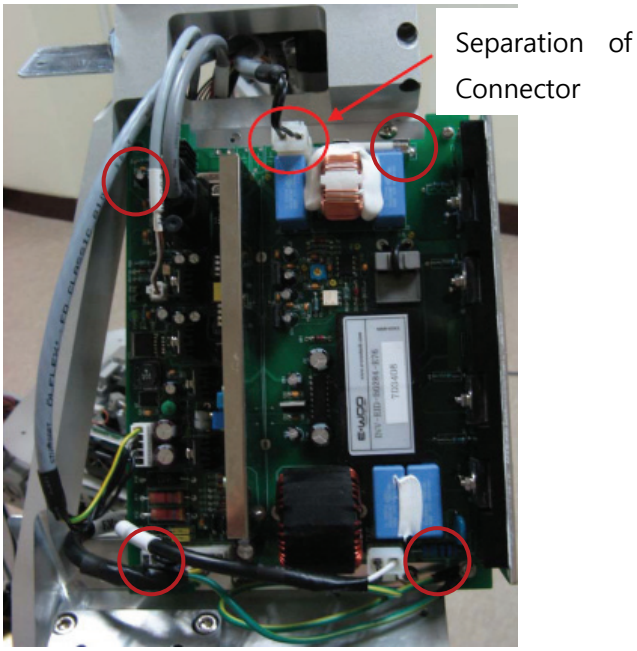
① First, separate the power cable completely from the wall.

② Then, separate the following part of the Rotating unit.



③ Separate various cables from the board which are connected to the board.

④ Remove 4 screws as shown in the following figure.



⑤ After finishing replacement, reassemble in reverse sequence. At this point, be careful for the polarity of cable or to ensure there are no twisting and no interference with other devices.

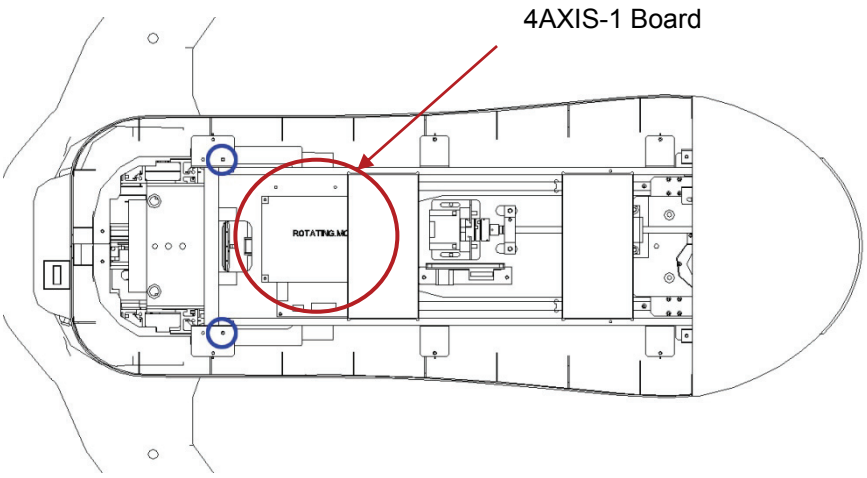
IMPORTANT

When testing after replacement, make sure that the connector is separated as shown in above figure to prevent any X-ray from dosing.

3.3 4AXIS-1 MCU Board Replacement

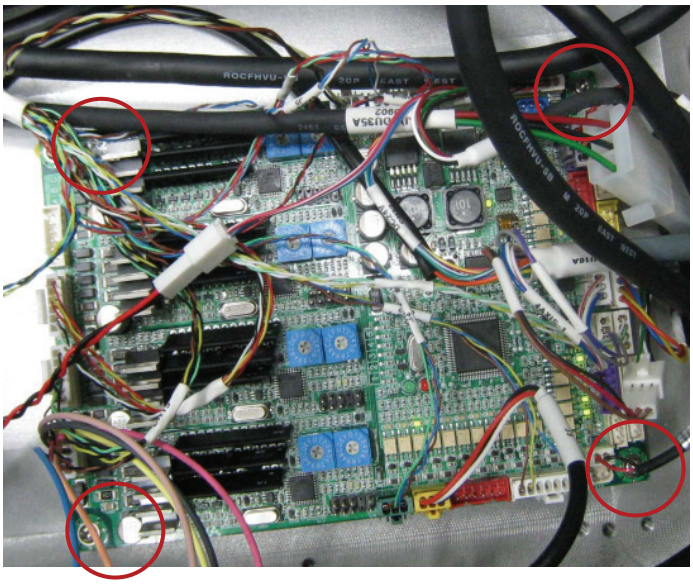
① First, separate the power supply cable completely.

② Then, separate the Vertical frame cover as shown in the following figure.



③ Separate various cables which are connected to the board.

④ Remove 4 screws as shown in the following figure.

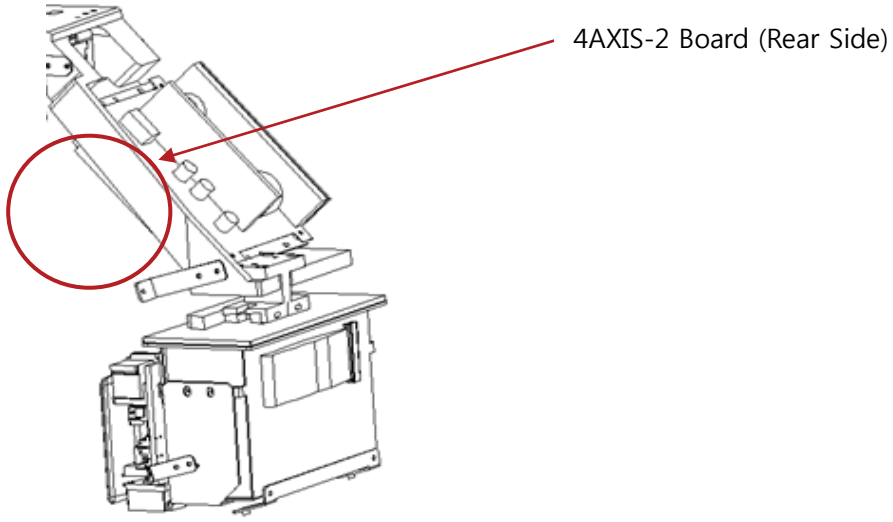


⑤ After finishing replacement, reassemble in reverse sequence. At this point, be careful for the polarity of cable or to ensure there is no twisting and no interference with other devices

3.4 4AXIS-2 MCU Board Replacement

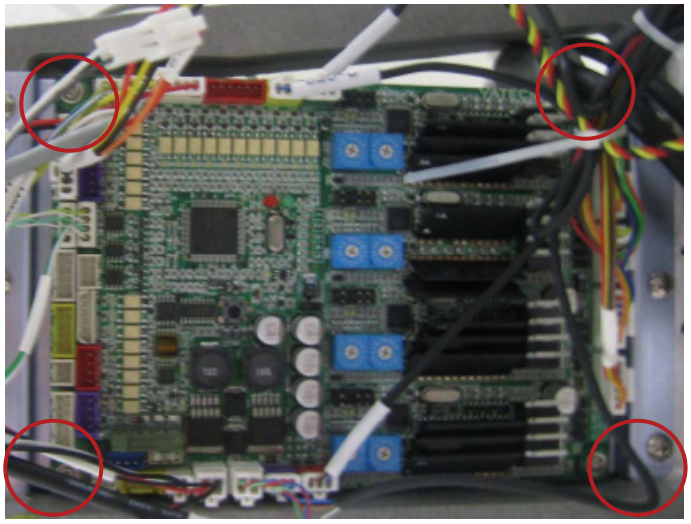
① First, separate the power supply cable completely.

② Separate the cover of the Vertical frame as shown in the following figure.



③ Separate various cables which are connected to the board.

④ Remove 4 screws as shown in the following figure.

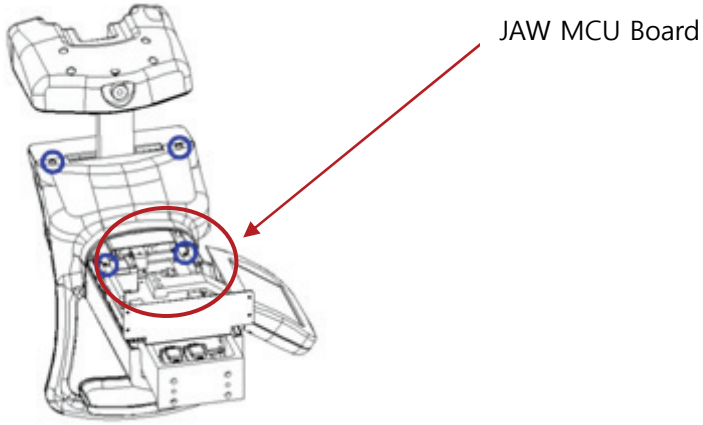


⑤ After finishing replacement, reassemble in reverse sequence. At this point, be careful for the polarity of cable or to ensure there is no twisting and no interference with other devices.

3.5 JAW MCU Board Replacement

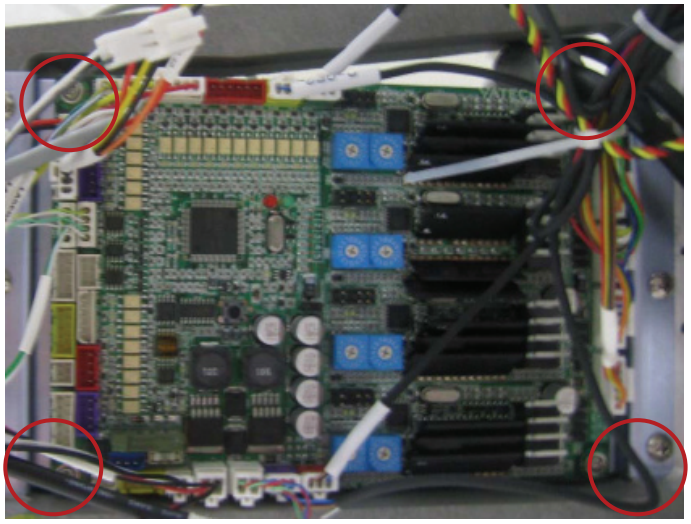
① First, separate the power supply cable completely.

② Separate the cover of Vertical frame as shown in the following figure.



③ Separate various cables which are connected to the board.

④ Remove 4 screws as shown in the following figure.



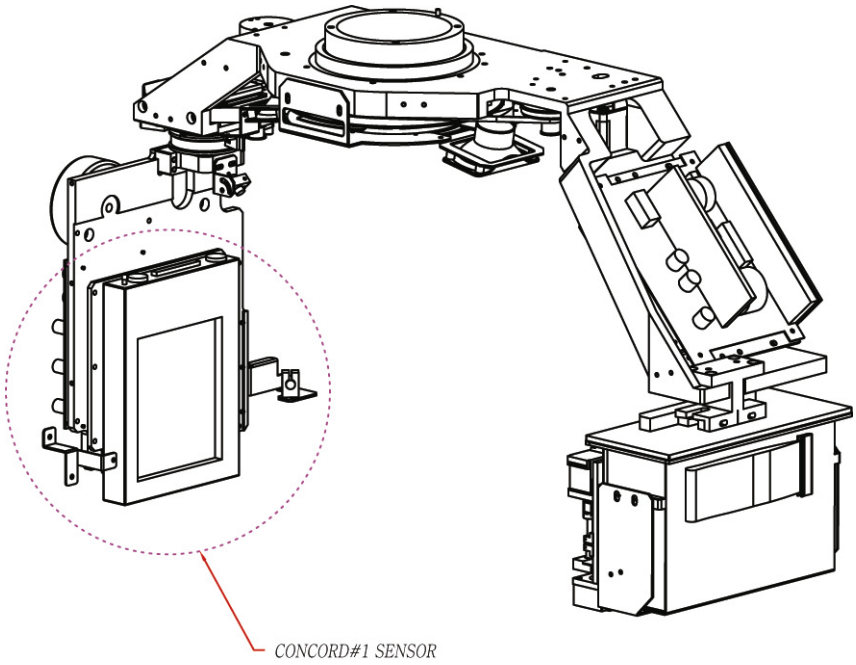
⑤ After finishing replacement, reassemble in reverse sequence. At this point, be careful for the polarity of cable or to ensure there is no twisting and no interference with other devices.

Chapter 4 Replacement Methods of Major Parts

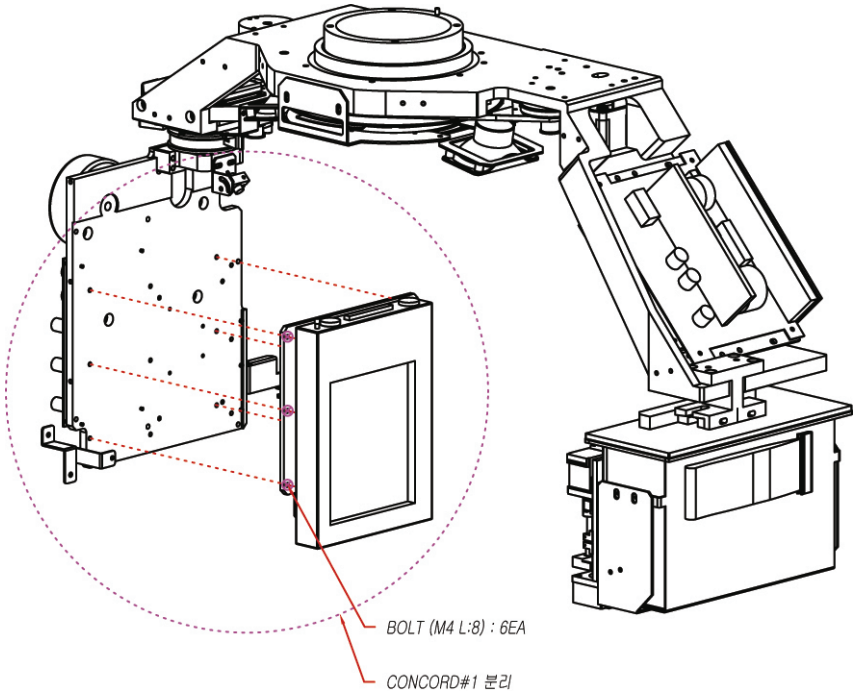
4.1 Sensor Module Replacement

1. Concord 1 Replacement (When Concord 1 Sensor is installed)

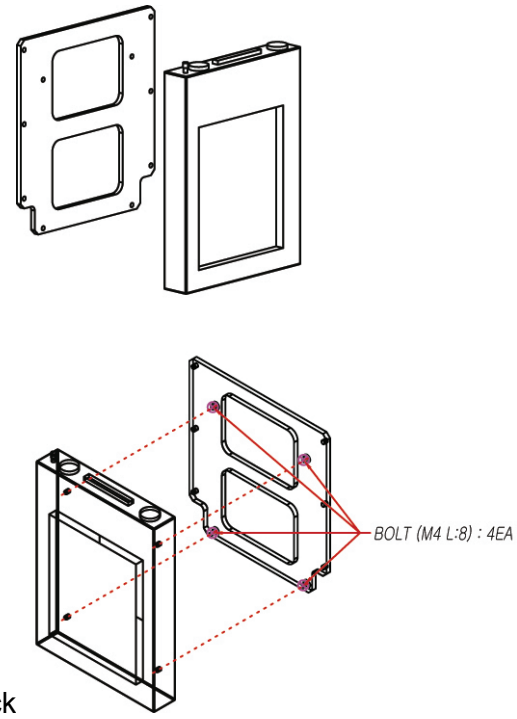
① Check on concord 1 sensor as shown in the following Figure.



② Remove 6 bolts (M4 L:8), and then separate the sensor.

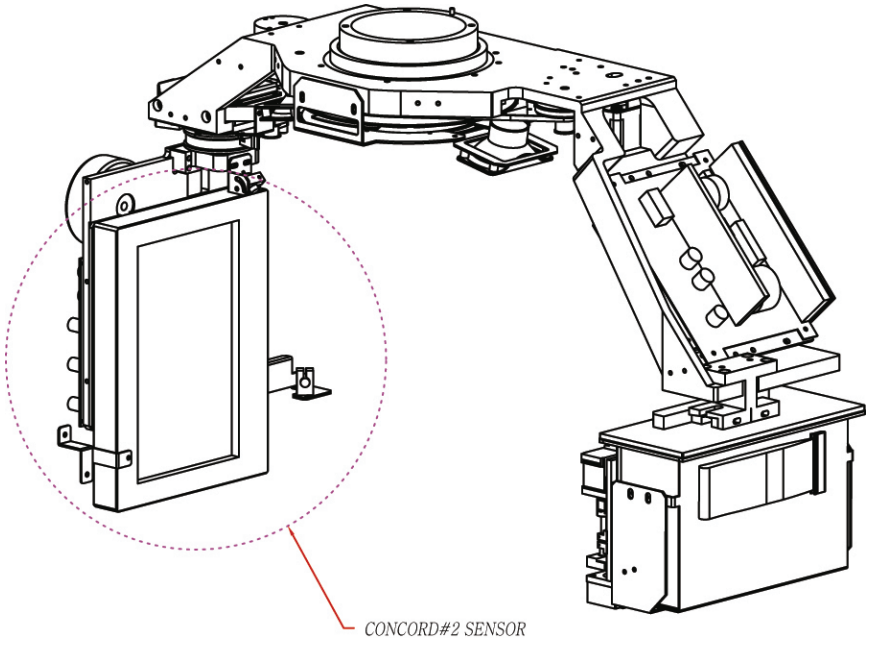


③ After removing 4 bolts (M4 L:8), and then separate the sensor from the sensor support block

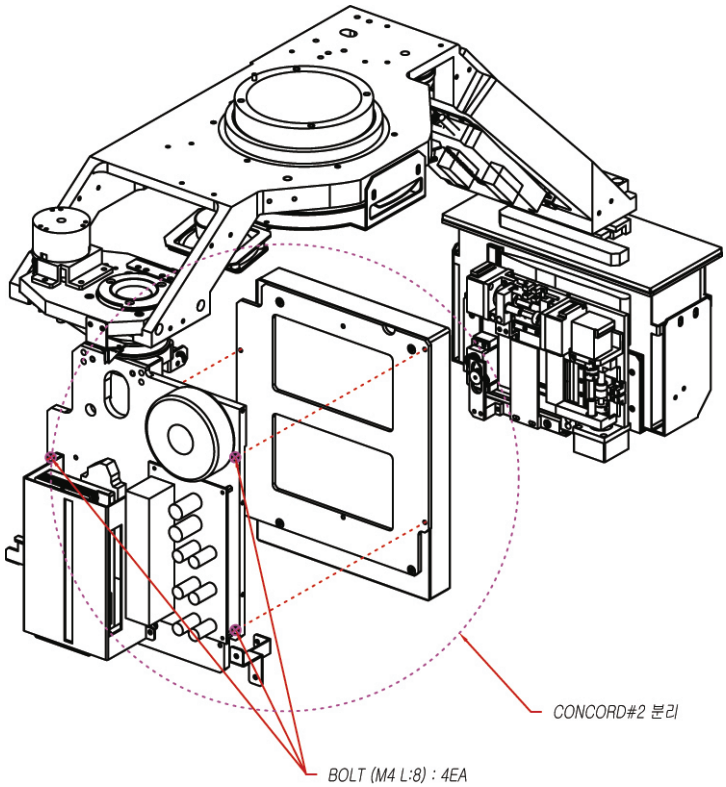


2. When Concord 2(FOV size: 24 x15cm) is installed

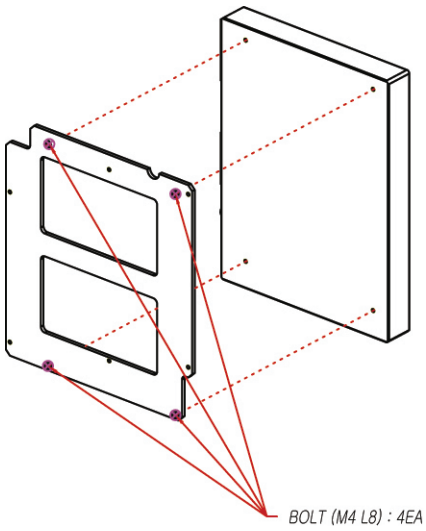
① Check on the position of sensor as shown in the following figure to prepare for separation.



② Remove 4 bolts(M4 L:8) and then separate the sensor and its supporting bracket from the equipment.

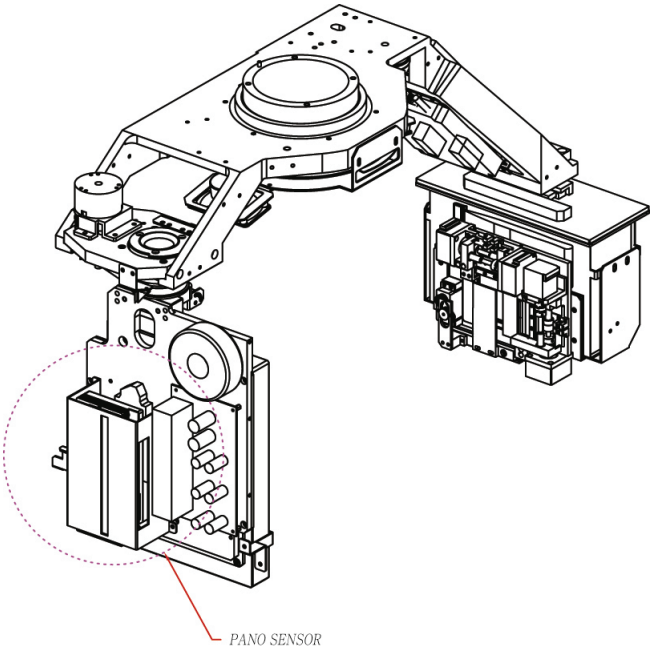


③ Remove 4 bolts(M4 L:8) and then separate the sensor itself from the block.

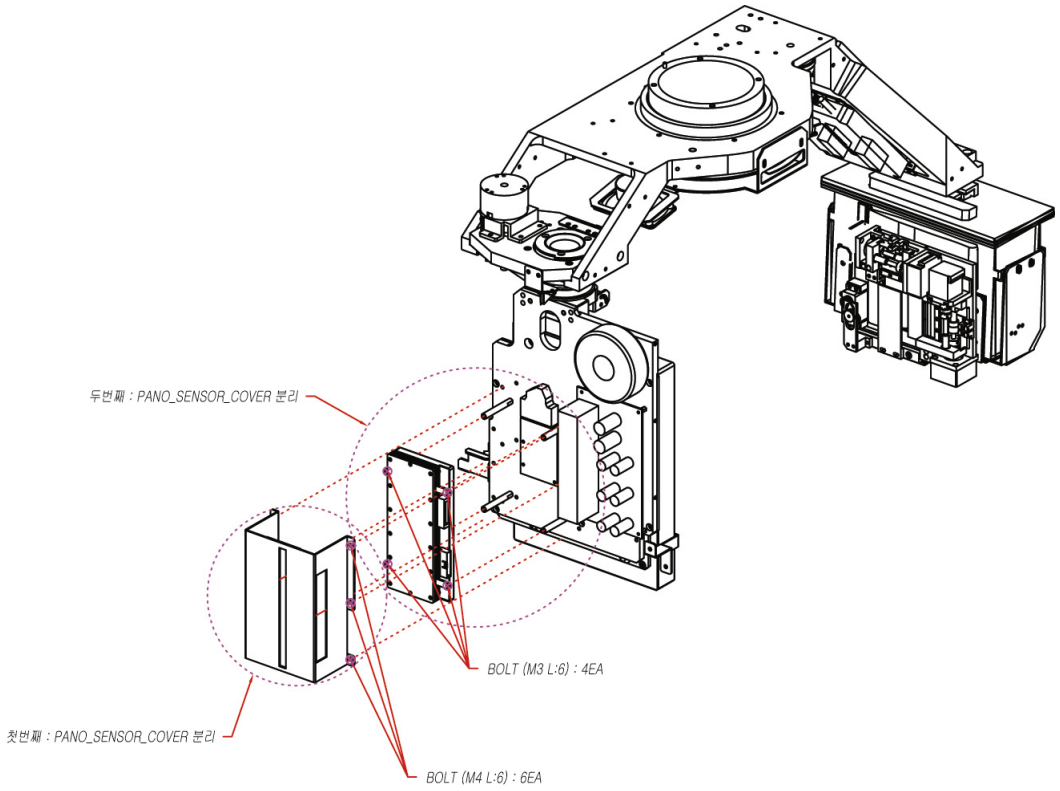


3. Pano Sensor Disassembly

① Check on the Pano Sensor.

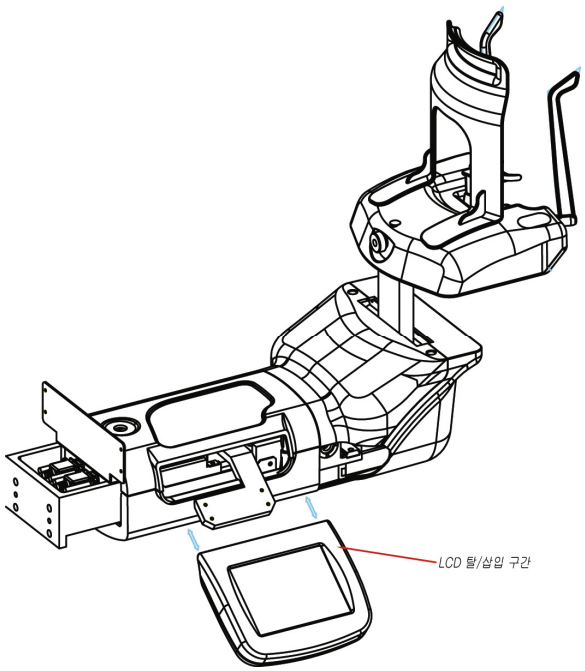


② After separating the front and the rear Pano sensor covers, remove the related bolts(M3 L:6 4 bolts) (M4 L:6 6 bolt) and then separate the sensor.

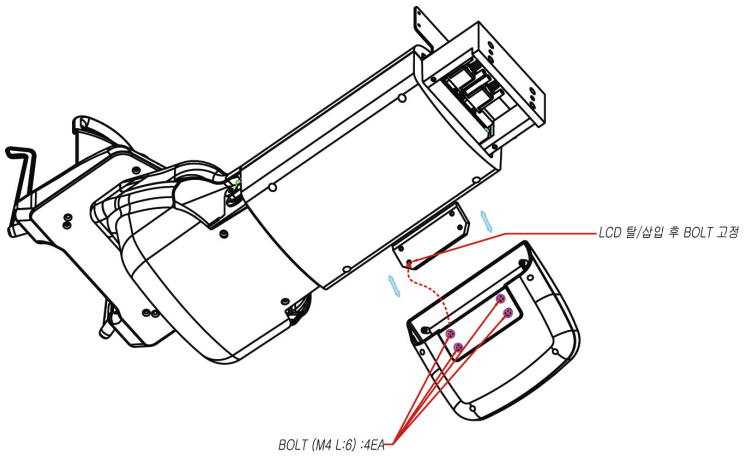


4.2 Touchpad Screen Replacement

① After removing four truss bolt (M4 L:6), detach the Touchpad screen Module.

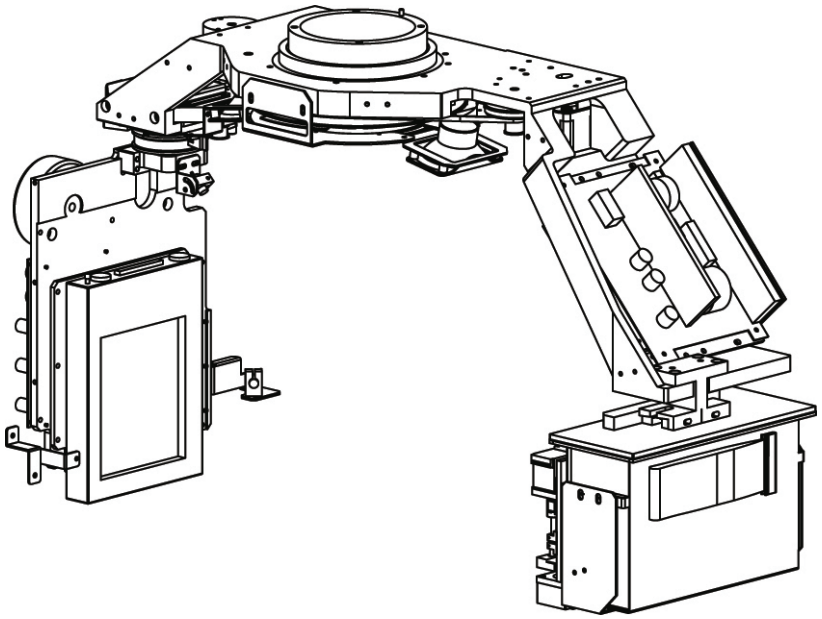


② In order to assemble it, do reverse work. Be careful to combine the Touchpad screen Module with four truss bolt by making sure they are well aligned.

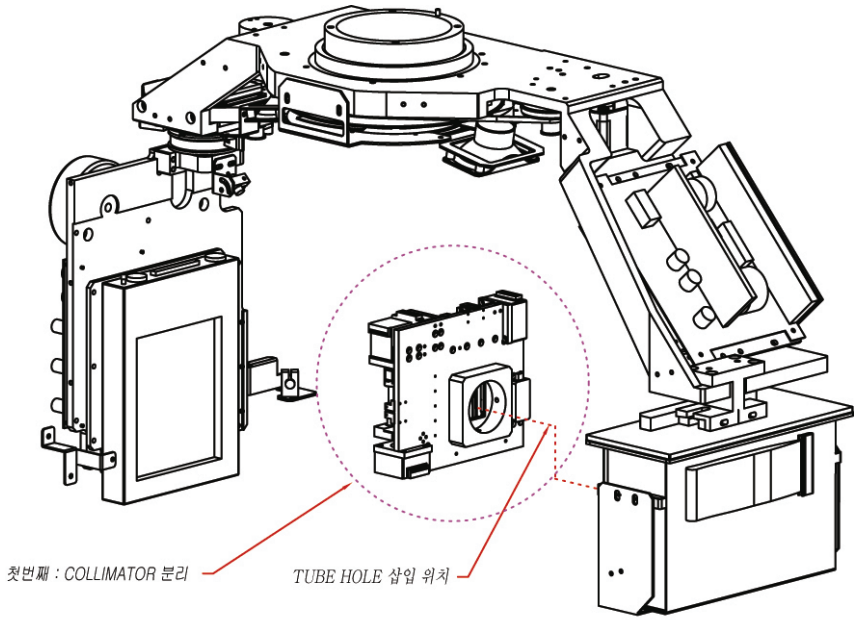


4.3 Tube Head Replacement

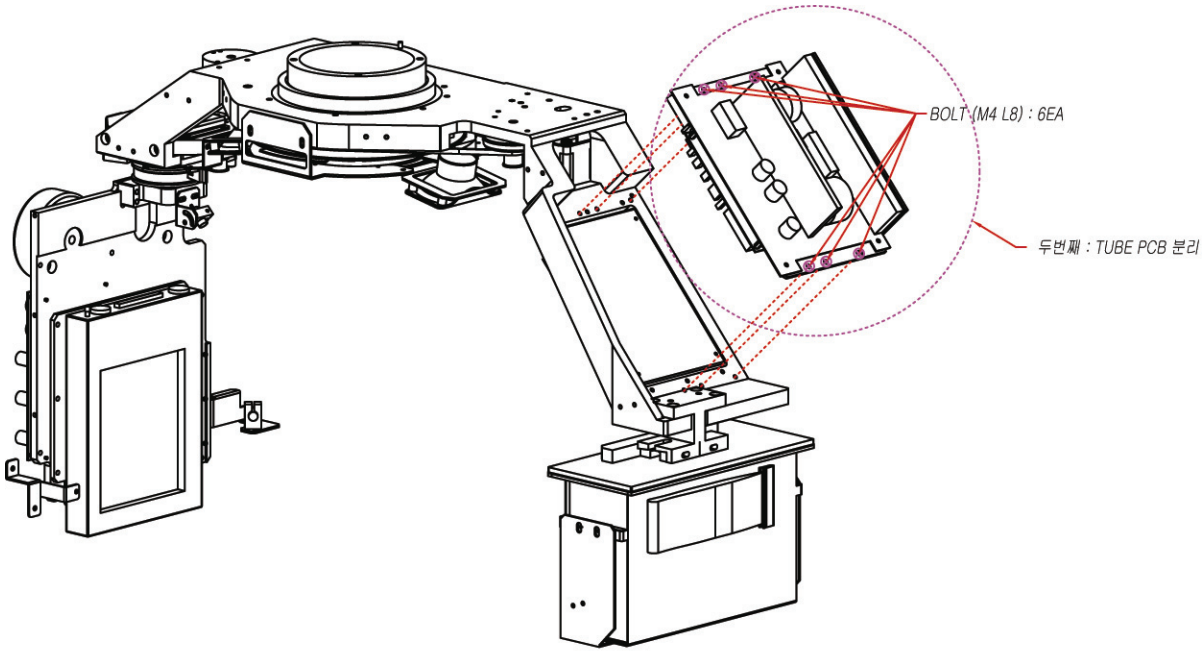
① The following figure is the one before replacing tubes.



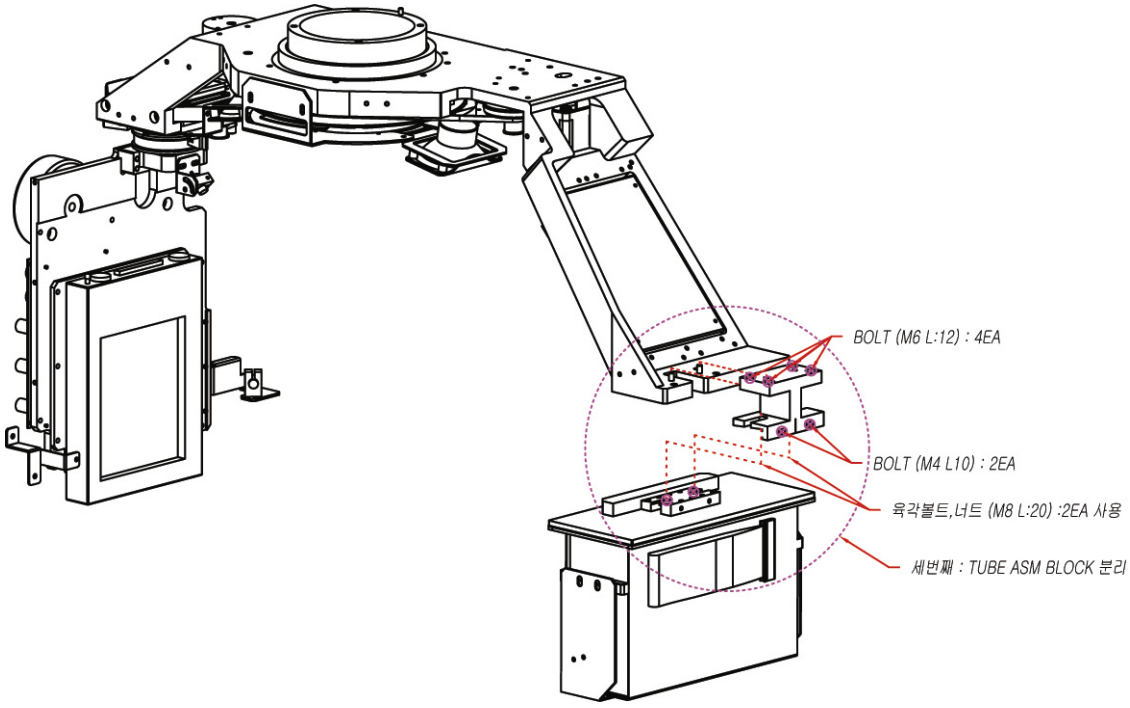
② Separate the Collimator as shown in the following figure.



③ Then Remove 6 bolts (M4 L:8), and then separate the Tube inverter board.

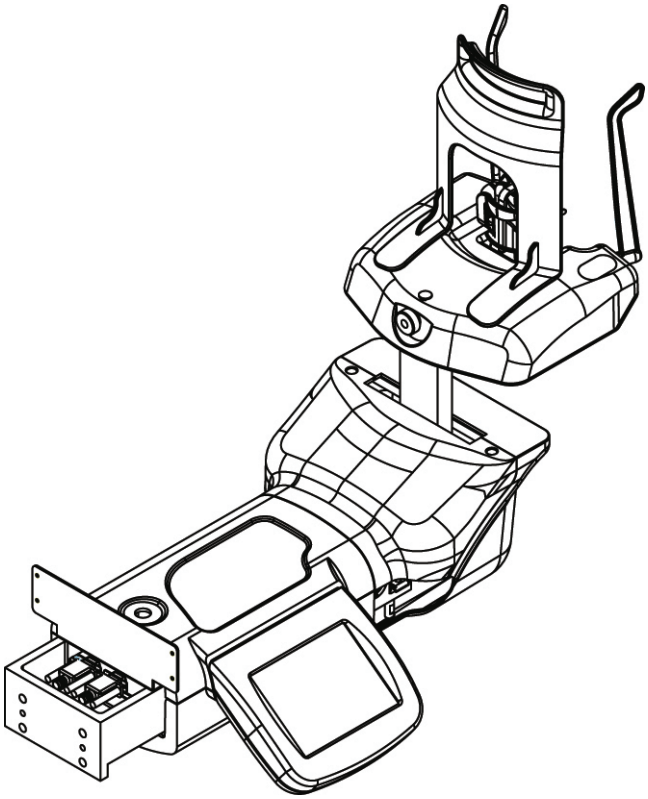


④ Separate the Tube Assembly Block as shown in the following figure.
First, after removing 4 bolts (M6 L: 12), separate the Block, then remove 2 of bolt and nut (Bolt: M4 L: 10 Nut: M8 L: 20).

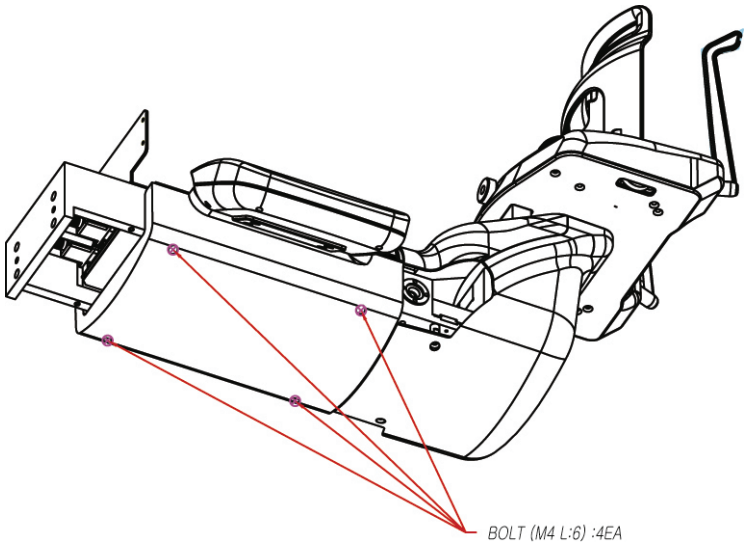


4.4 Handle Frame Replacement

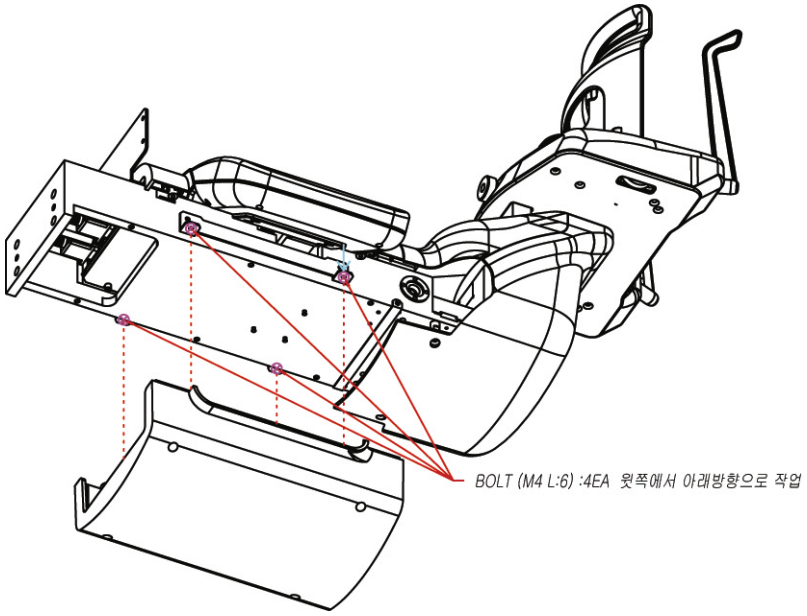
① Check on the handle frame as shown in the following figure.



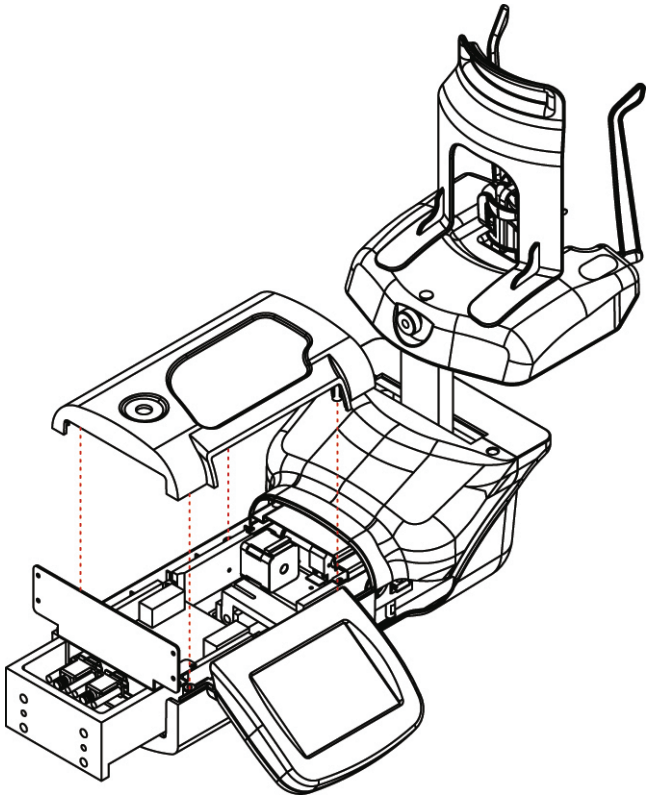
② Remove 4 bolts (M4 L: 6) as shown in the following figure.



③ After removing 4 bolts (M4 L: 6) downwards from the upper side, separate the lower cover.

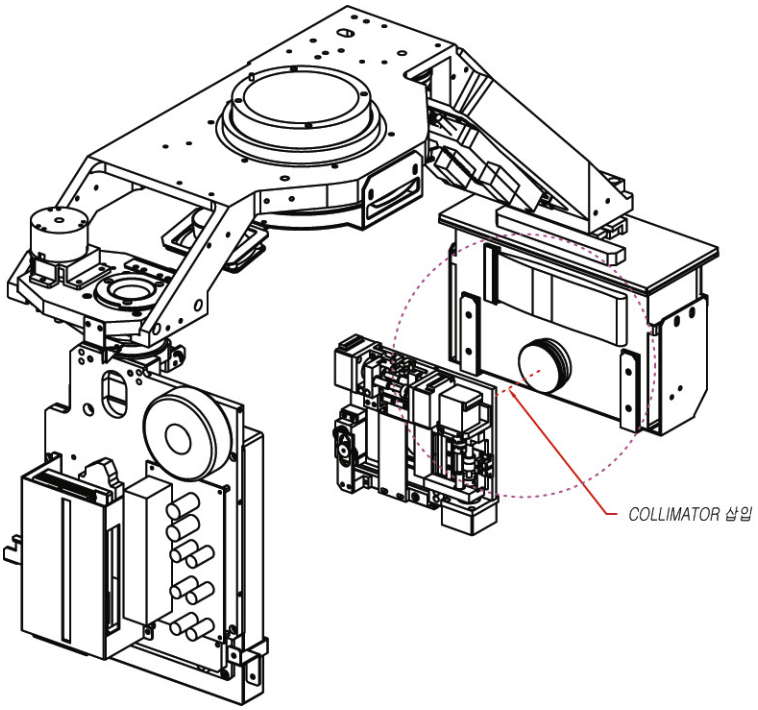


④ Separate the upper cover.

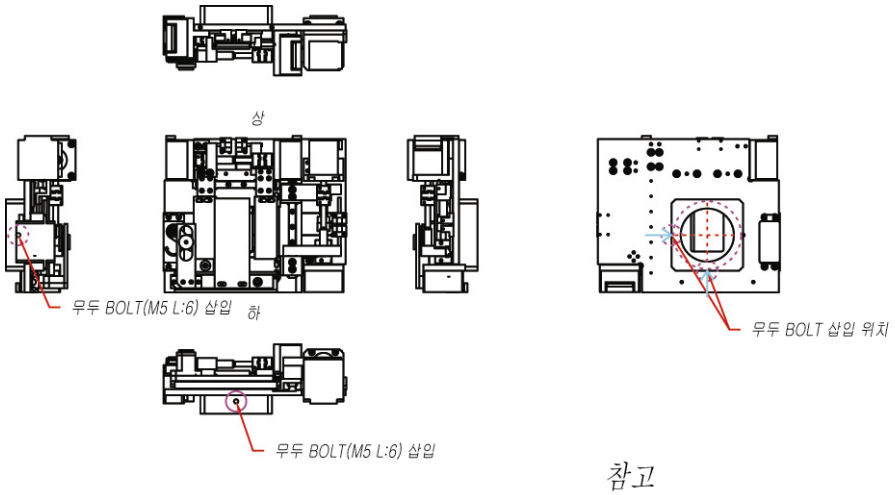


4.5 Collimator Replacement

① Insert the Collimator as shown in the following figure.

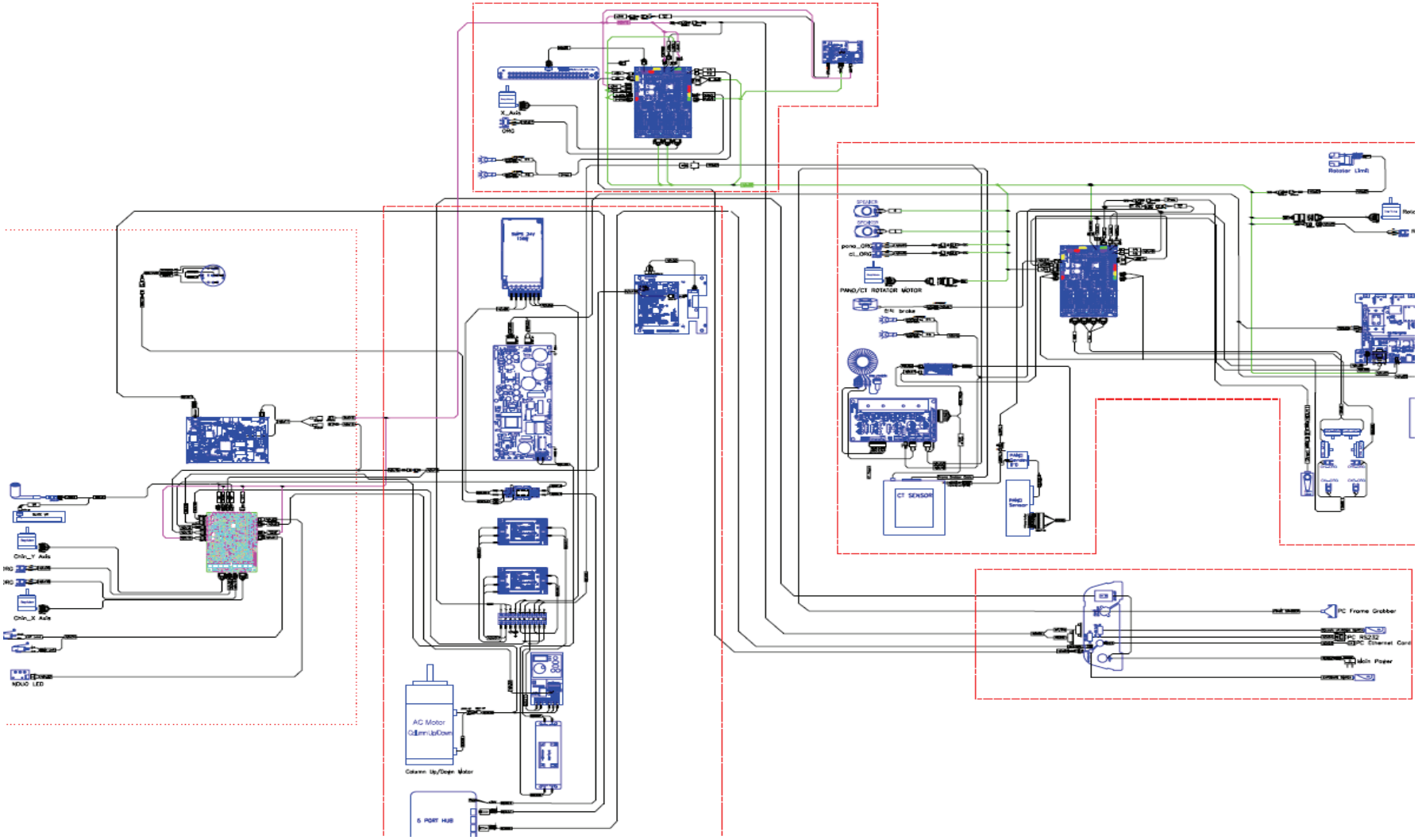


② Couple the Collimator to the tube in horizontal way and fix it by inserting socket set screws in the sequence as described in the following figure.

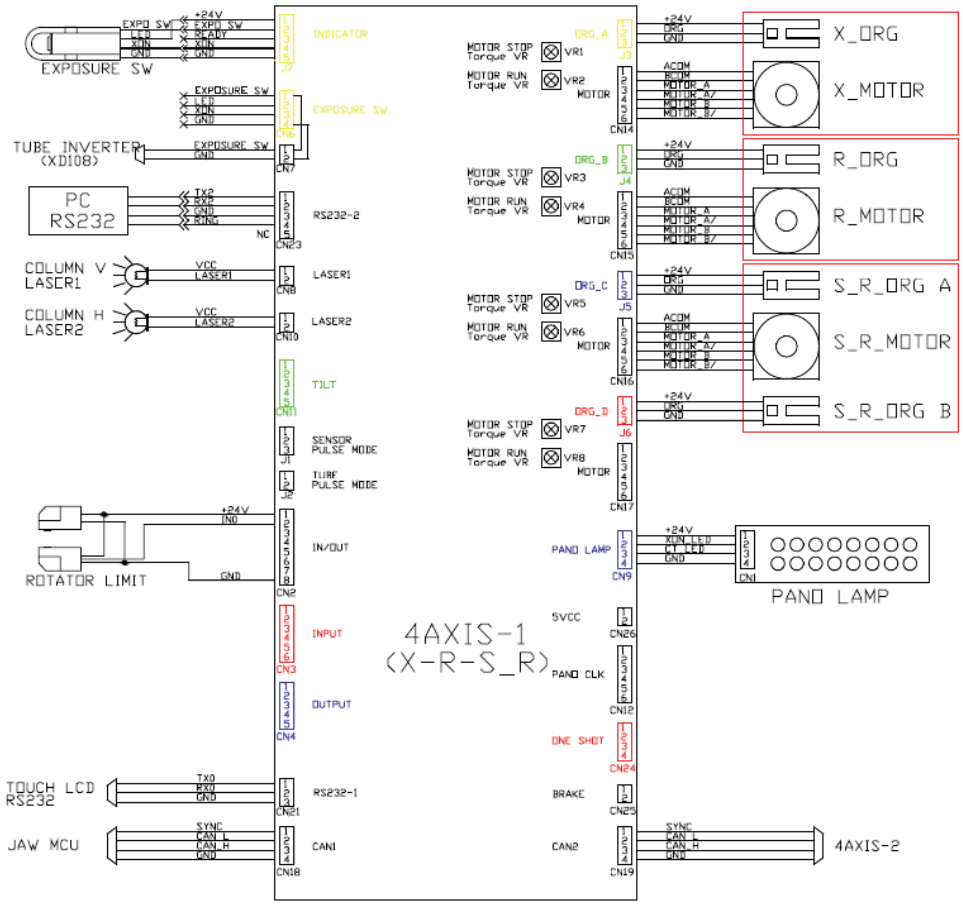


참고
-COLLIMATOR를 TUBE에 수평하게 결합 후 무두Bolt 삽입으로 고정.

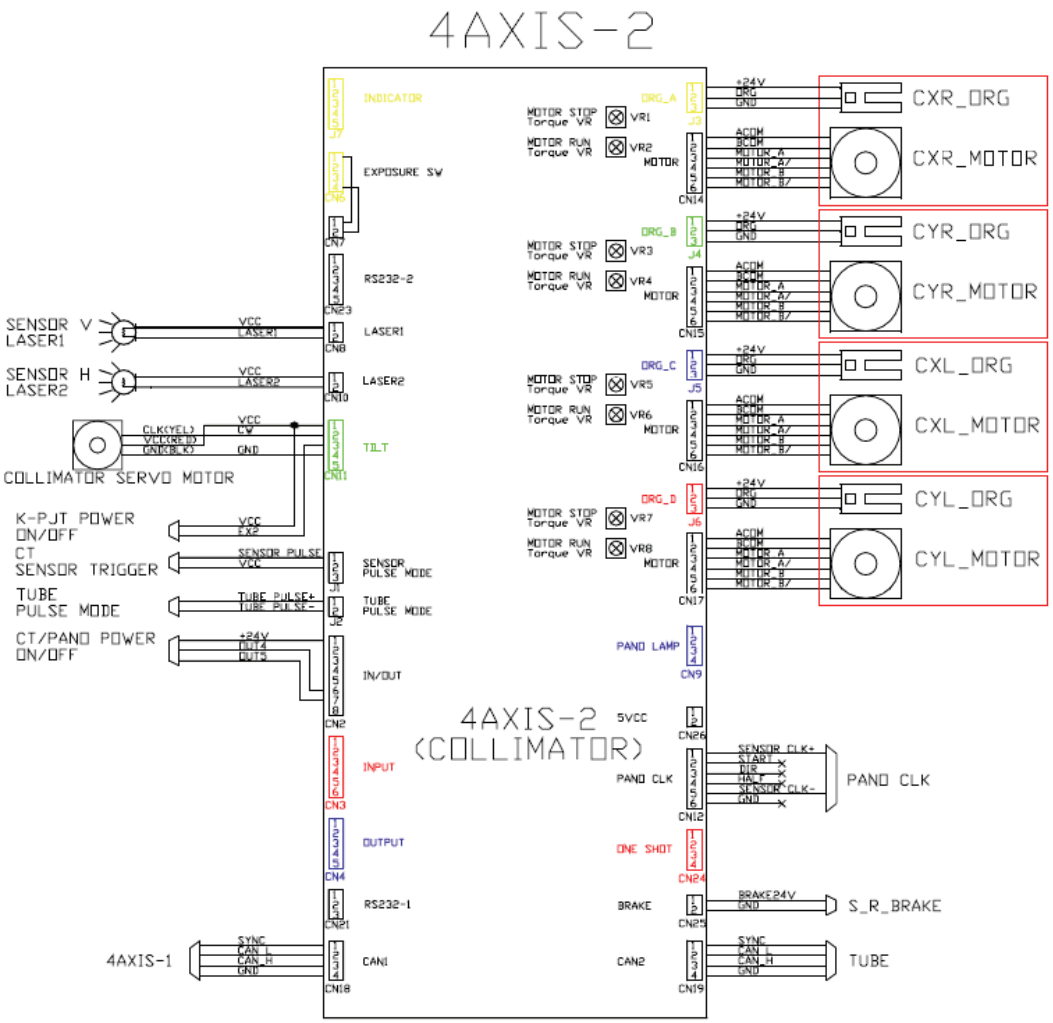
Chapter 5 Inter-Parts Connections



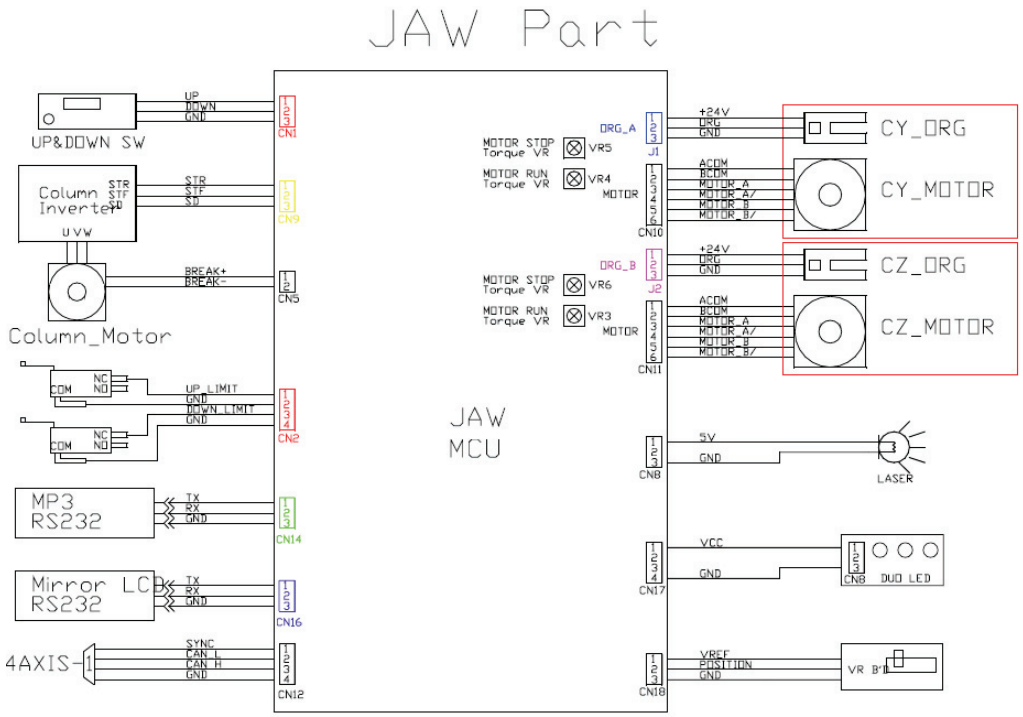
5.1 Connection Diagram of 4AXIS1 MCU Board and Peripheral Devices



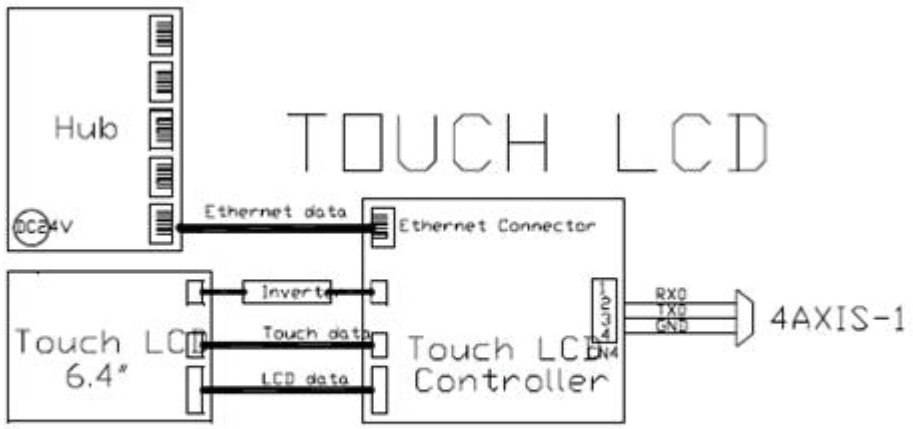
5.2 Connection Diagram 4AXIS2 MCU Board and Peripheral Devices

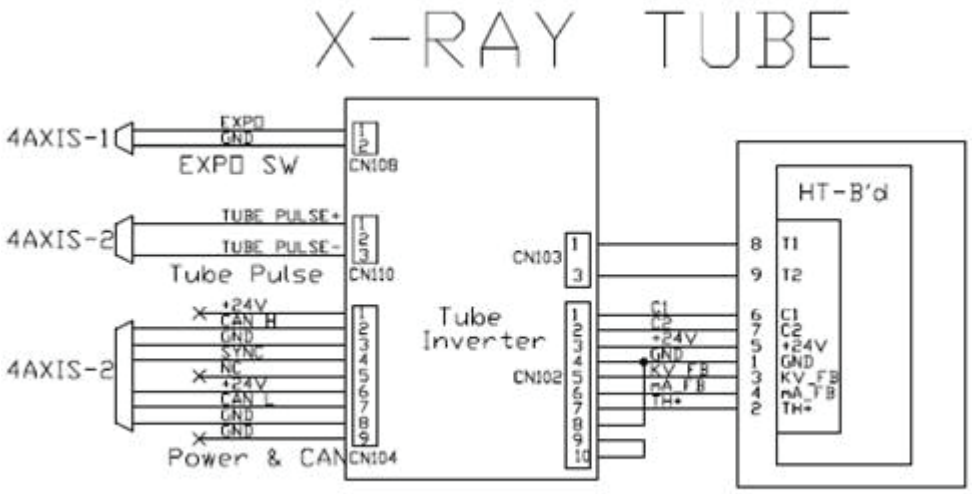


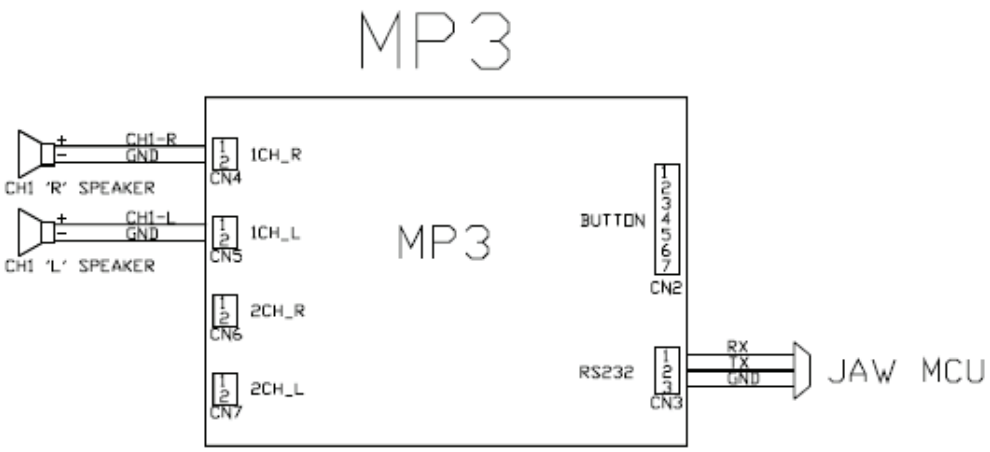
5.3 Connection Diagram JAW MCU Board and Peripheral Devices

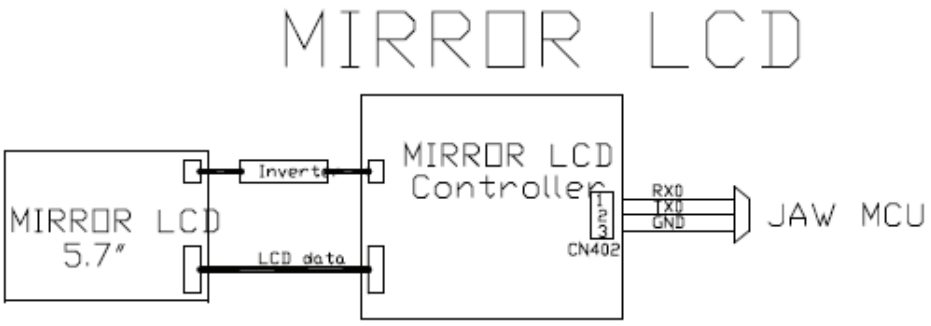


5.4 Other Boards




X-RAY TUBE
4AXIS-1
EXPO
GND
EXPO SW
CN108
4AXIS-2
TUBE PULSE+
TUBE PULSE-
Tube Pulse
CN110
4AXIS-2
+24V
CAN_H
GND
SYNC
NC
+24V
CAN_L
GND
GND
Power & CAN
CN104
Tube
Inverter
CN103
CN102
HT-B'd
T1
T2
C1
C2
+24V
GND
KV_FB
mA_FB
TH+


MP3
CH1 'R' SPEAKER
CH1-R
GND
1CH_R
CN4
CH1 'L' SPEAKER
CH1-L
GND
1CH_L
CN5
2CH_R
CN6
2CH_L
CN7
MP3
BUTTON
CN2
RS232
RX
TX
GND
CN3
JAW MCU


MIRROR LCD
MIRROR LCD
5.7"
Invert
LCD data
MIRROR LCD
Controller
CN402
RX0
TX0
GND
JAW MCU

Chapter 6 Diagnostics Methods for Various Boards

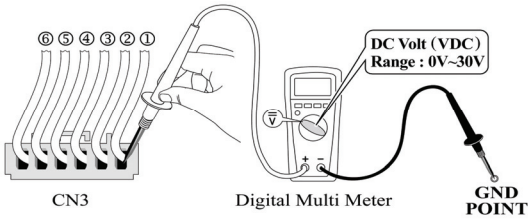
1. Important matters:

- When intending to perform measurement, it requires extreme caution to ensure the pin subjected to measure does not contact with adjacent pins at the same time.
- Because parts very sensitive to static electricity is installed on the electric field board, the load accumulated in the body should be discharged in prior to beginning the measurement. Putting a discharge pad on an arm is one of the methods.
- Check on the equipment whether it is earthed well.
- When separating cables from various connectors, do not overly treat them.
- When it is considered as necessary, ask for other person to held for handling the equipment.

2. Required Tools and Measuring Devices:

Type	Description
Multimeter(measurable up to 1500VDC)	
Alligator clip	
Phillips(Cross head) screw driver	
Flat head driver	

3. General example of connecting DMM

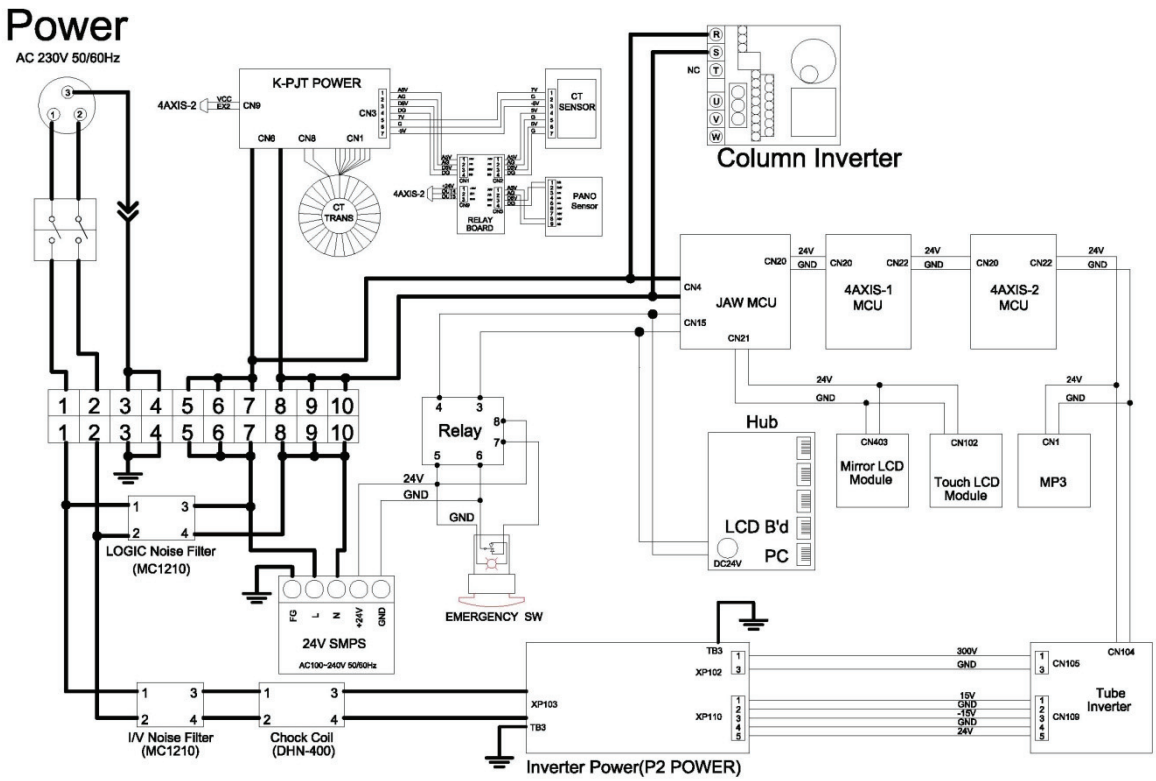


6.1 Power Board

1. Functions

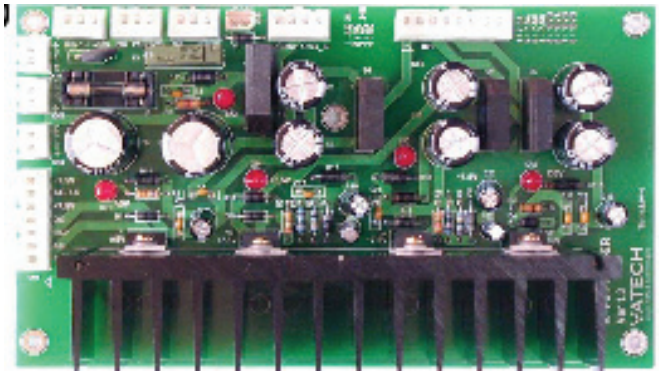
- Supply the voltage to the inverter board
- Supply the voltage to 2 of 4 axes board
- Supply the power required for other system and driving equipment

2. Entire Power Circuit Diagram

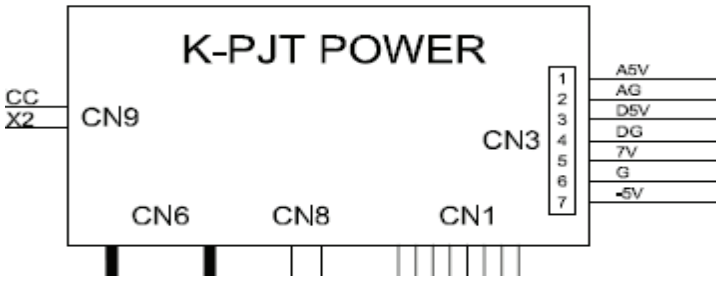


A. K-PJT Power Board

Role: Supply the voltage to Pano and CT sensors



Block Drawing



NOTE

By separating the analog ground and the digital ground, it is possible to minimize the diffusion of the noise generated from the power supply to the direction of sensors.
Herein AG: analog ground DG: digital ground

<Voltage measurement methods by each CONNECTOR and the measured value>

WARNING

When measuring this board, much caution should be taken. Since very high voltage and current exist on some part of the board, if not being careful, it is possible to be exposed to electric shock.
When contacting each pin, very careful caution is required to ensure there is not short incurring from contacting with each other.

- **CN3:**

  Role: Connection part to supply power to CT sensor and Pano sensor

  Measurement Method

  ① Set the measurement mode of multi-meter as voltage measurement.

  ② Set the measurement range just as it for automatic method, or within 30VDC if for manual.

  ③ After making + (Red) Probe of multi-meter contact carefully to the red line contact and – (Black) Probe to the black line, read the measured value. At this point, the values in following table should be measured.

  ④ When measuring Pin1, make – (Black) rod of DMM contact with AG (pin2) and + (Red) Probe with pin1, then perform measurement. At this point, the measured value should be +5V.

⑤ When measuring Pin3, make – (Black) rod of DMM contact with DG (pin4) and + (Red) Probe with pin3, then perform measurement. At this point, the measured value should be +5V.

⑥ When measuring Pin5, make – (Black) rod of DMM contact with G (pin6) and +(Red) Probe with pin5, then perform measurement. At this point, the measured value should be +7V.

⑦ When measuring Pin7, make – (Black) rod of DMM contact with G (pin6) and +(Red) Probe with pin7, then perform measurement. At this point, the measured value should be -5V.

NOTE **Use the crocodile clip to earth probe to let it engage with suitable earth point, making it as + probe, it will be useful for effective work.**

Pin number	Pin name	Pin color	Normal Value
1	analog power	Red	+5V
2	Analog ground	Black	0
3	Digital power	Yellow	+5V
4	Digital ground	Black	0
5	CT sensor power	Brown	+7V
6	Ground	Black	0
7	CT sensor	Blue	-5V

- **CN9:**

Role: Connection part of signal to on/off the K-PJT power from 4AXIS-2 board

Measurement Method

① Set the measurement mode of multi-meter as voltage measurement.

② Set the measurement range just as it for automatic method, or within 30VDC if for manual.

③ Measure Pin 1. +5V(VCC) is to be supplied through this pin to the board.

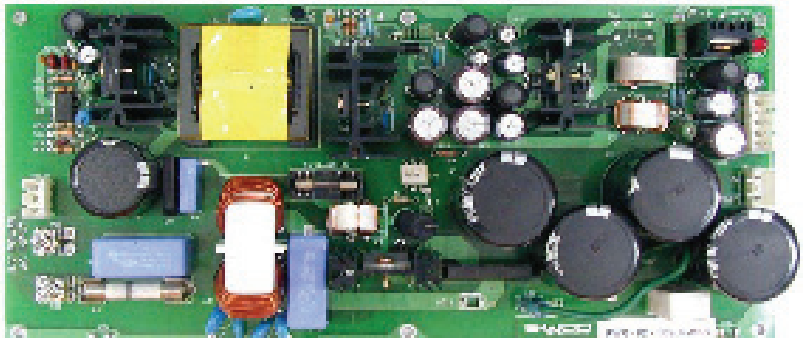
④ Measure Pin 2. On/Off control signal is connected through this pin.

Under normal condition, the measurement values are as shown in following TABLE.

Pin number	Pin name	Pin color	ON Measured Value	OFF
1	VCC	Yellow	+5VDC	+5V
2	EX2	Black	0	Over +4.5V

B. Inverter power(P2 power)

Role: Supply the power to tube inverter board



<Measurement Method by each connector and the measured value>

WARNING

When measuring this board, much caution should be taken. Since very high voltage and current exist on some part of the board, if not being careful, it is possible to be exposed to electric shock.

- **XP102:**

  Role: Connection part for power supply (300V DC) to the Tube Inverter Board

  Measurement Method

  ① Set the measurement mode of multi-meter as voltage measurement.

  ② Set the measurement range just as it for automatic method, and within 600V DC if for manual.

  ③ After making +(Red) Probe of multi-meter contact carefully to the red line contact and –(Black) Probe to the black line, read the measured value. At this point, the values in following table should be measured. At this point, the measured value should be about +300V DC.

④ If measured less than 280V, it is considered as the defect of the board so it should be replaced.

NOTE **Use the crocodile clip to earth probe to let it engage with suitable earth point, making it as + probe, it will be useful for effective work.**

Pin number	Pin name	Pin color	Normal Value
1	Inverter power	Red	+300VDC
2	NC	NC	
3	Ground	Black	0

- **XP110:**

Role: Connection part for power supply to the Inverter Board (Connected with CN 109 of Tube inverter board)

Measurement Method

① Set the measurement mode of multi-meter as voltage measurement.

② Set the measurement range just as it for automatic method, and within 30V DC if for manual.

③ Measure Pin 1. Through this pin, 15V is to be supplied to the inverter/generator board.

④ Measure Pin 2. Through this pin, the earth ground is connected.

⑤ Measure Pin 3. Through this pin, -15V is to be supplied to the inverter/generator board.

⑥ Measure Pin 5. Through this pin, +24V is to be supplied to the tube inverter board.

NOTE **Use the crocodile clip to earth probe to let it engage with suitable earth point, making it as + probe, it will be useful to work effectively.**

Under normal condition, the measurement values are as shown in following TABLE.

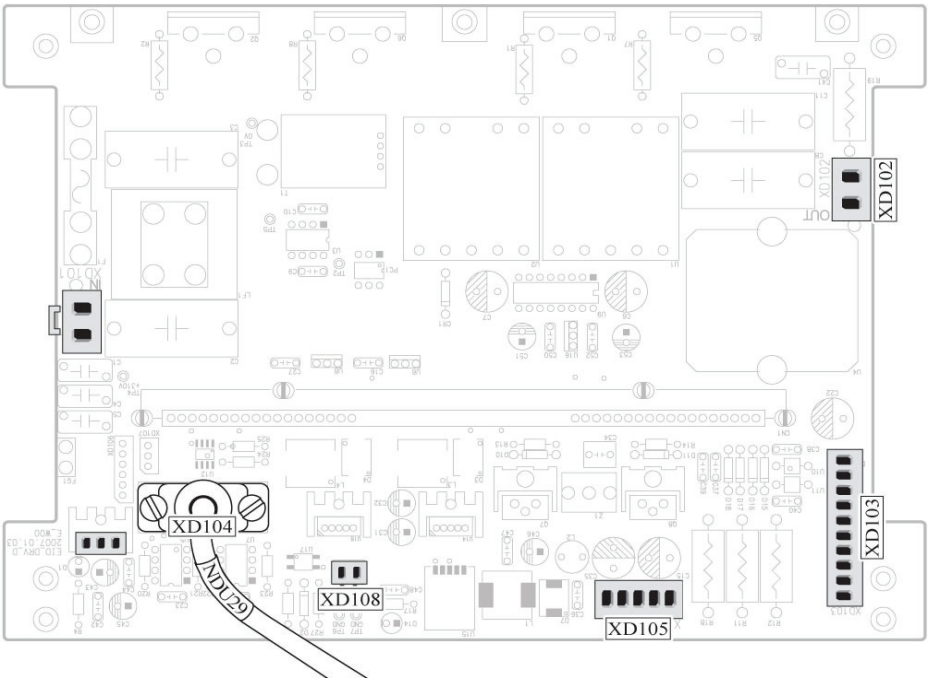
Pin number	Pin name	Pin color	Normal Value
1	Inverter/generator	Yellow	+15VDC
2	Ground	Black	0
3	Inverter/generator	Blue	-15VDC
4	Ground	Black	0
5	Inverter Board	Orange	+24VDC

6.2 Tube inverter Board

1. Role

Electro-magnetic circuit to generate the tube voltage (several 10 kVp) that is impressed between anode and cathode of X-ray tube.

2. Location of Board connector



3. Measurement Method by each connector and the measured value

WARNING

This board operates with very high voltage which is impressed to some part; therefore extreme caution should be taken when performing check up at the field. When being not careful, it can cause very severe shock to the human body.

The measured voltage value by each pin is normal when they are as shown in the Table.

- **CN104**

Pin number	Pin name	Pin color	Normal Value
1	Power supply	Red	+24VDC
2	Ground	Black	0

- **CN105**

Pin number	Pin name	Pin color	Normal Value
1	Inverter power	Red	+300VDC
2	NC	NC	
3	Ground	Black	0

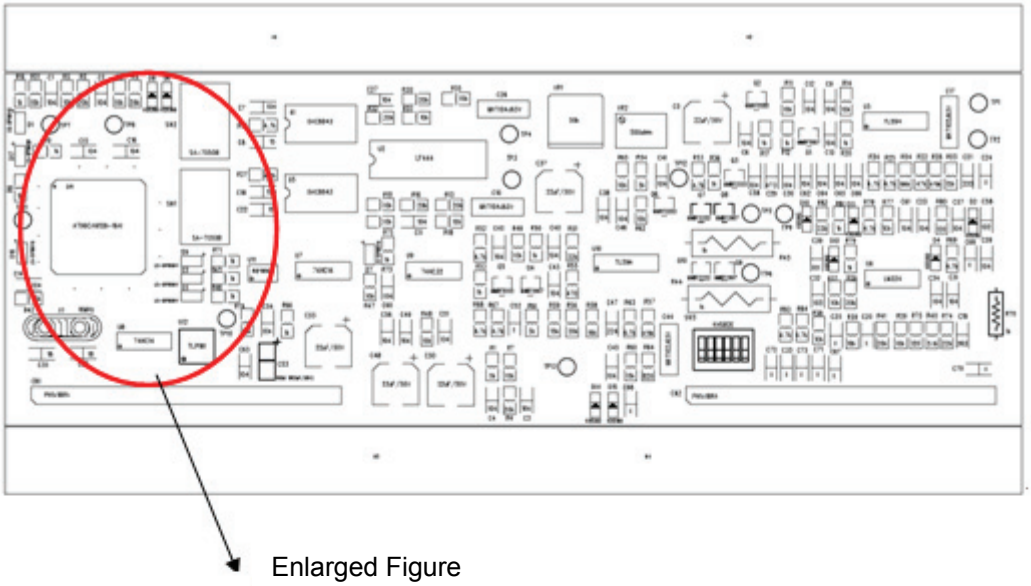
- **CN109**

Pin number	Pin name	Pin color	Normal Value
1	Power	orange	+15 VDC
2	Ground	yellow	0
3	Power	green	-15VDC
4	Ground	Black	0
5	Pano sensor	white	24VDC

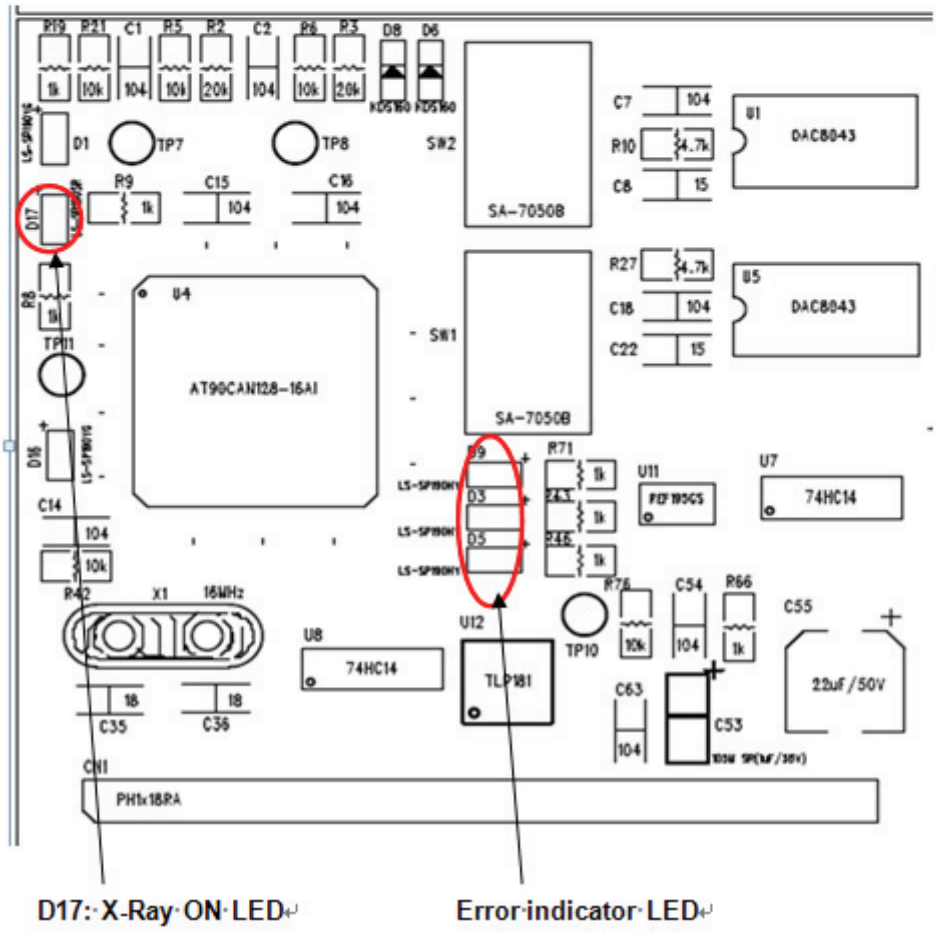
4. Judgment on Failure Cause according to the Error Message

A. Inverter LED and TP Point

The followings are the figure of Daughter board installed to the inverter board.



Enlarged Figure



- **X-Ray On LED**

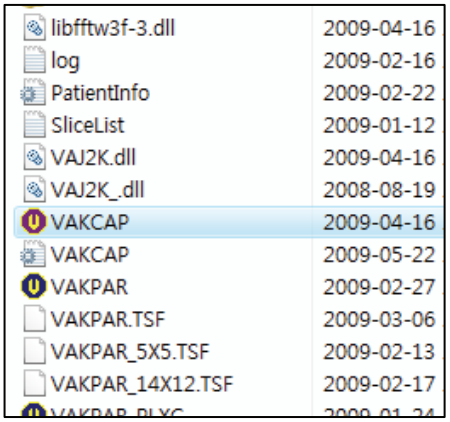
No.	LED	Color	Action	Description
1	D17	YELLOW	LED illuminated when X-Ray is irradiated	LED to check on X-Ray irradiation status

- **LED Indication by Error and the Cause**

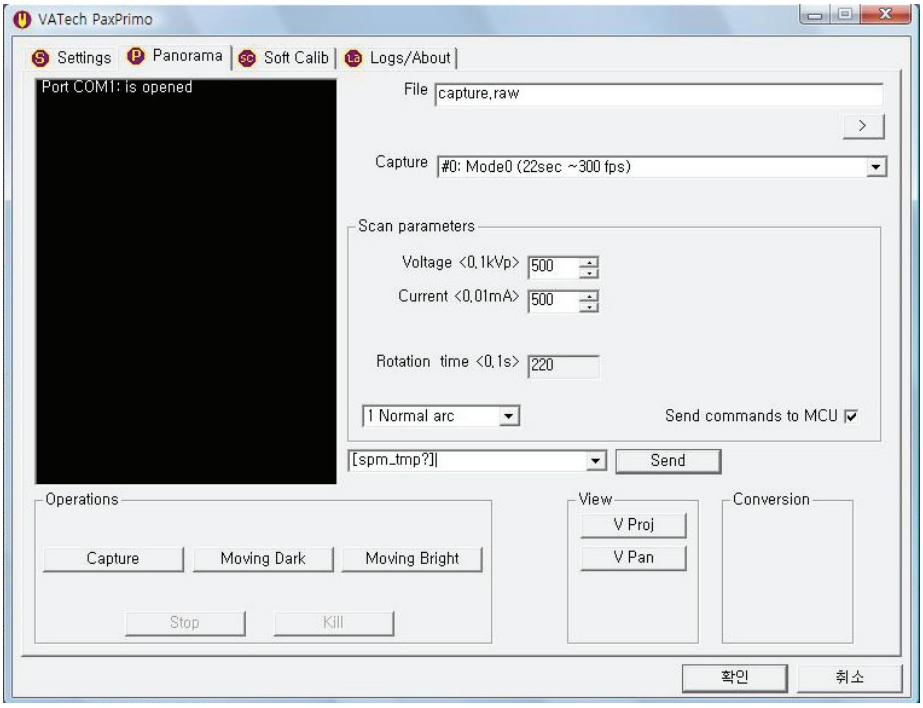
Error LED Status			Error List	Description
A	B	C		
Lighted	-	-	Inter Lock	When the Cable connected to Connector [CN102] is snapped and When the cable is disconnected.
-	**Lighted**	-	OCP	When current value at the primary side of mono tank is higher than the tolerable value.
Flash	-	-	kV Ref.	When kV Ref. value has difference of ±10kV.
-	**Flash**	-	mA Ref.	When mA Ref. value has difference of ±0.5mA.
Flash	**Flash**	-	kV Feedback	When kV Feedback value has difference of ±20kV.
-	-	**Flash**	mA Feedback	Incurs when the tube current is higher or lower than the set point.
Lighted	**Lighted**	-	Temp. Error	When the mono tank temperature is higher than the tolerable value.
-	-	**Lighted**	Current Error	When current value at the primary side of mono tank is over +1A higher than the reference value.
Lighted	-	**Lighted**	X-Ray On Error	When there is no X-Ray On Command in the System even though X-Ray Switch is On.
-	**Lighted**	**Lighted**	X-Ray Off Error	When there is no X-Ray Off Command in the System even though X-Ray Switch is Off.

5. The method to confirm on whether the CAN communication with Inverter Board is working

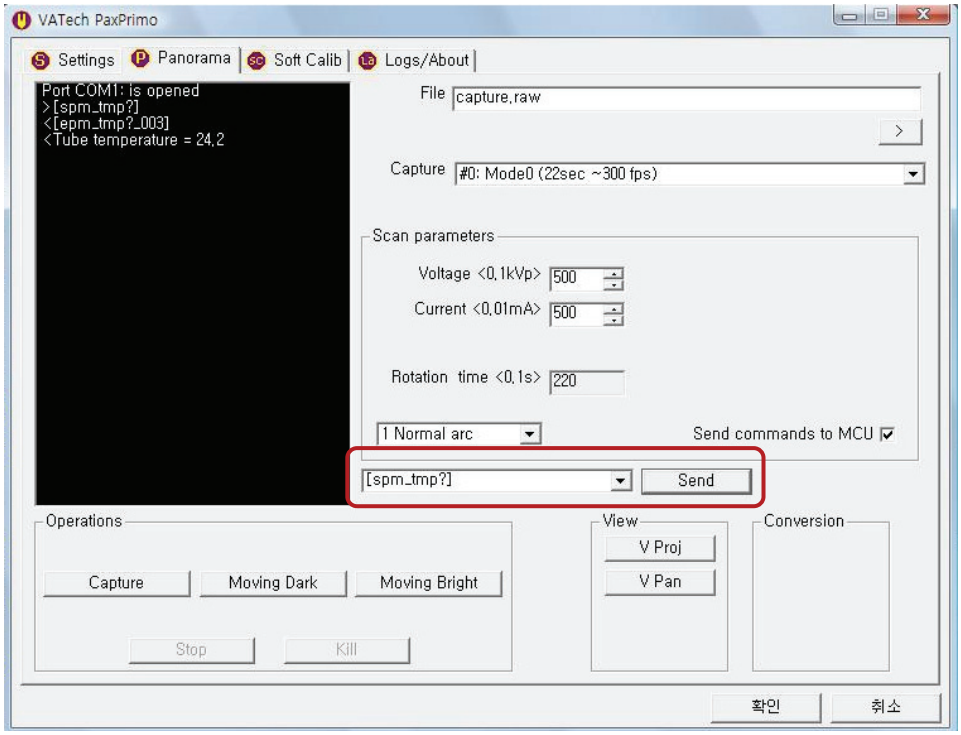
① Execute the exe. file of **VAKCAP** from My Computer C:\>PaXPrimo>pano
(Also confirmable by using the Hyper-terminal)



② VAKCAP Window is to be displayed as follows.



③ Input **“[SPM_TMP?]”** in the command input window, then click **“Send”**.
Then, the next window will be displayed, indicating the current internal temperature of the Tube. And also it shows the CAN communication with the inverter board is normally working. But if there is no response, it indicates that the CAN communication is not being performed.

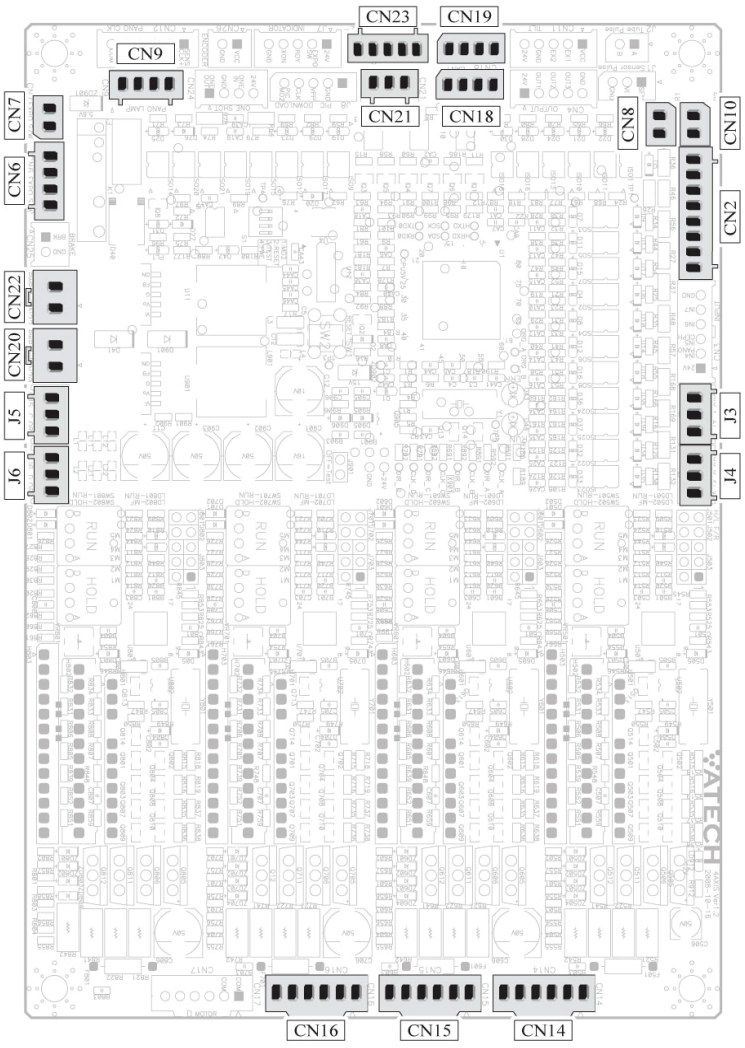


6.3 4AXIS-1 MCU Board

1. Function

- Serial communication with PC in use of RS232
- X-Ray irradiation function in use of irradiation switch
- Generate vertical and horizontal laser beam for column.
- Detecting the limiting of Rotating unit
- Serial communication with Touchpad
- CAN communication with JAW MCU and 4AXIS-2

2. Exterior of Board



3. Description on Pin Allocation Table

Pin number	Function	Description
CN2	Rotator limit	Function to control between the sensor and the Rotator with S/W to ensure the rotation does not exceed the initial value when the rotator spins
CN7	Tube inverter	Tube inverter board X-ray irradiation On/Off control
CN8	Column V Laser1	Vertical Beam Laser Generating Laser for Patient Alignment
CN10	Column H Laser2	Horizontal Beam Laser Generating Laser for Patient Alignment
CN14	X_MOTOR	Motor to drive the equipment corresponding to various arch loci. X-axial motor moves with variable speeds, corresponding to the applicable arch during scanning.
CN15	R_MOTOR	Functions to turn the Rotator
CN16	S_R_MOTOR	Motor to spin the Sensor Rotator
CN18	CAN1	Connector for CAN communication with JAW MCU
CN19	CAN2	Connector for CAN communication with 4AXIS-2 MCU Board
CN21	TOUCH LCD RS232	Connector for Serial communication with Touchpad Screen
CN23	PC RS232	Connector for Serial communication with PC

4. Measurement Method and the measured value

- **CN2**

  Measurement Method

  ① Set DMM as DC measurement mode.

  ② Pin 8 is GND, put the black lead rod at Pin 8 and measure Pin 1.

  ③ At this point, +24V is to be measured at all times.

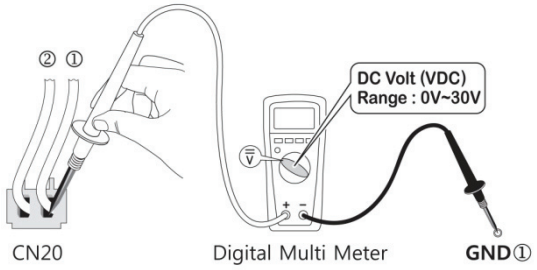
  ④ When limit is detected, 0V is input to the board at Pin 2.

Measured value

Pin Number	Role	Equipment idling	Equipment operating
1	24V power supply	24V	24V
2	Signal	24V	0V
8	GND	0	0

- **CN7**

Measurement Method



① Send “[XOF]” in use of MCS.

② As shown in above figure, make (-) Lead rod of DMM (Digital Multi Meter) contact to GND① while making (+) Lead rod contact to Pin ① of CN20.

③ After checking on the voltage at Normal Status shown in the Table, then Press the irradiation switch to measure at operation status.

The measurement result value is equal to the values as shown in following table at normal status.

PIN Number	PIN NAME	Normal Status	Operating Status
①	EXPO_SW	Over about 20V	Less than about 2V
②	GND	0V	0V

- **CN8**

Measurement Method

① Execute MCS and then input the command “[SPM_PANO]”.

② When inputting the command “[SPM_LON_]”, the vertical and the horizontal lasers of the equipments turn ON.

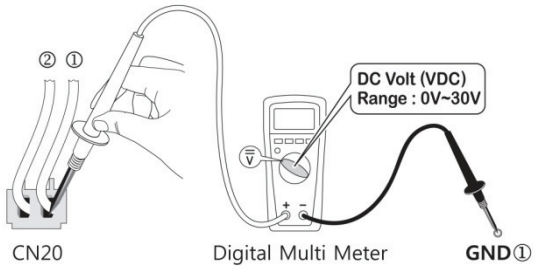
③ Make (-) Lead rod of DMM contact to GND①, then 0V is to be measured from Pin ③ of CN1 Connector on (+) Lead rod.

④ Input the command “[SPM_LOF_]”, and the Laser turns off. At this point, if measuring Pin ③, it is possible to confirm that it becomes 4.5V.

At Pin 1, 5V is to be measured at all times.

PIN Number	PIN NAME	Idle Status	Operating Status
1	VCC	Over about 4.5V	About 4.5V
2	signal	Over about 4.5V	Less than about 1V

- **CN10**



Measurement Method

① Execute MCS and then input the command “[SPM_PANO]”.

② When inputting the command “[SPM_LON_]”, the vertical and the horizontal lasers of the equipments turn ON.

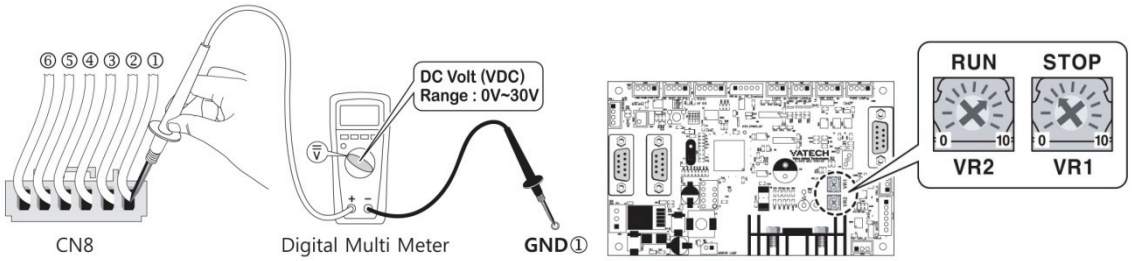
③ Make (-) Lead rod of DMM contact to GND①, then 0V is to be measured from Pin ③ of CN1 Connector on (+) Lead rod.

④ Input the command “[SPM_LOF_]”, and the Laser turns off. At this point, if measuring Pin ③, it is possible to confirm that it becomes 4.5V.

At Pin 1, 5V is to be measured at all times.

PIN Number	PIN NAME	Idle Status	Operating Status
1	VCC	Over about 4.5V	About 4.5V
2	signal	Over about 4.5V	Less than about 1V

- **CN14**



Measurement Method

① When the power is ON, Pin ① and Pin ② of CN8 Connector present about 23V output at all times.
VR2 (RUN) performs its function to control the RUN Current (Motor's rotational strength) of X-axis motor.

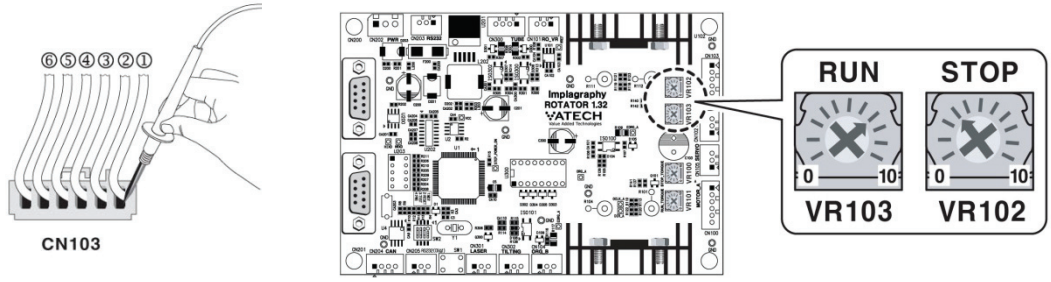
② Set the Arrow mark to "7" as shown in above figure.

③ VR1 (STOP) performs its function to control STOP Current (The force when the motor is stopped) of X-axis motor.

④ Set the Arrow mark to "3" as shown in above figure

PIN Number	PIN NAME	Idle Status	Operating Status
①	VCC24	Over about 23V	Over about 23V
②	VCC24	Over about 23V	Over about 23V
③	A_MOTOR_A	Over about 18V (Frequency)	Over about 18V (Frequency)
④	A_MOTOR_A/	Over about 20V (Frequency)	Over about 18V (Frequency)
⑤	A_MOTOR_B	Over about 20V (Frequency)	Over about 18V (Frequency)
⑥	A_MOTOR_B/	Over about 20V (Frequency)	Over about 18V (Frequency)

- **CN15**



Measurement Method

① When the power is ON, Pin 1 and Pin 2 of CN 103 Connector present about 23V output at all times.

② VR103 and VR102 are the parts to let Rotate Unit drive. Adjust them referring to above figure.
(RUN '7' / STOP '3')

PIN #	PIN NAME	Normal Status
①	VCC24	Over about 23V
②	VCC24	Over about 23V
③	A_MOTOR_A	FREQUENCY
④	A_MOTOR_A/	FREQUENCY
⑤	A_MOTOR_B	FREQUENCY
⑥	A_MOTOR_B/	FREQUENCY

Immeasurable with DMM

NOTE

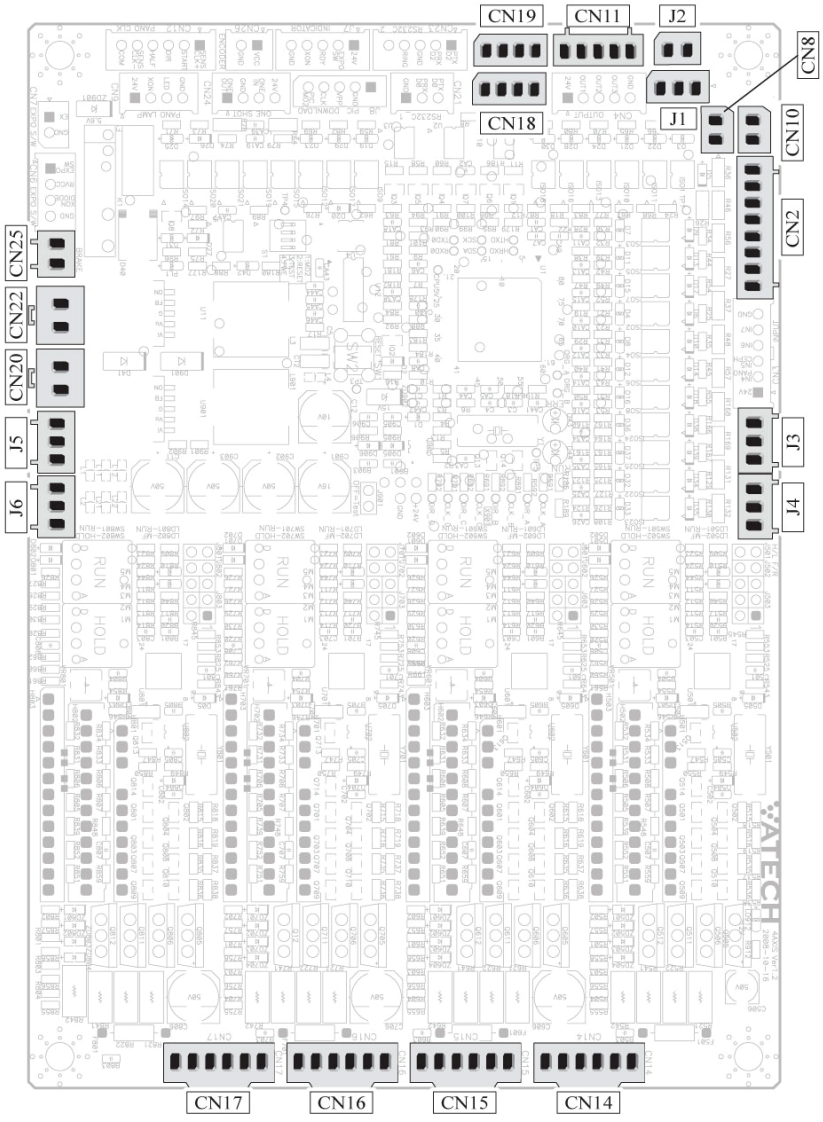
RUN VR: Variable resistance that controls the revolution rate of Motor.
STOP VR: Variable resistance for Torque size regulation when Motor is stopped.

6.4 4AXIS-2 MCU Board (Collimator)

1. Functions

- Adjusting the Position of Collimator
- CAN communication with 4AXIS-1 MCU Board
- CAN communication with TUBE inverter board
- CT/PANO power on/off

2. Exterior of the Board



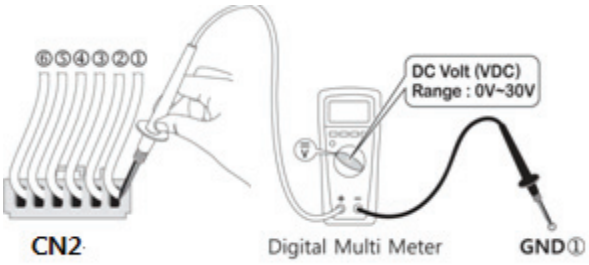
3. Pin Allocation and Description of Functions

Pin number	Function	Description
CN2	CT/PANO power on/off	Power supply or cut-off to Pano and CT sensors
CN8	Sensor V Laser1	Vertical Beam Laser Generating Laser for Patient Alignment
CN10	Sensor H Laser2	Horizontal I Beam Laser Generating Laser for Patient Alignment
CN11	Collimator servo motor	Connection to supply voltage for driving of Collimator servo motor
CN14	CXR_motor	Motor Connection Part to move Collimator to the left/the right
CN15	CYR_motor	
CN16	CXL_motor	
CN17	CYL_motor	
CN18	CAN1 4AXIS-1	CAN communication with 4AXIS-1 Board
CN19	CAN2 Tube	CAN communication with Tube inverter board

4. Connector Measurement Method and the Measured Values

- **CN2**

  Role: Connection part to supply power to the sensors corresponding to each scanning mode.



Measurement Method

① Connect the black color lead rod of DMM to Θ and + lead rod to each pin subjected to measurement.

② When scanning by Panoramic, Pin 6 drops near to about 0V.

③ When scanning by CT, Pine 7 drops near to about 0V.

Pin Number	Pano Scanning	CT Scanning	At Equipment Idling
1	24V	24V	24V
6	About 0V	Float	Float
7	Float	About 0V	Float

- **CN8 and CN10**

① Execute MCS and then input the command “[SPM_PANO]”.

② When inputting the command “[SPM_LON_]”, the vertical and the horizontal lasers of the equipments turn ON.

③ Make (-) Lead rod of DMM contact to GND① and then 0V is to be measured from Pin ③ of CN1 Connector on (+) Lead rod.

④ Input the command “[SPM_LOF_]”, and the Laser turns off. At this point, if measuring Pin ③, it is possible to confirm that it becomes 4.5V.

At Pin 1, 5V is to be measured at all times.

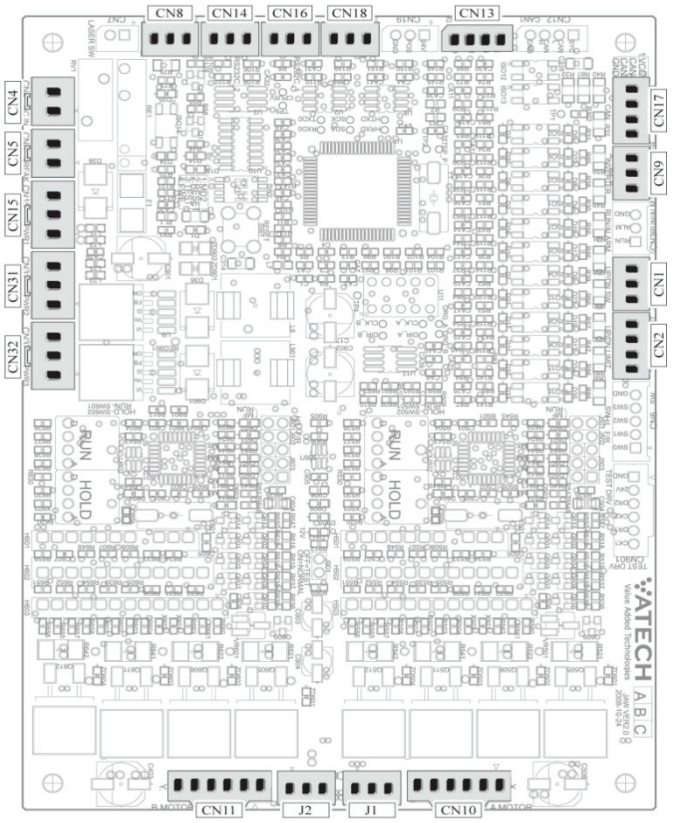
PIN Number	PIN NAME	Idle Status	Operating Status
1	VCC	Over about 4.5V	About 4.5V
2	signal	Over about 4.5V	Less than about 1V

6.5 JAW MCU Board

1. Functions

- Up/Down SW function
- Column Motor Drive
- Communication of Data with MP3 and Mirror LCD in use of Rs232 communication
- CAN communication with 4axis-1 board
- Adjust the height by driving Chin rest motor

2. Exterior of the Board

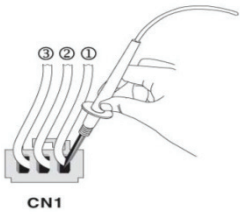


3. Pin Allocation and Description of Functions

PIN Number	Connector name	Description
CN1	UP/DOWN SW	Switch connection part to move the Column Up or Down.
CN2	UP/DOWN Limit SW	Limiting sensing switch to prevent moving out of the minimum and the maximum points of Column.
CN5	Column Motor	Control the motor suspension power when moving the Column up/down.
CN8	Laser	Switch to on/off the laser for patient alignment. And have additional function to move to the location of lamp.
CN10	Chinrest	Chinrest movement to the left/ the right
CN11	Chinrest	Chinrest movement upward /downward
CN12	4ASXIS-1	CAN communication
CN14	MP3 board	Serial communication with MP3 Board through RS-232 communication.
CN16	Mirror LCD	Serial communication with Mirror LCD Board
CN17	Duo LED	
CN18	VR board	

4. Connector Measurement Method and the Measured Values

- **CN1 (UP/DOWN SIGNAL OUTPUT)**
  Connector that receives the up/down signals when pressed the switch for equipment up/down,
  (As pressed the up switch from the Up/Down switch, from Pin 1 of CN1, the Voltage of less than about 2V is measured and the green LED is illuminated at D2 (UP SWITCH INPUT LED). When release the Up switch, from Pin 1, again the voltage over about 20 V is measured and the light on D2 LED disappears.)



Measurement Method

① Press the Up part from the Up/Down switch.

② When putting + part of tester to Pin 1 of CN1 connector and contacting – part to GND, the voltage less than about 2V is measured.

③ At that point, if the equipment moves upward, it is considered as the switch operating normally.

PIN NUMBER	PIN NAME	Pin color	Idle Status	Operating Status	
				Up	Down
①	UP SW	Green	Over about	Less than about	float
②	DW SW	White	Over about	float	Less than about
③	GND	Brown	0V	0V	0V

- **CN2 (UP/DOWN LIMIT SWITCH SENSING)**

The connector receives the upper and the lower limits detecting signals when moving the column UP/DOWN.

(When the column is detected from the highest point by UP LIMIT SWITCH, about 2V of low voltage is impressed to Pin 1 of CN2 connector, so the column does not go up any more, and on the contrary, when it is detected from the lowest point by DOWN LIMIT SWITCH, about 2V of low voltage is impressed to Pin 3 of CN2 connector so the column does not go down any more. At normal status, the high voltage over about 20V is being impressed.

Measurement Method

① Position the column at the highest point.

② If testing Pin 1 of CN2 connector, the voltage less than about 2V is measured.

③ This indicates the UP LIMIT SWITCH of column at that time operates normally. (On the contrary, with same operation, for DOWN, perform the measurement and confirm it)

PIN NUMBER	PIN NAME	Pin color	Normal Status	Operating Status
①	UP LIMIT	Orange	Over about 20V	Less than about 2V
②	GND	Gray	0V	0V
③	DW LIMIT	Black	Over about 20V	Less than about 2V
④	GND	White	0V	0V

Chapter 7 Scanning Programs

7.1 Peripheral Devices Interlocking with Scanning Programs

Part		Version	Remarks
Scanning SW		1.0.1.1	
LCD		1.20	
Firmware	P-B'd	1.0045	Using 4-Axes Board
	S-B'd	1.0018	Using 4-Axes Board
	J-B'd	1.0017	Using 2-Axes Board
	-	-	-
Panorama Sensor		-	Xmaru1501CF (Any Pano):
CT Sensor		-	Xmaru1215CF(Concord 1) Xmaru1524CF(Concord 2)

7.2 Description on Major Functions

1. **CT**

   FOV Size

   Xmaru1215CF: [120 X 85], [85 X 85], [85 X 80], [50 X 50]

   Xmaru1524CF: [150 X 135], [120 X 85], [85 X 85], [50 X 50]

2. **Panorama**

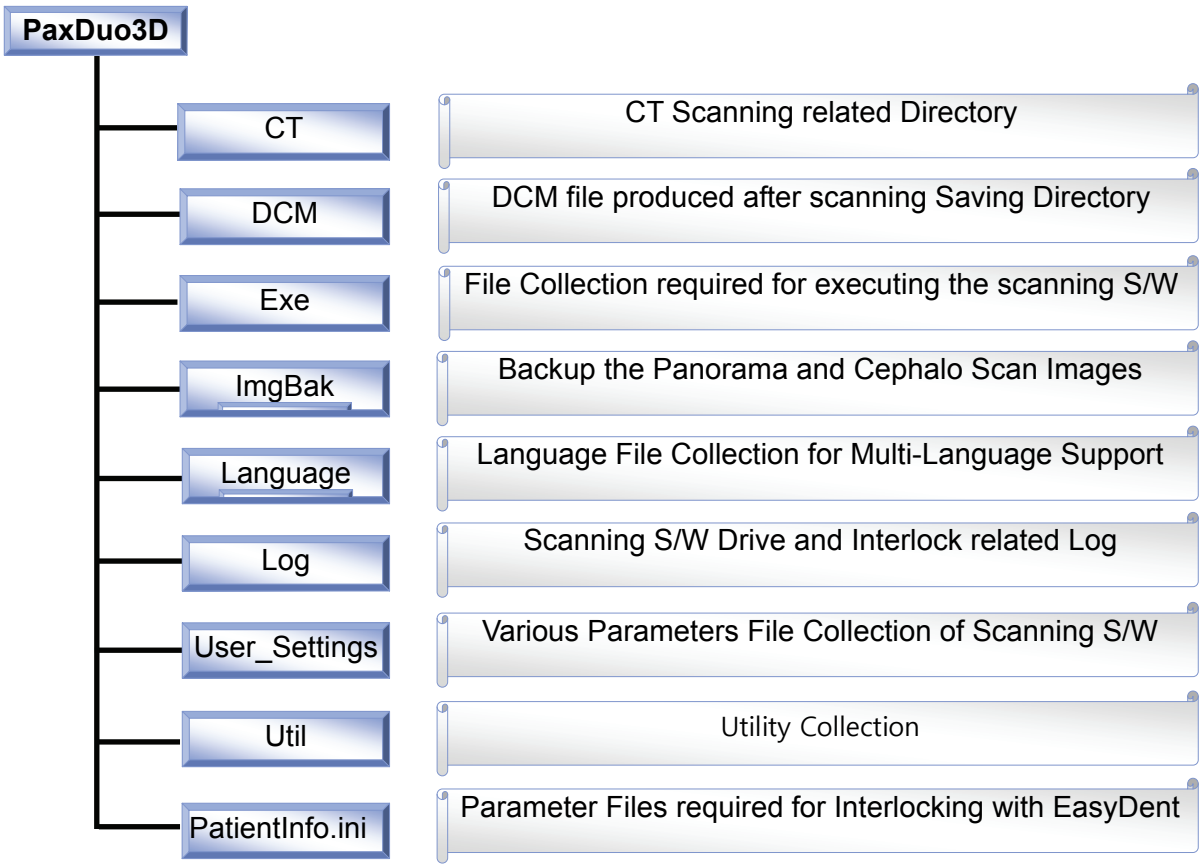
   Standard Mode: Standard, Fast, TMJ Open, TMJ Close, Front, Left, Right, Sinus

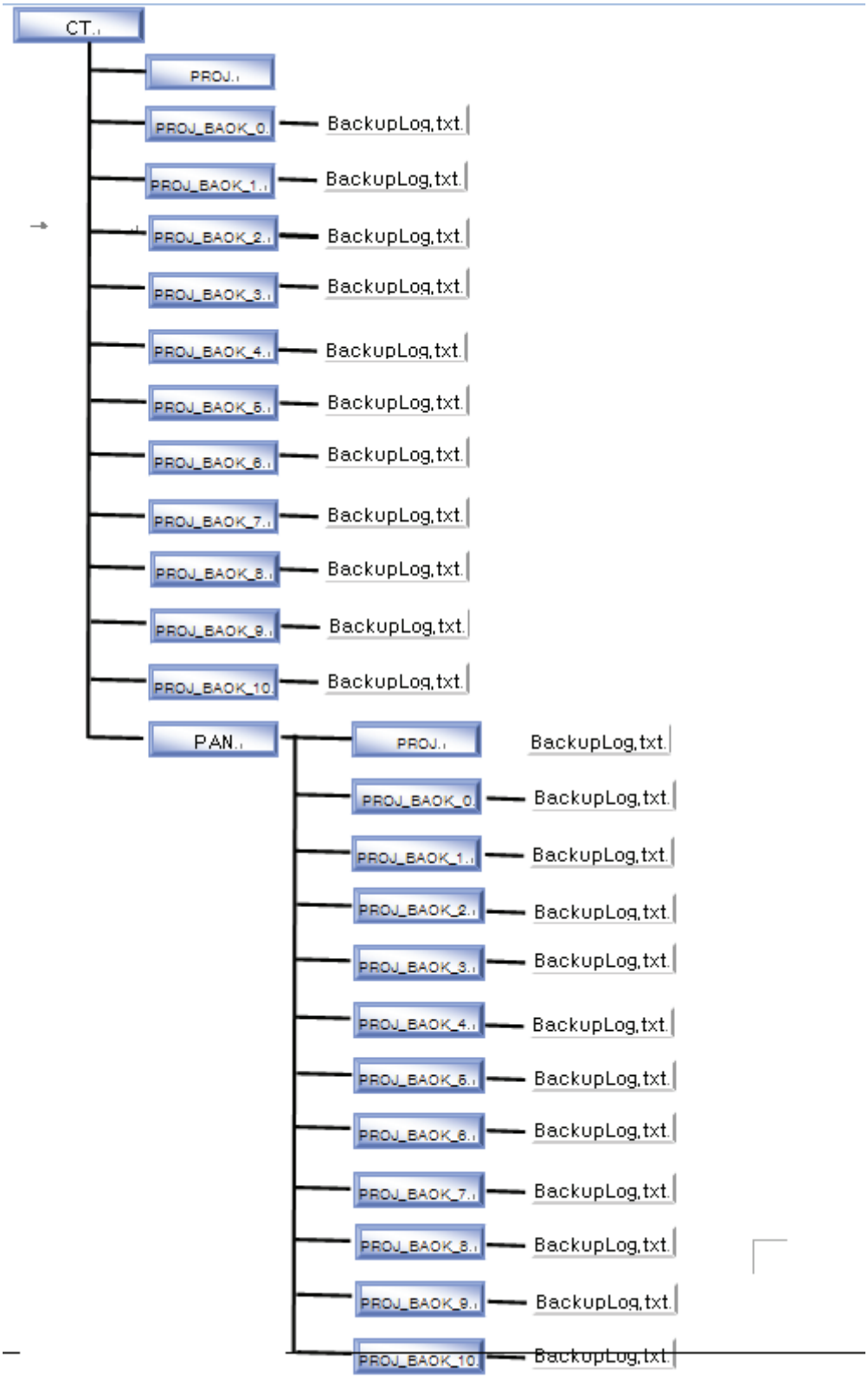
   Special Mode: Maxillary Clear Right, Maxillary Clear Left, Canal Clear Right, Canal Clear Left, Incisor Clear, Orthogonal

3. Major Functions of Scanning Program

Major Functions	Description on Major Functions
Mode Select	Provides UI that selects the Sub-mode of Each Panorama Modes such as Standard / Special / TMJ / Sinus
Capture Sequence	Performs overall controls such as the direct control on the equipment and image acquisition, Image processing, DB saving
Parameter Calculation	When the set point is changed by input of UI, calculates the parameters required for scanning
Equipment Control	Control the equipment through pre-agreed command.
LCD Interlock	Interlocks the UI indication with LCD S/W through pre-agreed command.
Image Acquisition	Acquires X-ray images in use of VAKPAR~. EXE, VAPAN~.EXE Module
Image Restructuring(CT)	Restructures the acquired image in 3D information in use of VAKPAR~. EXE Module
DICOM Conversion(CT)	Converts the Slice Image restructured in 3D information to the DICOM Standard Specifications
Image Optimization (Panorama)	Improves the quality of acquired image by emphasizing the features of each section in use of VAPAN~. EXE Module
Image Viewer	Provides the optimized CT and Panorama Image Viewers.
DB Saving	Supports SDK and Easy Dent 4.xx version

7.3 Folder Composition




CT
PROJ
PROJ_BAOK_0
PROJ_BAOK_1
PROJ_BAOK_2
PROJ_BAOK_3
PROJ_BAOK_4
PROJ_BAOK_5
PROJ_BAOK_6
PROJ_BAOK_7
PROJ_BAOK_8
PROJ_BAOK_9
PROJ_BAOK_10
BackupLog.txt
PAN
PROJ
PROJ_BAOK_0
PROJ_BAOK_1
PROJ_BAOK_2
PROJ_BAOK_3
PROJ_BAOK_4
PROJ_BAOK_5
PROJ_BAOK_6
PROJ_BAOK_7
PROJ_BAOK_8
PROJ_BAOK_9
PROJ_BAOK_10
BackupLog.txt

1. PROJ images scanned by the scanning S/W are saved automatically in folders by CT/PANO from Proj_Back_0 to Proj_Back_10.
2. For saving sequence, the initial scanned images are transferred from PROJ folder to Proj_Back_0 folder, and at the 2nd time scanning, Proj_Back_0 is transferred to Proj_Back_1 folder, recording the information on images at BackLog.txt files inside each folder.

   The following presents an example of information saved in the backupLog.txt file

==========BackupLog.txt sample==========

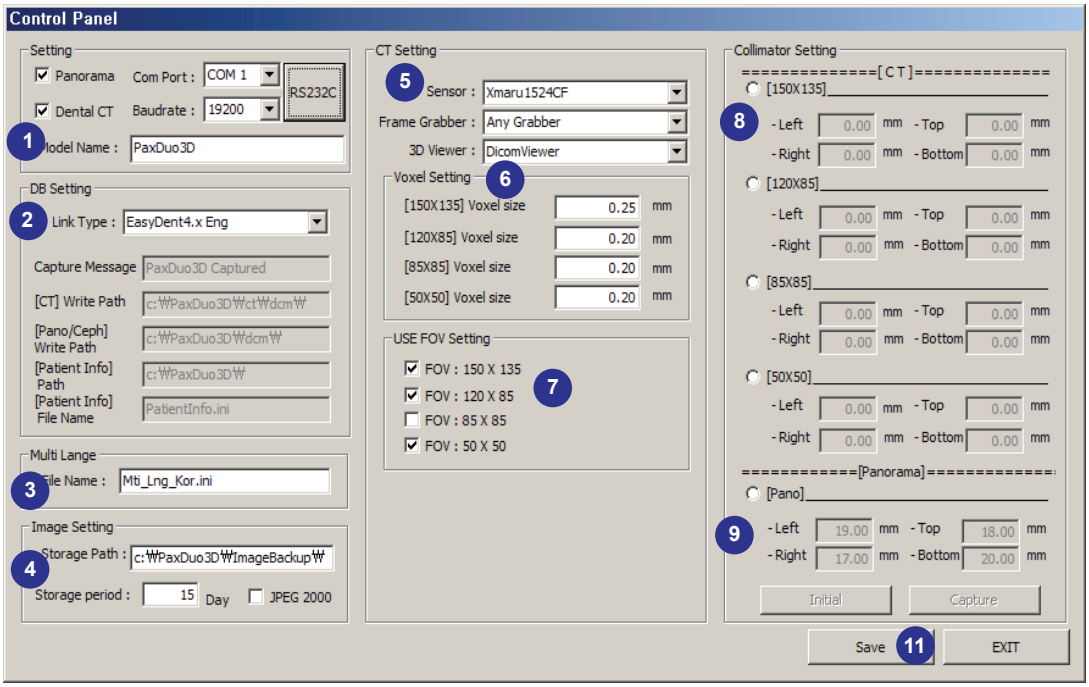
[Capture Mode]
Capture=CT_SHOT
mA=400
kVp=850
[Patient Info]
Name=Vatech
Chart Num=6838
Gender=F
Age=30
[System Log]
LogFileName=C:\PaxReve3D\Log\20090106_130702.log

==========

7.4 Environment Setting

The following screen is the initial screen of scanning program in the PC.
Click “Setting” at the right upper side and a small dialog box is to be displayed as shown in following figure.

Password: Input **vatech** (input with small characters) and click login, then a communication window is to appear as shown in the following figure.

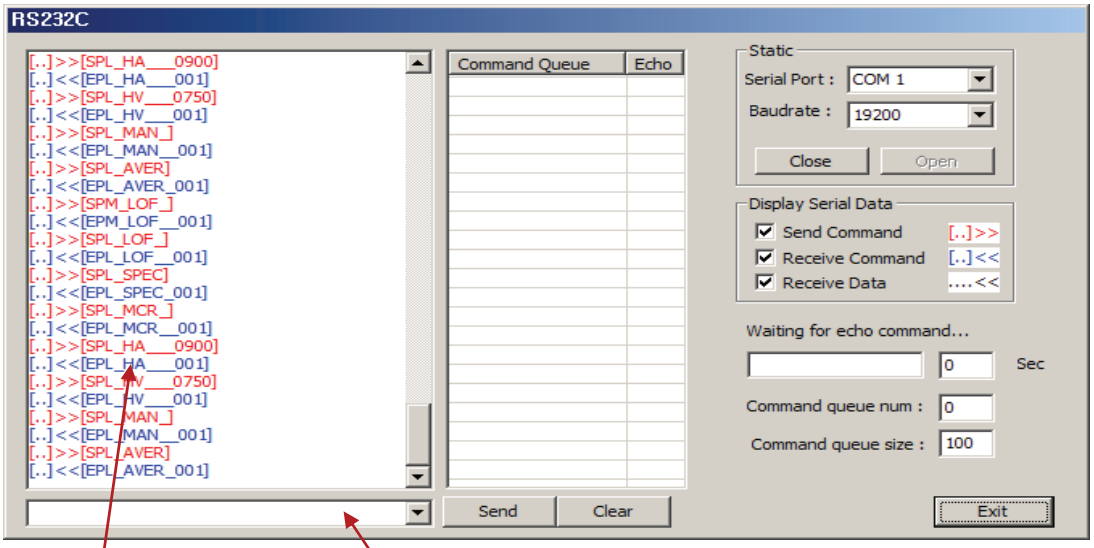


1. Setting

- Panorama: Function to Enable Panorama function
  When the check is revoked, the canceled function is no longer usable.
- Dental CT: Function to Enable CT function
  When the check is revoked, the canceled function is no longer usable.
- Comport: Communication Port setting for serial communication with the equipment.
- Baud rate: Communication speed setting for RS232 communication with the equipment (Default: 19200bps)
- Model Name: Function to set the Equipment name that is to be indicated on the taskbar.
- In case of equipments sold to overseas such as PaxDuo3D, Picasso Duo and etc, the model name of equipment is separately classified in respect to the certification, therefore, it is added to be changed depending on the selling country.
- RS232: Terminal Interface Utility Program capable of direct commanding on the communication details of the equipment

NOTE

This program can be used on behalf of HyperTerminal.



Echo Window Command Input Window

2. DB setting

- Link type: Setting to interlock the scanned image information with the patient management program
  Easy Dent 4.x For Domestic Use ➔ Support
  Easy Dent 4.x For Overseas Use ➔ Addition in progress
  Easy Dent 3.x For Domestic Use ➔ Addition undetermined
  Easy Dent 3.x For Overseas Use ➔ Addition undetermined
  SDK Link ➔ Support
- Capture Message: Global Message required for SDK interlocking
- Write path [CT]: CT Image Saving Path for SDK interlocking
- Write path {Pano/ceph}: Panorama, Cephalo Image Saving Path for SDK interlocking
- Path [patient info]: Location of Patient Information File for SDK interlocking (Provided from the Patient Management Program)
- File name: Patient Information File Name for SDK interlocking

3. Multi language

- File name: Setting the language file to support the multi-language
  For Domestic Use: Mti_Lng_Kor.ini

For Overseas Use Mti_Lng_Eng.ini

Currently supports Korean and English only

4. Image setting

- Storage path: Function to set the backup position for acquired images.
  Save raw images and bmp images of acquired images in the folder arbitrarily defined by the user.
- Storage period: Storage Period of Backup Images.
  User can set this considering the capacity of hard disc drive.
  Basically, store the images for 15 days.
- JPEG2000: Function to JPEG Compacting of outputting DICOM images.
  Unusable because the current patient management program does not support.

5. CT setting

- CT sensor selection
  Xmaru1215CF: Implementation of Max. 120 X 85 FOV Size
  Xmaru1524CF: Implementation of Max. 150 X 135 FOV Size
  ## When selecting the FOV sensor, automatically transformed into FOV ##
- CT frame grabber selection
  National Instrument: supports PCI 1424 and PCI 1422
  Any Grabber: support In-house Grabber
- CT image viewer selection
  Supports Dicom Viewer
  Supports EzImplant
  Supports Ez3D, Ez3D2009

6. Voxel setting

120X85 FOV (When selecting Xmaru1524CF sensor 150 X 135) Voxel size setting
85X85 FOV (When selecting Xmaru1524CF sensor 120 X 85) Voxel size setting
85X50 FOV (When selecting Xmaru1524CF sensor 85 X 85) Voxel size setting
50X50 FOV (When selecting Xmaru1524CF sensor 50 X 50) Voxel size setting

7. FOV size setting

120X85 FOV (When selecting Xmaru1524CF sensor 150 X 135) Enable function
85X85 FOV (When selecting Xmaru1524CF sensor 120 X 85) Enable function
85X50 FOV (When selecting Xmaru1524CF sensor 85 X 85) Enable function

50X50 FOV (When selecting Xmaru1524CF sensor 50 X 50) Enable function

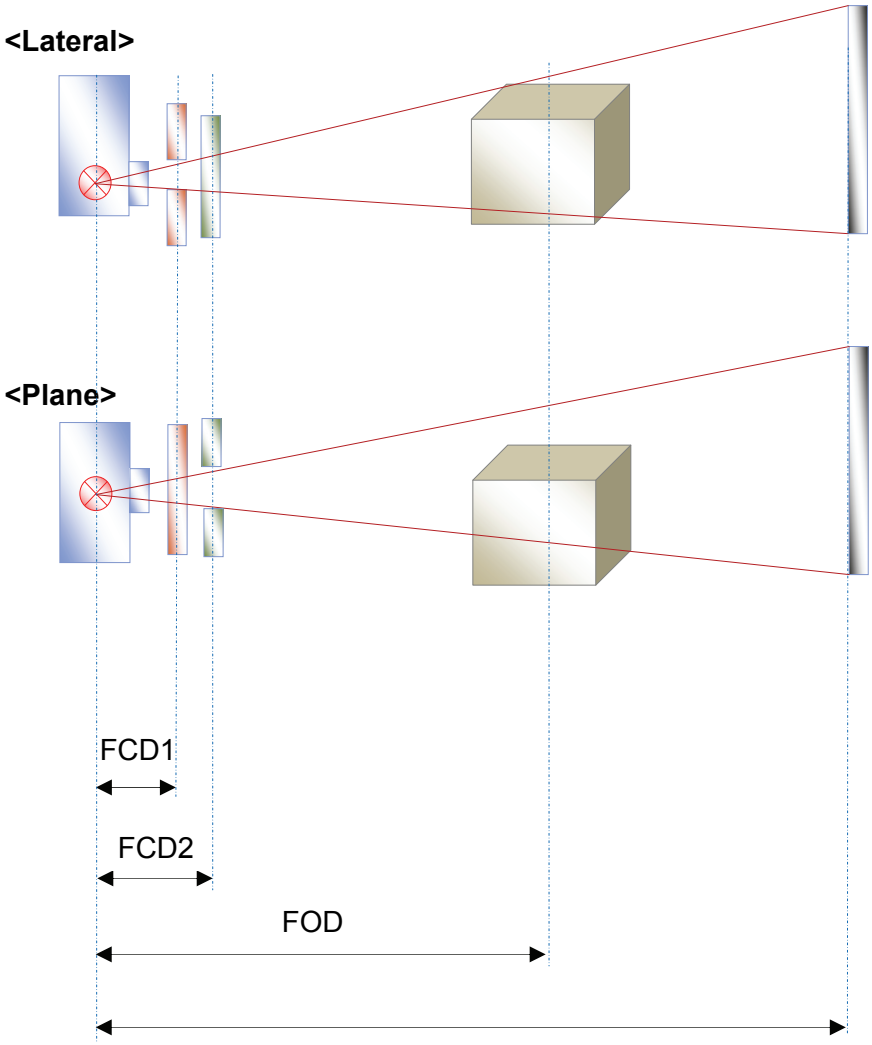
8. Collimator setting[CT]

See 7.5

9. Collimator setting[Pano]

See 7.5

7.5 Collimator Setting

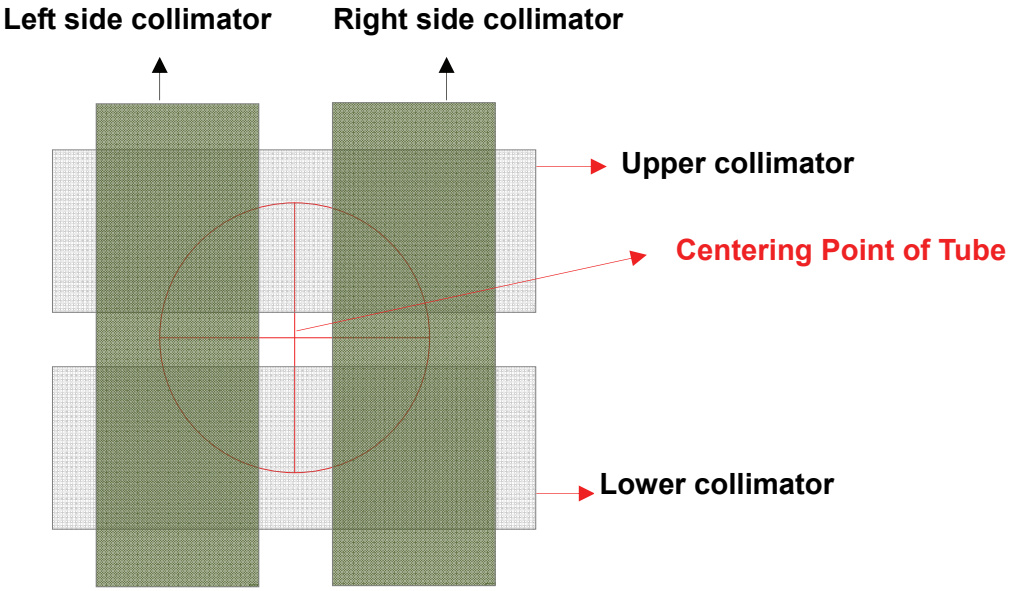


For initialization for Collimator setting, select the collimator of desired mode to change, and click No. 8 Button of Environment Setting. Then the equipment starts preparation for image acquisition.

When preparatory task is completed, the No. 30 Button of Environment Setting is to be activated, and when clicking this button, the image viewer is to be executed.

After confirmed images through the image viewer, set No. 27 item (CT) and No. 29 item (Panorama) of Environment Setting. The setting methods are as follows.

Find the value corresponding to the reference by changing the position of each collimator in manual way.



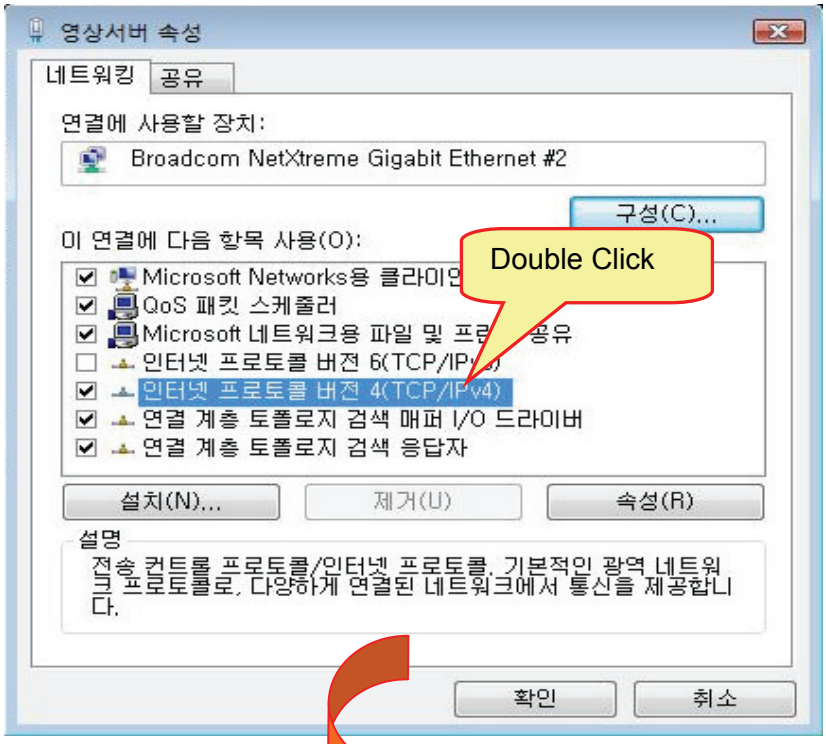
The unit is 0.1 mm that is the distance of collimator's actual movement. The base of all collimators is the center, and its value is 0. Set the distance being alienated from the center in positive number unit. When it is negative number, the collimator moves in opposite direction (Necessary for Panorama)

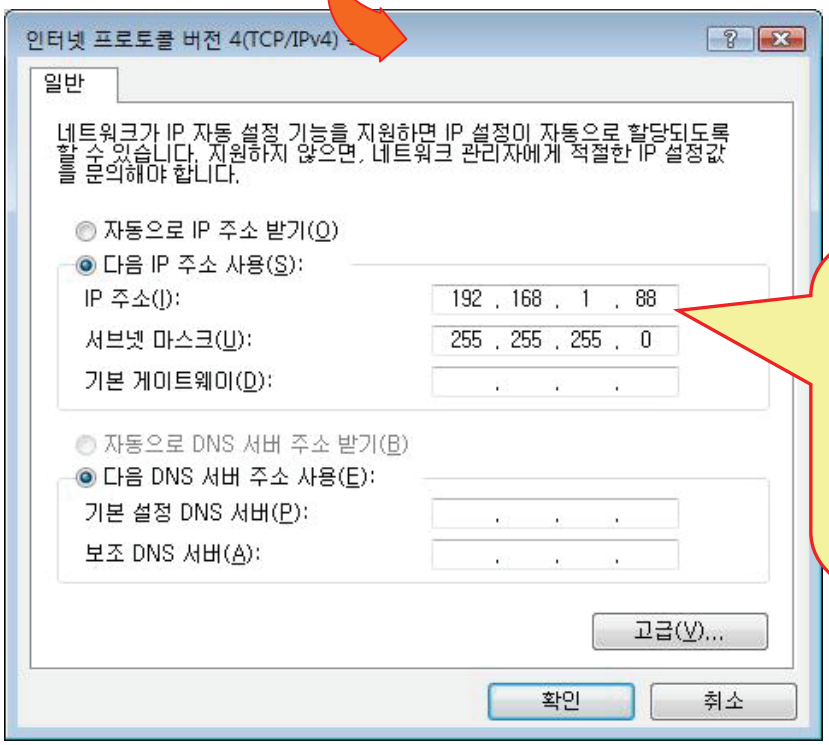
No. 27 item and No.28 item of Environment Setting

- Left ➔ Coordinates of Left side collimator
- Top ➔ Coordinates of Upper side collimator
- Right ➔ Coordinates of Right side collimator
- Bottom ➔ Coordinates of Lower side collimator

7.6 Network Setting

Click in sequence of [Start] → [Setup] → [Control Panel] → [Network Connect], and the screen as follows is to appear. Double click the Lan card to connect to the equipment with mouse.

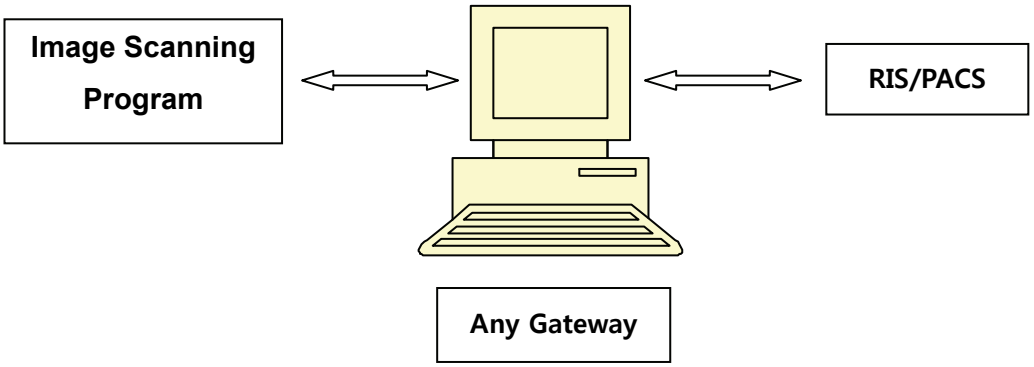




1. Select the following IP Address.
2. Set the IP Address as shown in the Figure.
3. Leave all columns of DNS server as blank

Chapter 8 Software Interlock

The image scanning program is basically to work with EasyDent and Ez3D2009. However, in order to interlock the image scanning program and other application programs, the environment should be setup in following sequence.



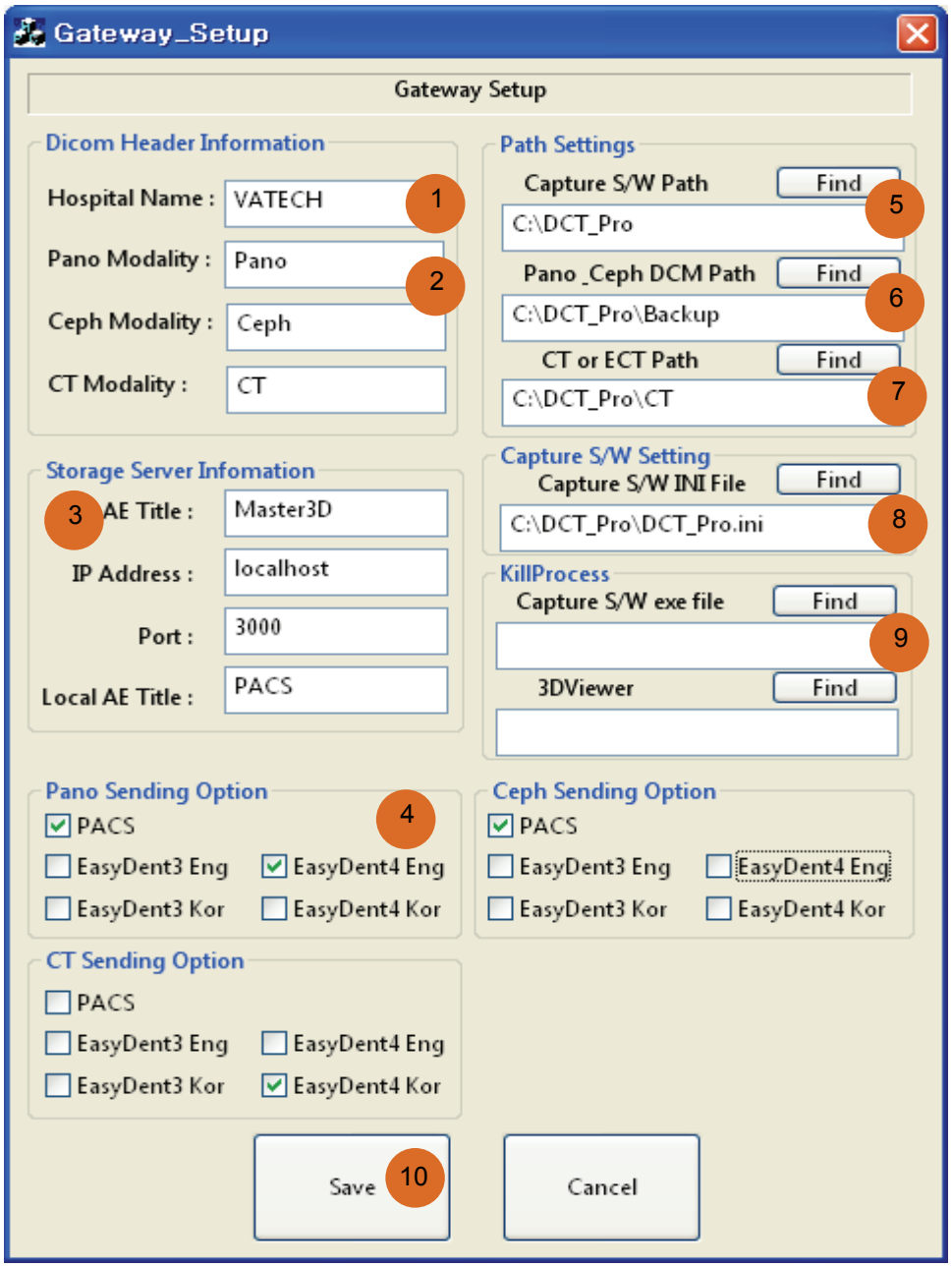
8.1 Gateway Program Installation

1. Relieve the compaction program provided to suitable directory.

2. Click **"Setup.exe"** to begin installation**.**
3. After a few steps, complete the installation.
4. When the installation is successfully completed, 2 subdirectories are to be created inside **C:\Pacs_Utils** as follows.

8.1.1 Parameter Setting after Gateway Installation

Click **C:\Pacs_Utils\Gateway\Gateway_Setup.exe,** and following screen is to appear.



① **Hospital name:** Designate the clinic name to save in Dicom

② **Dicom header information:** Select Modality (Equipment name) of Pano, Ceph, CT

③ **Storage server information:** Write the server information to which the image is to be transmitted.

④ **Pano sending option:** Select the program that Gateway is to transmit (Double selection possible)

It is possible to designate the program to transmit by classifying with Modality

⑤ **Capture s/w path:** ROOT folder where the scanning program is installed.

⑥ **Pano DCM path:** Designate the folder where the Pano image is to be acquired.

⑦ **CT or ECT path:** Designate CT (ECT) folder where Vakpar.exe is enclosed.

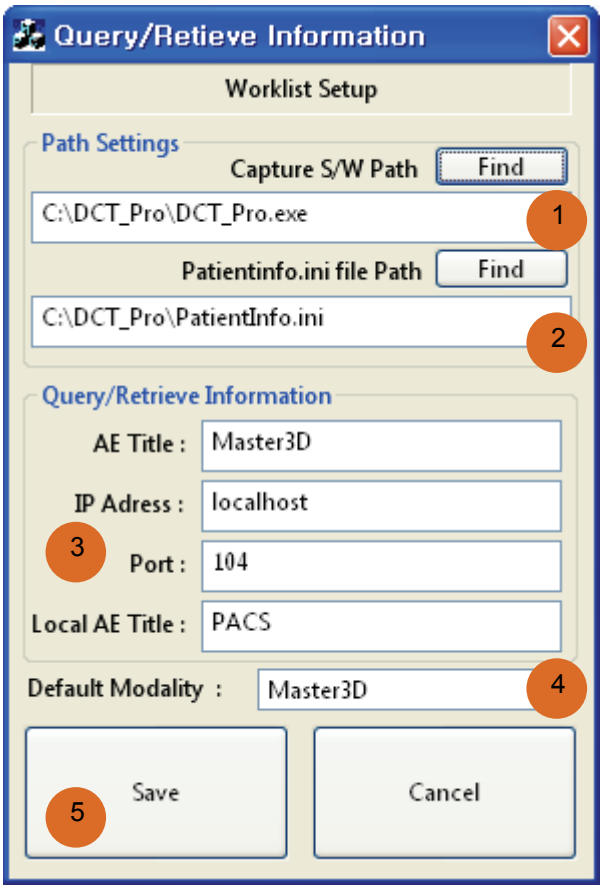
⑧ **Capture software setting:** Scanning software environment setting file.

⑨ **Kill Process:** End the S/W to scan and Review at the time of Sending (Not required to set in general circumstances)

⑩ **Save:** Save all set values.

8.1.2 Work list Parameter Setting

Click **C:\PACS_Utils\Worklist\worklist_Setup.exe**, and following screen is to appear.



① **Path setting:** Designate the execution file of scanning S/W.

② **Patientinfo.ini path:** Designate the patient information record file of scanning S/W.

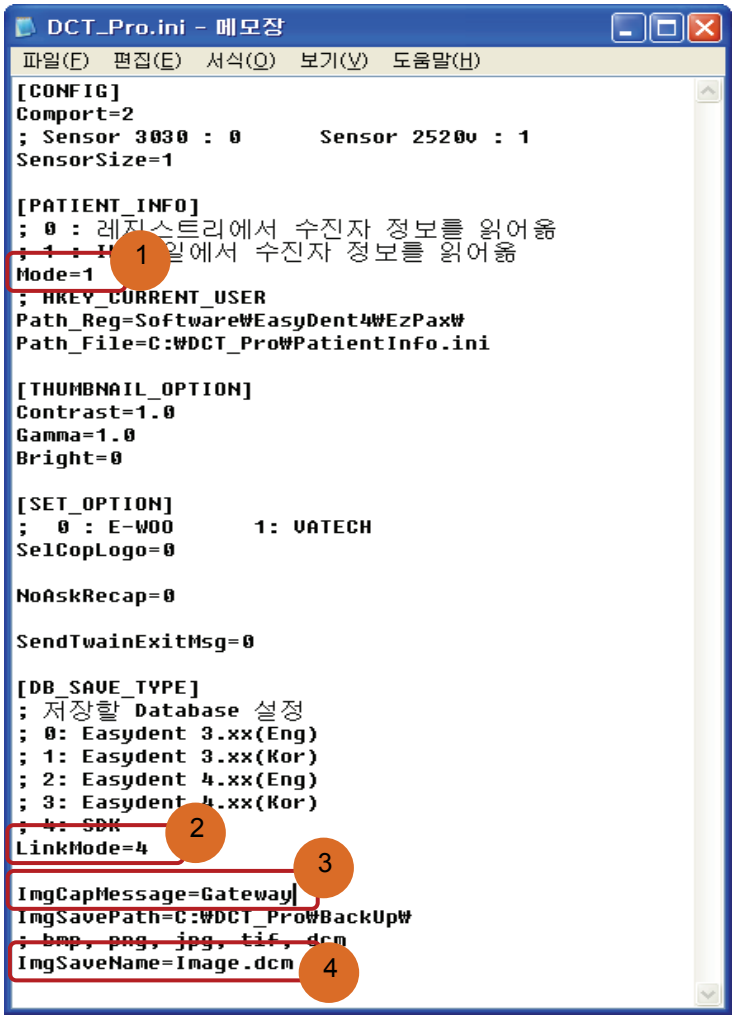
③ **Query/Retrieve information:** Set the Work List Server which will receive the Order information.

④ **Default Modality:** Select Default Modality of Work list. (Initial Modality when executing Work list)

8.1.3 Scanning Platform Environment Setting (Environment Setting.ini. included in the Scanning S/W)

The following figure is an example of **.ini** file of DCT_Pro equipment and is same with other equipments.

Therefore, it can be applied just as it is.



① **Mode=1:** Set as 1 to import the patient information from .INI file.

② **LinkMode=4:** Set as 4 to use SDK.

③ **ImageCapMessage=Gateway:** Set the message to send when calling SDK from Scanning S/W as gateway.

④ **ImagSaveName=Image.dcm:** Change Image.bmp to image. DCM to allow the Pano and Ceph Images to be produced as DICOM file.

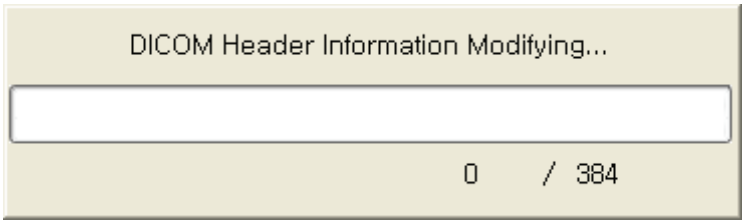
Cautions for Scanning S/W

1. The version of Scanning S/W should support the SDK Mode.
(Check whether the item of ImgCapMessage is in the set file (ini))
2. It should be the version capable of producing the images of Pano and Ceph as dcm.
(Check whether the item of ImgSaveName is in the set file (ini))
3. The Scanning S/W should be capable to be driven in SDK Patient Information File (Patientinfo.ini) without the patient's name information (FNAME, LNAME)
4. SliceList.txt, MarList.txt files should be incorporated to SliceList.txt.

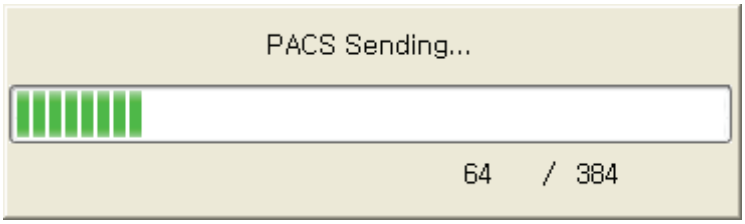
8.2 How to Use

8.2.1 Gateway

- Gateway does not require the user's manipulation since it is executed and operates as background when necessary.
- Select the Save After Scanning button from Scanning S/W, and the progressive bar is to appear in the Gateway as shown in following figure.



This is a process to write the patient information selected from Work list into DICOM file.

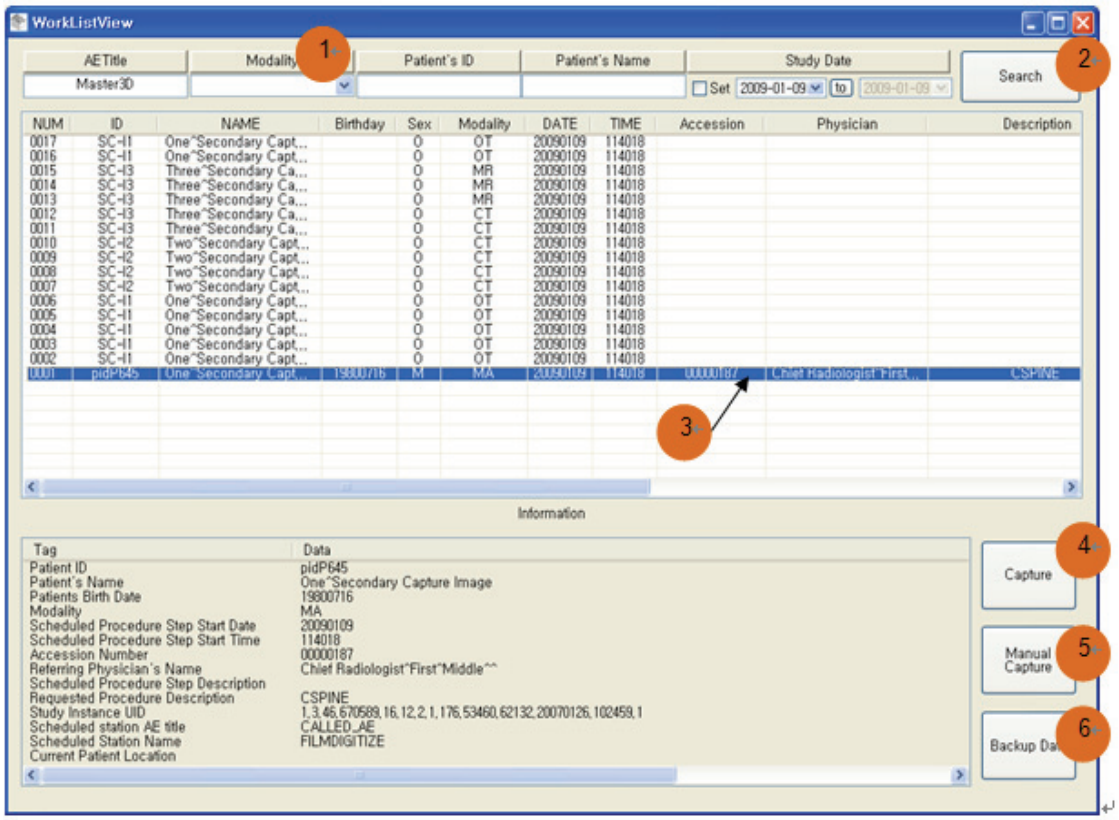


This is a process to transmit the image to PACS file server

The time consuming to send CT differs depending on the total volume of the sending image, the internal network environment of the clinic (Transmission speed, Network traffic control method like QOS), and Receive speed of PACS Storage Server.

8.2.2 Work list

1. Order Search



① **Modality:** When executing Work list, Default Modality (Select from the environment setting for Work list) is to be indicated.

② **Search:** Press the Search button to search Order.

③ **Order selection:** Click and select the Order subjected to scan from the list using mouse.

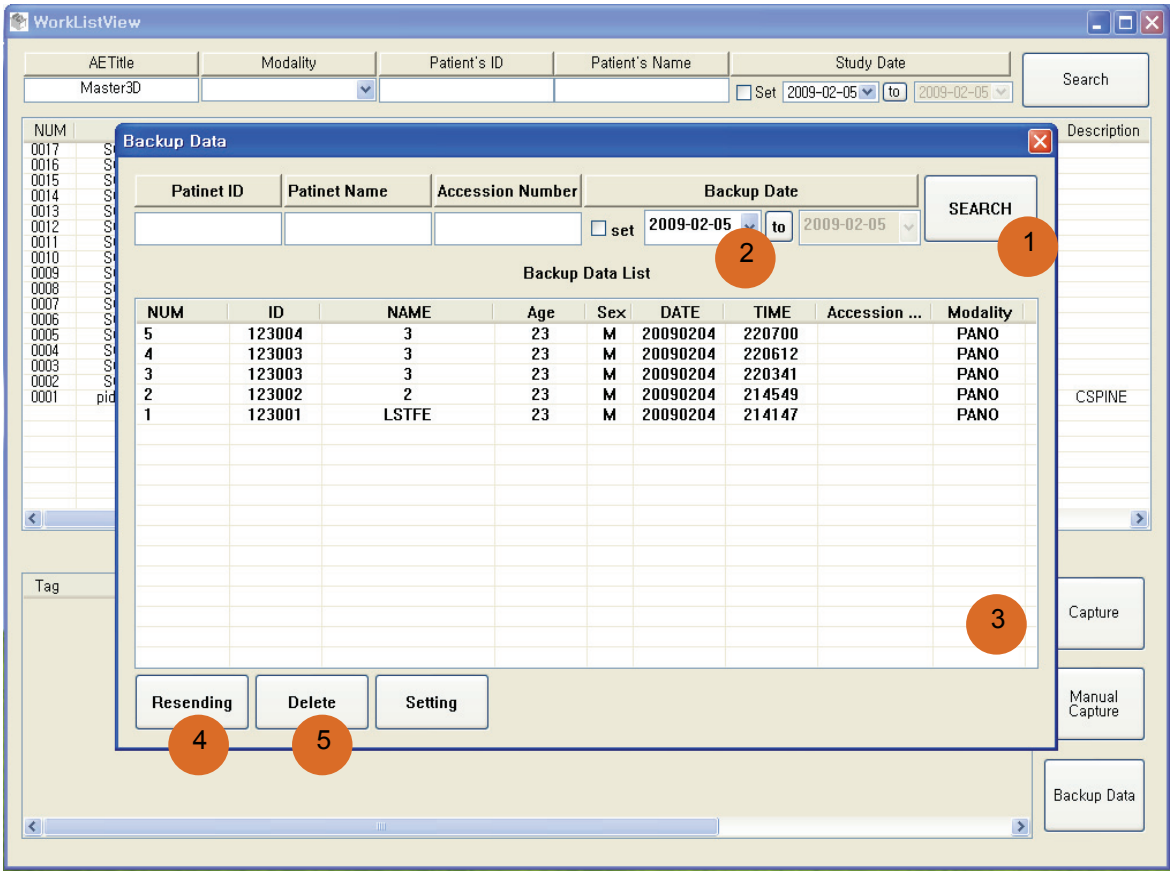
④ **Capture:** Start the scanning of selected Order.

⑤ **Manual capture:** Use this when scanning by direct input of patient information, not selecting the Order from the list.

⑥ **Backup data:** Manage the backup data of scanned images.

2. Backup Data Management

- After scanning, back up the scanned images in C:\PACS_Utils\Backup in prior to Sending.
- The backed up information can be checked with Backup Data of Work list and can be resent.



① **SEARCH: Backup:** Search the backed up data.

② **Backup Date:** Select the storage period of backup data.

③ **Backup data list:** List items of backup data

④ **Resending:** Perform Resending the selected backup data to PACS Storage Server. Perform the Sending to the designated place for transmitting to Gateway_setup.ini.

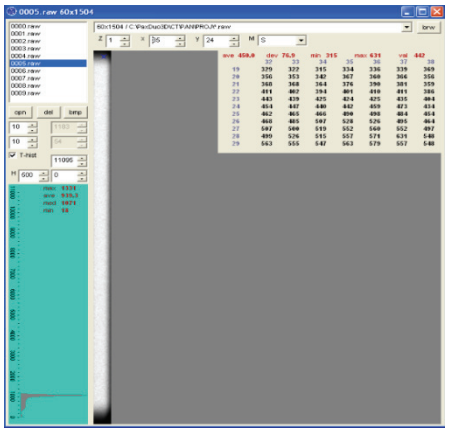
⑤ **Delete**: Delete the selected backup data.

Chapter 9 Panoramic Image Assessment

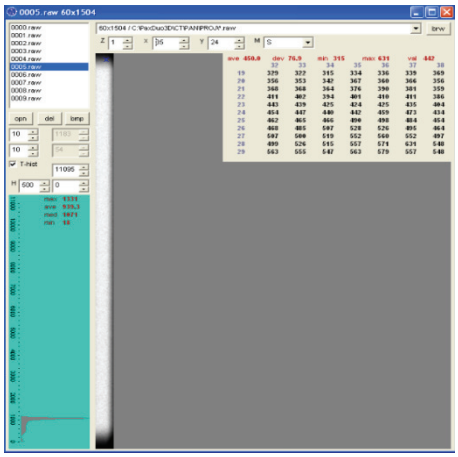
9.1 Collimator Setting Standards

Following figure is the confirmation screen of Proj file

Confirmation screen of Proj file



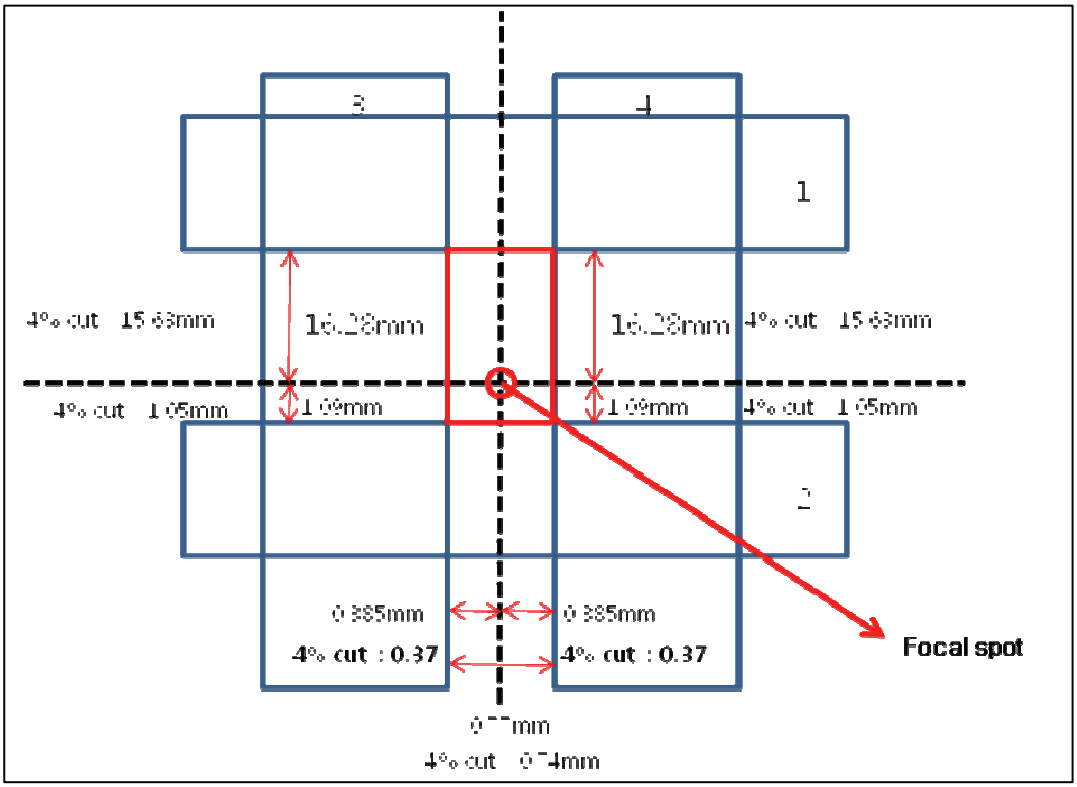
Above screen shows the confirmation screen (above) of Proj file



Above screen shows the confirmation screen (below) of Proj file

1. Collimator Requirements

Collimator Drawings Standards



Above and Below: Apply 4% Cut.

PaX-Duo3D Collimator Standards Setting					
	Equipment Set Point _Height (Apply 4% Cut)		Equipment Set Point _Width (Apply 4% Cut)		Remarks
Remarks	Top	Bottom	Left	Right	
	15.2 mm	1.8 mm	0.3 mm	0.7 mm	
Total	17.0 mm		1.0mm		

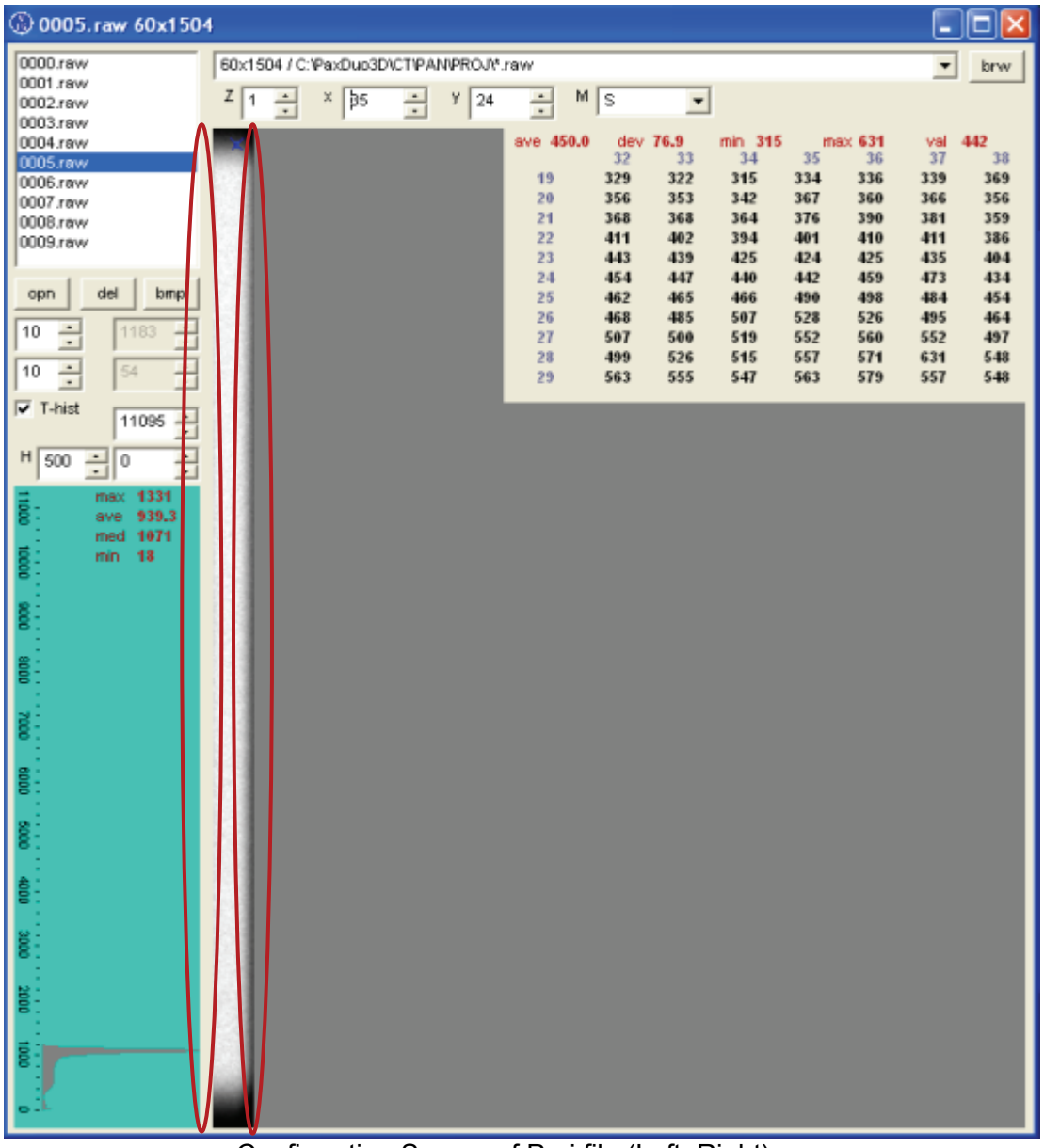
- Each Collimator (**Top, Bottom=17.0mm**, **Left, Right=1.0mm**) values of equipments is to be the default value. **The width is fixed as 1mm**, and the height can be changed within 17±1mm depending on the tolerance of device.
- When setting the height, the standard of 4% Cut is based on the area that its **Pixel level is less than 1000, as each 20 ~ 40 pixel** for top and bottom respectively. (Because it did not use the copper filter, the X-ray irradiated areas are mostly over 4000 Level)

- In Child mod, Collimator does not needs separate child mode Collimator setting because the upper part of image is being cut by 20% automatically without any individual adjustment.

[Cautions]

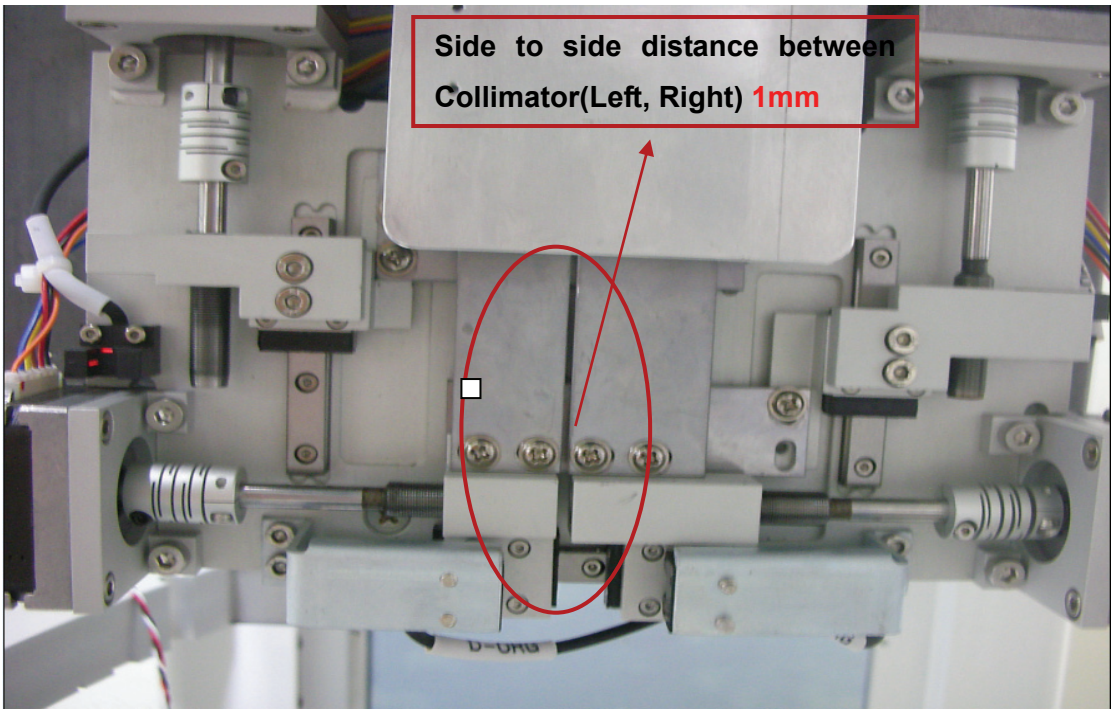
- When setting the Collimator value, the top and bottom values are the matters of device tolerance. Therefore, when there is difference of values, the longitude default value 17mm can be changed within the range of ±1mm.

Confirmation Screen of Proj. File (Left, Right)



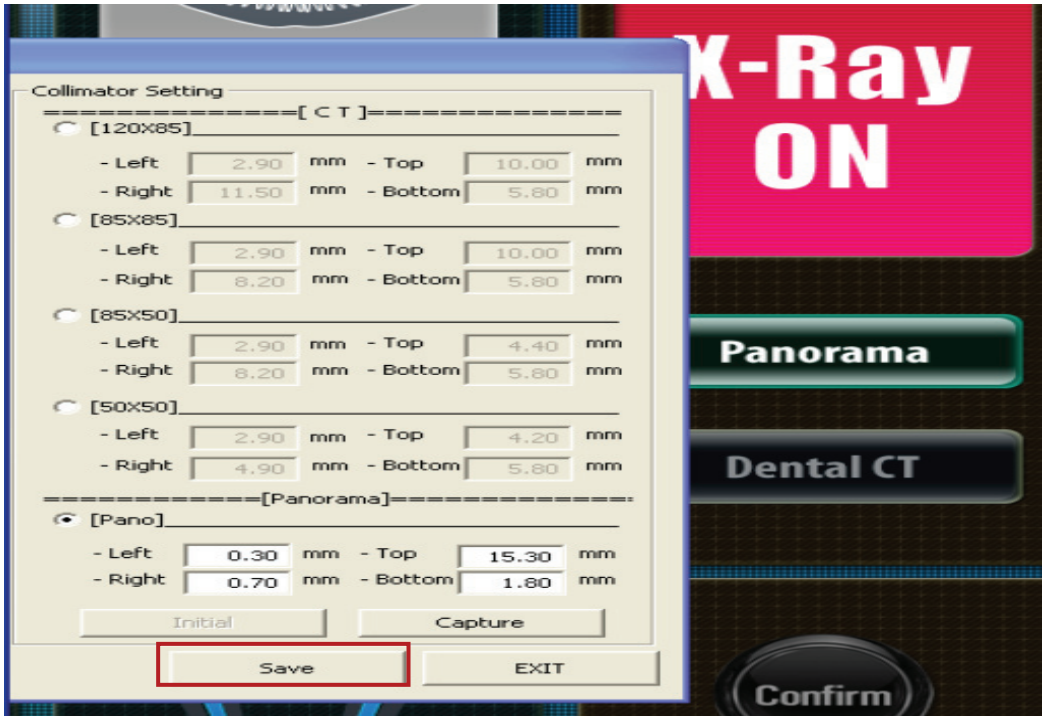
Confirmation Screen of Proj file (Left, Right)

2. Visual Confirmation on Collimator Distance



Confirmation on Collimator Distance

3. Saving the Completion of Setting

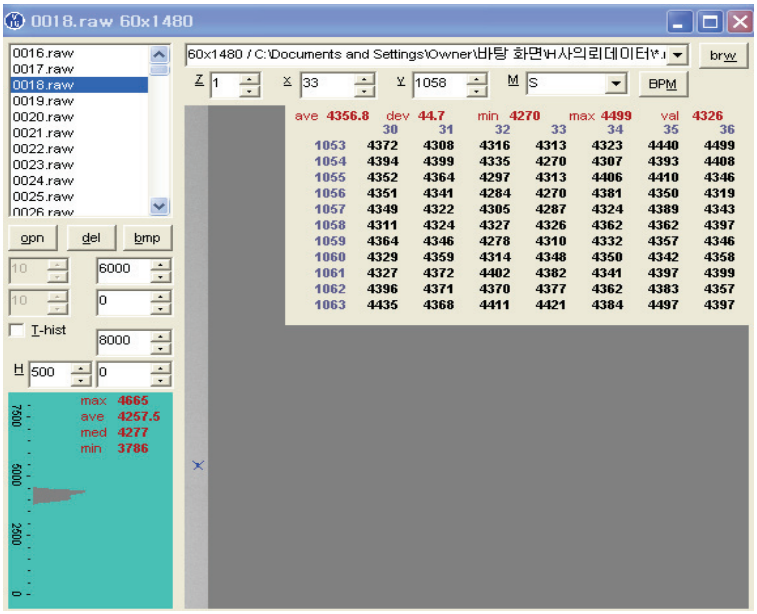


As shown in above figure, when the Collimator setting is completed, press the “save” button to save the values.

9.2 Alignment Confirmation

1. Execute VAKCAP.exe in C:\PaXReve3D\CT folder.
2. Check whether the Imaging interface is selected as 3.IMAQ-Pano from Settings Tab. ☞ Panorama Mode
3. Select the Capture as #3: Mode4 (13sec~200fps) from Panorama Tab, and set the Scan parameter as Voltage: 700, Current: 900.
4. Input [spm_pano] at Command window.
5. When clicking 'Capture', the Panorama scan command is sent automatically, and the Vapan window is to be activated. Then press the irradiation switch.
6. From Vie, click V Proj, and then View16 is to be executed. Check whether X-ray is irradiated with uniformity on applicable projection data.

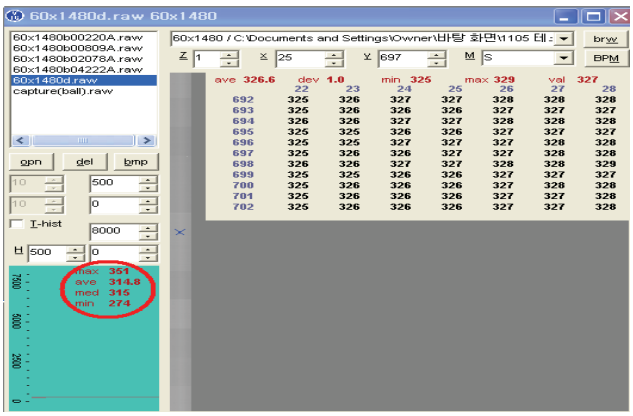
Following figure is an example of image with correct X-ray Align.



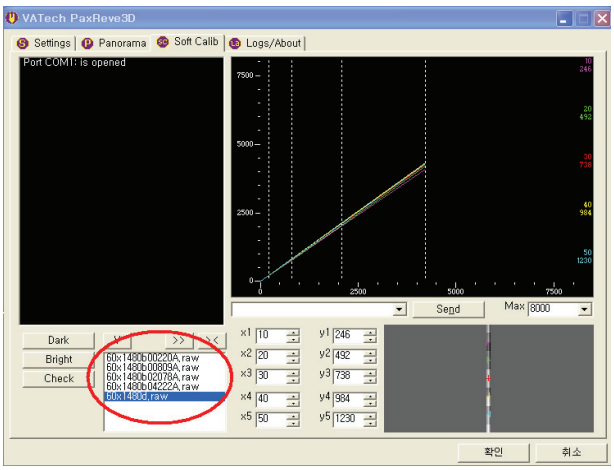
9.3 Acquisition of Calibration Data

Reference: *This method is similar to the acquisition method from CT images.*

1. Check on Clause 12.1, 1 and 2.
2. From **Soft Calib** Tab, click **dark,** then the dark data is acquired automatically and is saved as **60x1480d.raw** inside **C:\PaXReve3D\CT\Cal** folder.
3. The acquired dark data can be confirmed through View16, with its **Average(ave) Level** should belong to the range of **310 ± 30**.



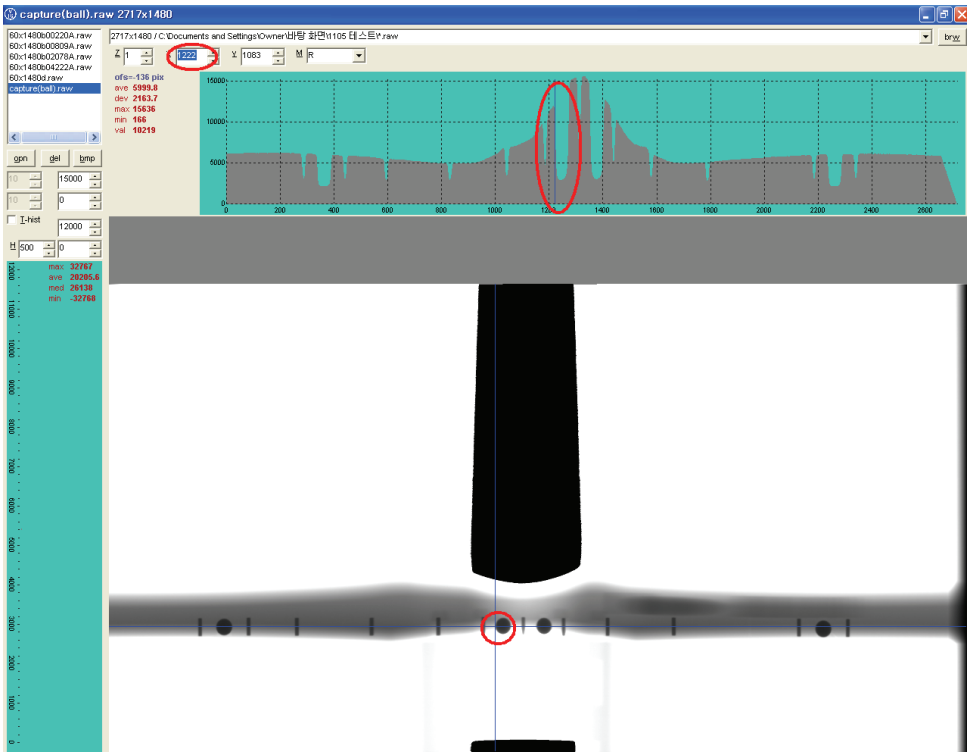
4. When clicking **'Bright'** from **Soft Calib** Tab, the command is sent automatically and when **Vapan** window is activated and by pressing the irradiation switch for about 1 second, the applicable bright date is to be acquired.
5. Since it use 4 point calibration in total, 4 of bright data are required. Also Vapan window is activated for 4 times, and when pressing the irradiation switch for 4 times, then, 4 of bright data is to be acquired.
6. The 4 bright data acquired is to be saved with following names.
   60x1480b0XXXXA.raw: 60x1480➔ File size, b➔bright, 0XXXX➔ Average level value
   Ex) **60x1480b00220A.raw ➔** bright, means that the average level is 220



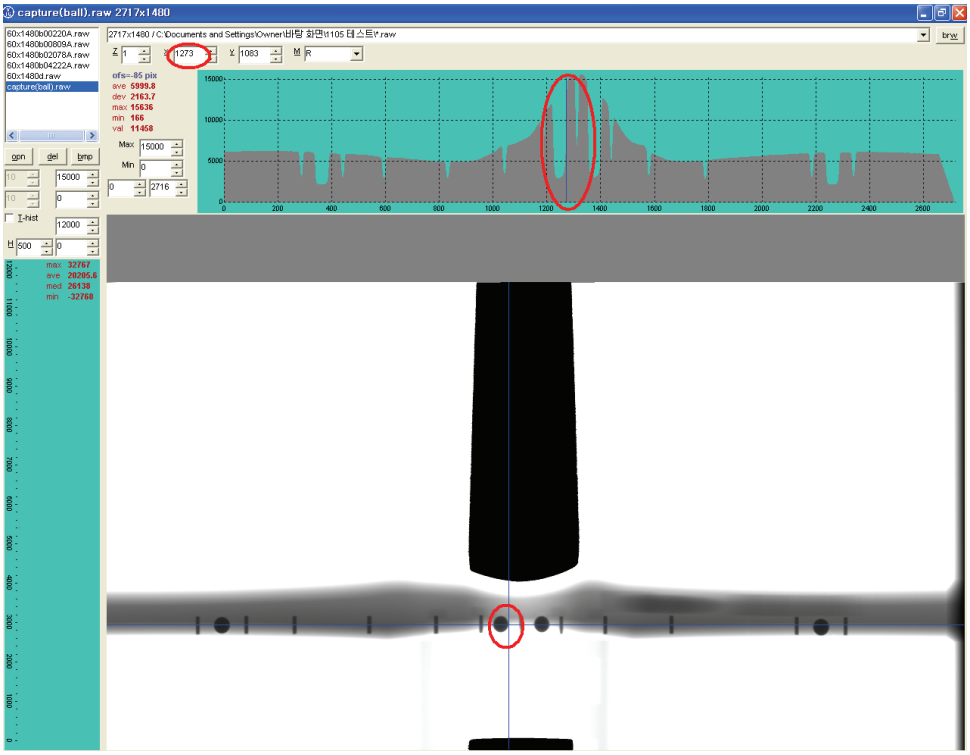
9.4 X-Axis Reference Value Setting/Ball Phantom Enlargement Ratio

1. After confirmation on Dogtooth /Vertical/Horizontal laser and the Ball Phantom Horizon, Scan the ball phantom in normal mode.
2. Using View16 program, import **capture.raw** into **C:\PaXReve3D\CT\Pan**.
3. Set the measuring position precisely to the center of vertical length of Ball.
4. As measured each of 4 balls on their respective horizontal length, adjust the X-axis value to be in the range of **50~51 pixel**.
5. **[spm_xpst_1380] ➔ default value**, [spm_xp?_] ➔ Current xp value confirmation command
   - For the size of ball > 52 pixel, reduce [xpst] value
   - For the size of ball < 50 pixel, increase [xpst] value
6. The horizontal lengths of 4 balls are equal as in the range of 50~52 pixel, the X-axis reference value setting is to be completed.

Screen at the time of measuring

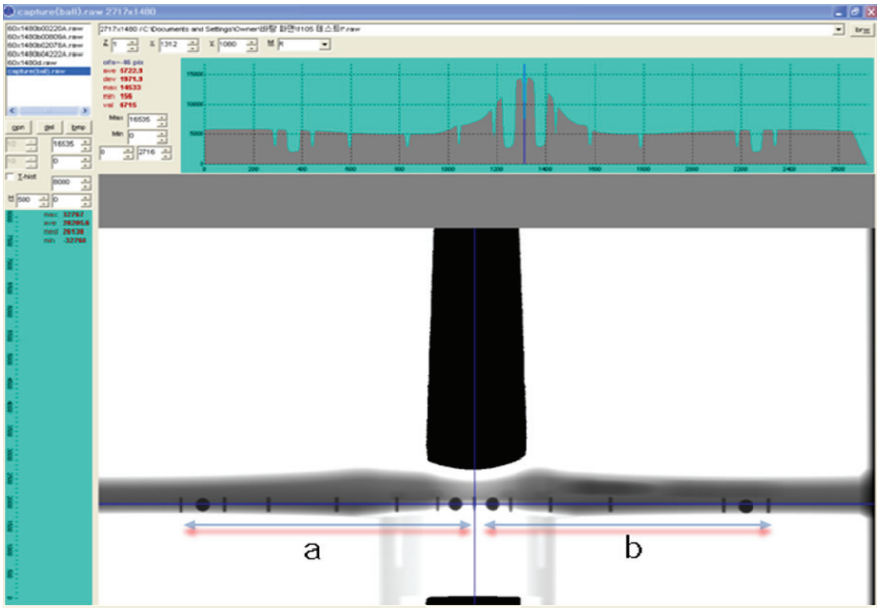


Horizontal Length of Ball: 51 pixel (1222 ~ 1273)


capture(ball).raw 2717x1480
2717x1480 / C:\Documents and Settings\Owner\바탕 화면\t105 테스트\r.raw
brw
Max 15000
Min 0
ave 5999.8
dev 2163.7
max 15636
min 166
val 11458
opn
del
bmp
I-hist
12000
max 32767
ave 28205.6
med 26138
min -32768

9.5 Confirmation on X-ray's Transverse Distance Enlargement Ratio

1. Import the ball phantom image acquired by setting the X-axis reference value under Clause 12.3 in use of View16.
2. Using aforementioned image, measure the transverse distances between both side pins having the center pin as the standard point.
3. The length of transverse distance should be equal within the error limit of **10 pixel**.
4. **If any error over 10 pixels incurs, it means the transverse distances from standard point at the center to the left and to the right are difference, resulting the one side enlargement in the final image.**
5. When an error over 10 pixel incurs, input [spm_vp?_] and confirm on the current value, then make adjustment using **[spm_vpst_10xxx]** command.
   - 10xxx ➔ The front 2 digits presents the direction
     (10➔Left side direction, 00➔Right side direction)
   - 10xxx ➔ The rear 3 digits presents the shift value
6. In the measured result, value A and value B should be equal as shown in following figure.



9.6 Scan Starting Angle Setting

1. When set XP value and VP value based on above 3)~4), and if the center pin of ball phantom is not positioned at the median center, or if the sizes of 2 ball images in the center are different, the scan starting angle should be set.
2. Use [spm_hf?_] to confirm on the current value, then make adjustment by using [spm_hfst_0000] command.
3. Even when the scan starting angle is changed, the lengths of a and b do not change, but only the starting position is to change as well as the sizes of two ball images become equal.
4. After setting the scan starting angle, scan the ball phantom as final, and make final confirmation on whether XP value and VP value are normal

9.7 Skull Image Checking

1. 20 Standards Mode : For Normal/Wide/Narrow/Child Arch, check on the normal operation of modes such as Normal, Fast, Left, Right and Center and the final image.
2. 2 Standards Mode (Use a special chinrest)
3. TMJ: Confirm on the open/close continuous scanning and reconstruction.
4. Sinus: Image confirmation after adjusting the dogtooth beam.
5. 6 Specials Mode: check on the normal operation of modes such as Orthogonal, Canal(left/right), Molar(left/right), Incisor Clear and the final image.

Chapter 10 CT Image Assessment and Correction

10.1 Work Environment Setting

1. **Pax-Duo3D Install Software Composition List**
   - VAKPARH.exe: V 7.3.7.8
   - (Pax-Duo3D CT Image Acquisition and Reconstruction Program)
   - VAKCAP.exe: V 7.3.7.8 (Program for Engineering Test)
   - VAKRecon.dll: V 8.2.0.0 (GPU Reconstruction Program)
   - HASP driver: V 5.22.0 (Hardware Key Driver)

2. **Hardware Composition for CT Image Tasks**
   - Sensor (Xmaru1524CF™ Model)
   - RS232 Cable
   - Frame Grabber (Any Frame Grabber)
   - HASP key (For 3D Viewer and Reconstruction)
   - Exposure Switch
   - PC –Minimum Specification

Component	FOV size: 15x 13.5	FOV size: 12x 8.5	Remarks
CPU	Intel Quad core 2.50 GHz	Intel Xeon® CPU E5420@2.50 GHz	Recommendable PC: HP Work Station XW 4600(**12x 8.5)** XW 8600(**15x 13.5)**
RAM	2GB	2GB	
HDD	1TB (500GB 2EA))	500GB 1EA (S-ATA2 Type, C:\ 100GB, D:\ 400GB)	
VGA	GeForce GTX260 (RAM 1GB)	ATI HD 3870 (RAM 512MB)	
Operation System	Window XP professional SP2	Window XP professional SP2	

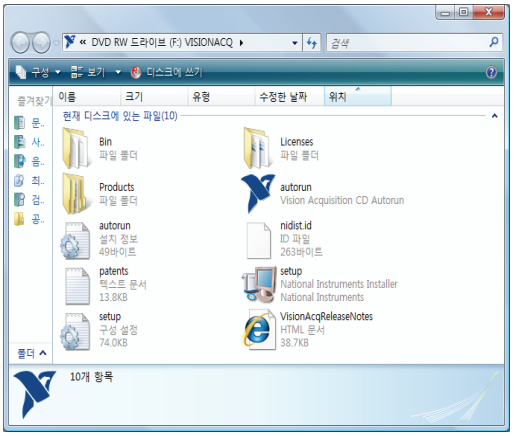
1,2 When the applicable environment is prepared and ready, it is possible to install VATECH program according to the Install Process.

10.2 Frame Grabber Installation

※Caution: The network should be connected to the internet because it must get the Authenticity Certification

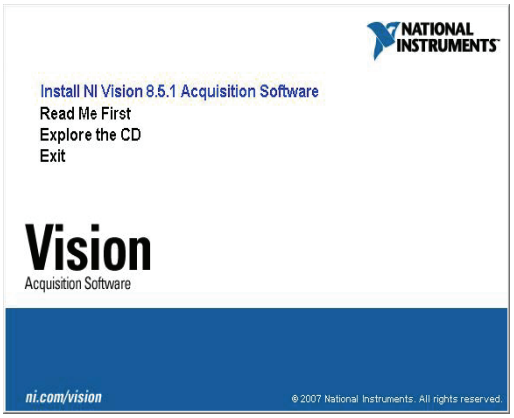
1. Searching the installation file

Execute autorun.exe in the Frame grabber folder.

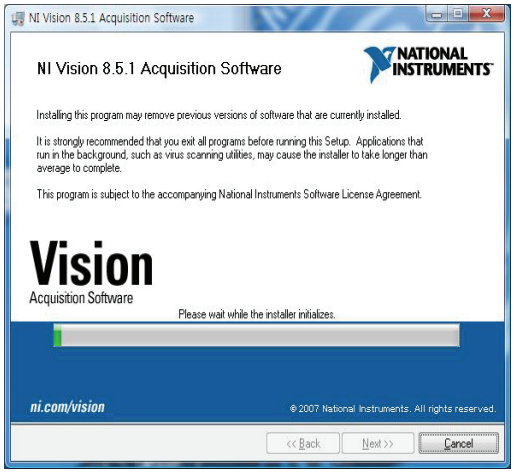


2. Frame grabber setup

<Setup Initial Screen>



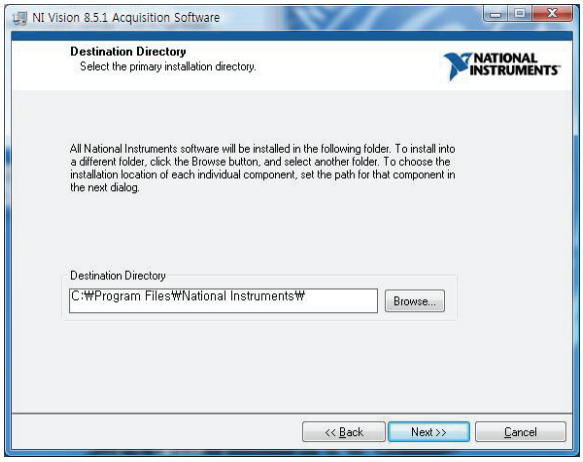
<Setup Preparation Screen>



<Start the Frame grabber setup>

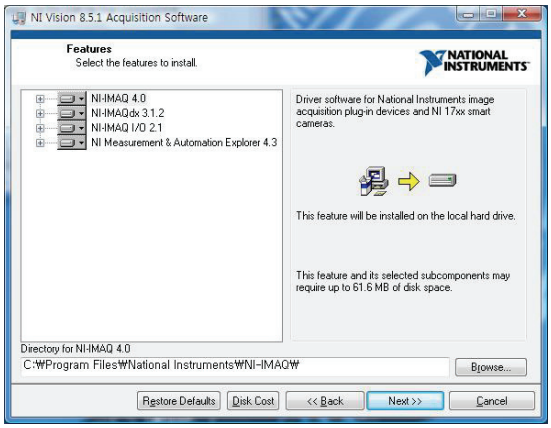
For starting Frame grabber, click "Next" icon.

<Check on the selection of S/W installation folder>



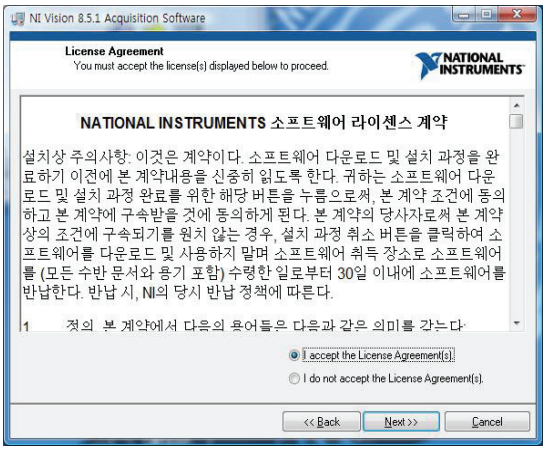
After confirmation on the installation folder, click "Next".

<Select the installation file>



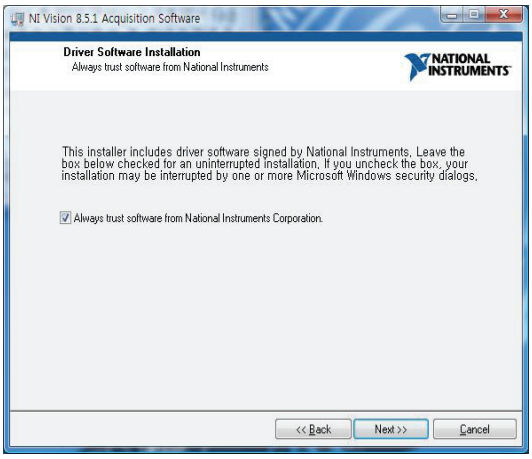
After confirmation on the file to install, click "Next".

<S/W License Agreement>



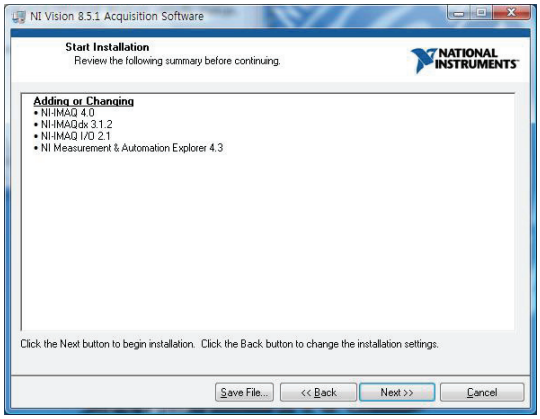
After selecting I agree for the License Agreement, click "Next".

<Confirmation on Agreement for S/W Use>



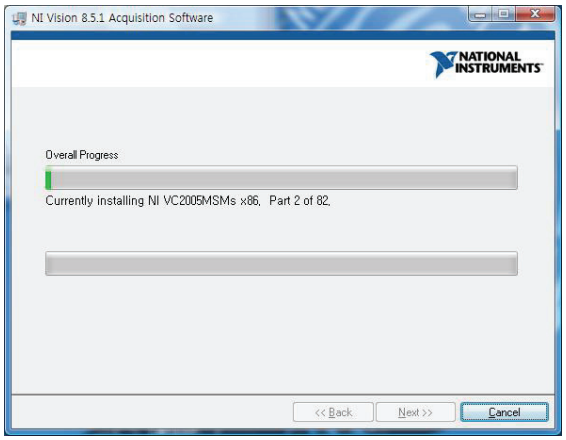
After selecting S/W Use Agreement, select "Next".

<Confirmation on S/W Installation file>



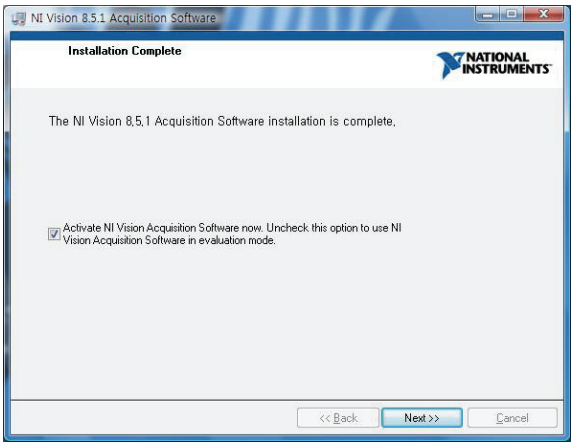
After checking S/W Installation File, select "Next".

<S/W Installation>



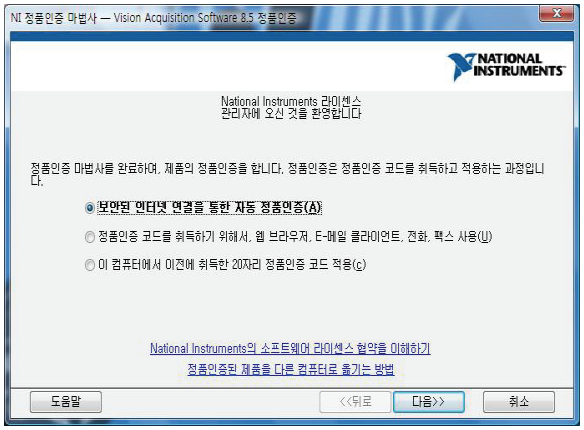
S/W Installation in progress

<Confirmation on the completion of Installation>



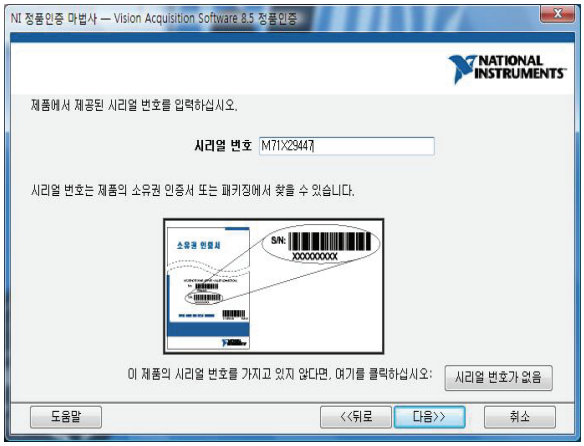
After confirmation on the installation complete, select "Next".

<Confirm on the Frame grabber Certification Stage>



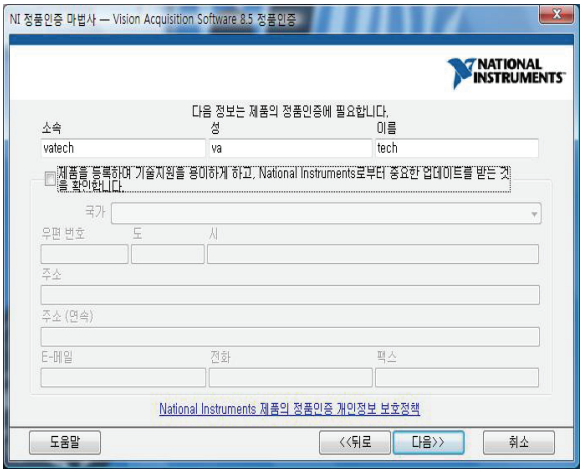
After selecting the Frame grabber certification method, select "Next".

<Input the Serial Number>



After entering the serial number on the Frame grabber CD, select "Next"

<Input the user information>

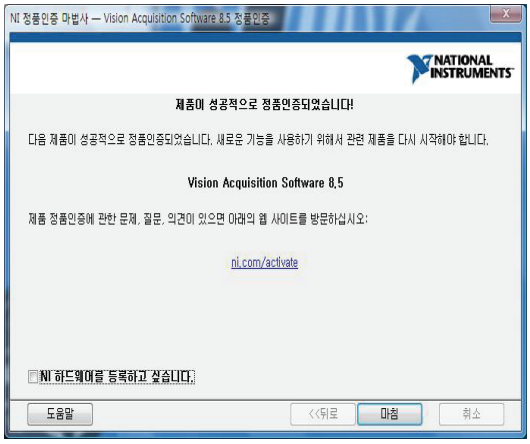


After entering the user information, select "Next".

<Confirm on Send the Authenticity Certification Mail>

For “Do not select Send the Authenticity Certification Mail”, click ‘Next’

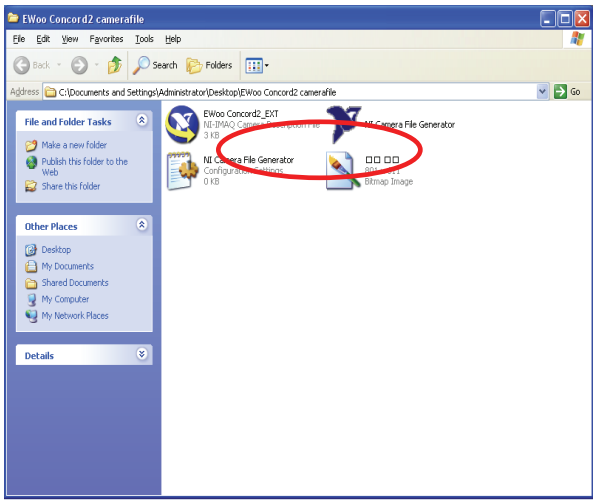
<Certification Completed>



Authenticity Certification completed.
After completing the product certification, reboot the PC for ending the process.

3. Copying of Camera file

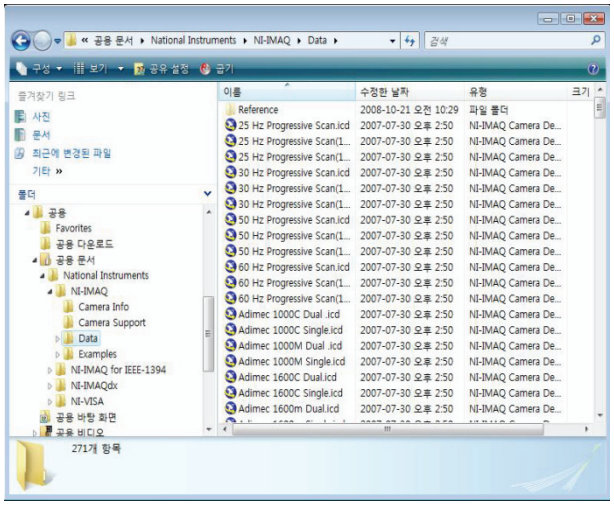
Confirm on Camera file as follows



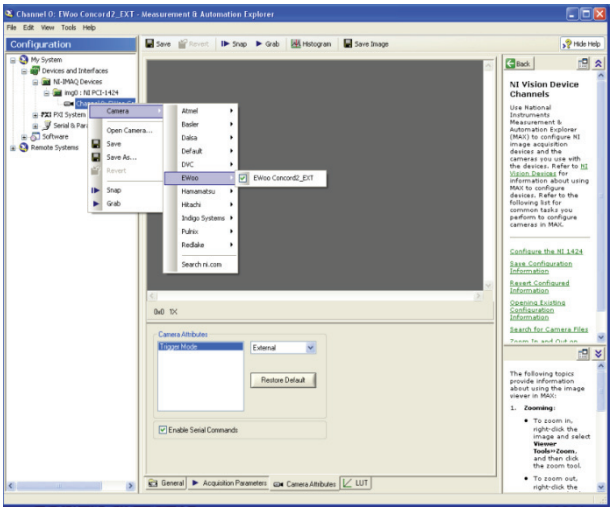
Copying the EWoo Concord2_EXT.icd Camera File.

Path: Copy it in C:\ My Document \Shared Document \National Instruments\NI-IMAQ\data.

※Select Measurement & Automation on Background Screen



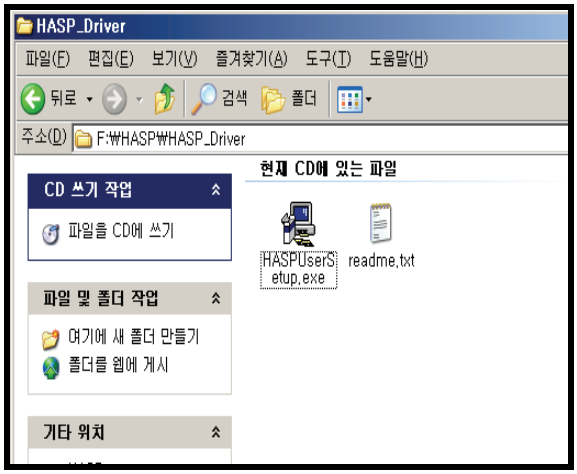
Check on NI frame grabber Setting.



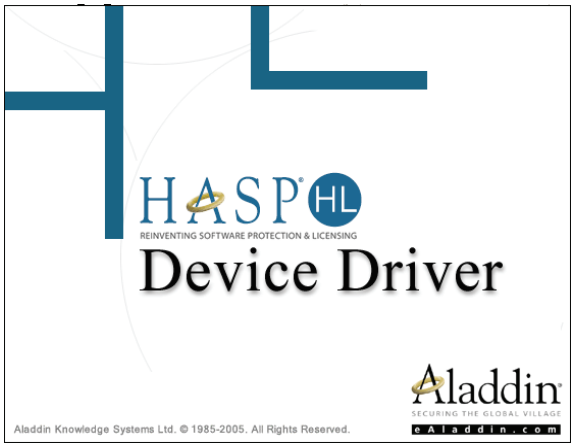
10.3 Installation Procedures of Vatech Reconstruction S/W

1. HASP Driver(V 5.22) Install

Execute the file, HASPUserSetup.exe to begin the driver installation.

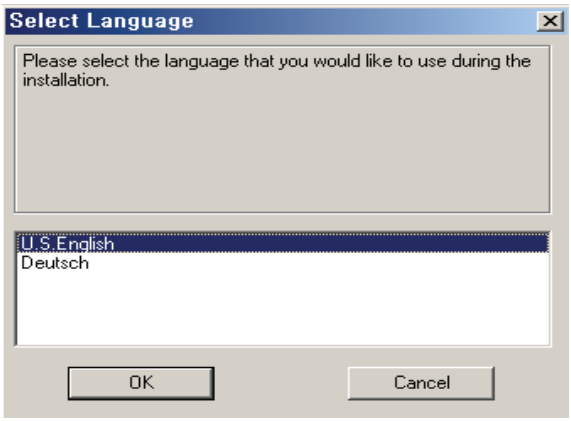


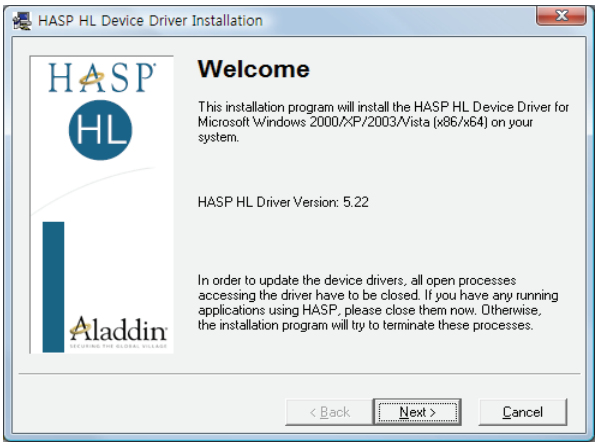
Select options in following figures and install S/W.



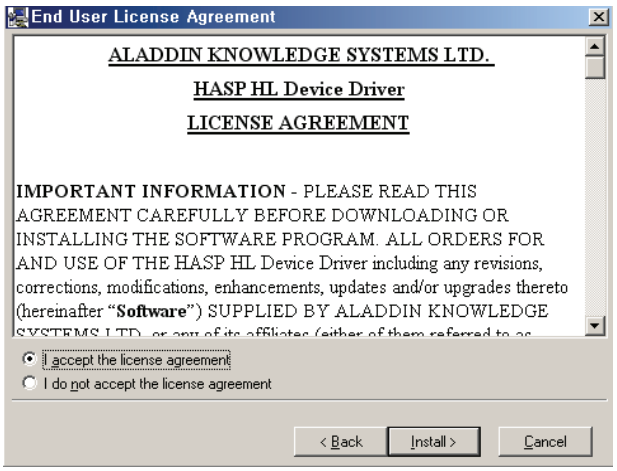
Confirm on the preparation screen for driver Setup.

Select the language.



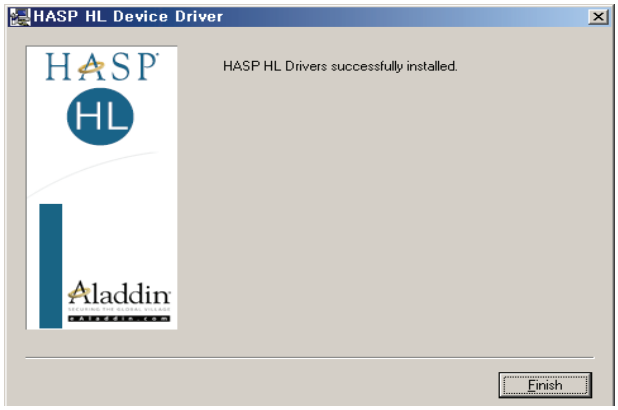


After confirming on Version, select "Next".



After selecting the Agreement accept, select "Install".

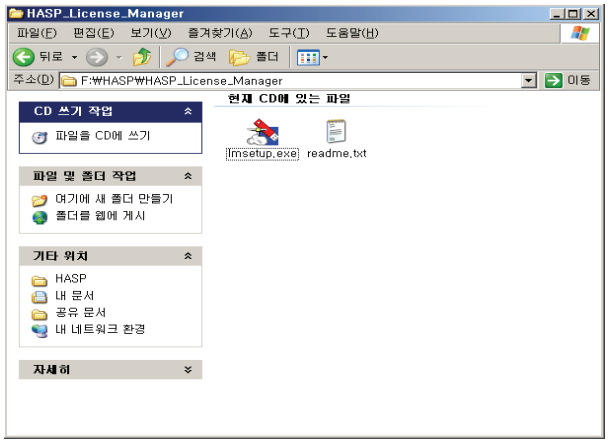
Install in progress--------



After completing installation, select "Finish".

2. License Manager(V8.31.5.24) Install

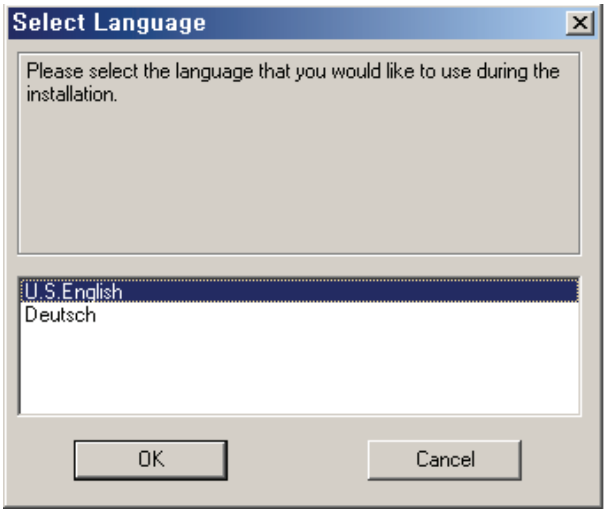
Execute the file, lmsetup.exe to begin the License Manager Installation



Confirm on License Manager Install Folder

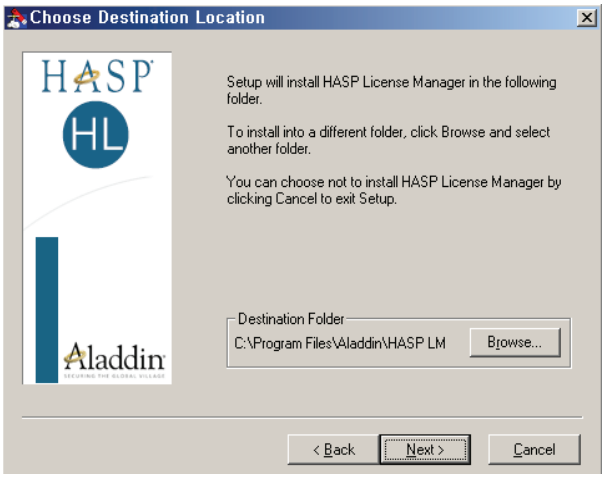
Select options in following figures and install S/W.

Confirm on the preparation screen for License Manager Setup

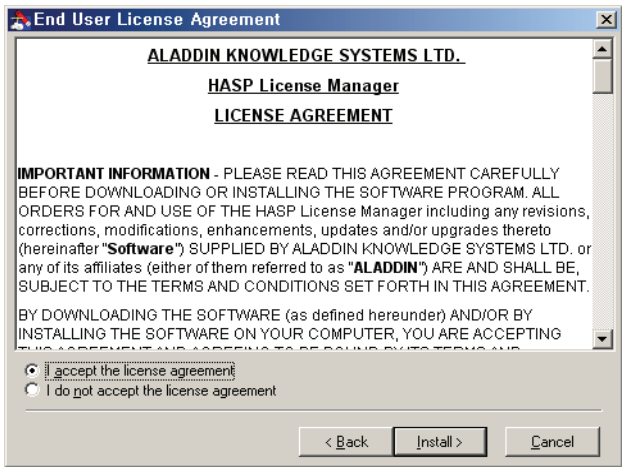


After selecting U.S. English, select "OK".

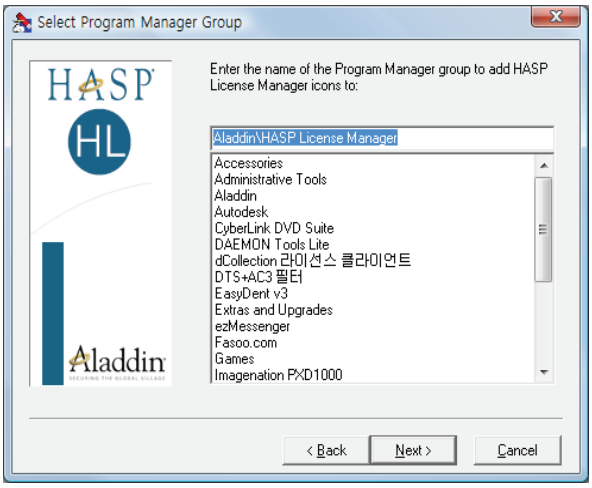
After confirming on the version of HASP License Manager, select "Next".



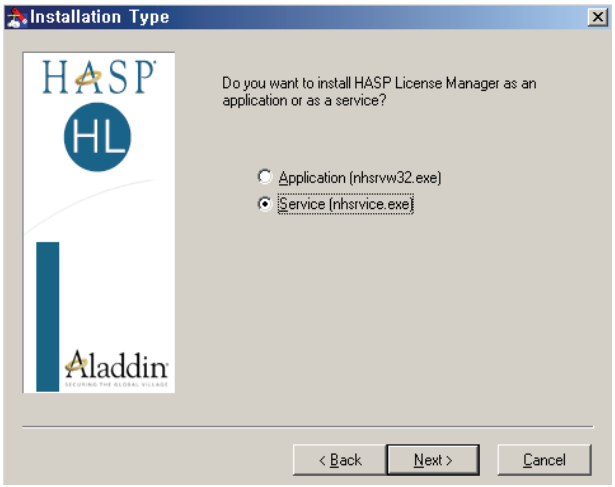
After checking Installation File, select "Next".



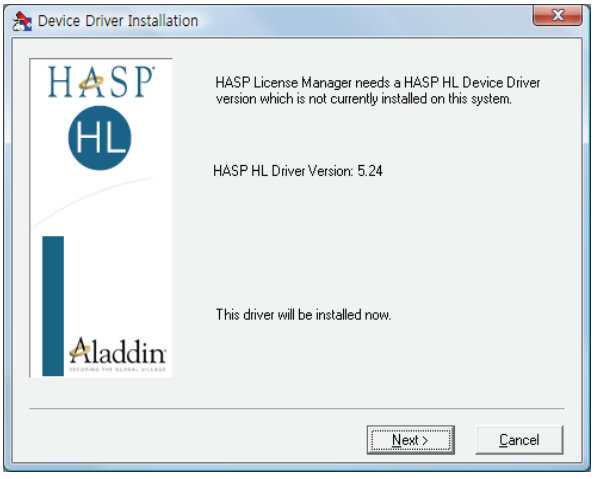
After selecting the Agreement accept, select "Install"



After confirming on Aladdin/HASP License Manager, select "Next".

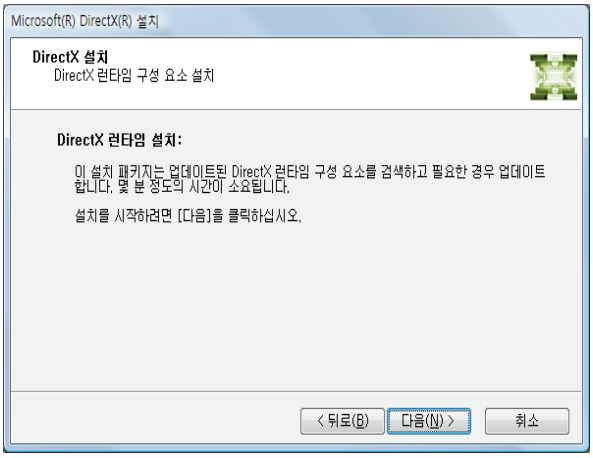


After selecting Service, select "Next".



After confirming on HASP HL Driver Version, select "Next".

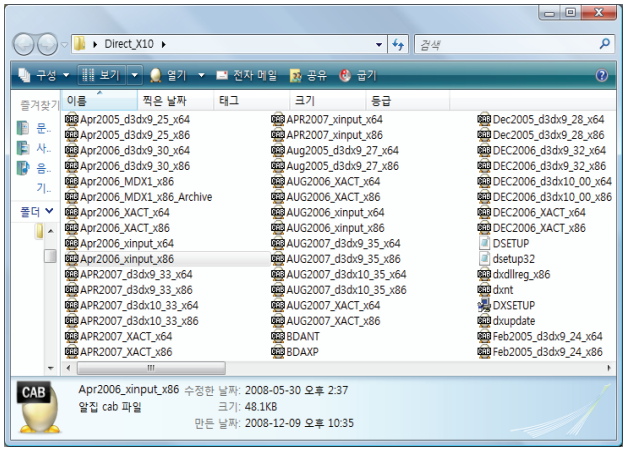
Select 'Yes' and select "Finish".



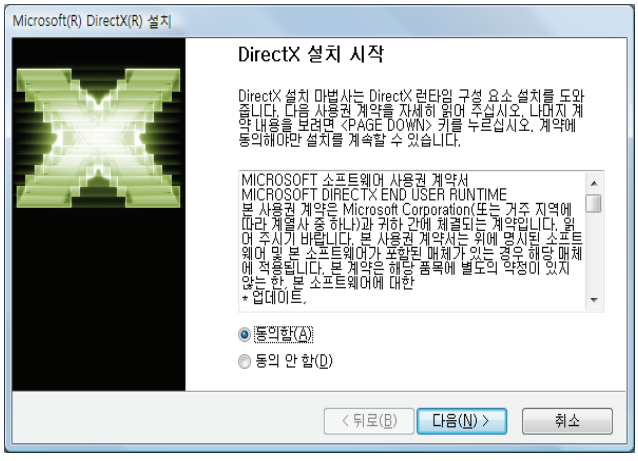
Select "Next" to start installation

3. DirectX (V4.9.0.904) Install

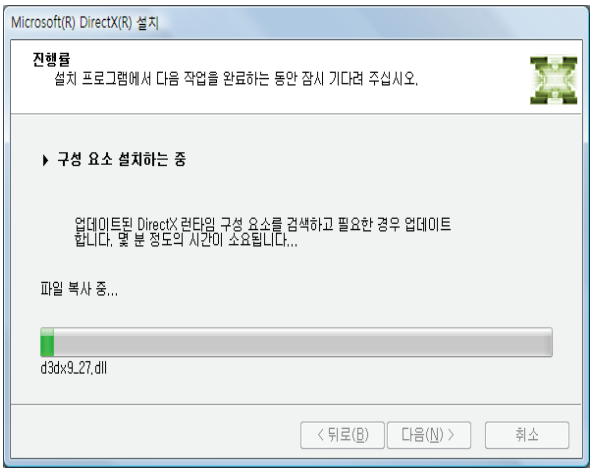
Execute DirectX Installation Program to start installing DirectX.



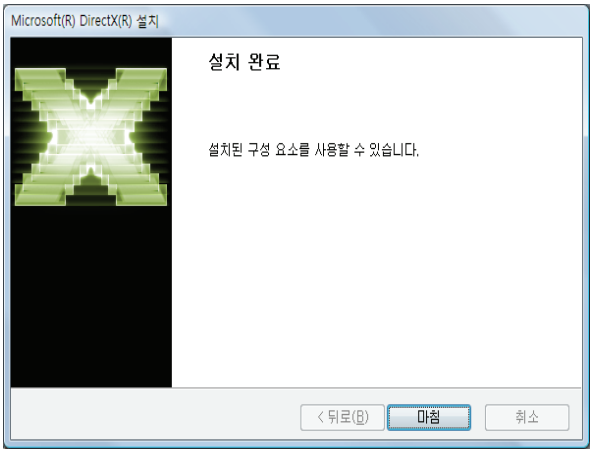
Confirm on DirectX Installation folder



After selecting the Agreement accept, select "Next".



S/W Install in progress



After completing installation, select "Finish".

10.4 Optimization of 15x13.5 and 12x8.5 Images

10.4.1 PaX-Duo3D Components

- Sensor
  CT sensor: E-WOO Company
  FOV size 15x 13.5: Xmaru1524CF
  FOV 12x8.5: Xmaru1215CF
- Frame grabber
  Use National Instruments frame grabber
  Any frame grabber
- Frame grabber cable
  PC to CT sensor connection
  10m
- Serial card
  System Base社 PCI Comport Board
- HASP key
  Image Reconstruction Key
  3D viewer (EzImplant) Key
  3D viewer (Ez3D2009) Key: 12 x 8.5

10.4.2 Confirmation on Cable Connection

- Confirmation on Sensor power cable connection
  Confirm on whether the power cable is well connected between Sensor and power supply.
- Confirmation on Frame grabber cable connection
  Confirm on whether the frame grabber cable is well connected between CT sensor and PC's frame grabber.
- Confirmation on RS 232 cable connection
  Confirm on whether the RS 232 cable is well connected between PaxDuo3D equipment and PCI board of PC.
- Confirmation on Irradiation Switch connection
  Confirm on whether the irradiation switch cable is well connected to PaxDuo3D equipment.

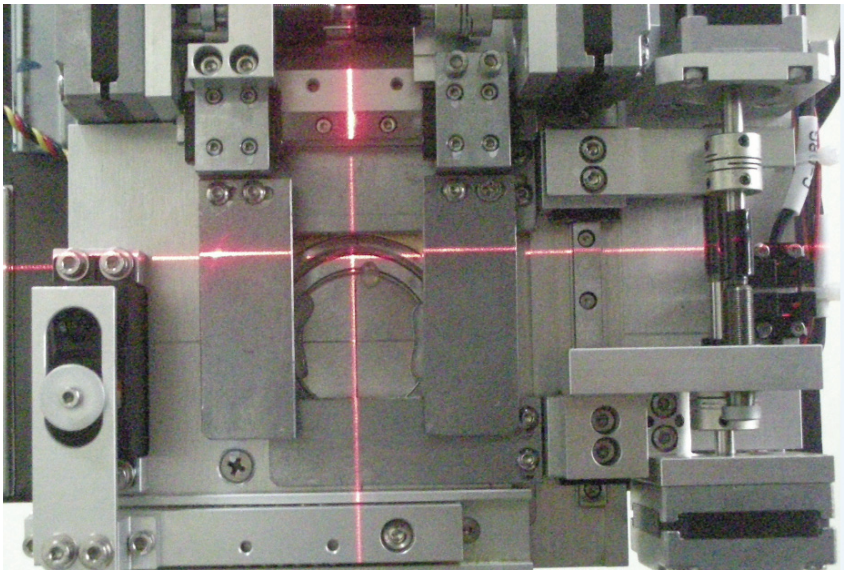
10.4.3 Hardware Calibration

- **Laser beam alignment**

  ① Confirm on Laser Beam Strength/Direction.

  ② Align the vertical laser to the align line of collimator whereas align the horizontal laser for the upper side of the left sensor and the upper side of the right side serbo motor to be horizontal.

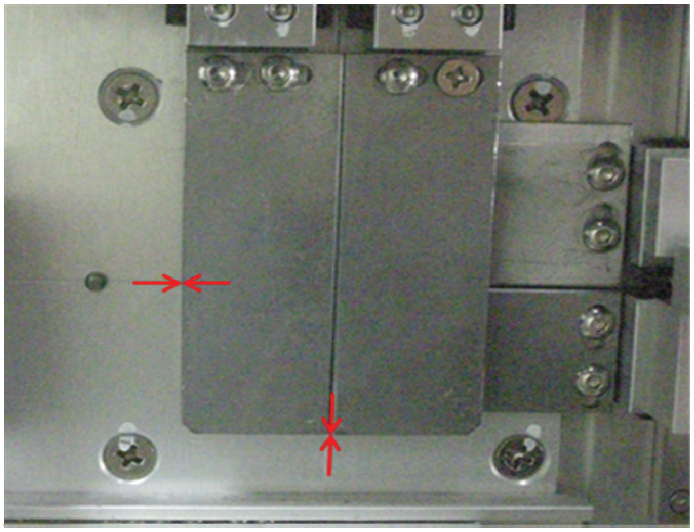
  ③ Align each laser, referring to the following figure.



- **X-ray alignment**

  ① Alignment standards for collimator

  ② Align collimator to the standard line as shown in the following figure.

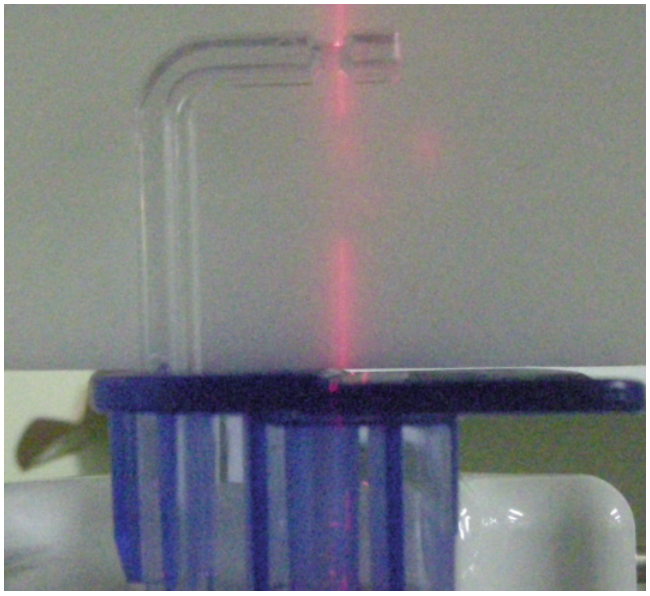


③ CP value setting(CT P Axis Standard Value)

Commands to be used for CP value setting:

[SPM_CP?_]

- After entering the command at Hyper-Terminal, confirm on the current value.
- As shown in the following figure, enter the command in [SPM_CPST_0000] Hyper-Terminal to position the vertical laser at the center of bite, and set the CP value to bring the vertical laser to the center of Bite as shown in the following figure.



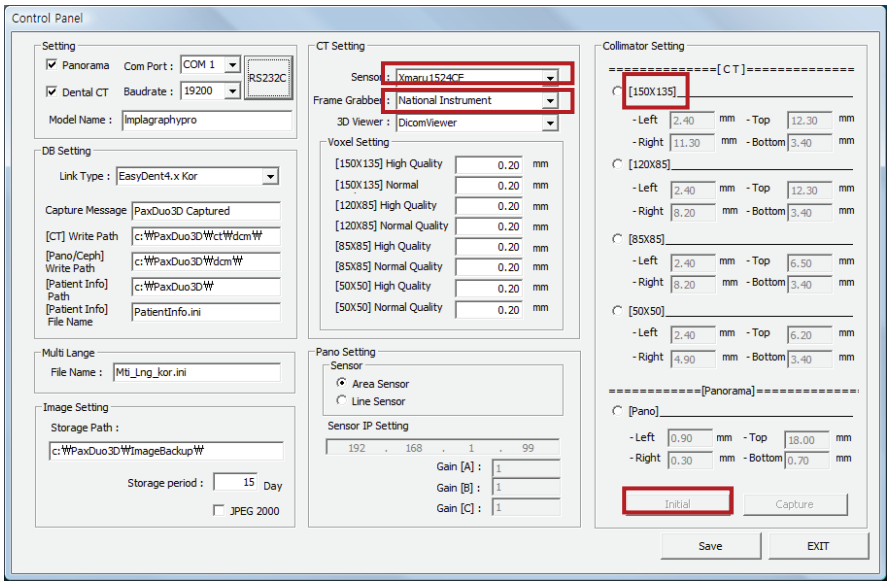
④ Collimator Adjustment

A. As shown in the following figure, execute the scanning program and click 'SETTING' at the right upper side. Then input VATECH as Password for login.

B. Confirm on Com Port first from Control Panel and then on whether it is set as Baud rate 19200.

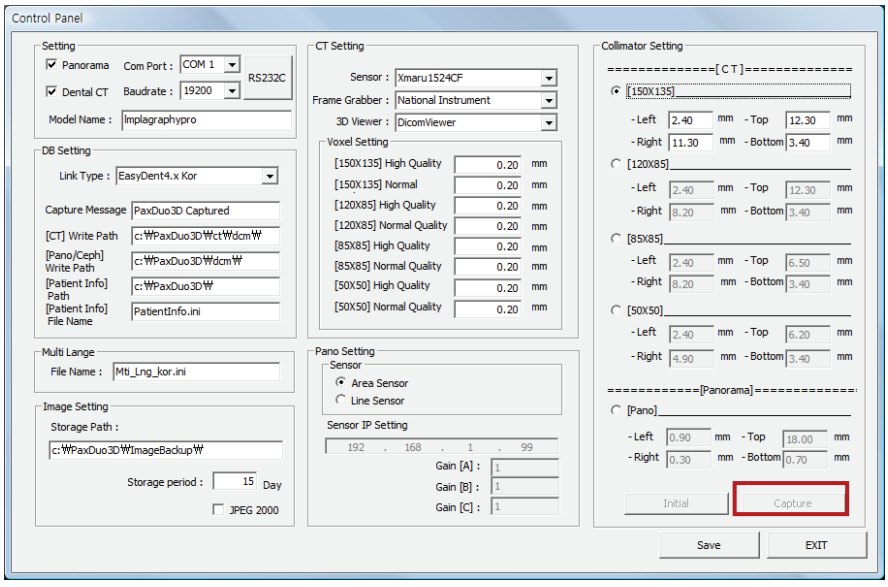
C. Perform the Setting of Sensor and Frame Grabber type from CT Setting as shown in the following figure.

- Sensor : Xmaru1524CF(15x13.5), Xmaru1215CF(12x8.5)
- Frame Grabber : National Instrument, Any Grabber



D. Check on [150x135] at Collimator Setting and enter the values of left/right/Up/down. Then click 'Initial', and the equipment is to operate in CT mode.

E. When completed the operation in CT mode, select 'Capture' to acquire the image and adjust the collimator at the same time.

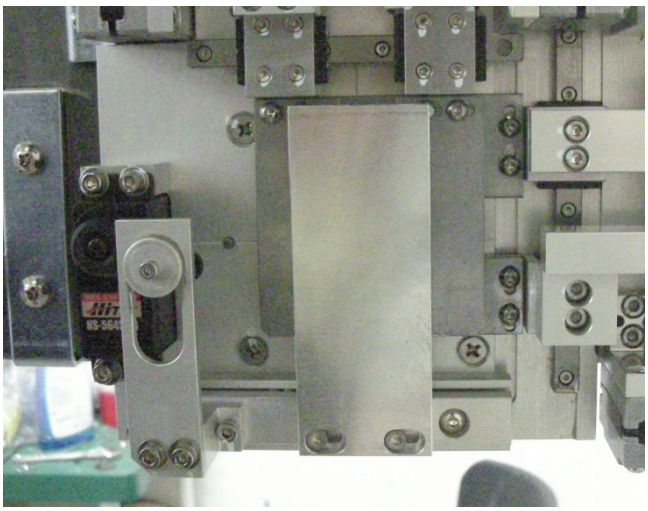


F. Adjust the left/right/up/down values of collimator to present the image as shown in the following figure.

G. Make the section marked with black color to be **within 5 Pixel**.

H. From [120x85], [85x85], [50x50] FOV Mode, perform the processes of D to G repeatedly, and set each collimator within Active area 5 pixel.
(*FOV size: for 12x8.5 : from [85x85], [85x50], [50x50] FOV Mode, perform the process of D to G repeatedly, and set each collimator within Active area 5 pixel)*

⑤ Confirmation on the operation status of Aluminum Filter.
When operating in CT mode, Confirm on whether the 5mm Al Filter comes into the alignment line and whether the opened collimator by each FOV are all covered from the scanning program.



- **Calibration of Sensor**

① Al Filter Attachment

As shown in above figure, attach 5 mm Al Filter in front of Collimator as basic, and put 1mm Copper Filter on it in addition .

(For FOV size 12x 8.5 : *As shown in above figure, basically 5 mm Al Filter is attached to the front of Collimator therefore it is not necessary to attach Al Filter additionally)*

② Checking on Setting Files

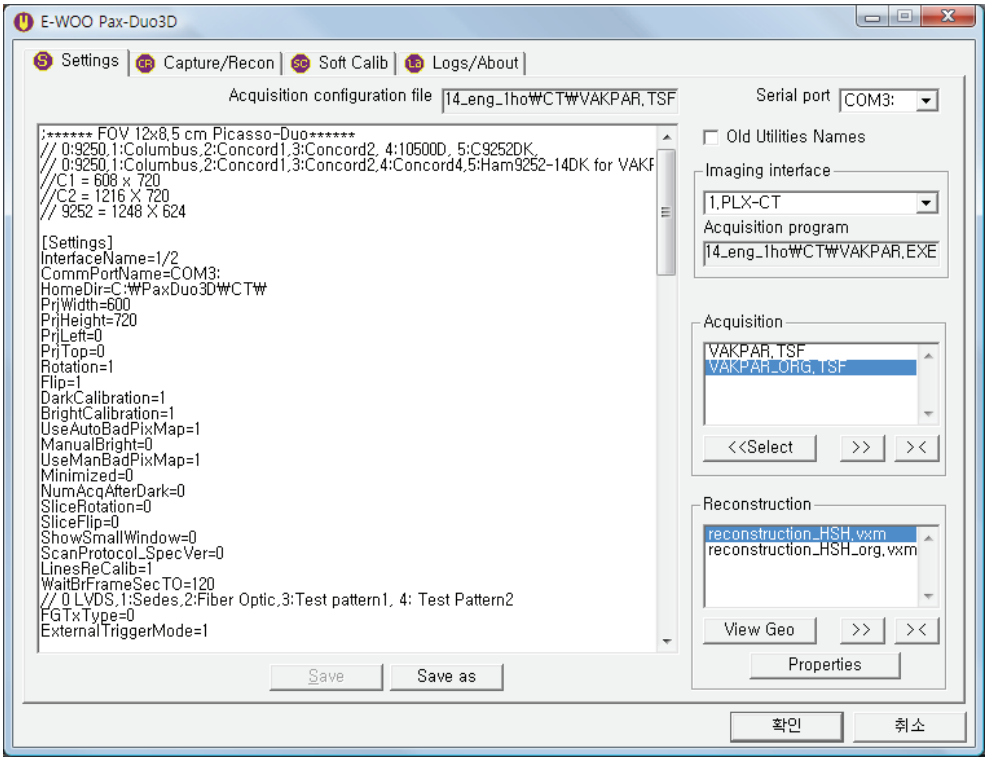
A. After selecting **VAKPAR_ORG.tsf** file that is corresponding to the model, click ‘ Selection’ icon to prepare for Calibration of Sensor.

[Settings]
InterfaceName=img0/2 :Frame grabber setup port (setup after confirmation)/Sensor (0:9250, 1:Columbus, 2:Concord1, 3: Concord2, 4: Concord4, 5: Ham9252)
CommPortName=COM1 :RS232 communication port
HomeDir=C:\ PaxDuo3D\CT\ : Image Saving Path
PrjWidth=700 : Sensor Transverse Pixel size
PrjHeight=1114 : Sensor Longitude Pixel size
PrjLeft=0
PrjTop=90
Rotation=0
Flip=0
CalBSkip=5 : **Initial Bright Frame Skip**
CalBAve=60 : **Bright Acquisition Frame**
CalDSkip=5 : **Initial Dark Frame Skip**
CalDAve=30 : **Dark Acquisition Frame**
DarkCalibration=1
BrightCalibration=1
UseAutoBadPixMap=1
ManualBright=0
UseManBadPixMap=1
Minimized=1

ShowSmallWindow=3
LinesReCalib=1 : Whether to apply **LinesReCalib**
ForceTriggerInt=0
NumAcqAfterDark=0
ScanProtocol_SpecVer=0

[ProjFilter]
Median=1
Smooth=5
Gamma=0
AddConst=200 : **Back Ground Level Default Value**
AddConstLeft=0
LinesReCalibR=516,3 : **LinesReCalib Applied Transverse directional Pixel and Area size**
LinesReCalibC= 71,2 72,2 143,2 144,2 215,2 216,2 287,2 288,2
LinesButC=0
LinesButR=516

[Overrides]
Enable=0 : **Overrides Application 0: Not applied, 1: Applied**
ROILeft=0 : **PrjLeft Change Value**
ROITop=790 : **PrjTop Change Value**
ROIWidth=285 : **Prjwidth Change Value**
ROIHeight=426 : **PrjHeight Change Value**
CubeSizeXY=248
CubeSizeZ=248 } **Reconstruction.vxm File Change Value**
CubePitchXY=0.2
CubePitchZ=0.2



[BrightCalibration]
NumPoints=1
kVp0=400
mA0=220
kVp1=900
mA1=220

FOV size: 12x8.5

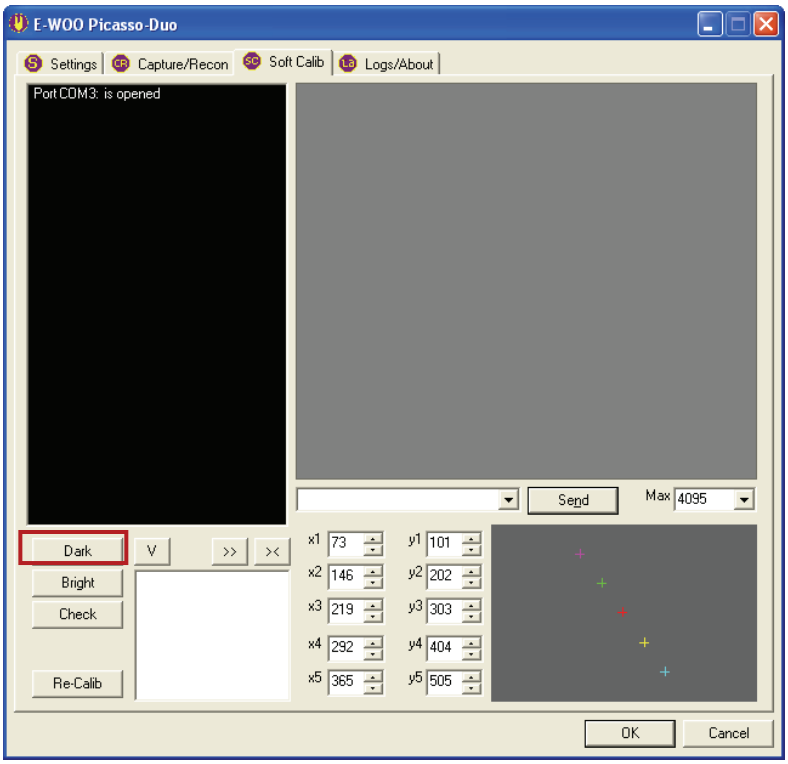
[BrightCalibration]
NumPoints=7
kVp0=400
mA0=250
kVp1=900
mA1=240

FOV size: 12x8.5

B. At the Bright Calibration Setting of Setting Window, Set the NumPoints as 1 basically.
C. The number of Bright Calibration data to acquire is 6 Point, and by attaching the **copper filter with 1mm thickness** to X-ray source, acquire by 1 point each.
D. For Bright Calibration, it is recommended to adjust mA to correspond to the Target requirements.

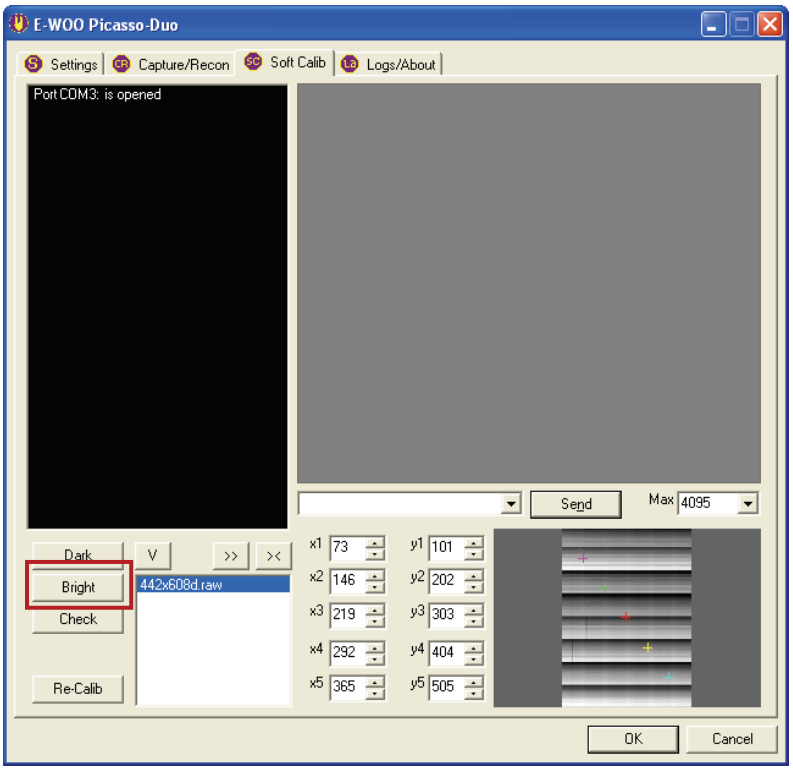
③ Dark Calibration

From Tab menu of VAKPAR.exe, click [DARK] of Soft Calib section to execute Dark Calibration.



④ Bright Calibration

A. From Tab menu of VAKPAR.exe, click [BRIGHT] of Soft Calib section to execute Bright Calibration **(**Execute Bright Calibration **in the condition that collimator is covered by the attachment of Al filer with 5 mm thickness and the copper filter with 1 mm thickness.)**



For FOV: 12x8.5

(Covering Collimator with Al filter of 5 mm thickness that operates as serbo motor, execute the Bright Calibration)

B. Before performing Bright Calibration, create a new folder inside CAL folder.

C. Immediately prior to perform Bright Calibration, acquire Dark and then execute Bright Calibration.

D. When the message [Hold the button for 3 sec~] is displayed, keep pressing the irradiation switch continually.

E. After acquiring Bright Calibration, save it in the new folder.

F. Make it come in the following standards of Bright Calibration.

G. By implementing the processes of C to E repeatedly, acquire Bright Calibration data of 6 Point and then copy the Bright data saved in the new folder again back to the CAL folder.

FOV: 15x13.5

Cal point	Standard Level
Point 1(60Kvp 2mA)	100±20
Point 2(70Kvp 2mA)	350±100
Point 3(80Kvp 2mA)	800±100
Point 4(90Kvp 2mA)	1600±100
Point 5(90Kvp 4mA)	2800±200
Point 6(90Kvp 8mA)	5600±20

FOV: 12x8.5

Cal point	Standard Level
Point 1	70±20
Point 2	300±50
Point 3	750±100
Point 4	1600±200
Point 5	3200±200
Point 6	5200±300
Point 7	7700±300

⑤ Power calibration

FOV size: 15x13.5

Patient Scanning Mode	Irradiation Requirements	Back Ground Level Standards (Gray Level of Air section)
Adult Mode (Adult)	90kVp/2.7mA	10500±200
The Weak and the Elderly Mode (Weak)	90kVp/2.5mA	9500±200

FOV size: 12x8.5

Patient Scanning Mode	Irradiation Requirements	Back Ground Level Standards (Gray Level of Air section)
Adult Mode (Adult)	85kVp/5.0mA	10500±200
The Weak and the Elderly Mode (Weak)	85kVp/4.5mA	9500±200

A. In above standards, when matching to the Back Ground Level Standard, correct mA among the irradiation requirements for matching.
B. When found mA value that satisfies the standard, write the result in following files.

Model	tsf File Name
12×8.5	**C:\PaxDuo3D\user_settings\PwrParam.ini**

10.4.4 Optimization of the images

1. Image Scanning

From Tab menu of VAKCAP.exe, click [Capture] of Capture/Recon section to execute the image scanning.

2. DETOFFSETYY Value Measurement

A. Scanning Hole Phantom

① Put Hole **Phantom on the Jig with well set horizon** and scan the image.

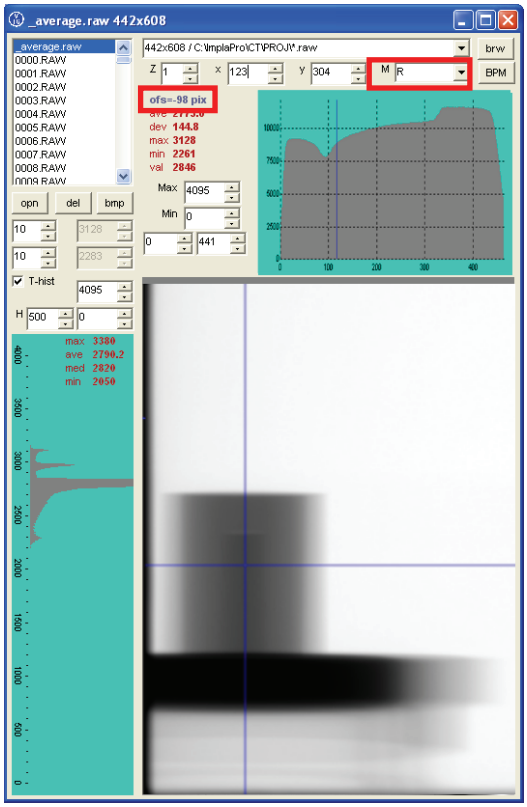
② From Tab menu of VAKCAP, click [Pano] icon at the right lower side of [Capture/Recon] section.

③ From Pano Util window, click [Process] icon of Average section at the left middle area to create_average.raw file.

④ After clicking [V Proj] at the right lower side of [Capture/Recon] from Tab menu, select _average.raw from View window.

⑤ Select R from M section at the right upper side.

⑥ Click the rotary center of the image and read **ofs value** as shown in following figure.



B. DETOFFSETYY Value application

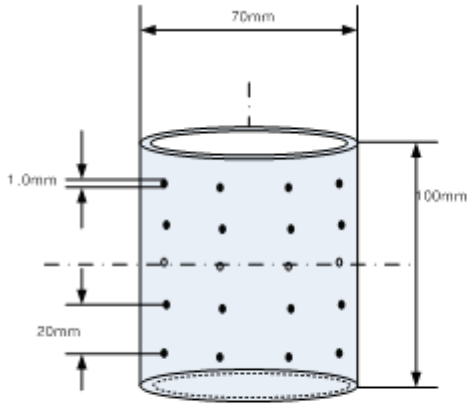
Save ofs value measured from step ① into the image reconstruction parameter file

Applicable parameters are as follows.

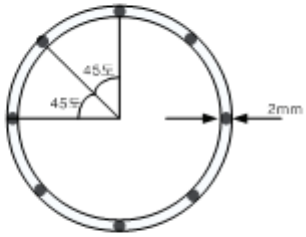
Model	Parameter File Name
15×13.5	reconstruction_HSH.vxm reconstruction_HSH_org.vxm
12×8.5	reconstruction_HSH.vxm reconstruction_HSH_org.vxm

3. DETOFFSETZZ Value Measurement

A. Specifications of Bead Phantom



Front view Drawing



Cross-sectional Drawing

B. Bead Phantom Alignment Standards and Scanning

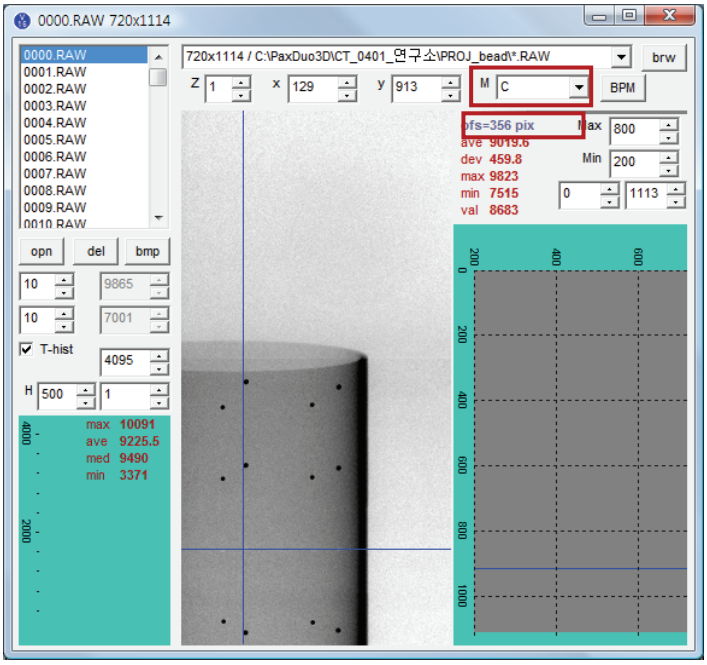
① Balance the horizon of Jig on which Chinrest or Bead Phantom is to be put.

② Put Bead Phantom on Jig or Chinrest.

③ Align the scanned image to be up/down symmetric centering on the layer without Bead as shown in following figure.

④ Scan for 24 seconds.

⑤ After scanning the image, from Tab menu of VACAP, click **[V Proj]** icon at the right lower side of [Capture/Recon] section to display the scanned image.



⑥ Select C from M section at the right upper side.

⑦ Find the position that the Bead part is placed in straight linearity horizontally in the scanned Bead Phantom image, and read **ofs** value from the upper side of Project Viewer window.

C. DETOFFSETZZ Value application

Save ofs value measured from step ① into the image reconstruction parameter file.

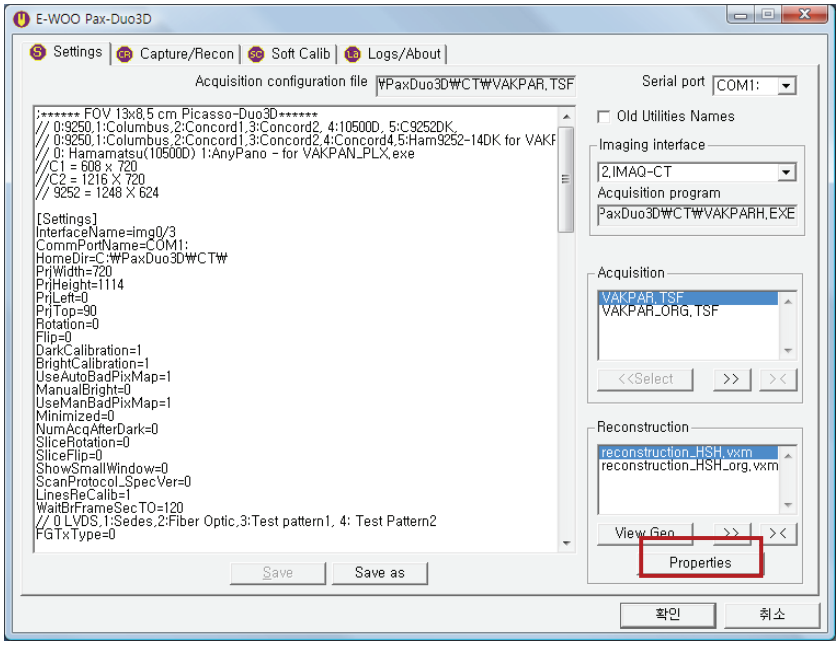
Applicable parameters are as follows.

Model	Parameter File Name
15×13.5	reconstruction_HSH.vxm reconstruction_HSH_org.vxm
12×8.5	reconstruction_HSH.vxm reconstruction_HSH_org.vxm

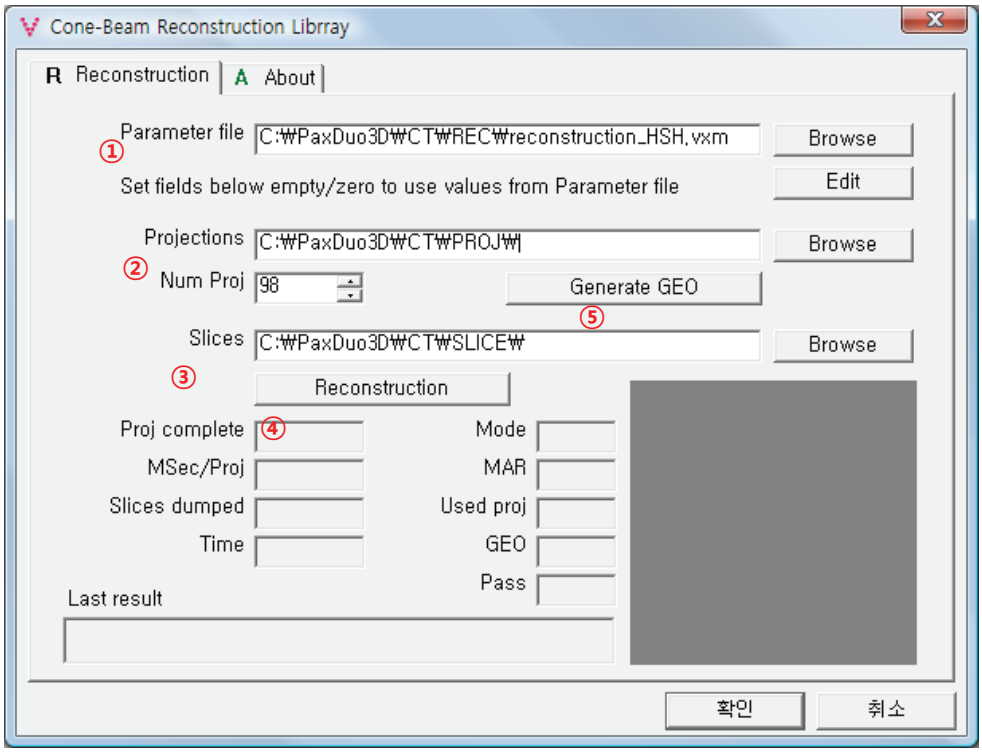
4. Implementation of Geometry correction

A. Creation of Geometry correction parameter

① After scanning Bead Phantom, select [Settings] of Tab Manu and then click Properties button at the right lower side.



② In use of default offset, reconstruct the scanned image.



Select VXM file from ① for Reconstruction.

(Example: C:\PaxDuo3D\CT\REC\reconstruction_HSH.VXM)

NOTE

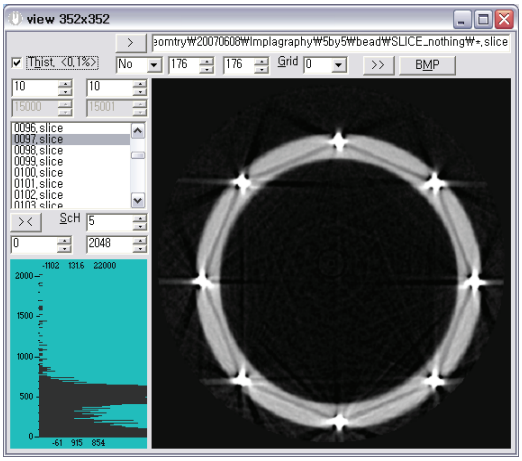
When implementing Geometry correction, set the parameter of VXM file as STARTANGLE=0, and after completing the implementation of Geometry correction, correct to STARTANGLE=40 and save it.

Select PROJ folder from ② for Reconstruction.

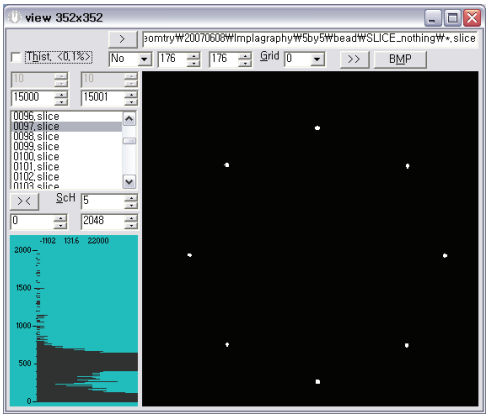
(Select bead phantom scan folder)

Select the folder to save the SLICE reconstructed from ③.

As aforementioned, after setting the accurate folder, click reconstruction icon of ④ to perform reconstruction.



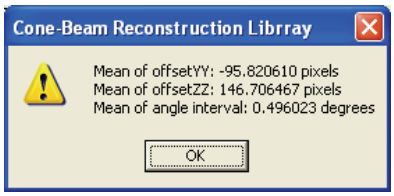
If Bead is appeared in the form of letter U, this indicates that DETOFFSETYY is not optimal, therefore adjust the value and perform the reconstruction again.



As shown in above figure, set the difference of each window level as 1, and as changing the level, confirm on the proper threshold value that shows all of 8 beads on one slice.

Input the confirmed threshold value in the BEADTHRES section of reconstruction_HSH.VXM file, and save it.

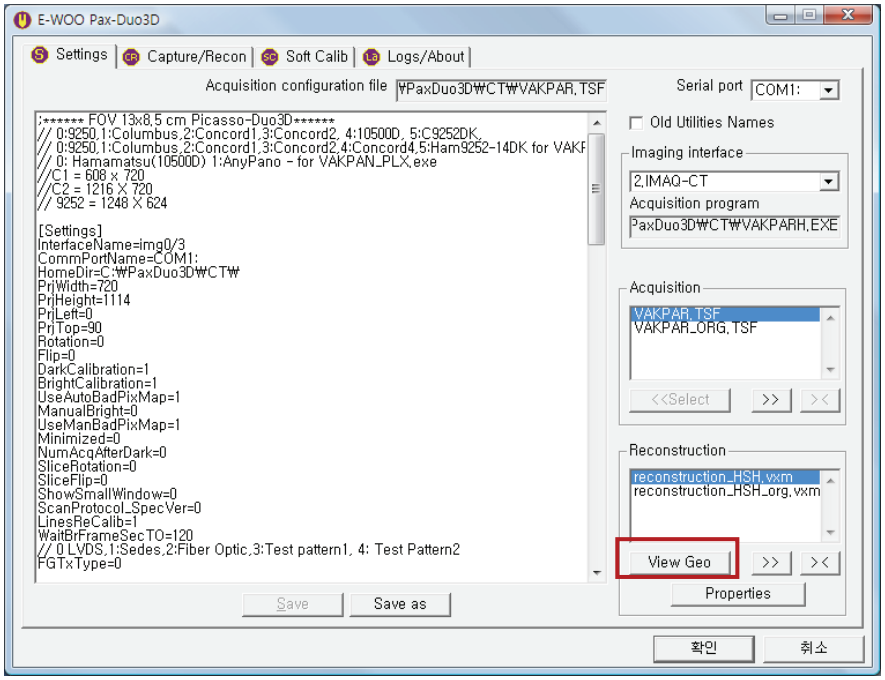
After entering the threshold value of Bead, click Generate GEO of ⑤, and then, Geometry correction parameter file is to be saved in C:\PaxDuo3D\CT\PARA\ folder with display of brief report on result as shown in following figure.



B. DETOFFSETYY/ DETOFFSETZZ Value Reconfirmation

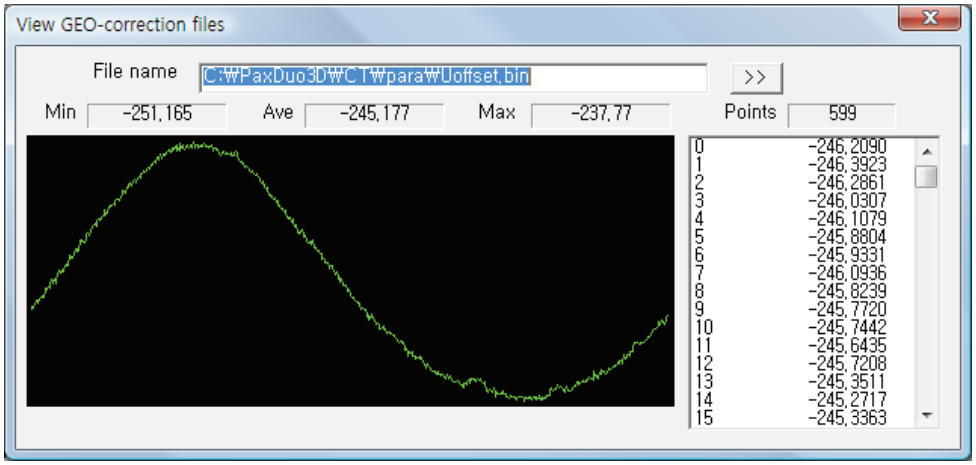
① Execution of View Geo Menu

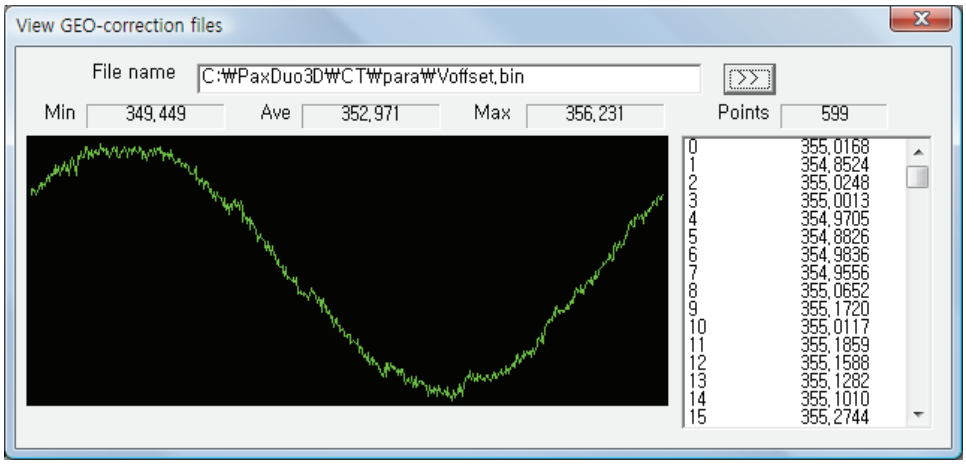
After executing VAKCAP, click "**View Geo**" button at the right lower side.



② Geometry parameter file loading

Click "**>>**" button next to the address bar at the upper side to call out each of Uoffset.bin and Voffset.bin from following path and confirm on the mean value.





③ DETOFFSETYY, DETOFFSETZZ Value application

Apply each respective mean value of Uoffset.bin and Voffset.bin that are measured at Step B as DETOFFSETYY and DETOFFSETZZ in following files. Applicable parameter files are as follows.

Model	Parameter File Name
15×13.5	reconstruction_HSH.vxm reconstruction_HSH_org.vxm
12×8.5	reconstruction_HSH.vxm reconstruction_HSH_org.vxm

5. Inspection of Image and Offset Adjustment

A. The height of Chinrest

- Using the scanning program, scan the Skull in High quality, Normal reconstruction Mode, and then perform the image reconstruction. At reconstruction, use following files.

Model	Parameter File Name
15×13.5	reconstruction_HSH.vxm
12×8.5	reconstruction_HSH.vxm

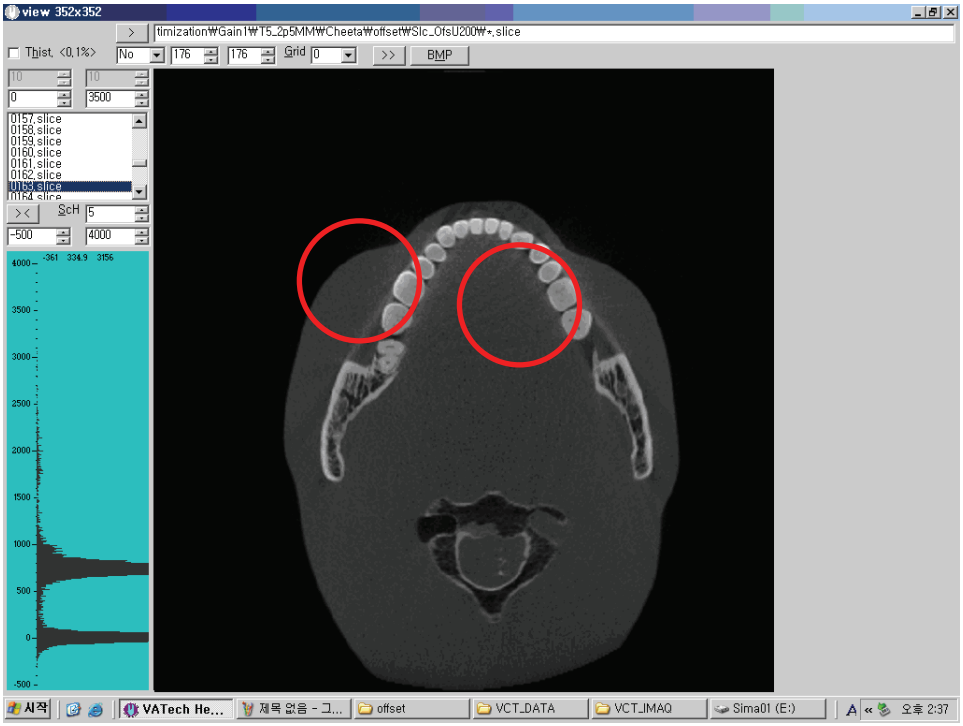
- Click [V vol] icon at the right lower side of [Capture/Recon] section from Tab Manu of VAKCAP for image loading.
- Confirm on whether the lower side of Chinrest is positioning at the lower side of image, and if not, adjust the value of **CUBEORIGINZ** to match the height.

CUBEORIGINZ Adjustment	**Result**
Increase the value	The reconstructed image shifts upward
Reduce the value	The reconstructed image shifts downward

- When finished the confirmation on the image, apply the confirmed CUBEORIGINZ value to all parameter files.

B. Reconstructed Image Inspection

Inspect the matching of the image's disposition, or on distortions



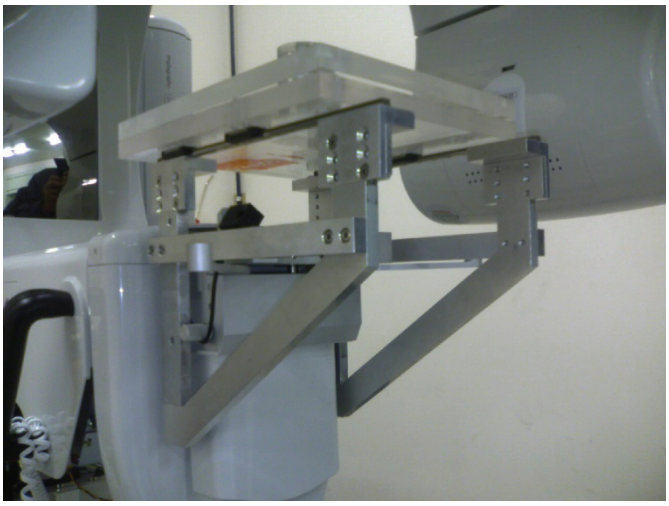
6. CT number Calibration

A. tsf File name and path that is being used

C:\PaxDuo3D\user_settings\PaxDuo3D.tsf

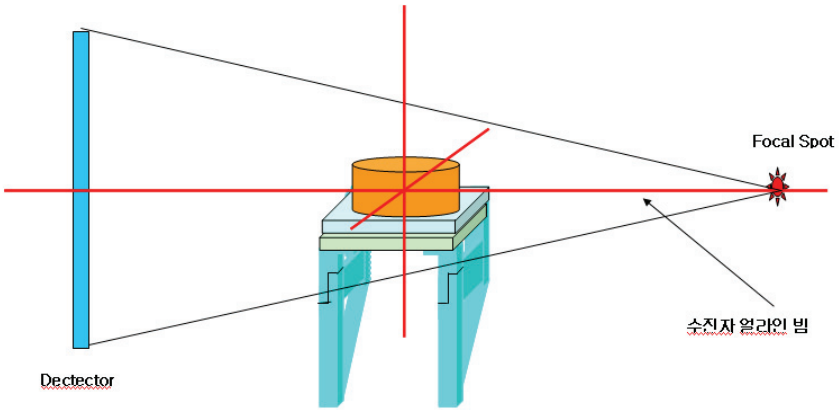
B. Phantom jig attachment

For Mounting CT Phantom Jig, mount Jig in accordance with the User Manual.



[Example Photo of CT Phantom Mounting on Implagraphy Equipment]

Align CT number Phantom with horizontal and vertical matching.

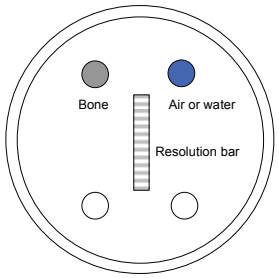


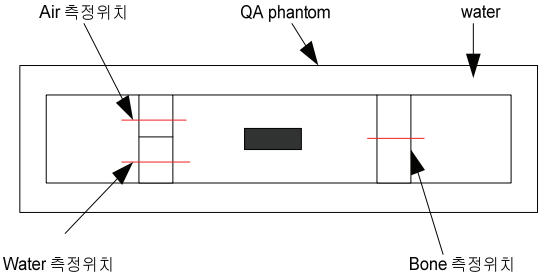
[Figure 2. Drawing for Align method after mounting CT Phantom Jig]

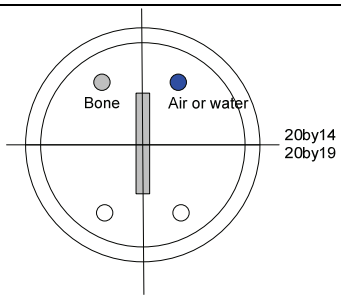
- Scan the CT Phantom Image in the Adult mode and the Weak Mode, and acquire the respected Slice file for each mode.
- Measure the mean value of air and water from the reconstruction Slice file, and write them down in the respective file corresponding to each model. Refer to following figure.

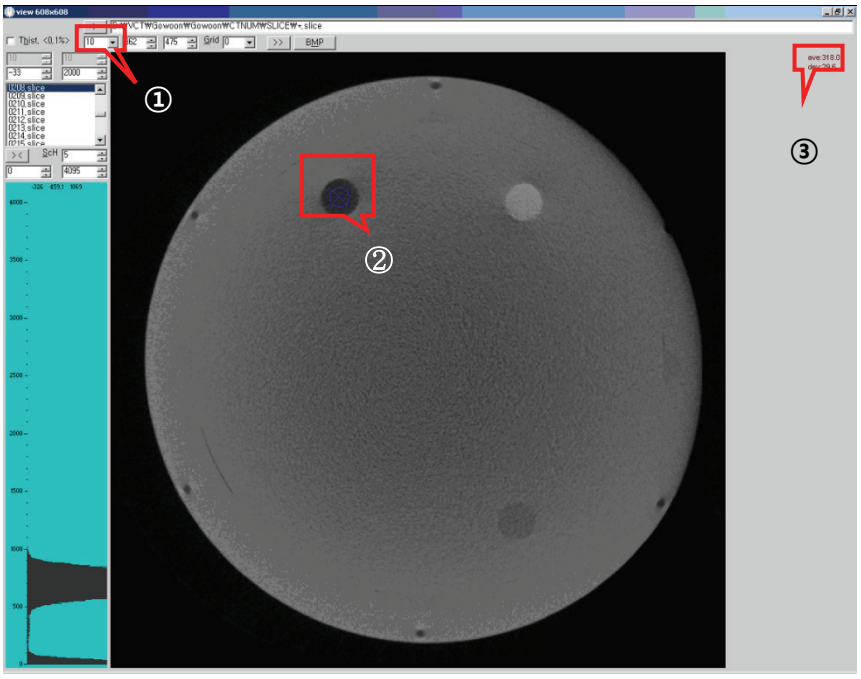
C. Measurement Point and Method

Measure the mean value of air and water from the reconstruction Slice file, and write them down in the respective file corresponding to each model. Refer to following figure.

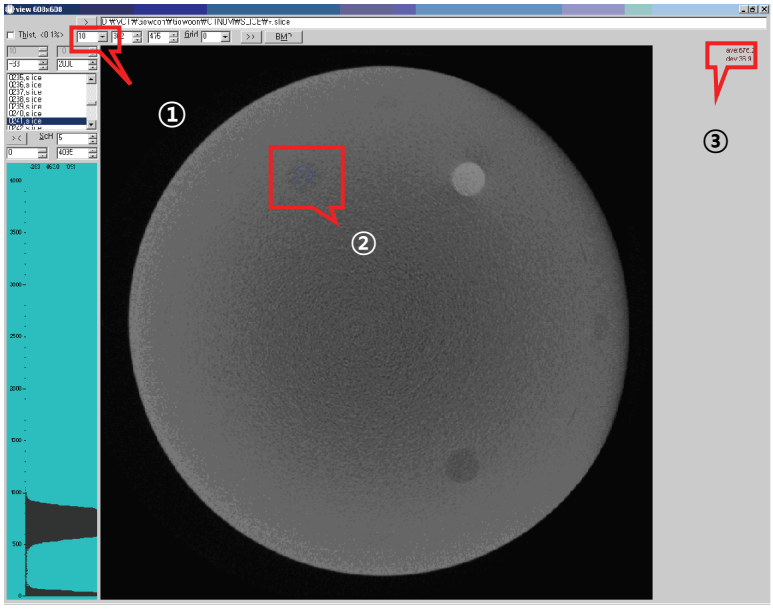
<table>
<tr>
<td>Phantom Measuring Point</td>
<td>




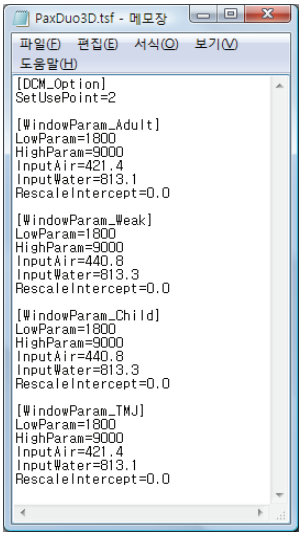
Phantom Measurement Position Cross Sectional Drawing
Phantom Measurement Position Lateral Side Drawing
</td>
</tr>
<tr>
<td>Vertical Beam Align Point of Phantom at Patient side</td>
<td>


</td>
</tr>
<tr>
<td>Air Measuring</td>
<td>


1. Select Air Layer Slice Image from Phantom Image.
2. Set the Pixel size at Air Measuring Position as 10.
</td>
</tr>
</table>

Air Measuring	3. Place the center of Pixel Area at the center of Air Measuring Position. 4. Read the Average Value from the first line at the right upper side. 5. Write it in Input Air section of PaxDuo3D.tsf file and save it.
Water Measuring	 1. Select Water Layer Slice Image from Phantom Image. 2. Set the Pixel size at Water Measuring Position as 10. 3. Place the center of Pixel Area at the center of Water Measuring Position. 4. Read the Average Value from the first line at the right upper side. 5. Write it in Input Water section of PaxDuo3D.tsf file and save it.

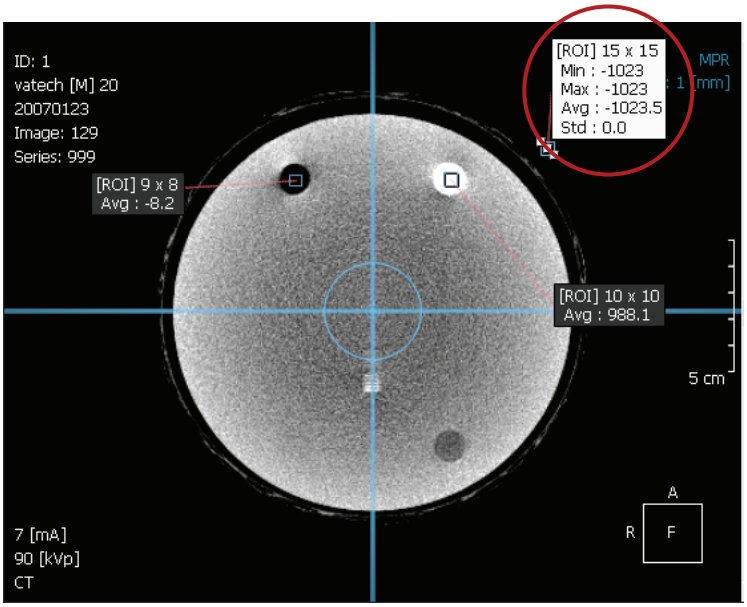
Open Tsf file and write the measured values of each substance as Input Value and save them. For **Adult and TMJ, enter the equal measured value and for Weak and Child, enter the equal value.** See the figure file (Enter the values of applicable measured substances in the circle (input) and save them)

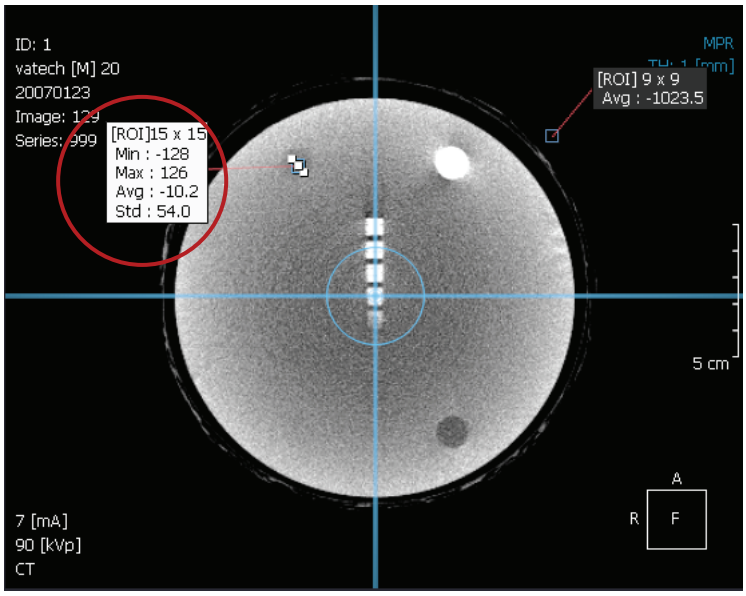
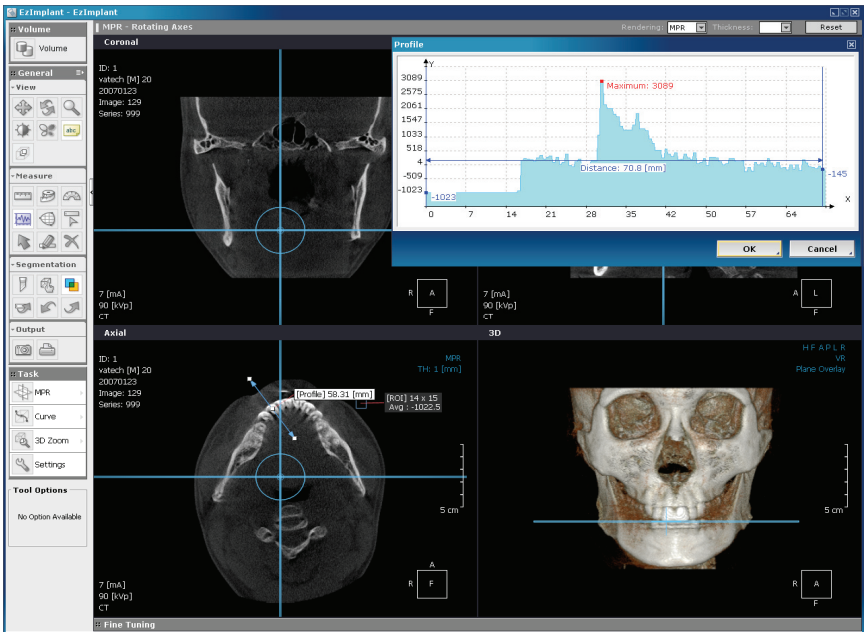


For WindowParam16_adult section, scan the CT Phantom in the Adult Mode, and the average values of each measured substances, that are air and water, should be recorded. Also, for WindowParam16_child, scan CT Phantom in the Weak Mode, and the average values of each measured substances should be recorded for use.

D. CT number correction inspection and image confirmation

In use of scanning program, check and inspect the accuracy of CT numbers of CT Phantom.

CT number Inspection	 1. Set the Pixel as about 15x15 at the center of Air Measuring Position. 2. Read the Average value of Air and check whether it is within the CT Number reference value -1000 ± 100

CT number Inspection	 1. Set the Pixel as about 15x15 at the center of Water Measuring Position. 2. Read the Average value of Water and check whether it is within the CT Number reference value 0 ± 20.
Skull CT Number Inspection	 1. In 3D viewer, Place the Axial Image Section at the Lower Jaw tooth head. 2. Set about 15x15 Pixel at the outer angle section of Air. 3. Read the Average value of Air and check whether it is within the CT Number reference value -1000 ± 100.

According to aforementioned procedures, confirm and check whether CT number Calibration has been performed in normal way, then finish CT number Upgrade

- CT Number reference

Measured Substance	CT Number Reference	Remarks
Water	0 ± 20	
Air	-1000 ± 100	
Teflon	855 ± 100	

- CT Number Adjustment Method

  Using CT Number Phantom, after completing CT Number Calibration, the CT number values of water and air that are measured from 3D View deviate from their references, perform CT Number Correction by using following method.

Ex) CT Number Correction

Measured Substance	PaxDuo3D.tsf Input Value	Measured CT Number value	Corrective Method
Water	InputWater = 588	-40	1. About -40 lower against the reference value. 2. Calculation: 588 – 40 = 548 2. Correction of InputWater = 548 Input
Air	InputAir = 265	-870	1. + 230 higher against the reference value 2. Should set lower than - 950 3. Calculation: - 950 + 870 = - 80 265 + 80 = 345 4. Correction of InputAir= 345

Chapter 11 Firmware Upgrade

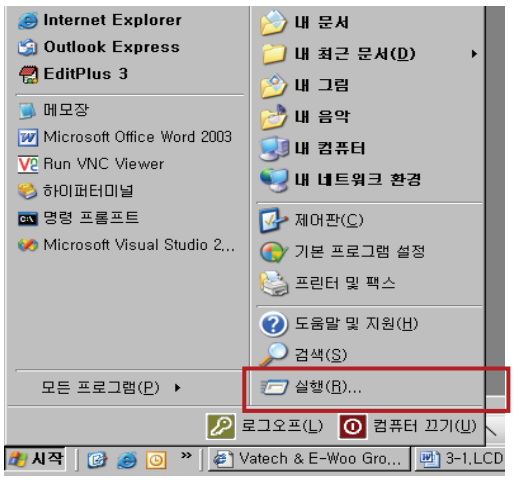
11.1 Touchpad Screen Firmware Upgrade

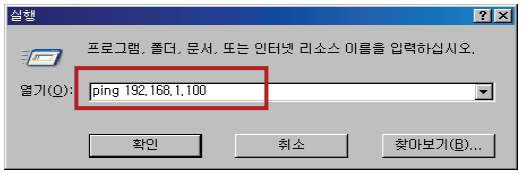
First, check the version of currently installed firmware from the upper right side of front side LCD Panel and make record on it.

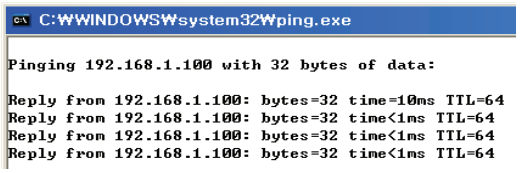
Touchpad LCD main GUI

11.1.1 Confirmation on Network Communication Connection Status between LCD and PC

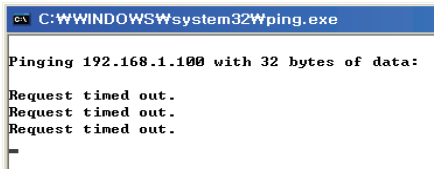
Start from PC by clicking Start→Execute, then click in following sequence.







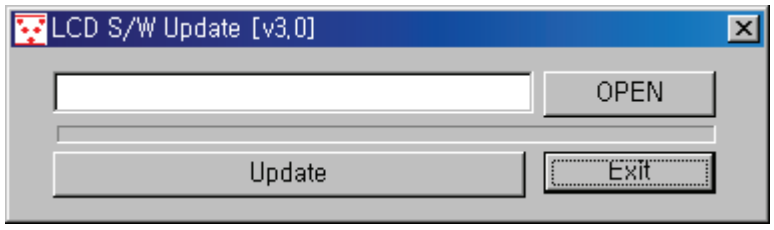
Normal Connection



Unconnected

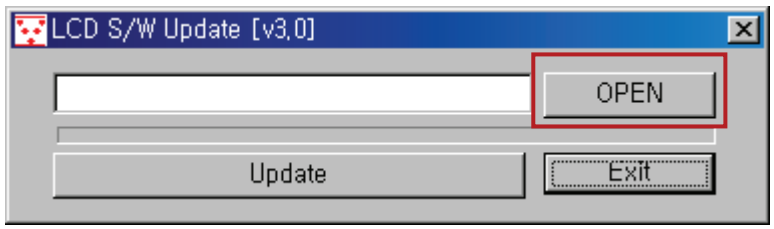
11.1.2 Execution of LCD Firmware Upgrade Tool

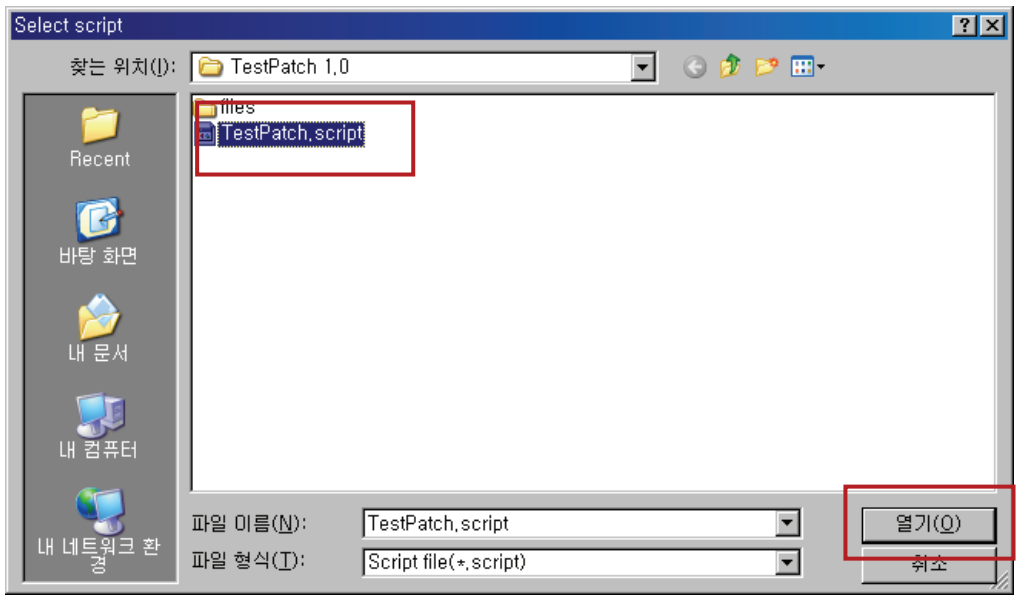
1. Impress the power supply to the equipment and perform the confirmation on the normal operation of Touch LCD and Ping Test as well.
2. **Execute LCD_Update[v3.0]. exe**
   Following window is to appear.



Basic Tool

3. Press [Open] button, and fine the patch file of its extension is script, then press [Open] button.





Press [Update] button of the program, then a dialog box will pop up, asking whether to continue patch and begins the patch processing. When patch is completed, a dialog box pops up again to notify on the completion, then, the program finishes.

Check the right upper side of main GUI again and confirm on whether the correct version is installed.

11.1.3 Error

1. Appearance of Error

- When it fails Ping Test, confirmation should be made on whether the network function is operating in normal conditions as well as on whether the network setting is changed.
- If the update program is not being executed, it indicates that Microsoft .NET Framework v2.0 is not installed yet.

2. Ping Test Failure

- Check on whether power supply is impressed to the equipment as well as whether Touch LCD is operating in normal conditions.
- Check on the connection status between PC and Ethernet cable of the equipment.
- Refer to Clause 7 to confirm on the IP address setup, and if it is not the default value, make correction on the update script file with reference to Clause 6-3, then attempt the update again.

3. Other Patch Failure and Causes for Malfunctioning

- Check on whether Touch LCD is operating in normal conditions.
- Check on whether the version of patch is correct and applicable to the model.
- Check on whether the patch is processed from the old version to the latest version in orderly way.

11.2 PaX-Duo3D Patient Monitoring Camera Related Setting

1. Input the command into [Start]-[Execute] window and bring the DOS window for display.
2. Input 'ipconfi' to confirm IP. Perhaps 2 IP addresses would be identified.
   ex) IP 1: 192.168.1.88
   IP 2: 192.168.0.88
3. When the 3rd IP is No. 1 among 2, it is usually the IP address of Ethernet Card connected to the equipment.
4. If both of them are indicated as 192.168.1.xxx, pull out the Ethernet cable that is connected to the clinic network for disconnection, and check the remaining addresses.
5. Input 'route print'.
6. If either of 224.0.0.0 or 224.168.10.102 is seen in the array of lists and permanently designated items below, input the following commands.
7. Input either one of 'route delete 224.0.0.0' or 'route delete 224.168.10.102', or Input both of them to correct the contents of Table.
8. Input 'route print' and check once more. If the route still exists, repeat the process under No. 5.
9. Input 'route add 224.168.10.102 192.168.1.88 –p'.

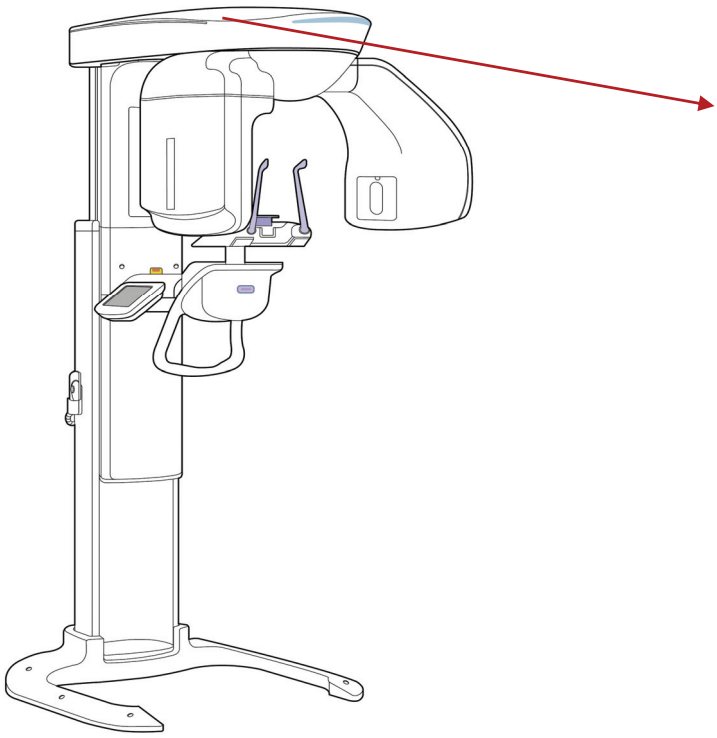
-p command designates the permanent route so that it can be maintained even after rebooting.

Also, the 2nd IP address should be the address being connected with the equipment which was checked under No. 2.

10. Finally, execute the scanning S/W and check on whether images are being acquired.
    In prior to commence this kind of setting, check on whether the communication with Touch LCD is undertaken always well by inputting ping 192.168.1.100 once again, and if it doesn't work still, remove the clinic network cable and perform the test again.
11. If all of aforementioned attempts still do not solve the problem, then, check again on the entire cable line of Ethernet that is connected including even the equipment.

11.3 4AXIS-1 MCU Board Upgrade

In order to upgrade X -axis MCU Board, it needs FDT tool installed already as described in Appendix A-1 (See the Appendix A-1.)



Location of 4Axis-1 MCU Board

For 4AXIS-1 MCU PCB Upgrade, Flash Development Toolkit(=FDT) is used only, therefore, if FDT is not installed in the computer, “Firmware Uploading Tool (=FDT) Installation” and “ Firmware Uploading Tool’s Work Environment Setting” should be performed. Confirmation is required for pre-task version and post-task version, using the *Hyper-Terminal* for accurate upgrade (See: “How to Use Hyper-Terminal” in Appendix)

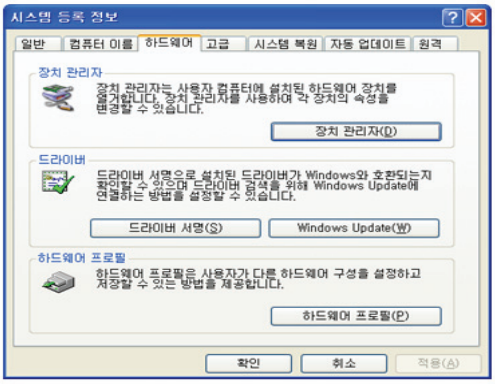
For this MCU PCB Upgrade, the upper case of vertical frame needs to be separated.

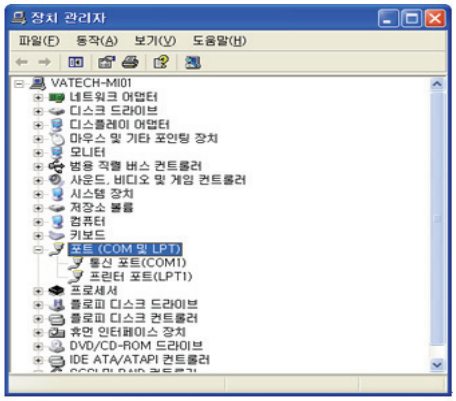
In communication between PaX-Duo3D and the computer, use the communication port that is installed as addition and confirm the name of additionally installed communication port.

Select in sequence of **Start > Control Panel > System,** then the window for ‘System Registration Information” will be displayed. From this window, select **‘Hardware’** tab and then select “Device Manager**”**.

From ‘Device Manager’ window, check on the communication port that is connected with the equipment.

When it is extension of 1 communication port, usually it appears as “Com3” For more than2 communication ports extension, it is possible to distinguish by checking the manufacturer and product name of the extension card.



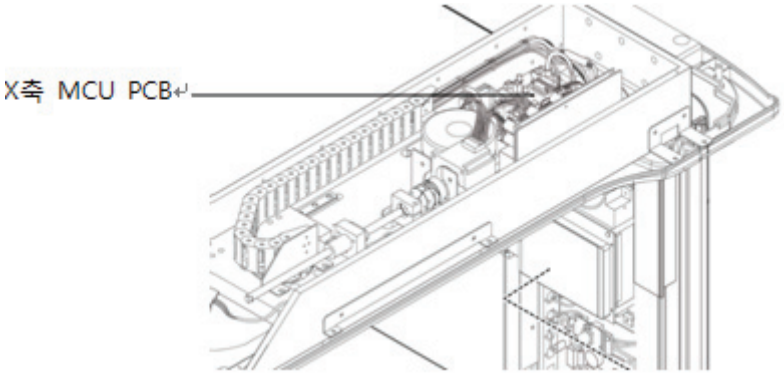


IMPORTANT

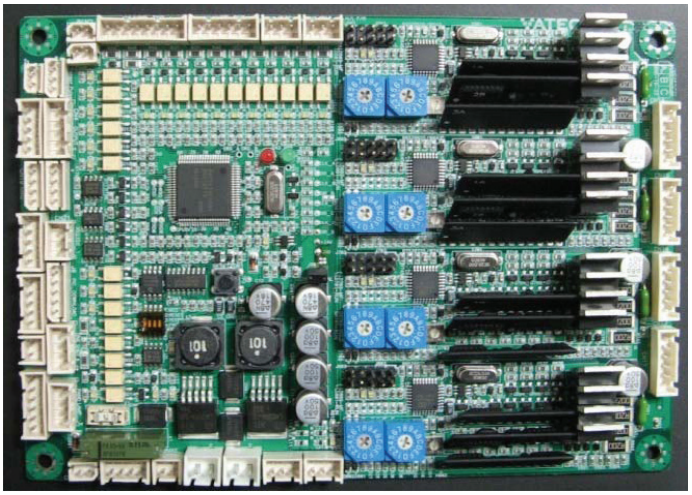
Should download the latest version Firmware.

Execute the Firmware upgrade in following sequence.

1. Separate the Vertical frame cover and check the MCU Board

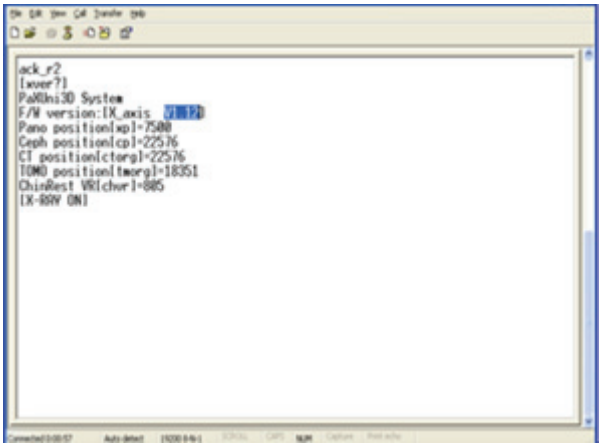


2. Connect PC and COM port in the Board of the equipment by using RS 232 Cable.

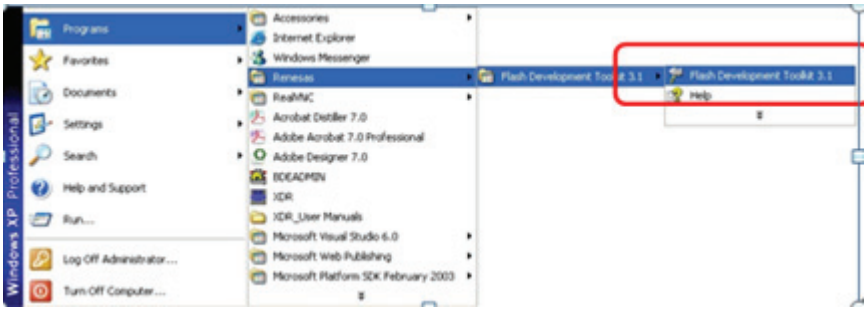


3. Turn DIP Switch No.1 on X-axis Board to the position of **"On"**.
4. As shown in above figure, press "Reset" button to refresh.
5. Execute HyperTerminal, confirm & record the current version.

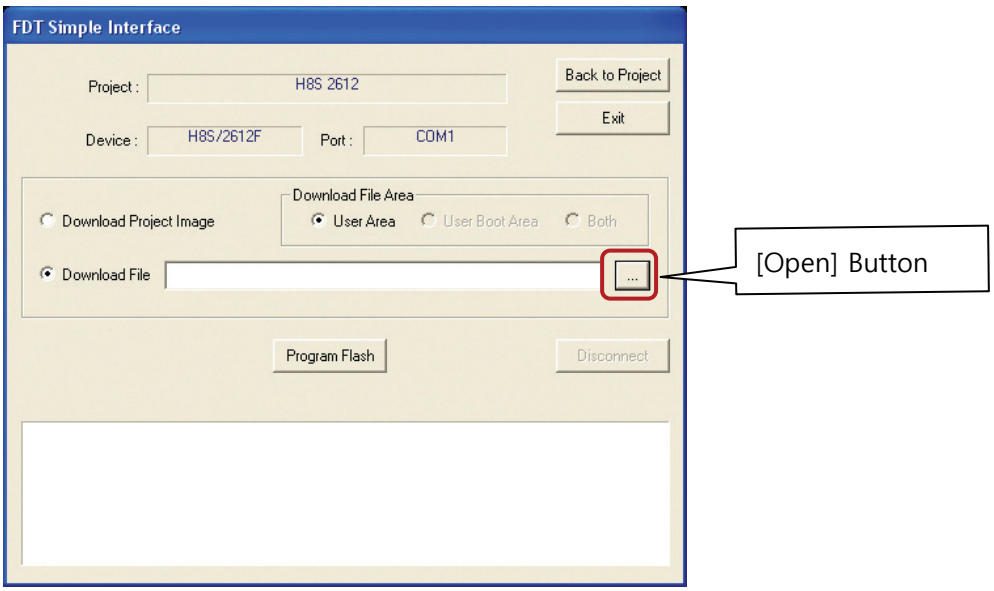
   The command used at this time is **[xver?].** This process is to confirm whether the firmware is upgraded exactly as intended. *Make sure to close HyperTerminal*



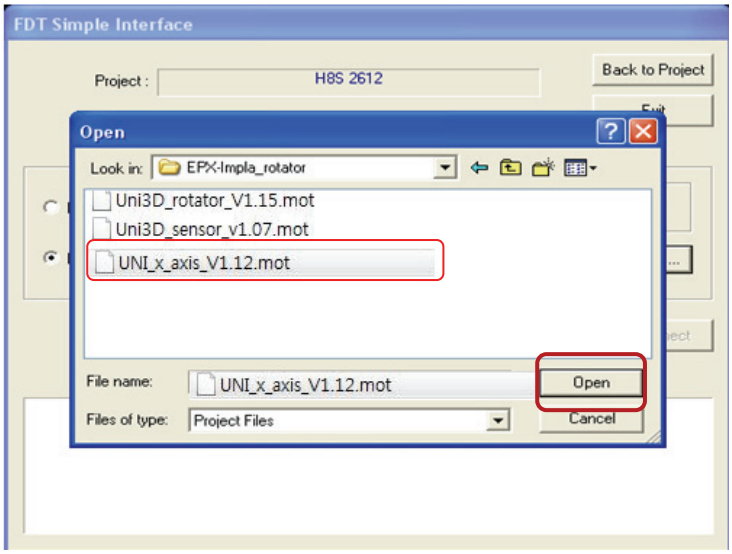
6. Execute FDT.



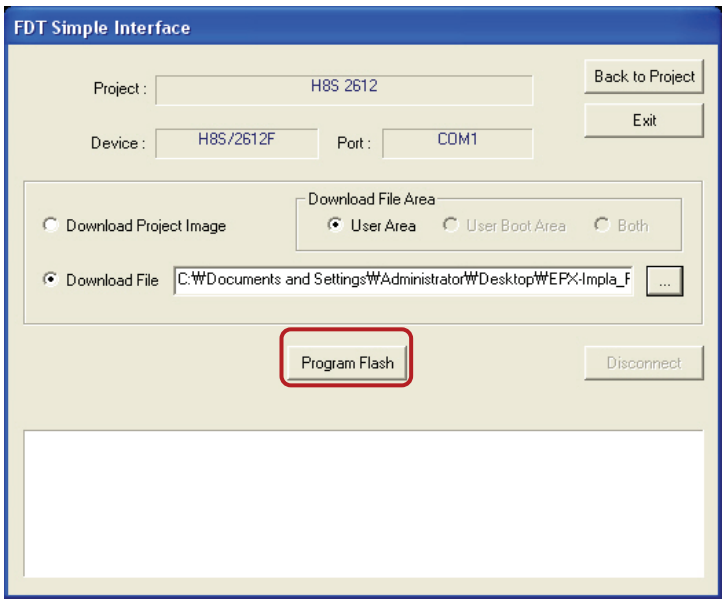
7. Press [Open] button from following figure.



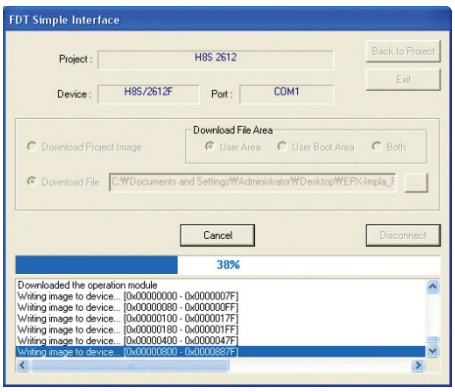
8. As the new version which was downloaded, select **'Uni3D_x_axis_V1.12.mot'** file among the firmware files. And click 'Open" (here, the exampled case is Uni3D, and for other equipment, others are equal except the file name is different.



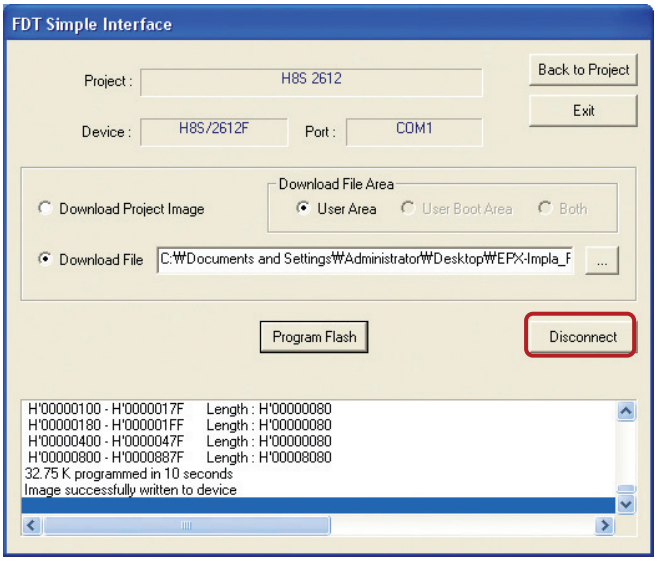
9. Select **'Program Flash',** then the new firmware uploading to MCU begins.



10. Indicates the progress rate.



11. After the uploading of X-axis MCU new firmware is completed, select **'Disconnect'** button.



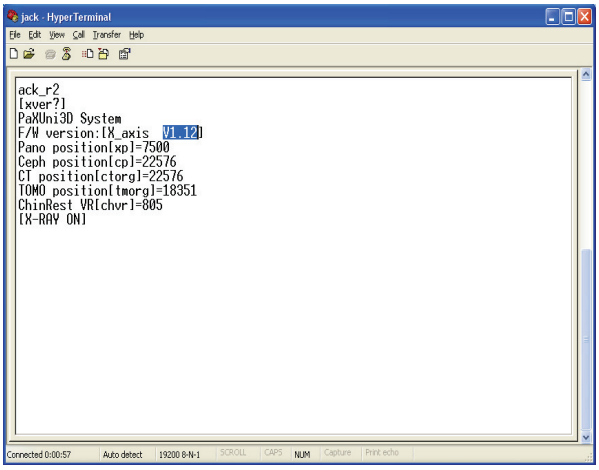
12. *As final, Change DIP switch of X-axis MCU Board to **"OFF'***. (Very important). This means returning to the initial position.

IMPORTANT

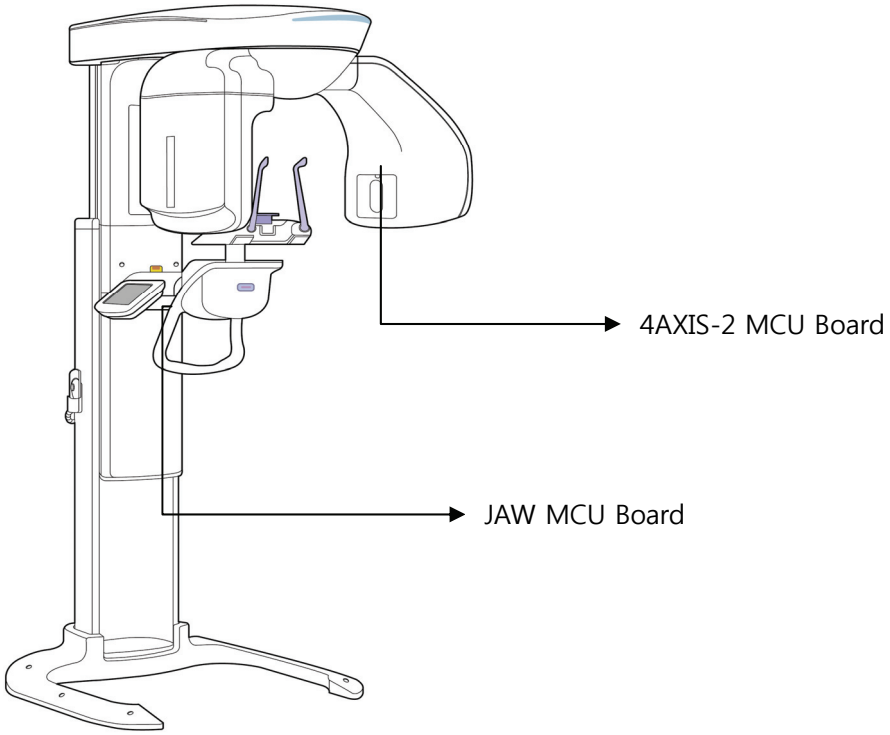
Make sure to return DIP switch to its original position.

13. **Reset** the power supply of System (PaX-Uni3D) to ensure that the new firmware is applied.

14. Input **"[xver?]"** at Hyper Terminal window, using the keyboard and check the task of firmware upgrade of X-axis MCU is being done in correct way, then close the HyperTerminal Window. **(* This task should be performed about 10 seconds after since the system power supply is reset)**



11.4 4AXIS-2 and JAW MCU Board Upgrade



4AXIS-2 MCU and JAW MCU Boards use **EzCAN (Version: 1003)** program to implement the firmware upgrade.
Therefore, the method of 4AXIS-2 MCU Board Upgrade is to be described in specific details and for the upgrade of other boards, only the different parts is to be described.

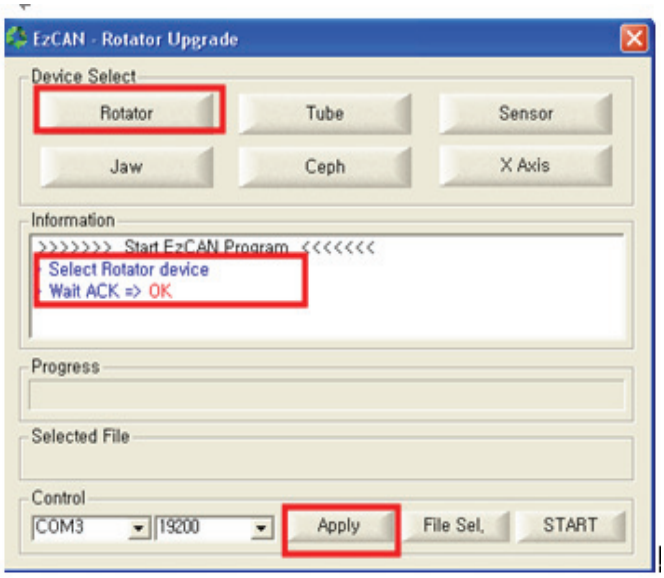
For **EzCAN** function and the method to use, see the Appendix.

NOTE

4AXIS-1 MCU Board uses FDT 3.1 Program

11.4.1 4AXIS-2 MCU Board upgrading

1. Click **EzCAN.exe** to execute it. Then, following screen will be displayed.



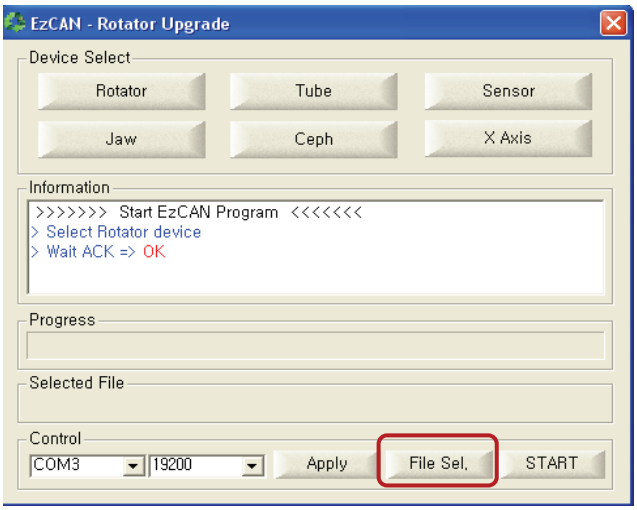
2. Select Rotator from Device Select. Thereafter, if the communication with the equipment is successful, **"Wait ACK=>OK"** will appear after a few seconds on the Information window.

IMPORTANT

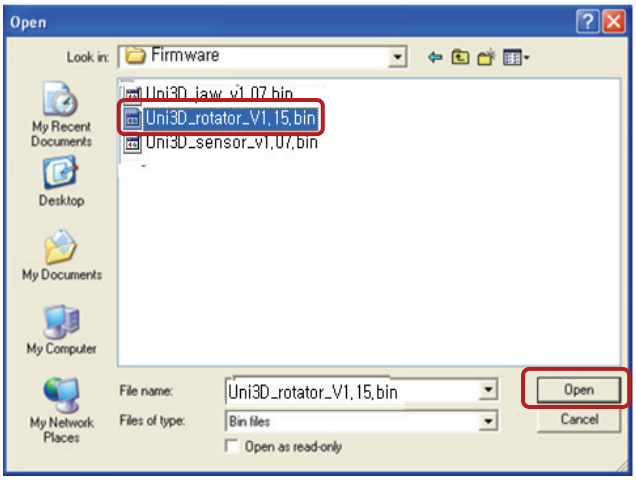
At initial connection between Rotator MCU Board and EzCAN, there should be "OK" response to the Information window in order to say the communication is achieved successfully. If there is no "Ok" response, it means the failure of communication, and it should not progress further. This issue should never be overlooked. This issue is applied to all MCU Boards that use EzCAN.

3. Set COM port and bps value
   Com Port Set Value can be different for each computer.
   ① Set the **com** port value
   ② Set the communication speed to "**19200**"
   ③ Click **[Apply]** and save the input values. (After application of **"Apply",** the absence of anything from display is normal.)
   ④ Click **[File Sel]**.

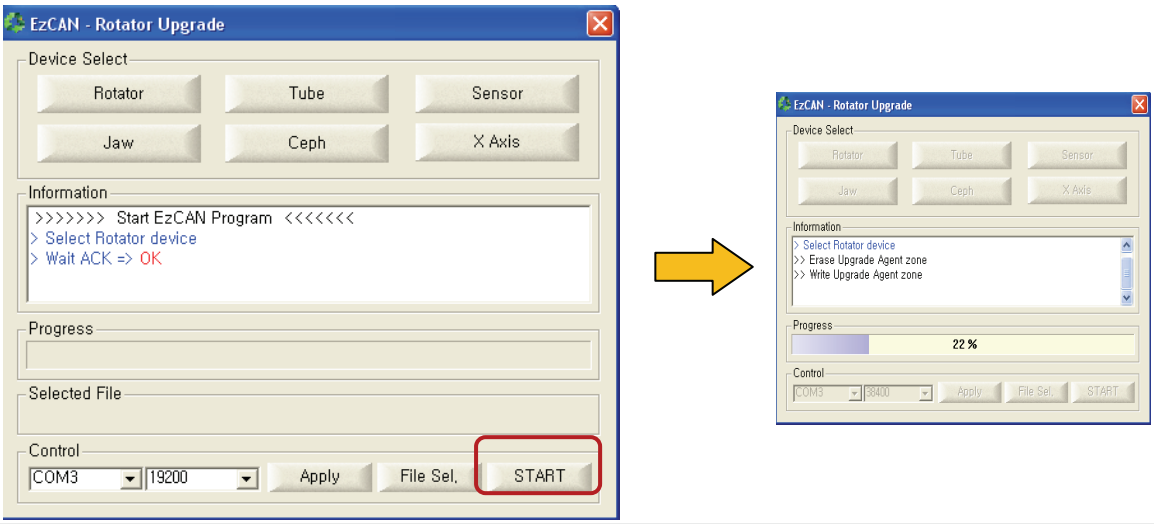
When clicked [Apply] to save the parameters after setting, it is normal when no appearance is indicated.



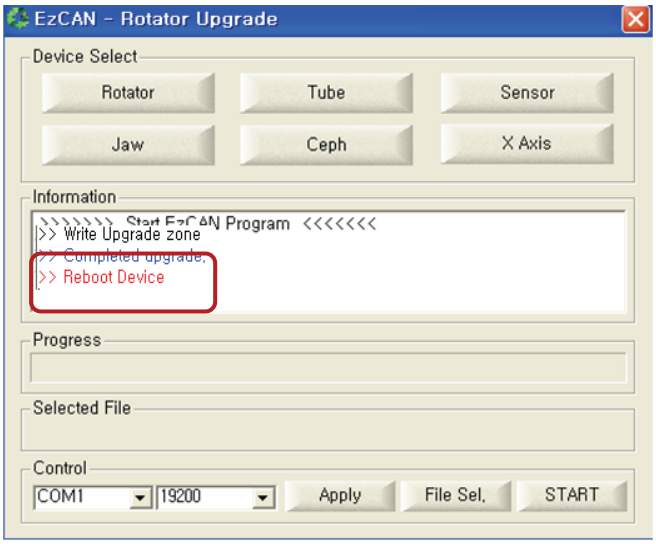
4. Select **Uni3D_rotator_V1.15.bin,** and click **"Open"**.



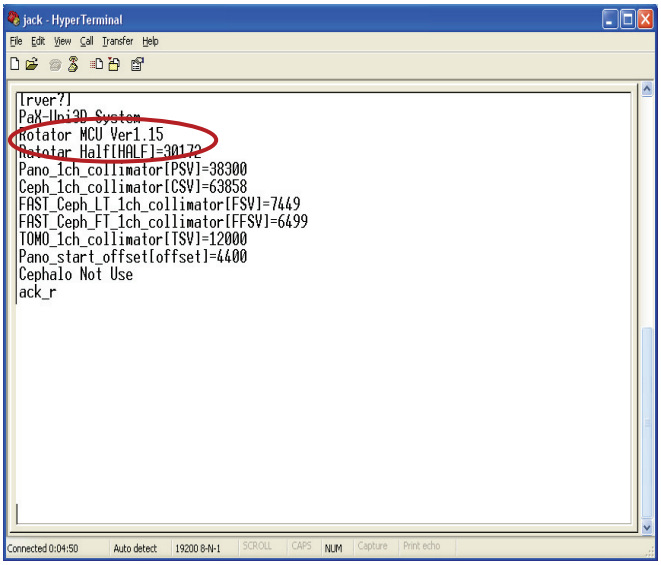
5. Press **[START]** button to begin upgrading.



6. **Reboot** the system to apply the new firmware version.

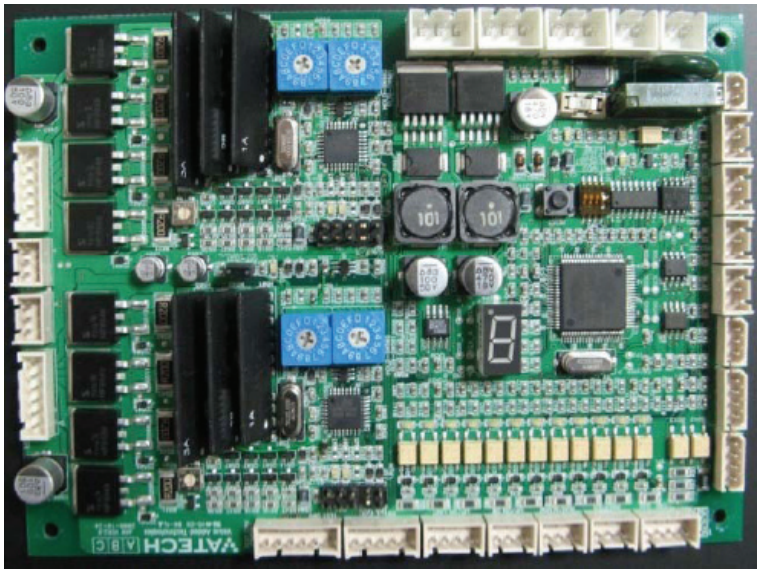


7. Open HyperTerminal and send the command **[rver?]** to check whether the upgrade is being successful.



8. Close HyperTerminal. (Important)

11.4.2 JAW MCU Board Upgrade



The method is almost the same with the aforementioned 4AXIS-2 MCU Board Upgrade method.

Difference is to click **"JAW"** button after executing EzCAN.

1. First, execute HyperTerminal, then check and record the current version.
2. Close it.
3. Execute EzCAN.
4. Click JAW from Device Select.
5. Input various set values as aforementioned.
6. The rest of processes are the same. The file name of new firmware selected at this point is **Uni3D_jaw_V1.07.bin**.
7. As final, execute HyperTerminal once again to check whether the new firmware is successfully installed. At this point, the command to use is **[jver?]**.

NOTE

When clicked [Apply] to save the parameters after setting, it is normal when no appearance is indicated.

Chapter 12 Appendix

12.1 FDT3.1 Installation

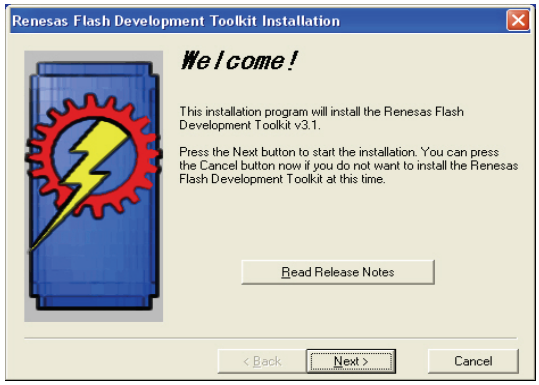
12.1.1 FDT Installation

1. Prepare a new version of Firmware

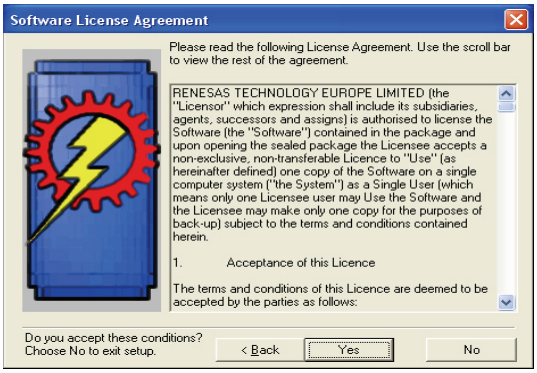
Should check that the version is the newest firmware version before installation.

2. Firmware Download Tool(Flash Development Toolkit)Installation: FDT

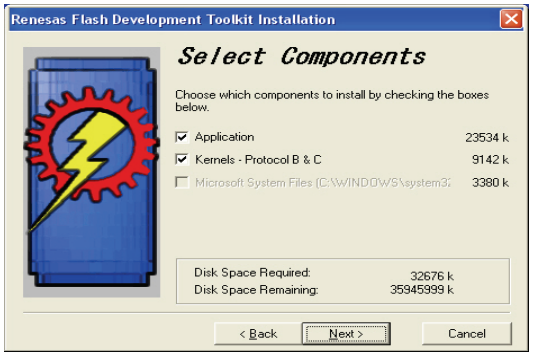
① Execute "**fdt3_1.exe"** file, then a message window "Welcome" will appear.
Click **"Next"** button.



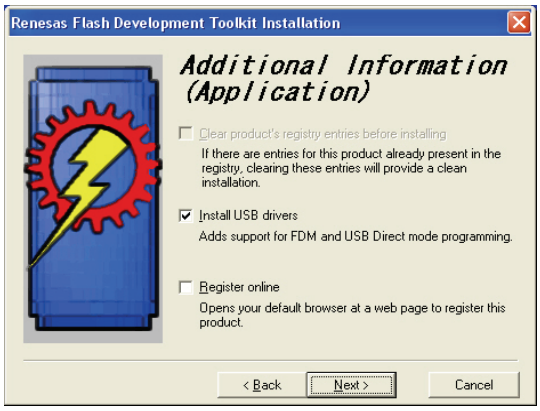
② Click **"Yes"** from next window.



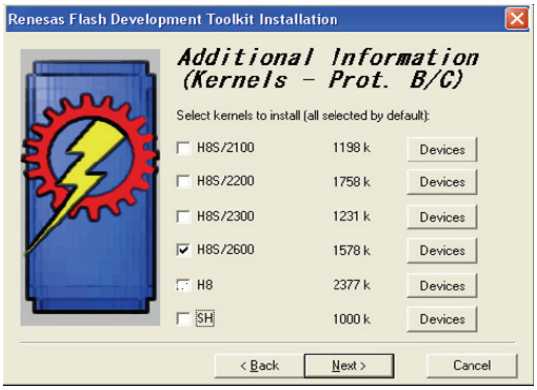
③ The "Select components" window appears, the click " Next" button.



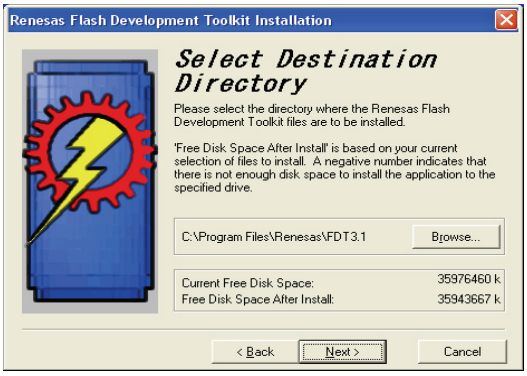
④ If there is anything to install additionally, check the applicable button, and Click **"Next"** button.



⑤ Cancel checking on other items except H8S/2600, and select “Next” button.

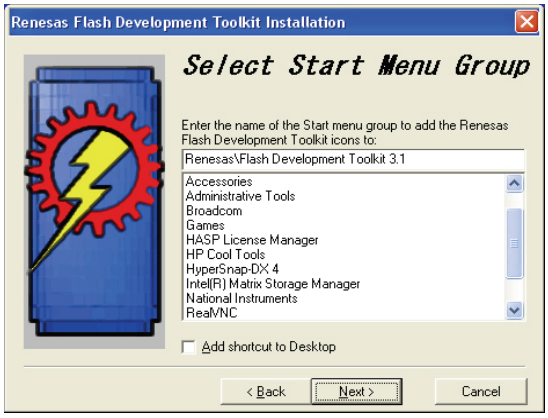


⑥ Select the folder where to install, and click “Next”. At this point, it is possible to change the location of folder



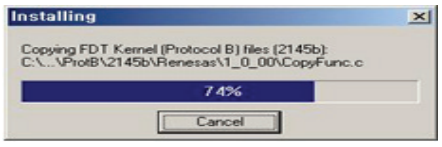
⑦ Select the backup folder and select “Next” button.

⑧ Select Start menu group and then select “Next” button.



⑨ Select “Install” button”.

This shows the status of installation in progress.

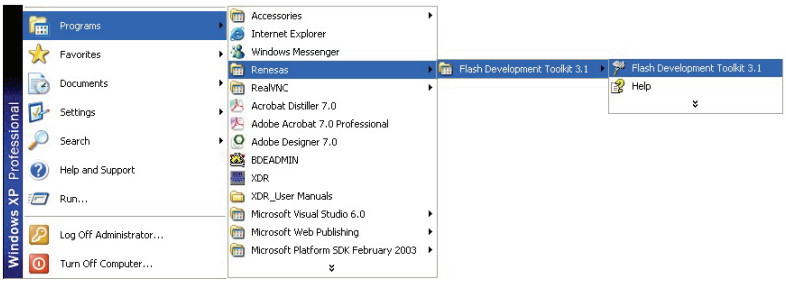


⑩ When the installation is completed, the “Installation completed” window displays, and select “Finish” button.

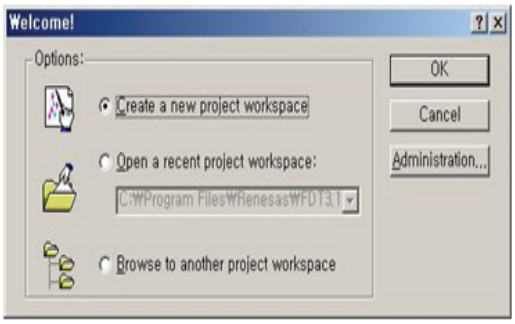
12.1.2 Work Environment Setting for Flash Development Toolkit

When executing FDT for the first time, the work environment for new project should be set. Process in following sequence.

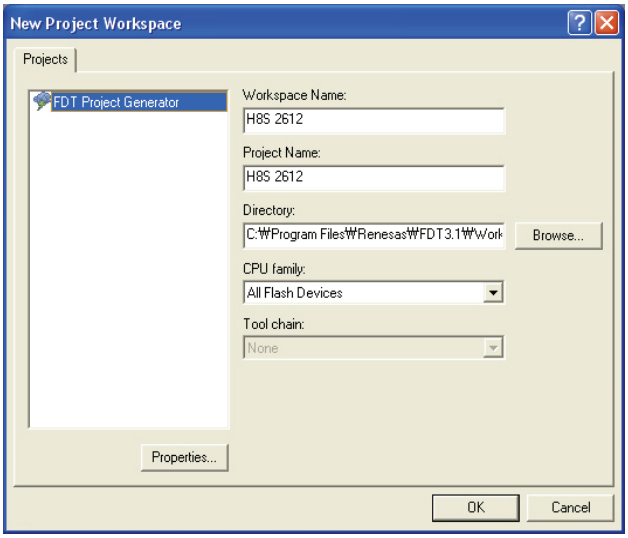
1. Select Start > Program > **Renesas > Flash Development Toolkit3.1 >" Flash Development Toolkit 3.1"** to execute it.



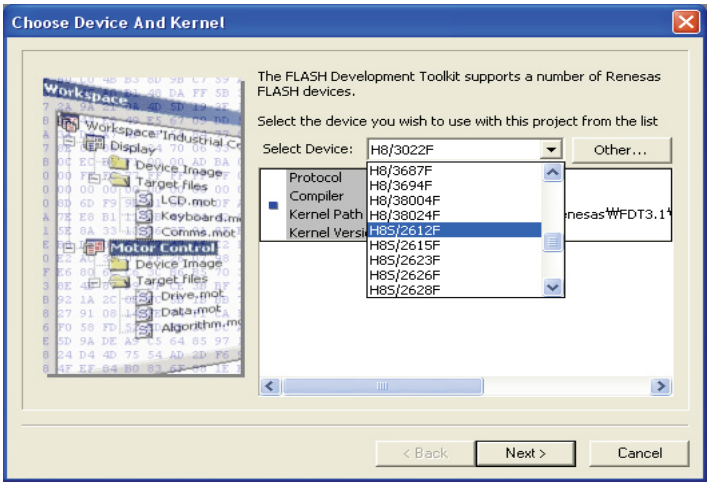
2. Then following window is to appear. From this window, select **"Create a new project workspace"** to create the work environment of new project, and then select "OK" button



3. Enter **'H8S2616'** in Workspace Name and Project Name, using Keyboard, then select **"OK"** button.



4. Select **'H8S/2612F'** device, and press **"Next"** button.



In the communication between PaX-Duo3D and the computer, the additionally installed communication port name, using the newly attached communication port in addition to the computer.

Select **Start > Control Panel > System** and the 'System Registry Information' window are to appear. From it, select "Hardware" tab and select "Device Manager" button.

From "Device Manager" window, check the communication port that is connected to the equipment.

When it is extension of 1 communication port, usually it appears as "Com3" For more than2 communication ports extension, it is possible to distinguish by checking the manufacturer and product name of the extension card.

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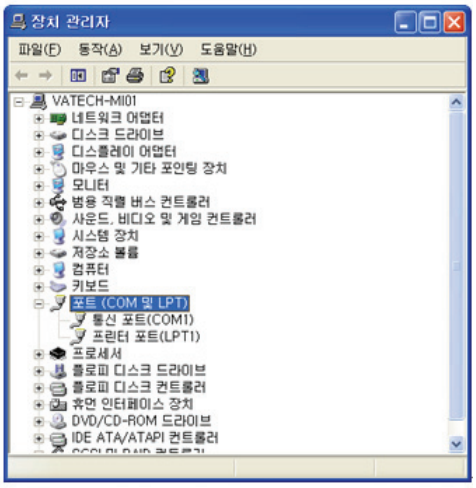
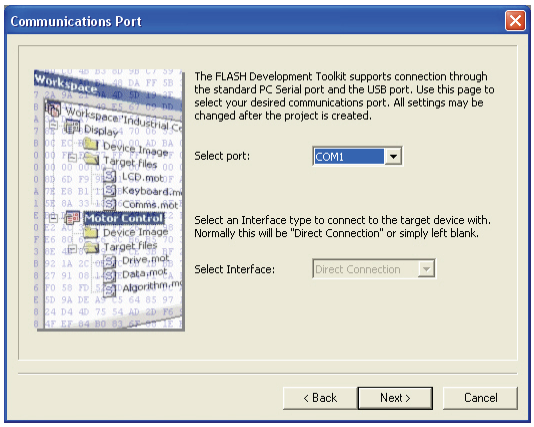
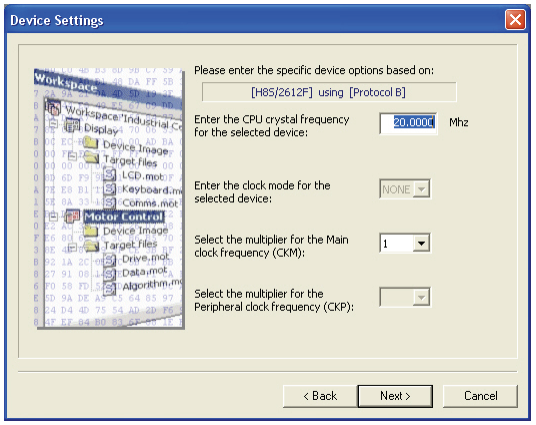
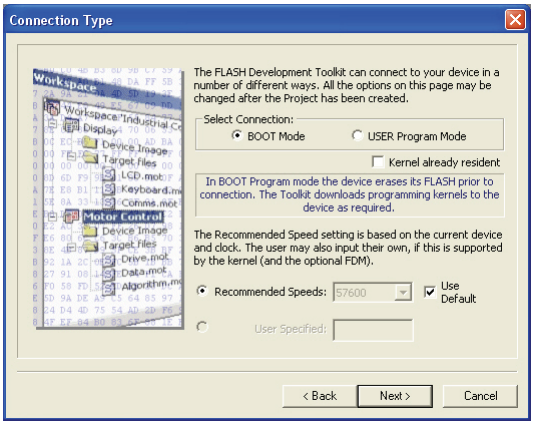


5. Check and select the communication port between the equipment and the computer (=Comport).
   Select **“Next”** button.

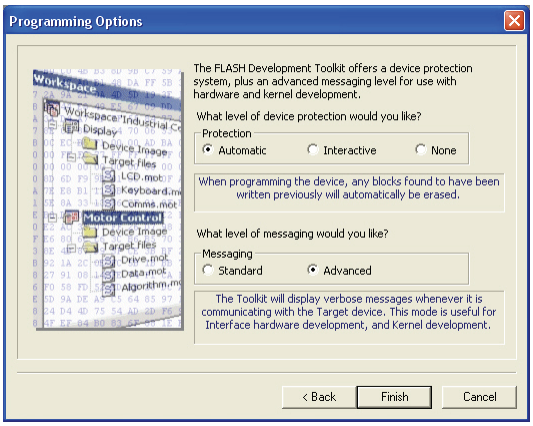




6. Select the connection type as ‘BOOT Mode’, then select **“Next”** button.



7. Select ‘Automatic’ for the device protection level and ‘Advanced’ for message notification level, then select “ Finish” button.



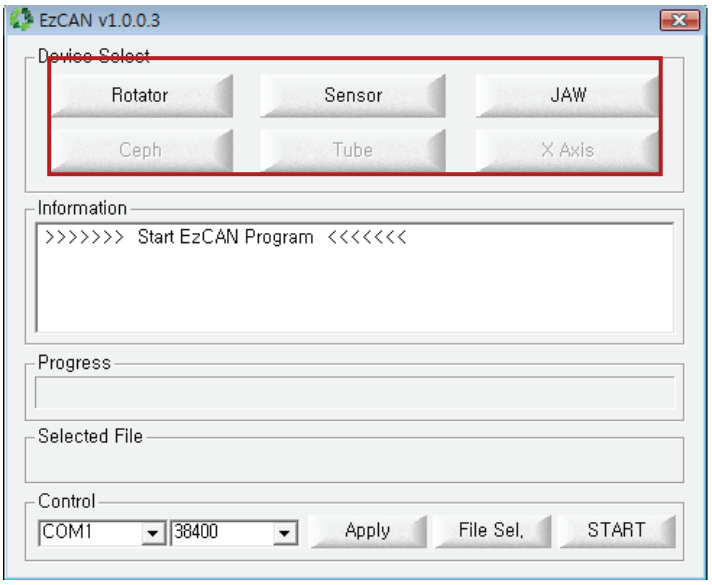
12.2 EazyCAN1003 Installation

PaX-Duo3D Equipment exchanges the information from each board through CAN (controlled area network) with each other and share the details on current status. This program is used when upgrading the Firmware of the Boards performing CAN communication.

But it should be noted that when upgrading Firmware upgrade, 4AXIS-1 MCU Board do not use **Easy CAN** but uses, **fdt3_1.exe**.

1. **EzCAN Program Execution**

   Double click **EzCAN.exe** and the following screen is to appear.



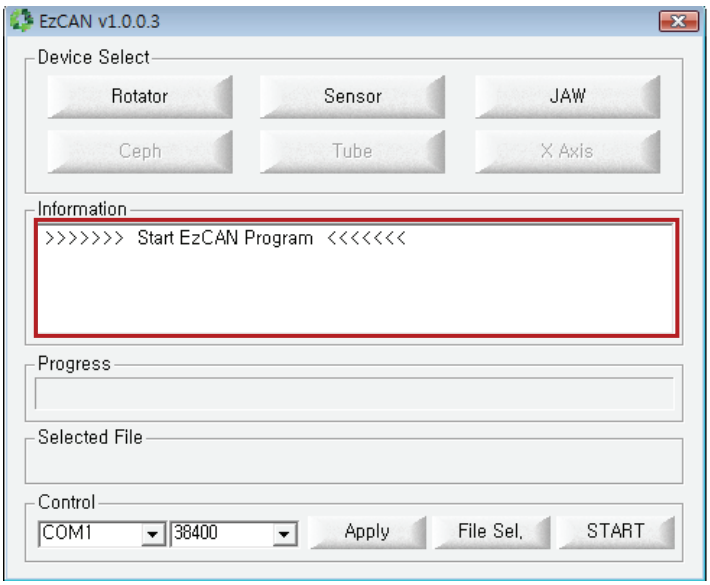
2. **EzCAN Functional Explanation**

   First, describe the role by each function

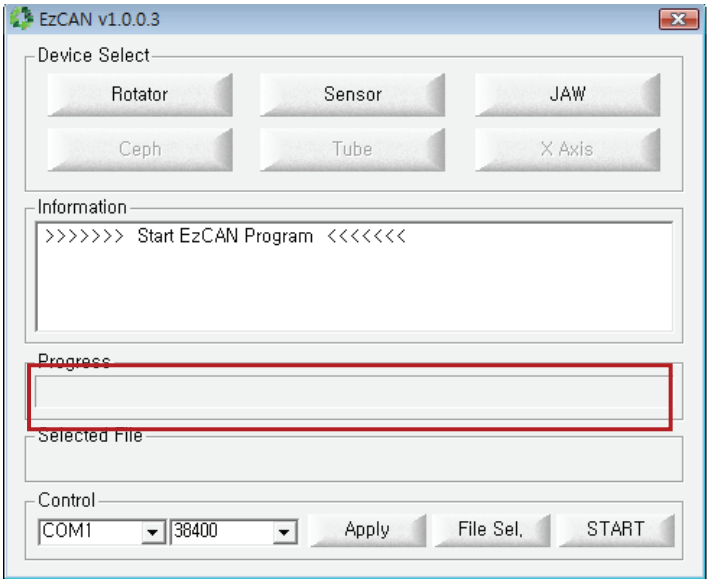
   Device Select panel: there are 3 boards possible for upgrade.

   - **Rotator:** Button for Rotator Unit Upgrade
   - **Tube:** Use then on for Tube System Upgrade (Not being used)
   - **Sensor:** Use the Sensor MCU Board Upgrade
   - **Jaw:** Use Jaw MCU Board Upgrade for Chinrest Unit
   - **Ceph:** Use Ceph MCU Board Upgrade (Not being used)
   - **X-Axis:** Use X-Axis MCU Board Upgrade (Not being used)

Information panel: Indicates the upgrade progress of each stage .



Progress panel: Indicates the ratio of progress



Control panel

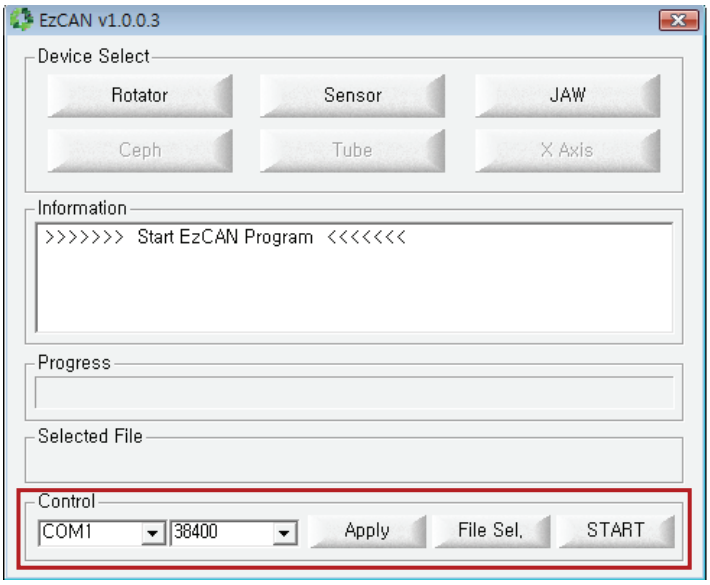
Com port: Serial Com port to be used

Bits per second: Use bps **"19200"** as the speed to use (Default Value 38400)

Apply: Save the input parameter values.

File Sel (file select): Select the Upgrade file **". bin"**.

START: Begin the downloading of Upgrade.



NOTE

The following examples are the files related to the Firmware Upgrade of PaX-Uni3D equipment and for PaX-Duo3D equipment, similar type files are to be provided.

Firmware files related to Upgrade:

These files are in :\Firmware_with_EzCAN\Firmware.


Uni3D_jaw_v1.07.bin


Uni3D_rotator_V1.15.bin


Jni3D_sensor_v1.07.bir

Uni3D_jaw_v1.07.bin: Firmware files for Chinrest

Uni3D_rotator_v1.15.bin: Firmware files for Rotator

Uni3D_sensor_v1.07.bin: Firmware files for Sensor

12.3 PaX-Duo3D Equipment Commands Sets

12.3.1 Command Usage Format

Command is a collective set of series of predetermined language protocol between the equipment and PC, to be used through PC in order to drive the equipment, upgrade the firmware of the equipment, and to maintain the optimal status.

1. **Communication protocol**
   Uses HyperTerminal

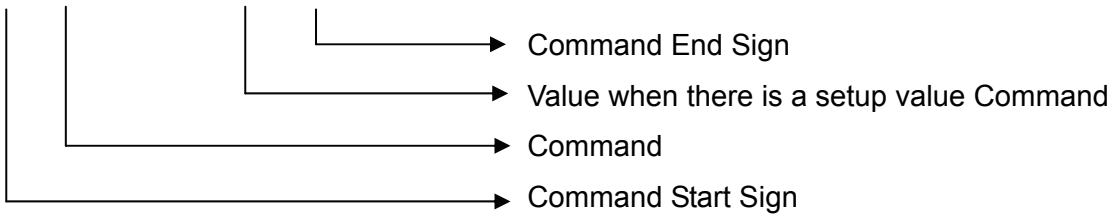
   Predetermined communication protocol is in following format.

   - **Communication setting**
     All commands used for PaX-Duo3D uses **HyperTerminal** (RS232 communication) to input data and communication setting parameters are as follows.

parameter	Set value
Baud(Speed)	19200bps
Data bit	8bit
Stop bit	1bit
Parity	None
Stream Control	None

   - **Command format**
     The command format is

[Command Value]



Example: **[SPM_HV___0800]:** Tube Voltage Setting Command

NOTE

There are rules that comprise the commands

1. **It should be consisted of 4 letters**
2. **No delimit between Capital/Small letters.**
3. **S: Send, P: Scanning Program S/W, L: LCD, M: firmware.**
4. **But, backspace does not work when input the command.**

12.3.2 Commands Sets

1. Common Commands

Command	Description	
[SPM_LMP_]	Lamp position set	Command for Initial Position Shift of the Equipment
[SPM_RET_]	Return position set	Command for Scanning Position shift of the Equipment
[SPM_ERDY]	Expose Switch ready set	Command for Ready to press the irradiation switch
[SPM_PANO]	PANORAMA mode set	Command for enter into Panorama Mode
[SPM_CT__]	CT mode set	Command for enter into CT Mode
[SPM_HV___0000]	Tube kVp set	Command for Tube voltage strength setting
[SPM_HA___0000]	Tube mA set	Command for Tube current strength setting
[SPM_LON_]	Laser On	Turn on the Laser
[SPM_LOF_]	Laser Off	Turn off the Laser
[SPM_CPON]	sensor power on	sensor power on
[SPM_CPOF]	sensor power off	sensor power off
[SPM_PVER]	P axis version	To identify P-axis board version
[SPM_SVER]	Sensor version	To identify sensor board version
[SPM_JVER]	Jaw version	To identify chinrest board version
[SPM_TUTS]	Tube Test	Tube feedback test with expose switch.
[SPM_BKON]	sensor tilting Break on set	Turn on sensor tilting brake
[SPM_BKOF]	sensor tilting Break off set	Turn on Sensor tilting brake
[SPM_VOCH]	Voice Child	Set as child voice
[SPM_VOMA]	Voice Man	Set as man's voice
[SPM_VOWO]	Voice Woman	Set as women's voice

2. Pano Mode related Commands

[SPM_NOR_]	normal capture mode	Normal Mode
[SPM_LEF_]	left capture mode	Normal Mode (Left)
[SPM_RIG_]	right capture mode	Normal Mode (Right)
[SPM_CEN_]	center capture mode	Normal Mode (Center)
[SPM_FNO_]	fast normal capture mode	Fast scan mode
[SPM_TMO_]	TMJ open capture mode	TMJ (Open)
[SPM_TMC_]	TMJ close capture mode	TMJ (Close)
[SPM_SIN_]	sinus capture mode	Sinus
[SPM_ORT_]	orthogonal capture mode	Orthogonal
[SPM_ICC_]	incisor capture mode	Incisor
[SPM_MCR_]	molar right capture mode	Right side of molar
[SPM_MCL_]	molar left capture mode	Left side of molar
[SPM_CCR_]	canal right capture mode	Right side of canal
[SPM_CCL_]	canal left capture mode	Left side of canal
[SPM_STAN]	standard arch capture mode	Standard Arch
[SPM_NARR]	narrow arch capture mode	Narrow Arch
[SPM_WIDE]	wide arch capture mode	Wide Arch
[SPM_CHIL]	child capture mode	Children
[SPM_DARK]	PANO Dark calibration capture	Dark
[SPM_SSB_]	PANO Bright calibration capture	Bright

3. CT related Commands

[SPM_CTCY_0000]	Ct mode y axis move value	y-axis shift value setting in CTMode setting(1000 digits is for direction, less than 100 digits is shift value.)
[SPM_CTCX_0000]	Ct mode x axis move value	x-axis shift value setting in CTMode setting (1000 digits is for direction, less than 100 digits is shift value.)
[SPM_CTXZ_0000]	Ct mode z axis move value	z-axis shift value setting in CTMode setting(1000 digits is for direction, less than 100 digits is shift value.)
[SPM_SCTM_0000]	Speed of ct capture	CT mode scanning speed setting. Default as 22.464 sec. (~)
[SPM_CTB_]	CT bright	Begin Bright calibration in CT Mode.
[SPM_K_UP]	CT jaw up	Chinrest Up in CT Mode
[SPM_K_DN]	CT jaw down	Chinrest down in CT Mode.
[SPM_K_ED]	CT jaw end	Chinrest stop in CT Mode
[SPM_TA__]	CT short scan mode set (185 degree)	Short scan mode set (185 degree) in CT Mode

4. Service related Commands

[SPM_HF?_]	Half value request	Request for currently setting half value
[SPM_HFST_0000]	Half value set	Half value setting (1~28125)
[SPM_HFRN]	Half auto Run	Setting Half automatically (Put the reference point on the straight line with column and input command
[SPM_XPST_0000]	PANO X axis position value set	x-axis position setting in panorama mode (1~1999)
[SPM_XP?_]	PANO X axis position value request	Request x-axis position value in panorama mode
[SPM_CPST_0000]	CT X axis position value set	x-axis position value setting in CT mode

[SPM_CP?_]	CT X axis position value set	Request x-axis position value in CT mode
[SPM_POFS_00000]	PANO rotator offset value save	Save Scan rotator starting value and offset value in Pano Mode (Five digits 10000: The highest is direction) The first front digit is “1, then clockwise direction, if it is +""0 is clock-reverse wide direction +"
[SPM_PO?_]	PANO rotator offset value request	Request Scan rotator starting value and offset value in Pano Mode
[SPM_XON_]	x ray on	Enable the X-ray irradiation
[SPM_XOF_]	x ray off	Disable the X-ray irradiation
[SPM_TMP?]	Tube Temp? request	Request the Tube Temperature (Usable Tube communication check)
[SPM_TBRD]	Tube ready? Request	Request on the Tube Initialization Completion
[SPM_CTOZ_00000]	Jaw Horizontal Set	Chinrest Vertical Position (Up/down) Center Standard value setting (1~19999) Default value is 2000
[SPM_CZ?_]	Jaw Horizontal value request	Request Chinrest Vertical Position (Up/down) Center Standard valu
[SPM_JVST_00000]	Jaw Vertical Set	Chinrest Vertical Position (Up/down) Center Standard value setting (1~19999) Default value is 16320
[SPM_JV?_]	jaw vertical value request	Request Chinrest Vertical Position (Up/down) Center Standard setting value
[SPM_CHST_0000]	Chinrest VR value reference value set.	Set the Chinrest dogtooth position value as the standard point
[SPM_CHV?]	Chin rest VR value	Request the current chinrest dogtooth position value.
[SPM_PLEN_0000]	Tube Pulse mode Enable	Tube Pulse Mode Setting. (0:continue mode, 1:pulse mode(default))
[SPM_VOLU_0000]	Volume value set	MP3 Volume Adjustment.(0~82)

[SPM_SPOT_0000]	Servo Pulse On Time	Collimator Servo Motor On Time setting (75~223): When input the value in Pano Mode, it is saved as shift vale when it is Pano Mode, when input the value in CT Mode, it is saved as shift value in CT Mode.
[SPM_SPTT_0000]	Servo Pulse Total Time	One Cycle Time of Collimator Servo Motor (default 500)
[SPM_PR?_]	Parameter print	p-axis related parameter output
[SPM_CL?_]	ct sensor lamp offset request	Read the CT sensor tilting offset value
[SPM_CLST]	ct sensor lamp offset set	CT sensor tilting offset value setting
[SPM_PL?_]	pano sensor lamp offset request	Read the PANO sensor tilting offset value
[SPM_PLST]	pano sensor lamp offset set	PANO sensor tilting offset value setting
[SPM_XLFV_0000]	X axis Left Collimator Frequency value set (Immediate Response)	Adjust Left side Value of Collimator. 1000 digits is direction (0001 ~ 1300)
[SPM_XRFV_0000]	X axis Right Collimator Frequency value set(Immediate Response)	Adjust Right side Value of Collimator . 1000 digits is direction (0001 ~ 1300)
[SPM_YTFV_0000]	Y axis Top Collimator Frequency Value set(Immediate Response)	Adjust Upper Side Value of Collimator (0001 ~ 1400)
[SPM_YBFV_0000]	Y axis Bottom Collimator Frequency Value set(Immediate Response)	Adjust Lower side Value of Collimator (0001 ~ 1400)
[SPM_XLST_0000]	Collimator XL ref value set.	//Collimator XL Value setting

[SPM_XL?_]	Collimator XL ref value request.	//Collimator XL Default Position Value
[SPM_XRST_0000]	Collimator XR ref value set.	//Collimator XR value setting
[SPM_XR?_]	Collimator XR ref value request.	//Collimator XR Default Position Value
[SPM_YTST_0000]	Collimator YT ref value set.	//Collimator YT Value setting
[SPM_YT?_]	Collimator YT ref value request.	//Collimator YT Default Position Value
[SPM_YBST_0000]	Collimator YB ref value set.	//Collimator YB Value setting
[SPM_YB?_]	Collimator YB ref value request.	//Collimator YB Default Position Value
[SPM_FOVO]	Collimator all open	//Collimator All Open
[SPM_FOVS]	Collimator auto set.	Automatically set the current Collimator position as the Default Position (Similar function with Half Auto Run)
[SPM_FREQ_0000]	Frequency speed set in ct mode.	Set the frequency rate that is supplied to the CT sensor/tube. (Varies depending the image solution. default:25Hz)
[SPM_DUTY_0000]	Frequency duty set in ct mode.	Set the frequency duty ratio that is supplied to the CT sensor/tube.(Varies depending the image solution. default:65%high)

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