DIAGNOSTIC X-RAY UNIT

User Manual

ULTRA 90BT

- ORANGE 9020BT, ULTRA 9020BT, ANYPLX 3-BT

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Revision : 1.1

For better performance and safety, this manual may be changed without any prior notice.
The original version of ULTRA 90BT is being written in English.

Diagnostic X-ray Unit
USER MANUAL

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Section 4. (Schematics)

Section 1.

General Information

Complied Standard

The diagnostic x-ray unit is manufactured according to the following standard and associated equipment.

■ FCC (Federal Communication Commission)

☞ ANSI C 63.4:2014 FCC Part 15 Subpart B

■ Rechargeable Lithium Polymer Battery Pack

☞ ST/SG/AC.10/11Rev.5 Amend.1 (Test Report No. : HCT-S-1505-B001-1)
(Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria, Part III, Sub-Section 38.3-Lithium metal and lithium ion batteries)

☞ IEC 62133:2012 (Test Report No. : HCT-S-1512-I002)
(Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary lithium cells, and for batteries made from them, for use in portable applications)

Contact

■ Manufacturer

Ecoray Co., Ltd.

- Manufacturer : Ecoray Co., Ltd.
- Address : #714-716, ForHu B/D, 58, Wangsimni-ro, Seongdong-gu, Seoul, Korea.
- TEL : +82-70-7510-3400 / FAX : +82-70-8630-3420
- E-Mail : info@ecoray.kr / info@ecoviewmedical.com
- URL : www.ecoviewmedical.com

Guarantee Condition & Contact

Manufacturer offers the following guarantee to the purchaser of this equipment. The guarantee is valid for **24 months** (**Battery Pack : 12 months)** from when the equipment is handed over to the first retail purchaser. The guarantee covers all problems caused by faulty manufacture or faulty material. Call the customer department where purchased when problems arise. Customer responsible for freight charges for repairs.

- The guarantee is valid only when the equipment is installed in the proper environment as specified in the usage guide section. Make sure to use the equipment as instructed in the usage guide section.
- The guarantee does not cover the damage and loss caused by outside factors such as fire, flood, storm, tidal wave, lightening, earthquake, theft, abnormal conditions of operation, and intentional destruction of the system.
- Insubstantial defects do not qualify refund e.g. prices for the batteries, training materials, and supplies are not covered.
- We do not take responsibility for damages or loss which appear after the guarantee period.
- The guarantee does not cover additional and indirect damages related with system operation.
- Service may be requested by callings +82 70 7510 3400 (or email to info@ecoray.kr) customer service department for R.A numbers. The product name, serial number, date of purchase and the details of the problem should be provided.
- Defective equipment should be packed properly in a return box and return to authorized dealer or manufacturer.
- This guarantee can replace all other guarantees for detailed parts and product.

Diagnostic X-ray Unit
USER MANUAL

Intended Use

This X-ray unit is the equipment to diagnose the fracture of the object.

Product Name Designation

- Main product name : ULTRA 90BT
- Addition product name : ORANGE 9020BT, ULTRA 9020BT, ANYPLX 3-BT

Notes to User

To ensure safe operation and long term performance stability, it is essential that you fully understand the functions, operating and maintenance instruction reading this manual before operating equipment.

Particular attention must be paid to all warnings, cautions and notes incorporated herein. In correct operation, or failure of the user to maintain the equipment relieves the manufacturer or his agent from responsibility for any damage or injury as a result of the system noncompliance.

The responsibility about use of medical apparatus and management of maintenance is in a user side.

Symbols and Terms

The following symbols will be used in this manual: their meaning and their application are described further below.

Warning : It warns of the conditions and situations which, if not taken over or avoided, could cause heavy damages to people or cause fatal unrepeatable damages to the equipment.

Caution : Calls attentions to action or conditions that could cause light injury to the user or damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

Note : They inform the reader about the relevant facts and conditions ; they draw the attention to important information but, if they are not taken into consideration, they do not necessarily cause damages to people or to the equipment.

Safety Information

This equipment is designed and manufactured with due consideration given to the safety of the operator and subject, and also to the reliability of equipment. The following precaution must be observed for additional safety.

Caution

[General]

- Only an experienced expert should operate the unit.
- Before you operate the unit, please fix the unit at a mobile or any stand.
- Attention should be paid not expose the unit to factors such as, slant, vibration and shock (including when traveling) in where the unit should be.
- The equipment has been factory-adjustment for optimum performance. Do not attempt to adjust any present controls or switches except those specified in this manual for operation.
- If you have experienced any trouble with the equipment, turn off the main switch immediately, and contact its authorized dealer for the service for assistance.
- Do not use the other connector which it does not provided from manufacturer.
- The equipment is designed for the purpose of radiographic diagnostic x-ray use therefore the unit shall not be used for fluoroscopy.
- The equipment is designed for the diagnosis purposes, the equipment shall not be used for therapy.
- Be careful not to drop the unit when moving or installation.
- The system should be away from water.
- Do not use with wet hands.
- Do not use the equipment random.
- Review operational environmental condition in the manual before use.

Caution

[Battery]

- When you discover strange smell or liquid leakage, turn off the power immediately and report to authorized dealer or manufacturer.
- If any liquids from the battery get into eyes, clean it with pure water immediately and take a medical service as soon as possible.
- If battery does not fully charge after prescribed time, stop the recharging and report to authorized dealer or manufacturer.
- Used battery packs have to keep out from reach of infant or children. Electric shock may be occurred by residual current.
- Don't utilize the used battery packs for other purposes except using at this equipment. Should be disposal it according to national laws or standards.
- If user do not use this equipment for a long time, recharge the battery periodically for preventing a shortening of battery life.
- When you change the battery pack or find an error in battery charging, please take an inspection through engineer of branch-office which you bought the equipment. If the user arbitrarily remove(combine) the battery pack from(to) the equipment, there might be an electrical problem.

[Battery Charger]

- The battery charger for this equipment is rechargeable. Should not be used for any purpose except recharging.
- The equipment is designed not to operate while it is charging so separate the battery charger before using the equipment.

[Cleaning]

- To make sure that power is off for diagnostic x-ray unit while cleaning. Use a non-alcohol based disinfectant only - wipes, or a cloth dampened with liquid. Diagnostic x-ray unit is not designed to be used to sterilize anything else. Do not use by any other chemical liquid.

Radiation Information

This equipment is manufactured with the necessary devices and it protects object from the ionized radiation that is radiated form the X-ray source assembly.

Caution

- User and operator must use a protective devices (X-ray protection partition) and a protective clothing (Lead Apron) as appropriate to the workload involved.
- During X-ray exposure, only object should stay in the region of radiation. Otherwise, the extra object can make unexpected effect to X-ray image that may interfere correct diagnosis.
- Eliminate all the useless objects from the zones, because they are a further source of secondary radiation, above all near the source.
- The focal to skin distance shall be no shorter than 45 cm.
- Operators are requested to use minimum kV and mAs values for experimental use.
- Do not exceed in the size of the radiograms and limit the X-ray field size to the size of interest only.
- User(Doctor or Expert) must know object body condition when radiation X-ray.
- Operator should exposure at the minimum significant zone of occupancy referring page.33.
- If irradiate X-ray while hold the equipment by one's hand, can cause a radiation exposure and image vibration. Please use the X-ray only stand. Refer Page.39 for installation.

Warning Information

This is the important information for the reader or user. User or reader should pay attention to this important information. If not, serious damage to people or equipment can be occurred.

Warning

[General]

- Do not modify this equipment without authorization of the manufacturer.
- This unit has built-in dual laser modules for targeting SID therefore Please keep your eyes away from the source of laser that may harm your bare eyes.
- Do not use the equipment close to a flammable or an aesthetic gas. It has the danger of explosion.

[Battery]

- This equipment has a built-in battery pack. So, it must avoid high temperature, direct ray of light. If temperature of battery rise up, heating, explosion and ignition may be occurred by internal short.
- Don't put the battery pack into fire. Don't heat it. A electrolyte can be leaked if insulating materials are melted. And this can make also heating, explosion and ignition.
- Don't give a strong impact to the battery pack. A protective device of battery can be destroyed so the battery may be recharged by abnormal current & voltage. Also, an abnormal reaction(heating, explosion, ignition and etc.) can be happened.
- Don't take apart or remodel the battery pack. It causes also abnormal reaction(heating, explosion, ignition and etc.).
- The battery pack has a protective device. Don't use the equipment in the place with lots of static electricity. The protective device can be damaged and abnormal reaction stated above can be happened.

[Battery Charger]

- Please use the battery charger sold by its manufacturer only. Using uncertified battery charger can make heating, explosion and ignition due to overcharging or abnormal current.

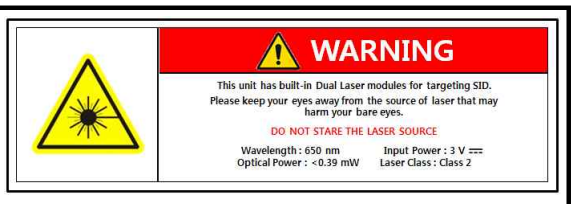
Warning Label Information

Warning of ionized Radiation

This label placed on the top of top case. The ionized radiation is dangerous for the operator if the appropriate safety measures are not strictly observed.

Warning of dangerous voltage

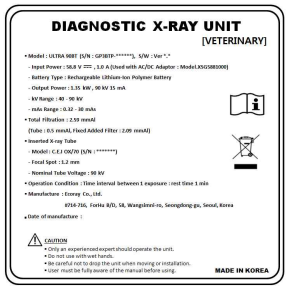
This label placed on the top of HV Tank. HV Tank uses high voltage to generate X-ray so cut off the power before checking and repairing the unit.



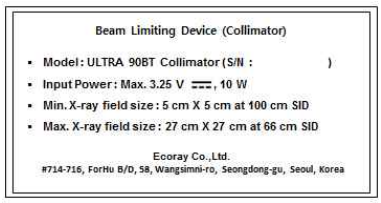
Warning of Laser

This label placed on the side of collimator. Please keep your eyes away from the source of laser that may harm your bare eyes.

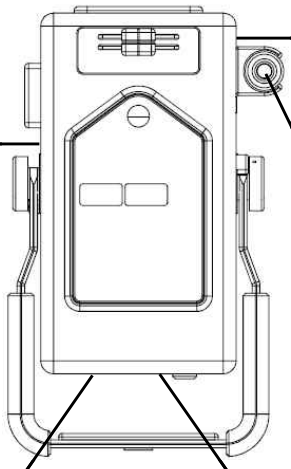
Label Information



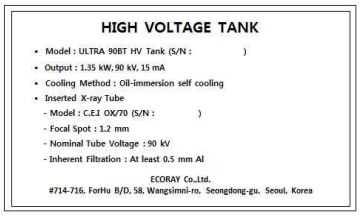
Identification
This label placed on the bottom case. This label explained product information.



Beam Limiting Device
This label placed on the side of collimator. This label explained collimator information.

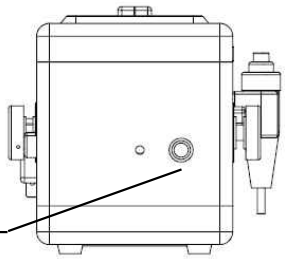


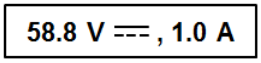
Hand Switch
This label placed on the side of Hand switch. This label explained manufacturer and model name, S/N.



High Voltage Tank
This label placed on the top of HV tank. This label explained HV tank information.

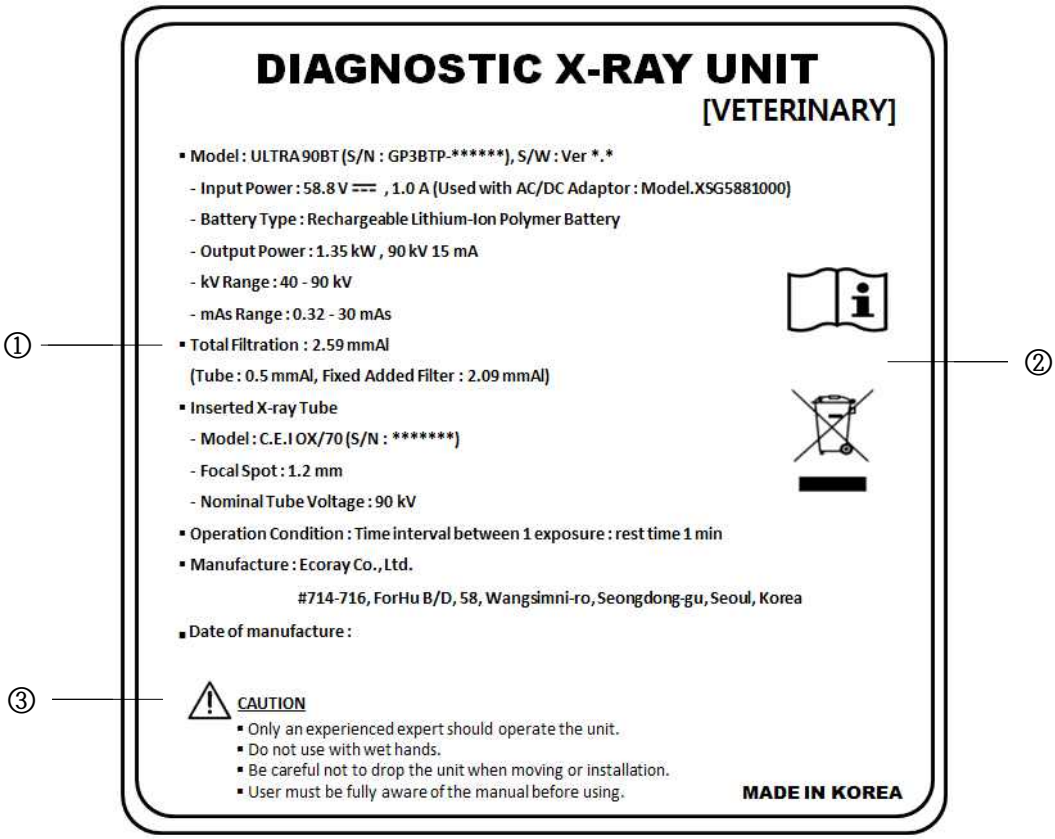
Battery Pack
This label placed on the top of battery pack. This label explained battery pack information.





Input Power
This label placed on the under power inlet. This label is input power spec.

Identification Label



No.	Explanation		
①	General Information		
	⎓	Electric Current	Direct Current
②		User Manual	User must be fully aware of the manual before using.
		Disposal	Disposal of this product must be handled according to local laws and regulations
③		Caution	General caution

Proper Environment

Caution : Avoid the following environments for operation or storage ;

- Where the equipment is exposed to water vapor.
- Where the equipment is exposed to direct sunlight.
- Where the equipment is exposed to dust.
- Where the equipment is exposed to high humidity.
- Where there is a ventilation problem.
- Where the equipment is exposed to a salty atmosphere.
- Where the equipment is exposed to chemicals or any gas.

■ For normal operation, you must keep away from the place with a strong vibration and maintain the following range of temperature and humidity.

- Operation Environment

Temperature range:	10 - 40°C (Charge)
	10 - 40°C (Discharge)
Relative humidity range:	30 - 75% RH
Pressure:	700 - 1,060 hPa
Height range:	0 - 2,000 m

- The most optimal recommended rage of temperature and humidity

Temperature range:	17 - 23°C,
Relative humidity range:	40 - 60% RH

■ For storage and transportation condition, you must maintain the following range of temperature and humidity and atmosphere.

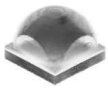
- Storage / Transport Environment

Temperature range:	-20 - 45°C (Storage 1 month)
	-20 - 35°C (Storage 2 month)
	-20 - 20°C (Storage 1 year)
Relative humidity range:	10 - 95% RH
Air pressure range:	500 - 1,060 hPa

* non-condensing, not packaged for outdoor storage.

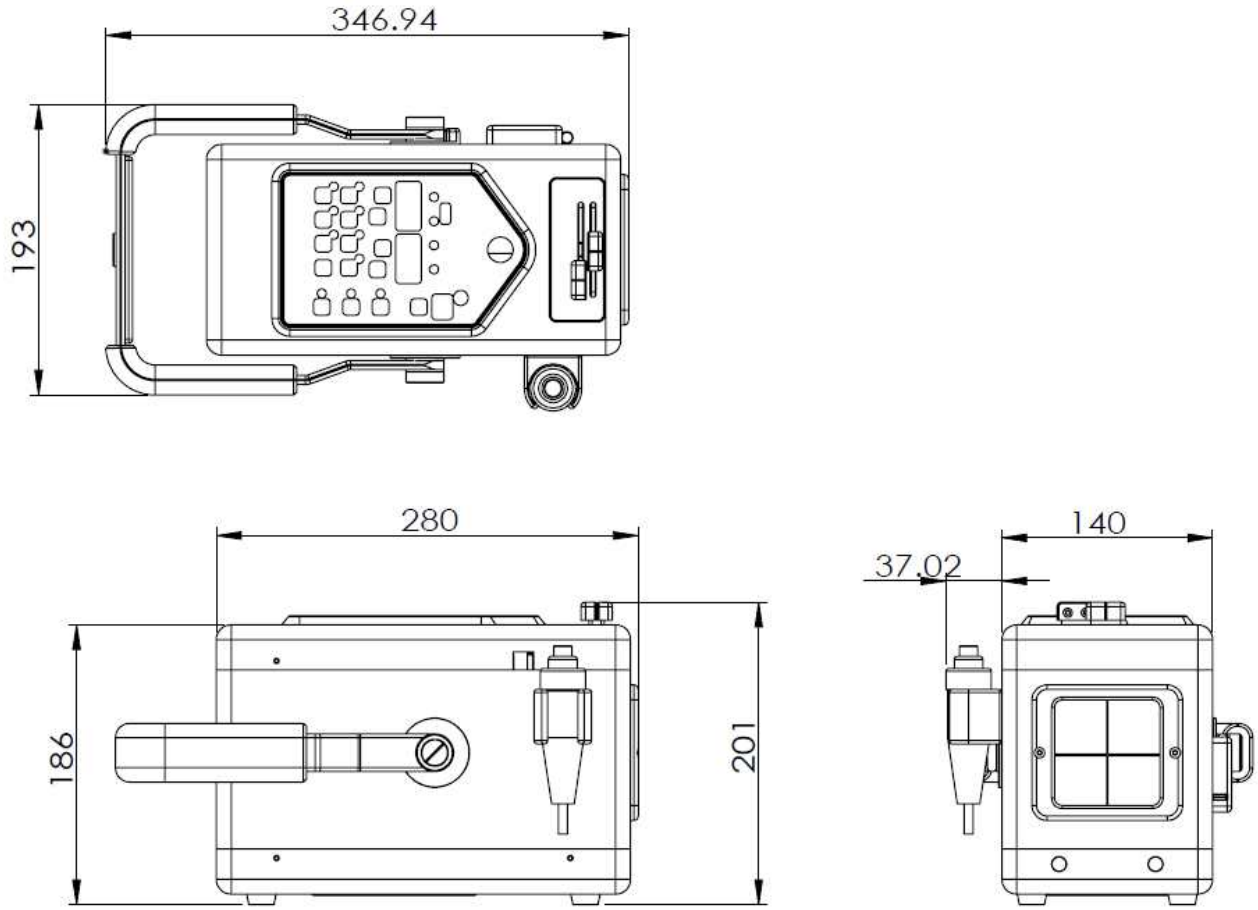
Accessories Composition

This diagnostic x-ray unit is essentially built up of the following parts:
Since diagnostic x-ray unit is integrated one body X-ray equipment therefore following regions are firmly fixed and connected of consist of.

Picture	Name	Specification
	Hand Switch	- Manufacture : OMRON - Model : C2U (Push button switch) - 2 Steps (1 Step : "Ready", 2 Step : "Shot")
	LED Lamp	- Manufacture : CREE - Model : XP-L - Voltage : Max. 3.25 VDC, 10W
	Extra Fuse	- Manufacture : Littlefuse - Model : 65TL - Voltage : 30 A, 250 V~
	Battery Charger	- Manufacture: Xinsu Global - Model : XSG5881000 - Input : 100 – 240V~, 50/60 Hz, 1.3 A - Output : 58.8 VDC, 1.0 A
	Battery Pack (Lithium-Ion Polymer)	- Manufacture : Ecoray Co., Ltd. - Voltage : 51.8 VDC - Charge Voltage : 58 VDC ± 0.05 VDC - Capacity : 2600 mAh - Size : W118 X L172.5 X H59.5 mm
	User Manual	- Size : W150 X H120 mm
	Aluminum Carrying Case Shoulder Strap	- Length : 125 mm
	Aluminum Carrying Case	- Size : W395 X L245 X H220 mm
	Stand (Option)	- Size : W775 X L720 X H1255(1715) mm

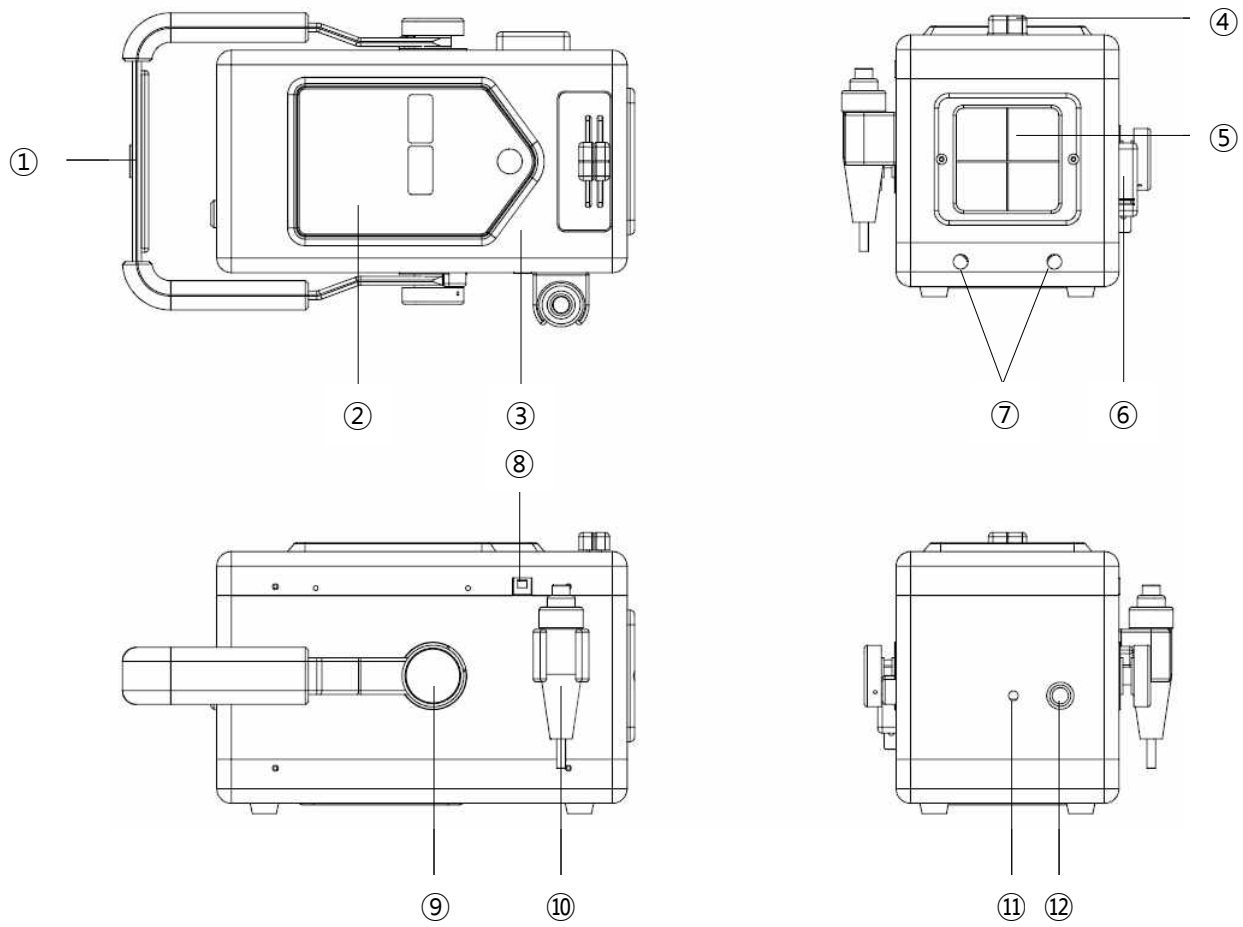
Caution : Use hand switch and battery charger, battery pack which provided from manufacture only. When problems occur by using other parts, the manufacture does not bear any responsibility.

Dimension



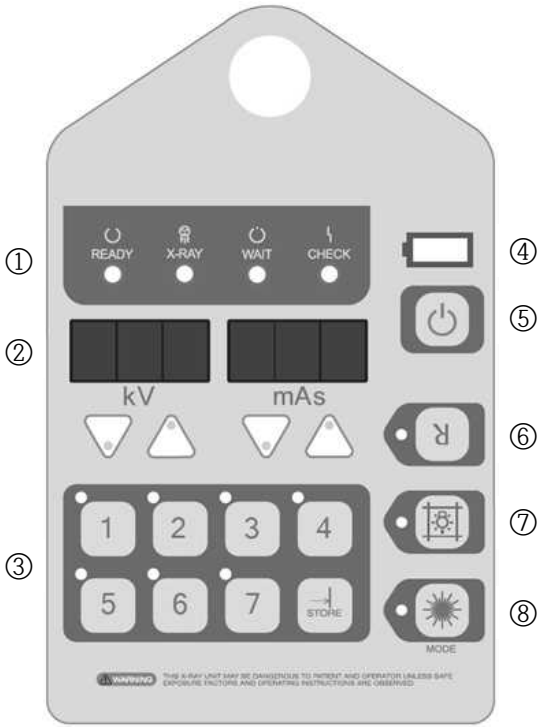
(Unit : mm, Without accessories Weight : About 8.7 kg)

Name of Each Part



①	Handle	⑦	Laser Beam Outlet
②	Operation Panel	⑧	Hand Switch Connector
③	Main Body	⑨	Angle Meter
④	Collimator Knob	⑩	Hand Switch
⑤	Collimator	⑪	Mono Jack
⑥	Measuring Tape	⑫	Battery Charging Connector

Operation Panel



No.	Name	Performance
①	System Indicate READY X-RAY WAIT CHECK	This green lamp indicates the unit is ready for exposure. This yellow lamp indicates the exposure is being made. This red lamp indicates 15 sec wait time after exposure. This red lamp indicates the system problem.
②	kV & mAs Key & Display	kV & mAs can be set and display.
③	APR & Store Key	It is available for 12 / 7 APR data memory and save APR data.
④	Battery Charging Display	This lamp indicates the status of battery charged.
⑤	Main Switch	It is battery power ON / OFF switch.
⑥	Display Reversal Key	To reverse the display of kV and mAs.
⑦	Collimator Lamp Key	Turn on the collimator light.
⑧	Laser Beam Key	For exposure focus.

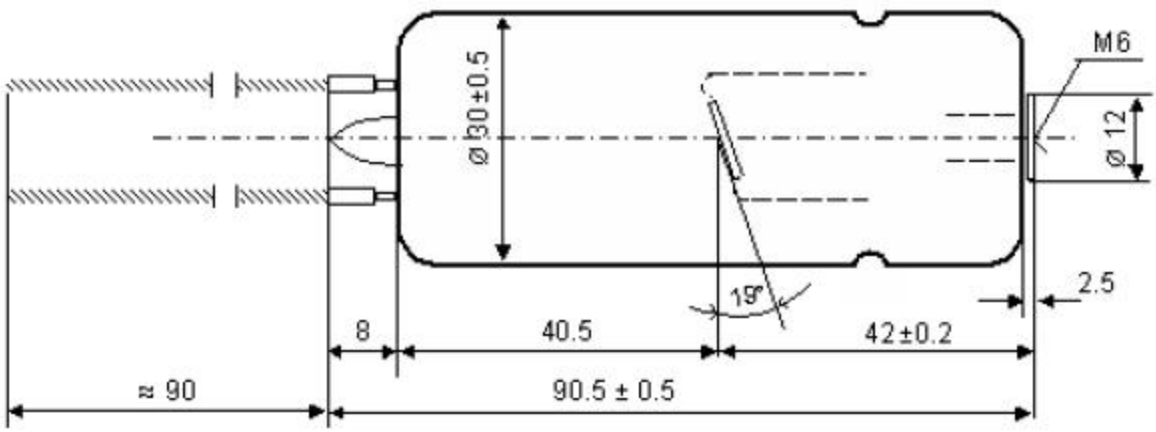
Specifications

- **Classification**
  - Electrical classification: External electrical source **Class II**
  - Electrical type: No applied parts
  - IPX specification: IPX 0 : Ordinary equipment
  - Mode of operation: Continuous operation with intermittent (Time interval between 1 exposure : rest time 1 min)
- **Input Power**: Battery : 51.8 VDC, 2600 mAh (Lithium-Ion Polymer Battery)
  Battery Charger : 100 – 240V~, 50/60 Hz, 1.3 A (Input)
  58.8 VDC, 1.0 A (Output)
- **Output Power**: 1.35kW, 90kV 15mA
  - Radiography kV range: 40 ⁻ 90 kV
  - mA range: 12 ⁻ 20 mA
  - mAs range: 0.32 ⁻ 30 mAs
  - Max. kV deviation: ± 5%
  - Max. mAs deviation: ± 10%
- **Generator / Inverter Drive (Mono Block Type)**
  - Output: 90 kV, 15 mA
  - Ripple voltage: Less than 2%, 90 kV 15 mA
  - Rising time of kV: Less than 21 msec to top voltage
  - Cooling method: Oil-immersion self-cooling
  - Switching frequency: 65 kHz
  - Weight: About 2.45 kg
- **Collimator with dual laser pointers, Measuring Tape**
  - Type: Double slit type, Manually operation
  - LED Lamp: 30 sec, Max. 3.25 VDC, 10 W / Higher than 100 lx
  - X-ray field size: Max. : 27cm X 27cm, 66cm SID / Min. : 5cm X 5cm, 100cm SID
  - Laser pointers: Class 2, < 0.39 mW, 650 nm
  - Measuring tape: 2 m
- **X-ray Total Filtration**
  - X-ray tube inherent filtration: 0.5 mmAl
  - Fixed added filter: Aluminum Filter : 1.5 mmAl
    Collimator Acrylic Window : 0.37 mmAl
    Collimator Mirror : 0.22 mmAl
  - Total filtration: 2.59 mmAl

X-ray Tube Specification

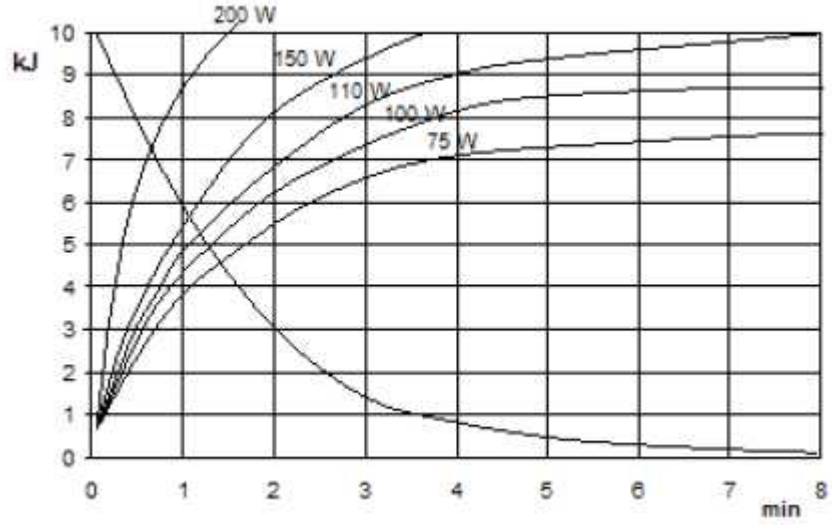
● Manufacture	C.E.I OX/70
● Type	Stationary
● Focal spot	1.2 mm
● Target angle	19 degrees
● Target material	Tungsten
● Inherent filtration	At least 0.5 mm Al
● Voltage	90 kV
● Anode heat storage capacity	10000 J
● Max. anode input cooling rate	110 W
● Nominal anode input power at 0.1 s (DC)	1890 W

■ **X-ray tube outline dimension**

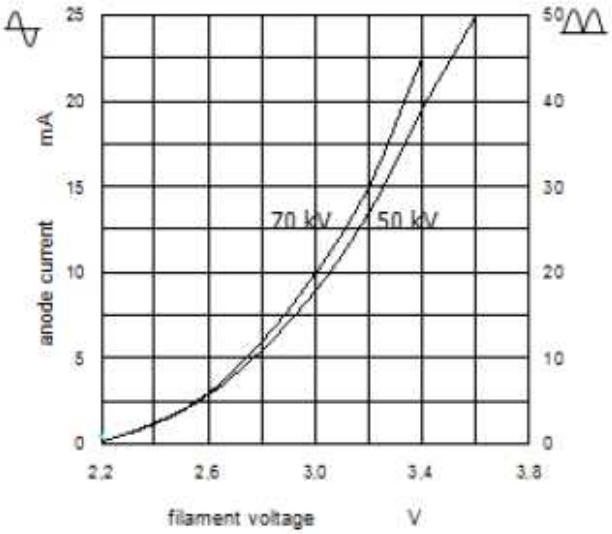


■ Rating Chart

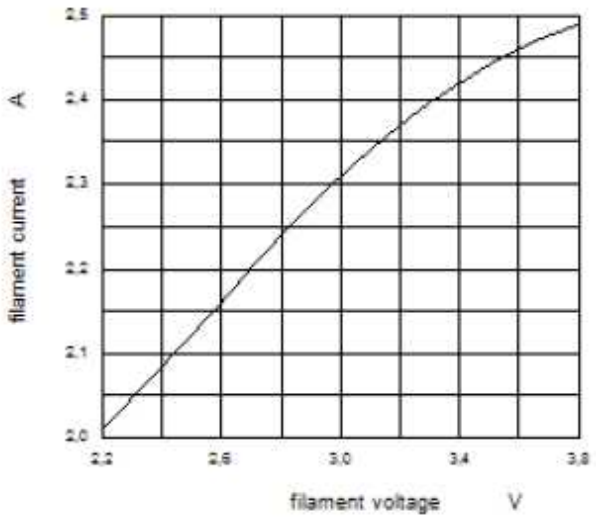
THERMAL CURVES



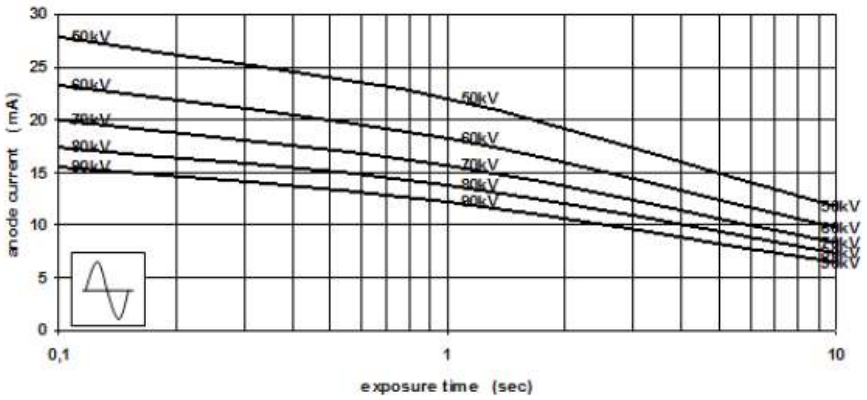
EMISSION CHARACTERISTICS

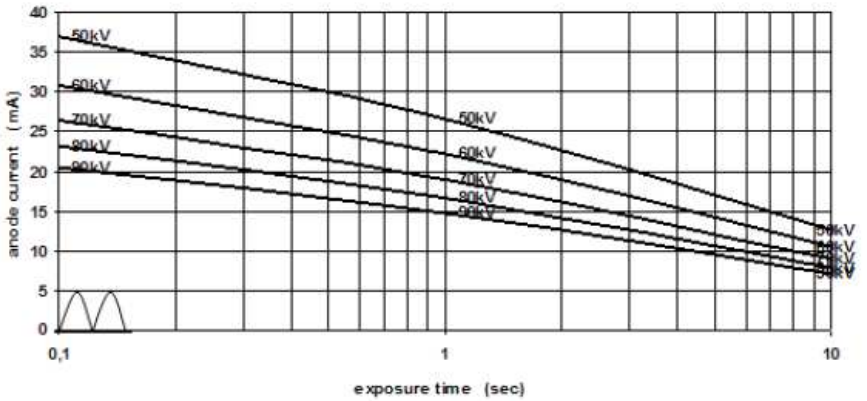


FILAMENT CHARACTERISTICS

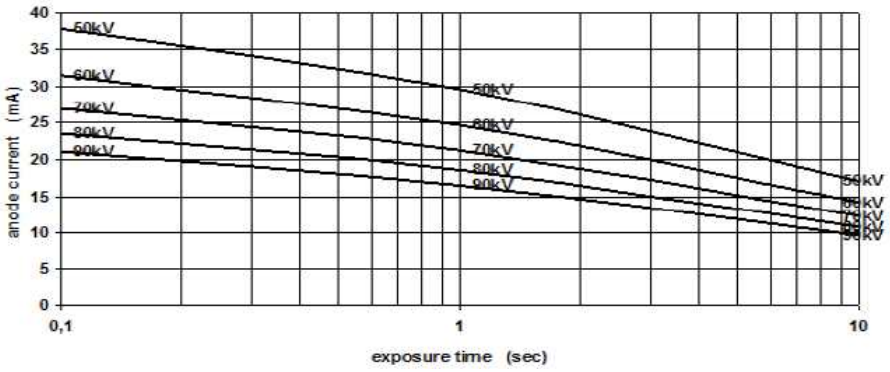


RATING CHARTS

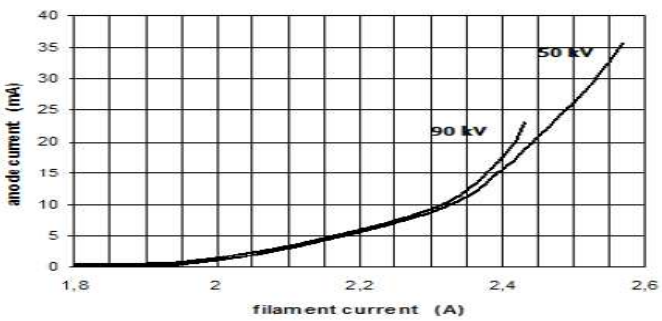




DC RATING CHARTS



DC EMISSION CHARACTERISTICS



Section 2.

Operation

Operation Conditions

- **Power Source**
  - Battery : 51.8 VDC, 2,600 mAh (Lithium-Ion Polymer Battery)
  - Battery Charger : 100 – 240 V~, 50/60 Hz, 1.3 A (Input)
    58.8 VDC, 1.0 A (Output)
  - Battery charging time : About 3.5 hrs
  - Power consumption : Approximately 1.35 kW (Max.)

- The diagnostic x-ray unit has the technique selection function as follows.
  - Manual : kV, mAs
  - APR (Anatomical Programming Radiography) : 12 or 7 Mode (selectable)

- The parameters chosen by the operator (kV, mAs)
  - kV : The operator establishes the value; the system chooses automatically the maximum value of mA in order to obtain the maximum radiological result.
  - mAs : The operator establishes the value; the system chooses automatically the minimum value in order to the maximum radiological result.

Operation Instruction

■ Collimation Practices

1) Positioning the object with the collimator.
2) Place the loaded cassette on the object backside.
3) Set SID using with the scale that is located the side of the collimator.
4) Turn on the collimator lamp and laser pointer by pushing the collimator/laser "ON" switch. If the collimator/laser "ON" switch is pushed further once again while the lamp lights up, the lamp and the laser pointer will light up simultaneously.
5) Limit the x-ray beam exactly the size of the film with the x-ray field adjustment knobs.
6) The collimator and the laser pointer turn off the light automatically after 30 seconds with the timer.

■ Operation Practices

1) Please wear a lead apron while you make exposures.
2) Please step back at least 2 m from the unit or to the full extension of the hand switch cord before making exposure.
3) Always use the proper field size and technique factors for each procedure to minimize X-ray exposure and produce the best diagnostic result.
4) Check the digital display carefully before making an exposure: verify that the selected technique is the intended technique. Pay particular attention to the placement of the decimal point in the mAs setting to insure that whole numbers are not mistaken for an intended mAs fractional number.
5) Ask visitors to step outside the room during exposure.
6) Be sure to follow the maintenance schedule. (every 1 years perform a calibration)
7) Under most conditions, cumulative radiation dose to the operator will not exceed recommended maximum permissible levels. However, as with all radiation producing device, a qualified radiation expert should evaluate situations involving frequent exposures using high kV and mAs techniques to determine if extra protective devices are necessary.

■ Normal Operation Check

1) Please wear a lead apron while you make exposures.
2) Check the display of operation panel for confirming the battery's state.
3) If battery charging is completed, turn the main switch "ON". Then default value(kV : 40, mAs : 0.32) will be displayed on the panel with beep sound.
4) Press all keys in operation panel to check every keys working properly.
   - kV and mAs Up / Down key
   - Reversal key
   - Lamp key
   - Laser key
   - Store key (APR Mode, See Page.29)

5) Expose x-ray 3 times each following the chart below and check it exposes correctly. Review "Implementation of Radiographs" in page.30 for reference of procedure of x-ray exposure. (every 1 exposure, take the rest of 1 minutes. The below chart also uses for x-ray tube aging)

First	3 exposures using technique of 50 kV/5.0 mAs
Second	3 exposures using technique of 70 kV/5.0 mAs
Third	3 exposures using technique of 80 kV/5.0 mAs

6) Positioning the device at "READY" position by pressing the hand switch in half way and hold until the "READY" LED turns ON.
7) When "READY" LED is ON, usually collimator lamp and laser pointer are turned on together. Then, press and hold the hand switch all the way to make X-RAY exposure. During the exposure, "X-RAY" LED will be ON.
8) After exposure is completed, "WAIT" LED will turn on for **15 sec.** until the device is ready for next exposure.

■ APR Mode

The 'APR Mode' is a function for user's convenience, that user can store an irradiation values of each exposure part in advance. In 'APR Mode', User can store twelve values at '12 Mode' and seven values at '7 Mode'.

Mode	APR Key
12 Mode	1+5, 1+6, 1+7 / 2+5, 2+6, 2+7 3+5, 3+6, 3+7 / 4+5, 4+6, 4+7
7 Mode	1, 2, 3, 4, 5, 6, 7

1) Turn on the equipment's power switch.

2) Enter into the 'User Mode' by pressing Laser Key for 2 second.

3) Set to "U02" by kV UP/DOWN key, and select the Mode that user want by using mAs UP/DOWN key. (12 Mode : "01", 7 Mode : "00")

4) After choosing the Mode, press the "Store" key during 2 sec for saving the Mode.

5) Press the "Laser" key again for 2 sec and get out from User Mode.

6) 12 Mode Store
Select the one of 1-4 key on the OP Panel, and store the irradiation values that user want at each 5-7 key. Set the kV value that user want by using kV UP/DOWN key and also, set the mAs value by using mAs UP/DOWN key. After that, save the values by pressing "Store" key for 2 sec. DO NOT press the number from 1-4 key and 5-7 key at the same time.

7) 7 Mode Store
Press the "Store" key for 2 sec to save the irradiation value which is set by 'kV & mAs UP/DOWN key' at the each 1-7 key.

■ Implementation of Radiographs

1) Please wear a lead apron while performing an x-ray
2) Turn on the main switch.
3) If you need to warm up this unit, expose 3 times each following the 5) chart in page.27.
4) Select the technical mode : Manual or APR mode.
   - Choose the most appropriate techniques for the exposure setting value both the kV by means of the key and of the mAs by means of the key .
   - When you select APR mode, and you want to store setting kV and mAs, you should press the Store key for APR , and an audible buzzer sounds at end of the store.
5) Exposure
   ① As making an exposure, press the hand switch half way down.
   ② During 1.5 seconds after this first press, the filament is heated and green lamp (READY) lights.
   ③ Now depress the hand switch fully down and the exposure is given immediately. The duration of the exposure is signaled by the orange lamp (X-RAY) and an audible X-ray buzzer sound at the exposure.

Note:
1. The exposure must be made pressing the exposure switch in two different times as above illustrated. However, it is possible to press the switch all the way down at once and the device will make the execution of the exposure automatically after the heating (1.5 seconds) delay of the filament heating.
2. The button should be depressed and held until the exposure is fully completed.
3. In case some trouble occurs, the kV display indicates the error code.

Error Code and Corrective Actions

Code	Meanings of Error	Corrective Action
Err01	The ready contactor of the hand switch is closed even it is not pushed.	Reset main switch. If proper operation is unavailable, change the hand switch.
Err02	It is displayed when the EP FB signal is not detected in the state of standby.	Reset main switch. If proper operation is unavailable, replace MAIN BOARD.
Err03	It is displayed when the IP FB signal is not detected in the state of standby.	Reset main switch. If proper operation is unavailable, replace MAIN BOARD.
Err04	It is displayed when the FIL FB signal is not detected in the state of standby.	Reset main switch. If proper operation is unavailable, replace MAIN BOARD.
Err05	It is displayed when the Over Current Protect is detected,	Reset main switch. If proper operation is unavailable, replace MAIN BOARD or replace PWR BOARD.
Err06	It is displayed when the IP FB and EP FB signal is high in the state of exposure.	Reset main switch. If proper operation is unavailable, replace MAIN BOARD.
Err07	It is displayed when the mAs error.	Reset main switch. If proper operation is unavailable, replace MAIN BOARD or replace PWR BOARD.
Err08	It is displayed when the mAs is over in the state of exposure.	Reset main switch. If proper operation is unavailable, check the IP FB level and adjust it. Replace MAIN BOARD.
Err09	It is displayed when the Memory error.	Reset main switch. If proper operation is unavailable, replace MAIN BOARD.
Err10	It is display when overheated (55 ℃) of HV Tank.	When the temperature reach 50 ℃, the "CHECK" LED Lamp turns off then reset the main switch.
Err11	It is display when thermistor circuit open of HV Tank.	Repair HV Tank.

Exposure Data Table

[CHART FOR EQUINE]

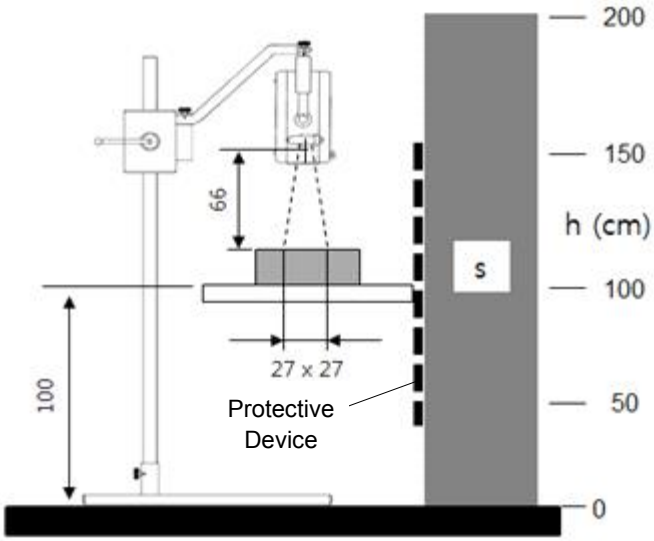
ANATOMY	VIEW	High Contrast		ESD/Radiograph (mGy)	Mid Contrast		ESD/Radiograph (mGy)
		kV	mAs		kV	mAs	
NAVICULAR	AP	74	1.6	0.10	78	1.25	0.08
	LAT	74	1.25	0.08	78	1.0	0.07
	P3	74	1.0	0.06	-	-	-
FETLOCK	AP	74	1.6	0.10	78	1.25	0.08
	LAT	70	1.25	0.08	78	1.0	0.07
KNEE	AP/FLEX	74	1.6	0.10	78	1.25	0.08
	LAT/OBI	74	1.25	0.08	78	1.0	0.07
SPLINT BONE	LAT	70	1.0	0.05	76	0.8	0.05
HOCK	AP/HIGH	74	2.0	0.13	78	1.6	0.11
	AP/LOW	74	1.6	0.10	78	1.25	0.08
	LAT	74	1.25	0.08	78	1.0	0.07
STIFLE	LAT	-	-	-	80	3.2	0.24
	PA	-	-	-	80	5.0	0.37
ELBOW	AP	-	-	-	80	3.2	0.24
	OTHER	-	-	-	80	2.0	0.15

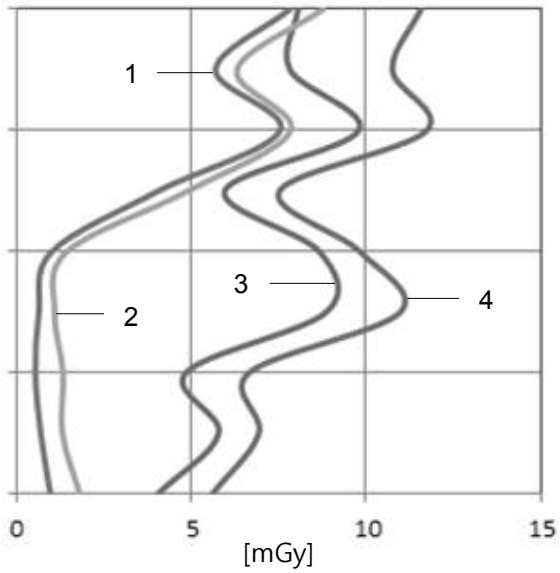
- 26 Inch (66cm) SID
- 400 Speed Rare Earth Film / Screen

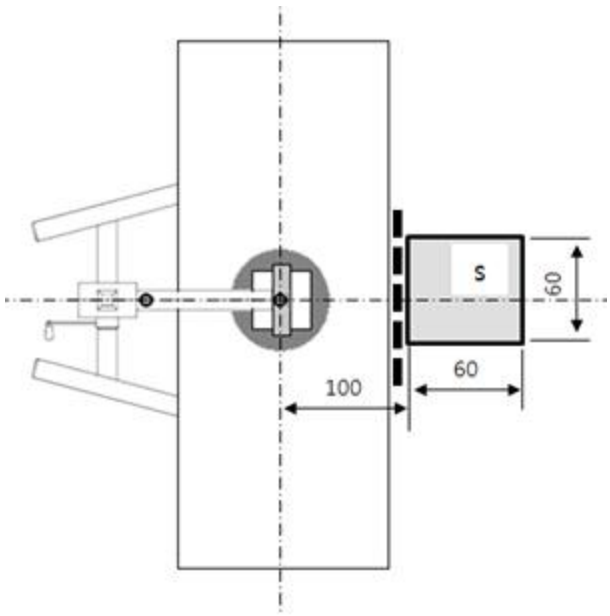
Note: 1. This exposure data table can considerable different accordingly development condition.
2. This exposure data table can different kV and mAs accordingly a object body situation.

Designated Significant Zones of Occupancy

In case the operator brings x-ray unit out of designated place to object location, he must take free-radiation space before x-ray examination as following diagram indicates any significant zone of occupancy designated in accordance with this sub clause shall have a floor area of dimensions not less than 60 cm x 60 cm and a height of not less than 200 cm and wear appropriate lead apron(protective device) to protect himself from leakage radiation.







h Height above floor

1 70kV with protective device
2 90kV with protective device
3 70kV without protective device
4 90kV without protective device

S Significant zone of occupancy

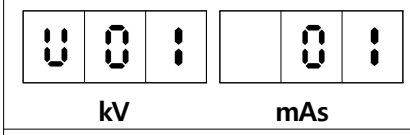
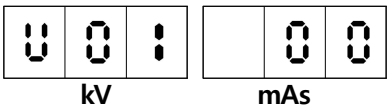
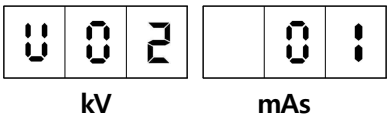
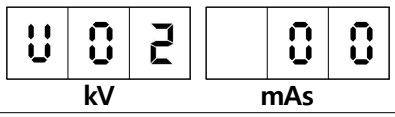
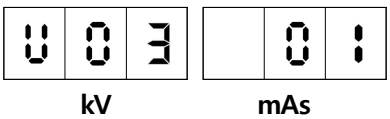
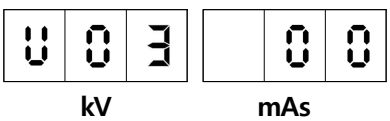
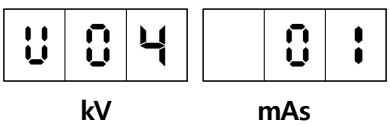
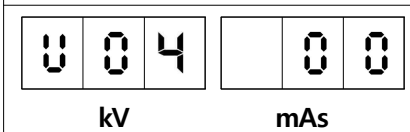
Section 3.

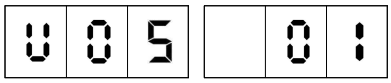
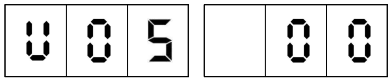
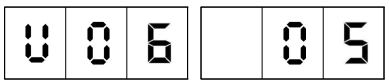
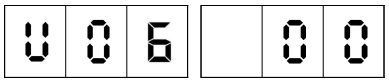
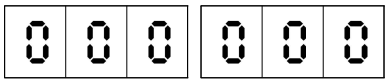
Service Manual

User Mode

In this mode, user can select the mode which they want among below table.

1. Press the 'Laser Key' for 2 second to access the User Mode.
2. Set the mode by pressing kV key(UP/DOWN).
3. The ON/OFF, TIME, CANCELLATION of selected mode can be set by mAs key(UP/DOWN).
4. To save the function of selected mode, press the 'APR Store Key' for 2 second.
5. After saving selected mode, press the 'Laser Key' for 2 second to get out from the User Mode.
6. Use the equipment.

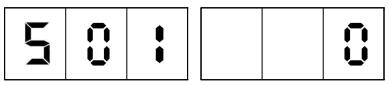
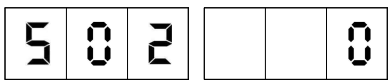
Section	Setting	Fuction	Description
Buzzer	 kV mAs	Turn ON or OFF the buzzer sound of all keys (kV / mAs, Reverse, Lamp, Laser, APR)	Mode : U01 Set the mAs to "01", then buzzer sound "ON"
	 kV mAs		Mode : U01 Set the mAs to "00", then buzzer sound "OFF"
APR	 kV mAs	Select the 12 or 7 mode of APR mode.	Mode : U02 Set the mAs to "01", then APR "12 Mode".
	 kV mAs		Mode : U02 Set the mAs to "00", then APR "7 Mode".
Laser Point	 kV mAs	When usually irradiates X-ray, Laser pointer and Collimator lamp are turned on together at the Ready state(Press the hand switch until first stage). In this mode, User can control the Laser pointer's ON/OFF function at the Ready state.	Mode : U03 Set the mAs to "01", then Laser point "ON".
	 kV mAs		Mode : U03 Set the mAs to "00", then Laser point "OFF".
Collimator Lamp	 kV mAs	In this mode, User can control the Collimator lamp's ON/OFF function at the Ready state.	Mode : U04 Set the mAs to "01", then Collimator Lamp "ON"
	 kV mAs		Mode : U04 Set the mAs to "00", then Collimator Lamp "OFF"

Sleep	 kV mAs	This is a function that automatically switches to power-saving mode if the operating of equipment is not work above the setting time. "Wait" LED flashes in the power saving mode. To use the equipment again, just press any key.	Mode : U05 Set the mAs to "01", then user can choose the time by unit of 1 min, from 1 to 10.
	 kV mAs		Mode : U05 Set the mAs to "00", then exit Sleep Mode.
Power Off	 kV mAs	This is a function that automatically shuts off for conserve the power if the operating of equipment is not work above the setting time.	Mode : U06 Set the mAs to "05", then user can choose the time by unit of 5 min from 10 to 30.
	 kV mAs		Mode : U06 Set the mAs to "00", then exit Power Off Mode.
X-Ray Counter	 kV mAs	User can confirm the number of X-ray irradiation.	User can see the number of X-ray irradiation up to 999,999.

Calibration Mode

Because this equipment uses battery power source, long-time use of battery can make some deviation of kV or mA value. Therefore once in year, should be measure the kV or mA periodically by kV or mA Meter. If deviation is found, calibrate it by using one of below Mode.

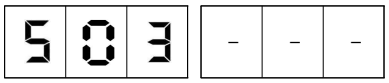
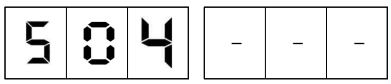
1. To access the Calibration Mode, turn off the equipment and turn on again while pressing the 1 & 4 key together on the OP panel.
2. Select the Mode by kV key(UP/DOWN).
3. After selecting the Mode, adjust the deviation values by mAs key(UP/DOWN).
4. If calibration is finished, press 'APR Store key' for 2 second for storing new calibrated values.
5. Turn off the equipment and turn on again.
6. Use the equipment.

Section	Setting	Function	Description
kV		Mode for adjust the kV deviation.	Adjust from -5 to 5 by using the mAs key (UP/DOWN).
mA		Mode for adjust the mA deviation.	Adjust from -5 to 5 by using the mAs key (UP/DOWN).

Default Mode

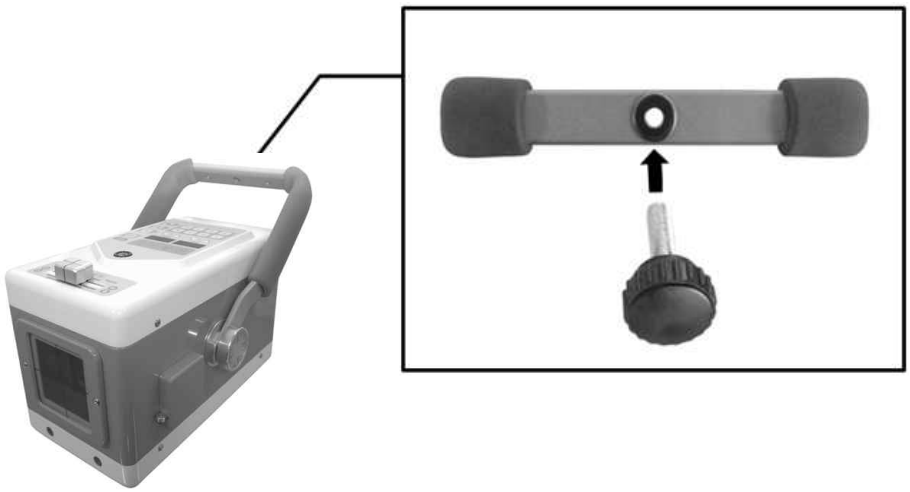
This Mode will initialize the User Mode and APR Mode that user saved.

1. The way to access the Default Mode is same with Calibration Mode.
2. The saved values of User Mode or APR Mode will be initialized if you press the "APR Store Key" for 2 second after choosing "S03" or "S04" by kV control key (UP/DOWN).

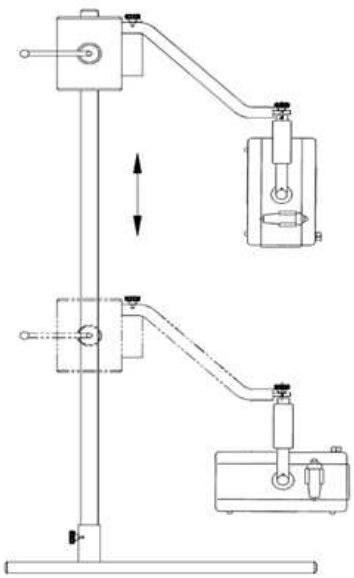
Section	Setting	Function	Description
User Mode		"S03" Mode initializes all the values of User Mode.	The initialized setting is like below. - Buzzer "ON" - APR "12 Mode" - Laser & Collimator Lamp "ON" - Sleep Time "5min" - Power Off Time "15min"
APR Mode		"S04" Mode initializes all the values of APR Mode.	-

Diagnostic X-Ray Unit Stand Fixing

1. When installing diagnostic x-ray unit to the Stand, insert captive bolt (8 mm) through middle hole (8.5 mm) as below picture and make it stable by tighten the bolt.



2. Before purchasing the Stand, check the size of captive bolt is 8 mm.



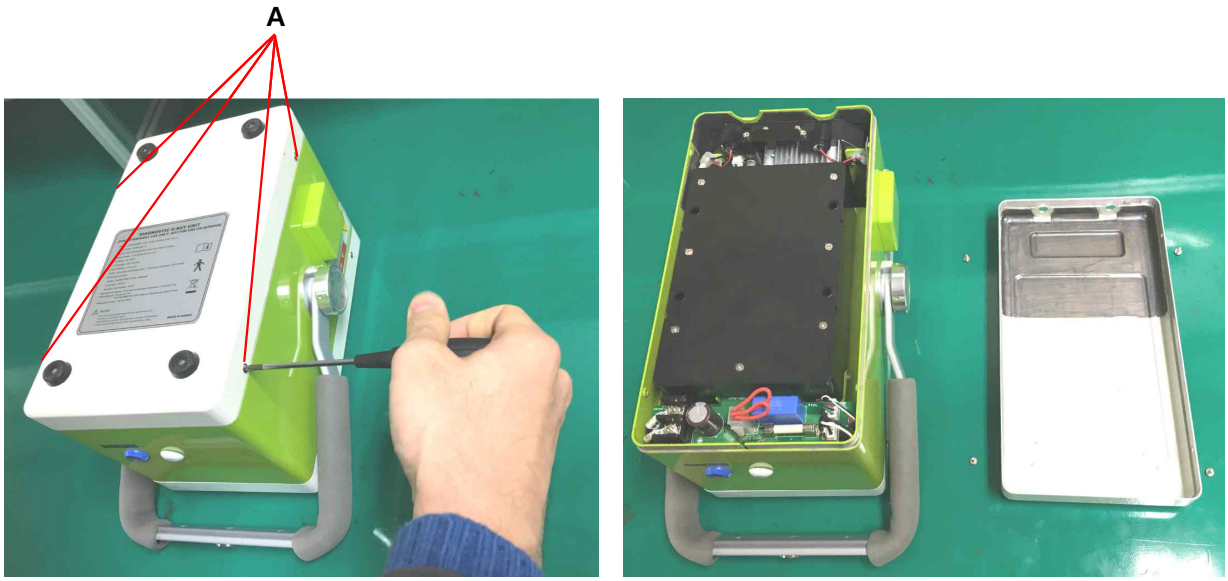
[Fixed Form]

Battery Pack Exchange Procedure

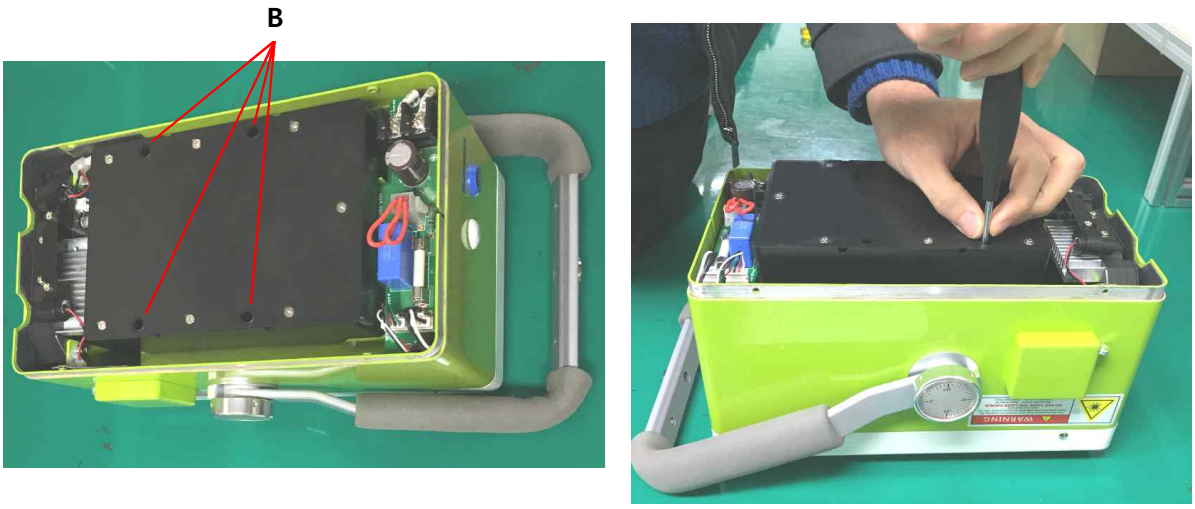
In need of replacing the battery, please do pursuant to the followings

1. Power "OFF" the equipment

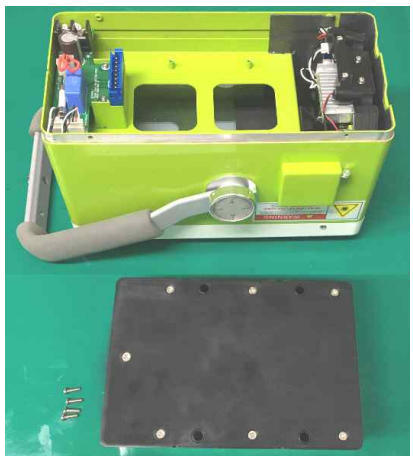
2. Turn over the equipment, and loosen the four bolts by using a regular screw-driver like "A". Then, separate the bottom cover. At this procedure, please be careful not to damage the collimator knob.



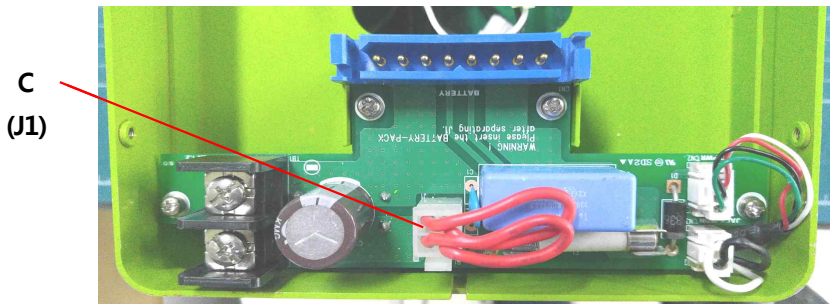
3. The bottom side of the existing battery pack has the four holes like "B". Loosen the four bolts fixed by a long regular screwdriver. (Be careful not to lose the bolts in course)



4. After loosening the four bolt of "B", separate the existing battery pack lifted by a hand.



5. Please remove the "C" connector from the connector housing "J1", ahead of installing a new battery pack.



Warning

Whenever installing a new battery pack after separating the existing device, the "C" connector must be removed from connector housing of "J1" in advance. In case of installation the battery pack without removing the "C" connector from the connector housing "J1", it is able to damage the equipment by causing a spark. If this case occurs with a equipment malfunction, please ask to the retailer or manufacturer.

6. After removing the "C" connector from the connector housing "J1", Install a new battery pack. Afterwards, fix the battery pack tightly with the bolts in the reverse

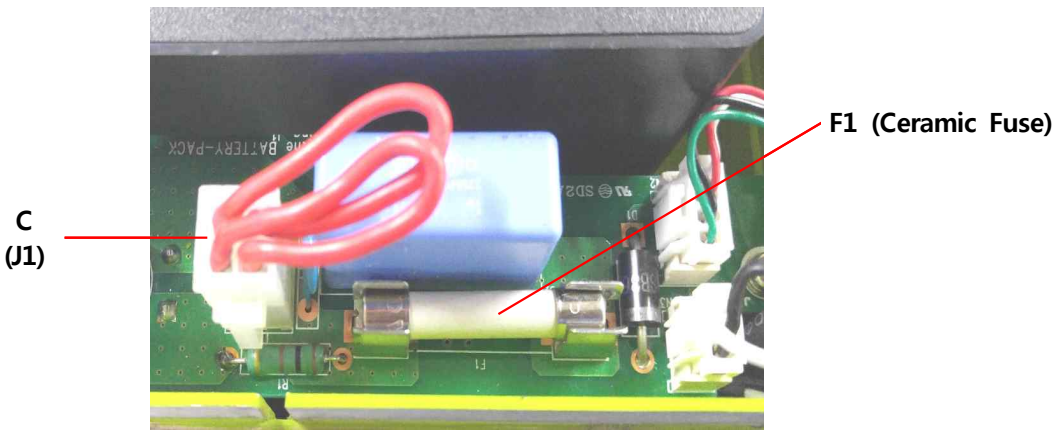
order of the procedure 3. and assemble the "C" the connector at the connector housing "J1". At last, assemble the bottom cover in the reverse order of the procedure 2.

Fuse Exchange Procedure

In case of an unexpected occurrence of over current causing the disconnection of fuse, the equipment is unable to operate. In this incident, check whether of fuse conduction by multi-tester. If fuse is disconnected, please replace fuse according to the followings.

1. Separate the bottom cover like the procedure 2, Page.39.

2. After removing the "C" connector from the connector housing "J1" and remove faulty ceramic fuse(30A, 250V) located in the bottom of the battery pack marked as "F1". Replace new ceramic fuse and assemble the "C" the connector at the connector housing "J1".



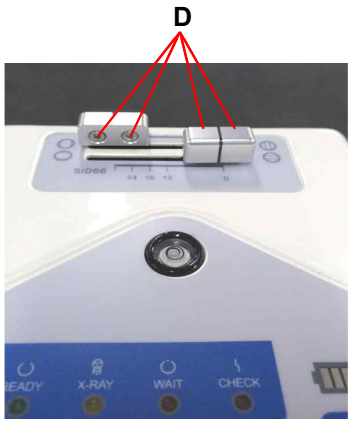
3. After replacing a new ceramic fuse, Assemble the bottom cover in the reverse order of the procedure 1. and check whether of showing the proper operation. In case of being unable to power on or an abnormal operation, please ask to the retailer or manufacturer.

Collimator LED Lamp Exchange Procedure

In case of No-light of collimator's LED lamp by a damage, please replace according to the followings.

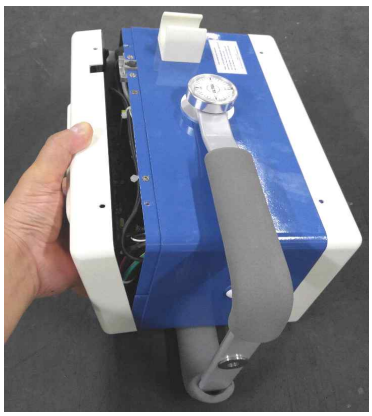
1. Turn "OFF" the equipment

2. Place the collimator knob like the following photo, loosen the four bolts fixed with collimator knob by a regular screwdriver as indicated by "D".

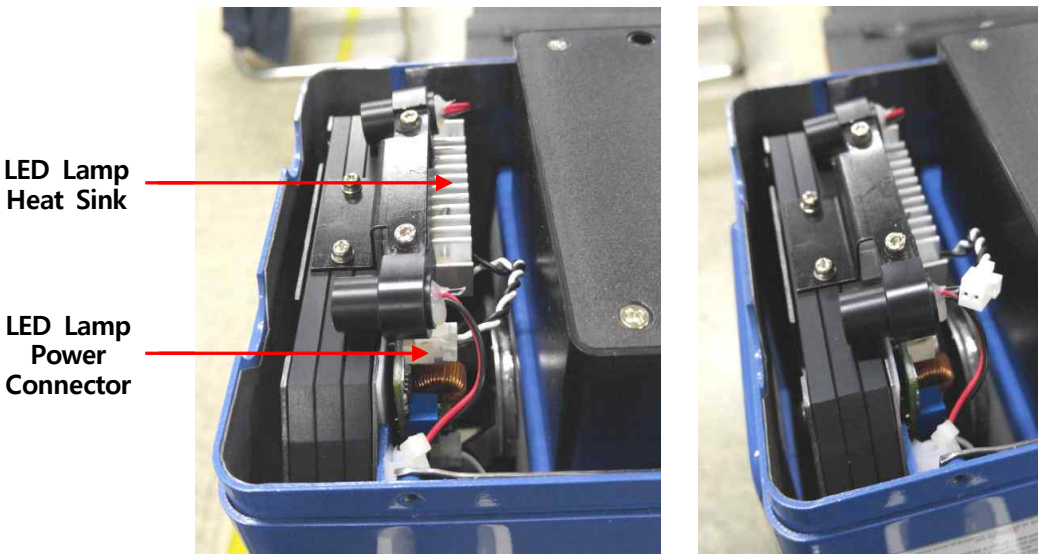


3. Loosen the eight bolts fixed on the both left and right of the upper and bottom cases by a regular screwdriver.

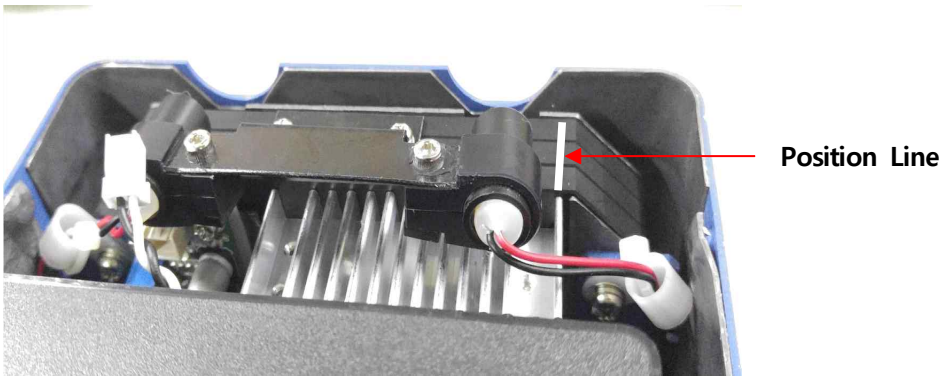
4. Separate the both upper and bottom cases from the equipment. In case of separating the upper case, gather collimator knob to the middle like the below photo. And Separate the case by lifting only the right side in condition of laying the case towards the left. Never lift the upper case by holding the upside or downside of the case, which causes damaging collimator knob resulting in deviating LED lamp from X-ray field.



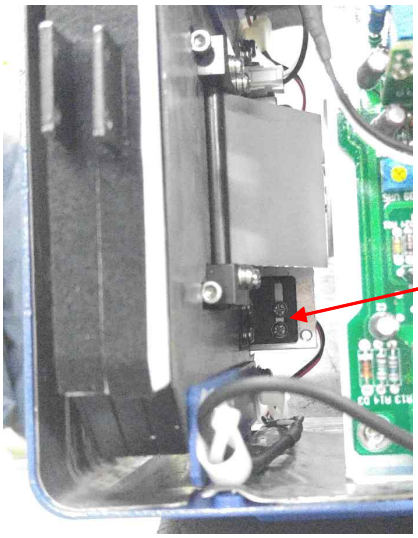
5. It can be checked of heat sink equipped with LED lamp on the bottom side of laser module after separating the bottom case from the equipment. Separate the power connector of LED lamp from PCB.

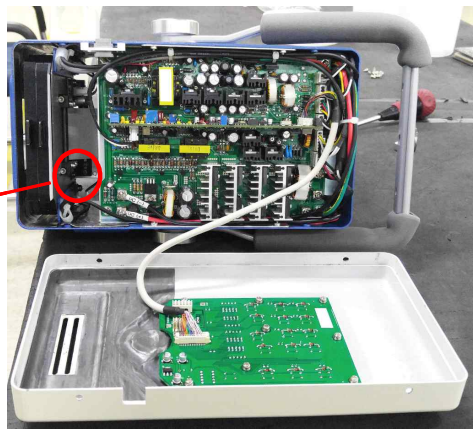


6. After separating the power connector of LED lamp from PCB, draw a line by a bright-color or white pen on the collimator side located just above the right-end side of the existing LED lamp heat sink like the below photo. The drawn line indicates the position of the heat sink of a install-planned new LED lamp. In case of not making the line, it is able to cause the deviation between the light of LED lamp and X-ray field. When installing the Heat Sink equipped with a new LED lamp, assemble the heat sink as matching the right side of the heat sink with the drawn line.

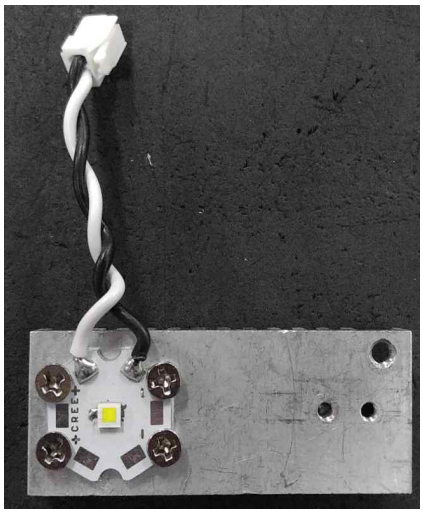


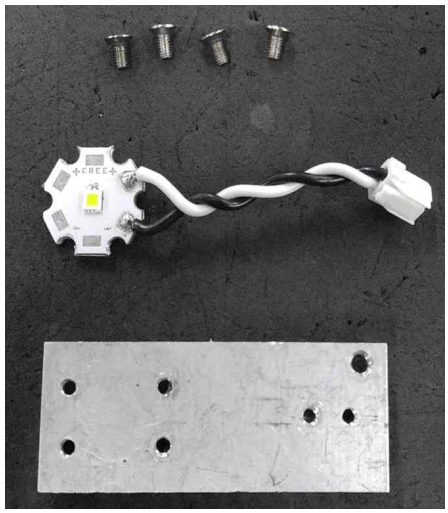
7. Find the bracket located on the bottom of collimator mirror's left after laying the equipment like the right in the below photos. Then, separate the two bolts fixing the bracket by a regular screwdriver.





8. After separating the existing LED lamp heat sink from the bracket, separate the (damaged) LED lamp from the heat sink by a regular screwdriver. (The correct re-assembly is like the right photo below)



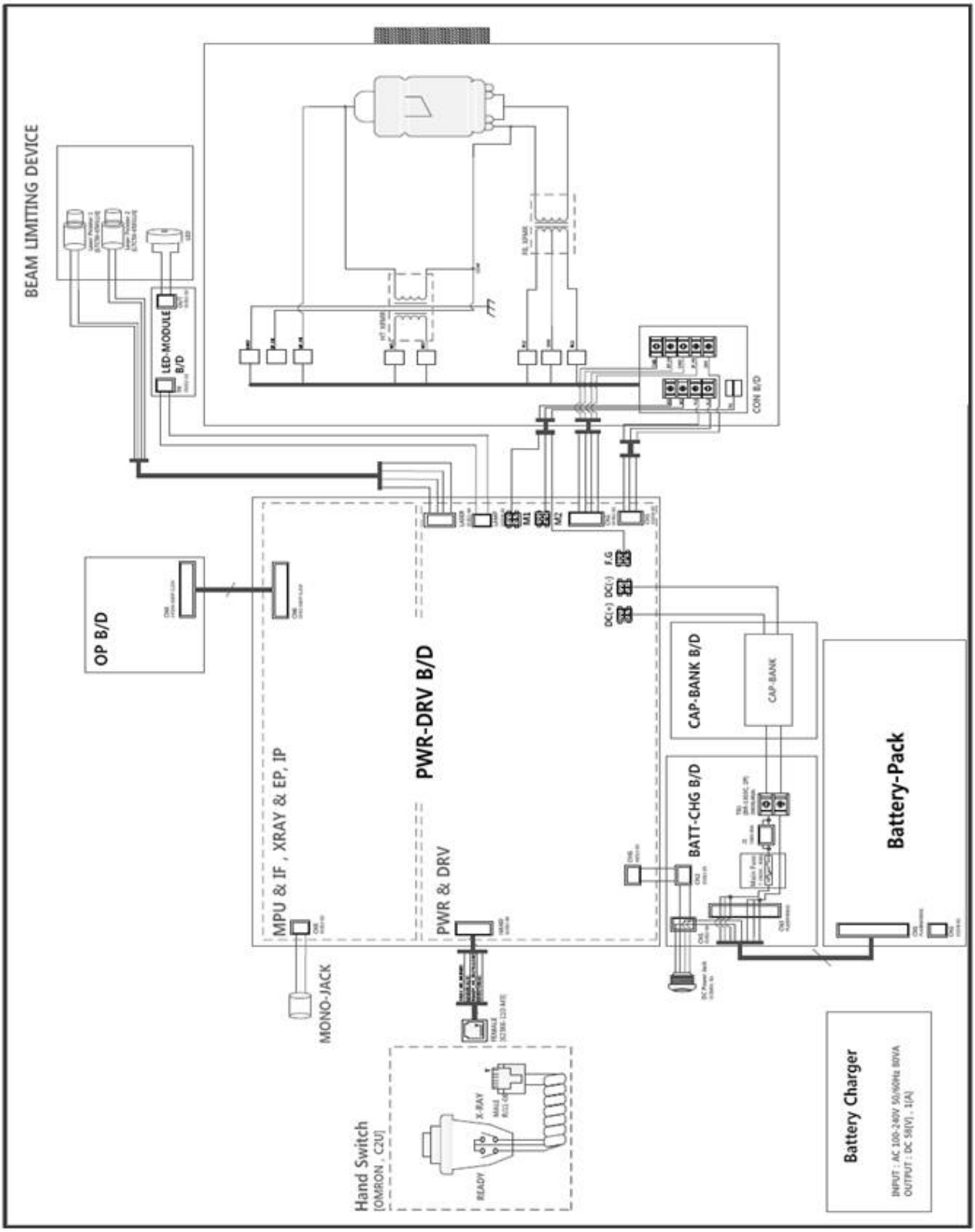


9. After installing a new LED Lamp to the Heat Sink of the existing LED Lamp, re-assemble in the reverse order of the procedure 2 - 7.

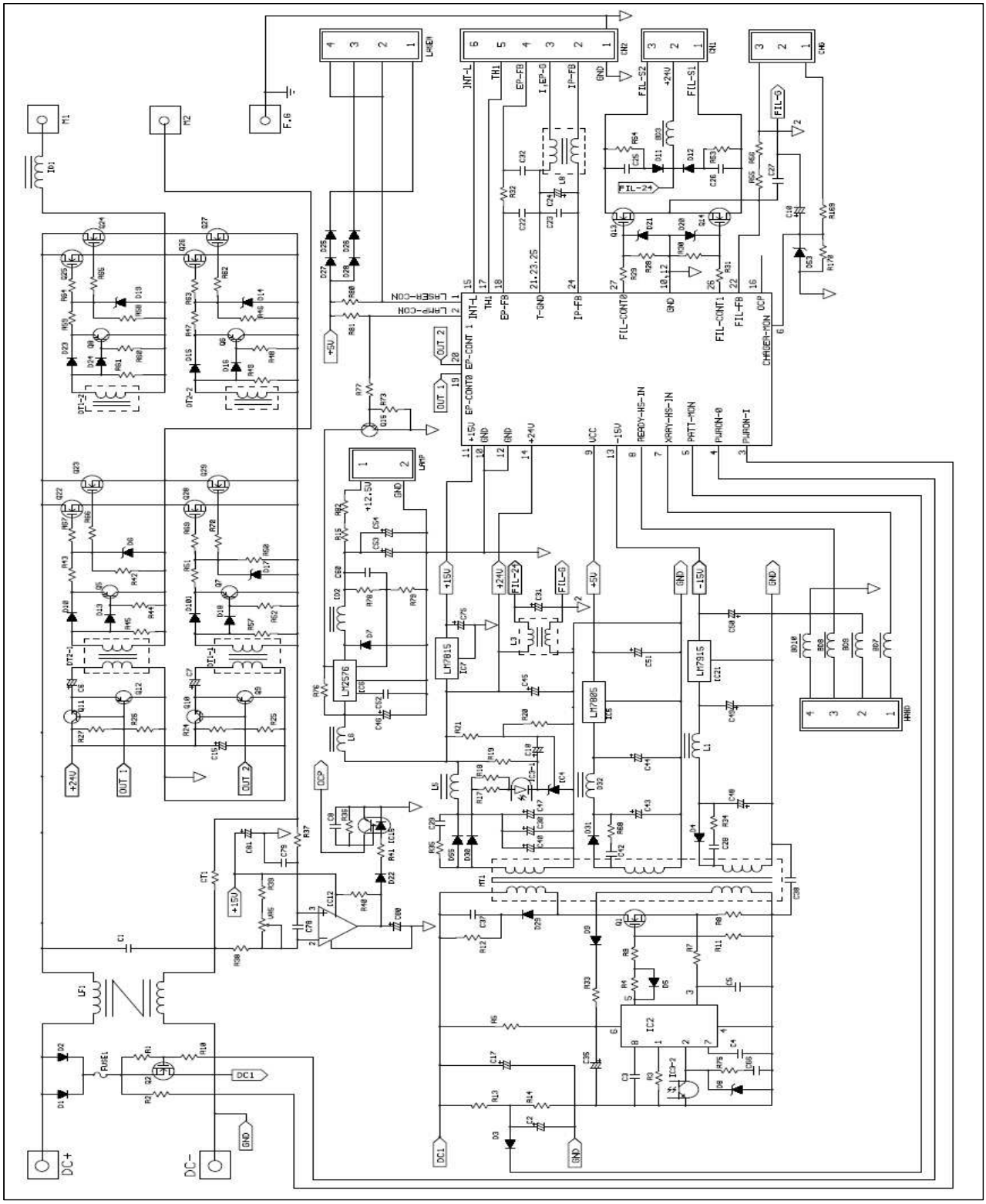
Section 4.

Schematics

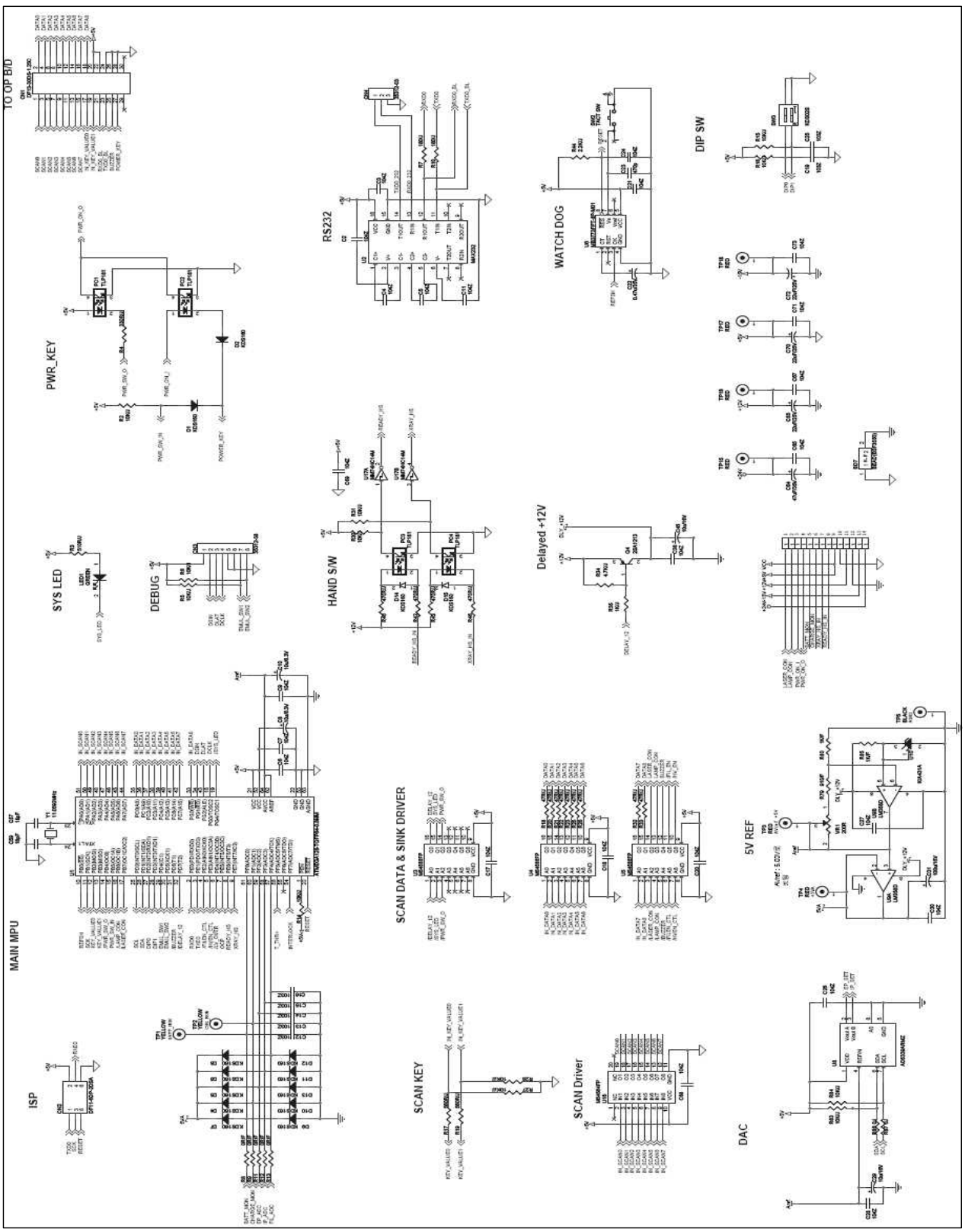
Block Diagram



Power & Driver Board



Main Board – CPU



Main Board – EP_IP FB