

NEXGEN 940pa (Power Assist)

[Installation, Operation and Service Manual]



- Contents –

<i>1.1 Introduction</i>	<i>5</i>
<i>1.2 Manual Contents</i>	<i>5</i>
<i>2.4 Contraindications to the use of X-Rays</i>	<i>10</i>
<i>2.5 Options</i>	<i>10</i>
<i>2.6 Side Effects</i>	<i>10</i>
<i>2.7 X-Ray protective equipment</i>	<i>10</i>
<i>2.8 Classification of Equipment</i>	<i>10</i>
<i>2.9 Essential Performance</i>	<i>10</i>
<i>2.10 Intended patient population</i>	<i>11</i>
<i>2.11 Intended User Profile</i>	<i>11</i>
<i>2.12 Symbols marked on Nexgen 940pa</i>	<i>12</i>
<i>3.1 General Safety</i>	<i>15</i>
<i>3.2 Safety from Explosion or Electric Shock</i>	<i>15</i>
<i>3.3 Risk of Collision</i>	<i>16</i>
<i>3.4 Radiation Safety</i>	<i>16</i>
<i>3.5 Radiation Protection</i>	<i>16</i>
<i>3.6 Electromagnetic Compatibility</i>	<i>17</i>
<i>3.7 Disposal</i>	<i>17</i>
<i>3.8 Service Information</i>	<i>17</i>
<i>3.9 Service Life</i>	<i>17</i>
<i>3.10 Disinfection and cleaning</i>	<i>17</i>
<i>3.11 Temperature limitation (Applied parts)</i>	<i>17</i>
6 Preparation before installation	31
<i>7.1 Generator installation</i>	<i>39</i>
<i>7.1.1 Input power connection</i>	<i>39</i>
<i>7.1.2 High voltage cable connection</i>	<i>40</i>
<i>7.1.3 Wiring of Tube Anode Side</i>	<i>42</i>
<i>7.1.4 Wiring of HV Cable of Tube</i>	<i>46</i>
<i>7.2.1 Connector the communication cable of mini console</i>	<i>47</i>
8 Calibration	51
<i>8.1 Generator Calibration</i>	<i>51</i>
<i>8.2 Generator Calibration (When using to mini console)</i>	<i>57</i>

<i>11.2 Purpose of Product Maintenance</i>	<i>81</i>
<i>11.3 Maintenance Procedure</i>	<i>81</i>

Chapter 1

Manual Introduction

Diagnostic X-Ray System

[NEXGEN 940pa]

1 Manual Introduction

1.1 Introduction

This manual provides information necessary for installation of the Nexgen 940pa (power assist), troubleshooting, using the product, and performing product maintenance.

This manual is copyrighted by Medicatech USA Inc., and it is illegal to copy and use part or all of the contents of this manual without our consent.

Nexgen 940pa Generator is a product designed and manufactured in Korea.

Product functions or specifications are subject to change without notice.

1.2 Manual Contents

All illustrations in this manual are examples and may differ from the actual ones. This manual is not described with all options being included. Therefore, the options selected by the customer may not be included in the manual.

Product users should read the manual and be familiar with the contents, and after reading it, store it in an easy-to-find place to prevent loss.

1.3 Service

For technical support and purchase of accessories, contact the number below.

Medicatech USA Inc.

50 Maxwell, Irvine, CA 92618

Phone: (949) 679-2881

Fax: (949) 679-2880

E-mail: support@medicatechusa.com

Homepage: medicatechusa.com

1.4 Service period

The free service period of the product is based on the factory shipment date, and is free of charge for 2 years, and the paid service is within 5 years from the end of the free service.

5. Responsibility

- Medicatech USA is responsible for product quality when installation, product maintenance, or repair is performed by an engineer authorized by Medicatech USA.
- Medicatech USA shall not be held liable for failure caused by user's negligence to maintain the product, wrong combination of the product, or the wrong product use.
- The product should be operated only by persons who have the required qualifications and training to use the product, and the product user is responsible for checking and managing it.

1.6 Revision History

The revision number identifies the update status of the manual, and the revision number and revision details are summarized in the table below.

Revision No.	Application date	Changes
01	2025-04-29	First edition

Chapter 2

Introduction of Products

Diagnostic X-Ray System

[NEXGEN 940pa]

2. Introduction

Nexgen 940pa is a general radiography X-Ray system and it was controlled by high frequency type. This equipment is consisting of X-Ray tube, tube stand, wall bucky stand, patient table, X-Ray generator. Also, it has accessories with hand switch for X-Ray exposure. Among them, this document is about X-Ray generator.

- Model name : Nexgen 940pa

2.1 Intended Use

The Nexgen 940pa is a diagnostic X-Ray system intended for use in generating radiographic images of human anatomy for general purpose. The system obtains necessary information of patient's anatomical structure by an image processing (workstation) after process of examination using radiation exposure with DR. This system is not intended for mammography applications.

2.2 Intended part of the body or type of tissue applied to or interacted with Intended part of the body:

Anatomical region	Exam example
Spine	C-spine AP/OBL, C-spine Lateral, Swimmers, T-spine AP/OBL, T-spine Lateral, L-spine AP/OBL, L-spine Lateral
Chest	Chest PA(High), Chest PA(Low), Chest AP, Chest Lateral, Chest Portable.
Thorax	Sternum RAO, Sternum Lateral, Ribs AP/PA/OBL upper, Ribs AP/PA/OBL lower
Shoulder	Shoulder AP, Shoulder Axillary, Scapula AP, Scapular Lateral.
Abdomen	Abdomen – KUB, Abdomen – upright/decubitus, Contrast Studies (IVP, GB)
Pelvis	Pelvis AP, Hip AP, Hip X-Table lateral.
Upper-Extremity	Forearm AP, Forearm Lateral, Elbow, Humerus.
Lower-Extremity	Ankle AP-Mortise, Ankle Lateral, Tib-Fib AP, Tib-Fib Lateral, Knee AP-Lateral, Knee Tunnel, Femur AP-Lateral.

Caution:

System Users should place the medical gauze on the equipment for the area such as top side of wall bucky stand, where patient can possibly make direct contact with chin part, before patient gets positioned for examination for sanitary reasons.

2.3 Features

This equipment is used in X-Ray room for general radiography purpose and it has features as follows.

High frequency inverter type X-Ray generator, it could get stability X-Ray output and low voltage ripple.
Dual focal X-Ray Tube with high level heating unit to get more good image and high value X-Ray output.

- Robust structure and smooth movement structure.
- Low dose Collimator
- Overheating sensor and Protection circuit for X-Ray tube.

2.4 Contraindications to the use of X-Rays

The exposure of humans to ionizing radiation must always be medically justified. Especially on pregnant women, children and adolescents this procedure should be used with caution or be avoided altogether. However, the final decision lies with the attending physician or attending surgeon.

For the purpose of diagnosis on diseases using radiation, it is not recommendable for the listed patients as following on radiation diagnosis.

- * Pregnant women
- * Patients who get an implantable pace makers or implantable defibrillators transplant.
- * Infants under 6 months.
- * Patient with cardiovascular disease or orthosis.

2.5 Options

The present Operating Instructions describe a system with maximum configuration. The system configuration chosen by you may not contain all options and functions described here.

2.6 Side Effects

- Exposing high dose of radiation directly to patient's eyeballs might cause eye diseases.
- Exposing radiation to infant or pregnant woman without protection might cause genetic disorder.
- Exposing radiation to patient equipped with cardiac pacemaker due to cardiovascular disease might cause stop of the cardiac pacemaker.

2.7 X-Ray protective equipment

We recommend that you use the following X-Ray protective equipment:

- X-Ray protective apron
- X-Ray protective eyewear
- Thyroid collar
- X-Ray protective gloves

2.8 Classification of Equipment

This system is classified as follows, based on safety standards for electrical medical equipment.

- Type of protection against electric shock: Class I
- Methods of sterilization: The equipment is not intended to be sterilized by user
- Degree of safety application for use in an oxygen environment: Not applicable
- Mode of operation: Non-continuous operation (Resting time: Min. 5 min at max. mAs condition)

2.9 Essential Performance

Accuracy of LOADING FACTORS
Reproducibility of the RADIATION output
Imaging performance

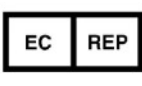
2.10 Intended patient population

Item	Details
Age	No special requirements
Gender	No special requirements
Weight	Max. 140 kg
Height	No special requirements
Race	No special requirements
Health	No special requirements

2.11 Intended User Profile

Item	Details
Education	- A professional with specialist knowledge/ qualifications who has fully understood the product and the contents of this document. (Such as a doctor or radiological technologist)
Knowledge	- Read and understand Western "Arabic numerals" written in Arial font - Can distinguish human body - Understands hygiene
Language Understanding	- Understanding of manual that is written in English
Experience	- Physician or certified operator
Permissible impairments	- Mild reading vision impairment or corrected vision to log MAR 0.2 - Average degree of age-related short term memory impairment - Impaired by 40 % resulting in 60 % of normal hearing at 500 Hz to 2 kHz

2.12 Symbols marked on Nexgen 940pa

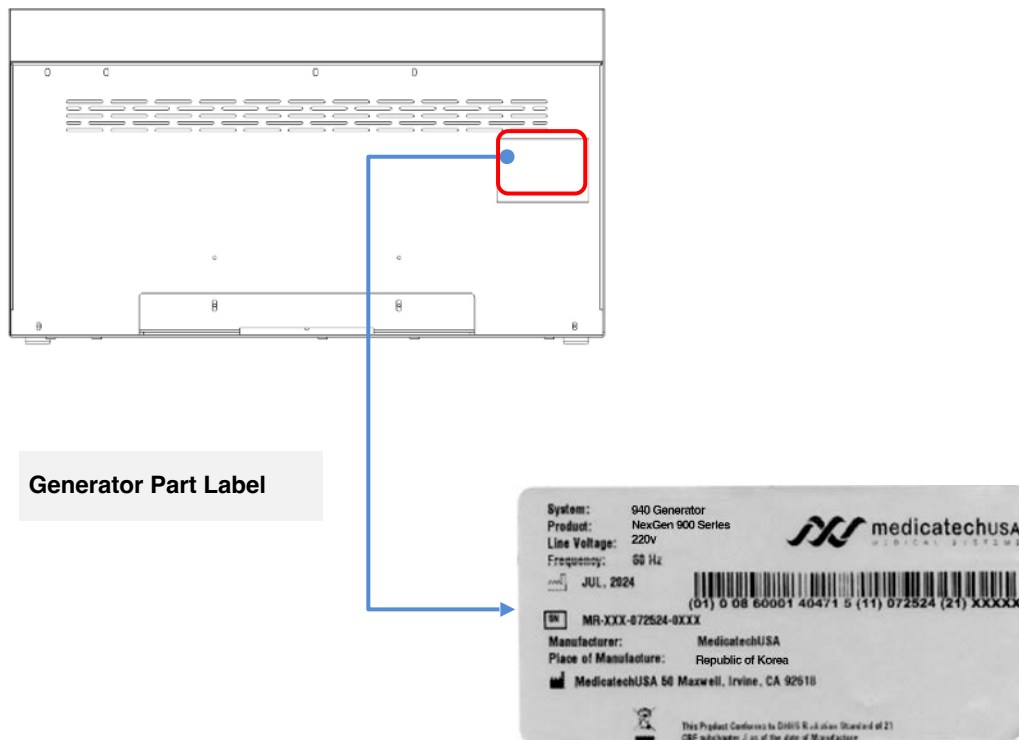
Symbol	Description
	Read and understand all instructions and warning labels in the product documentation before using the equipment. Keep this manual for future reference.
	General warning: This symbol indicates hazard.
	High Voltage Caution: This symbol means high voltage parts included.
	Radiation Warning: This symbols indicates radiation warning.
	Protective earth: This symbols means protective earth.
	Serial Number: This symbol means serial number of product.
	EU-Representatives information: The manufacturer's EU representative information shows with this symbol.
	Country and date of manufacture
	Manufacturer information: The manufacturer's information shows with this symbol.
	The Waste Electrical and Electronic Equipment Regulations indicate separate collection for electrical and electronic equipment.
	Alternating current : To indicate on the rating plate that the equipment is suitable for alternating current only; to identify relevant terminals.
	Medical device
	Unique device identifier

Rx only	For U.S. Caution : Federal law restricts this device to sale by or on the order of a licensed practitioner
	Consult instructions for use

2.13 Label

The label attached to the product displays the product name, product model, input power, manufacturing date, manufacturer name, manufacturer address, and product serial number, and the label is attached at the following location.

- **Generator Part:** It is attached to the back of the X-Ray Generator.



Chapter 2

Safety

Diagnostic X-Ray System

[NEXGEN 940pa]

3. Safety

3.1 General Safety

WARNING▶

You must be familiar with the contents of the present operating instructions in order to be able to operate the system as intended. Read and understand the present operating instructions before operating the system. It is important to observe all directions, safety instructions and warnings!

WARNING▶

The responsibility for management of use and maintenance of medical equipment lies in a user.

WARNING▶

Never modify the equipment! Please contact our service agency if it is necessary to modify the device. When an APPLIANCE COUPLER or MAINS PLUG or other separable plug is used as an insulating means, ME equipment should not be positioned in a way that makes it difficult to operate the disconnecting device. If an abnormality occurs during product operation, turn off the power to the device and stop its functions by pressing the emergency stop button.

Operation ▶

Only properly trained personnel are allowed to operate the system.

Assembly and service▶

Only authorized personnel are allowed to assemble the system and to provide technical service. The necessary qualifications can only be obtained by attending a training course provided by the manufacturer.

WARNING▶

Never use the system if you suspect any electrical or radiation-generating components to be defective or if the system exhibits unexpected malfunctions!

WARNING▶

Always be sure that audible and visual communication between the operator and patient are established throughout the entire examination. If necessary, communication must be maintained through technical means, for instance, an intercom.

Cybersecurity▶

- In the event of a cyber security incident, contact the manufacturer's emergency number and wait for instructions from the administrator until further action is taken.
- The software used on the device should be a product that does not engage in encrypted communication for data and should only be used within the hospital's closed network. Additionally, ensure the use of a PC with security systems such as a firewall and antivirus software.

3.2 Safety from Explosion or Electric Shock

WARNING▶

Do not use the system in an atmosphere containing combustible gas. The system is not an AP device. Its use in an atmosphere containing combustible gas carries the risk of fire or explosion.

WARNING▶

Do not use disinfectant sprays that are flammable or could cause an explosion. The vapor from a disinfectant spray may ignite, causing life-threatening or serious injuries and damage to the system.

WARNING▶

To avoid the risk of electric shock, this equipment must only be connected to a supply with protective earth.

3.3 Risk of Collision

WARNING►

Ensure that there are no persons and objects in the range of the tube assembly movement.
Please keep a safe distance to prevent any collision or unnecessary stop of the operation.

WARNING►

Ensure that the patient does not use the control grip as a handle.

3.4 Radiation Safety

The system produces X-Rays. If you do not observe the safety measures and precautions required by your local radiation protection regulatory body, these X-Rays can be hazardous both to operating staff and other persons.

Maximum Permissible Dose (MPD)

Many kinds of researches on effects or influences about X-radiation provide basics about maximum permissible dose. These research results were used for ICRP to recommend Maximum Permissible Dose but it is hard to define exactly and it is updated from time to time with new research result. For occupational exposures, the ICRP 60 recommends that the MPD accumulated shall not exceed the following limits:

- Annual effective dose 50 mSv
- Annual dose for the lens of the eye 150 mSv
- Annual dose for all other parts of body 500 mSv

WARNING►

The system is intended for procedures where the skin dose may be so high that there is a risk of deterministic effects, even if the system is used as intended.

WARNING►

The system may only be operated by personnel who has undergone radiological training.

WARNING►

The relevant radiation protection regulations of the country of installation must be observed.

WARNING►

In order to avoid unintentional radiation, the hand switch must be hung up on the hand switch support when the system is switched on, but not in use.

WARNING►

Always be aware that any material brought into the path of radiation between the patient and the image receptor (e.g. film) will have a negative influence on the image quality as well as on the patient dose.

WARNING►

Operator's operation of X-Ray function should be operated and X-Ray examined only in a designated place(Shielded room).

3.5 Radiation Protection

Protection of staff

Staff members who stay within the radiation controlled area must wear X- Protection of staff ray protective clothing.

Protection of the patient

- To minimize the radiation burden of the patient, you must keep the source/skin Distance as large as possible.
- In addition, radiation should not be irradiated when the distance between the source and the patient's skin is less than 20 cm.

WARNING►

When you initiate radiation and no live image is displayed although all necessary settings have definitely been made, please contact your after-sales service center!

3.6 Electromagnetic Compatibility

Medical electrical equipment requires special precautionary measures with respect to EMC and must be installed and put into service in accordance with the EMC guidelines contained in the accompanying documents.

Portable and mobile RF communications equipment may interfere with medical electrical equipment.

All operating modes of the system have been considered in the EMC tests. There are no exceptions to the rules.

Only conductors, connecting cables and accessories that are specified by the manufacturer may be used.

WARNING►

Using components other than those specified may result in increased electromagnetic emissions or reduced electromagnetic immunity.

3.7 Disposal

The meaning of the symbol on the product, its accessory or packaging indicates that this product shall not be treated as household waste. Please, dispose of this equipment at your applicable collection point for the recycling of electrical & electronic equipment waste. In the European Union and Other European countries which there are separate collection systems for used electrical and electronic product. By ensuring the correct disposal of this product, you will help prevent potentially hazardous to the environment and to human health, which could otherwise be caused by unsuitable waste handling of this product. The recycling of materials will help conserve natural resources, please do not therefore dispose of your old electrical and electronic equipment with your household waste. For more detailed information about recycling of this product, please contact your local city office, your household waste disposal service or the shop where you purchased the product.



3.8 Service Information

Technical support and purchase of accessories are available through your authorized Medicatech USA reseller or Medicatech USA direct.

3.9 Service Life

The system's service life is 4 years, and is limited to systems that receive the prescribed maintenance checks.

3.10 Disinfection and cleaning

- Wipe it with a dry cloth slightly dampened with a neutral detergent.
- Do not use solvents such as alcohol, thinner or benzene. Doing so may damage the surface of the equipment.
- The power should be switched off and equipment should be unplugged before cleaning.
- The exterior of the array can be cleaned with 70% alcohol solution can also be used.

3.11 Temperature limitation (Applied parts)

- Max temperature : max. 43.0 °C
- Contact time : $t < 1 \text{ min}$
- Patient contact time should not exceed 1 minute.

Chapter 4

Product Configuration

Diagnostic X-Ray System

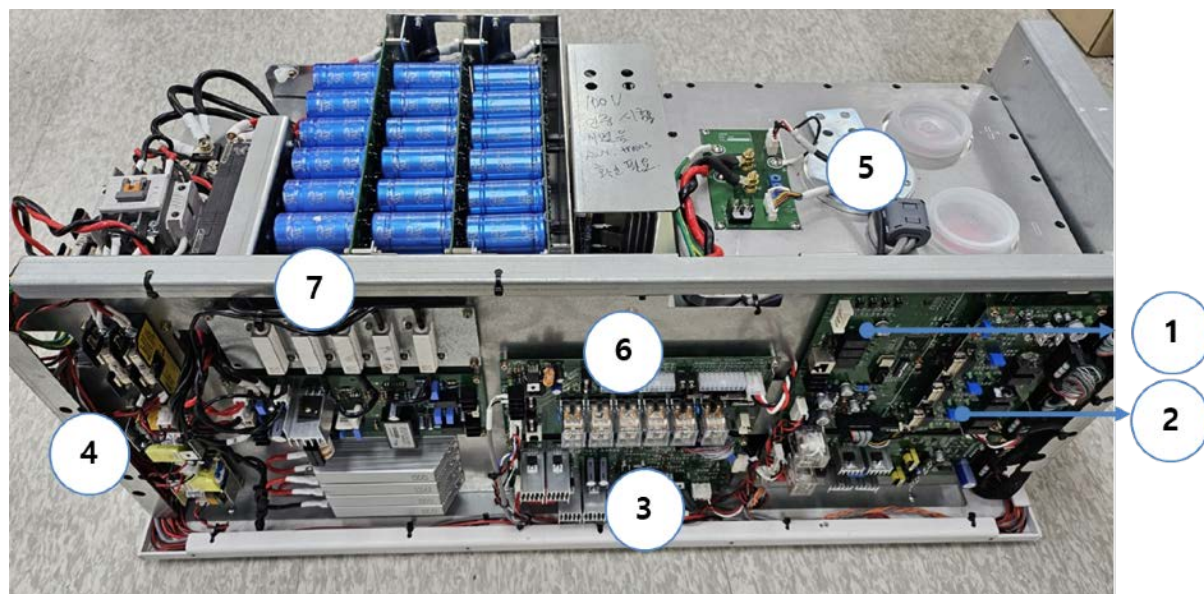
[NEXGEN 940pa]

4 Product Configuration

4.1 Product Configuration

The Nexgen 940pa is an X-ray generator and is a key component of the Nexgen 900 Series.

4.2 Product of X-Ray generator (940pa)

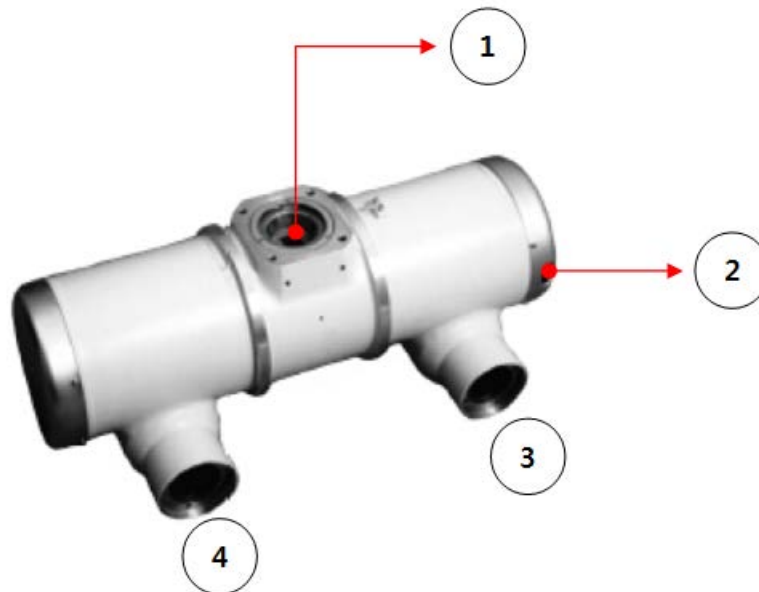


Product Functions

It is a device that adjusts the X-Ray value according to the X-Ray irradiation conditions set in the Console. The adjusted data is input to the high voltage transformer and outputs the high voltage and tube filament voltage to the X-Ray tube.

NO	Function	Description of Functions
1	Main CPU Board	Controls the X-Ray dose according to the data set in the console.
2	AEC Board	Automatically controls X-Ray irradiation time.
3	Filament control Board	Controls Tube Filament according to the signal from the main CPU.
4	Filament SMPS	Supplies power voltage to each board.
5	HVT	Supplies generated high voltage to the X-Ray tube.
6	GC Board	Connected to external devices such as tube, table, upright stand, etc.
7	PSU Charger	Energy bank charging power - High-voltage charge to the capacitor bank (Cap Bank) - Stay on standby after charging is completed

4. 3 X-Ray tube (E7239X, E7242X, E7884X, E7252X)



Description of Product Functions

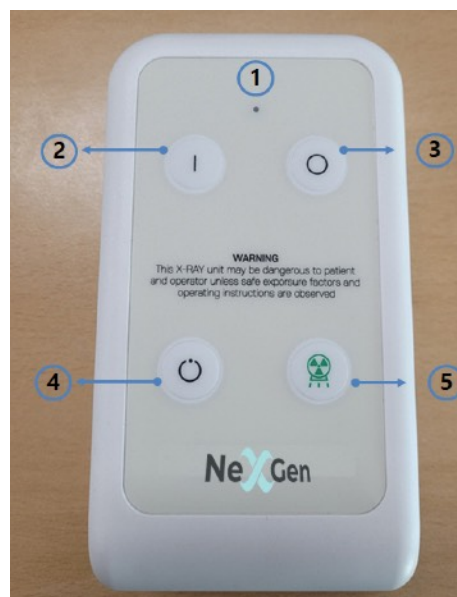
X-Ray tube is selected according to the X-Ray output, and the function of the X-Ray tube is the same for both models. As a vacuum tube that generates X-Rays, it is composed of a filament for heat electron emission, a high pressure input part, and a radiation aperture.

NO	Function	Description of Functions
1	Radiation Aperture	Aperture to which the generated X-Ray is radiated.
2	Wiring connector	A connector that wires tube anode stator, temp SW, etc.
3	Anode	Receptacle to which the positive high voltage cable is connected.
4	Cathode	A receptacle to which negative high voltage cable is connected.

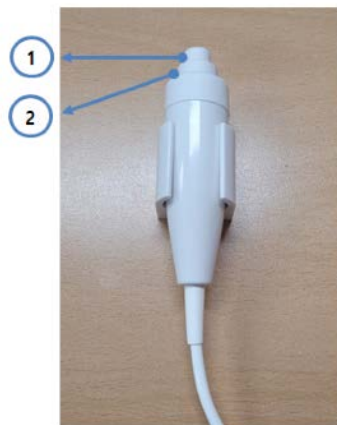
4. 4 Mini Console



No.	Function	Description of Functions
1	X-Ray irradiation switch	Preparation for examination, X-Ray examination
2	Mini console	Main device
3	Connector cable	Connector cable connecting to the control unit



No.	Function	Description of Functions
1	Indicator	When the generator power is on, the green LED turn on.
2	Generator On Switch	Turn on the generator
3	Generator Off switch	Turn off the generator
4	Ready Switch	Make the generator ready for operation.
5	X-Ray Switch	Make the X-Ray irradiated.



Description of X-Ray irradiation switch

As a switch for X-Ray irradiation, it activates Ready and X-Ray.

Used with mini console.

NO	Function	Description of Functions
1	Ready Switch	Make the generator ready for operation.
2	X-Ray Switch	Make the X-Ray irradiated.

Chapter 5

Product Specification

Diagnostic X-Ray System

[NEXGEN 940pa]

5 Specifications

5.1 Product Size and Weight

The size unit is mm, the tolerance range is within $\pm 10\%$, the weight unit is kg, and the tolerance is within $\pm 10\text{kg}$.

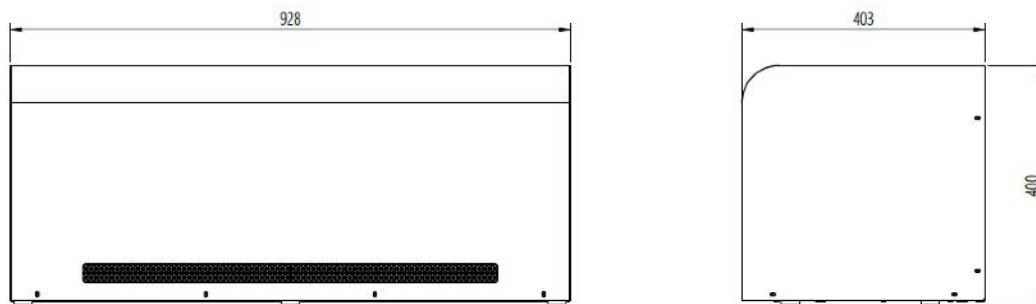
► CAUTION

Product dimensions and weights presented below are before packaging and may vary according to revision or options.

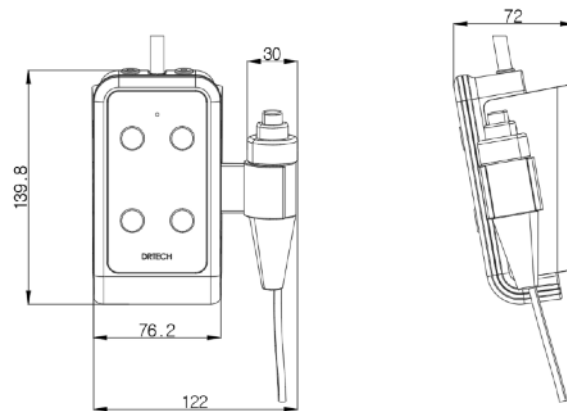
5.1.2 Dimensions and weight of major parts

5.1.2.1 X-Ray generator

■ 940pa (weight: 140 kg)



5.1.2.2 Mini Console (weight: 0.42kg)



5.1.2.3 X-Ray irradiation Switch (weight: 0.5kg)



5.2 Product Performance

5.2.1 X-Ray Generator (40kW) – 940pa

Items	Description
Maximum output capacity	40kW
Line rating	AC 220-230V~, 50/60Hz, Single phase
kV range	Min. 40 kV ~Max.125kV, 1kV step
mA range	Min. 10 mA to Max.500mA
Irradiation time range	Min. 1msec to Max. 10sec
Interval time After Exposure	1minute at 100KV, 400mA, 100msec
Accuracy	kV<±(3%+1kV), mA<±(5%+1mA), Time<±(1%+1ms), mAs<±(5%+1mAs)
Output rating	<u>500mA@80kV at 100msec</u>
	<u>400mA@100kV 100msec (max. 40kW Rating)</u>

5.2.2 X-Ray tube

(1) E7239X

Focal Spot size	Small: 1.0mm, Large: 2.0mm
Anode Heat Capacity	140kHU
Target angle	16°
Tube Voltage	Max. 125kV
Anode Rotation speed	50Hz: Minimum 2700 min ⁻¹ , 60Hz: Minimum 3200 min ⁻¹ ,
Anode Stator Input Voltage	Stating: Max. AC220V, Running: Max. AC60V
Anode Stator Input power	Stating: Max. 2000W, Running: Max. 150W.
Inherent filtration value	0.9mmAl @75kV
Weight	16kg

(2) E7242X

Focal Spot size	Small: 0.6 mm, Large: 1.5 mm
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Anode Heat Capacity	200kHU
Target angle	14°
Tube Voltage	Max. 125kV
Anode Rotation speed	50Hz: Minimum 2700 min ⁻¹ , 60Hz: Minimum 3200 min ⁻¹ ,
Anode Stator Input Voltage	Stating: Max. AC220V, Running: Max. AC60V
Anode Stator Input power	Stating: Max. 2000W, Running: Max. 150W.
Inherent filtration value	0.9mmAl @75kV
Weight	16kg

(3) E7884X

Focal Spot size	Small: 0.6 mm, Large: 1.2 mm
Anode Heat Capacity	300kHU
Target angle	12°
Tube Voltage	Max. 125kV
Anode Rotation speed	50Hz: Minimum 2700 min-1, 60Hz: Minimum 3200 min-1,
Anode Stator Input Voltage	Stating: Max. AC220V, Running: Max. AC60V
Anode Stator Input power	Stating: Max. 2000W, Running: Max. 150W.
Inherent filtration value	0.9mmAI @75kV
Weight	16kg

(4) E7252X

Focal Spot size	Small: 0.6 mm, Large: 1.2 mm
Anode Heat Capacity	300kHU
Target angle	12°
Tube Voltage	Max. 125kV
Anode Rotation speed	50Hz: Minimum 2700 min-1, 60Hz: Minimum 3200 min-1,
Anode Stator Input Voltage	Stating: Max. AC220V, Running: Max. AC60V
Anode Stator Input power	Stating: Max. 2000W, Running: Max. 150W.
Inherent filtration value	0.9mmAI @75kV
Weight	18kg

5.2.4 PC (with Econsol2)

Recommended PC Specification	■ CPU : Intel i3-12100 ■ RAM : 16GB ■ HDD : NVME 256MB / HDD 1TB ■ OS : windows 11 64bit ■ Display Size : 24 inch ■ Display Resolution : 1920 x 1080
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Chapter 6

Preparation before Installation

Diagnostic X-Ray System

[NEXGEN 940pa]

6 Preparation before installation

6.1 Introduction

This chapter describes how to install NexGen 940pa. Read the manual carefully and refer to it when installing. Also, check the list of ordered items before installation, and after installation, organize the item confirmation data and forward them to the orderer.

► WARNING

If any signs of product damage are found during unpacking, you should stop the installation and notify the sales agent of the facts to take action before proceeding with the next operation.

► WARNING

If it is not installed or wired according to the method suggested in this chapter, or if the cable is damaged, the power switch should not be operated.

► WARNING

Before installation, be sure to read the manual.

6.2 Operating Environment

- Ambient temperature: 10°C ~ 40°C
- Humidity: 30% RH to 75% RH
- Air pressure: 800hPa ~1,060hPa
- Altitude : Max. 2000 m

6.3 Transport and Storage Conditions

- Temperature: -10°C ~ 60°C
- Humidity: 10% RH ~ 90% RH
- Air pressure: 800hPa ~1,060hPa

6.4 Power Requirements

- Input power: Single phase or Three Phases AC
- Frequency: 50/60Hz
- Standard Voltage:
 - Nexgen 940pa (40kW) : 100V~ / 220-230 V~
- Voltage variation range: $\pm 10\%$ of standard voltages
- Supply Impedance: 100, 110, 120 V: 1.0Ω or less, 200, 220, 230, 240 V: 4.0Ω or less
- Earth terminal: Earth resistance of 100Ω or less
- The wire thickness of the X-Ray Generator and the capacity of the overload breaker are as shown in the table below, and the wire thickness may vary according to the installation environment and wire length.

Generator model	Maximum capacity of overload breaker [A]	Voltage[V]	Power line thickness (3m standard)
Nexgen 940pa	16	100V~ $\pm 10\%$ 220-230 V~ $\pm 10\%$	Over 0.75mm^2

6.5 Tools required for Installation

When installing the product, prepare the following basic tools. Additional installation tools may be required, if necessary.

- Hand tools and standard service tools (eg. screwdriver, hexagon range set, etc.)
- Hammer drill, nipper, pliers
- Multi tester, Oscilloscope
- Leakage current tester for measurements according to IEC 60601-1
- Assorted cable ties
- Measurement and leakage current tester capable of testing according to IEC60601-1.
- Measurement and protective earth tester capable of testing according to IEC60601-1.

6.6 Installation Space

6.6.1 Condition of packaged product

(Depending on the option selected, the composition of the packaged product may vary.)

Item Name	Size / Weight	Quantity (Unit: each)
X-Ray generator	Refer to “Clause 5.1 Product Size and Weight”	1
Accessories		1

6.6.2 After unpacking, check the manual and other documents, and check if the following parts are included.

- X-Ray generator
- Tube (optional)
- Mini Console (optional)
- Accessories (optional)

6.7 Countermeasures in Case of Product Damage

If the received product is different from the ordered product, or if the product is damaged, contact the ordering office or Medicatech USA customer support department for action.

► NOTE

Carefully remove the packaging. Sharp tools may damage the contents.

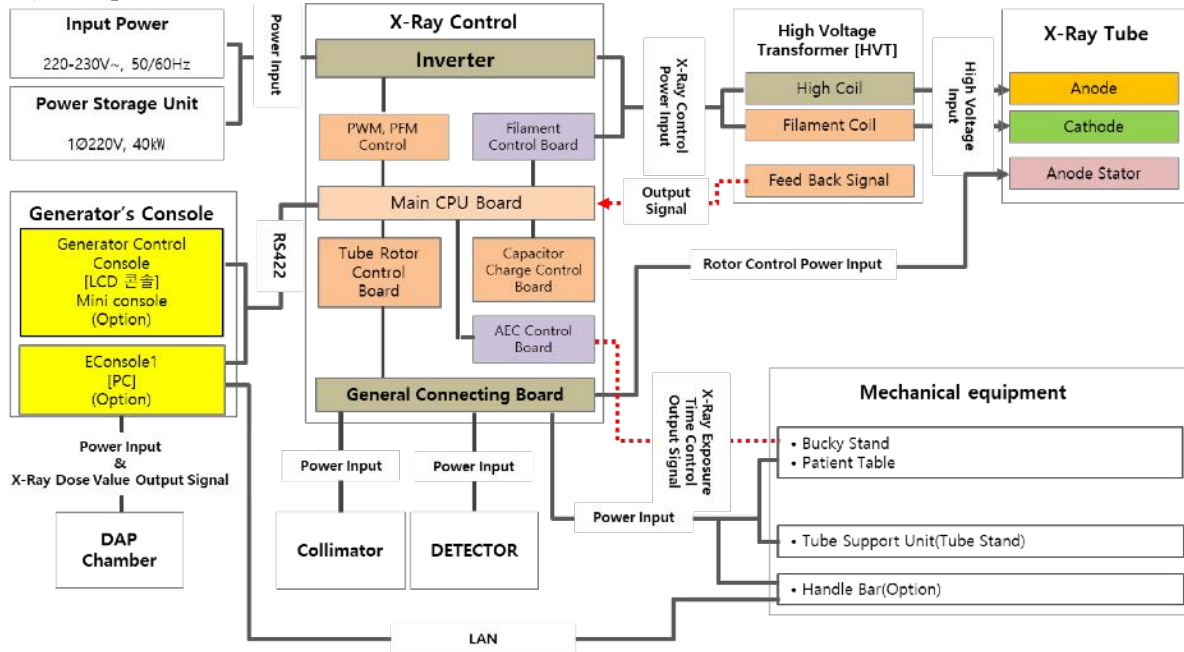
► CAUTION

The product is heavy and should not be lifted or moved by a single person without proper equipment or assistance.

6.8 Configuration of Major Parts

6.8.1 Wiring Diagram

1) 940pa



6.8.2 Functions and Information of Main Cables

The functions of the cable provided at the factory are as follows.

Cable No	Quantity (each)	Cable length (Unit: m)	Function	Note
Cable 1	1	5	Power line	It is an input power line, and 1Ø, 230V power line (including ground line) is provided according to the generator capacity.
Cable 2	1	12	RS232 Cable	It is a communication cable for signal connection between EConsole2 and generator.
Cable 3	1	1.5	Hand switch	It is connected to the generator and is a switch that executes Ready, X-Ray.
Cable 4	1	8	Tube rotor wiring	It is a connection cable between the GCB board of the generator and the tube stand, and supplies power to the tube rotor and the collimator.
Cable 5	1 pair	6	High voltage cable	It is a high-voltage cable connecting the HVT of the generator and the X-Ray tube, and supplies high-pressure to the X-Ray tube.
Cable 6	1	8	RS232 Cable	It is a communication cable for signal connection between EConsole2 and DAP C-chamber.
Cable 7	1 pair	8	RS232 Cable	It is a communication cable for signal connection between AEC Chamber and the Generator.
NOTE  The power ground must be in accordance with the regulations, and the ground terminal connection is located next to the main fuse of the X-Ray generator.				

6.8.3 Fuse capacity of main parts

No.	Classification	Fuse location	Fuse name	Size	Fuse capacity	Quantity
1	Generator (940)	Main Power Fuse	F1, F2,	10 X 38	400V, 32A	2
2		Generator Internal Fuse	F3, F4	10 X 38	500V, 6A	2
3		Rotor Board	F901	5 X 20	250V, 10A	1
4		Filament Board	F906	5 X 20	250V, 3.15A	1
5		CND Board	F958, F955	5 X 20	250V, 10A	2
6		GC Board	F959, F961	5 X 20	250V, 3.15A	2
7		GC Board	F952, F955, F958	5 X 20	250V, 5A	3
8		GC Board	F960	6 X 30	250V 10A	1
9		Charger Board	F101	5 X 20	250V 6A	1

Chapter 7

Installation

Diagnostic X-Ray System

[NEXGEN 940pa]

7 Installation

7.1 Generator installation

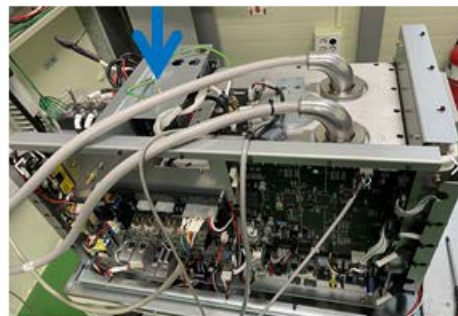
7.1.1 Input power connection

- 940pa
 - Input power is single-phase, 230V~. (or 100V~)
 - It is an input power line that connects the provided 1Ø, 230V(or 100V) power line (including ground line) to the main fuse according to the generator capacity.
 - Connect the input power line to the main fuse and the ground wire to the ground terminal.



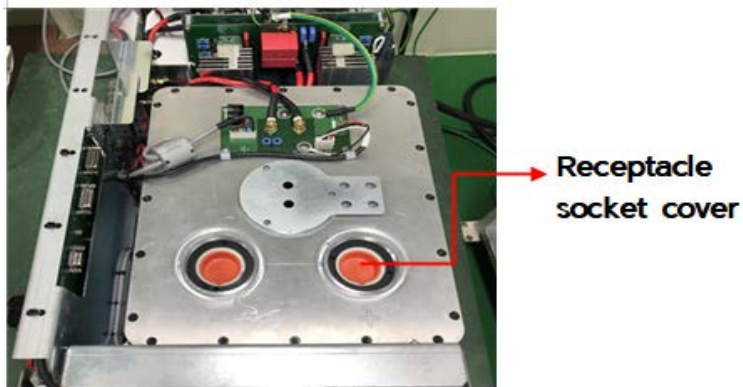
Connect the power cable of Generator

Connect the earth cable

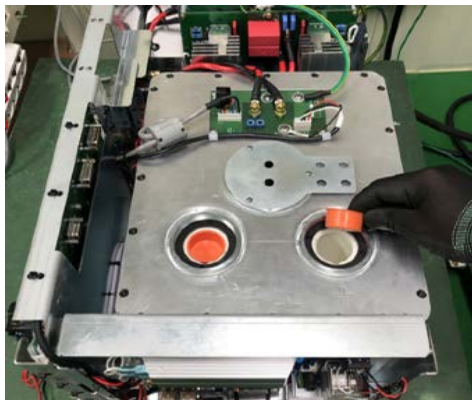


7.1.2 High voltage cable connection

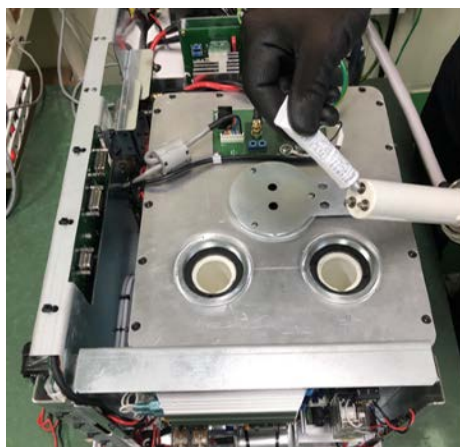
- Connect the high-voltage cable between HVT's anode and cathode and X-Ray tube's anode and cathode.
- Before connecting the HV cables, always close the cover of the receptacle socket to prevent foreign substances from entering.



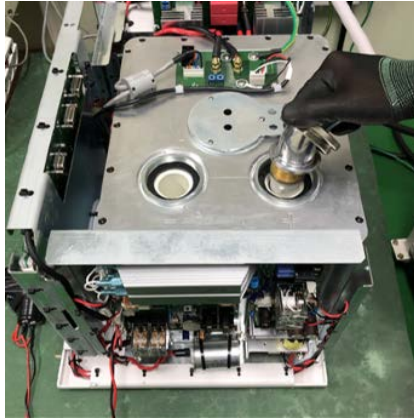
- Remove the receptacle socket cover for HV cable connection.



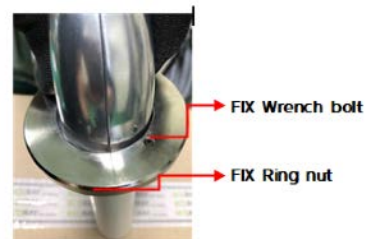
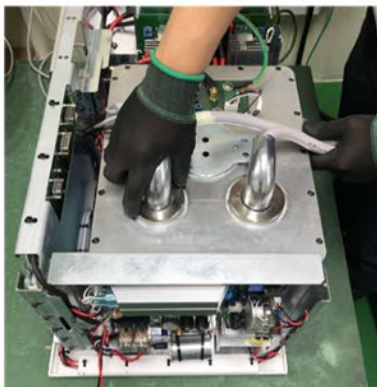
- Apply enough insulation silicon oil to the end of the plug of the HV cable.



- Insert HV cable plug into receptacle socket and connect.



- After locking the HV cable plug fix ring nut tight, fix the HV cable plug completely with the fix wrench bolt.



WARNING ►

Bushing terminal pins are elaborate and easy to damage, so care must be taken when handling them.

WARNING ►

HV Cable Plug and Receptacle socket must be kept clean at all times, and care must be taken not to get foreign substances.

WARNING ►

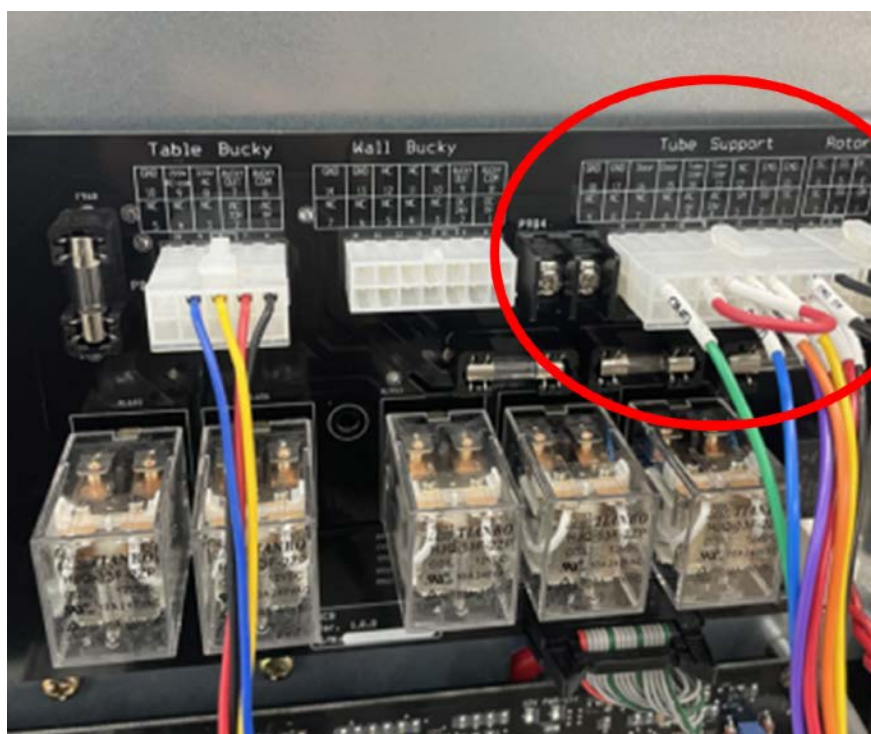
After the HV cable plug and receptacle socket are connected, the ring nut and wrench bolt must be

completely fixed. If the fixing condition is poor, it may cause high voltage discharge or other failure due to the poor socket connection.

7.1.3 Wiring of Tube Anode Side

Tube anode side wiring consists of anode stator, collimator power, and tube temperature switch.

- The power of Anode Stator and Collimator of the tube is connected to P805 (Picture 1) of the generator GC Board.



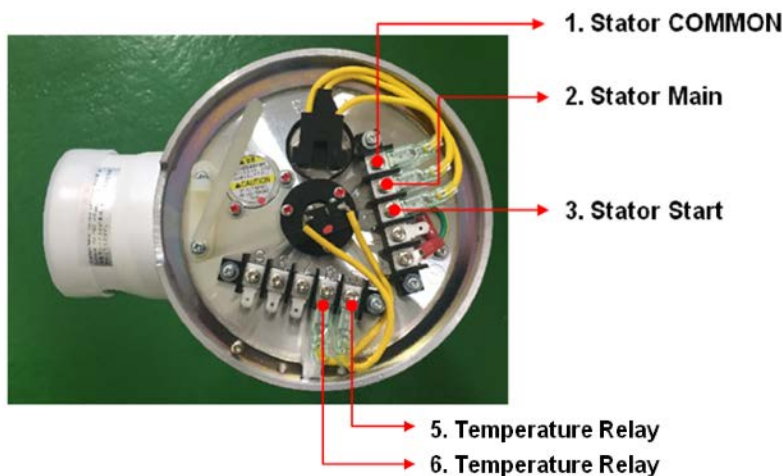
- PIN configuration of P805 of GC board is as follows.

PIN	Signal	NOTES	Remark
1	SM	SM (Stator Main Coil) Use pins 1 and 6	The P805 connector of the GC board supplies voltage to the anode stator start coil and connects with the tube anode stator.
2	NC		
3	SS		
4	NC		
5	SC	SS (Stator Start Coil) Use pins 3 and 8	
6	SM	SC (Stator COMMON Coil)	
7	NC		

8	SS	Use pins 5 and 10	
9	NC		
10	SC		

■ Wiring the tube anode side.

- Connect the Temperature Relay attached to the Tube Anode Side to no. 13 and no.14 of P976 of Generator GC Board. (The generator stops working, when the tube gets overheated)
- Wire between P805 of GC Board and X-Ray Tube Anode Stator.
- Check the configuration of X-Ray Tube Anode Side.



- The wiring configuration between X-Ray Tube Anode Side and P805 of GC Board is as follows.

NO	P805 of GC board		X-Ray Tube Anode Side	
	PIN NO	P805 Wiring		
1	SM	1,6 PIN	Stator Main	2. Stator Main
2	NC			
3	SS			
4	NC	3. 8 PIN	Stator Start	3. Stator Start
5	SC			
6	SM			
7	NC	5, 10 PIN	Stator COMMON	1. Stator COMMON
8	SS			
9	NC			
10	SC			

WARNING ►

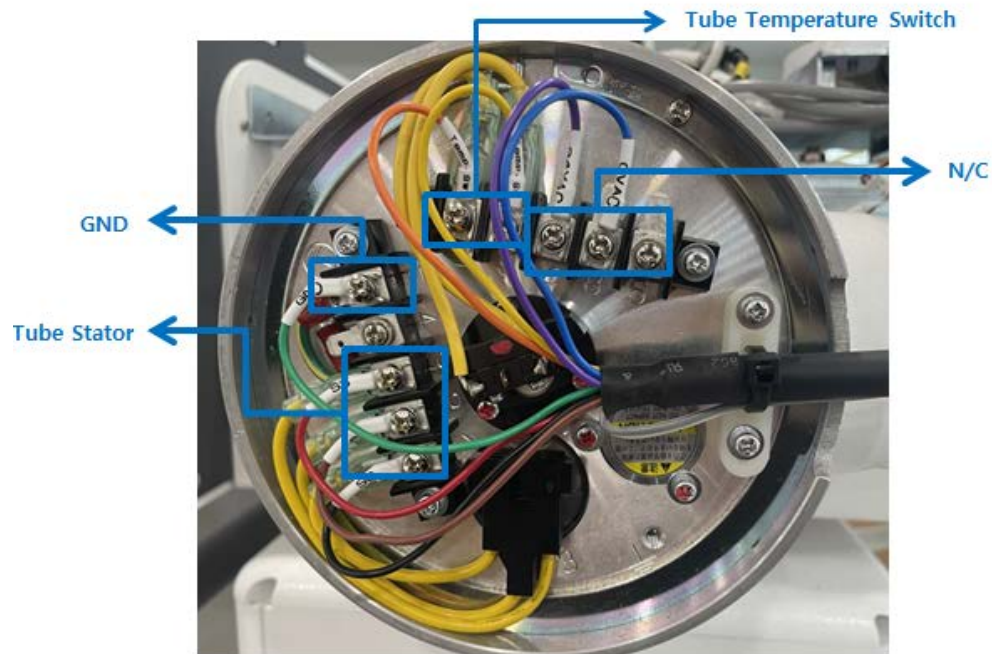
X-Ray tube positive stator wiring must be done correctly according to the X-Ray tube manufacturer's

recommendations.

WARNING ►

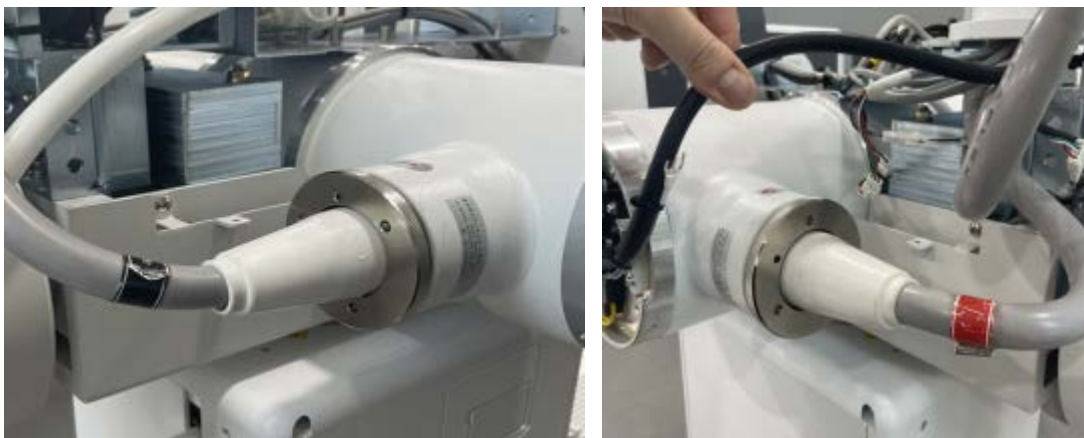
Do not connect the stator coil's COMMON terminal to the temperature relay of Tubes no. 5 and no. 6.

- Connect the tube anode side wiring and CON703 of generator GC board.
 - Tube anode side wiring consists of anode stator, collimator power, and tube temperature switch.



7.1.4 Wiring of HV Cable of Tube

- Connect the HV plug to receptacles of tube



7.2 Connector the communication cable of mini console

7.2.1 Connector the communication cable of mini console

■ Connect the communication cable

- Connector the communication cable to the generator



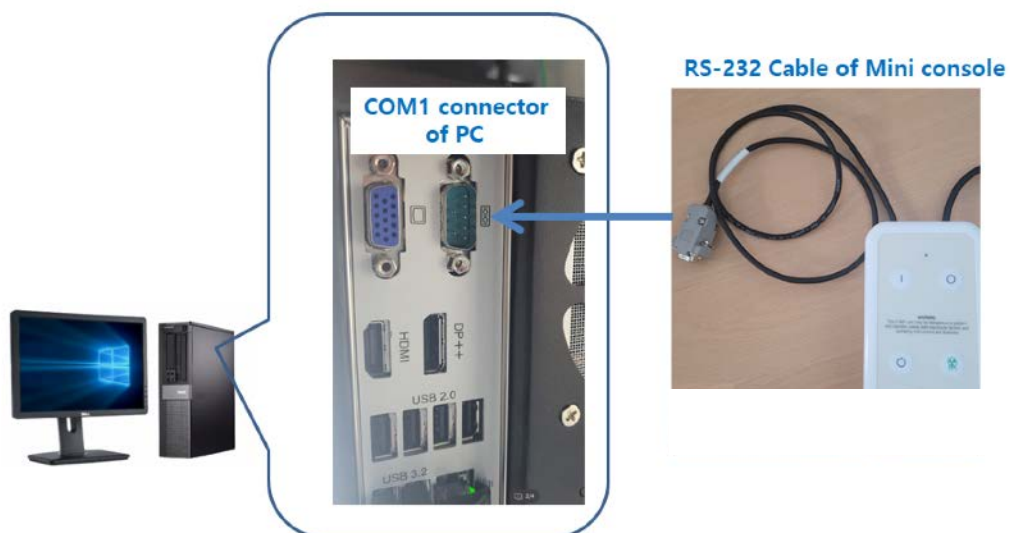
P802 connector is connected to 13 and 14 of MiO board, and the pin configuration is as follows.

PIN	Signal	NOTES	Remark
1	MiO RESET	Q616 Base (CON2 MiO RESET)	Connect P803 of Generator MIO Board and P803 of Console Connector Board.
2	M2CRX-IN	RX (13 of U602)	
3	M2CTX-OUT	TX (14 of U602)	
4	NC	NC	
5	GND	GND	
6	+V	30VDC	
7	+V	30VDC	
8	GND	GND	
9	GND	GND	
10	GND	GND	
11	EEPROM Write	Connect with EEPROM WP	
12	M2MCON IN	P803 RX (PC)	
13	M2MCON OUT	P803 TX (PC)	
14	EXP. IN	Connected to pin 2 EXP IN of P910.	
15	READY IN	Connected to pin 3 READY IN of P910.	

- Connect the communication cable to the Mini console



- Connect the RS-232 communication cable of Mini Console to COM1 connector of PC



Chapter 8

Calibration

Diagnostic X-Ray System

[NEXGEN 940pa]

8 Calibration

8.1 Generator Calibration

8.1.1 Overview

This Generator calibration must be performed only by the calibration software program of Medicatech USA

8.1.2 Characteristics of calibration software program

- The calibration software program is operated on PC.
- It has functions for changing X-Ray exposure parameters (eg kV, mA and selection of X ray tube) and can be saved.

8.1.3 Tool and equipment for calibration

Calibration requires the following tool and equipment.

- Calibration software program of Medicatech USA (CD)
- Digital Voltmeter (DVM)
- X-Ray kVp meter
- X-Ray mA meter
- X-Ray exposure time meter
- Radiation Dose meter
- Aluminum HVL attenuators for HVL measurements
- Others for equipment for calibration

8.1.4 Check before calibration start

- Power input (Supply mains)
- Protective earth condition
- Tool and equipment for calibration
- Selected X-Ray tube model, type reference of the per

8.1.5 When to do calibration

When to do	What to do	Remarks
After product installation, including relocation	Calibration for X-Ray exposure parameters	Refer to the chapter 4
Periodic testing for maintenance (Every six months or as required)	Calibration for X-Ray exposure parameters	Refer to the chapter 4
Replacement or repair of critical components	Calibration for X-Ray exposure parameters	Refer to the chapter 4 and 6
After product installation, including relocation	Calibration for System parameters.	Refer to the chapter 4 and 6

8.1.6 Critical Components that could affects the product performance

Replacement or repair of critical components requires a calibration for X-Ray exposure parameters.

Critical components are the followings:

- X-Ray tube assembly
- MiO Board (Main CPU Board)
- FnD Board (FET Driver Board)
- FILA Board (Filament Driver Board)
- HVT (high Voltage Transformers)
- High voltage cables

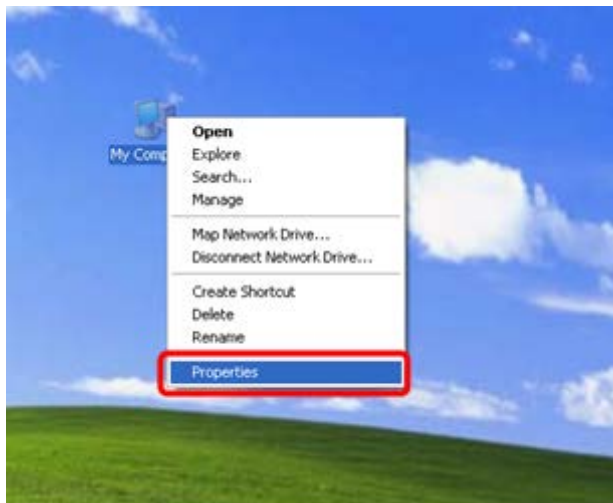
8.1.7 Installation of “USB to RS232 Converter Driver”

Specifications

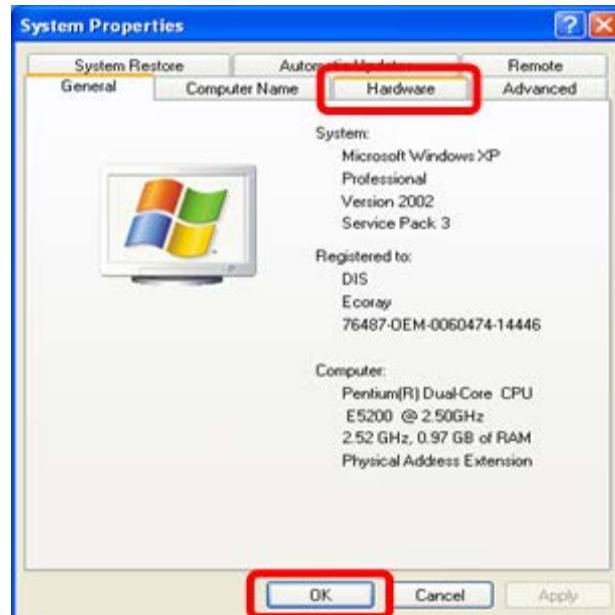
- Identification: USB to RS232 Converter
- Confirmation of PC specifications (**Refer to 5.2.4**)
- The software for RS232 Driver is available on the website and the installation method refers to a manual which is accompanied the RS232 Converter.

Installation

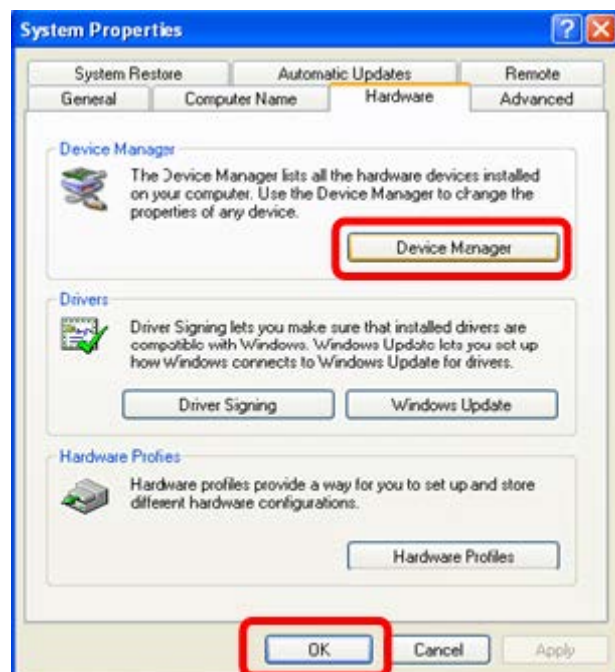
- Turn on PC.
- Click “My Computer” icon from the wallpaper on PC to execute “Properties”.
- Click “Properties”.



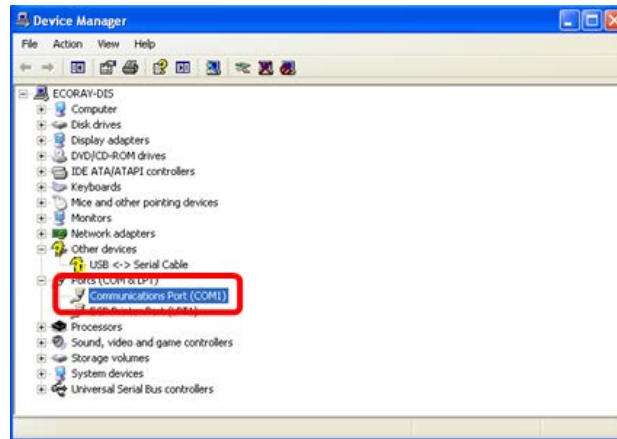
- Click “Hardware”, then click “OK”.



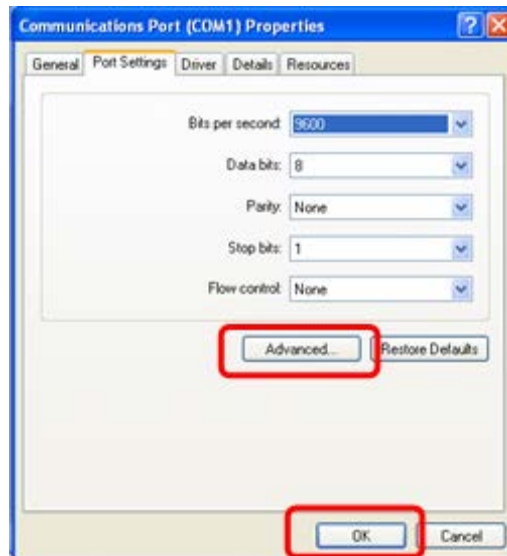
- Click “Device Manager”, then click “OK”.



- Click “Communications Port(COM1)”, then click “Port Settings”.



- Check the selected values.
- Click “Advanced”, then click “OK”.



- On the displayed “Advanced Setting for COM1”, select “Use FIFO buffers(requires 16550 compatible UART)”.
- Select a suitable one from COM1 to COM5, then click “OK”.
- Installation of “USB to RS232 Converter Driver” is finished

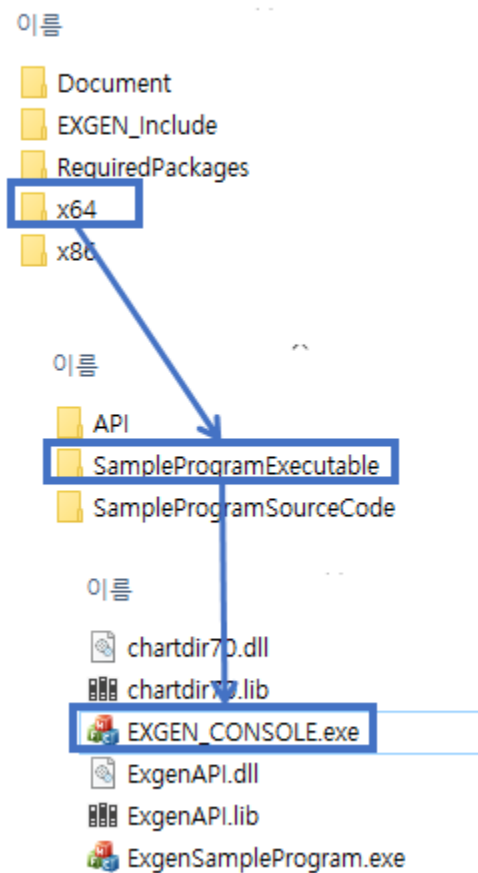
NOTE ►

If you do not select a one from COM1 to COM5, this program would not operate.

8.2 Generator Calibration (When using to mini console)

This system calibration must be performed only by the calibration software program of Medicatech USA

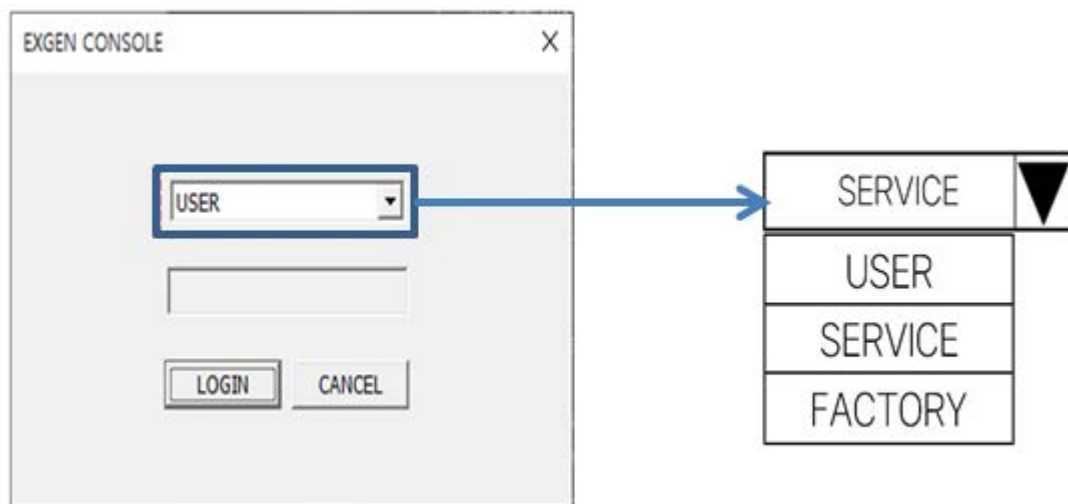
- a. Run the 'EXGEN_CONSOLE.exe' in the 'sample program Executable' folder of the program folder appropriate for your PC(32/64bit) in the provided EXGEN API SDK folder.



b. LOG-In

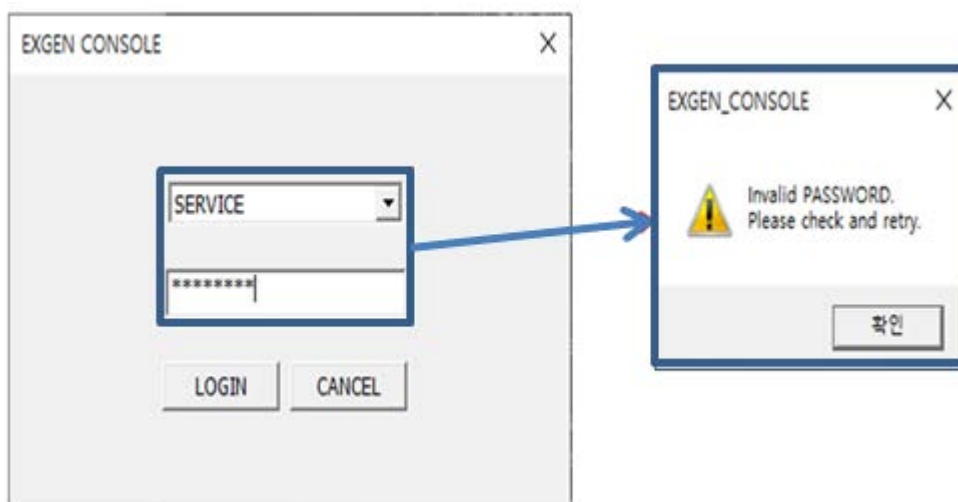
Log-In levels are divided into three types like below.

Log-in leve	Password
User	NO Password
Service	MTU1245
Factory	MTU123

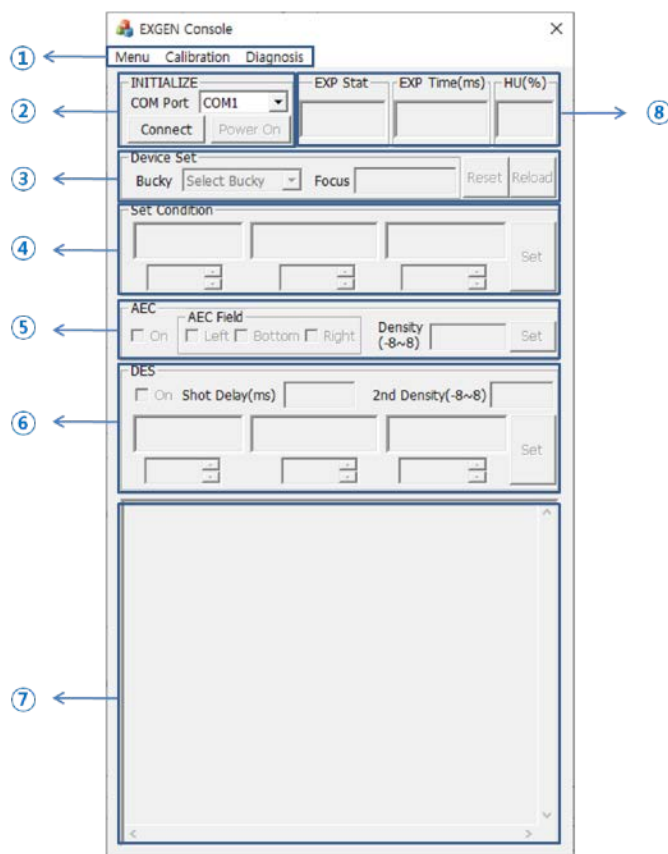


If you
don't
enter
the
correct

password, A warning window appear instead of going to the main console window like below



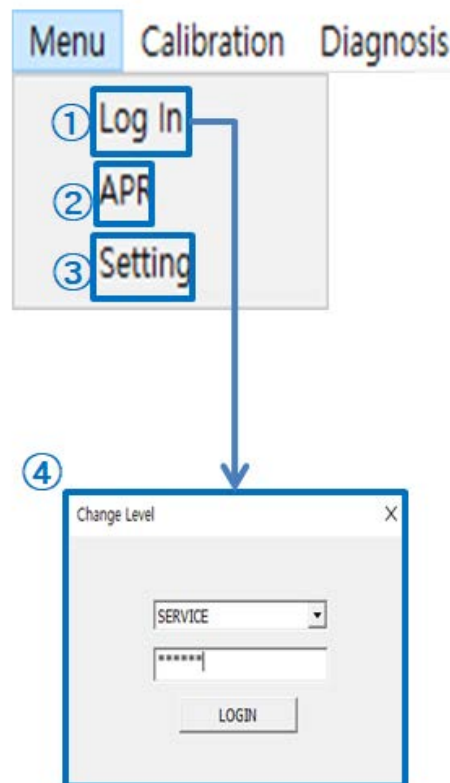
c. Main Console of EXGEN Console



NO	Function	Description of Functions
1	Manu Bar	Consists of Manu, Calibration, Diagnosis
2	Initialize function	a. Turn of the System b. Select the Part. c. click the "Connect" d. click the "Power On"
3	Device set	Consists of Bucky type, Focus type, Reset button and Reload button Bucky: No bucky, Table bucky, Wall bucky Focal: Large, Small. Reset: When click, the error is reset Reload: When click, Reload the All condition.
4	X-Ray conditon	Control the X-Ray Condition(kV. mA, Sec)
5	AEC	Control the AEC Function

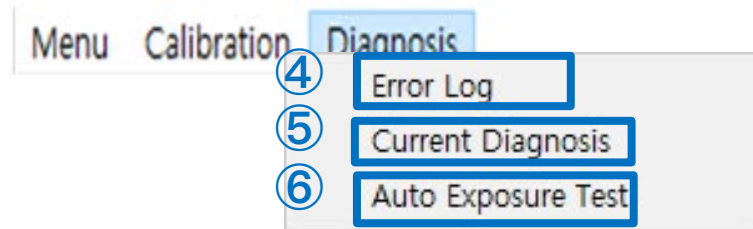
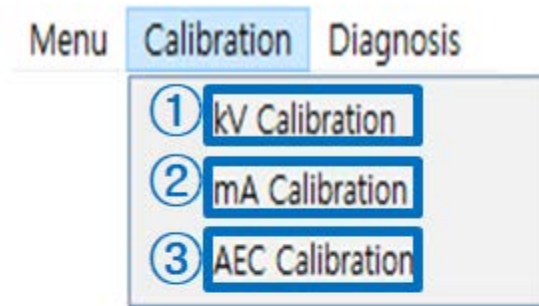
6	DES	Control the DES Functon
7	Log Window	Display the log.
8	Status Window	Display the generator status.

d. Menu



NO	Function	Description of Functions
1	Log-In	Change the Log-In level
2	APR	Open the APR Setting Window
3	Setting	Open the Setting Windwo
4	Change Level	Change the Log-In level. Refer to 'c. Log-In'

e. CALIBRATION & DIAGNOSIS



NO	Function	Description of Functions
1	kV Calibration	Display the window of kV calibration.
2	mA Calibration	Display the window of mA calibration.
3	AEC Calibration	Display the window of AEC Calibration
4	Error Log	Display the window of Error Log.
5	Current Diagnosis	Display the window of Current Diagnosis.
6	Auto Exposure Test	Display the window of Auto Exposure Test

f. The Window of Setting

The window of setting consists of Tube/lock, Bucky, Limit, and Generator

- The window of Tube/Lock

The screenshot shows a software window titled "Setting" with a close button (X) in the top right. It features five tabs: "Tube/Lock", "Bucky", "Limit(Service)", "Generator", and "Limit(Factory)". The "Tube/Lock" tab is active. Inside this tab, there is a "Tube Setting" group box containing a "Tube Model" dropdown menu (labeled 1), an "Overload Parameter" text input field with a "Set" button (labeled 2), and a "Rotor Setting" group box containing "Rotor Speed" (labeled 3) and "Boost Time(ms)" (labeled 4) dropdown menus. To the right of the "Tube Setting" group is a "Lock Enable" section (labeled 5) with three checkboxes: "Door Lock", "Ex. Interlock", and "S/W Lock". A "Reload" button is located in the top right corner of the window.

NO	Function	Description of Functions
1	Tube mode	Select the X-Ray model.
2	Overload parameter	Set the overload parameter of X-Ray tube - Default: 90% - Range: 0 ~ 100%
3	Rotor Speed	Set the rotor speed type of X-Ray tube. - Low speed starter - Dual speed starter
4	Boost Time(ms)	Set the rotor speed of X-Ray - For rotor speed, refer to the X-Ray tube datasheet
5	Lock Enble	Set the Lock type. - Please check if you want to enable each lock.

- The Window of Bucky

NO	Function	Description of Functions
1	DR Enable	Please check if you want to activate the DR detector sync. Function(Optional)
2	No Bucky Enable	Please check if you want to activate the the NO Bucky.
3	AEC Chanber ON	Please check if you want to activate the AEC chamber of each bucky.
4	Bucky Enable	Please check if you want to activate the bucky function.
5	DR On	Please check if you want to activate the DR function.
6	Grid Type	Select the Grid type - Spring, Motor, etc.
7	Delay(ms)	Select the dealy time of moving grid.

- The Window of Limit(Service)

Please note that click the each “Set” button to complete the setting

NO	Function	Description of Functions
1	KW Limit	Set the Max kW of each focus. -Refet to X-Ray Tube Data sheet and specification of generator.
2	KV Limit	Set the Min. and Max. kV of each focus. -Refet to X-Ray Tube Data sheet and specification of generator.
3	mA Limit (Small Focus)	Set the Min. and Max. mA of small focus. -Refet to X-Ray Tube Data sheet and specification of generator. - Default: Small Min: 10mA, Small Max. 100mA
4	mA Limit (Large Focus)	Set the Min. and Max. mA of large focus. -Refet to X-Ray Tube Data sheet and specification of generator. - Default: Small Min: 110mA, Small Max. 40KW: 500mA, 50kW: 630mA
5	AEC Max. Time	Set the AEC Max. time to use AEC chamber - Recommended Time: 500ms

- The Window of Generator

NO	Function	Description of Functions
1	Serial Number	Check the serial number of generator
2	EXP Count (Total, Today)	Check the Exp. conut(total, today) of generator
3	Generator Setting	Check the Input power and release data of generator
4	Enable Setting	- Please click to use the buzzer - Please click to use the AEC - Please click to use the PSU - Please click to use the Power off delay

g. KV Calibration

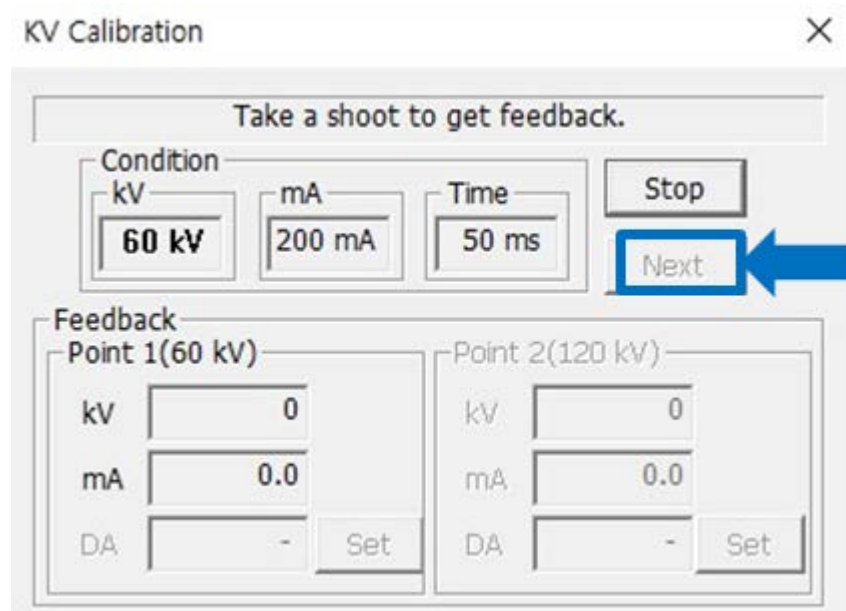
- Click the “Calibration” and “ KV Calibration”
- Click the “Start”

The 'KV Calibration' dialog box has a title bar with a close button (X). Inside, a message box says 'Press 'Start' to start kV Calibration.' Below this is a 'Condition' section with three input fields: 'kV' (set to '-'), 'mA' (set to '200 mA'), and 'Time' (set to '50 ms'). To the right of these fields are two buttons: 'Start' (highlighted with a blue arrow) and 'Next'. Below the 'Condition' section is a 'Feedback' section. It contains two columns for 'Point 1(60 kV)' and 'Point 2(120 kV)'. Each column has three input fields: 'kV' (set to '0'), 'mA' (set to '0.0'), and 'DA' (set to '-'). To the right of the 'DA' field in each column is a 'Set' button. At the bottom of each column, it says '1 bit = about 0.05 kV'.

- When click the start button, the system operates the seasoning of X-Ray tube for 3 minutes.
- Exposure the 60kV/200mA using X-Ray irradiation switch.
- Check the X-Ray Values(kV) using X-Ray meter.
Acceptance Criteria: 58.4 ~ 61.6kV
- Change the DA Value and Click the “Set” like below
If the kV value of X-Ray meter is high, Set the DA value to a low value.
If the kV value of X-Ray meter is low, Set the DA Value to a high value.

The 'KV Calibration' dialog box is shown again, but now the 'Condition' section has 'kV' set to '60 kV'. The 'Feedback' section is the same as before. The 'Set' button for the 'DA' field in the 'Point 1(60 kV)' column is highlighted with a blue arrow.

- Click the “Next”



KV Calibration [X]

Take a shoot to get feedback.

Condition

kV	mA	Time	Stop
60 kV	200 mA	50 ms	Next

Feedback

Point 1(60 kV)		Point 2(120 kV)	
kV	0	kV	0
mA	0.0	mA	0.0
DA	- Set	DA	- Set

-Exposure the

120kV/200mA using X-Ray irradiation switch.

- Check the X-Ray Values(kV) using X-Ray meter.

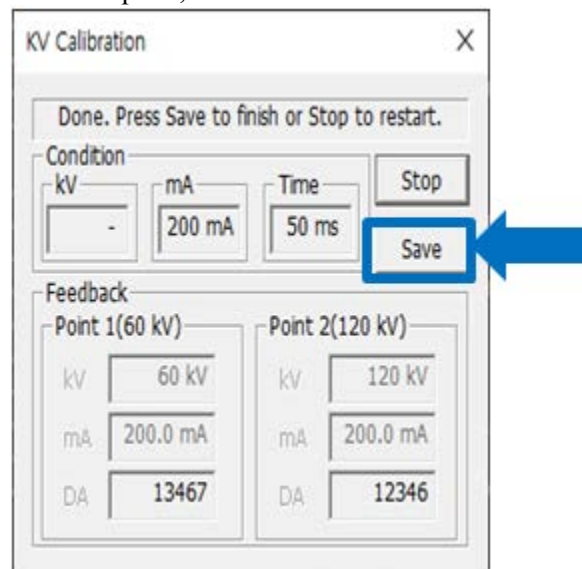
Acceptance Criteria: 117.8 ~ 122.2kV

- Change the DA Value and Click the “Set” like below

If the kV value of X-Ray meter is high, Set the DA value to a low value.

If the kV value of X-Ray meter is low, Set the DA Value to a high value.

- When kV calibration is complete, Click the “Save” button.



KV Calibration [X]

Done. Press Save to finish or Stop to restart.

Condition

kV	mA	Time	Stop
-	200 mA	50 ms	Save

Feedback

Point 1(60 kV)		Point 2(120 kV)	
kV	60 kV	kV	120 kV
mA	200.0 mA	mA	200.0 mA
DA	13467	DA	12346

- Manual

1. Set the X-Ray condition(KV,mA,Sec)
- 2,3 Check the X-Ray Values(mA).

Acceptance Criteria: $\pm 1\% \pm 1\text{mA}$

If “Fail” appears in the Pass/Fail window, Change the DA Value and Click the “Set” like below

If the mA value of Feedback(FB) is high, Set the DA value to a low value.

If the mA value of Feedback(FB) is low, Set the DA Value to a high value.

4. Completing the calibration of setting condition, Click the “Save” button.

[illegible]

- Auto

1. Click to load the calibration table.
2. Set the X-Ray condition(KV,mA,Sec) by changing the number of Auto.
(Recommend staring form number 1.)
3. Click the “Start”
4. When Auto of mA calibration is completed, click the “Save” button.
5. Check the calibration information in “Indexs window(4)”

The screenshot shows the 'mA Calibration' software interface. At the top, a message box says 'Press 'Load Table' first. and Wait for all data loaded.' Below this, there are several controls:

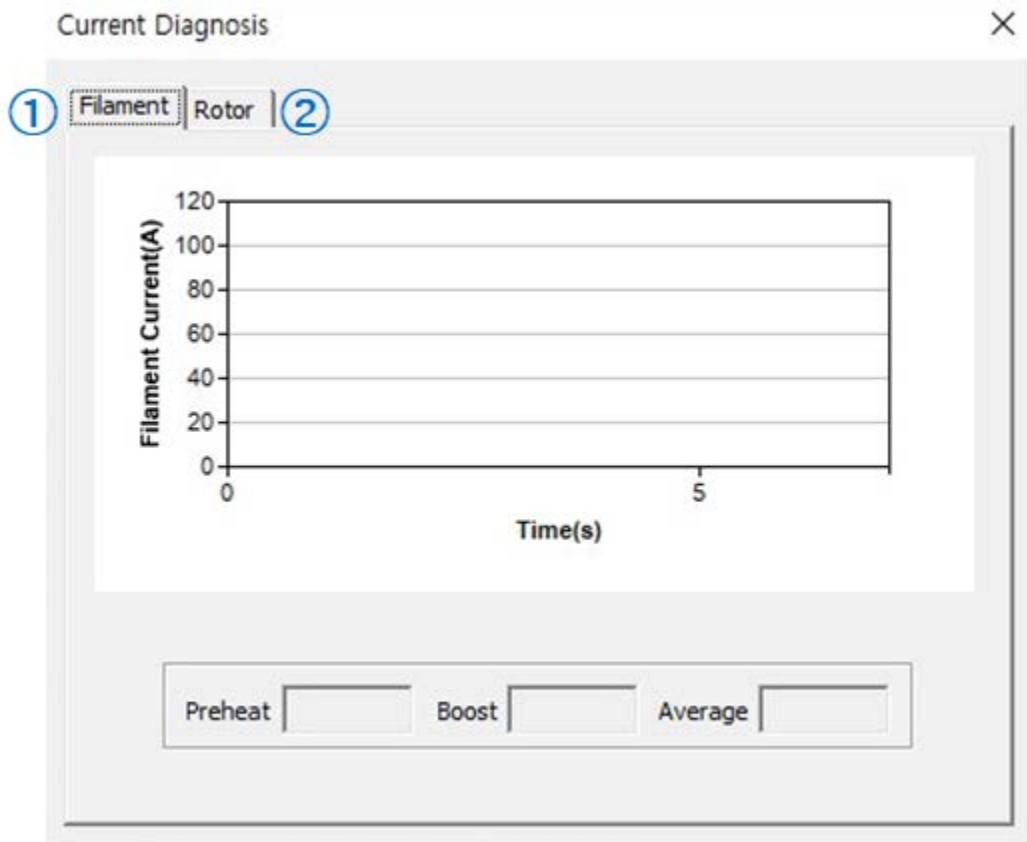
- A dropdown menu set to 'Auto'.
- A button labeled 'Load Table' with a blue circle and the number '1' next to it.
- A page indicator showing '1 / 179' and a 'Set' button, with a blue circle and the number '2' next to it.
- Under the 'Condition' section, there are input fields for 'kV' (0), 'mA' (0.0), and 'ms' (40), each with a 'Set' button.
- Under the 'Feedback(FB)' section, there are input fields for 'kV' (0), 'mA' (0.0), and 'DA' (0), each with a 'Set' button.
- To the right of the feedback section are 'Start' and 'Save' buttons, with blue circles and numbers '3' and '4' next to them respectively.
- Below the feedback section is a 'Pass / Fail' dropdown menu and a checked 'Graph' checkbox.
- At the bottom is a data table with columns: Point, kV, mA, ms, DA, Pass, FB_kV, FB_mA. A blue circle with the number '5' is placed in the first empty row of the table.

i. Diagnosis

- Click the “Diagnosis” and “Error Log”
- Click the “ Load Data” button.
- Check the information of “System Info(1)”, “Error Log(2)” and “Command(3)”

[illegible]

- Click the “Diagnosis” and “Current Diagnosis”
- Click the “ Filament(1)” or “ Rotor(2)”
- Check the current of “Filament” or “ Rotor”



Chapter 9

System Startup and Shutdown

Diagnostic X-Ray System

[NEXGEN 940]

9 System Start / Shutdown

9.1 System Preparation

Before starting the system (e.g.: after transport), the accessories must be connected and the system must be powered on.

System operation should be performed under the following conditions.

- √ Check the capacity, grounding and fuse of the overload breaker.
- √ Connect the power cable of the X-Ray generator to the overload breaker installed in the X-Ray room.
- √ Check the supply voltage.
- √ Check if there are any obstacles in the operating position of the system.
- √ Wear appropriate protective clothing.

9.2 Power On/Off

9.2.1 MINI CONSOLE

9.2.1.1 Power On

- (1) Turn on the Generator using mini console



9.2.1.2 Power Off

(1) After pressing the OK icon on console, turn off the system after 10 sec with 5 beep sound at the mini console.

If click the Off-button of mini console, turn off the system after 10sec. with 5 beep sounds.

And console still works.



Chapter 10

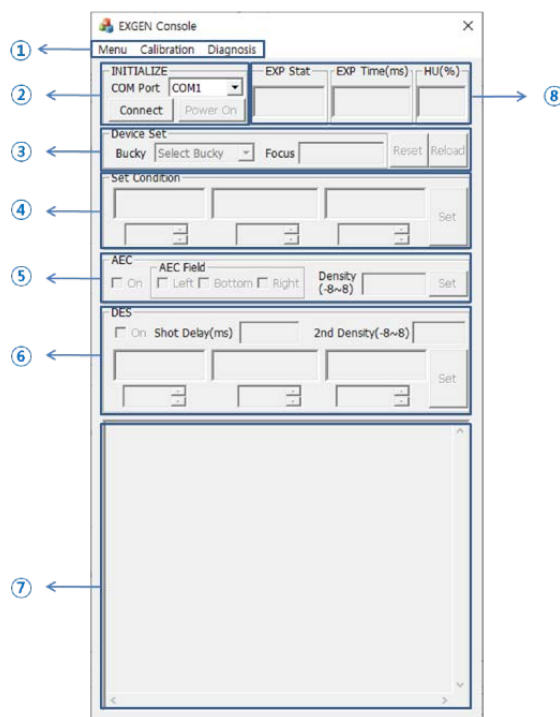
How to use

Diagnostic X-Ray System

[NEXGEN 940]

10 How to use

10.1 Main Functions of EXGEN Console



NO	Function	Description of Functions
1	Manu Bar	Consists of Manu, Calibration, Diagnosis
2	Initialize function	a. Turn of the System b. Select the Part. c. click the "Connect" d. click the "Power On"
3	Device set	Consists of Bucky type, Focus type, Reset button and Reload button Bucky: No bucky, Table bucky, Wall bucky Focal: Large, Small. Reset: When click, the error is reset Reload: When click, Reload the All condition.
4	X-Ray condition	Control the X-Ray Condition(kV. mA, Sec)
5	AEC	Control the AEC Function
6	DES	Control the DES Function
7	Log Window	Display the log.
8	Status Window	Display the generator status.

Chapter 11

Product Maintenance

Diagnostic X-Ray System

[NEXGEN 940]

11 Product Maintenance

11.1 Overview

A thorough product maintenance is required for safe and reliable operation of 940.

This chapter summarizes the main contents necessary for product users to determine product maintenance lists and management cycles when preparing a product maintenance plan.

11.2 Purpose of Product Maintenance

940 is a device that requires product maintenance, and if product maintenance is neglected, the product performance may deteriorate and the product may be in an unstable operating state.

In addition, deterioration of product performance or unsafe product condition may cause injury or death, so thorough product maintenance is required.

The purpose of product maintenance is to secure stable patient diagnosis and patient safety through efficient product management.

11.3 Maintenance Procedure

- The product user prepares a product maintenance plan according to the maintenance lists and maintenance cycle, and conducts inspection according to the product maintenance cycle.
- The user sets the service items to be requested to the manufacturer, and negotiates service schedules, if necessary.
- After inspection, the user records and keeps the inspection details in the product maintenance plan.

11.4 Product Maintenance Lists and Inspection Cycle

The product user must prepare a specific product maintenance plan for each product maintenance list and then execute product maintenance.

The maintenance standards and inspection cycles of the products presented below are the minimum standards, and the product user must prepare and execute the product maintenance plan by adding more necessary details.

Classification	Maintenance Lists	Inspector	Inspection cycle (more than once)		
			Daily	Monthly	Annually
Product Exterior Check	There should be no damage or broken parts on the outer surface of the product.	user	○		
	The display device must work normally on the X-Ray console, etc.	user	○		
	Cables exposed to the outside should not be pressed, twisted, or disconnected.	user	○		
	Various switches should work normally.	user	○		
Operation State Check	There should be no noise or irregular changes in X-Ray dose during generator operation or X-Ray irradiation.	user	○		
	The generator's performance and operating conditions should be normal, and the radiation dose should be within the tolerance.	Service engineer		○	
	The performance and operating conditions of the mechanical device should be normal, and parts should not be damaged.	Service engineer		○	
Radiation Safety Check	It should be used after regular inspection in accordance with radiation safety management regulations.	Request to the relevant institution.	Comply with radiation safety management regulations.		
	The product must be used by a person who has obtained the product license and the relevant qualifications.	user	○		
Mechanical Safety Check	The product should be used, if the wires of the working part of the bucky stand and tube stand are damaged.	Service engineer		○	
Operation Environment	The product should not be installed or used in a place that does not comply with the radiation safety management regulations.	Request to the relevant institution.	Use after regular inspection in accordance with radiation safety management regulations.		
	Check whether the product user uses the product without any harmful factors from radiation exposure.	user	○		

11.5 Preparation of Product Maintenance Plan

11.5.1 The product user prepares and executes an annual product maintenance plan.

11.5.2 Product maintenance lists in the product maintenance plan must include the contents suggested in **[12.4 Product maintenance lists and inspection cycle]** , and product maintenance lists can be added, if necessary.

11.5.3 Product maintenance management ledger should be prepared and managed, and inspection records should be kept.

11.6 Inspection Method

11.6.1 Product appearance inspection

As a result of checking the following management lists, if there are traces of product colliding with other objects, switch failure or malfunction, or traces of pressing cables, ask a professional engineer for inspection.

Maintenance Lists	How to check
Check if there are any damaged or broken parts on the outer surface of the product.	Visually check for signs of product collision with other objects or scratches during operation.
Display devices such as X-Ray console and handlebar display should operate normally.	Visually check if the X-Ray irradiation conditions set in the console are displayed in the same way on the handlebar.
Cables exposed to the outside should not be pressed, twisted, or disconnected.	Visually check if the exposed cable has any signs of collision with other objects or scratches during operation.
Various switches should work normally.	Check if no operation or malfunction occurs by pressing the function switch on the console.

11.6.2 Operation State Check

As a result of checking the following management lists, if abnormal noise occurs or irregular X-Ray dose changes during the generator operation or X-Ray irradiation, ask a service engineer for inspection and take action.

In case of damage or failure of parts, it must be replaced with a part that meets the standards.

Maintenance Lists	How to check
There should be no noise or irregular changes in X-Ray dose during generator operation or X-Ray irradiation.	Irregular changes in X-Ray dose should be checked every day, and if necessary, you must contact a service engineer and take actions.
The generator's performance and operating conditions should be normal, and the radiation dose should be within the tolerance.	If an irregular change in X-Ray dose occurs or if the X-Ray dose is out of the tolerance range, you must contact a service engineer and take actions.
The performance and operating conditions of the mechanical device should be normal, and parts should not be damaged.	In the event of damage to parts, you must contact a service engineer and take actions.

11.6.3 Radiation Safety Check

- (1) The product user must obtain a product use license from the relevant institution before using it, and only person with the relevant qualification should use the product.
- (2) Radiation safety inspection should be conducted by the relevant institution, and the device should be used after regular inspections in accordance with the radiation safety management regulations.

11.6.4 Mechanical Safety Check

The product should not be used, if the parts such as the bucky stand, wires of the operating part of the tube stand, the spring balance wire of the ceiling device, and the column wire are damaged. If the damaged parts are used, the product performance may deteriorate and it may injure the human body due to system instability and unsafe product conditions. Therefore, mechanical safety check should be thoroughly carried out.

Maintenance Lists	How to check
The product should not be used if the bucky stand, wires of tube stand's operating parts, ceiling device's spring balance wires, and column wires are damaged.	Depending on the inspection cycle, maintenance must be carried out at least once a year, and measures must be taken after inquiring service engineers.
If two or more of the wires are damaged, the wires of the stand bucket, the wires of the working part of the tube stand, the wires of the spring balance of the ceiling device, or the wires of the column must be used only after replacing the wires.	

11.6.5 Operating Environment Check

The system should be installed and used in a place that meets the requirements of the radiation safety management regulations. Therefore, the product user must obtain a product use license from the relevant institution and periodically check whether the radiation of the X-Ray chamber is leaking or not.

Maintenance Lists	How to check
The product should not be installed or used in a place that does not comply with the radiation safety management regulations.	Check if the product is being used in a place that does not comply with radiation safety management regulations.
Check whether the product user uses the product without any harmful factors from radiation exposure.	Check if it is installed in a place suitable for radiation safety management regulations and that the condition is maintained.

11.6.6 Cable Check

- Check with product user or service engineer.
- Check if various cables are connected and fixed properly.
- Check the external condition of the cable.

11.6.7 Console and Handlebar Check

- Check with product user or service engineer.
- Check the wiring and operation status of the console hand switch.
- Set X-Ray irradiation conditions on the console and check the X-Ray operation status by irradiating.
- After setting the X-Ray irradiation condition to the overload condition on the console, check the overload, error message, or warning display.
- Check the status of the console switch operation.
- Check if the signals of PC, DAP, AEC, DR SW, etc. connected to the console are normal.

11.6.8 HVT (High voltage transformer) Check

- Check with product user or service engineer.
- Check for signs of moisture around the HVT.
- Check the wiring status and ground wire fixed status of HVT.
- Check the HVT for signs of oil leakage.
- If traces of oil leakage are found in HVT, check if the tank cracks, and check the oil level. (normal: The oil level is within 15mm from the upper surface of the HVT, and check at least once a year)
- If any signs of oil leakage are found in HVT, clean it with a dry cloth.
- Check the tightness of the HVT high voltage cable bushing and receptacle.
- After removing the high-voltage cable from the HVT, check the state of the high-voltage cable bushing. If the bushing has arc marks or the parts are bad, wipe the bushing with a dry cloth and apply silicon oil to the receptacle, and request a service engineer to check it.

11.6.9 Generator Check

- Inspection should be carried out by service engineer.
- Check for signs of moisture around the generator.
- Check the voltage supplied to the generator.
- Check the voltage supplied to the main boards.
- Check the condition of the internal parts of the generator, and check if there is any noise, heat, or smell.
- Check the fixed state of the parts assembled to the generator.
- Check the wiring status and ground wire fixed status of the generator.
- Check the tightness of the cable wired to the generator.
- Completely remove dust inside the generator with a dry cloth, brush, or air compressor.

11.6.10 X-Ray Tube Check

- Inspection should be carried out by service engineer.
- Check for signs of moisture around the X-Ray Tube.
- Check the wiring status and ground wire fixed status of the X-Ray Tube.
- Check the X-Ray Tube for any signs of oil leakage.
- If traces of oil leakage are found on the X-Ray tube, check the tube housing for cracks.
- If traces of oil leakage are found on the X-Ray Tube, clean it with a dry cloth.
- Check the tightness of the bushing and receptacle of the high voltage cable.
- After removing the high-voltage cable, check the state of the high-voltage cable bushing. If the bushing is in poor condition, wipe the bushing with a dry cloth and apply silicone oil to the receptacle.
- Check the operation and noise condition of the tube anode rotor.

11.6.11 Mechanical Device Check

- Inspection should be carried out by service engineer.
- Check for signs of moisture around the equipment.
- Check the wiring condition of mechanical device and the ground wire fixed condition.
- Remove the upper cover of the ceiling, and check the abrasion and damage of the wire connected to the spring balance of the ceiling device. If more than two strands of wires are damaged, they should be replaced.

- Remove the upper cover of the ceiling, and check the abrasion and damage of the wire connected to the column of the ceiling device. If the wires are damaged by more than 2 strands, they should be replaced.
- Remove the upper cover of the ceiling, and check the safety device of the ceiling device.
- Remove the front cover of the bucky stand, and check the abrasion and damage of the wire connected to the bucky device. If the wire is damaged by more than 2 strands, it should be replaced.
- Remove the front cover of the tube stand, and check the abrasion and damage of the wire connected to the tube device. If the wire is damaged by more than 2 strands, it should be replaced.

11.6.12 Precautions for maintenance

- After the generator power is turned off, the charging voltage in the circuit occurs, and when repairing the generator, the engineer must discharge the charging state in the circuit.
- Discharge method is to make the discharge resistance contact both ends of Electric Discharge point, and make the voltage between both ends of Electric Discharge point less than DC10V.
- After checking the voltage between both ends of the electric discharge point, proceed to maintenance.

11.7 List of Main Parts

The main parts required for service are as follows, and for other parts other than the main items, contact our customer management team.

Application	Part Name	Part Model	Quantity (each)	Factory release days after order
Generator	Generator	940	1set	within 2 weeks
	HVT (high pressure tank)	DXG-HT	1	within 2 weeks
	Main IO Control Board	MiO Board	1	within 2 weeks
	Filament Drive Board	FND Board	1	within 2 weeks
	Charge & Discharge Board	CND Board	1	within 2 weeks
	Filament Board	FILA Board	1	within 2 weeks
	FET Block	FET Block	1	within 2 weeks
	Tube Rotor Control Board	LS Board	1	within 2 weeks
	AEC Control Board	AECBoard	1	within 2 weeks
	General Connecting Board	GC Board	1	within 2 weeks
X-Ray Tube	X-Ray Tube	E7239X / E7242X / E7884X / E7252X	1	within 4 weeks

Chapter 12

Error Code

Diagnostic X-Ray System

[NEXGEN 940]

12 Error Code

When a problem occurs in the X-Ray generator, Nexgen Diagnostic software checks the circuit in real time and displays the error status on the console interface. The error code provides the engineer with necessary information for fault repair, and the error status for each fault is as follows.

[Generator Error]

Order	ERROR	Error status	Troubleshooting methods
3001	ERR_CHARGE_LINE_HIGH	When the input power for charging the main capacitor is over 360V.	1. Check the power input voltage. DXG-40P : 187 ~ 253 VAC(ref. 230VAC) 2. Change the CND Board.
3002	ERR_CHARGE_LINE_LOW	When the input power for charging the main capacitor is less than 264V	1. Check the power input voltage. DXG-40P : 187 ~ 253 VAC(ref. 230VAC) 2. Change the CND Board.
3003	ERR_CHARGE_CAP_HIGH	When the charged voltage of the main capacitor is over 360V.	1. Check the power input voltage. DXG-40P : 187 ~ 253 VAC(ref. 230VAC) 2. Change the CND Board.
3004	ERR_CHARGE_CAP_LOW	When the charged voltage of the main capacitor is less than 264V	1. Check the power input voltage. DXG-40P : 187 ~ 253 VAC(ref. 230VAC) 2. Change the CND Board.
3005	ERR_ROTOR1_LOW	The current of low speed starter is low.	1. Change the LS Board.
3006	ERR_ROTOR_HIGH	The current of high speed starter is high	1. Change the LS Board.
3007	ERR_ROTOR_TEMP	The IGBT temp. error of high speed board	1. Change the LS Board.
3008	ERR_ROTOR_CON	The connector of high speed board is not connected	1. Change the Cable. (MIO Board to High Speed Board)
3009	ERR_ROTOR_COM	The High speed board does not communicate.	1. Change the High Speed Board.
3010	ERR_ROTOR_STR_TEMP	The temperature of X-Ray tube stator is high	1. Use after at least 30 minutes of rest.
3011	ERR_FILAMENT_CUR_HIGH	When the current flowing through the tube filament is high.	1. Change the Filament Board.
3012	ERR_FILAMENT_CUR_LOW	When the current flowing through the tube filament is low.	1. Change the Filament Board.

3013	ERR_FILAMENT_ OFF_HIGH	When current continues to flow through the tube filament under the power off state.	1. Change the MIO Board.
3014	ERR_PWR_HIGH	When the actual input voltage is higher than the value of the input voltage set in the console (setting range: within 20%~50%).	1. Change the 24V SMPS.
3015	ERR_PWR_LOW	When the actual input voltage is lower than the value of the input voltage set in the console (Setting range: within 20%~50%).	1. Change the 24V SMPS.
3017	ERR_PROT_POWER	As a protection circuit, when the DC12V power of the FND board is more than 14V or less than 2.2V during X-ray irradiation.	1. Change the FND Board.
3018	ERR_PROT_ FET1_OCP	As a protection circuit, when high current flows through FET block 1 during X-ray irradiation.	1. Change the X-ray Tube.
3019	ERR_PROT_ FET2_OCP	As a protection circuit, when high current flows through FET block 2 during X-ray irradiation.	1. Change the X-ray Tube.
3020	ERR_PROT_ HV_OVP	As a protection circuit, when the output voltage of high voltage is over 150.5KV during X-Ray irradiation.	1. Change the HV Tank.
3021	ERR_PROT_ HV_OCP	As a protection circuit, when the output current of high voltage is rating current or more during X-Ray irradiation.	1. Change the HV Tank.
3022	ERR_PROT_ FIL_OCP	As a protection circuit, when the tube filament current is high during X-Ray irradiation.	1. Change the MIO Board.
3023	ERR_Door_Open	When the door to the X-Ray room is not completely closed.	1. Chagne the Door Switch. 2. Change the GC Board.
3024	ERR_FET1_ TEMP_HIGH	When the temperature of FET block 1 is over 50°C or below -20°C.	1. Change the FET temperature sensor.
3025	ERR_FET2_ TEMP_HIGH	When the temperature of FET block2 is more than 50°C or below -20°C.	1. Change the FET temperature sensor.
3026	ERR_FET1_ TEMP_LOW	When the temperature of FET block 1 is below -20°C.	1. Change the FET temperature sensor.

3027	ERR_FET1_TEMP_LOW	When the temperature of FET block2 is below -20°C.	1. Change the FET temperature sensor.
3028	ERR_DR_RDY_RTN	When Ready signal is not returned from DR detector within 5 seconds after input of X-Ray exposure signal, while DR is used in manual trigger method.	1. Change Detector Manual Trigger Cable.
3029	ERR_DR_EXP_RTN	When exposure OK signal is not returned from DR detector within 5 seconds after input of X-Ray exposure signal, while DR is used in manual trigger method.	1. Change Detector Manual Trigger Cable.
3030	ERR_HU_OVR	When X-Ray are irradiated with the selected tube, and more than 90% of the accumulated heat-unit value is being irradiated.	1. Use after at least 30 minutes of rest.
3031	ERR_HV_FB_LOW	When the HV feedback value is 50% or less than the set KV during X-Ray irradiation.	1. Retry to Tube Calibration. 2. Chagne the FND Board.
3032	ERR_mA_FB_LOW	When the HV feedback value is 50% less than the set mA during X-Ray irradiation.	1. Retry to Tube Calibration. 2. Chagne the FND Board.
3033	ERR_mA_CAL	The mA calibration is not accurate. Or when IB DAC data is over 4000 among calibration data.	1. Check the setting value(Tube Selection) on the EXGEN console.
3034	ERR_KV_CAL	The KV calibration is not accurate. When HV DAC data is over 4000 among calibration data.	1. Check the setting value(Tube Selection) on the EXGEN console.
3035	ERR_AEC_Tim_OVR	When Signal is input for more than 800ms in the AEC chamber	1. Change the MIO Board.
3036	ERR_AEC_Chamber	When AEC board is not connected, there is no feedback from the chamber..	1. Chagne the MIO Board.

[Generator Warning]

Order	ERROR	Error status	Troubleshooting methods
3901	WAR_OVERLOAD	The X-Ray exposure conditions exceed the allowable values.	1. Check the dose value.

3902	EXP_TIME_WARN		1. Keep the Hand switch button pressed until the exposure is complete. 2. Change the Mini Console. 3. Change the MIO Board.
3903	WAR_HU	When X-Ray are irradiated with the selected tube, and more than 80% of the accumulated heat-unit value is being irradiated.	1. Use after at least 30 minutes of rest

Chapter 13

Troubleshooting

Diagnostic X-Ray System

[NEXGEN 940]

13 Troubleshooting

13.1 Overview

When a problem occurs in the X-Ray generator, the circuit is checked in real time and the error status displayed on the console interface. The fault details should be provided to the engineer with the necessary information for troubleshooting and quick after-service.

13.2 Tools used

The tools required for troubleshooting are as follows, and other necessary tools must be separately prepared by an engineer.

- √ Hand tool and service standard tool (eg. screwdriver, hexagonal range set, etc.)
- √ Nipper, pliers, multi tester, X-Ray dose meter, service PC, oscilloscope

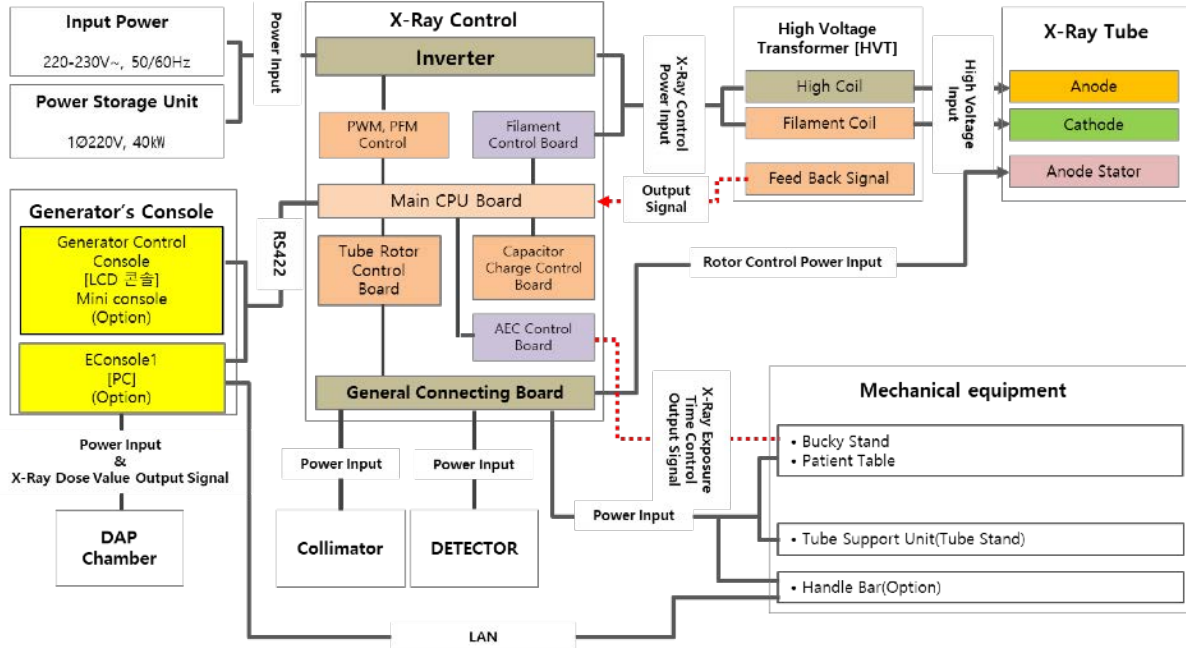
13.3 Repair Method according to Failure

When a problem occurs in the X-Ray generator, the circuit is checked in real time and the error status is displayed on the console. The error status is displayed differently depending on the type of failure.

When an error occurs, the error status can be removed by pressing the reset switch on the console, but the error status may be displayed on the console display window even though the error status is removed by pressing the reset switch.

13.4 Block Diagram

1) NEXGEN 940



13.5 Repair Method according to Failure

When a problem occurs in the X-Ray generator, the circuit is checked in real time and the error status is displayed on the console. The error status is displayed differently depending on the type of failure.

When an error occurs, the error status can be removed by pressing the reset switch on the console, but the error status may be displayed on the console display window even though the error status is removed by pressing the reset switch.

13.5.1 Charge and Discharge Circuit Failure

(1) Error Status Display: Err_Charge_Line_High occurs in the console window.

(1-1) Symptoms: This error occurs when the power input voltage for charging the main capacitor is DC340V or higher, and the error status is displayed on the console window.

(1-2) Troubleshooting Method: Check the input voltage and check the CND Board



- Visually check whether D960 and D501 Diodes are on.
- Check the status of F955 and F958 fuse disconnection.
- Check the voltage between No. 1 and No. 3 of P963 (normal: within 230VAC±5%)
- Check the connection status of P974.
- Check the connection status of P961.
- Check voltage between No. 1 and No. 4 of P961 (normal: within 340VDC±5%)
- Check if there is a short between No. 1 and No. 2 of P966.
- After turning the generator “ON”, check Relay RLY951 and RLY952 operation status (normal: Relay ON)
- Check P967 voltage (normal: within 220VAC±5%)

- Check voltage between No. 1 and No. 3 of P807 (normal: within 220VAC±5%)
- While pressing SW501, check the frequency between TPGND and TP501 (Normal: within 75khz±0.5khz)
- If the frequency between TPGND and TP501 is abnormal, adjust the frequency with VR952.

- (2) Error status display: Err_Charge_Line_LOW occurs in the console window
(2-1) Symptoms: This error occurs when the power input voltage for charging the main capacitor is less than DC290V, and the error status is displayed on the console window.
(2-2) Troubleshooting method: Check the input voltage and check the CND Board.
(2-3) Check the CND Board in the same way as (1) Err_Charge_Line_High in 12.3.1 Charging and Discharging Circuit Failure.
- (3) Error status display: Err_Charge_CAP_High occurs in the console window
(3-1) Symptoms: This error occurs when the charging voltage of the main capacitor is DC340V or higher, and the error status is displayed on the console window.
(3-2) Troubleshooting method: Check the input voltage and check the CND Board.
- (4) Error status display: Err_Charge_CAP_LOW occurs in the console window
(4-1) Symptoms: This error occurs when the charging voltage of the main capacitor is DC290V or lower, and the error status is displayed on the console window.
(4-2) Troubleshooting method: Check the input voltage and check the CND Board.
(4-3) Check the CND Board in the same way as (3) Err_Charge_CAP_High in 12.3.3 Charge and Discharge Circuit Failure.

13.5.2 Filament Circuit Failure

(1) Error Status Display: Err_Filament_Cur_High occurs in the console window.

(1-1) Symptoms: When Ready, preheating voltage is converted to driving voltage. It is an error that occurs when the current flowing through the tube filament is high due to high driving voltage. Error status is displayed on the console window.

(1-2) Troubleshooting Method: Check the tube filament wiring and the filament board.



- Turn the generator on, and check with power on.
- Check the connection status of P101.
- Check the lighting status of D901 (normal: light on)
- Check the status of F906 and F905 fuse disconnection.
- Check voltage between No. 2 and No. 4 of P604 (Normal: within 35 ± 1 VDC)
- Check voltage between No. 2 and No. 3 of P604 (Normal: within 35 ± 1 VDC)
- Check voltage between No. 1 and No. 3 of P965 (Normal: within 35 ± 1 VDC)
- Check voltage between No. 2 and No. 3 of P965 (Normal: within 35 ± 1 VDC)
- Check voltage between No. 4 and No. 3 of P965 (Normal: within -35 ± 1 VDC)
- Check voltage between No. 5 and No. 3 of P965 (Normal: within -35 ± 1 VDC)

(2) Error status display: Err_Filament_Cur_LOW occurs in the console window.

(2-1) Symptoms: Under Ready, preheating voltage is converted to driving voltage. It is an error that occurs when the current flowing through the tube filament is low due to low driving voltage. Error status is displayed on the console window.

(2-2) Troubleshooting method: Check the tube filament wiring and the filament board.

(2-3) Filament board check is done in the same way as (1) Err_Filament_Cur_High in 12.3.3 Filament circuit failure.

(3) Error status display: Err_Filament_Off_High occurs in the console window.

(3-1) Symptoms: It is an error that occurs due to disconnection of tube filament, circuit failure, and non-detection of feedback data, and the error status is displayed on the console window.

(3-2) Troubleshooting method: Check the tube filament wiring and the filament board.

(3-3) Check the filament board inspection in the same way as (1) Err_Filament_Cur_High in 12.3.3 Filament circuit failure.

(2) Error status display: Err_PWR_LOW occurs in the console window.

(2-1) Symptoms: This error occurs when the voltage input to the MiO Board is lower than the standard, and the error status is displayed on the console window.

(2-2) Troubleshooting method: Check the MiO Board.

(2-3) Filament board inspection should be done in the same way as (1) Err_Filament_Cur_High of 12.3.4 MiO Board Power Circuit Failure.

13.5.4 Tube Temperature Circuit Failure

(1) Error Status Display: Err_Stator_Temp 1 occurs in the console window.

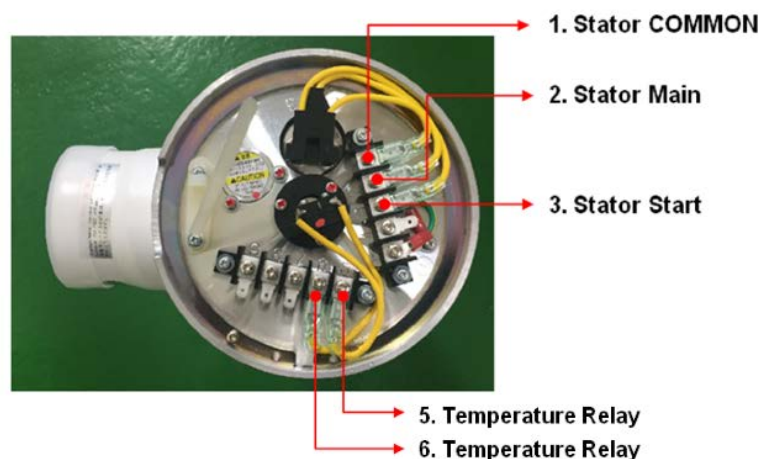
(1-1) Symptoms: This is an error that occurs due to tube temperature sensor failure or GC board failure by incorrect wiring, and the error status is displayed on the console window.

(1-2) Troubleshooting Method: Check the GC board and tube temperature wiring status.

Check the wiring status of P967 of GC board.



- Check the tube temperature wiring status of the tube anode.

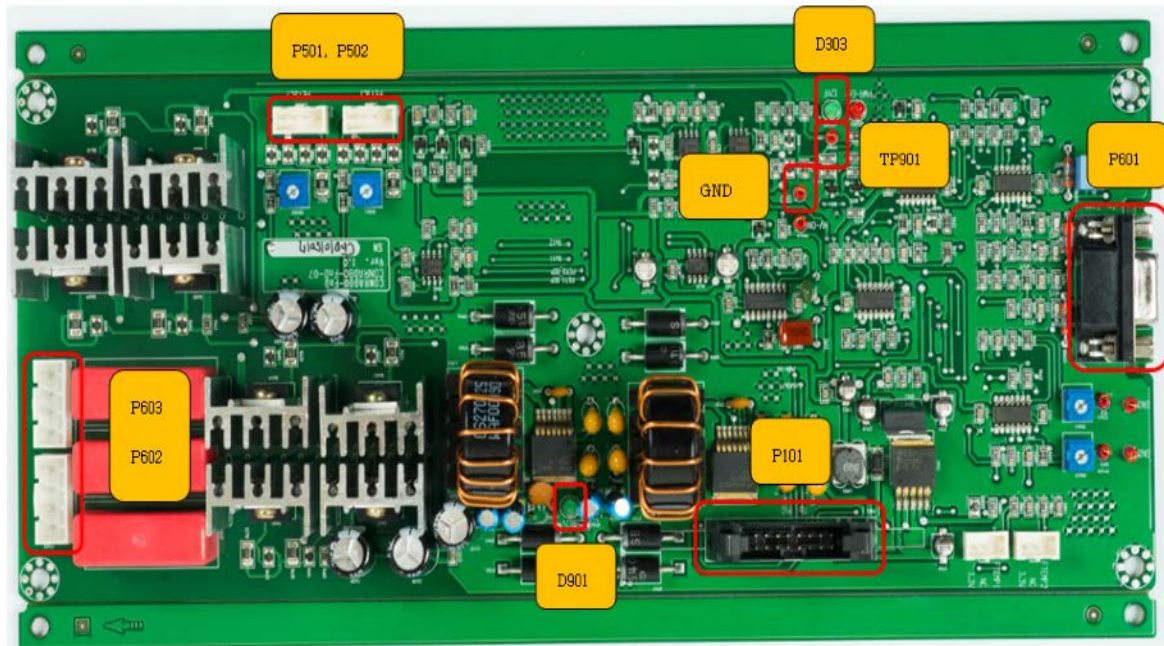


13.5.5 FND Board Power Circuit Failure

(1) Error Status Display: Err_PROT_Power occurs in the console window.

(1-1) Symptoms: It is an error that occurs when the 12VDC and 2.2VDC voltage of the FND board is inappropriate, and the error status is displayed on the console window.

(1-2) Troubleshooting Method: Check the FND Board.



- Check the connection status of P101 Connector.
- Check the connection status of P603 and P602 connectors.
- Check the connection status of P501 and P502 connectors.
- Check D303, D901 Green LED lighting status (normal: light on)
- Check voltage between GND and TP901 (Normal: within 11.5VDC±1VDC)

13.6 Method of Generator & System Firmware Update

13.6.1 Update the Firmware for Generator MIO board

13.6.1.1 Tools

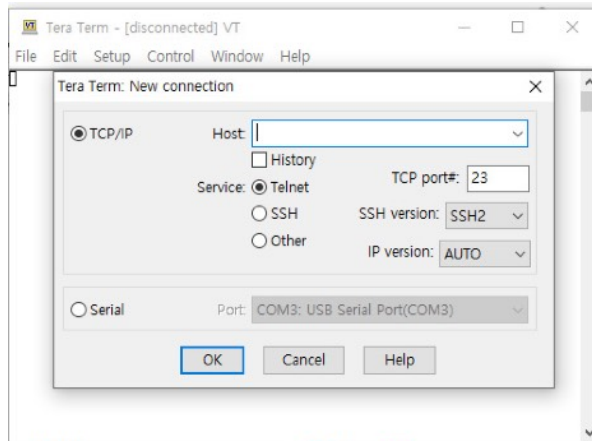
- ⌚ Teraterm

13.6.1.2 Required Effort

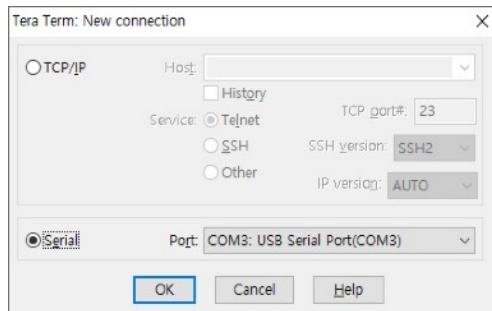
- ⌚ Personnel: 1 Field Engineer
- ⌚ Time: 5 minutes

13.6.1.3 Procedure

1. Run the Teraterm on the main PC.

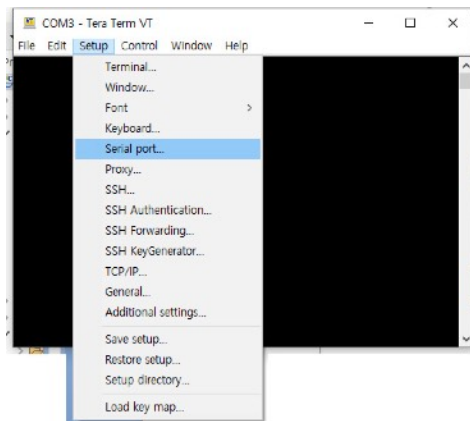


2. Select to "serial".

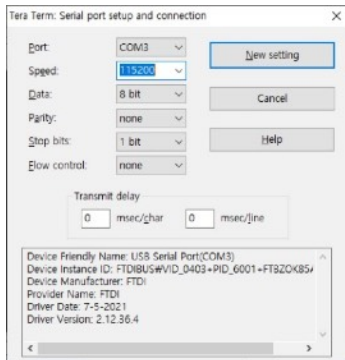


3. Select "Serial Port" from the Setup menu.

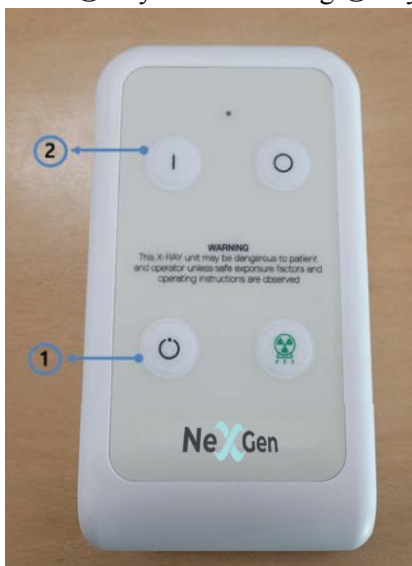
Nexgen 940pa (Rev. 01)



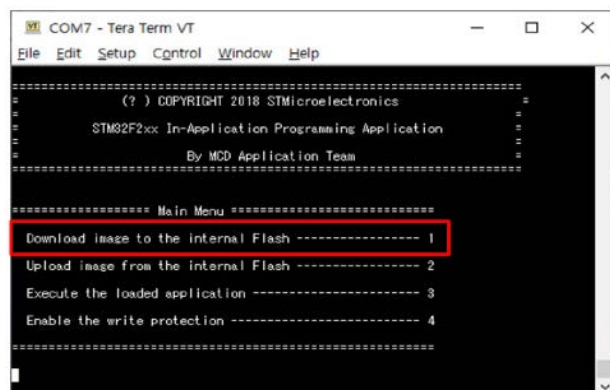
4. Select Baud rate 115200 and select “New Setting”



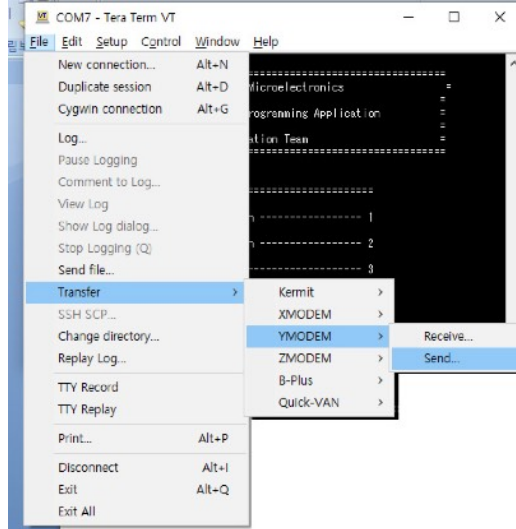
5. Press ② keys while holding ① key on the Mini Console.



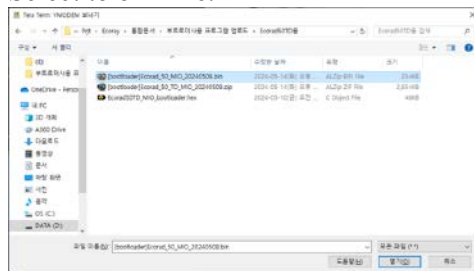
6. Enter "1"



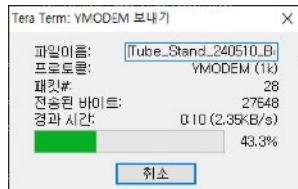
7. Setting to YMODEM. (File tap -> Transfer -> YMODEM -> Send)



8. Select to bin File.



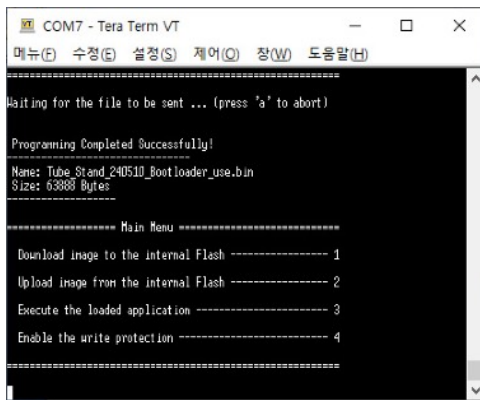
9. Please wait until transfer is complete.



- If no completion message after the transfer window disappears, the transfer fails. If the transfer fails, try again from Step 5.

10. Enter "3" to run downloaded FW.

Nexgen 940pa (Rev. 01)



The screenshot shows a Tera Term VT window titled "COM17 - Tera Term VT". The menu bar includes "메뉴(F)", "수정(E)", "설정(S)", "제어(C)", "창(W)", and "도움말(H)". The main text area displays the following content:

```
=====
Waiting for the file to be sent ... (press 'a' to abort)

Programming Completed Successfully!
Name: Tube_Stand_240510_bootloader_use.bin
Size: 63888 Bytes
=====

===== Main Menu =====
Download image to the internal Flash ----- 1
Upload image from the internal Flash ----- 2
Execute the loaded application ----- 3
Enable the write protection ----- 4
=====
```