PEXRAYTECH

User Manual, PXR GEN 160

DOC0045 V7

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Warnings

Warning symbols used in this manual:

⚠️	Caution or Attention, review or consult accompanying documents.
☢️	Ionizing radiation.
⚡	Electrical shock hazard.
❗	Note
♻️ REZY	Instruction for handling product at end of life.
🗑️	Separate collection for Waste Electrical and Electronic Equipment to Directive 2002/96/EC (WEEE)
☠️	DANGER

General Information

The main purpose of this manual is to instruct you how to install and operate the PXR Generator 160 (later referred to as "PXR Generator" or just "Generator") provided by Pexray Oy.

Pexray Oy is here afterwards referred to as Pexraytech or PXR.

❗	DO NOT OPERATE THE DEVICES UNTIL YOU HAVE READ THIS MANUAL!

❗	Service should be performed only by personnel trained by Pexraytech.

	Do not drill, penetrate, heat or incinerate the battery packs of the product or the user interface as this may result in fire or explosion of the battery cells and cause serious injuries or lead to death.
	Unauthorized use of the Generator can cause health hazard by X-rays. The Generator must never be used by unauthorized personnel.
	All batteries self-discharge over time. In worst scenarios the battery can become completely drained. In this case the battery cannot be charged again. In order to prevent damaging the batteries, please follow these rules: • Batteries should be charged at least every four (4) months. • When not in use, remove batteries from the equipment. General warranty offered by Pexraytech does not cover batteries if these rules are not followed resulting to unusable batteries. All PXR devices using batteries should only use batteries supplied by Pexraytech. Pexraytech must not be held accountable if other batteries are used. Only Pexraytech chargers and adapters should be used for charging PXR devices. Pexraytech must not be held accountable if other chargers are used in PXR devices or chargers have been used to charge other devices.
	The AC/DC power supply must be connected to a grounded outlet. The AC/DC power supply is designed for indoor use only. The AC plug on the AC/DC power supply is used as a disconnecting device and must be kept in an easily accessible location.
	The PXR Generator 160 is intended to be used in basic and industrial electromagnetic environment. The PXR Generator 160 is not intended to be used in medical or veterinary applications.

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Disclaimer

All Pexraytech systems are sold with the understanding that the user assumes sole responsibility for radiation safety (as well as any national, state, provincial, or local regulatory compliance) and that Pexraytech, its agents or distributors or representatives, do not accept responsibility for:

- any injury or danger to personnel from X-ray exposure,
- image over/under exposure due to incorrect operating techniques or procedures,
- equipment not properly serviced or maintained in accordance with instructions contained in this publication, and
- equipment which has been damaged, modified, or tampered with in any way.

The information in this manual is subject to change without notice.

- The manufacturer assumes no responsibility for any errors that may appear in this manual.
- The reproduction, transmission or use of this document or contents is not permitted without permission from the manufacturer.

Safety

Before using this product, read this manual to ensure correct usage of the product. After reading, store this manual in a safe place for future reference.

Note! Service and maintenance should be performed only by Pexraytech trained personnel.

Type label

Figure 1 Type label for PXR GEN160-XX

Intended Use

The PXR Generator is used for taking X-ray images of various objects. The product is intended to be used for security and NDT applications with flat and scanning panels controlled by Pexraytech Software (PXR Studio). Main applications are:

- border or customs control
- police and security operatives
- anti-terrorist use
- pipe insulation inspections
- corrosion inspections
- quality assurance

Please refer to Pexraytech System Manual for specific configurations.

Radiation safety

The X-ray generator generates radiation which, in large doses, poses a threat to human health. Thus, exposure to X-ray radiations must be minimized. Operators using portable X-ray systems must undergo a formal safety training before using them. The operator must understand the potential dangers of working with X-ray systems and ways of operating safely.

	If the equipment is used in a manner not specified by Pexraytech, the protection provided by the equipment may be impaired.

Operators must understand and update themselves about their current local regulations and legislation that are in place for the use of X-ray systems and for locations where the X-ray generator will be operated.

	Pexraytech under no circumstances can be held liable or responsible for any injury or danger, image over or under exposure, any accidents or damages caused by the incorrect use of the systems described hereinafter or the failure to comply to national, state, provincial, or local regulations regarding the work with X-rays!

- All X-ray generators need to be approved by the end-user's National Regulatory Authority.
- Pexraytech expects that the end user will do the necessary actions for obtaining the operational approval of an X-ray system.
- Use only cables and accessories provided by Pexraytech for continued safety and regulatory compliance.

Safe Operating Distance

An X-ray Generator emits radiation which, in large doses, is hazardous to health. The exposure to X-ray radiation must be minimized. Easiest way to reduce the radiation dose is to increase operator distance to the generator. The further, the better!

Pexraytech strongly recommends the use of personal radiation dosimeters while operating the system!

The safety distance is determined by maximum yearly radiation dose of the operator. There are several aspects that need to be considered:

- The direction of the radiation beam
- Radiation beam strength
- Leakage radiation from the Generator
- Scattered radiation from the object, the panel and background
- The frequency of the X-ray Generator usage by the same person.

⚠	Note that the X-rays are partially reflected on contact with surfaces. Therefore, the exact safety distances can differ depending on the scanned object and the material behind the panel.
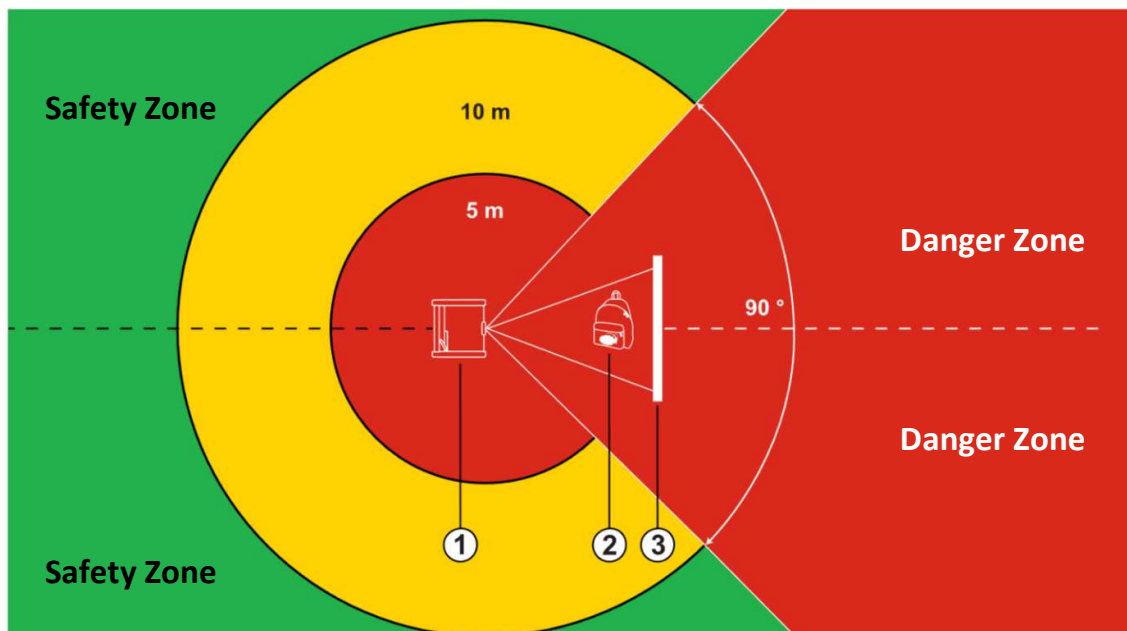
Figure 2 Recommended minimum operator distance. (1) Generator, (2) object, (3) Panel

Below are some examples of typical values of doses from different sources:
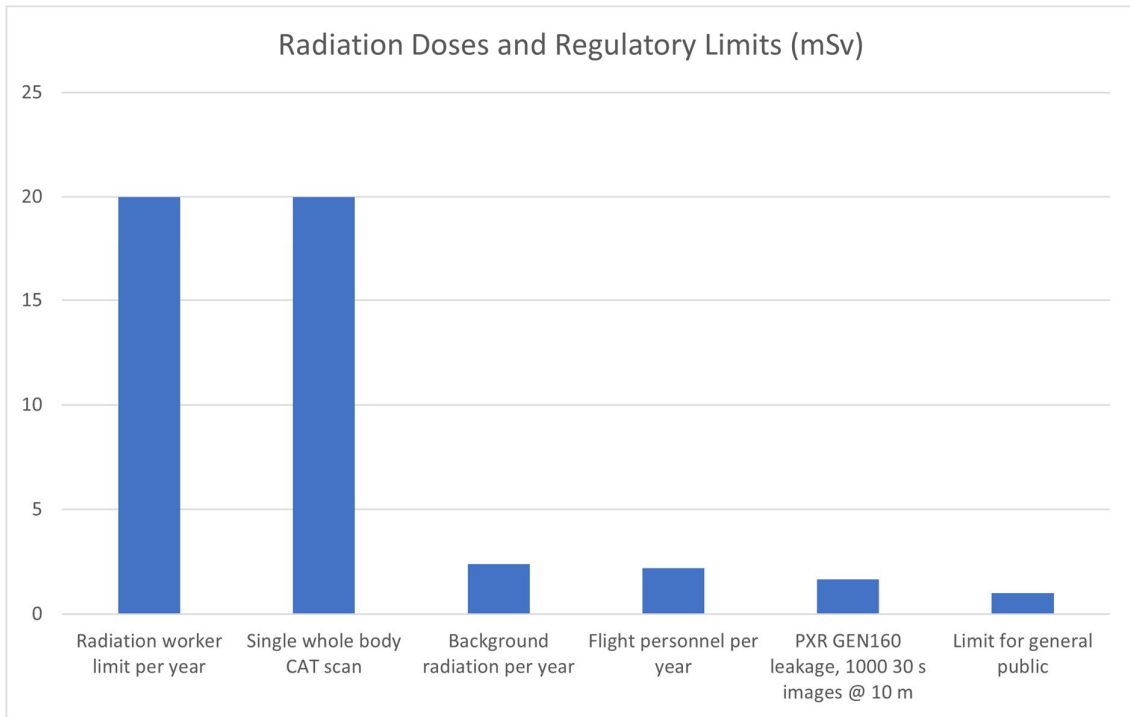
Figure 3 Radiation dose comparison, PXR Generator operated at full rated power.

Introduction

Pexraytech PXR Generator is designed to be used with both PXR Scanning panels and Flat panels. PXR Generator coupled with PXR Alpha panels enables one of the most accurate images in the portable X-ray market. Adjustable kV and small focal spot enable inspection of tiniest details of any item.

Key benefits:
- Adjustable kV. This enables dual energy capabilities without any extra accessories.
- Tiny focal spot. This enables sharp images at small SDD.
- Built in wireless communications. No need for cables or extra communication hubs.
- IP65 rating, designed for demanding outdoor conditions.
- Long battery life and easy to replace batteries on the field.
- Rugged waterproof connectors

Overview

Product Overview
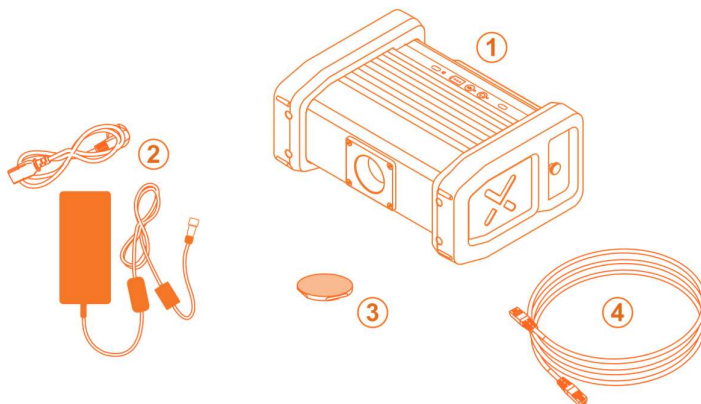
Figure 4 Main components

The main components are:

1. PXR GEN160
2. AC/DC power supply for charging the batteries
3. Removeable X-ray blocker (blind) to the radiation window
4. 3 m Ethernet cable to PC

Product Parts

Overview
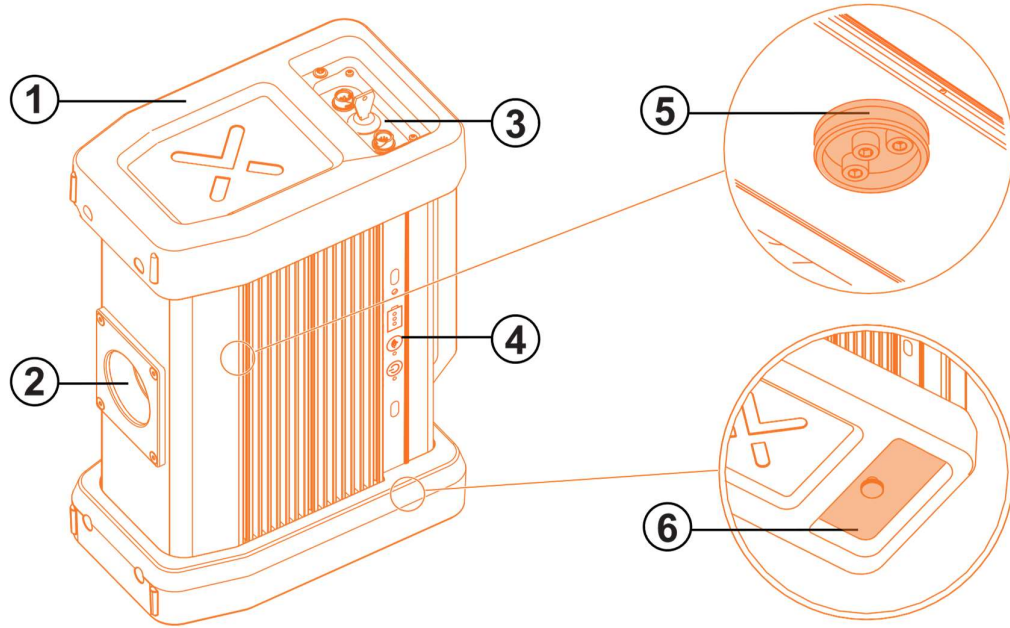
Figure 5 Overview

#	Item	Description
1	Soft bumpers	For Generator mechanical protection.
2	Radiation port	Window for X-rays, X-ray blocker goes here
3	Connector panel	Power connector, data connector, safety keylock.
4	Control panel	Power button, Wi-Fi button, LED-indicators.
5	Tripod attachment	This is used to attach the Generator to a tripod
6	Battery door	For replacing batteries.

Connections
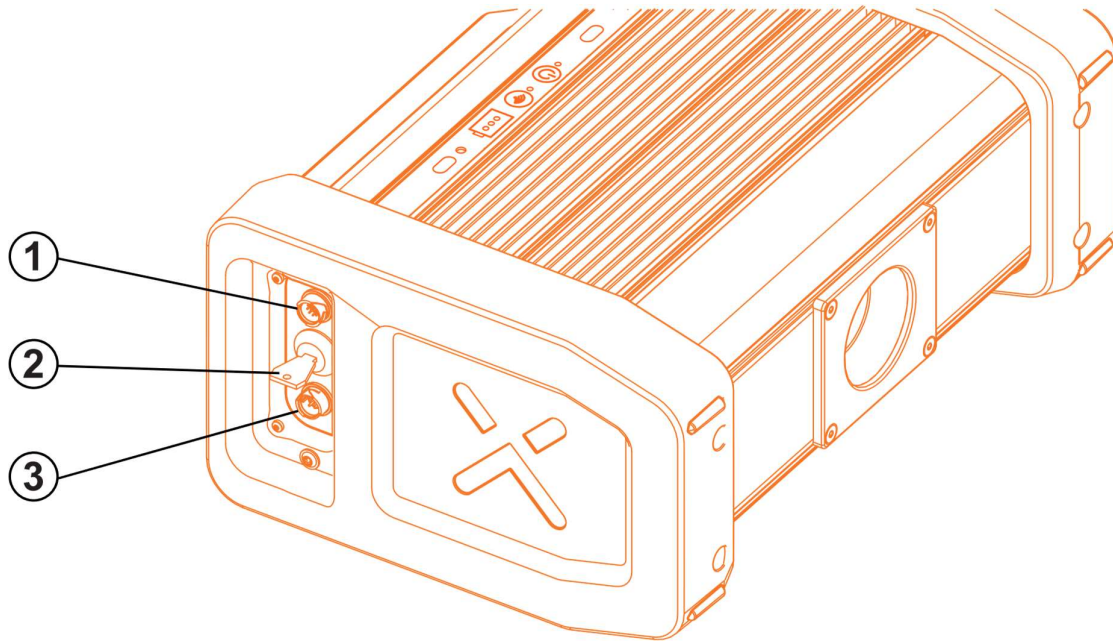
Figure 6 Connectors and key switch

	Function	Description
1	Ethernet port	Ethernet port for connecting to the PC or PXR SIU
2	X-ray safety keylock	Turn 90° clockwise to power the Generator on and/or enable X-rays.
3	Charging port	Connector for charging the built-in batteries.

Control panel
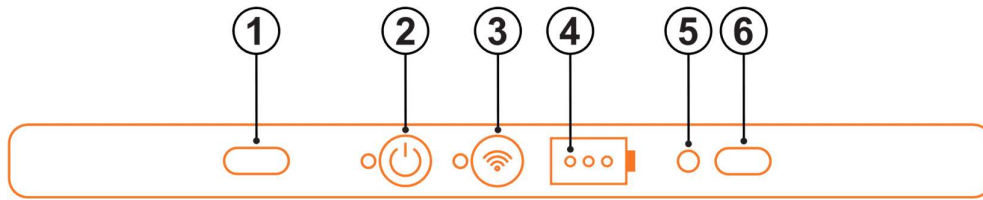
Figure 7 User interface

	Function	Description
1 and 6	Generator status lights	**Blue** – power is ON (keylock OFF/key not in place) **Green** – ready to radiate (keylock ON) **Red** – radiating, X-rays ON **Yellow** – Error
2	Power button & LED	Press to power Generator ON or OFF.
3	Wi-Fi button & LED	Toggle wired/wireless control of the Generator
4	Battery level LEDs	1, 2 or 3 LEDs show the remaining battery capacity 1 LED – below 33% 2 LEDs – 33 to 66% 3 LEDs – 66 to 100% Note: Below 20 % battery level a warning sound is produced.

Installation

Before taking the product into use, make sure that the delivery package includes all the items listed in Product Overview. Make sure there is no visible damage on the product or the supplied wires. If an item looks damaged after unboxing contact your retailer to preserve the warranty.

Installing batteries

For the PXR Generator to operate both batteries must be installed in the battery compartment. Operation from the power supply alone is not possible. Insert and change batteries only in a clean environment, such as indoors, to avoid getting dirt inside the battery compartment. To install the batteries, rotate the battery door finger screw a few turns counterclockwise and pull from the screw to remove the battery door.
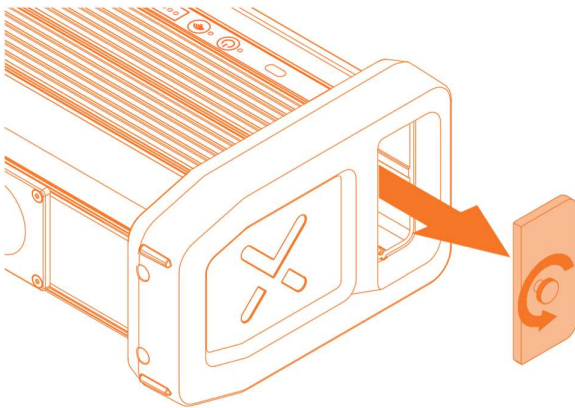
Figure 8 Battery door

Insert both batteries connector end first into the cavity as shown below:
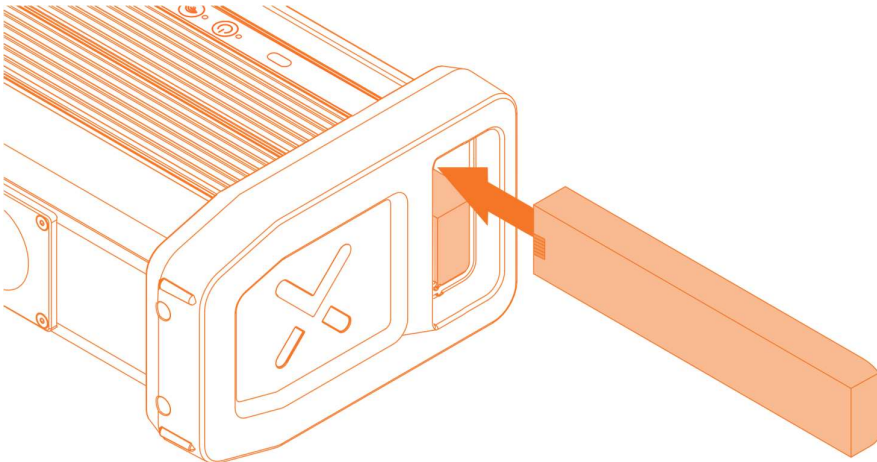
Figure 9 Inserting batteries

Close the battery door and tighten the finger screw with fingers only. No tools are necessary.

Charging batteries

Charge the batteries before first use.

To charge the batteries connect the power cord to the provided AC/DC power supply and the power supply cord into to the four-pin charging connector.
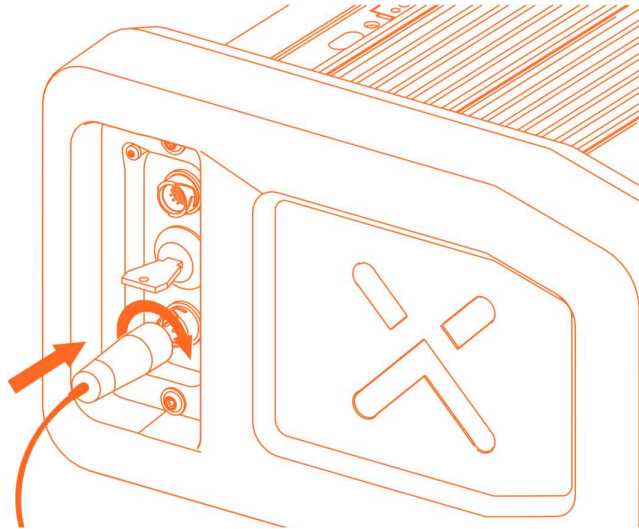
Figure 10 Charging connector

Generator will turn on automatically and start charging the batteries. During charging the battery level LEDs flash slowly and stay on when batteries are full.

Disconnecting the power supply after charging automatically powers OFF the Generator after a while to save batteries.

Note! For the Generator to operate both batteries must have equal charge. If not, the batteries must be charged before use.

Pexray provides a separate battery charger accessory that can also be used to charge the batteries outside of the Generator.

Note that the power supply used for charging is intended for indoor use only.

Pexray Safety Interlock Unit (SIU) accessory

The PXR Safety Interlock Unit (SIU) can be connected to the Ethernet port (1). Ethernet cable from PC is then connected to the SIU.
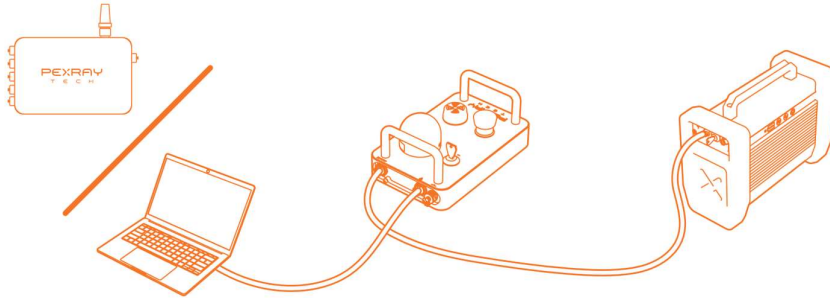
Figure 11 Wired connections for the Safety Interlock Unit

The SIU works also in wireless mode:
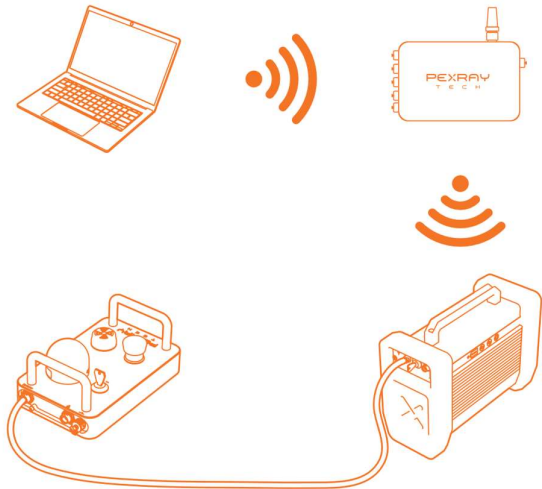
Figure 12 SIU with wireless (Wi-Fi) control (the PXR HUB is optional)

The SIU must be enabled by turning ON the DIP switch 2 behind the Generator battery door:
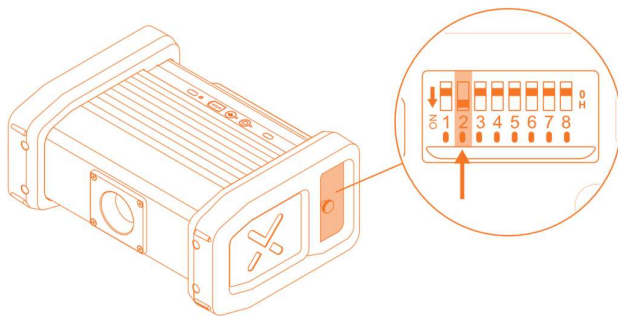
Figure 13 SIU enable DIP Switch (#2) on the Generator

When the SIU is enabled, the PXR Studio gives an error message if the SIU is not connected, or any interlock is open.

Please see *DOC0065 User's Manual, PXR Safety Interlock Unit* for more information.

Tripod mounting

The Generator can be mounted on a tripod equipped with a kino head. On the bottom of the generator is a cylindrical mounting point that is used to attach the generator to the kino head.

⚠️	It is user's responsibility to verify that the tripod does not trip caused by wind or uneven ground or any such reason. User must verify that the Generator is not overbalanced when mounted on tripod.

Mount the generator the kino head so that one leg is in front of the generator to avoid tripping.

Adjusting is easiest when the kino head handles are pointing to back and right, aligned to the generator axes.

Connections

Connection to the PXR Generator can be wired (Ethernet) or wireless (Wi-Fi).

PXR Generator operating distance with wired connection is up to 100 m and wireless operating distance is up to 50 m in optimal conditions. By using PXR accessories the distance can be increased to over 200 m with both wired and wireless connection.

| ⚠️	To prevent accidental exposure to X-rays, activate the keylock only when connection to the PXR Studio is established and nobody is in the radiation danger zone!

Wired use (Ethernet cable)

Direct connection to PC
Normally all Ethernet data goes through a router that gives IP addresses to all equipment connected to it. When using direct connection without router the PC Ethernet adapter IPv4 address must be set to 10.18.1.100 manually using Windows Control Panel. The subnet mask is 255.0.0.0.

For PCs provided by Pexray this is already configured at the factory.

With PXR HUB or Scanning Panel as router
PXR HUB or Panel gives the IP address automatically. No manual configuration is needed.

In both cases proceed as follows:

1. Turn on your laptop or tablet and start PXR Studio.
2. Check that the LED next to the Wi-Fi button is **OFF**. If not, press the Wi-Fi button to turn it OFF to switch to wired mode.
3. Attach Ethernet cable between Generator and PXR HUB/PXR Panel.

4. Connect the PXR HUB/PXR Panel to PC.
5. Power On the Generator with Power button, verify that the status light is BLUE (keylock in OFF position to prevent accidental exposure).
6. Generator now automatically connects to the PC.
7. Check from PXR Studio that the connection is established.
8. Turn the safety keylock clockwise to enable radiation.
9. Use PXR Studio to take images.

Wireless use (Wi-Fi)

Direct connection

If the Generator is to be connected directly to the PC the Generator must be set to Access point mode. In this mode the Generator creates a Wi-Fi network named PXR-GEN. User must then connect the PC to this network. Network password is on a label in the Generator package.

With Wi-Fi router as Access Point (PXR HUB or Scanning Panel)

If the Generator is connected via a router to the PC the Generator must be set to Client mode. In Client mode the Generator connects automatically via the router to the PC.

The Access Point (SSID and password) where the Generator connects is programmed in production. If the Access Point name must be changed, please consult the manufacturer.

Switching between Access Point and Client mode

Short press on the Wi-Fi button turns the Wi-Fi ON or OFF.

To switch between Access Point and Client press the Wi-Fi button for a few seconds until you hear a beep. The Wi-Fi LED will flash according to the mode: fast flash is Client mode; slow flash is Access Point. The LED stops flashing when connection is established (Client) or the Access Point is ready.

In both cases proceed as follows:

1. Turn on your laptop or tablet and start PXR Studio.
2. Power ON the Generator with *Power button*, verify that the status light is BLUE (keylock in OFF position to prevent accidental exposure).
3. Check that the LED next to the Wi-Fi button is **ON**. If not, press the Wi-Fi button shortly to turn it ON.
4. The Generator now connects to the defined Wi-Fi access point (Client) or creates an Access Point for the PC to connect.
5. Check from PXR Studio that the connection is established.
6. Turn the safety keylock clockwise to enable radiation.
7. Use the PXR Studio to take images.

Operation

⚠️	Before using the Generator, make sure to understand and follow the guidance explained in the Radiation safety chapter.

Power on the Generator either by using the key switch (1) or the power button (2). If powered on using the key switch, the Generator must also be powered off from the key switch.

If powered on using the power button, connection to the PXR Studio can be verified without the safety key switch.
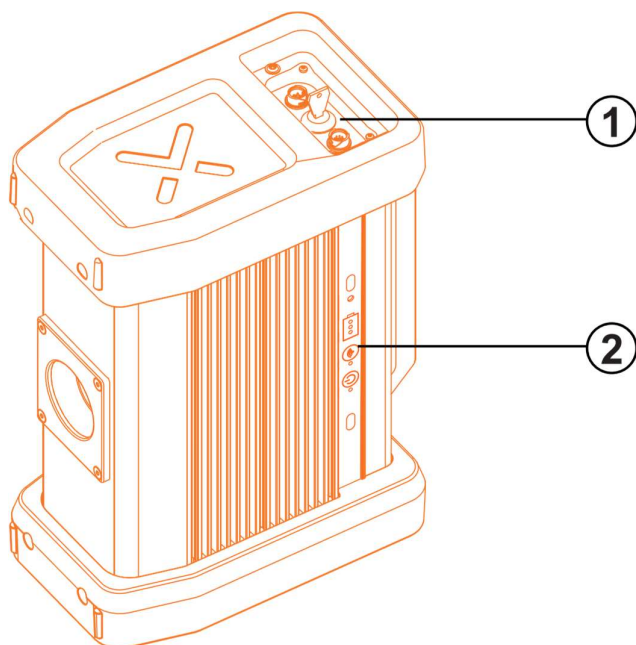
Figure 14 Powering ON/OFF

Duty Cycle and Thermal Derating

Even though the batteries last a long time the Generator may heat in elevated temperatures during operation so that the internal thermal limit prevents exposure. This is not typically problem at or below room temperature but can be faced during very long exposures at high ambient temperature.

The limiting factor is usually the Li-Ion battery temperature and can be remedied by replacing the batteries with ones held in room temperature. Charging the batteries inside the Generator warms them up and is thus not recommended at elevated temperatures.

To reduce heating protect the device from direct sunlight and let it cool down a while between long exposures.

At low temperatures (below 0°C) Li-Ion batteries cannot provide enough current for the Generator to operate at full rated power. This can be remedied by keeping the batteries warm and inserting them only before operating the Generator.

PXR Studio automatically limits the X-ray tube current based on the set tube voltage to keep the output power below maximum allowed.

Output power can be calculated by multiplying the kV value by the mA value, for example 120 kV x 1.0 mA = 120 W or 160 kV x 0.75 mA = 120 W.

🛈	**Note** that the battery charge must be above 20 % when operating over 120 W output power. **Note** that the Generator automatically reduces the maximum allowed power based on battery temperature.

Below is a chart for thermal derating:
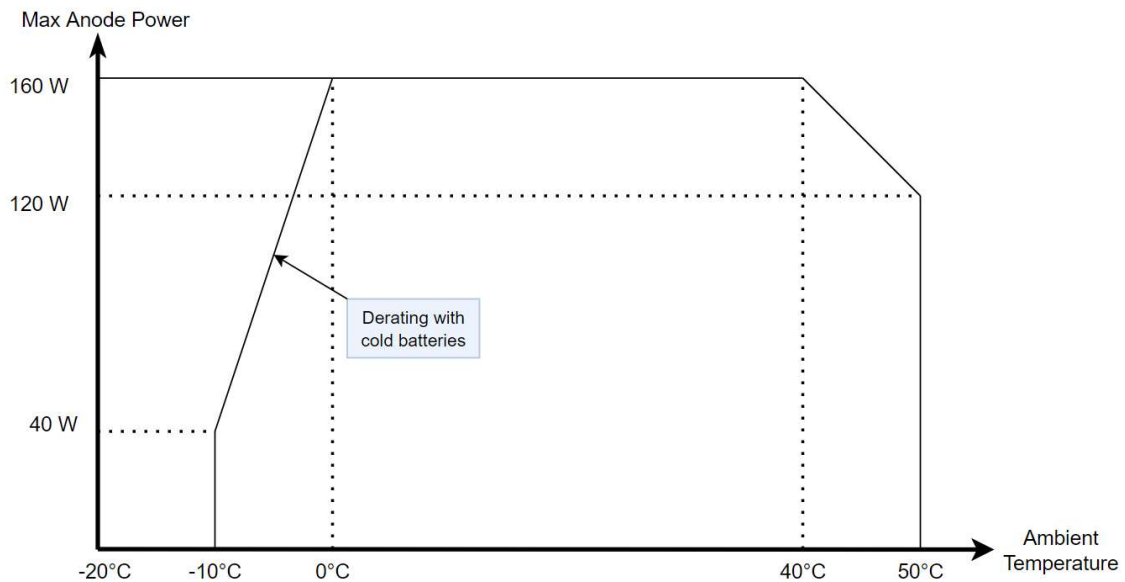
Figure 15 Thermal derating of maximum output power

🛈	The PXR generator 160 does not have any means to control the exposure parameters or start the scan from the unit. As a safety measure the only way to control the Generator is by software.
🛈	If connection to the PXR Studio is lost during exposure the Generator automatically cancels the exposure as a safety measure.
🛈	To protect the X-ray tube the duty cycle of the Generator is limited by software. Please see the technical specifications in this manual for the duty cycle.

Tube Seasoning & Warm up

For reliable operation the X-ray tube must be seasoned when not been used for a while. Without seasoning the X-ray tube can arc at high voltages. Arcing can cause image artifacts and shortens the tube lifetime.

Warm up takes about one minute is recommended daily before operating the generator to increase the tube lifetime. In cold condition several Warmup cycles is recommended.

Short seasoning takes approximately 6 minutes and is recommended when the Generator has not been used for a few weeks.

Long seasoning takes approximately 22 minutes and is recommended when the Generator has not been used for more than a few weeks.

⚠️	**Note that the Generator produces X-rays during warm up and seasoning!** To minimize radiation exposure, use the supplied radiation shutter on the X-ray window.

Specifications

Electrical Specifications

Power Input	48 V DC; 64 W
Batteries	2 x Li-Ion 21,9 V; 2750 mAh; 6S1P
Battery lifetime	Approximately 30 minutes at full specified output power, fresh batteries, in room temperature
Battery charging time	2.5 h
Maximum cable length	100 m for Ethernet cables
Wi-Fi module	Telit WL865E4-P
Wi-Fi band	802.11 b/g/n, 2.4GHz
Wi-Fi radiated power	Max 19 dBi on antenna port
Antenna	2.4 GHz; 0 dBi; RP SMA-connector
Wired Interface	Ethernet 100BaseT
Appliance class	Class III
AC/DC Desktop Power Supply	
Input	100 – 240V AC, 50-60 Hz, 70 W
Output	48 V DC; 1.35 A
Electrical Safety	EN 60950-1:2012
Ingress protection	Indoor use only
Operating temperature	-0 °C to +40 °C (32 °F to +104 °F)
Appliance class	Class I

Mechanical Specifications

External dimensions	340 x 290 x 150 mm
Weight	12 kg (10.5 kg without batteries and bumpers)
Enclosure Material	Aluminum
Ingress Protection	IP 65 (IEC 60529)
Operating temperature	-20 °C to +50 °C (-4 °F to +122 °F)
Storage temperature	-25 °C to +60 °C (-4 °F to +140 °F) short term 0 °C to +30 °C (32 °F to +86 °F) recommended to maximize battery lifetime
Humidity	20 - 90% non-condensing
Elevation	2000 m max
Pollution Level	2

Radiation Specifications

Beam angle	50 ° (±25°)
Tube voltage range	30 - 160 kV
Tube current range	0.1 – 1 mA
Maximum anode power	160 W
Inherent filtration	3 mm Al equivalent
Focal spot	0.9 mm (EN 12543-2)
Leakage radiation	< 2 mSv at 1 m from surface (with X-ray shutter in place)
kV and mA rise time	500 ms typical
Preheat time	5 s
Duty Cycle	5/6 (83%) at full rated anode power

Environmental Specifications

Recyclable parts should be taken to the appropriate processing centers. Remove all hazardous waste completely. Check your local regulations for further information about the appropriate processing centers.

Note that the PXR Generator contains approximately 1 kg of lead (Pb) that is used to shield the X-ray tube to minimize leakage radiation.

Note that the PXR Generator contains 3 liters of insulation oil that must be disposed properly.

All parts containing hazardous material must be disposed of in accordance with local environmental laws and regulations. Necessary precautions must be taken when handling hazardous waste.

Standards

EMC + Radio	2014/53/EU Radio Equipment Directive (RED)
Electrical Safety	EN 61010-1
RoHS	EU RoHS 2

Troubleshooting and Maintenance

Connection problems

Power off all equipment and restart the PC, install any pending Windows updates. Then power on all again.

Wired connection

With wired connection check that the cables are not damaged, and the connectors are locked and have no bent or missing pins.

	Note that wireless connection must be disabled using the Wi-Fi button on the Generator for the wired connection to work (only one connection to the Generator can be enabled at a time).

The IP address of the Generator is fixed to 10.18.1.25. Using Windows command prompt try to PING the IP address to see that the product can be reached in the network.

If the Generator is connected to the PC/Tablet directly (without PXR HUB) the PC Ethernet adapter IP address must be set to Fixed 10.18.1.100 so that is in the same address segment as the Generator. With PXR HUB the HUB operates as DHCP server and gives PC the address automatically.

Figure 16 Using Windows Control Panel to set Ethernet adapter IP address (without PXR HUB)

With **Wi-Fi** connection check that you have connected to correct wireless network on the laptop or tablet. Check that the antenna is not loose.

Artefacts in X-ray images

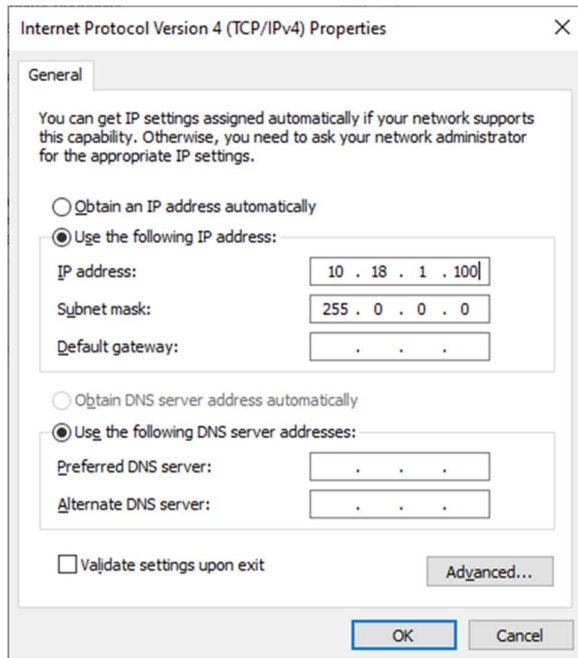These are accompanied with snapping/clicking sound from the generator during exposure. This is caused by the X-ray tube arcing. A long seasoning (see chapter *Tube Seasoning & Warm up*) is required to remedy this issue.

Reporting the System Logs

Use the PXR Studio to save system logs that you can send to manufacturer in case you need assistance in troubleshooting.

Oil leaks

The unit contains approximately 3 liters of oil. If the unit leaks oil it must be returned to the factory for service.

	HEALTH HAZARDS: May be fatal if swallowed and enters airways. IF SWALLOWED: Immediately call a POISON CENTER/doctor. Do NOT induce vomiting

The full safety data sheet (SDS) for the oil is available from the manufacturer.

Maintenance and Service

Cleaning the Product
Clean the product by swiping the surface with a damp cloth. Do not use soap or detergents.

How to Contact the Maintenance Service
Please contact your local reseller in case of problems. Each local reseller has their own service times and contact details. Please discuss the contact methods and service times with your local reseller.

The product must be serviced using parts supplied by the manufacturer only.

Pexraytech will be notified of all issues.

Emergency Procedure

In case the generator does not shut down when requested and continues producing X-rays walk away from the generator, verify that no one is in the danger zone and wait for the battery to run out.

Warranty

Warranty does not cover consumables such as batteries.

The product is meant to be used as described in this user guide. The warranty resolves in following cases:

- Incorrect use
- Modifications to the product

Shipping

The Generator contains Lithium-Ion batteries. If shipped by air the guidance issued by IATA and any national institutions must be followed.
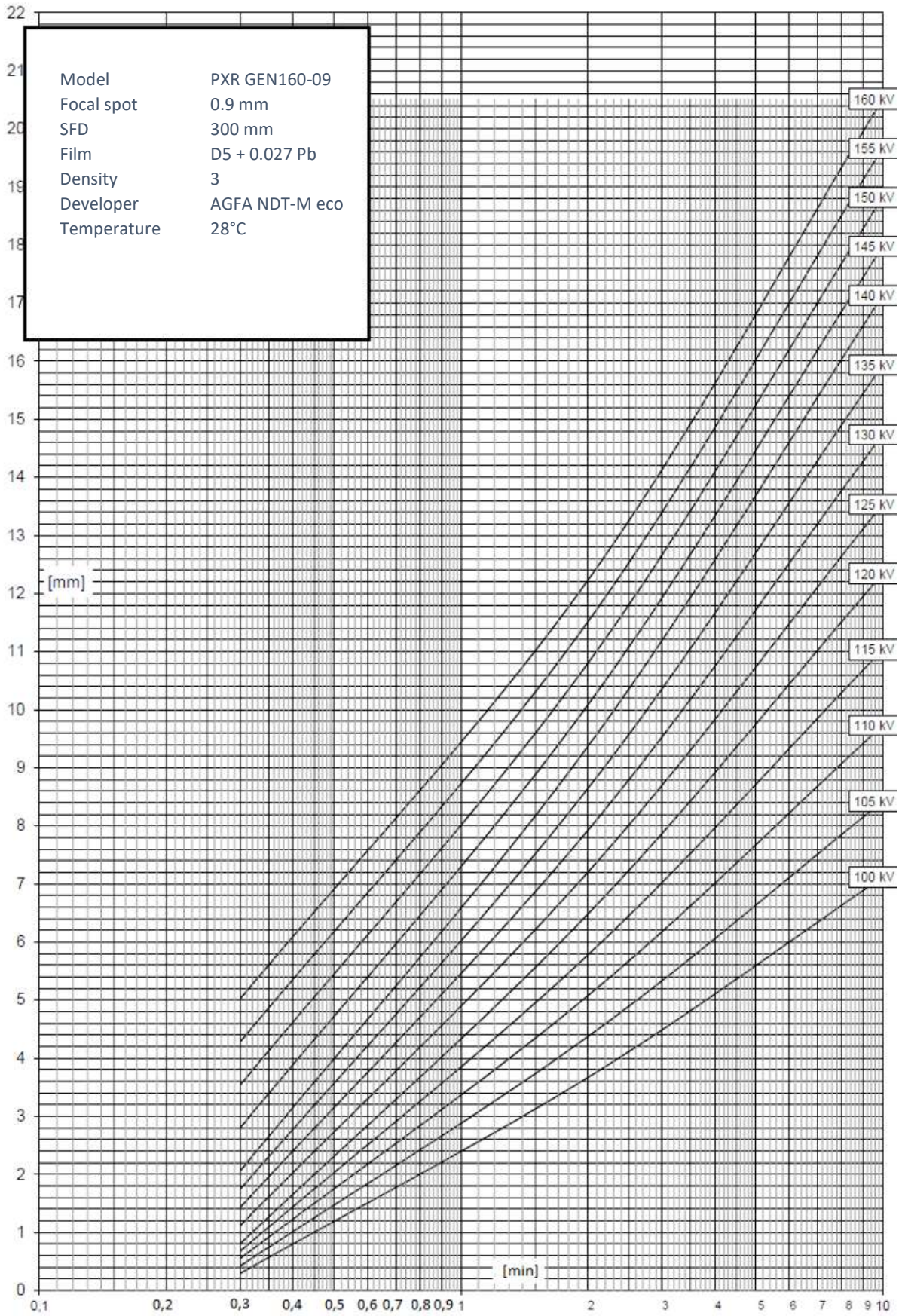
Figure 17 Graph for exposure time vs. steel thickness vs. kV

The figure contains the following legend:

Model	PXR GEN160-09
Focal spot	0.9 mm
SFD	300 mm
Film	D5 + 0.027 Pb
Density	3
Developer	AGFA NDT-M eco
Temperature	28°C

The vertical axis is labelled [mm] and ranges from 0 to 22. The horizontal axis is labelled [min] and ranges from 0,1 to 10 (logarithmic). The curves are labelled: 100 kV, 105 kV, 110 kV, 115 kV, 120 kV, 125 kV, 130 kV, 135 kV, 140 kV, 145 kV, 150 kV, 155 kV, 160 kV.

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EU Declaration of Conformity

Radio Equipment:

    PXR GEN 160   PXR8903565

Manufacturer:
Pexray Oy
Tekniikantie 12
02150 Espoo
Finland

This declaration of conformity is issued under the sole responsibility of the manufacturer who declares that the above described radio equipment is in conformity with the following relevant Union harmonisation legislations:

Radio Equipment Directive	**2014/53/EU (RED)**
RoHS	**EN 2015/863**

The conformity assessment procedure used for this declaration is Annex II.

Conformity to the essential requirements of the legislation(s) have been demonstrated by using the following standards:

Health and Safety:	EN 61010-1:2010 Ed.3	
	IEC 62133-2:2017	(Dekra, report 4353980.50)
EMC:	EN 61000-3-2:2014	
	EN 61000-3-3:2013	
	EN 61326-1:2012	
	EN 301 489-1 V2.1.1	
	EN 301 489-17 V3.1.1	
Spectrum:	EN 300 328 V2.2.2	

The following accessories allows the object of the declaration described above to operate as intended and in conformity with this EU declaration of conformity: Software version: 1.0.0 and backward, Li-Ion battery: Celltech 175-8410, AC/DC Power supply: Coolpower/Adapter Technology ATS065T-P

Signed for and on behalf of: Pexray Oy

Place and date of issue: Espoo, Finland, 2021-11-11

    Lauri Westling, CEO

Pexray Oy • Tekniikantie 12 • 02150 Espoo • Finland • contact@pexraytech.com • www.pexraytech.com

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