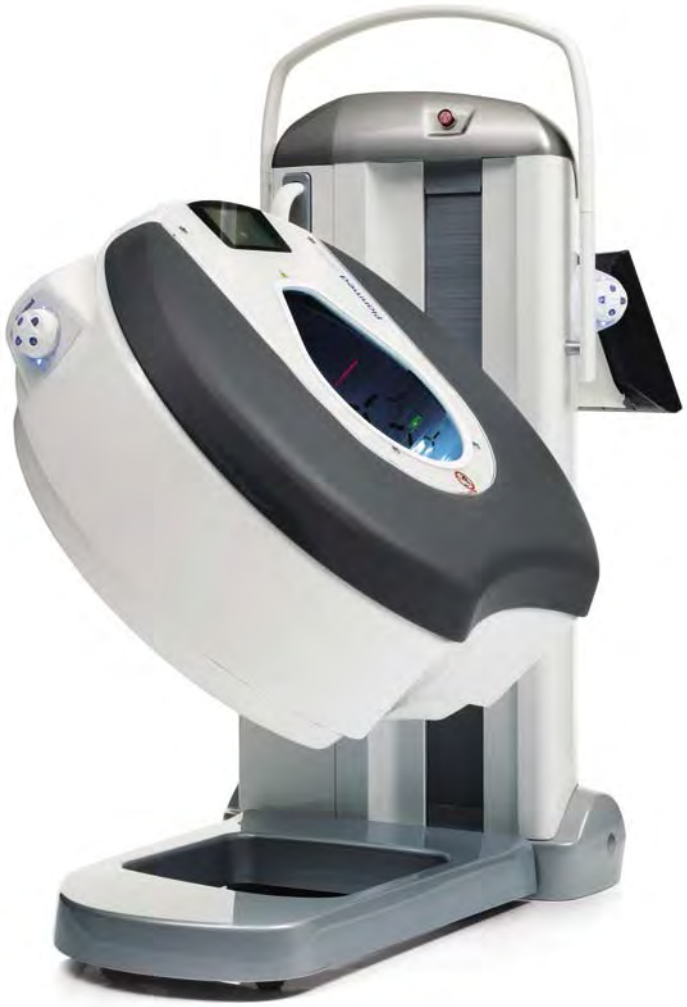
Planmed



Planmed Verity®

extremity scanner

EN

technical manual

Digitally signed by Chicu Natalia
Date: 2023.12.21 14:14:32 EET
Reason: MoldSign Signature
Location: Moldova

20008141

The manufacturer, assembler and importer are responsible for the safety, reliability and performance of the unit only if:

- installation, calibration, modification and repairs are carried out by qualified authorised personnel
- electrical installations are carried out according to the appropriate requirements such as IEC 60364
- equipment is used according to the operating instructions.

Planmed pursues a policy of continual product development. Although every effort is made to produce up-to-date product documentation this publication should not be regarded as an infallible guide to current specifications. We reserve the right to make changes without prior notice.

Publication number 20008141 Revision 14

Released 17 February 2021

Table of contents

1 General and technical data

1.1 Introduction

Planmed Verity is intended to be used for X-ray cone beam computed tomography imaging of anatomies within upper and lower extremities, neck and head. The system acquires high-resolution volumetric images of the target and includes a 3D weight-bearing (WB) imaging option for lower extremities.

The extended use of Planmed Verity enables imaging of the head area. The images can be used for examination of maxillofacial area, mandible, sinuses, airways and other anatomies with suitable positioning.

1.2 Associated documentation

Planmed Verity is delivered with the following manuals:

- User's manual
- Installation manual
- Technical manual (this manual)

1.3 Symbols on product labels

Refer to instruction manual/booklet (Standard ISO 7010).

Separate collection for electrical and electronic equipment according to Directive 2002/96/EC (WEEE).

Type B applied part (Standard IEC 60417).

Fulfils the requirements of Directive 93/42/EEC.

Class 1 laser product (Standard EN 60825-1: 2007)

Consult accompanying documentation for moving the device.

Do not step on gantry ring.

Ionizing radiation (Standard ISO 7010)

General warning (Standard ISO 7010).

Safe working load (IEC 60601-1)

1.4 Safety precautions

The following warnings, cautions and notes must always be considered while servicing Planmed Verity in order to avoid personal injury or damage to the device.

WARNING

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

RADIATION SAFETY RULES

CAUTION

Some procedures described in this manual produce X-ray radiation. Always follow the rules for radiation protection.

CAUTION

Never attempt to open the TUBE HEAD. It does not contain any serviceable parts, and radiation safety can no longer be guaranteed.

CAUTION

Never take exposures without filter or beam limiting device (collimator) in place. Otherwise radiation safety cannot be guaranteed.

ELECTRICAL SAFETY RULES

CAUTION

The device contains hazardous voltages. While servicing internal parts, always disconnect the unit from the mains (if possible) by removing the plug from the wall outlet, and wait for two minutes before touching any electrical parts.

CAUTION

Always replace fuses with those of the same type and rating. Otherwise patient, operator or equipment safety cannot be guaranteed.

CAUTION

The circuit boards can be damaged due to static discharges and require careful handling.

CAUTION

Do not connect items which are not specified as part of the system.

CAUTION

Do not connect a multiple portable socket outlet (MPSO) or an extension cord to the system.

CAUTION

If the device is not connected to an Uninterruptible Power Supply (UPS), disconnect the unit from mains during lightning storms.

CAUTION

Do not connect any USB devices with an external power supply (e.g. an external hard disc) to the USB com port.

CAUTION

The device is not suitable for use in the presence of a flammable anaesthetic mixture with air or with oxygen or nitrous oxide.

CAUTION

Make sure to position the unit so that the mains cable can be easily unplugged.

GENERAL SAFETY RULES

CAUTION

Planmed Verity must be serviced only by qualified personnel, trained by Planmed. Repairs and parts replaced by unqualified personnel carry no warranty.

CAUTION

Periodical maintenance as described in this manual must be performed on a regular basis to ensure safety and image quality.

CAUTION

Some procedures described in this manual could be dangerous if not followed as stated.

CAUTION

EMC requirements have to be considered, and the equipment must be installed and put into service according to the specific EMC information provided in section "EMC information" on page 29.

CAUTION

Do not perform any maintenance when preparing or using the unit for imaging.

CAUTION

Portable and mobile RF communications equipment can affect the device. For minimum distance between portable and mobile RF communications equipment and the device, see section "EMC information" on page 29.

CAUTION

Before starting the drive make sure that there is enough space for the gantry to move freely without causing any hazard to you, the patient or the surrounding property, and, especially, that there is no danger of anything squeezing under the gantry or between the gantry and the base.

CAUTION

Do not touch the gantry when it is moving.

CAUTION

When lowering down Planmed Verity from its wheels after transportation be careful not to leave e.g. your toes and the cables under the vertical column.

CAUTION

There are parts where toxics, including lead (Pb), are used in this product. Therefore, please execute proper processing of disposal in accordance with law, after consulting with our distributor about the disposal. The parts containing hazardous substances are as follows:

- Collimator
- Tube head assembly

NOTICES

NOTE

The display values shown in this manual are only examples and should not be interpreted as recommended values unless otherwise stated.

NOTE

It is very important that the place where the device is to be used and the position from which the user is to operate the device are correctly shielded. Since radiation safety requirements vary from country to country and state to state it is the responsibility of the user to ensure that all local safety requirements are met.

NOTE

If the device has been stored at temperatures under +10°C for more than a few hours, time must be allowed for it to reach room temperature before turning it on.

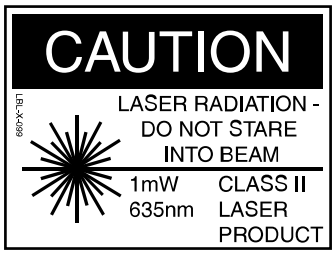
NOTE

Ensure efficient air conditioning in the X-ray room. It is recommended to keep the room temperature between +20°C and +25°C at all times.

NOTE

FOR US & CANADIAN USERS:

The patient positioning lights are class II laser products (21 CFR § 1040.10).



FOR EUROPEAN USERS:

Class 1 laser product (Standard EN 60825-1: 2007).

The patient positioning lights are class 1, inherently safe laser lights.

NOTE

External equipment intended for connection to signal input, signal output or other connectors, shall comply with relevant IEC standard (e.g. IEC 60950 for IT equipment and the IEC 60601 series for medical electrical equipment). Equipment not complying to IEC 60601 shall be kept outside the patient area (more than 2m (79 in.) from the device).

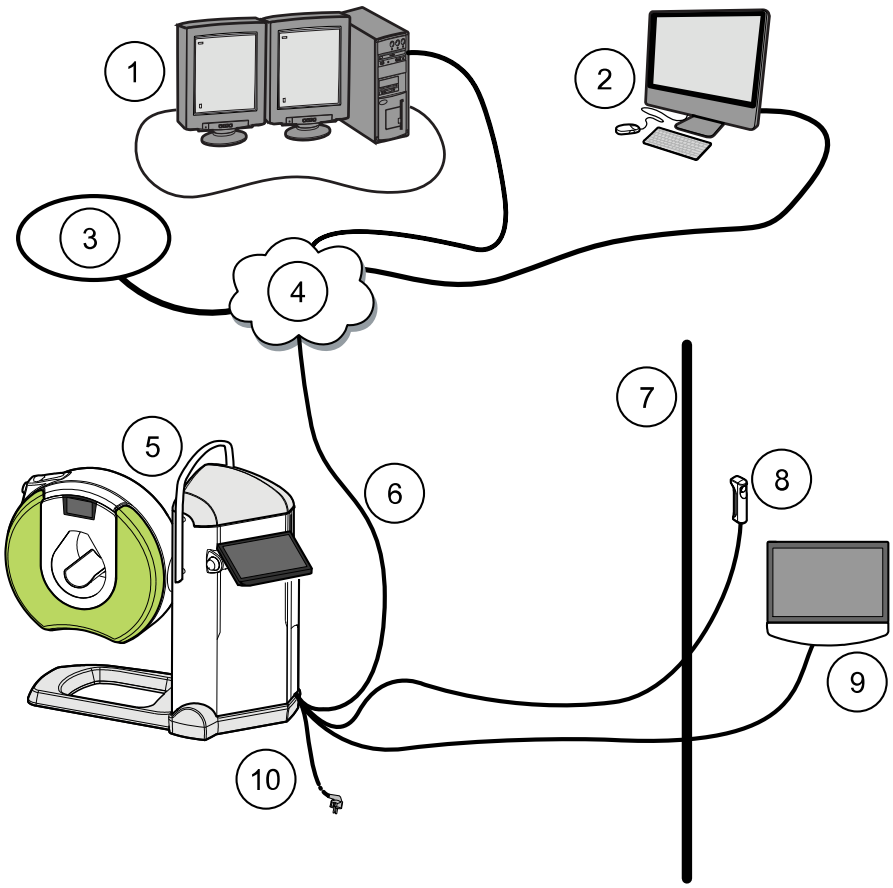
NOTE

Any person who connects external equipment to signal input, signal output or other connectors has formed a system and is therefore responsible for the system to comply with the requirements of IEC 60601-1-1. If in doubt, contact your service technician or local representative for help.

NOTE

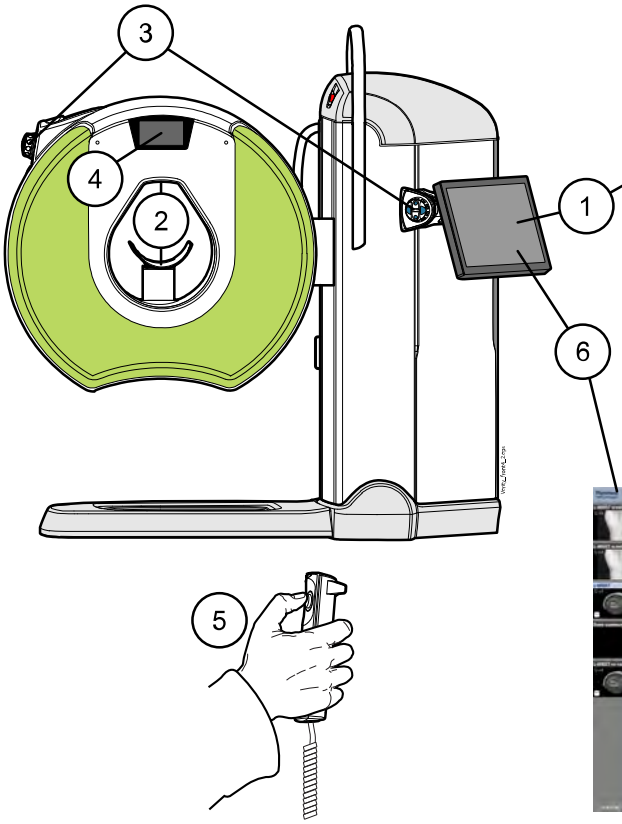
Never place or hang any objects on any part of the device.

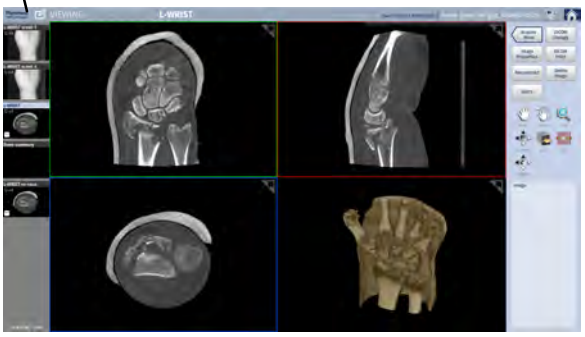
1.5 System overview



1 PACS workstation
2 Review workstation (RWS)
3 HIS / RIS
4 Private network
5 Planmed Verity
6 Ethernet cable
7 Radiation protection screen
8 Exposure switch
9 Secondary touch screen control panel (optional)
10 Power cord

1.5.1 Characteristics of use





- Selecting patient and imaging parameters:

  Patient, target and exposure parameters are selected from the touch screen **(1)**.

- Positioning the target:

  The target is positioned by attaching the appropriate positioning tray **(2)** using the positioning controls of the touch screen control panel (pre-set drive), the joysticks **(3)** and the positioning lasers with an optional positioning display **(4)**.

  The gantry can be driven up and down, tilted backwards up to 90 degrees (gantry ring is horizontal) and forwards up to 15 degrees from the vertical position.

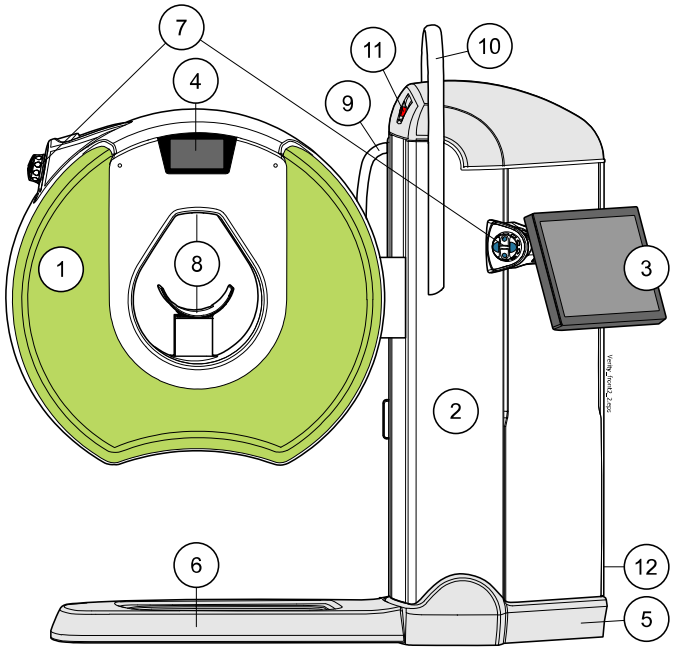
- The exposure switch is used to acquire images **(5)**.
- The acquired images are also viewed from the touch screen **(6)**.

A general Planmed Verity system setup is shown in the installation manual.

Typically, the following components are required to generate digital X-ray images of high diagnostic value:

- Planmed Verity X-ray unit
- Planmed Radiation Shield (optional); the required protection can also be provided by other means.

1.5.2 Main parts



1 Gantry
2 Vertical column
3 Touch screen control panel
4 Information screen
5 Base
6 Base support
7 Joysticks
8 Positioning lasers and trays
9 Support handle
10 Multi-purpose handle
11 Emergency stop button
12 On/Off switch (behind the door)

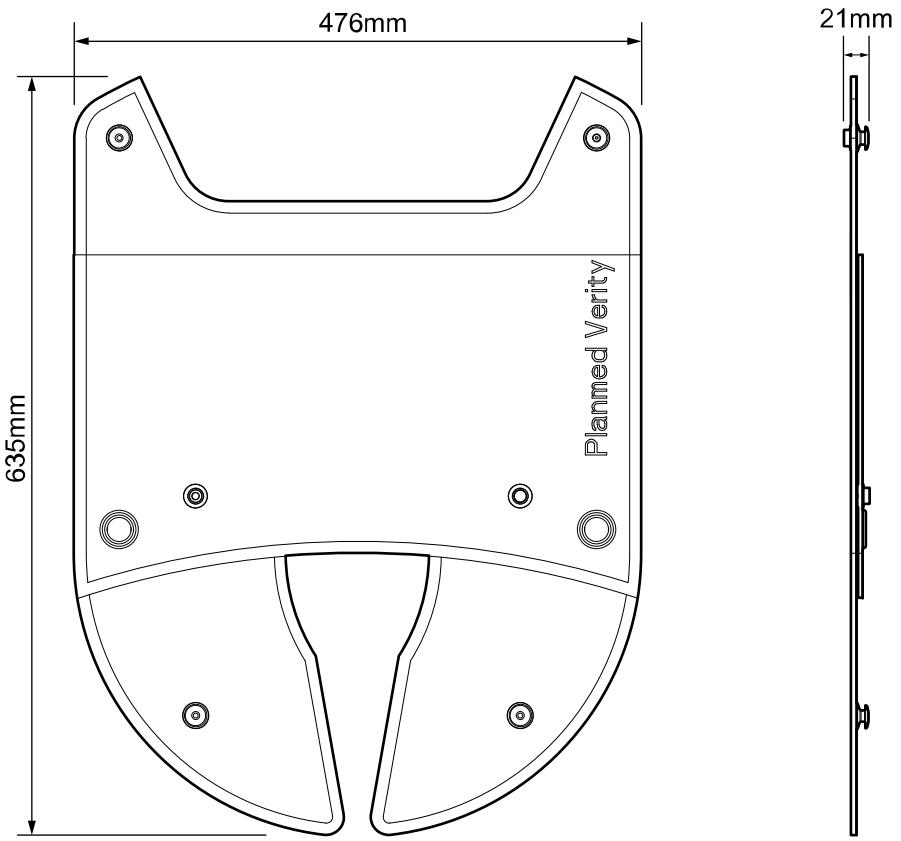
1.5.3 Accessories

The following sections list the different accessories used with the Planmed Verity extremity scanner.

1.5.3.1 Positioning trays

- Small positioning tray
- Large positioning tray
- Flat positioning tray
- Wide positioning tray
- Vertical positioning tray
- Head positioning tray (MaxScan)
- Head & Neck positioning tray

1.5.3.2 Stray radiation shield

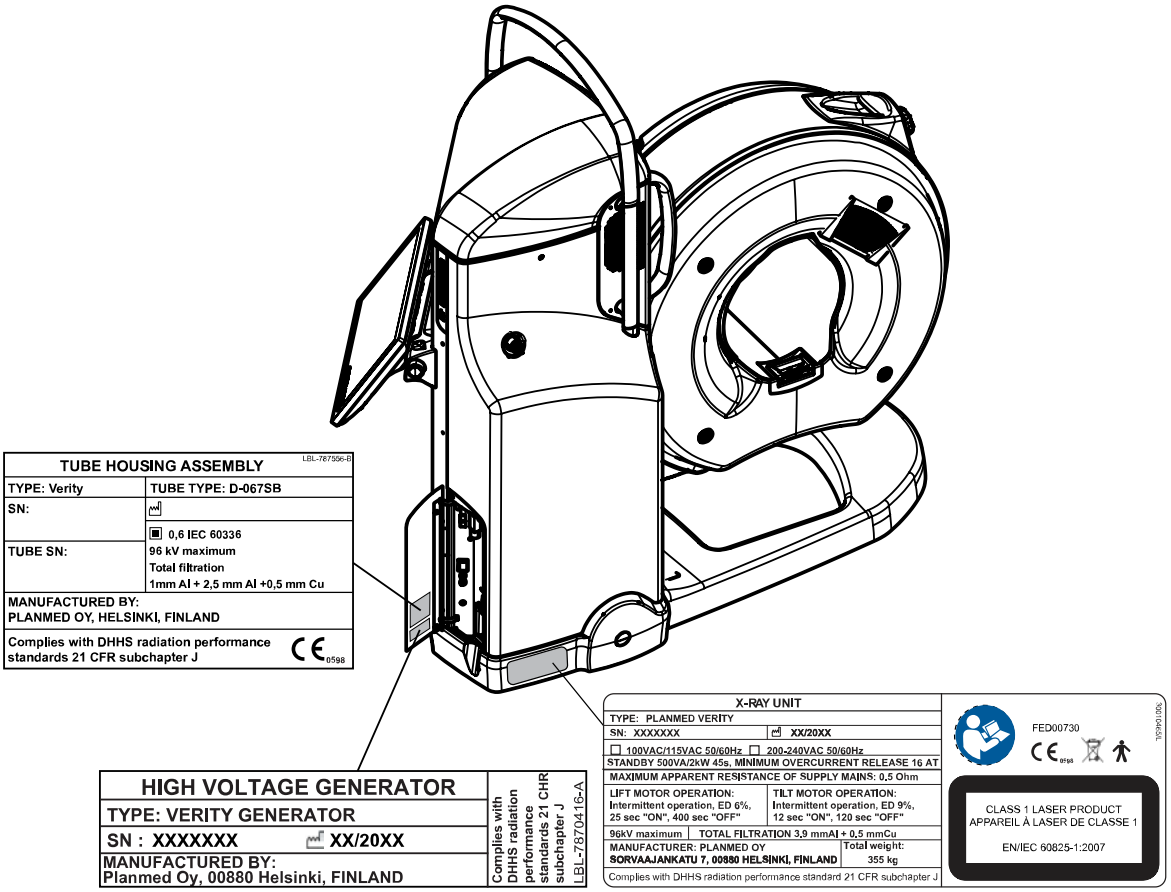


The Planmed stray radiation shield lead equivalent is 0.25 mmPb.

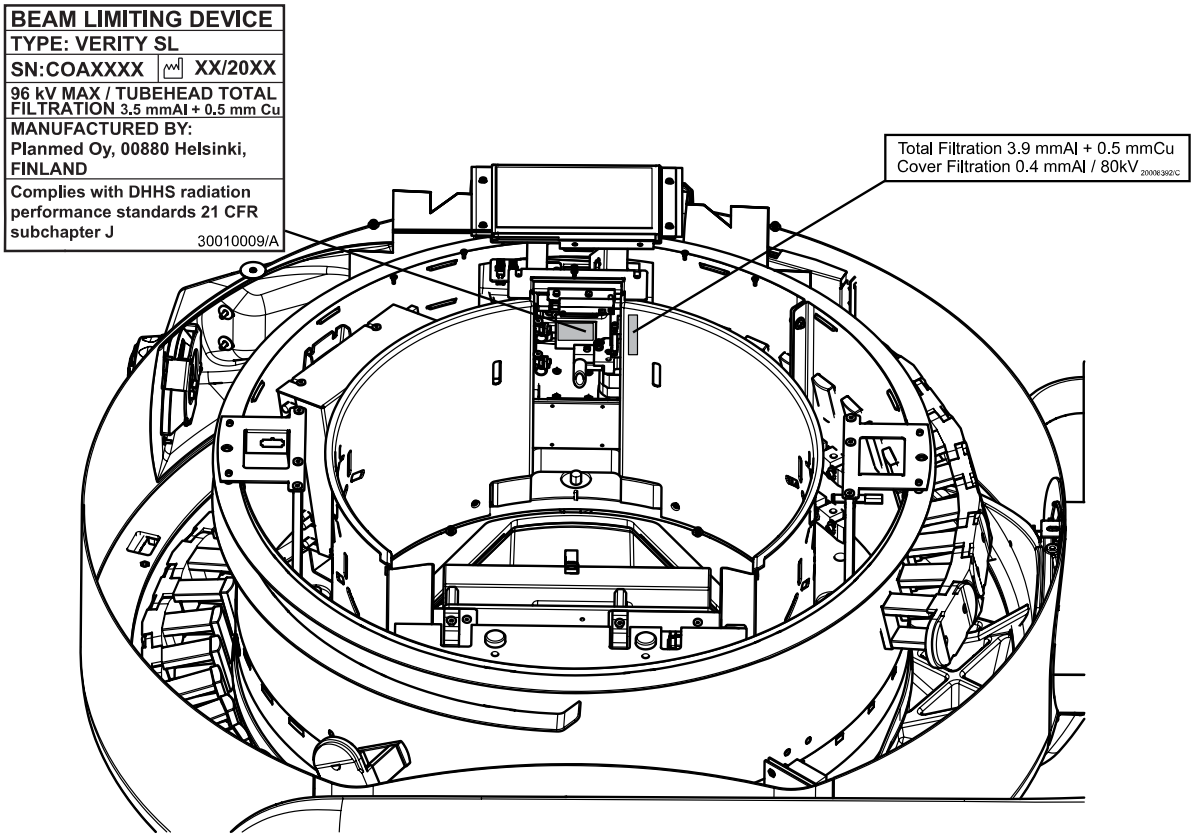
1.6 Product labels

The following sections list the different information labels on Planmed Verity, and shows their locations on the unit.

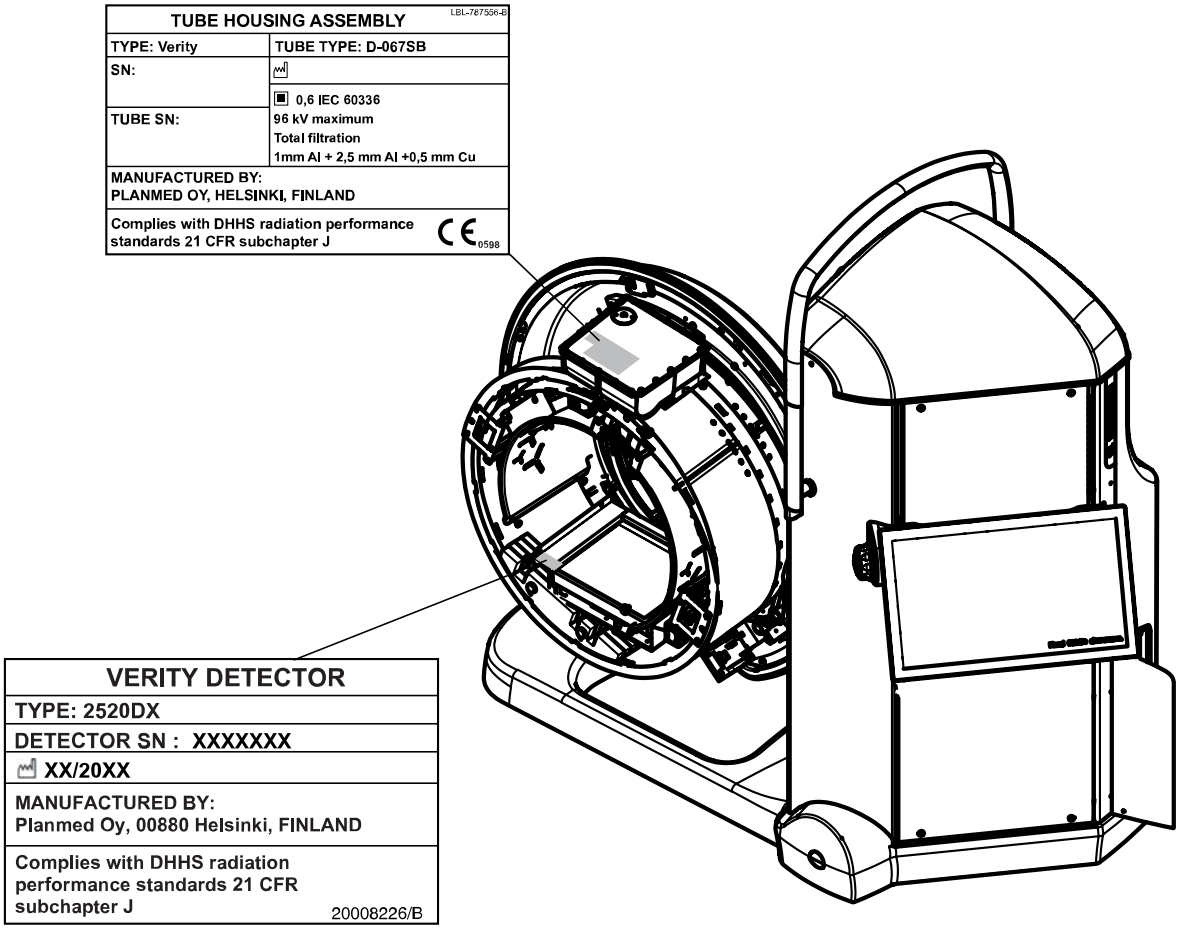
1.6.1 Planmed Verity device plate, high voltage generator & tube housing assembly labels



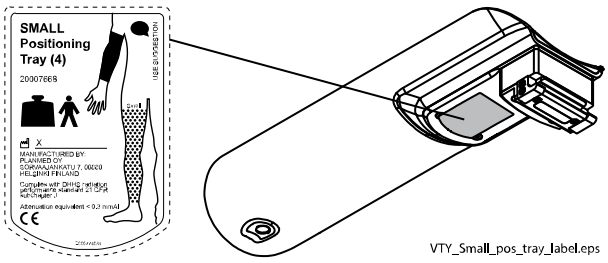
1.6.2 Collimator and tube head total filtration labels



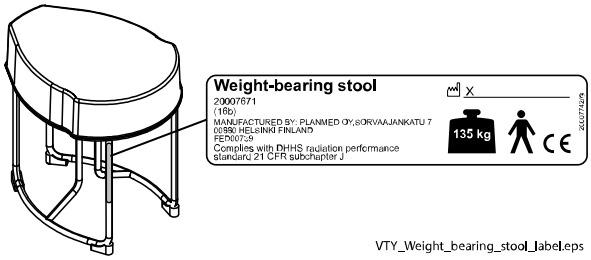
1.6.3 Tube housing assembly & detector head label

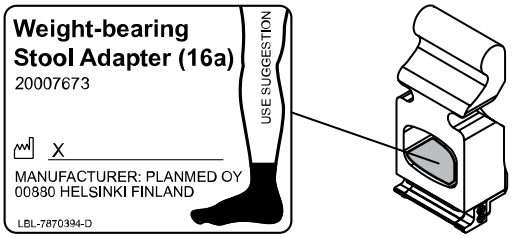


1.6.4 Positioning tray labels

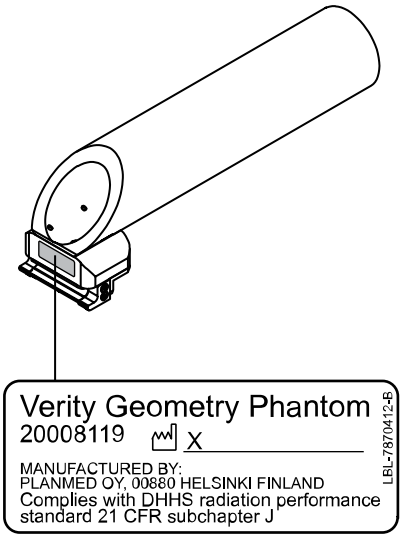


1.6.5 Weight-bearing stool labels

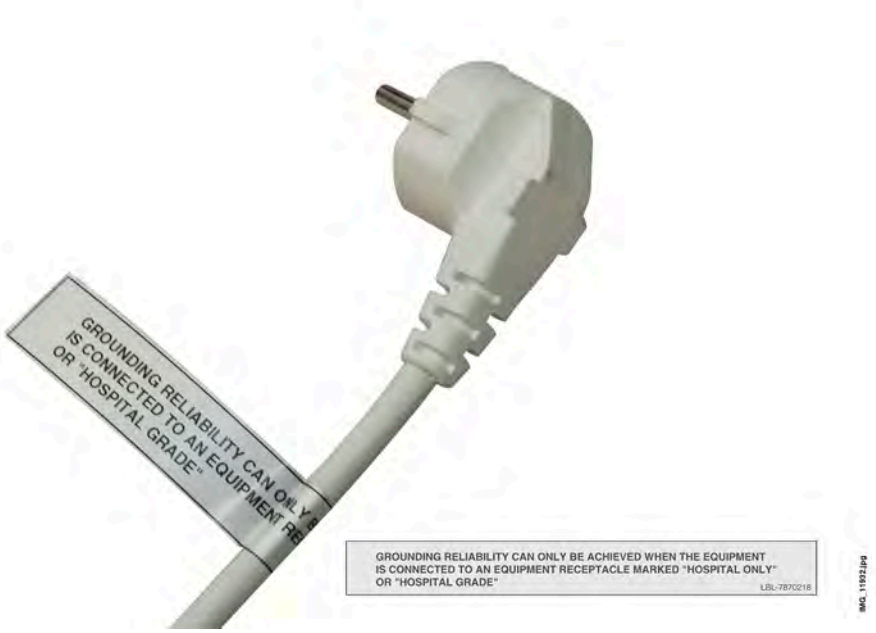




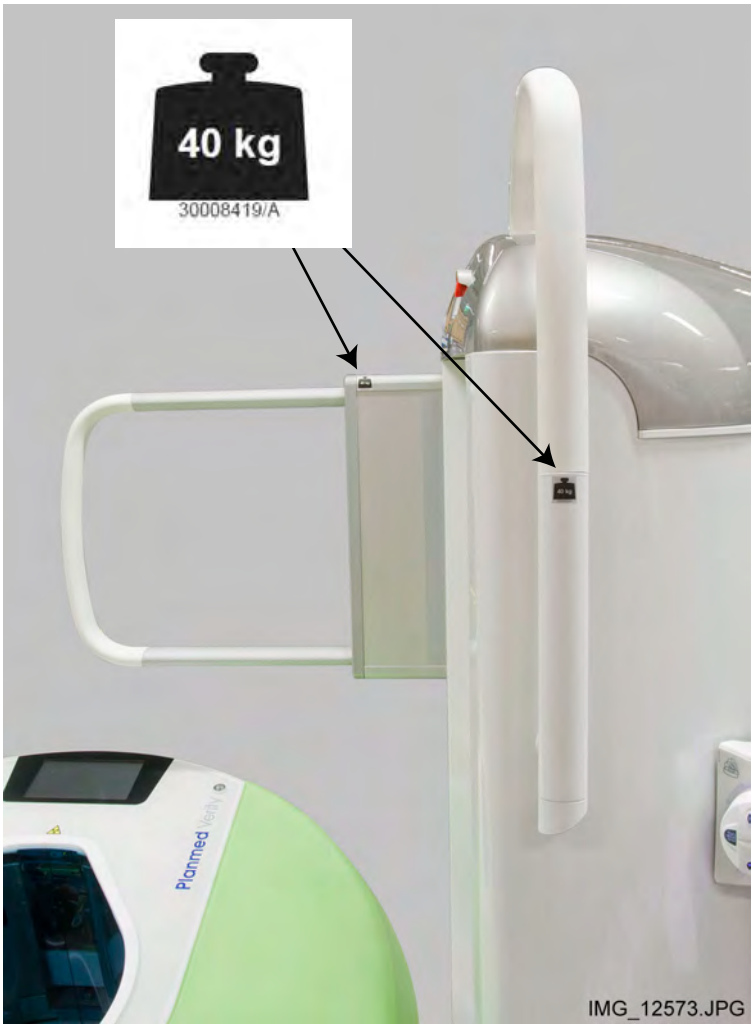
1.6.6 Phantom labels



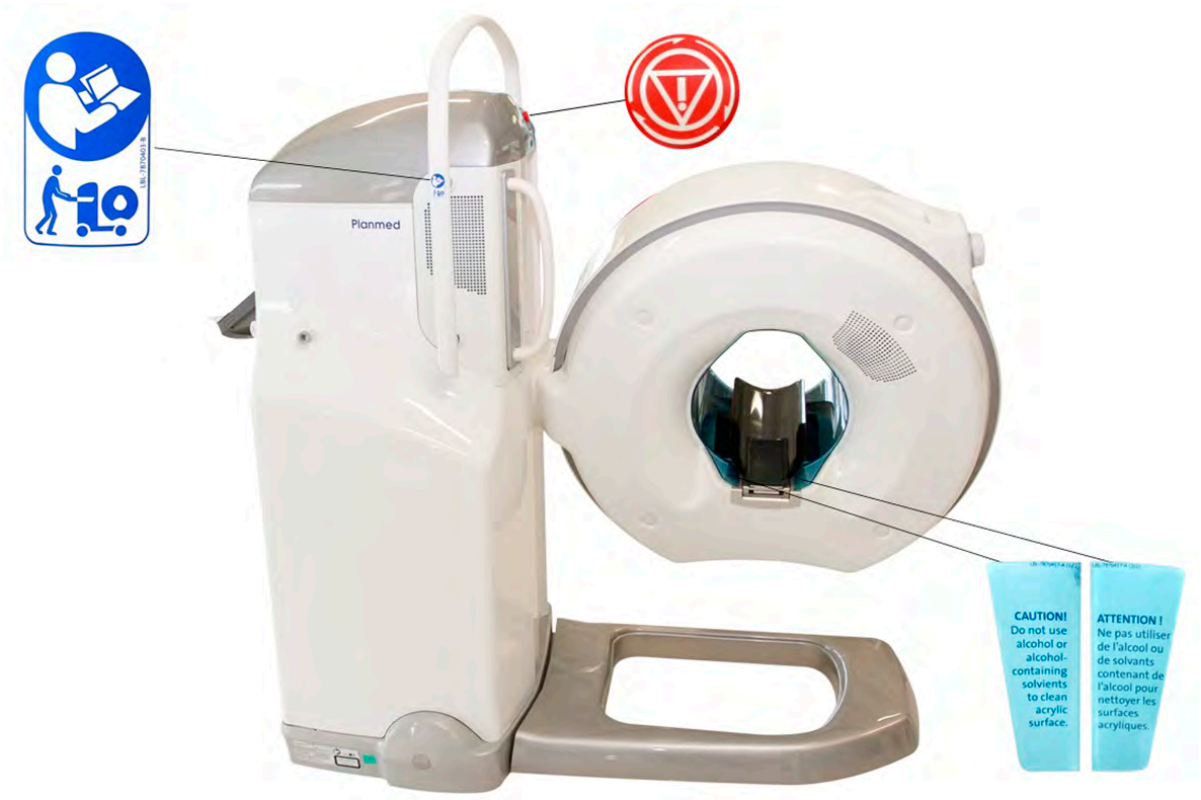
1.6.7 Power cord label

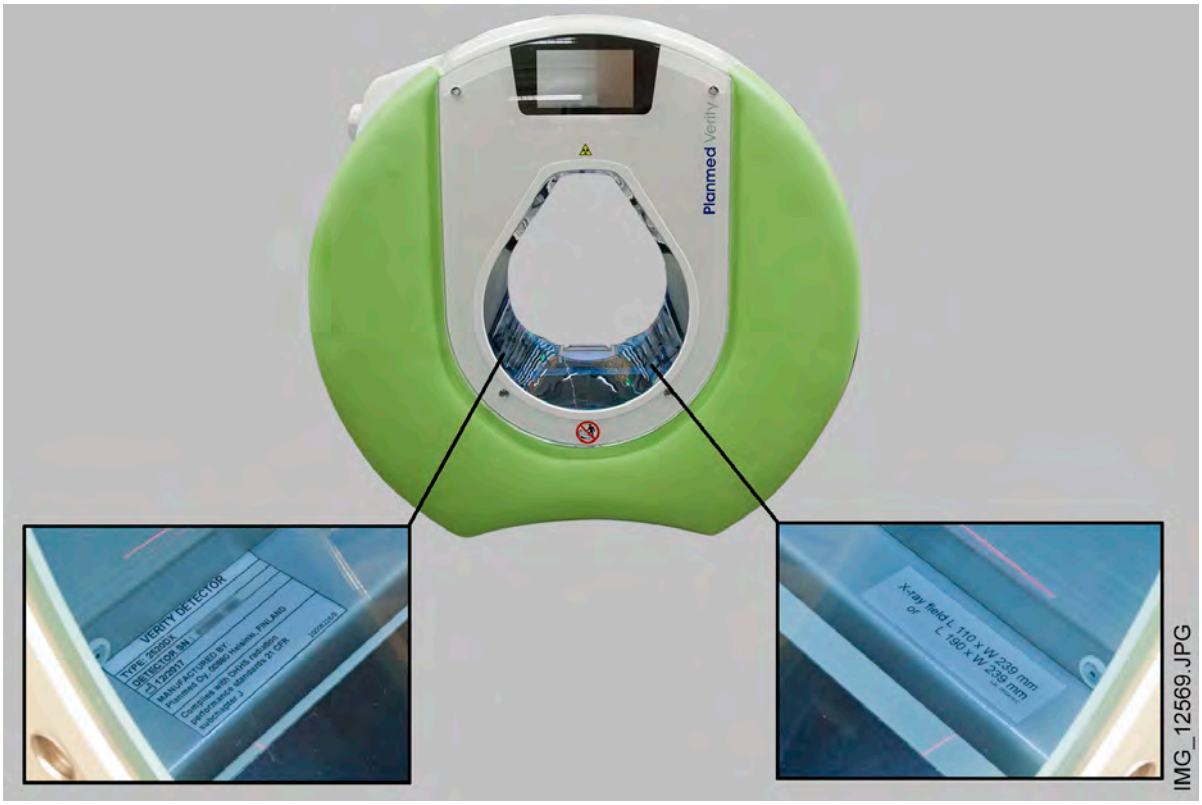


1.6.8 Multipurpose handle labels



1.6.9 Planmed Verity device notices





1.7 Software versions and compatibility

The following sections introduce the software used in the X-ray unit, its different versions and compatibility information.

1.7.1 Basic provisions

Since the Planmed X-ray unit is fully microprocessor controlled, its operation is controlled by the currently installed software. Planmed reserves the right to improve functionality or to add new features to the product by modifying the software and/or hardware. Manuals are updated accordingly and technical bulletins published in order to inform about changes or additions.

To check the latest manual and software versions as well as their compatibility information, visit the Planmed Dealer Support web pages at the address:

https://dealersupport.planmed.com

The technical bulletins can also be found there.

1.7.2 Software numbering and compatibility

The Planmed Verity unit contains Verity Manager PC software (VM) and Verity embedded software (CPU). VM and CPU software must be able to communicate together. Softwares are cross-checked during the startup sequence to ensure compatibility. In case of non- compatibility, the unit is unable to operate and software must be updated.

1.7.3 Current software versions

This technical manual is valid for the following software versions:

- Verity AWS SW 3.2.0
- Verity Embedded SW 3.2.0

If you find that your Planmed X-ray unit does not have some user interface functions, or its user interface functions differ from those described in this manual, then either the software must be replaced with at least the above mentioned version, or you have to refer to an older version of this manual. The former procedure is recommended.

1.8 Technical specifications

Component or feature	Properties
Electrical classification	Class I, type B
IP class	20
Weight	355 kg (783 lbs)
Colour	White (RAL 9016)
Generator	Verity Generator, Resonant-mode, DSP controlled, 80...160 kHz, complies with standard IEC 60601-2-7: 1998
X-ray tube	D-067SB, P
X-ray tube assembly type	Verity
Focal spot size	0.6 x 0.6 mm (according to IEC 60336)
Tube head inherent filtration	1.0 mmAl
Tube head additional filtration	0.5 mmCu + 2.5 mmAl
Tube head total filtration	0.5 mmCu + 3.5 mmAl
Cover filtration	0.4 mmAl / 80 kV
Total filtration	0.5 mmCu + 3.9 mmAl

Component or feature	Properties
Anode voltage	80 - 96 kV ±5%
Anode current	1 - 12 mA ±10%
Linearity of radiation output	< 0.1
Cooling period	Automatically controlled
Exposure time	Pulsed, effective 4.5 - 24 s, scout 2 x 20 ms
Focal Spot to Image Receptor Distance	580 mm (22.83 in.)
X-ray field size	• Large field 190 x 239 mm • Small field 110 x 239 mm
Line voltage	100/115 V~ ±10% 50/60 Hz 200-240 V~ ±10% 50/60 Hz
Line current	8A at 230V~, Max. 17A at 100V~
Line harmonics	cos better than 0.9
Max. permissible apparent impedance of supply mains	0.5 Ω (100 VAC)
Maximum continuous heat dissipation	< 600 W
Mode of operation	Continuous operation with intermittent loading

1.8.1 Fuses

FUSES	200-240V~	100V~, 115V~	TYPE
2 user replaceable fuses	8A FF	16A FF /500V	195100 ELU

1.8.2 Attenuation equivalents

Component or feature	Properties
Covers	0.4 mmAl
Small positioning tray	<0.3 mmAl
Large positioning tray	<0.3 mmAl
Flat positioning tray	<0.7 mmAl
Wide positioning tray	<0.2 mmA
Vertical positioning tray	<0.7 mmAl
Head positioning tray (MaxScan)	<1.2 mmAl
Head & Neck positioning tray	<0.7 mmAl

1.8.3 Environmental requirements

Ambient temperature (Operating)	+10°C to +35°C
Ambient temperature (Transport & Storage)	±0°C to +60°C
Humidity	10% - 90%
Ambient pressure	700 - 1060 hPa
Cooling	Sufficient cooling / ventilation must be made available and operating to guarantee above ambient temperature.

1.8.4 Original manufacturer

Planmed Oy Sorvaajankatu 7, FIN-00880 Helsinki, FINLAND
Tel. +358 20 7795 300
fax +358 20 7795 664
www.planmed.com

1.8.5 Detector

Detector specification

Feature	Properties
Detector type	VAREX Imaging Components PaxScan 2520DX
Flat panel active surface	189 x 238 mm
Pixel size	127 µm
Matrix size	1536 x 1920 pixels
Flat panel performance specification	MTF >45%@1lp/mm
Max linear dose	>5.9 uGy / frame (2 x 2 binning)
CsI scintillator thickness	700 µm

Defect specification

Type of defect	Number of defects
Defective Rows + Columns	≤ 7
Percentage of defective pixels in column or row prior to entire line being marked defective	35%
Defective Columns in the central 1/3 of array	Allowed
Double Columns	Allowed
Double Rows	Allowed
Double columns with double rows	Not allowed
Minimum separation between defective columns	1
Number of adjacent defective rows/ columns max.	0
Number of Class 4 cluster defects	N/A
Number of Class 5 cluster defects	≤ 50
Number of Class 6 cluster defects	≤ 30
Number of Class 7 cluster defects	≤ 10
Number of Class 8 cluster defects	0
Total number of individual point defects	≤ 1500

1.9 User's statement

The following sections include the user's statement data for Planmed Verity.

1.9.1 User's statement information

Feature / property	Details
Radiation leakage technique factors	At nominal tube voltage (96 kV), maximum continuous tube current is **2.6 mA**.
Filtration	The Radiation port contains additional filtration of at least **2.5 mmAl + 0.5mmCu**.
Imaging performance	MTF 10 1.25 lp / mm or more (96 kV & 4 mA)
Rated line voltage	100 - 240 V~ ±10%
Maximum line current	Maximum **17** Amperes at 100 V~, 8A at 230 V~
Technique factors that constitute the maximum line current condition	96 kV / 12 mA
Generator rating and duty cycle	**1.5 kW**, duty cycle approximately **1:10**. The wait period is calculated using the following formula: $t_w = f(HS_{MAX} - HS_1) - f(HS_0)$ where HS_{MAX} = maximum tube anode heat storage capacity (28 kJ) HS_0 = current tube anode heat storage HS_1 = heat storage caused by next intended exposure (kV x mA x s) f = tube anode cooling rate as a function of heat storage (given by tube manufacturer)
Maximum deviation of peak tube potential from indicated value	±5%
Maximum deviation of tube current from indicated value	±10%
Maximum deviation of exposure time from indicated value	±10%
Selectable mA stations	1, 1.3, 1.6, 2, 2.5, 3.2, 4, 5, 6.3, 8, 10 and 12 mA
Selectable mA stations (in calibrations and QC test)	1,2,3,4,5,6,7,8,9,10,11 and 12 mA

1.9.2 Loading factor values

The following table lists the loading factor values for reference. For more information on the loading factors and their relationships, see the following sections.

Specification (I)	Value		Specification (II)	Value
Highest tube current	12 mA	@	Nominal Voltage	96 kV
Highest tube voltage	96 kV	@	Highest tube current	12 mA
Highest electric power	1.152 kW	@	High-voltage circuit with:	
			Current	12 mA
			Voltage	96 kV
Nominal electric power	1.152 kW	@	Loading time	0.1 sec.
			Tube voltage	96 kV
			Tube current	12 mA

Specification (I)	Value		Specification (II)	Value	
Lowest current time product	4.5 mAs	-	Minimum 300 projections, 15ms/ projection	-	
Nominal shortest irradiation time	4.5 sec.	@	AEC: Minimum 300 projections, 15ms/ projection	-	
Maximum range for tube voltage	80 kV (min.) 96 kV (max.)	@	AEC: Preset kV value used	-	
Maximum range for tube current	1 mA (min.) 12 mA (max.)	@	AEC: Preset mA value adjusted ±20%	-	

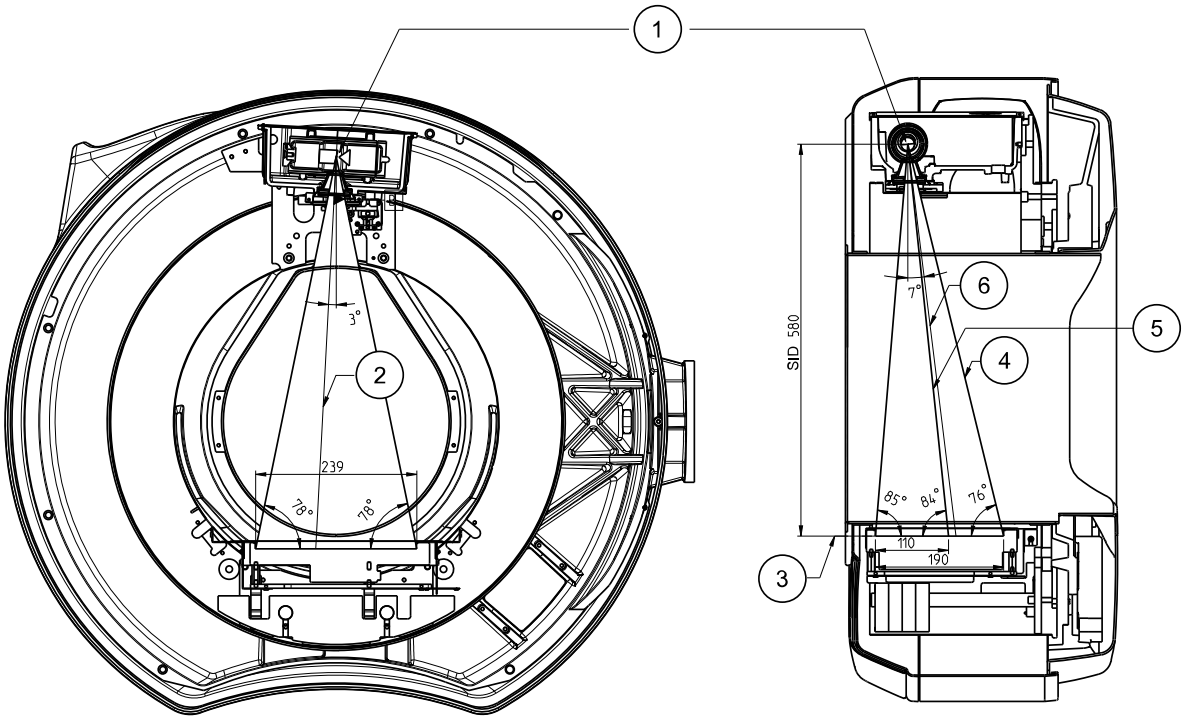
1.9.3 Definition of measurement criteria

Measurement criteria	Details
Exposure time	The beginning and end points of the exposure time are defined at **70%** of the peak radiation waveform. Measured with a calibrated X-ray monitor.
Peak tube potential	The maximum voltage difference over the X-ray tube. Measured with a calibrated non-invasive kVp meter.
Tube current	Defined by measuring the voltage difference over mA feedback resistors. The values of mA feedback resistors are known, so the mA value can be calculated from the feedback voltage.

1.9.4 Focal spot, X-ray beam and reference axis

The minimum distance between the focal spot and the bore surface is 165 mm.

The following drawing shows the position of the X-ray beam with respect to the position of the image receptor.



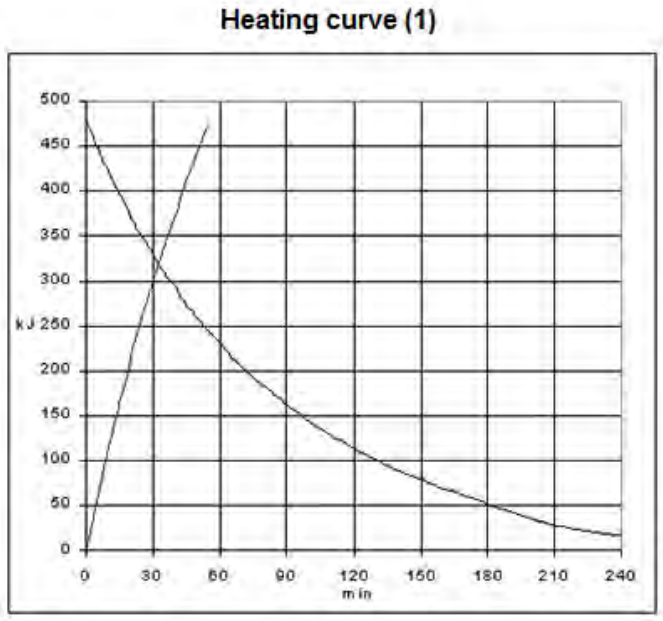
1. Focal spot	2. Reference axis	3. Imaging plane
4. Large field	5. Small field	6. Reference axis

1.9.5 Characteristics of tube head assembly

Measurement criteria	Details
Target material of the X-ray tube	Tungsten anode
Focal spot to image receptor distance	The Focal Spot to Image Receptor Distance (SID) for is 580 mm.
Target angle with respect to the reference axis	12°
Nominal focal spot value for the specified reference axis	0.6 mm
Tolerances of the focal spot on the reference axis	• X= ±0.5mm (sideways) • Y= ±0.5mm (in depth) • Z= ±0.5mm (in height)
Filtration in terms of quality equivalent filtration of the X-ray tube	Inherent filtration at least 0.8 mmAl/50 kV according to IEC 522/1976
Maximum X-ray tube assembly heat content	400 kJ
Maximum continuous heat dissipation of the X-ray tube assembly	6 kJ/min.
Dimensions of the tube head assembly	• W: 235 mm • H: 340 mm • D: 120 mm
Weight of the tube head assembly	• 10.3 kg without collimator assembly • 11.2 kg with collimator assembly

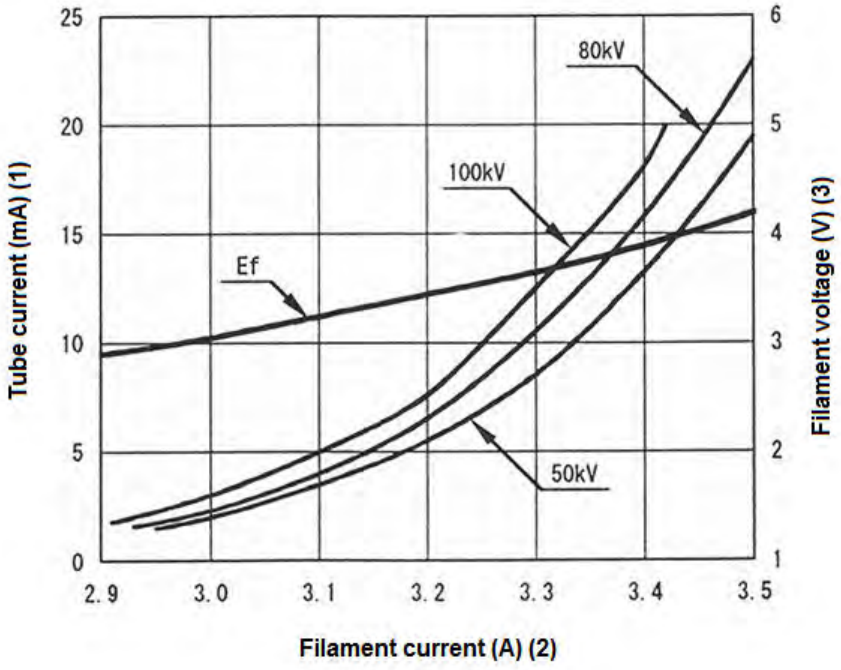
Measurement criteria	Details
Nominal anode input power of the X-ray tube	1152 W
Maximum anode heat content of the X-ray tube	35 kJ

1.9.6 X-ray tube assembly heating/cooling curve



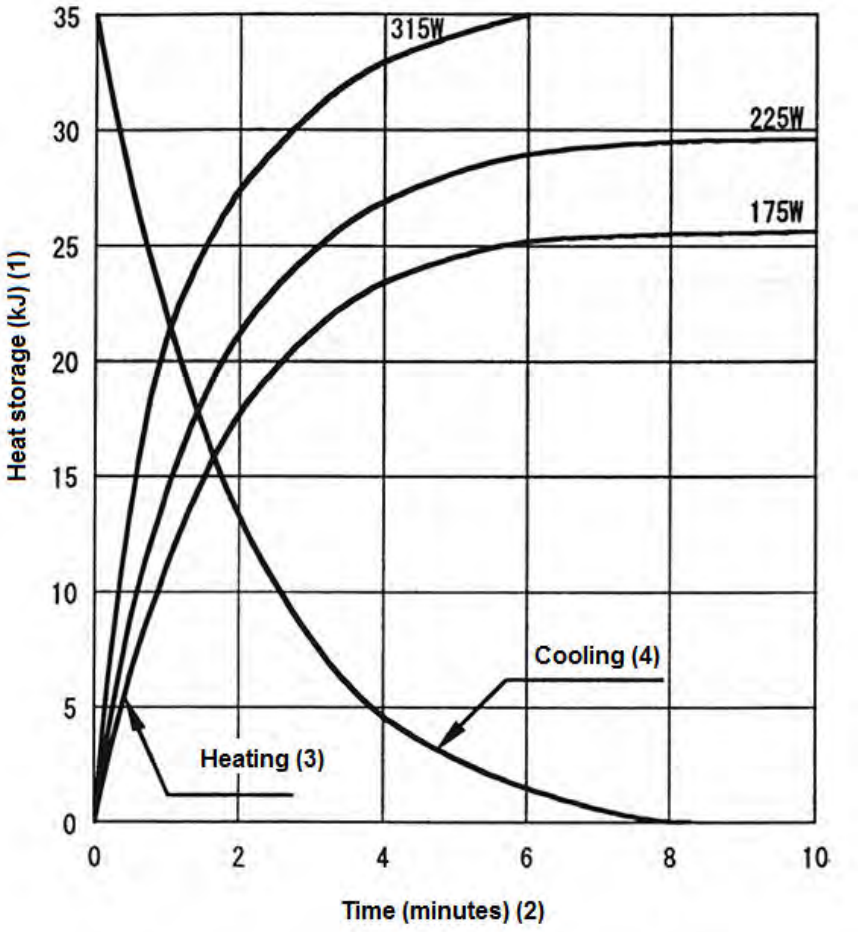
1. Heating curve	2. Cooling curve

1.9.7 Emission & filament characteristics of the X-ray tube



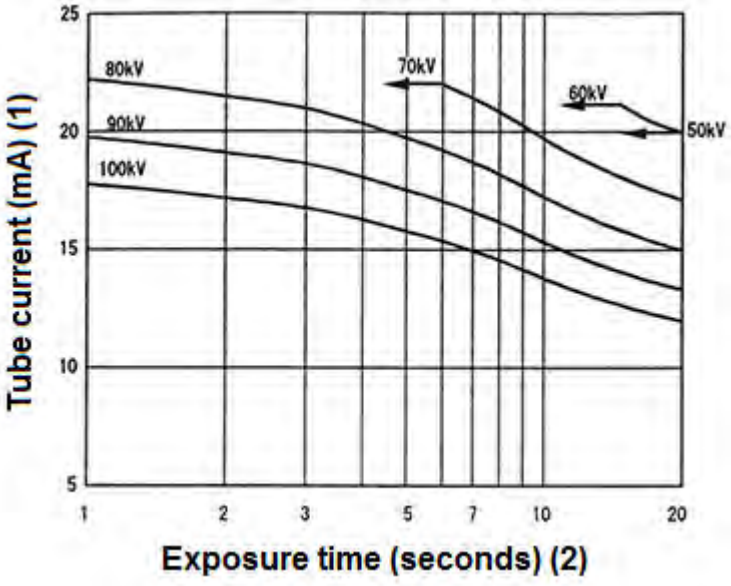
1. Tube current (mA)	2. Filament current (A)	3. Filament voltage (V)

1.9.8 Anode heating/cooling curve of the X-ray tube



1. Heat storage (kJ)	2. Time (minutes)
3. Heating	4. Cooling

1.9.9 Single load rating of X-ray tube



1. Tube current (mA)	2. Exposure time (seconds)

1.10 CTDI values

The following dose information was measured using a dosimetry phantom (head phantom) that is compatible with the specification in international standard IEC 60601-2-44.

The dosimetry phantom consists of a PMMA cylinder with a diameter of 160mm. The length of the phantom is 160mm. The phantom is no longer than the sensitive volume of the radiation detector used for the measurements. The phantom contains holes just large enough to accept the radiation detector. The holes are parallel to the axis of symmetry of the phantom and the centers of the holes are located at the center and 10mm below the surface of the phantom at 90° intervals.

Values were obtained using a dose meter manufactured by Radcal Corporation. Values are presented in milligray (mGy), except in items b) and c) where values are normalized accordingly.

Dose measurement process is as follows. First the conditions of operation are set. These conditions of operation include the parameters given in the following table:

Parameter	Range of possible values
Radiation source tube current (mA)	1.0, 1.3, 1.6, 2.0, 2.5, 3.2, 4.0, 5.0, 6.3, 8.0, 10.0, 12.0
Radiation source acceleration voltage (kV)	80, 84, 88, 90, 92, 96
X-ray beam collimation (length x diameter)	• Large volume: 100 x 160 mm • Small volume: 60 x 160 mm

After the conditions of operation have been set, the dose meter is placed inside the phantom, the dose meter display is reset and exposure is commenced. Dose meter display is recorded after the exposure.

1.10.1 Dose statements

a)

Default scanner conditions of operation in items a) 1- 3 are:

tube voltage: 90 kV

tube current: 10 mA

X-ray beam collimation: large volume

1.

$CTDI_{100\ (center)}$ = 4.06 mGy

2.

The location of the position where the CTDI100 at 1 cm interior to the surface of the phantom is maximum as specified in this item is on the midsagittal line of the imaged volume, superior to the axis of rotation.

$CTDI_{100\ (peripheral,\ max)}$ = 7.30 mGy

3.

90°:$CTDI_{100\ (peripheral,\ 90°)}$ = 5.18 mGy

180°:$CTDI_{100\ (peripheral,\ 180°)}$ = 1.89 mGy

270°:$CTDI_{100\ (peripheral,\ 270°)}$ = 4.64 mGy

4.

The average peripheral $CTDI_{100}$ value, $CTDI_{100\ (peripheral)}$ = 5.01 mGy

b)

NOTE

Values in this item are normalised to the $CTDI_{100\ (center)}$ in item a) 1).

Deviation from the default scanner conditions of operation	Relative $CTDI_{100\ (center)}$
X-ray tube voltage: 96 kV	1.292
X-ray tube voltage: 80 kV	0.606
X-ray tube current: 2 mA	0.20
X-ray tube current: 12 mA	1.20
Beam collimation: Small volume	0.743

c)

NOTE

Values in this item are normalised to the $CTDI_{100\ (peripheral,\ max)}$ in item a) 2).

Deviation from the default scanner conditions of operation	Relative $CTDI_{100\ (peripheral,\ max)}$
X-ray tube voltage: 96 kV	1.272
X- ray tube voltage: 80 kV	0.621

d)

Maximum deviation from the values given in items a), b) and c) is ±20%.

1.10.2 CTDIvol calculation

NOTE

The following section presents the method for calculating the $CTDI_{vol}$ value on the Verity Manager interface. All values are based on the manufacturer's measurements and may have minor variations between units.

$CTDI_{vol}$ has limited feasibility for CBCT applications as the size of the X-ray field exceeds the length of the probe used for $CTDI_{100}$ measurements.

The $CTDI_{vol}$ value shown on the user interface is based on following formula:

$$CTDI_{vol} = CTDI_{vol,ref} * \frac{mA}{mA_{ref}} * \frac{t_{pulse}}{20} * \frac{n}{300}$$

Where $CTDI_{vol,ref}$ is dependent on selected collimation and tube voltage according to the following table:

Tube voltage [kV]	Small collimation	Large collimation
96	6.62	5.5
92	5.65	4.7
90	5.18	4.29
88	4.75	3.95
84	3.92	3.27
80	3.12	2.64

mA_{ref} is 9.5 [mA]

t_{pulse} is 20 [ms]

n is the number of projections

mA is the used tube current [mA]

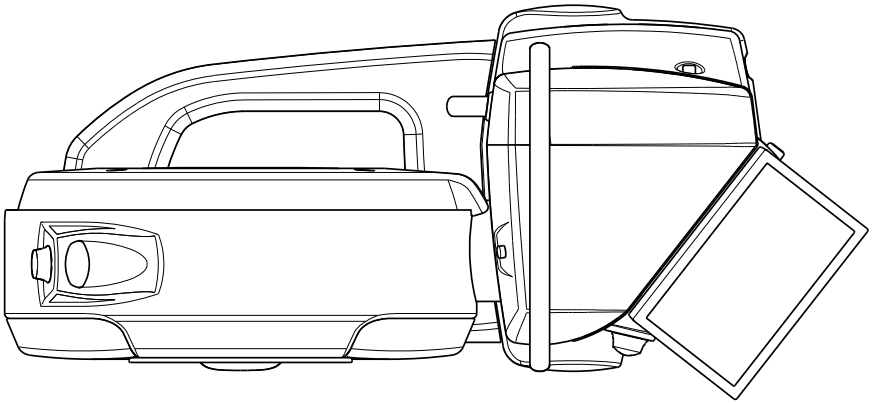
1.11 Stray radiation measurements

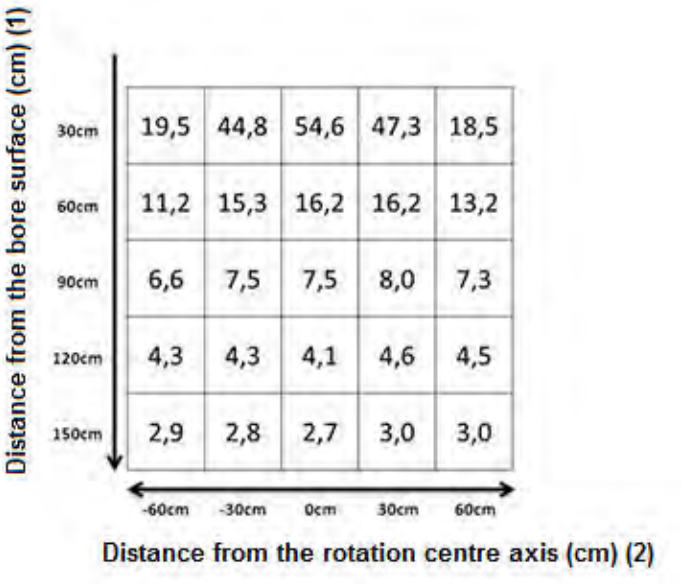
The measurements are given for loading factors which result in the maximum local dose per current time product. The loading factors include the highest selectable X-ray tube voltage (i.e. 96 kV, 12 mA, 6 s).

Planmed quality control phantom was positioned at the centre axis of the field of view.

The values were measured in the horizontal plane which was at the height of the centre axis of the field of view. All values are given in micrograys (µGy).

The stray radiation measurements have been carried out without a stray radiation shield.





1 Distance from the bore surface (cm)
2 Distance from the rotation centre axis (cm)

1.12 Handling precautions for PCBs and software chips

The following sections outline the precautions for safely handling PCBs and software chips.

1.12.1 Handling printed circuit boards

The circuit boards are well protected against static discharges when they are in the unit. However, some precautions are necessary when handling the boards since some internal nodes on the PCBs can easily be damaged by static electricity. This is true especially during low humidity conditions when there is a potential risk of static discharges.

WARNING

IMPROPER HANDLING MIGHT CAUSE DESTRUCTIVE DAMAGE TO THE CIRCUIT BOARDS. WARRANTY DOES NOT COVER SUCH DAMAGES.

Keep these few simple rules in mind when handling PCBs or software chips:

- Grounding wrist-straps are recommended but not necessarily required when handling the boards as long as you first always touch a grounded exposed metal part in the unit before touching the PCB.

- Place the removed PCB immediately in an antistatic plastic bag without landing it anywhere else in between. PCBs for warranty replacement must be returned to the factory properly packaged in antistatic plastic bags.
- Never place a removed PCB on any surface or hand it to another person without touching the surface or the person first.

1.12.2 Handling software flash memory chips

It is strongly recommended that the software is always upgraded electronically. If this is done by replacing the software chips, avoid static discharge problems by following the same rules that apply for PCBs, see section "Handling printed circuit boards" on page 28.

Software flash memory chips must always be stored in their specific anti-static plastic tubes that also protect them mechanically. A mechanically damaged chip might also damage the mating socket on the CPU board!

Since the software chips used are of the PLCC type (plastic leadless chip carrier), they must be removed only using a proper extracting tool (see the spare part manual for details). Using any other tool for removal can seriously damage the sockets on the CPU board.

1.13 EMC information

WARNING

Use of any accessories and cables other than those specified in Planmed Verity accompanying documentation, with the exception of cables sold by Planmed as replacement parts for internal components, may result in increased emission or decreased immunity of the device.

WARNING

Planmed Verity should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the device should be observed to verify its normal operation in the configuration in which it is used.

CAUTION

To make sure electromagnetic emissions and immunity do not degrade over the lifetime of the equipment, do not modify the Verity system in any way. Only qualified Planmed service technicians may conduct service and maintenance procedures.

Guidance and manufacturer's declaration - electromagnetic emissions

The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.

Emissions test	Compliance	Electromagnetic environment – guidance
RF emissions CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.

Emissions test	Compliance	Electromagnetic environment – guidance
RF emissions CISPR 11	Class B	The device is suitable for use in professional healthcare environment. Such environments are hospitals, clinics, multiple treatment or intensive care facilities, emergency rooms, patient rooms, physician offices and similar.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC 61000-3-3	Complies	

Guidance and manufacturer's declaration - electromagnetic immunity

The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15 kV air	±8 kV contact ±15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/ burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/ output lines	±2 kV for power supply lines ±1 kV for input/ output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line to line ±2 kV line to earth	±1 kV line to line ±2 kV line to earth	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips and voltage variations on power supply input lines	0 % U_T; 0,5 cycle at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315°	0 % U_T; 0,5 cycle at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315°	Mains power quality should be that of a typical commercial or hospital environment. If the user of the device requires continued operation during power mains interruptions, it is recommended that the device be powered from an uninterruptible power supply.
IEC61000-4-11	0 % U_T; 1 cycle and 70 % UT; 25/30 cycles (50/60Hz) at 0°	0 % U_T; 1 cycle and 70 % UT; 25/30 cycles (50/60Hz) at 0°	
Voltage interruptions	0 % U_T; 250/300 cycle	0 % U_T; 250/300 cycle	
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	30 A/m	30 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment. The power frequency magnetic field should be measured in the intended installation location to assure that it is sufficiently low.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment guidance
NOTE U_T is the a.c. mains voltage prior to application of the test level.			
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** **d = 1.2 √P** **d = 1.2 √P (80 MHz to 800 MHz)** **d = 2.3 √P (800 MHz to 2.5 GHz)** where **P** is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and **d** is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 
ISM band (industrial, scientific and medical)	6.765 to 6.795 MHz; 13.553 to 13.567 MHz; 26.957 to 27.283 MHz; 40.66 to 40.70 MHz	6 Vrms	
Amateur radio band	1.8 to 2.0 MHz; 3.5 to 4.0 MHz; 5.3 to 5.4 MHz; 7 to 7.3 MHz; 10.1 to 10.15 MHz; 14 to 14.2 MHz; 18.07 to 18.17 MHz; 21.0 to 21.4 MHz, 24.89 to 24.99 MHz; 28.0 to 29.7 MHz and 50.0 to 54.0 MHz	6 Vrms	
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.7 GHz	3 V/m	
Radiated RF spot frequencies IEC 61000-4-3	385 MHz, 27 V/m; 450 MHz, 28 V/m; 710, 745, 780 MHz, 9 V/m; 810, 870, 930 MHz, 28 V/m; 1720, 1845, 1970 MHz, 28 V/m; 2450 MHz, 28 V/m; 5240, 5500, 5785 MHz, 9 V/m		

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment guidance
NOTE At 80 MHz and 800 MHz, the higher frequency range applies. **NOTE** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the device is used exceeds the applicable RF compliance level above, the device should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the device. [b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.			

Recommended separation distances between portable and mobile RF communications equipment and device

The device is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the device as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	Separation distance according to frequency of transmitter m		
	150 kHz to 80 MHz d = 1.2 √P	80 MHz to 800 MHz d = 1.2 √P	800 MHz to 2.5 GHz d = 2.3 √P ()
0.01	0.2	0.2	0.3
0.1	0.4	0.4	0.7
1	1.2	1.2	2.4
10	4.0	4.0	8.0
100	12.0	12.0	24.0
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.			
NOTE At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies. **NOTE** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

2 Service and configuration

NOTE

This section is intended to be used by qualified Planmed representatives only. By default these settings do not need to be modified.

2.1 Accessing Service mode

To access the Service mode touch the *Options* arrow and select **Service**.

To save the changes made in the Service mode, touch **Save**. To restore previous settings, touch the **Restore** button.

2.2 Device

The *Device* tab shows the general device information and settings. The following sections describe the information in more detail.

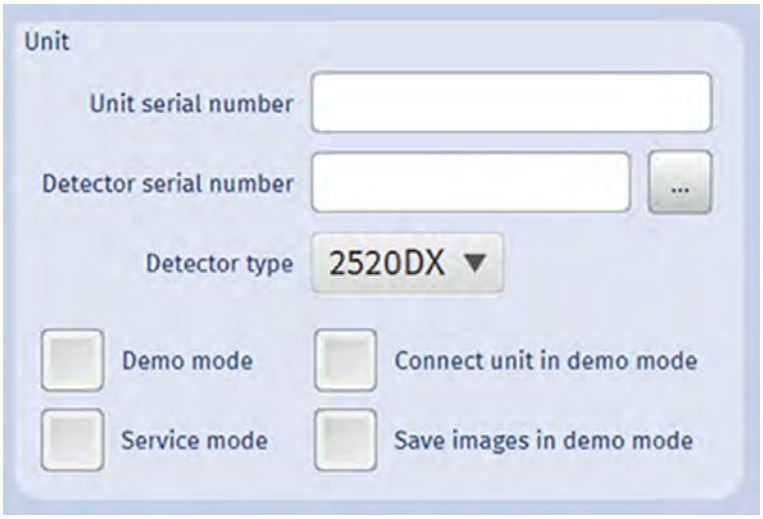
NOTE

Normally no modifications are required to this tab.

CAUTION

Only a qualified service technician is allowed to modify these settings.

2.2.1 Unit



2.2.1.1 Unit serial number

The device serial number is set at the factory and is printed in the Quality Control (QC) reports.

2.2.1.2 Detector serial number

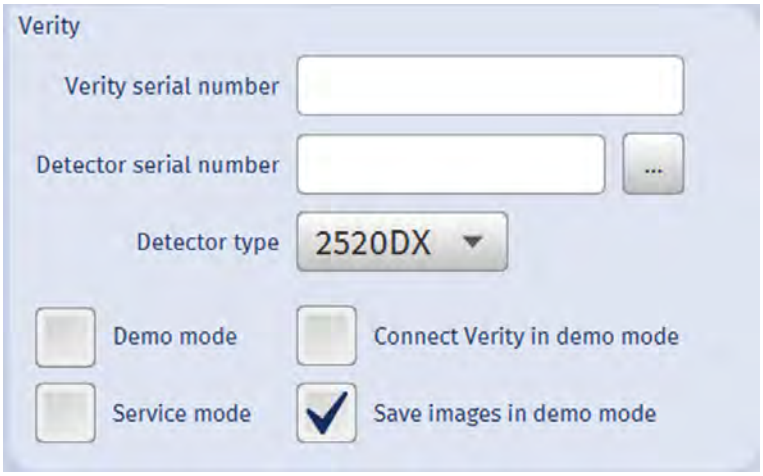
The serial number is required for detector communication. The serial number can be automatically found.

To search for a file containing the detector serial number:

1. Touch the square next to the *Serial number* field to open the right folder. The folder opens in a new window.
2. Select the appropriate file.

2.2.1.3 Detector type

The scanner supports two different detector types. Select the suitable detector type from the drop-down menu.



2.2.1.4 Demo mode

Apart from demonstration purposes the *Demo* mode can be used for fine-tuning image display. No exposures can be taken in Demo mode.

2.2.1.5 Connect Verity in demo mode

Select this option to allow pre-set movements while in demo mode. If there is no connection to the system, deselect this option.

2.2.1.6 Service mode

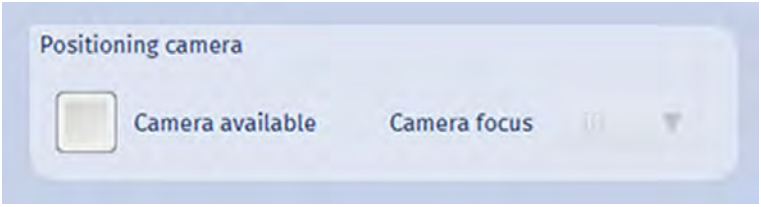
Use this mode when performing service operations.

2.2.1.7 Save images in demo mode

This option needs to be selected to be able to use the *Slicer* tool in Demo mode.

2.2.2 Positioning camera

This option refers to the small multi-purpose display and camera in front of the gantry. This option must be selected before camera availability can be selected.



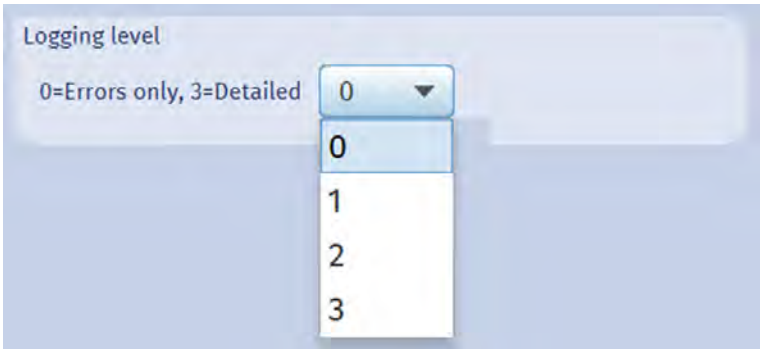
To enable the positioning camera check the *Camera available* option.

The *Camera focus* setting defines the focus distance from the target.

Select the suitable focus between 2 and 20. The default value is **10**.

2.2.3 Logging level

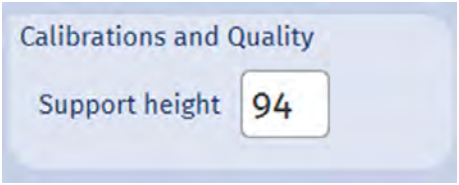
Select the appropriate level of details in the error log. The greater the value the more detailed the logging description. The default level is 0.



2.2.4 Calibrations and quality

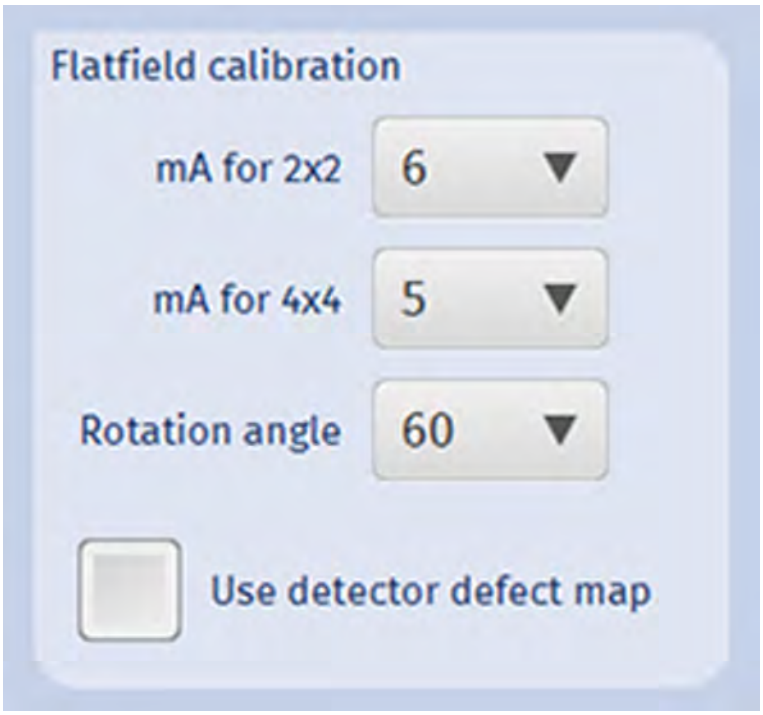
Support height

Enter the appropriate value to define the height (in millimetres) of the geometry calibration phantom. The default value is 94.



2.2.5 Flatfield calibration

In this section the default exposure values used in flat field calibration can be selected.



NOTE

If the *Use detector defect map* checkbox is checked, the detector manufacturer's defect map is used as the basis of the defect map created during flatfield calibration.

2.2.5.1 mA for 2x2

Select suitable value from the drop-down menu. The default value is 6 mA.

2.2.5.2 mA for 4x4

Select suitable value from the drop-down menu. The default value is 5 mA.

2.2.5.3 Rotation angle

Select suitable rotation angle for flat field calibration from the drop-down menu. The default value is 60.

2.2.6 Geometry calibration

2.2.6.1 kV

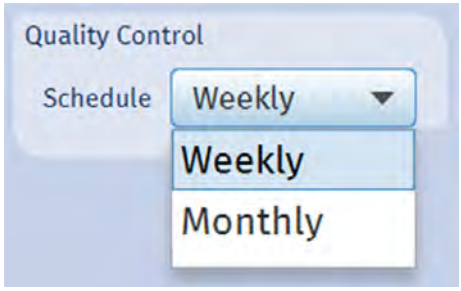
Select suitable kV value for geometry calibration from the drop-down menu. The default value is 92.

2.2.6.2 mA

Select suitable mA value for geometry calibration from the drop-down menu. The default value is 8.0.

2.2.7 Quality Control

Select the suitable time frame in which to perform quality control.

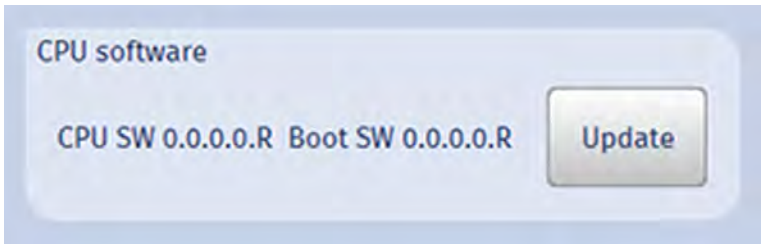


2.2.7.1 Schedule

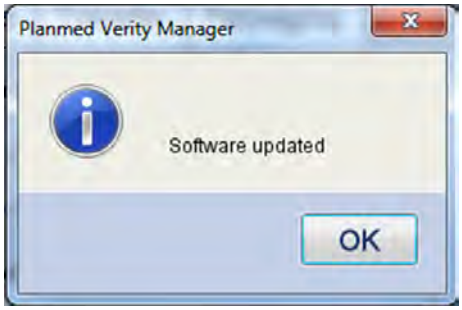
Select the appropriate schedule form the drop-down menu.

2.2.8 CPU software

To update the CPU software touch the **Update** button. Select the correct file.

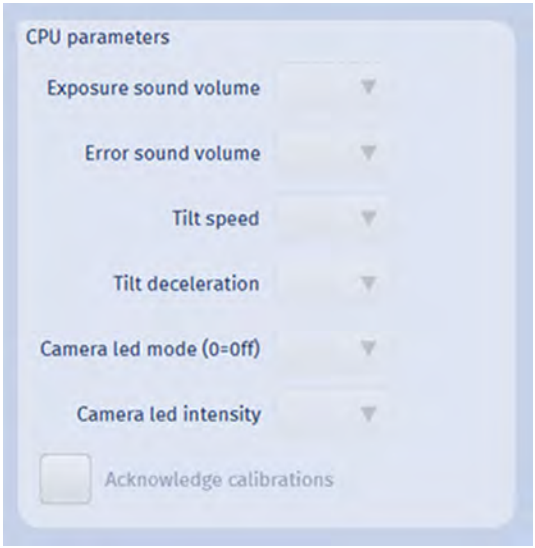


When the software has been successfully updated the following window appears.



2.2.9 CPU parameters

The following sections describe the *CPU parameters* options.



2.2.9.1 Exposure sound volume

To adjust the volume level of the device generated exposure sound, select appropriate value from the drop-down menu between 2 and 24. The default volume level is 6.

NOTE

This option does not affect the exposure switch sound volume.

2.2.9.2 Error sound volume

To adjust the volume level of the device generated error sound, select the appropriate value from the drop-down menu.

2.2.9.3 Tilt speed

The tilt speed of the gantry can be adjusted between 4 and 10.

2.2.9.4 Tilt deceleration

The tilt deceleration of the gantry can be adjusted between 0 and 4. The higher the number, the slower the tilt movement starts.

2.2.9.5 Camera LED mode (0 = Off)

The LED lights are designed to aid the positioning of the extremity. They will improve camera functionality in low lighting conditions by ensuring sufficient lighting without external atmosphere lighting.

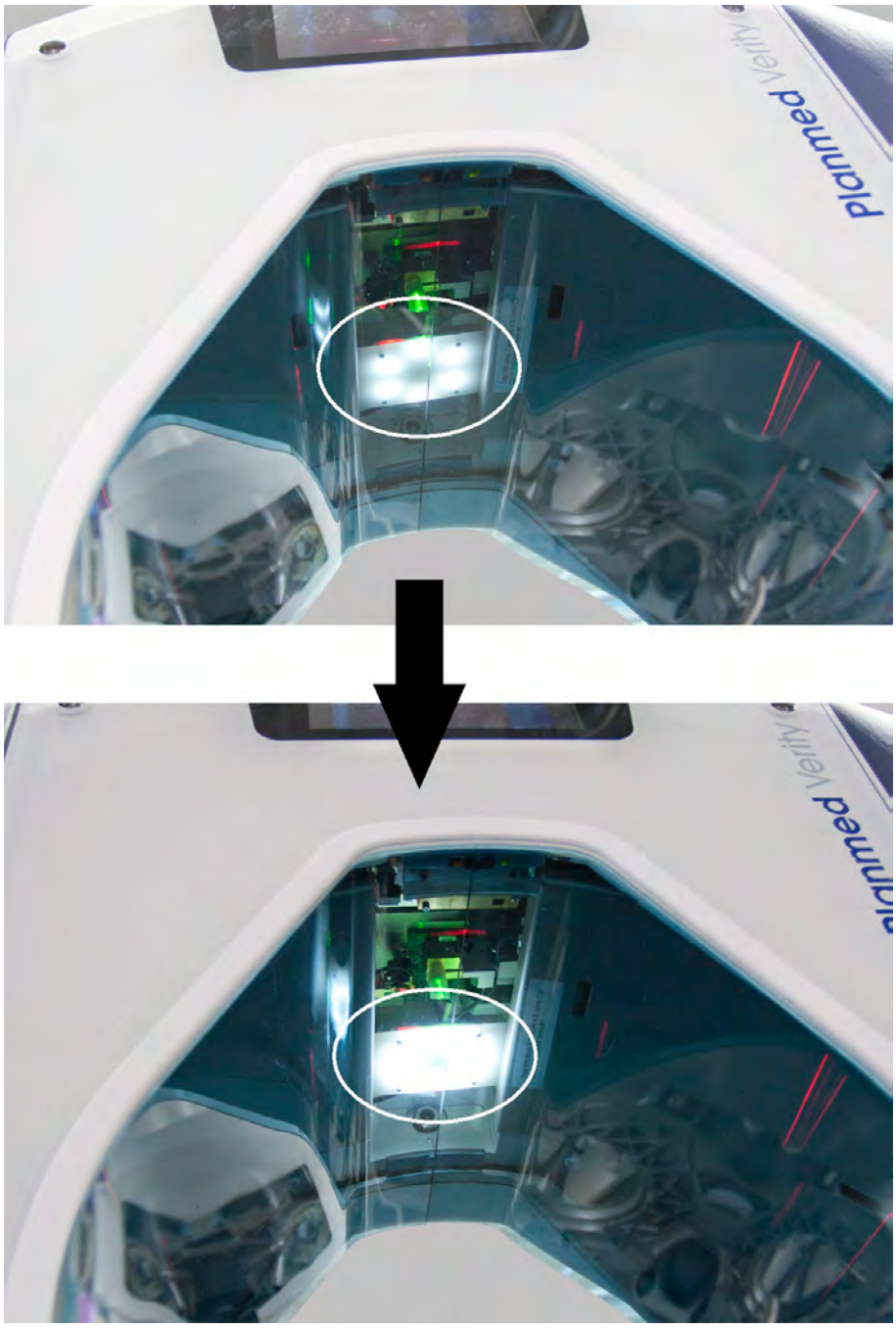
You can select the number of LED's on during positioning.

- 0: all LEDs off
- 3: all LEDs on

The camera LED is activated automatically when an extremity is inserted into gantry bore.

2.2.9.6 Camera LED intensity

The intensity of the camera LED can be adjusted between 0 (LED off) and 10. By adjusting the value you can see how it affects the intensity of the light.



2.2.10 Tube parameters

Exposure count indicates the amount of exposures taken.

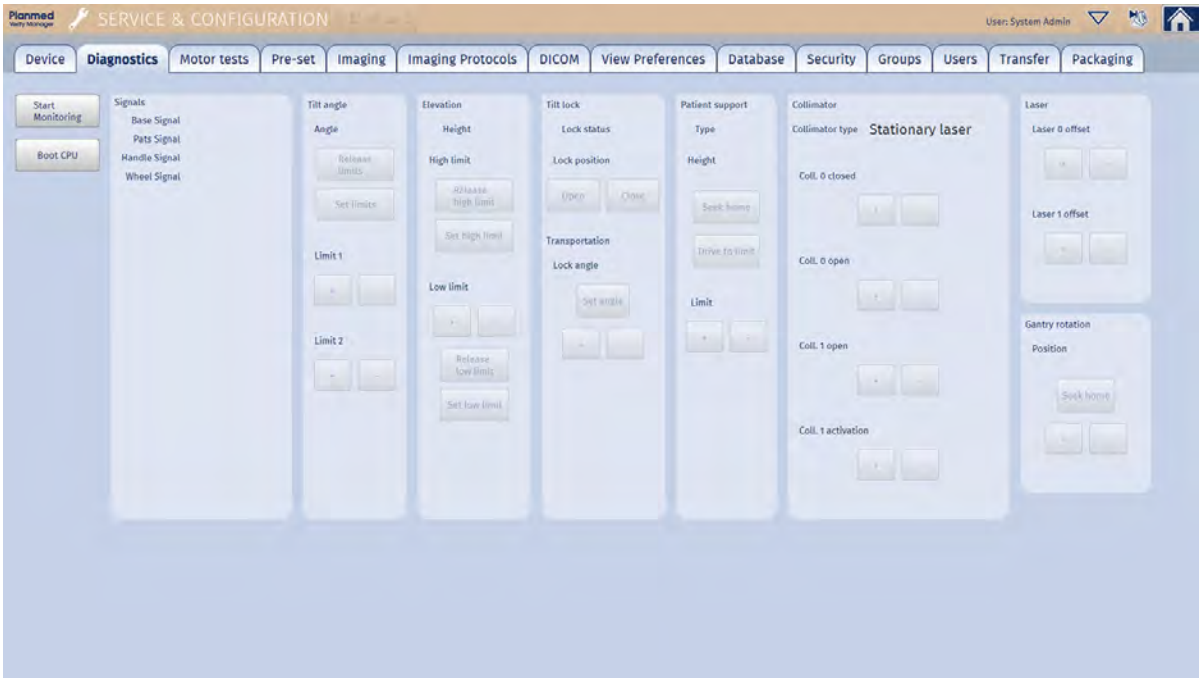
2.3 Diagnostics

The *Diagnostics* tab is intended for the adjustment of the movement limits and positions of the X-ray unit's imaging devices.

The following can be adjusted:

- C-arm rotation
- Vertical movement
- Tube head/collimator
- Laser lights

Limits must be set during repairs if essential components have been replaced or removed.



When to calibrate the movements:

- After changing critical parts that are related to the gantry movements
- After updating the CPU software if new parameters are added
- If there's a malfunction for e.g. in the gantry locking mechanism

NOTE

Before starting the calibrations, touch Start Monitoring.

2.3.1 Tilt angle

NOTE

Calibrate the Tilt angle before calibrating other movements.

Angle is the tilt angle of the gantry from the weight-bearing imaging position.

The *Limit 1* and *Limit 2* show the limit values for the rotation of the gantry.

1. Touch **Release limits**.
2. Manually rotate the gantry to weight-bearing imaging position until it reaches the mechanical limit.
3. Touch **Set limits**.

2.3.2 Elevation

1. Rotate the gantry to weight-bearing imaging position.
2. Touch **Release high limit** button.
3. Drive the gantry until it reaches the upper limit and drives itself a little bit backwards.
4. Touch **Set high limit**.
5. Rotate the gantry to weight-bearing imaging position.
6. Touch **Release low limit**.

7. Drive the gantry until it reaches the lower limit and drives itself a little bit backwards.
8. Touch **Set low limit**.

NOTE

Both high and low limits must be set every time.

2.3.3 Tilt lock

In the *Tilt lock* section the tilt mechanism of the gantry can be locked into weight-bearing imaging/transportation position.

The *Lock status* indicates whether the lock is in *on* or *off* position.

Lock position indicates the position of the locking mechanism in the number of steps of the step motor.

Lock angle indicates the vertical position of the gantry when driving to transportation position. The gantry is driven and locked into 90° angle.

The gantry is driven into transportation position until it locks in place.

1. Drive the gantry to the transportation position.
2. Close the lock by pressing **Close**. Check that the gantry is locked.
3. Rotate the gantry by hand and check the backlash angles.
4. Rotate the gantry by hand to the mean value of the backlash angles.
5. Touch **Set angle**.

NOTE

The gantry is locked only when Lock high limit = 1.

Fine-tuning can be done using **+ / -** buttons while test driving the packaging position.

2.3.4 Patient support

The patient support number and the height of the patient support is displayed in the *Type* field.

Enter the height of the patient support in the *Height* field.

1. Drive the patient support mechanism into the reference position by touching the **Seek home** button.
2. Touch **Drive to limit** to drive the patient support to its highest position.

If the patient support collides with mechanical limit, reduce the limit value using the **-** button.

After finding the correct value touch **Seek home**.

2.3.5 Collimator

The collimation assembly for the X-ray unit has two alternative mechanical configurations.

The collimator version is detected during the device startup sequence. The collimator and laser settings views depend on the collimator version.

The following sections describe the two alternative setups.

2.3.5.1 Stationary laser collimator settings

With the stationary laser setup there is no offset adjustment for the laser and the **Coll. 1 activation** field does not exist.

Collimator 0 closed

Sets the position of the collimators during dark image capture. Default value is **270**.

Collimator 0 open

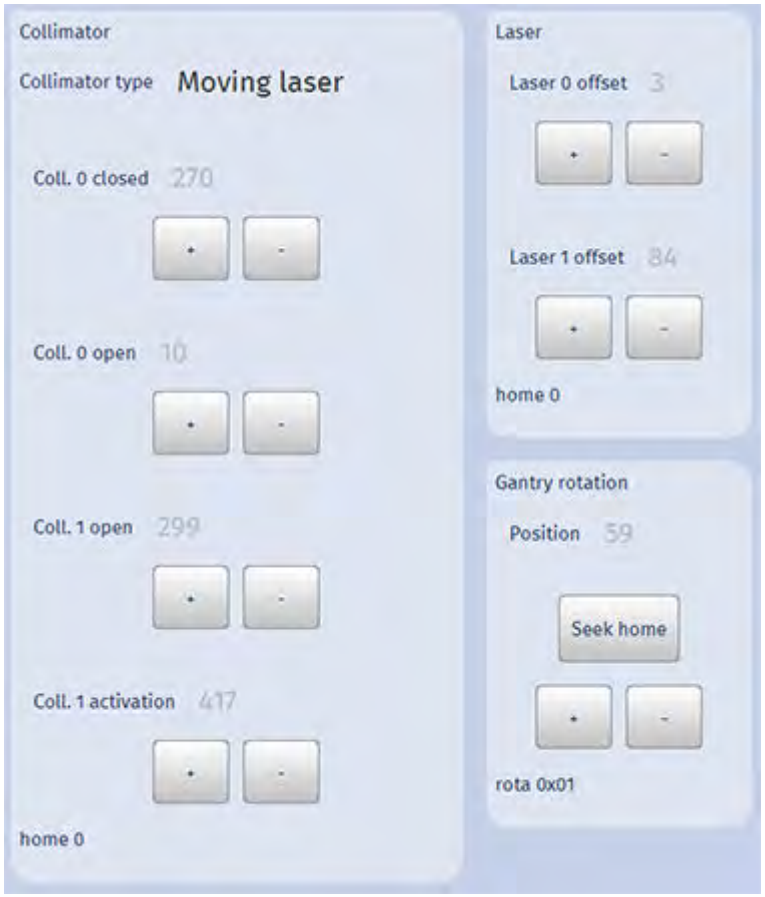
Sets the position of the back edge collimation. Default value is **28**.

Collimator 1 open

Sets the position of the front edge collimation for Small collimator.

The recommended value is 110 - 125. Default value is **115**.

2.3.5.2 Moving laser collimator settings



Collimator 0 closed

Sets the position of the collimators during dark image capture. Default value is **270**.

Collimator 0 open

Sets the position of the back edge collimation. Default value is **10**.

Collimator 1 open

Sets the position of the front edge collimation for Small collimator. If fogging is present on the rear edge, decrease the **Collimator 1** value. The recommended value is **290-310**.

Coll. 1 activation

Sets the position of the back edge collimation for Small collimator. The collimator lasers must be pre-aligned so that they hit the alignment pattern on the detector.

2.3.6 Laser

NOTE

Laser settings are adjustable only for the moving laser collimator setup option. For more information, see section "Moving laser collimator settings" on page 43.

Laser 0 offset

Sets the position of the back edge lasers for default collimator.

Laser 1 offset

Sets the position of the back edge lasers for small collimator.

2.3.7 Gantry rotation

In the *Position* field the offset value of the middle position of the imaging device can be set. This adjustment can be used to adjust the detector/tube head in the middle position.

1. Touch **Seek home** and wait until it reaches home position.
2. Fine-tune the position using the **+** and **-** buttons if necessary.

2.4 Motor tests

The motor tests are intended to be used for trouble shooting and checking the functioning of the device motors. In the test mode the motors can be driven in slow speed without restrictions of normal use. This can be useful for detecting possible mechanical faults in the motors. The motor tests are intended mainly for assembly purposes of the Planmed production department and not to be used in normal imaging.

CAUTION

Only a qualified service technician should perform these tests.

In the test mode the controls and limits of normal movement range activated in normal operation mode are overridden. This means that the motors can be driven without limits. By touching the test buttons the device automatically goes into test mode.

By touching the **Rotation** button the imaging devices can be manually rotated using the collimator buttons of the joysticks.

By touching the **Collimator** button the collimator can be manually driven using the collimator buttons of the joysticks.

By touching the **Laser** button the lasers can be manually driven using the collimator buttons of the joysticks.

The **Scan test** drives the series of movements as in a regular exposure cycle using the rotation motor of the imaging devices. The scan test can be used to test the rotation mechanism of the motor in case mechanical or optic sensor related faults are suspected.

CAUTION

In case the step motors are driven beyond their end limit the device cannot recover. Make sure that the movements are within acceptable limits before leaving the test mode.

To stop the tests and exit the test mode touch the **Stop tests** button.

2.5 Pre-set

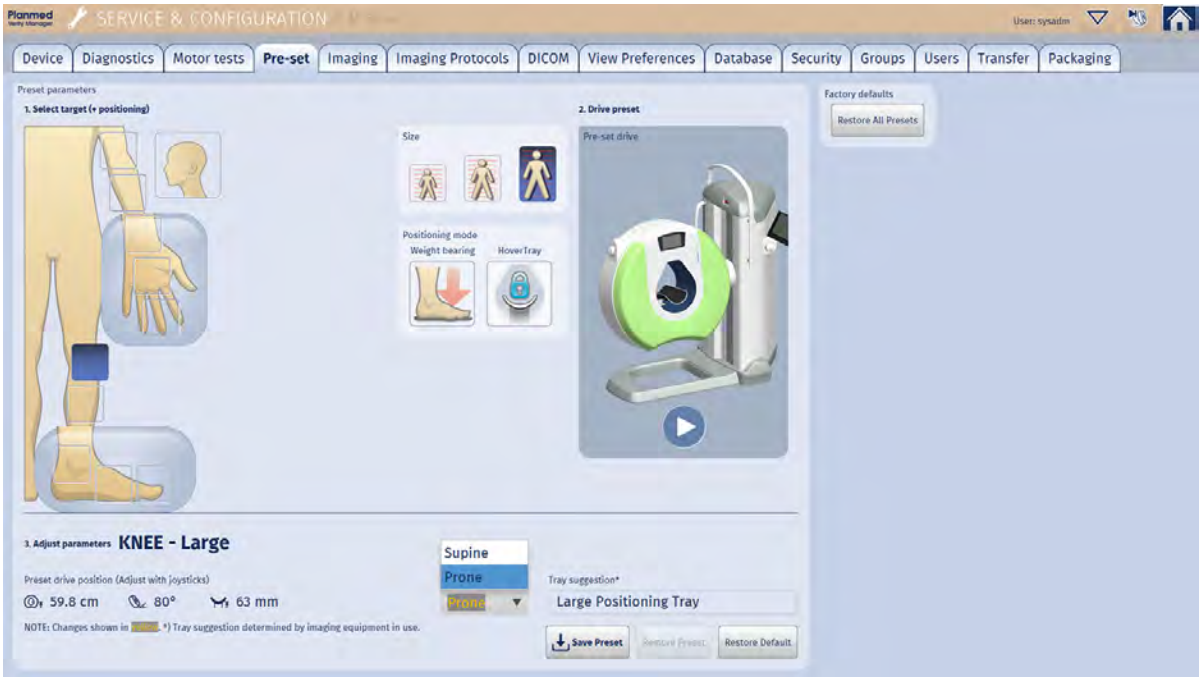
In the *Pre-set* tab, the pre-set drive positions and imaging values for different targets in different imaging modes for different types of patients can be set.

To set the position for specific imaging target:

1. Attach the correct patient positioning equipment to the gantry.
2. Select the target.
3. Select the patient size and positioning mode.
4. Press the **Play** button and hold down the joystick button to run the pre-set cycle.

   Editing of pre-set parameters is disabled until the pre-set cycle is complete.

5. When the pre-set cycle is complete you can modify the pre-set parameters. Patient positioning parameters are adjustable by joysticks.



You can modify pre-set parameters related to patient positioning, default anatomy orientation and tray suggestion. Changes are highlighted by yellow colouring.

NOTE

Changes affect only the selected patient size. If you want to edit pre-sets for several patient sizes, perform edits to each patient size setting one by one.

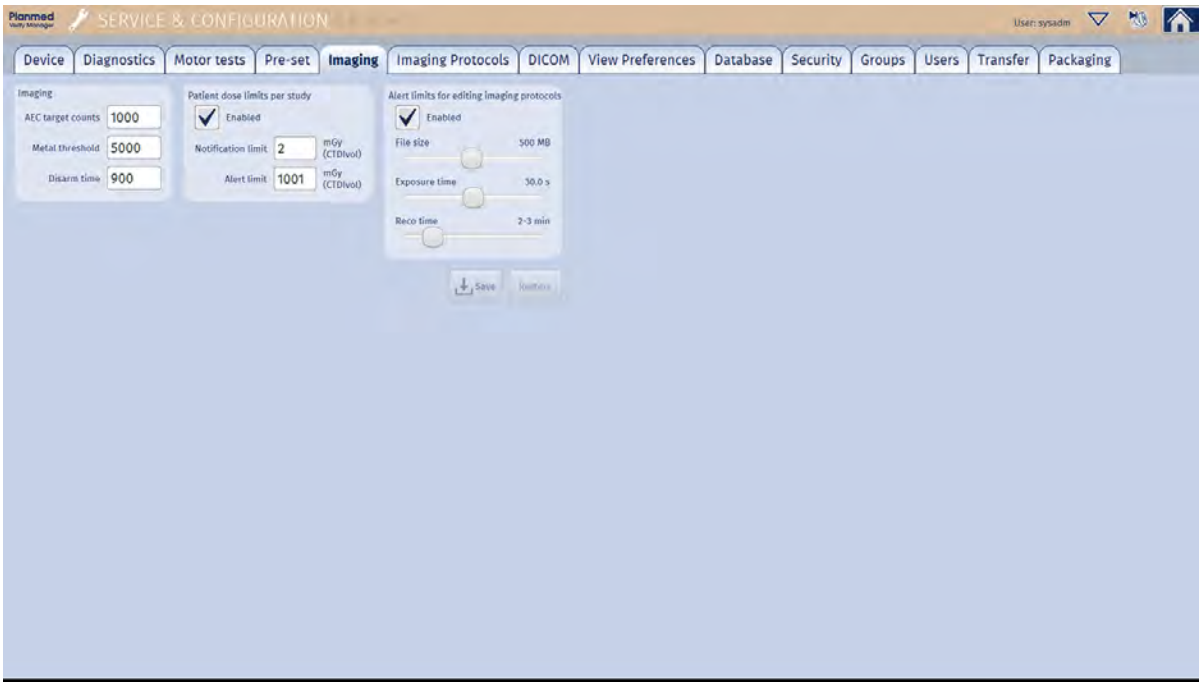
6. Tap **Save Preset**.

To return to the previously-saved pre-set values, tap **Restore Preset**.

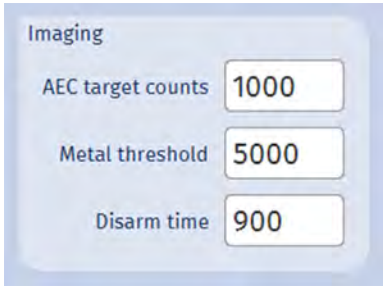
To restore the factory default position for the selected imaging target, tap **Restore Default**. To restore the factory default position for all pre-set values, tap **Restore All Presets** in the *Factory defaults* box.

2.6 Imaging

In the *Imaging* tab the general parameters for imaging can be set. In addition, patient dose limits per study can be enabled.



2.6.1 Imaging



AEC target counts

Enter the desired target count. The target counts sets the minimum signal target in projection images. Count values are always configured based on the sensitivity of 2520D X-ray detector. For 2520DX detectors, the count values are scaled automatically by the software from the values configured in this field.

NOTE

Adjusting the target count value affects the AEC functionality and can affect the patient dose and image quality.

Enable or disable AEC through the *View Preferences* tab's **Imaging** field. For more information, see section "Imaging" on page 61.

Metal threshold

Enter the desired metal threshold.

Disarm time

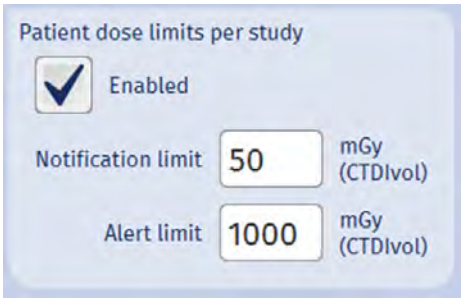
Enter the length of time, in seconds, after which the X-ray unit cancels the exposure if the user has not pressed the Exposure button. The disarm timer begins to count down when the user presses the Scouts or Acquire 3D buttons.

NOTE

The disarm time must always be less than the Windows automatic log out time.

2.6.2 Patient dose limits per study

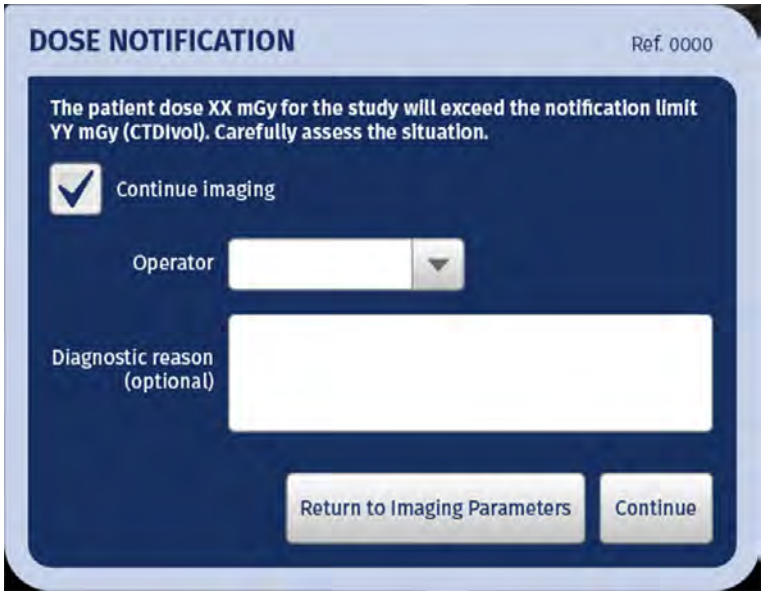
Patient dose accumulation is tied to a single study. A continued study counts included prior exposures.



If the selected exposure values would exceed the set dose limits upon running, a notification or alert is displayed after *Acquire scouts* or *Acquire 3D* has been selected.

- Notification / alert popup

  When the user enters an imaging view (Acquire scouts or Acquire 3D) with imaging values:



- Error popup

  Closing the notification resumes normal use:

Printing audit trail

To print out all dose alert and notification events, double click the `AuditTrail.bat` file in the `C:\Planmed\VerityManager` folder.

The `DoseAlertReport.txt` file appears in the `C:\Planmed\config` folder listing the events.

The following is an example of the .txt file output.

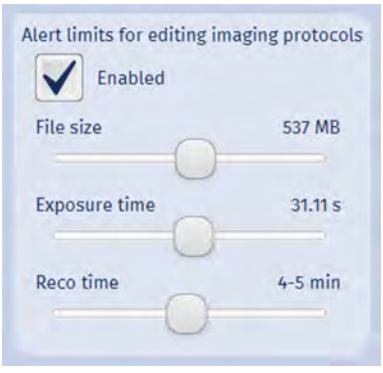
id	event_time	event_date	event	username	study_id	limit_value	value	description
1	140824550	20170928	0	HRZW732	666	1	3.0	
2	141048703	20170928	1	HRZW732	666	1	3.0	

NOTE

The number 0 in the event column indicates a dose notification event. The number 1 indicates a dose alert event.

2.6.3 Imaging protocol alert limits

Enable or disable the feature, and set file size, exposure time and reco time limits.



Imaging protocol alert limits apply to the **Target parameters** field in the *Imaging Protocols* tab, where **File size**, **Exposure time** and **Reco time** are

displayed for each anatomical area and show a red exclamation point when limits are exceeded. For more information on the **Target parameters** feature, see section "Target parameters" on page 51.

2.7 Imaging protocols

In the *Imaging Protocols* tab, the resolution and other imaging parameters can be set. The different target parameters can also be defined.

The following sections describe the general parameter features for the imaging protocols.

2.7.1 Shared parameters

The **Shared parameters** field shows the common parameters for exposures and reconstructions.

Exposure parameters

The exposure parameters affect the absorption of the X-ray image and therefore the potential radiation dose.

- Resolutions: 0.2, 0.4

  Changes the voxel size of the 3D image. This parameter does not effect the dosage.
- Projections: 300, 400, 500, 600

  Specifies the number of projections used to reconstruct one 3D image.
- Pulse length: 15, 20, 25, 30, 35, 40 ms

  Specifies the length of the pulse used to take the projection image.

Reconstruction parameters

Reconstruction parameters affect image processing.

- Noise filter: None, Light, Medium, Strong

Filtering improves soft tissue visibility and the quality of the 3D rendered image. The stronger the filter the smoother the image will be.

For more information, see the *Planmed Verity user's manual*.

- Kernel: Default, Soft, Sharp

  Soft Kernel improves soft tissue visibility and the quality of the 3D rendered image, and Sharp Kernel enhances the details in the image. Default generates a general image.

  For more information, see the *Planmed Verity user's manual*.

- HUCorrection: On, Off

  Additional function that corrects HU value information.

2.7.2 Target parameters

The **Target parameters** field allows you to select specific anatomical regions for which this protocol is available.

For each anatomical area, you can select the following values simultaneously according to the patient's size category:

- Voltage (kV): Adjusts used tube voltage
- Current (mA): Adjusts used tube current
- Field of view (size): Large or small, changes collimation between full field and field limited by 43%

Dose information changes according to selections. Dose information is indicated in terms of DLP, DAP and CTDIvol. For more information about CTDI values, see section "CTDI values" on page 25.

NOTE

A separate license is required to enable the 'Head' target region.

NOTE

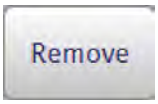
Weight-bearing and HoverTray positioning use different target parameters for 'Foot' and 'Toe' anatomies due to alternative exposure directions.

NOTE

You must accept all anatomies which are changed in the process of editing the shared parameters. Inspect the yellow-highlighted changes carefully.

NOTE

If alert limits are exceeded, values are indicated with a red exclamation point. For more information, see sections "Patient dose limits per study" on page 48 and "Imaging protocol alert limits" on page 49.



An anatomy selection can be removed with the **Remove** button.

2.7.3 Factory protocols

Use the following built-in protocols depending on the imaging requirements.

NOTE

Factory protocols are not always optimal for imaging requirements. Always take image- specific requirements into consideration during the imaging process.

- Standard: Normal imaging in most usual cases
- Ultra Low Dose: When a lower radiation dose is desired
- High definition: When high accuracy is desired

For more information, see the *Planmed Verity user's manual*.

Factory protocols can be edited, but not deleted. Factory protocol settings can always be restored. For more information, see sections "Restore last saved settings" on page 52 and "Restore factory settings" on page 52.

2.7.4 Creating new protocol

1. Press the **+** button.
2. Adjust the shared parameters.
3. Select anatomical areas and make adjustments to the target parameters.

4. Press the **Save** button.

2.7.5 Duplicating protocols

1. Select the protocol to be duplicated.

2. Press the **Duplicate** button.
3. Adjust the shared parameters.
4. Select anatomical areas and make adjustments to the target parameters.

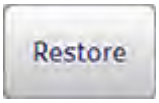
5. Press the **Save** button.

2.7.6 Delete protocol

1. Select the protocol to be deleted.

2. Press the **Trash** icon.

2.7.7 Restore last saved settings



Press the **Restore** button.

2.7.8 Restore factory settings

Press the **Restore Default** button.

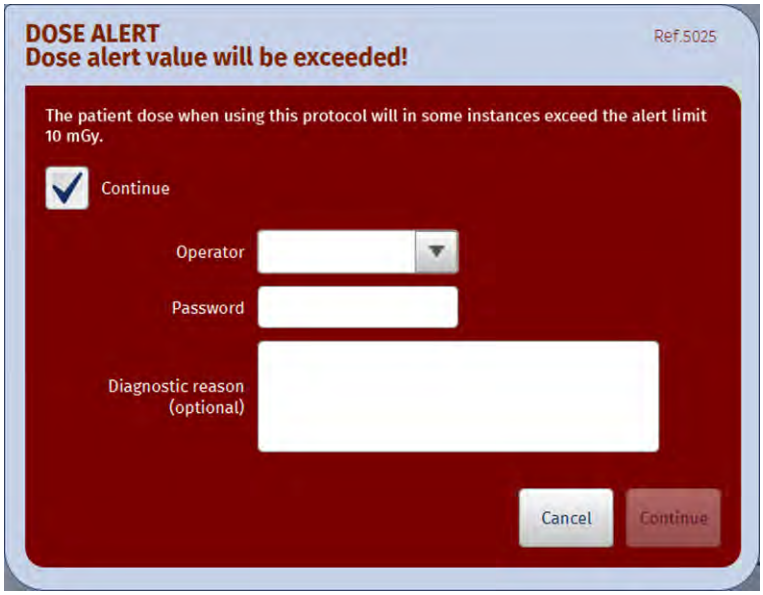
NOTE

The button is available only for Factory default protocols.

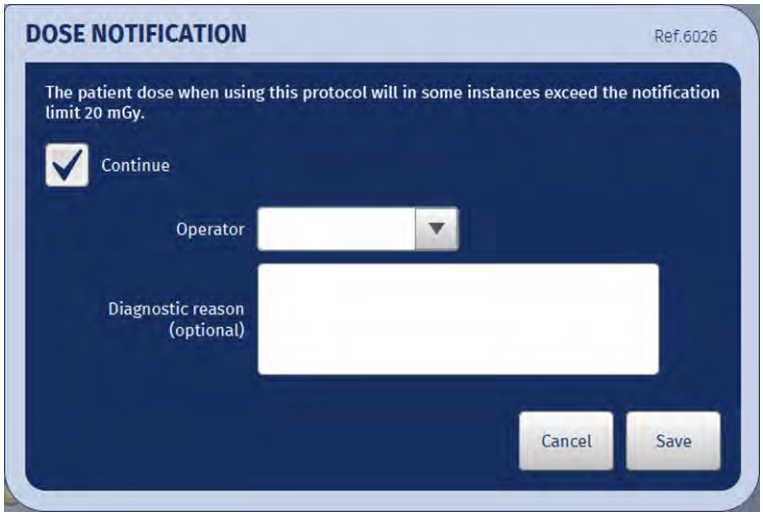
2.7.9 Imaging protocol messages

Planmed Verity Manager checks the dose limits when you save changes to the protocol settings in the **Service / Imaging protocols** tab.

If the dose for any combination of patient size and anatomy exceeds the configured alert limit for the selected protocol, a dose alert is shown.



If the dose for any combination of patient size and anatomy exceeds the configured notification limit for the selected protocol, a dose notification is shown.

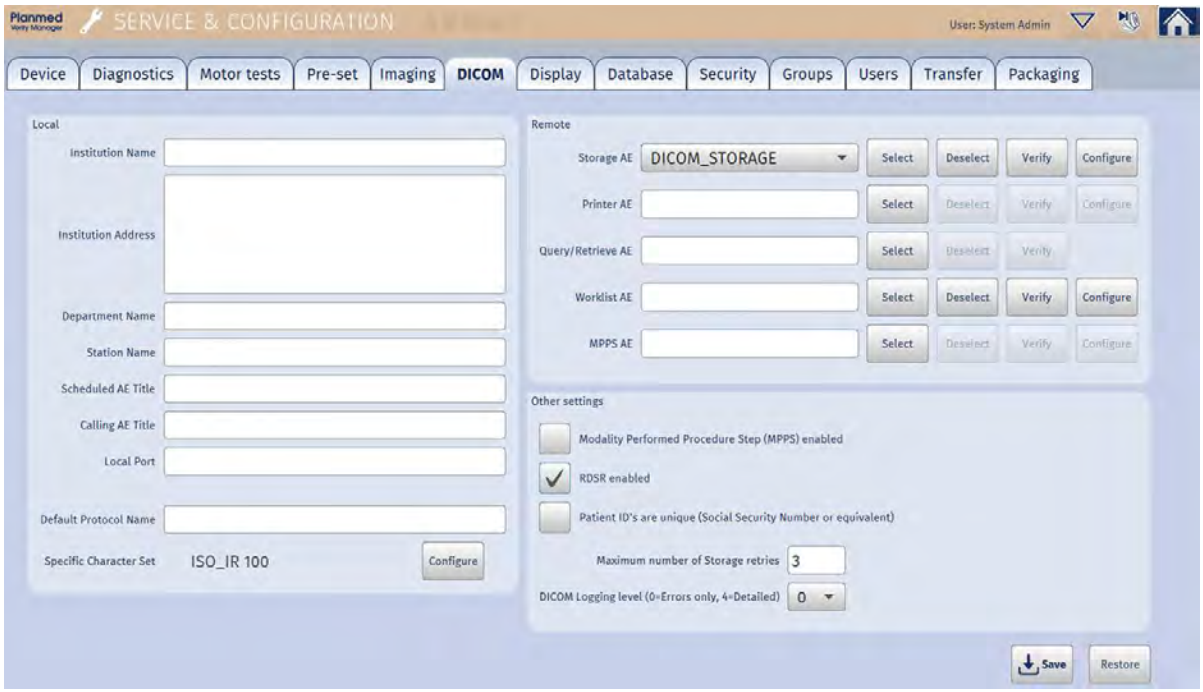


2.8 DICOM configuration

NOTE

For more detailed information on DICOM see the DICOM standard.

In the *DICOM* tab you can make required configuration changes for communicating with other DICOM enabled systems and define what information is sent to PACS with images.



2.8.1 Local

The local settings should be adjusted to suit the specific hospital environment and optional printers and worklist.

In order to configure DICOM destinations the following information is needed from the local network administrator:

- Institution name
- Institution address
- Department name
- Station name

NOTE

Changing the name of the station resets all settings.

- Scheduled AE title

  The scheduled AE title can generally be set to same as calling AE title.

- Calling AE title

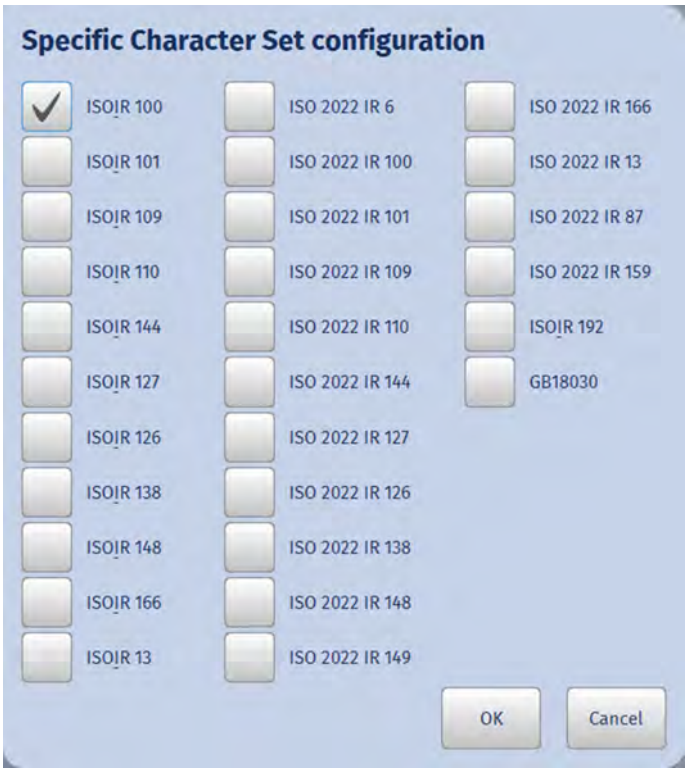
NOTE

If there are several Planmed imaging devices in the network the devices should have unique AE titles.

- Local port
- Default protocol name

- Specific character set

  Select the appropriate character set from the drop-down menu.



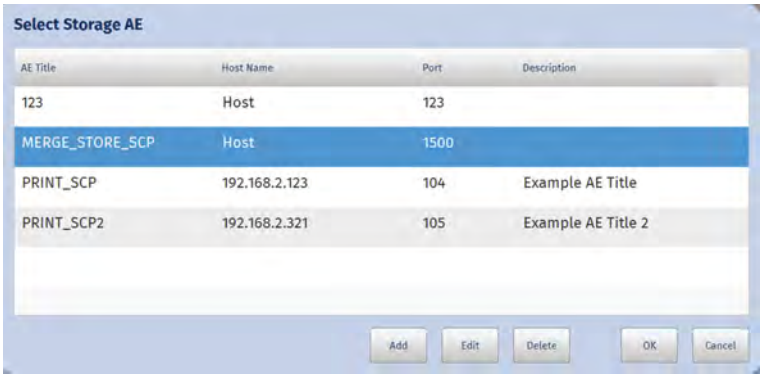
2.8.2 Remote

In the *Remote* field you can select, deselect or delete DICOM application entities. The application entities include:

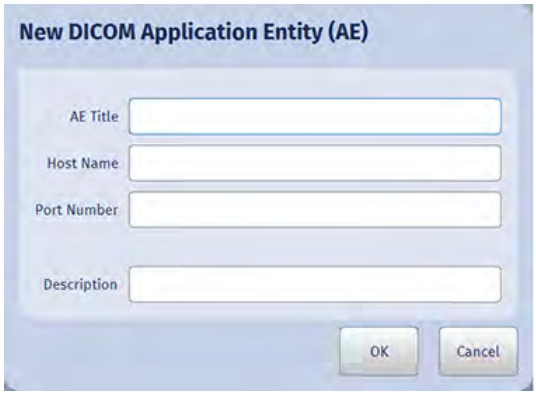
- Storage AE
- QueryRetrieve AE
- Worklist AE
- MPPS AE

2.8.2.1 Adding and editing application entity settings

1. Touch the **Select** button next to the application entity you want to modify.
2. In the opening window touch the AE title you want to modify and then touch **Add** or **Edit** button.



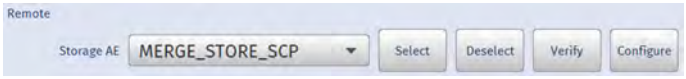
3. Enter the necessary information in the opening window and when finished touch **OK**.



2.8.2.2 Storage AE configuration

To access DICOM storage configuration touch the **Configure** button in the *Remote* field.

From the **Storage AE** drop-down menu, select the DICOM storage option.



- **Auto storage destination**

  The auto storage destination for patient images and quality control images can be defined separately.

  After leaving the image acquisition mode the images will be sent to the location(s) defined here.

- **Use enhanced CT format**

  DICOM includes two ways of storing CT images, so called Standard CT and the new and more advanced Enhanced CT format. Verity Manager uses internally only Enhanced CT format but there are still several older systems that only support Standard CT and therefore Verity Manager also allows exporting images in Standard CT format.

- **Send scout images**

  Select this option to send scout images to PACS.

- **Storage commitment enabled**

  By selecting this option the system will request storage commitment from the storage server.

- **Wait for commitment N-Event**

  By selecting this option the system will wait for commitment response during same association.

- **Storage commitment port**

  If Storage Commitment service is used, it normally uses the same port as the Storage service. In this case leave the Storage Commitment port blank. Otherwise enter the Commitment Port number to be used. It can usually be found from the receiving system's DICOM Conformance Statement. It is always good to check the port to be used from the clinic's IT personnel.

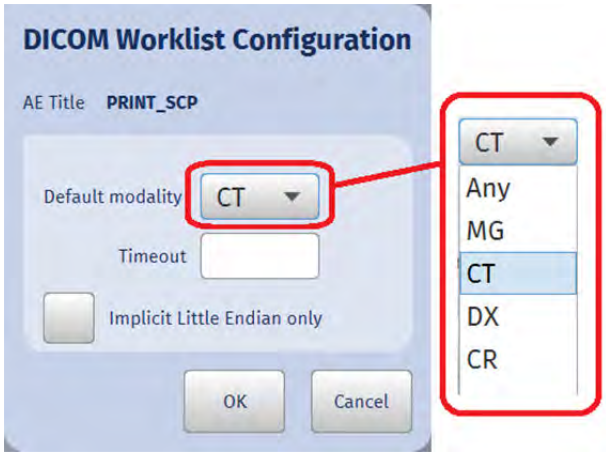
2.8.2.3 Worklist AE configuration

The DICOM Modality Work List AE listens on a predefined port for incoming TCP connections. Once a TCP connection is established, searches of the worklist are received and matching worklist entries are returned.

Default modality

Normally the default modality does not need to be changed. But in some rare cases the Worklist provider (RIS etc.) is not able to use modality CT. In this case the default modality should be changed to value supported by the Worklist provider.

Select the default modality from the *Default modality* drop-down menu.



MG Mammography
CT Computed Tomography
DX Digital X-ray
CR Computed Radiography

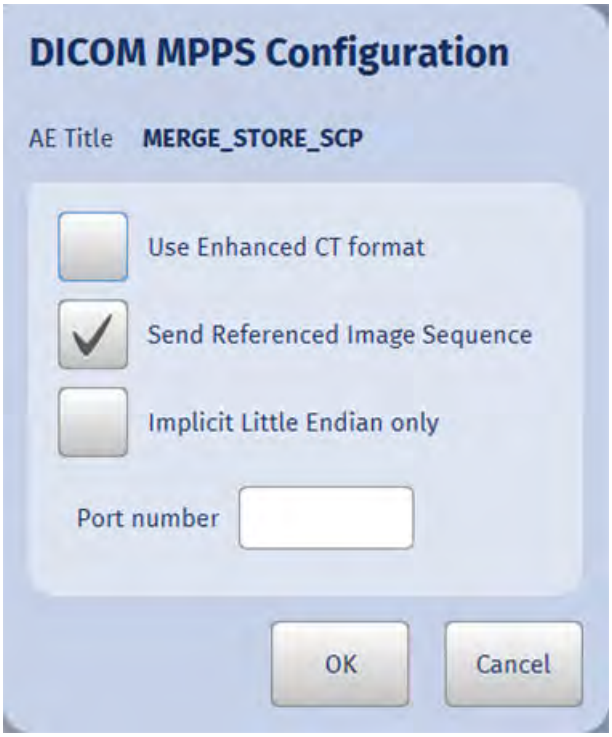
2.8.2.4 MPPS AE configuration

Use enhanced CT format

For more information, see the *Use enhanced CT format* segment in section "Storage AE configuration" on page 56.

Send referenced image sequence

Referenced image sequence provides detailed information about the acquired images. This sequence is not often used with CT modality.



2.8.3 Other settings

2.8.3.1 Modality performed procedure step (MPPS) enabled

DICOM MPPS SCU service is used together with DICOM Modality Worklist SCU service. If MPPS service is configured, the patient ID, status and dates of studies as well as patient name will be sent to HIS/RIS/MIS when starting the exposure. Dates and complete list of images including X-ray parameters will be sent to the HIS/RIS/MIS server after the study has been accepted.

To use MPPS specify the corresponding AE title and check the MPPS option.

2.8.3.2 RDSR (Radiation Dose Structured Report) enabled

The DICOM Standard has defined the Radiation Dose Structured Report (RDSR) to handle the recording and storage of radiation dose information from imaging modalities. The RDSR has been developed to incorporate most of the information, including CT Dose Index (CTDI) and Dose Length Product (DLP), needed to obtain the radiation output from imaging devices and this information can then be used to estimate the radiation dose.

To enable the use of Radiation Dose Structured Report (RDSR) functionality:

1. Check the option *RDSR enabled*.
2. Click the **Save** button and restart Verity Manager to enable RDSR functionality.

2.8.3.3 Patient IDs are unique (Social Security Number or equivalent)

This setting determines how the patient data is combined.

When importing an image or when receiving an image by DICOM Storage SCP the Verity Manager first checks whether the patient is already in the database. Patient ID, Last Name, First Name and Date of Birth of the data must match, otherwise the software considers the image as of a different patient. But if the patient ID's are unique (like national social security number), only the Patient ID and last name must match to be considered as the same patient (first name may have been written differently or date of birth may be missing).

2.8.3.4 Maximum number of storage retries

Set the maximum number of storage retries. The default value is 3.

2.8.3.5 DICOM logging level

The DICOM logging level details can be set between **0 = Errors** only to **4 = Detailed**.

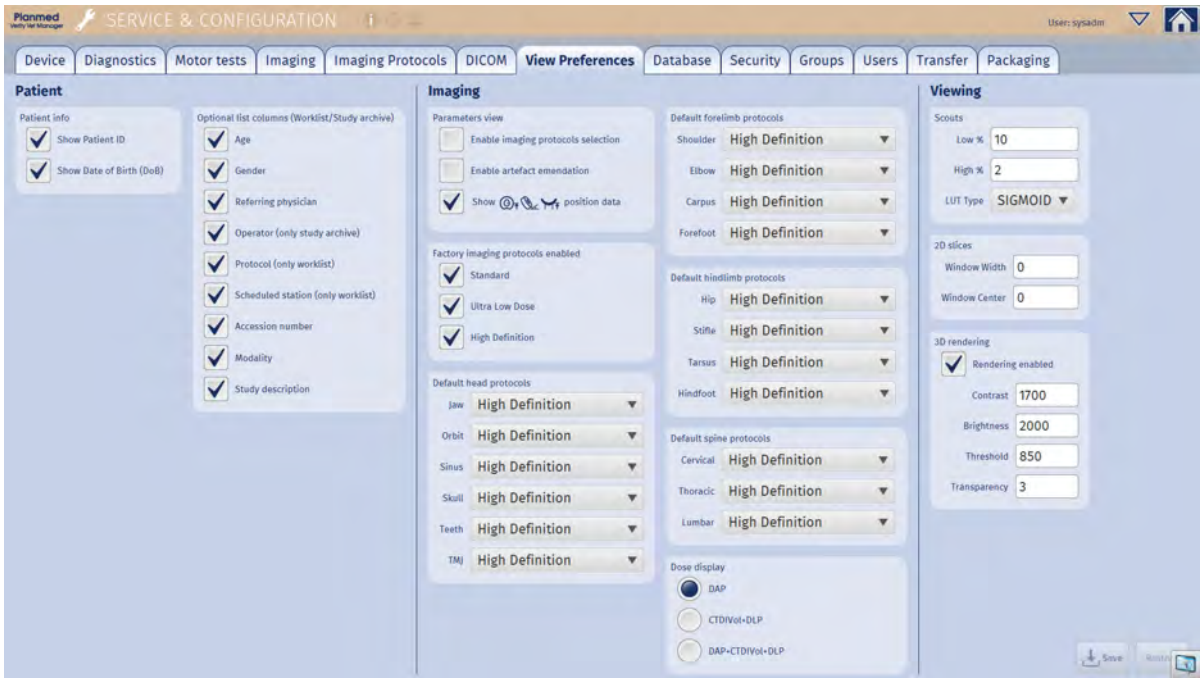
The normal setting is 0. The value can be increased for troubleshooting purposes.

NOTE

Make sure to set the value back to 0 when finished with troubleshooting.

2.9 View preferences

Use the *View Preferences* tab to define what type of patient information is shown in the patient list. Also rendering settings can be adjusted.



2.9.1 Patient

Patient info

In this field you can select whether to show:

- Patient ID
- Date of birth

Patient name order

In this field you can select whether to show the patient's last name or first name in the patient list first.

Optional list columns

In this field you can select which of the optional list columns will be shown in the user interface.

The optional list columns refer to both *Modality Worklist* and *Local Study Archive*.

Check the columns which you want to be visible in the worklist. The columns that are not checked will not appear in the lists.

The setting will be applied after you select **Save** and restart Verity Manager.

The columns *Protocol* and *Scheduled Station* are only in *Modality Worklist*.

The column *Operator* is only in *Local Study Archive*.

The optional worklist columns are the following:

- Age
- Gender
- Referring Physician
- Operator
- Protocol
- Scheduled Station

- Accession Number
- Modality
- Study description

2.9.2 Imaging

Parameters view

In this field you can enable or disable the following options:

- Hover tray positioning
- Metal artefact suppression
- AEC (only available for Standard and High definition imaging protocols with default parameters)
- Showing position data

Factory imaging protocols enabled

In this field you can enable or disable the following options:

- Standard
- Ultra Low Dose
- High Definition

Default head protocols

In this field you can select different protocols for the following head areas:

- Ear
- Face
- Jaw
- Neck
- Sinus
- Teeth
- Head (MaxScan)

Default upper extremity protocols

In this field you can select different protocols for the following upper extremity areas:

- Elbow
- Arm
- Wrist
- Hand
- Finger

Default lower extremity protocols

In this field you can select different protocols for the following lower extremity areas:

- Knee
- Leg
- Ankle

- Foot
- Toe

Dose display

In this field you can select from the following details for the dose data:

- DAP: Provides dose area product information
- CTDIVol + DLP: Provides CT dose index and dose length product information
- DAP + CTDIVol + DLP: Provides dose area product, CT dose index and dose length product information

2.9.3 Viewing

Scouts

In this field you can enter the following limits:

- Low %
- High %
- LUT Type

2D slices

In this field you can set the following parameters:

- Window Width
- Window Center

Automatic windowing is used if **Window Width** and **Window Center** have values of **0**.

3D rendering

In this field you can enable or disable rendering and define the contrast, brightness, threshold and transparency values used in 3D rendering.

NOTE

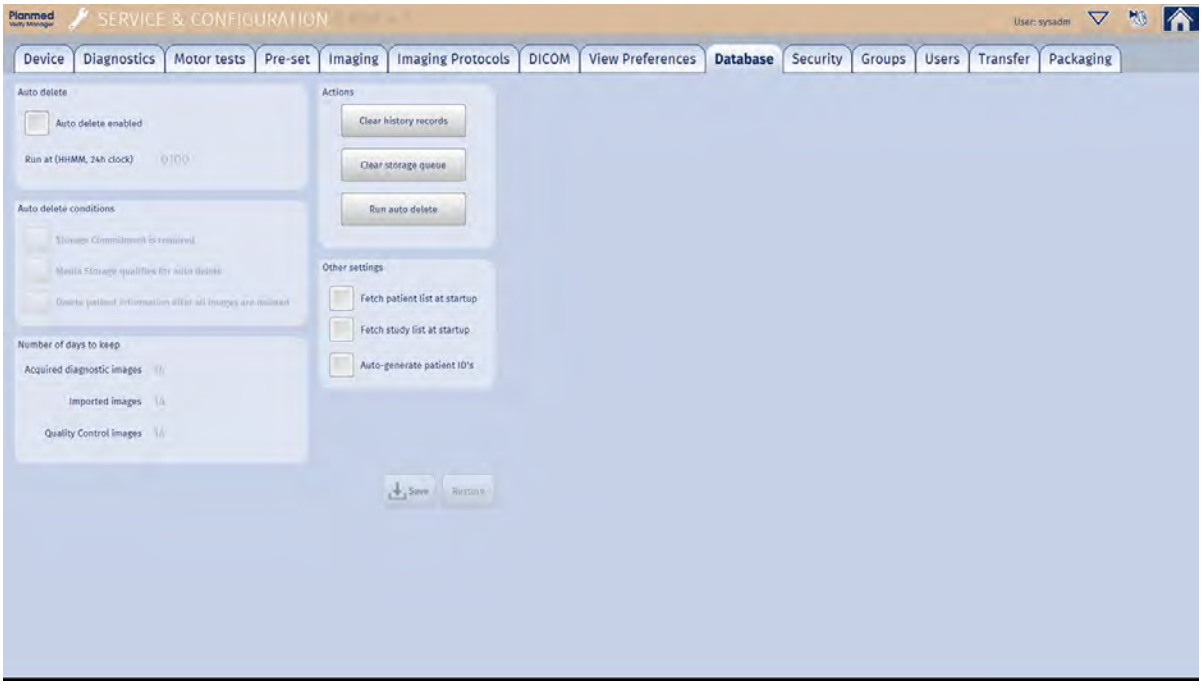
If rendering slows down the computer, deselect the *Rendering enabled* option.

- **Contrast:** Specify the default level of contrast to be used in 3D volume rendering. The default level is 1700.
- **Brightness:** Specify the default level of brightness to be used in 3D volume rendering. The default level is 2000.
- **Threshold:** Specify the default threshold value between 0-4095 to be used in 3D volume rendering. The default value is 850.

  Threshold value determines which voxels are visualized in 3D rendering. By lowering the threshold value you can visualise soft tissue and skin. By increasing the value the harder tissues such as bones are better visualised.
- **Transparency:** Specify the level of transparency of the overlay against the rendering: 0% for fully opaque and 100% for fully transparent. The suitable scale is 1-28.

2.10 Database

In the *Database* tab you can permanently delete rejected images, clear history, set auto delete time and define auto delete conditions.



Touch the corresponding button or enter the appropriate values to corresponding fields. To save your settings touch **Save**.

To restore previous defaults touch **Restore**.

2.10.1 Auto delete

By selecting the *Auto delete enabled* option the system will automatically delete images from the database at regular intervals.

To specify the time period for auto delete setting enter the appropriate time in the *Run at* field.

2.10.2 Auto delete conditions

In this section you can set the conditions for auto delete function.

To set the option *Storage commitment is required* as auto delete criterion, check that the corresponding PACS supports this function (if not, the auto delete does not function at all).

To set the option *Media Storage qualifies for auto delete* as auto delete criterion, check the corresponding box.

NOTE

By selecting the option *Media storage qualifies for auto delete*, the images are automatically deleted if stored on a USB memory stick or other external media even if the images had not been sent to PACS.

To automatically delete patients from the database in case the patient data contains no images select the option *Delete patient information after all images are deleted*.

2.10.3 Number of days to keep

To specify the minimum number of days after acquisition or import after which the data can be deleted from the database enter the number of days in the corresponding field.

2.10.4 Actions

History records contain information on modified patient and image data (e.g. deleted patients and images). In case you notice decrease in system performance (e.g. slow processing) use the **Clear history records** button to clear the history records.

The storage queue can be cleared for example if the storage destination has changed or is unavailable due to technical problems.

To delete the DICOM storage files from the queue tap the **Clear queue** button. In case the storage location changes, clearing the queue prevents the system from sending the files to a storage that no longer exist.

If the storage queue is cleared the unsent studies should later be manually resent. To resend the studies go to *Local Study Archive*, select the studies to be sent and select **Send**.

To delete images from the database tap the **Run auto delete** button. For more information, see section "Auto delete conditions" on page 63.

2.10.5 Other settings

Fetch patient list at startup

By selecting this option the patient list is automatically generated when the application is started.

Fetch study list at startup

By selecting this option the study list is automatically generated when the application is started.

Auto-generate patient IDs

If you haven’t manually entered a patient ID the software will automatically generate an ID if this option is selected.

To configure the automatic ID generation contact your service representative.

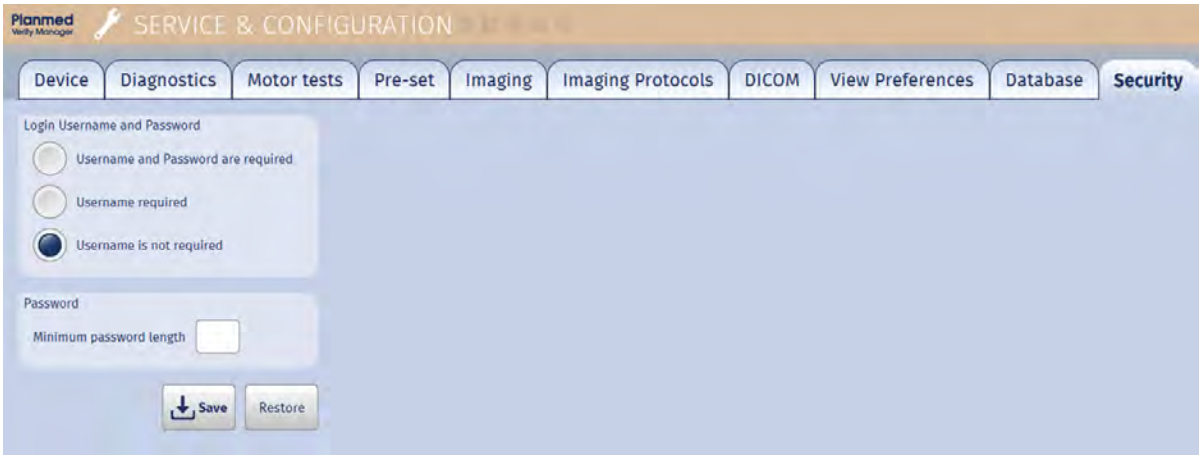
NOTE

The Auto-generate Patient IDs option does not affect the view on the worklist only Local Patient registry.

When the Auto-generate Patient IDs’ option has been configured the Patient ID field does NOT show in bold.

2.11 Security

The *Security* tab can be used to define requirements for user name and password for logging in to Planmed Verity Manager application.



2.11.1 Login user name and password

In the *Login User name and Password* field you can define user name and password requirements at login by checking the appropriate box.

The following login options are available:

- User name and Password are required
- User name required, Password is optional
- Nor user name, neither password is required

2.11.2 Password

In the Password field you can set the minimum number of characters required for password by typing the appropriate number in the corresponding field.

NOTE

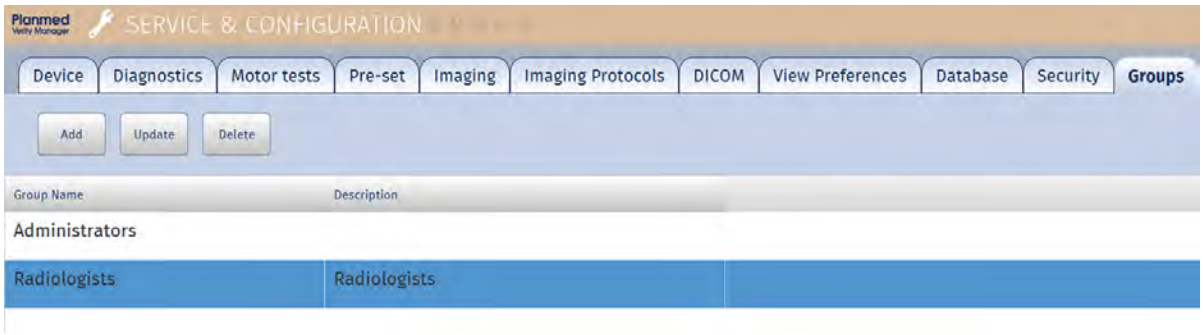
The recommended minimum number of characters is 5.

NOTE

In case you change the login setting from *Username not required*, from then on you cannot use the software without knowing user name and/or password.

2.12 Groups

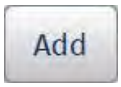
The *Groups* tab can be used to add new user groups and to update existing groups.



2.12.1 Adding new user group

NOTE

All permissions are granted at group level. Every user must belong to at least one user group.

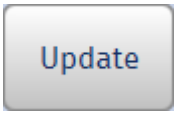


1. Tap the **Add** button.
2. In the following window:
   - The *Description* field can contain for example names or statuses of the group members or information on the purpose of the group.
   - In the *Group Name* field enter the appropriate name for the group.
   - In the *Permissions* field you can define the type of tasks the members are allowed to perform. Select or deselect the task (permission) and touch the **OK** button.
   - Set the group permissions. The options are:
     - All permissions
     - Access Service Mode
     - Perform Quality Control
     - Perform Calibrations
     - Manage users
     - Acquire images
     - Delete studies

3. When finished tap **OK**.

   To exit the settings without saving the settings tap **Cancel**.

2.12.2 Updating existing user groups



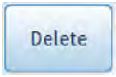
1. Select the user group to be updated from the list.
2. Tap the **Update** button.
3. Set the group permissions. The options are:
   - All permissions
   - Access Service Mode
   - Perform Quality Control
   - Perform Calibrations
   - Manage users
   - Acquire images
   - Delete studies

4. When finished tap **OK**.

   To exit the settings without saving the settings tap **Cancel**.

2.12.3 Deleting existing user group

1. Select the user group to be deleted from the list.



2. Tap the **Delete** button.

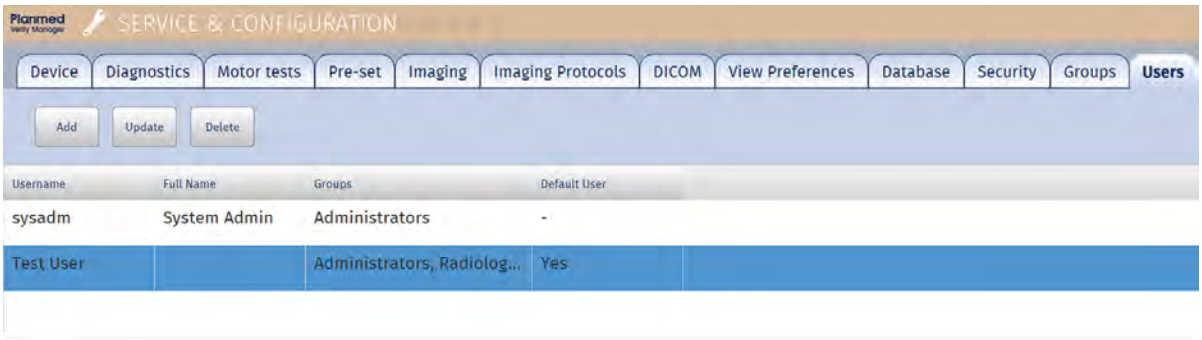
NOTE

Note that built-in user groups cannot be deleted.

3. Confirm by tapping **OK** .

2.13 Users

In the *Users* tab you can add, update or delete individual users from the database.



2.13.1 Adding / Updating a new user

1. Touch the **Add** button.
2. In the following window enter the necessary user information.

NOTE

Username is obligatory.

3. In the *Member of Groups* field select at least one of the groups.
4. When finished touch **OK**.

   To exit the screen without saving your modifications touch **Cancel**.

Default user

The default user option can be selected if user name is not obligatory.

NOTE

Only one default user should be defined.

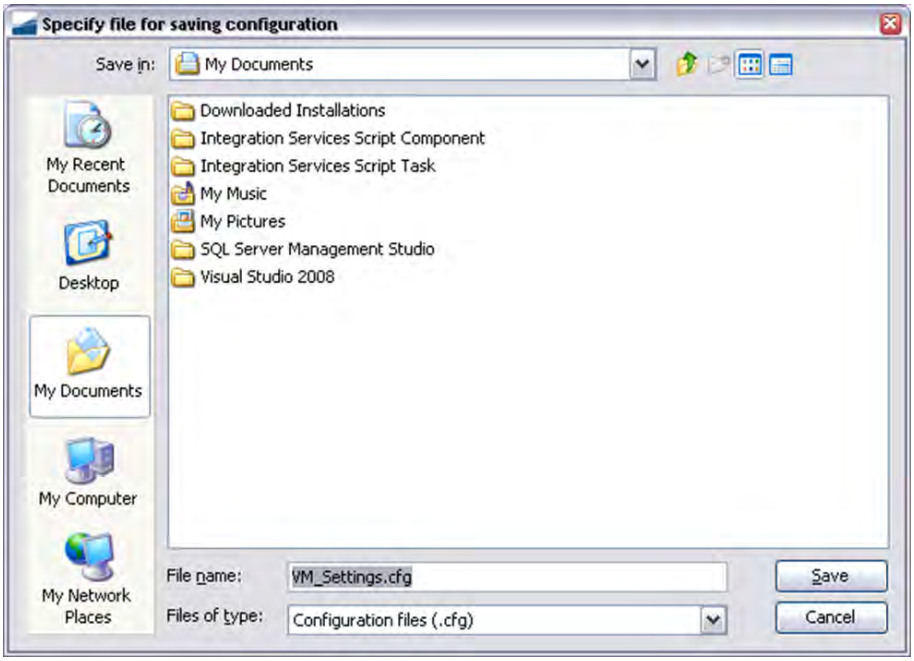
2.14 Transfer

In the *Transfer* tab the (default) settings can be copied and returned from one device to another (e.g. in case computer collapses due to power failure).

2.14.1 Save settings to file

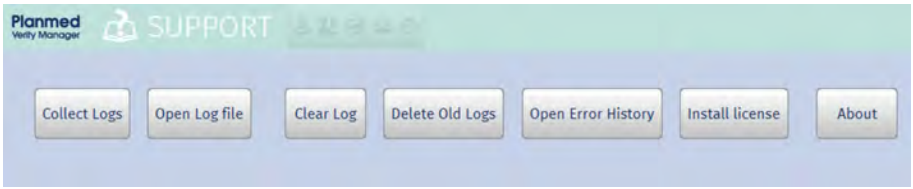
To save settings to another device select **Save settings to file**.

In the following window select the folder in which you want to save the file and touch **Save**.



By default the settings are saved to the folder *My Documents*.

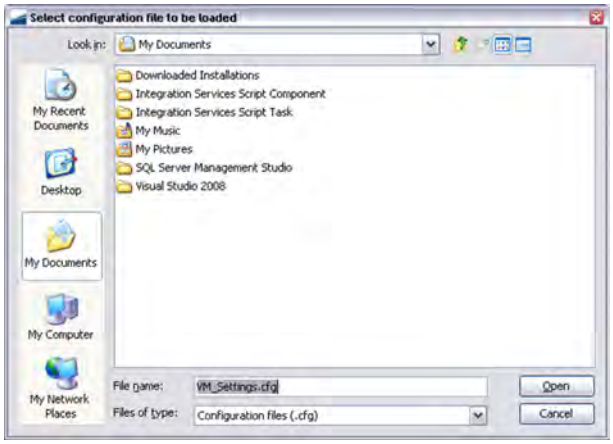
The settings will also be saved to the ZIP file created by the **Collect logs** function in the *Support* menu.



2.14.2 Load settings from file

To load settings from a file to another device touch the **Load settings from file** button.

In the following window select the folder from which you want to load the settings and touch **Open**.



2.15 Packaging

This section advises how to set and drive the device to packaging position.

NOTE

If you're transporting the device into another room and no packaging is required apart from the transportation bumper, see the *Planmed Verity user's manual* for transportation instructions.

NOTE

Perform Quality Control tests before starting to use the device in the new location.

1. Place the foam material between the base and the gantry.
2. Drive the gantry into the packaging position by touching the **Drive** button.
3. Wait for the computer to shut down before driving the gantry to the top of the upholstery.

2.16 Error messages

Verity error messages

Code	Description
10	**Unknown update command** Cause(s): Communication error between Verity CPU and Verity Manager. Corrective action(s): Check the Ethernet cable from ETH PCB to Input PCB.
11	**Data sequence failure** Cause(s): Communication error between Verity CPU and Verity Manager. Corrective action(s): Check the Ethernet cable from ETH PCB to Input PCB.
12	**Data packet too big** Cause(s): Communication error between Verity CPU and Verity Manager. Corrective action(s): Check the Ethernet cable from ETH PCB to Input PCB.
13	**Data packet size match** Cause(s): Communication error between Verity CPU and Verity Manager. Corrective action(s): Check the Ethernet cable from ETH PCB to Input PCB.
14	**Address over range (packet)** Cause(s): Update image file error. Corrective action(s): Reload software update file from Planmed Dealer Support
15	**Address over range (image)** Cause(s): Update image file error. Corrective action(s): Reload software update file from Planmed Dealer Support
16	**Address initialization failure** Cause(s): Communication error between Verity CPU and Verity Manager. Corrective action(s): Check the Ethernet cable from ETH PCB to Input PCB.
17	**Address sequence failure** Cause(s): Communication error between Verity CPU and Verity Manager. Corrective action(s): Check the Ethernet cable from ETH PCB to Input PCB.
18	**Data buffer overflow** Cause(s): Communication error between Verity CPU and Verity Manager. Corrective action(s): Check the Ethernet cable from ETH PCB to Input PCB.
19	**Image signature verification failed** Cause(s): Update file corrupted. Corrective action(s): Reload software update file from Planmed Dealer Support.
20	**Flash memory programming failed** Cause(s): 1. Flash memory chip incorrectly seated. 2. Flash memory chip failure. Corrective action(s): 1. Reseat Flash memory chips. 2. Replace Flash memory chips.

Code	Description
21	**Flash memory verification failed** Cause(s): 1. Flash memory chip incorrectly seated. 2. Flash memory chip failure. Corrective action(s): 1. Reseat Flash memory chips. 2. Replace Flash memory chips.
22	**Update state failure** Cause(s): Communication error between Verity CPU and Verity Manager. Corrective action(s): Check the Ethernet cable from ETH PCB to Input PCB.
101	**Exposure switch released before end of exposure.** Cause(s): Cable or switch failure. Corrective action(s): Press and hold down the exposure button for the entire duration of the exposure. Check exposure switch, check cabling and connections.
102	**Exposure switch continuously pressed or cable short circuited.** Cause(s): Exposure button jammed. Exposure PCB failure. Cable failure. Ethernet cable connected to PlanCan connector. Corrective action(s): Release the exposure switch after end of exposure. Check exposure switch and cabling.
103	**Scan interrupted, rotation end limit reached.** Cause(s): Reflection sensor or reflector failure. Corrective action(s): Seek Home position of the sensor, check reflective sensor PCB, check cabling.
105	**Emergency stop button pressed.** Cause(s): Emergency stop button pressed or emergency line unintentionally activated. Corrective action(s): Ensure safe use of the system, release emergency stop button and continue use. Check the jumper on Interface PCB. Check STOP button, cabling.
106	**Scan interrupted due to pre-pulse mA inaccuracy.** Cause(s): Tube mA has not reached correct value during pre-pulse. Measured mA differs more than 10% from correct value. Corrective action(s): Check cabling, PSU PCB and/or tube head.
107	**Scan interrupted due to pre-pulse time inaccuracy.** Cause(s): Pre-pulse duration is different from requested duration. Pulse duration differs more than 1% from requested duration. Corrective action(s): Check cabling, PSU PCB and/or tube head.

Code	Description
108	**Scan interrupted due to communication error.** Cause(s): Communication with PC failed during exposure. 1000ms communication time-out period exceeded. Corrective action(s): Check cabling, PSU PCB and/or tube head.
132	**Elevation low limit sensor activated.** Cause(s): Sensor or cable failure. Corrective action(s): Check the sensor and the cabling.
142	**Gantry pressure sensor activated. All downward movements are disabled due to obstacle under C-arm.** Cause(s): Micro switch connector loose or wire broken, micro switch broken. Micro switch adjustment failure. Corrective action(s): Cable from PSU PCB J3 to micro switch loose or broken. Check micro switch. Adjust the micro switch. Remove any obstacles under the gantry and attach the soft gantry cover if it's not attached to the gantry.
151	**Line voltage dropped too low during exposure.** Cause(s): Line voltage drops below 80VAC during exposure. Corrective action(s): Lower the mA value and try again. Long distribution line. Loose connection in wall socket or in Verity. Check mains connection and internal wiring.
152	**Line voltage is too low.** Cause(s): Line voltage was below 90VAC before exposure. Corrective action(s): Check mains connection, check PSU PCB.
161	**Temperature of tube head too high.** Cause(s): Tube head temperature is over 60°C. Failure of the temperature sensor on FBK PCB. Corrective action(s): Check ventilation, check temperature sensor on the FBK PCB.
162	**Temperature of elevation motor too high.** Cause(s): Temperature of the motor winding is over 200°C. Corrective action(s): Check ambient temperature, check wiring, change motor. Check the duty cycle from unit label and guide user about it. Change motor.
163	**Temperature of the power supply heat sink too high during exposure.** Cause(s): Power supply heat sink temperature was over 55°C during exposure. Fan stopped. Corrective action(s): Check ventilation, check heat sink sensor and PSU PCB.

Code	Description
164	**Temperature of the power supply heat sink too high.** Cause(s): Temperature of the heat sink over 55 °C. ED (duty cycle) of the lift motor exceeded. Corrective action(s): Check ventilation, check that the fan is rotating. Check the duty cycle from unit label and guide user about it.
165	**Temperature of the tube head too high for the selected exposure parameters.** Cause(s): Tube head temperature high, tube head can not stand high energy exposure. Operating temperature too high or temperature measurement fails. Corrective action(s): Wait until tube head has cooled or use lower kV or mA values. If ambient temperature is in normal operation temperature range, contact technical support.
167	**Tubehead temperature signal too low.** Cause(s): Tube head temperature is below 10°C. Operating temperature too low or temperature measurement fails. Corrective action(s): If the unit is cold for example after the transportation, wait until the unit has reached normal temperature. Alternative if device should be normal operation temperature the sensor malfunction may be cause of this error. Check temperature sensor cabling and sensor. If ambient temperature is in normal operation temperature range, contact technical support.
170	**Exposure aborted by backup timer.**
201	**Overheat in rotation motor control module.** Cause(s): The temperature of the MCM module is over 75°C. Corrective action(s): Let system cool down and retry. Check ventilation and temperature sensor. Change the MCM module on PSU PCB CH1.
202	**Overheat in tilt motor control module.** Cause(s): The temperature of the MCM module is over 75°C. Corrective action(s): Let system cool down and retry. Check ventilation and temperature sensor. ED (duty cycle) of the motor exceeded. Check the duty cycle from unit label and guide user about it. Guide the user about ED. Change the MCM module on PSU PCB CH2.

Code	Description
203	**Overheat in patient support motor control module.** Cause(s): The temperature of the MCM module is over 75°C. Corrective action(s): Let system cool down and retry. Check ventilation and temperature sensor. Change the MCM module on PSU PCB CH3.
204	**Overheat in tilt lock motor control module.** Cause(s): The temperature of the MCM module is over 75°C. Corrective action(s): Let system cool down and retry. Check ventilation and temperature sensor. Change the MCM module on CAM PCB CH4.
205	**Overheat in laser motor control module.** Cause(s): The temperature of the MCM module is over 75°C. Can happen during laser alignment as lasers are driven longer than during normal examination mode. Corrective action(s): Let system cool down and retry. Check ventilation and temperature sensor. Change the MCM module on CAM PCB CH6.
206	**Overheat in collimator motor control module.** Cause(s): The temperature of the MCM module is over 75°C. Corrective action(s): Let system cool down and retry. Check ventilation and temperature sensor. Change the MCM module on PSU PCB CH1.
211	**Rotation motor missing.** Cause(s): 1. Motor connector J7 on PSU PCB is loose or cable is broken. 2. Faulty MCM module. Corrective action(s): 1. Check connections, cables and motor. Replace cables and motor if necessary. 2. Change MCM module on PSU PCB CH1.

Code	Description
212	**Tilt motor missing.** Cause(s): 1. Motor connector J7 on PSU PCB is loose or cable is broken. 2. Faulty MCM module. Corrective action(s): 1. Check connections, cables and motor. Replace cables and motor if necessary. 2. Change MCM module on PSU PCB CH2.
213	**Patient support motor missing.** Cause(s): 1. Motor connector is loose or cable is broken. 2. Faulty MCM module. Corrective action(s): 1. Check connections, cables and motor. Replace cables and motor if necessary. 2. Change MCM module on PSU PCB CH3.
214	**Tilt lock motor missing.** Cause(s): 1. Motor connector J21 on CAM PCB is loose or cable is broken. 2. Faulty MCM module. Corrective action(s): 1. Check cables from CAM PCB J21 to tilt lock motor. Replace cables and motor if necessary. 2. Change MCM module on PSU PCB CH4.
215	**Laser motor missing.** Cause(s): 1. Motor connector J22 on CAM PCB is loose or cable is broken. 2. Faulty MCM module. 3. Faulty opto sensor on collimator. Corrective action(s): 1. Check connections, cables and motor. Replace cables and motor if necessary. 2. Change MCM module on PSU PCB CH6. 3. Check the opto sensor's wiring, if necessary replace the collimator (not motor) assembly.
216	**Collimator motor missing.** Cause(s): 1. Motor connector J25 on CAM PCB is loose or cable is broken. 2. Faulty MCM module. Corrective action(s): 1. Replace cables or collimator assembly if necessary. 2. Change MCM module on PSU PCB CH7.

Code	Description
231	**Overcurrent detected in rotation motor.** Cause(s): Motor or cable failure, 3.2 A current limit exceeded. Some obstacle is blocking the rotation movement. Corrective action(s): Check the motor cable from PSU PCB J7. Check that nothing is blocking the rotation movement. Change the MCM module on PSU PCB CH1.
232	**Overcurrent detected in tilt motor.** Cause(s): Motor or cable failure, 3.2 A current limit exceeded. Corrective action(s): Check the motor cable from PSU PCB J7 and the clutch. Change the MCM module on PSU PCB CH2.
233	**Overcurrent detected in patient support motor.** Cause(s): Motor or cable failure, 3.2 A current limit exceeded. Corrective action(s): Check the motor cable. Short circuit in flat cable from CPU PCB J13 to CPU Connector PCB J1. Short circuit in cable from CPU Connector PCB J5 to Interface PCB J3. Short circuit in cable from Interface PCB J5 to patient support assembly. Short circuit in patient support motor cable inside patient support assembly. Change the MCM module on PSU PCB CH3.
234	**Overcurrent detected in tilt lock motor.** Cause(s): Motor or cable failure, 3.2 A current limit exceeded. Corrective action(s): Check the motor cable. Short circuit in cable from CAM PCB J21 to tilt lock motor. Change the MCM module on CAM PCB CH4.
235	**Overcurrent detected in laser motor.** Cause(s): Motor or cable failure, 3.2 A current limit exceeded. Corrective action(s): Check the motor cable. Short circuit in cable from CAM PCB J22 to collimator assembly. Short circuit in internal wiring of collimator assembly. Change the MCM module on CAM PCB CH6. Change collimator.

Code	Description
236	**Overcurrent detected in collimator motor.** Cause(s): Motor or cable failure, 3.2 A current limit exceeded. Corrective action(s): Check the motor cable. Short circuit in cable from CAM PCB J25 to collimator assembly. Short circuit in internal wiring of collimator assembly. Change the MCM module on CAM PCB CH7. Change collimator.
270	**Elevation motor time-out.** Cause(s): Elevation motor does not rotate. Potentiometer not rotating. Corrective action(s): Check the cogwheel of the elevation motor. Check that the cable from PSU PCB J3 is not loose or broken. Check that the potentiometer cable is not loose or broken. Check that the potentiometer is not damaged. Check the motor wires and PSU PCB.
271	**Rotation motor time-out.** Cause(s): Motor has not reached the home position or does not give pulses during rotation. Corrective action(s): Check that the Connector Adapter PCB is properly assembled on the CAM PCB. Check that the Cable from Connector Adapter PCB J2 to Reflection Sensor J2 is not loose or broken. Check the Reflection Sensor PCB.
272	**Tilt motor time-out.** Cause(s): Tilt Motor does not rotate. Corrective action(s): Check the wires and PSU PCB. Check the potentiometers cogwheel. Check that clutch is not adjusted too tight.
273	**Patient support motor time-out.** Cause(s): Motor has not reached the home position. Corrective action(s): Check the Patient Support Limit PCB and the motor wiring.

Code	Description
274	**Tilt lock motor time-out.** Cause(s): Elevation motor does not rotate. Potentiometer not rotating. Motor has not reached the home position. Corrective action(s): Check the cogwheel of the tilt motor. Check the motor wiring. Check that the Cable from PSU PCB J7 is not loose or broken. Check that the tilt motor cable is not loose or broken. Check that the cable from CPU PCB J10 is not loose or broken. Check that the potentiometer cable is not loose or broken. Check that the potentiometer is not damaged. Force-drive the tilt motor in *Service* mode. Drive it to a position where it does not hit the lock slot. Eliminate the possibility of a mechanical fault before trouble shooting for an electrical one. Recalibrate tilt lock.
275	**Laser motor time-out.** Cause(s): Motor has not reached the home position. Corrective action(s): Check the condition of the belt and the wiring of the motor. Check also that the laser assembly is moving smoothly by pulling the belt.
276	**Collimator motor time-out.** Cause(s): Motor has not reached the home position. Corrective action(s): Check that nothing is blocking the collimator movement. Check the screw and motor wiring.
280	**Collimator version undefined.** Cause: Collimator version identifying function fails in initial sequence. Corrective action(s): Restart device. If the error recurs, contact technical support.
283	**Failed to initialize the patient support because weight bearing adapter is attached.** Corrective action(s): Remove the weight bearing adapter.
301	**Filament voltage missing completely.** Cause(s): Faulty filament cable or faulty filament power on PSU. Corrective action(s): Check the tube head and PSU PCB and cabling between them.
302	**Filament voltage too low during preheat calibration.** Cause(s): Failure in FBK PCB or PSU PCB. Corrective action(s): Check the tube head and PSU PCB.
303	**Filament voltage too high during preheat calibration.** Cause(s): Failure in FBK PCB or PSU PCB. Corrective action(s): Check the tube head and PSU PCB.

Code	Description
312	**Tube voltage too low.** Cause(s): Failure in voltage measurement in the tube head or FBK PCB. Mains voltage too low. Tube voltage was less than 90% of requested voltage during exposure. Corrective action(s): Check the tube head and PSU PCB.
313	**Tube voltage too high.** Cause(s): Failure in voltage measurement in the tube head or FBK PCB. Tube voltage was more than 110% of requested voltage during exposure. Corrective action(s): Check the tube head and PSU PCB. Repeat preheat calibration.
322	**Tube current too low.** Cause(s): Tube current was less than 80% of requested current during exposure. Corrective action(s): Check the cabling and PSU PCB. Perform preheat calibration. Check external power line voltage.
323	**Tube current too high.** Cause(s): Failure in current measurement in the tube head or FBK PCB. Tube current was more than 120% of requested current during exposure. Corrective action(s): Repeat the preheat calibration.
331	**Minor arcing across x-ray tube.** Cause(s): Tube arcs. Corrective action(s): Check the functionality of the tube head. If the X-ray unit has not been used for a week or more take an exposure using lowest possible kV and mA values. Perform preheat calibration in Verity Manager.
332	**Arcing across x-ray tube.** Cause(s): Tube arcs. Corrective action(s): Check the functionality of the tube head. If the X-ray unit has not been used for a week or more take an exposure using lowest possible kV and mA values. Perform preheat calibration in Verity Manager.
334	**Arcing at tube head anode end. Arcing at tube head anode end.** Cause(s): Tube head arcs. Impurity inside the tube head. Corrective action(s): Check the functionality of the tube head.
336	**Arcing at tube head cathode end.** Cause(s): Tube head arcs. Impurity inside the tube head. Corrective action(s): Check the functionality of the tube head.
337	**Tube kV overshoot.**
338	**Tube mA overshoot.**

Code	Description
401	**Tube head KVPOS offset failure, short-circuited.** Cause(s): Short circuit in kV positive feedback in tube head or FBK PCB. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
402	**Tube head KVPOS offset failure, out of boundaries.** Cause(s): Failure in kV positive feedback in the tube head or FBK PCB. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
403	**Tube head offset KVNEG failure, short-circuited.** Cause(s): Short circuit in kV negative feedback in tube head or FBK PCB Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
404	**Tube head KVNEG offset failure, out of boundaries.** Cause(s): Failure in kV negative feedback in the tube head or FBK PCB. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
405	**Tube head MAPOS offset failure, short-circuited.** Cause(s): Short circuit in mA positive feedback in tube head or FBK PCB. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
406	**Tube head MAPOS offset failure, out of boundaries.** Cause(s): Failure in mA positive feedback in the tube head or FBK PCB. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
407	**Tube head MANEG offset failure, short-circuited.** Cause(s): Short circuit in mA negative feedback in tube head or FBK PCB. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
408	**Tube head MANEG offset failure, out of boundaries.** Cause(s): Failure in mA negative feedback in the tube head or FBK PCB. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
409	**Tube head filament offset failure, out of boundaries.** Cause(s): Failure in the filament pick up winding inside tube head or FBK PCB. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
411	**Tube head kV-feedback imbalance.** Cause(s): Failure inside the tube head (cascade) or FBK PCB failure. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.

Code	Description
412	**Tube head mA-feedback imbalance.** Causes: Failure inside the tube head (cascade) or FBK PCB failure. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
414	**Tube head temperature measurement error (signal out of boundaries).** Causes: Temperature sensor or FBK PCB failure. Corrective action(s): Check the FBK PCB and the cable from CAM PCB If the problem persists replace tube head.
415	**Tube head electronics supply voltage error.** Causes: Supply Voltage on FBK PCB too low. Corrective action(s): Check the FBK PCB and the cable from CAM PCB. If the problem persists replace tube head.
416	**Tube head not calibrated.** Corrective action(s): Perform preheat calibration. Check FBK PCB.
501	**Power supply DC bus voltage too low.** Cause(s): DC bus voltage lower than 305VDC. Corrective action(s): Check PSU PCB.
701	**Gantry angle is out of unit's operating range.** Corrective action(s): Drive gantry back to the operating range to resume normal use. Calibrate the tilt mechanism. Check the potentiometer and wiring.
702	**Joystick was active at system start-up or joystick is jammed.** Corrective action(s): Check the functioning of the joystick and replace it if necessary.
705	**Tube head filament calibration failure (discontinuous tube current).** Corrective action(s): Perform preheat calibration. If the problem persists replace tube head.
706	**Tube head filament calibration failure (mA too low).** Corrective action(s): Perform preheat calibration. If the problem persists replace tube head.
707	**Tube head filament calibration failure (not enough samples).** Corrective action(s): Perform preheat calibration. If the problem persists replace tube head.
801	**Rotation motor control module missing.** Cause(s): MCM PCB is damaged or badly mounted to the CH1 on the PSU PCB. Corrective action(s): Check the mounting of the PCB or replace the PCB.
802	**Tilt motor control module missing.** Cause(s): MCM PCB is damaged or badly mounted to the CH2 on the PSU PCB. Corrective action(s): Check the mounting of the PCB or replace the PCB.
803	**Patient support motor control module missing.** Cause(s): MCM PCB is damaged or badly mounted to the CH3 on the PSU PCB. Corrective action(s): Check the mounting of the PCB or replace the PCB.

Code	Description
804	**Tilt lock motor control module missing.** Cause(s): MCM PCB is damaged or badly mounted to the CH4 on the CAM PCB. Corrective action(s): Check the mounting of the PCB or replace the PCB.
805	**Laser motor control module missing.** Cause(s): MCM PCB is damaged or badly mounted to the CH6 on the CAM PCB. Corrective action(s): Check the mounting of the PCB or replace the PCB.
806	**Collimator motor control module missing.** Cause(s): MCM PCB is damaged or badly mounted to the CH7 on the CAM PCB. Corrective action(s): Check the mounting of the PCB or replace the PCB.
902	**EEPROM communication failure.** Corrective action(s): Check the RTC PCB cabling and battery.
903	**EEPROM error log CRC failure.** Corrective action(s): Check the RTC PCB cabling and battery.
904	**EEPROM corrupted.** Corrective action(s): Check the RTC PCB cabling and battery.
905	**Tube head error log CRC failure.** Corrective action(s): Check FBK PCB, Check wire between CAM and FBK PCB.
906	**Tube head EEPROM communication failure.** Corrective action(s): Check FBK PCB, Check wire between CAM and FBK PCB.
910	**Movement calibration required.** Corrective action(s): Check the Acknowledge calibrations option in Service mode and perform calibration in the Device tab. Perform all the movement calibrations in service mode.
911	**EEPROM write failure.** Cause(s): CPU cannot write data to the EEPROM memory on the RTC PCB. Corrective action(s): Check the RTC PCB and wiring between RTC J2 and CPU J6.
912	**Tube head EEPROM write failure.** Cause(s): CAM PCB cannot write data to the EEPROM memory on the Feedback PCB. Corrective action(s): Check the FBK PCB and wiring between FBK J1 and CAM J6.

Verity manager error messages

Code	Description
5000	**Lost connection to Verity CPU.** Cause(s): Verity Manager is not able to communicate with Verity CPU. Corrective action(s): Check that Verity is ON (fuses, mains switch). Check The Ethernet Cable from ETH PCB to Input PCB. Check the connection cable between Workstation PC and Verity Input PCB.
5001	**Detector connection time-out. Imaging cancelled.** Cause(s): Detector communication interrupted. Corrective action(s): Check the Ethernet Cable between detector and computer. Check the sensor power (CAM PCB).

Code	Description
5002	**Detector serial number is not configured. Image acquisition is not possible.** Cause(s): Detector serial number is incorrect or missing. Corrective action(s): Configure the detector serial number in the Device tab of the Service section. If the problem persists, contact technical support.
5003	**Data folder for the detector is missing. Image acquisition is not possible.** Cause(s): Detector serial number is incorrect or missing. Corrective action(s): Create the data folder for the detector. If the problem persists, contact technical support.
5010	**Flat-field calibration is missing.** Cause(s): Flat-field calibration data missing. Corrective action(s): Perform flat-field calibration before acquiring patient images. If the problem persists, contact technical support.
5011	**Geometry calibration has not been performed.** Cause(s): Geometry calibration data missing. Corrective action(s): Perform geometry calibration before acquiring patient images. If the problem persists, contact technical support.
5012	**Hounsfield (HU) calibration has not been performed.** Cause(s): HU calibration data missing. Corrective action(s): Perform HU calibration before acquiring patient images. If the problem persists, contact technical support
5020	**Requested position could not be reached.** Cause(s): Errors in the gantry movements. Corrective action(s): Perform all the movement calibrations.
5021	**Weight bearing position could not be reached.** Cause(s): Gantry is not locked. Corrective action(s): Retry the pre-set drive or drive the gantry back to the operating range to resume normal use.
5022	**DOSE ALERT!** **The patient dose for the study will exceed the alert limit.** Cause(s): The cumulative patient dose of study will exceed the configured dose alert limit. Corrective action(s): Carefully assess the situation. Accept the alert and continue imaging only if the excess is justified. To lower the dose, return to imaging parameters and adjust the imaging values. Dose alert limit values are adjustable in Service mode.
5023	**Please attach the Head & neck positioning tray to continue.** Cause(s): Head and neck target anatomies (except Head) require Head & neck positioning tray. Corrective action(s): Attach Head & neck positioning tray to continue.
5024	**Please attach the Head positioning tray to continue.** Cause(s): Head target anatomy require Head positioning tray. Corrective action(s): Attach Head positioning tray to continue.

Code	Description
5025	**DOSE ALERT!** **The patient dose for the selected protocol will exceed the alert limit.** Cause(s): Selected protocol is configured to exceed alert limit. Corrective action(s): -
6000	**Activated weight-bearing mode requires that you use weight-bearing stool.** Cause(s): Activated weight-bearing mode requires that you use weight-bearing stool and adapter. Error in patient support recognition. Corrective action(s): To continue attach the weight-bearing adapter before placing the stool to the gantry bore. Check the Patient Support Sensor PCB. Check the cabling between patient support mechanism - Interface PCB - CPU Connector PCB - CPU PCB.
6001	**Unable to drive to selected pre-set destination because weight-bearing adapter is attached.** Cause(s): Weight-bearing stool adapter cannot be used while driving selected pre-set drive. Corrective action(s): Remove the weight-bearing stool and adapter to resume normal use.
6002	**The weight-bearing stool cannot be used in this imaging mode.** Cause(s): Error in patient support recognition. Corrective action(s): Remove the stool and adapter to resume normal use. Check the Patient Support Sensor PCB. Check the cabling between patient support mechanism - Interface PCB - CPU Connector PCB - CPU PCB.
6003	**Unable to drive the tray mechanism without a tray in weight-bearing mode.** Cause(s): Pre-set drive or patient position. Corrective action(s): Please attach correct tray to be used in weight-bearing mode to continue to drive the tray mechanism. Check the Patient Positioning Sensor PCB. Check the cabling between patient positioning mechanism - Interface PCB - CPU Connector PCB - CPU PCB.
6004	**Vertical tray may not be used in weight bearing mode.** Corrective action(s): Remove the tray.
6010	**The gantry angle is out of unit's operating range as gantry was tilted too much towards weight-bearing imaging position.** Corrective action(s): Drive the gantry back to the operating range to resume normal use. Calibrate the tilt mechanism. Check the potentiometer and wiring.
6011	**All downward movements are disabled due to pressure on base cover.** Cause(s): Base cover safety switch is activated. Corrective action(s): Remove pressure from the base cover and retry pre-set drive. Remove any weighing object from the top of base cover. Check microswitches and cabling.
6012	**Pre-set drive was halted because an object was detected inside the gantry.** Cause(s): Limb recognition sensor activated. Corrective action(s): Remove any object inside the gantry and retry pre-set drive. If the problem persists, ensure that recognition sensor transmitter and receiver are correctly placed and nothing is obstructing the signal.

Code	Description
6013	**All downwards movements disabled due to an object between gantry and floor.** Cause(s): Base cover safety switch is activated. Corrective action(s): Make sure that nothing is squeezed under the gantry while driving it downwards. Check microswitches and cabling.
6014	**Moving the unit is allowed only in transportation mode.** Cause(s): Transportation handle activated without first driving the unit in transportation mode. Corrective action(s): Lower the unit carefully back on ground and lock the handle in place to resume. If the warning appears but transportation handle seems to be correctly in place Check microswitches and cabling from patient support mechanism to the CPU PCB.
6015	**Automatic pre-set drive was stopped due to manually operating joysticks.** Corrective action(s): Drive the pre-set again to reach pre-set destination.
6016	**Support handle can only be used in weight-bearing imaging.** Cause(s): Weight-bearing handle or handle recognition activated. Corrective action(s): Push the handle in to resume. Check the microswitches and the cabling to the CPU Connector PCB.
6017	**Weight-bearing mode activated. Rotation with joystick disabled.**
6018	**Hover tray mode activated.** Cause(s): Hover tray mode is ready for use. Corrective action(s): -
6020	**Manual pre-set drive Press-and-hold down any joystick button to drive to a pre-set destination.**
6021	**Do not switch off the unit before the computer is powered off. Verify computer status from the indicator light in the device panel.**
6022	**The computer will automatically shut down after the pre-set drive to packaging mode is completed.**
6023	**The computer will automatically shut down after the pre-set drive to transportation mode is completed.**
6024	**The patient dose for the study will exceed the notification limit.** Cause(s): Selected imaging values exceed the set dose notification limit. Corrective action(s): -
6025	**Acquisition software is not compatible with the software installed on the device. > Please update latest software.** Cause(s): Old or invalid software version installed on CPU or no connection to CPU. Corrective action(s): Verify CPU connection and update correct CPU software version if necessary
6026	**The patient dose for the selected protocol will exceed the notification limit.** Cause(s): The selected protocol is configured to exceed notification limit. Corrective action(s): -
6030	**Software checksum error > Please verify or re-run PC software installation.** Cause(s): Corrupted Verity Manager software installation. Corrective action(s): Check Verity Manager installation package version and re-run PC software installation

Code	Description
6055	**Selected imaging mode does not support AEC. Manual imaging values are in use. > Carefully assess the situation.** Cause(s): Selected imaging protocol does not support AEC. AEC imaging mode is disabled and imaging values must be selected manually. Corrective action(s): Use imaging protocol that supports AEC or select imaging values manually.
6056	**Collimation cannot be changed during AEC exposure. > Please return previous collimation.** Cause(s): Collimation has changed after acquiring AEC scout images. Corrective action(s): Use the same collimation for scout images and 3D image in AEC mode.
6057	**No human tissue detected > Please make sure that anatomy is correctly positioned.** Cause(s): Dose measured at X-ray detector is too low and is not indicative of real anatomy. Corrective action(s): Run quality control tests and verify that nothing is blocking the X-ray beam and that the X-ray detector is working properly.
6058	**AEC scouts not found.** Cause(s): Not enough scout images found in study before AEC 3D imaging. AEC imaging requires four scout images. Corrective action(s): Acquire scout images in AEC mode before AEC 3D imaging to ensure correct amount of scout images.
6059	**Invalid protocol configuration -> Please make sure that at least one protocol contains exposure parameters for the selected anatomy.** Cause(s): Exposure parameters for selected anatomy were not found. Corrective action(s): Configure exposure parameters for selected anatomy in Service \ Imaging Protocols page.
6060	**Saving preset parameters without any positioning equipment is not possible. > Use suitable positioning equipment to save.** Cause(s): No positioning equipment was attached to gantry while adjusting preset values. Corrective action(s): Attach positioning equipment to gantry before saving the adjustments.
6061	**It is not recommended to acquire images without a tray. -> Please ensure the patient is sufficiently supported.** Cause(s): Positioning tray is missing or not detected. Corrective action(s): Attach positioning tray or ensure the patient is sufficiently supported before acquiring images.
6062	**Not licensed for clinical use.** Cause(s): Verity Manager has no connection to the detector or not able to find the license file. Corrective action(s): Check the connection between workstation and the detector and whether a license is correctly installed.
6063	**Verity Manager license is expired on x** Cause(s): Verity Manager license has expired. Corrective action(s): Install new Verity Manager license file.

Code	Description
6064	**x days to license expiration. Imaging is not possible after the license expires.** Cause(s): Verity Manager license is about to expire. Corrective action(s): Install new license.
6065	**Demo mode -> Demo mode activated** Cause(s): Verity Manager is configured to work in demo mode or Verity Manager license has expired. Corrective action(s): Change demo mode configuration on Service/Device tab or install new Verity Manager license file.
6066	**License is for detector** Cause(s): Verity Manager has no connection to the detector or the configured detector serial number does not match the license file. Corrective action(s): Check the connection to the detector and the configured detector serial number in Service/Device. Correct the serial number or change the Verity Manager license file if necessary.
6068	**The factory imaging protocol is in use and cannot be disabled.** Cause: This factory imaging protocol is in use as a default protocol. Corrective action(s): To disable the protocol its setting as default protocol must be removed. By checking the box to disable a default configured protocol for any anatomy, the pop-up opens and the deselect checkbox is disabled.

2.17 Modifying date and number format

About this task

The Planmed Verity Manager application uses the date format and number format specified in the operating system's regional settings.

You can check and modify the regional settings to ensure that the most common date and number format used in your region are used to avoid confusion. It is also recommend the system is set to recognise four-digit years.

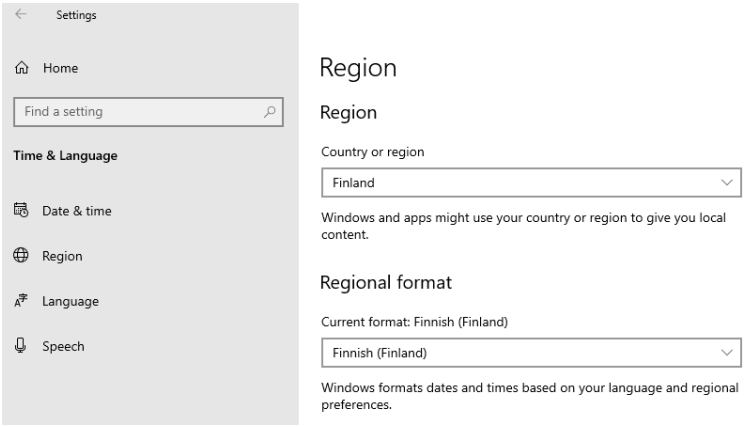
NOTE

For changing the settings you need the admin user rights.

Steps

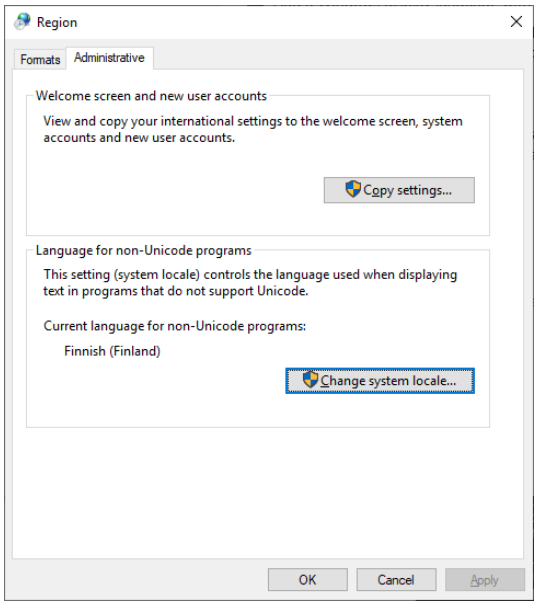
1. From the task bar, click the **Windows** icon and click the **Settings** icon.
2. Select the **Time & Language**.
3. Select the **Region** from the left menu-tree.

4. Select the most common number and date settings for the region.



   The date style should include four-digit years.

5. Select the **Language** from the left menu-tree.
6. Select the **Administrative language settings**.
7. In the **Region / Administrative** tab, set the language defined in the **Current language for non-Unicode programs:** field according to the used language.



8. Click the **Apply** and **OK** buttons.

3 Preventive maintenance

The maintenance program guarantees the Planmed Verity extremity scanner's long lifetime, and that the number of unexpected problems is as low as possible. Adhering to the maintenance program ensures that the environmental impact of using Planmed Verity is as minimal as possible.

The following sections describe the preventive maintenance processes for the X-ray unit.

3.1 System maintenance

The following sections describe the preventive system maintenance required for the Planmed Verity extremity scanner.

3.1.1 Cleaning

CAUTION

The device must not be exposed to gaseous disinfectants or explosive anesthetics. Never spill any liquids into the unit. If that happens, make sure that the liquid did not come into contact with any of the internal electronic parts (cables/sensors/ PCBs) before turning on the unit.

CAUTION

Do not use any cleaning agents in aerosol or spray form directly on device surfaces.

CAUTION

Do not use any alcohol-based cleaning agents on the gantry and column surfaces or the touch screen.

3.1.1.1 Unit outer surfaces

The X-ray unit's outer surfaces include the following:

- Surfaces of patient supports and handles
- Surfaces of gantry and vertical column
- Touch screen

For more information on cleaning the outer surfaces, see the user's manual.

3.1.1.2 Base

Open the vertical maintenance hatch as described in section "Vertical column covers" on page 107.

Vacuum the inner surfaces of the vertical column. Preferably use an antistatic vacuum-cleaner.

NOTE

If the inner part of the vertical column is very dusty, vacuum also the inner parts of the electronics control box.

3.1.1.3 Computer

Open the vertical column door and remove the vertical column back cover. Switch off the computer. Remove the outer cover of the computer as shown in the figure below.

Carefully vacuum the inner part of the computer. Preferably use an antistatic vacuum-cleaner.

3.1.2 Unit safety

The following sections describe the X-ray unit safety features and functions.

3.1.2.1 Exposure indicators

Confirm that the exposure indicator lights turn on in the control panel and in the exposure switch for the length of the exposure. Additionally, check also the (optional) external exposure indicator, if the unit is equipped with such.

3.1.2.2 Exposure warning signals

Confirm that the X-ray unit's buzzer comes on for the length of the exposure.

The exposure switch also contains a buzzer. Check that this buzzer also comes on for the length of the exposure.

3.1.2.3 Exposure switch

Confirm that the exposure switch requires continuous activation to maintain the exposure. Releasing the exposure switch during the radiation should stop the exposure and produce an error message. Make a visual check and check for possible wear or damage of the exposure switch spiral cable. Replace if necessary.

3.1.2.4 Emergency stop button

Check the emergency stop button operation every half a year.

NOTE

If possible, do not remove emergency stop button from the top cover during maintenance. If the removal of the emergency stop button from the top cover is necessary to perform maintenance operations, remove the emergency stop button intact without disassembling. For more information, see section "Vertical column top cover" on page 111.

3.1.2.5 Safety functions

Patient positioning tray

1. Drive the patient positioning tray to topmost position.
2. Press the red emergency button.
3. Push down the patient positioning tray.

   The tray should go down easily.
4. If the tray does not move, the tray mechanism is either dirty or broken. Clean or change the mechanism.

3.1.2.6 Fans

Check that the electronics box fan is rotating.

Check that the gantry fan is rotating.

3.1.2.7 Multi-purpose handle

- Release the multi-purpose handle by pushing the handle securing ring towards the vertical column.

- Turn the handle to 30° angle.

- Drive the gantry downwards. The gantry must not move. If it does, contact Planmed After Sales.

3.1.2.8 Gantry

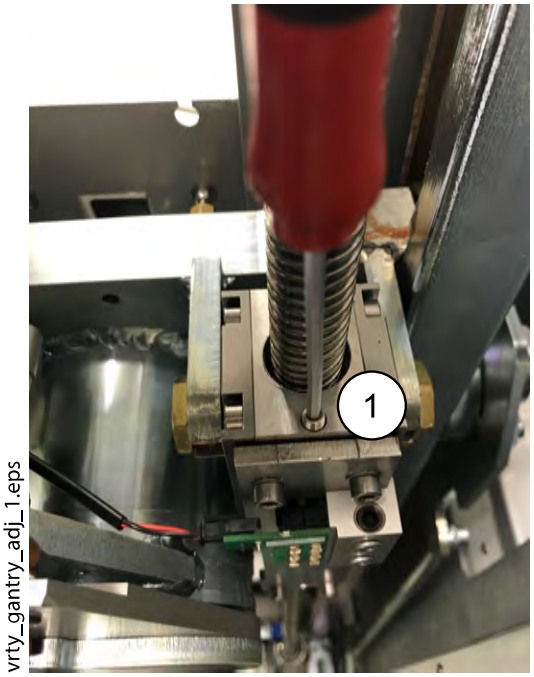
- Collision detection system: Drive the gantry to vertical position. Drive the gantry against an obstacle. The gantry should move slightly upwards if it hits an obstacle below it. The force caused by the gantry to the obstacle must be maximum of 30 kg in the lowest position. If the maximum force of 30 kg is exceeded, adjust the mechanism, see instructions in the section **Adjusting collision detection mechanism sensitivity** (below).
- If the weight-bearing option is installed: drive the gantry to the ankle exposure position using the pre-set drive. Press the gantry strongly

downwards from the patient side, near outer edge. The gantry must not rotate. If it does, contact Planmed After sales.

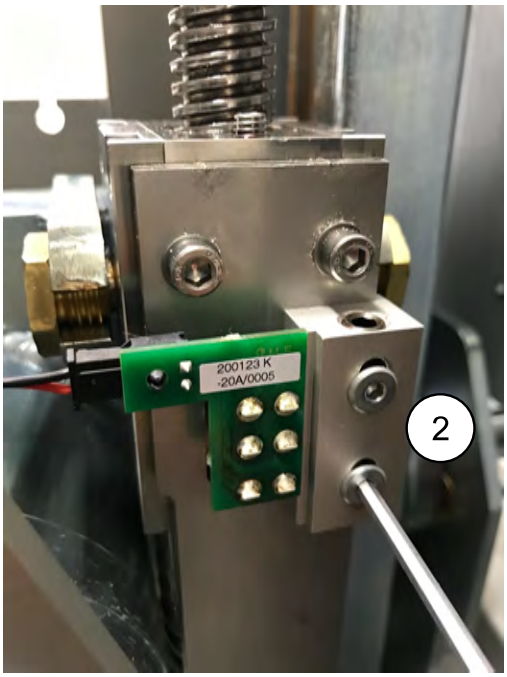
- Drive the gantry to approx. 80 cm height and tilt it to 45° angle. Pull the gantry sideways from above the information screen. The gantry should move (max. force 20 kg).
- Pull out the support handle approx. 5 cm. Drive the gantry upwards as fas as possible. The gantry should stop to the position where you can pull fully out the support handle.
- Drive the gantry downwards and simultaneously push the base cover down. The gantry must not move. If it does, contact Planmed After Sales.

Adjusting collision detection mechanism sensitivity

1. Loosen the set screw **(1)**.

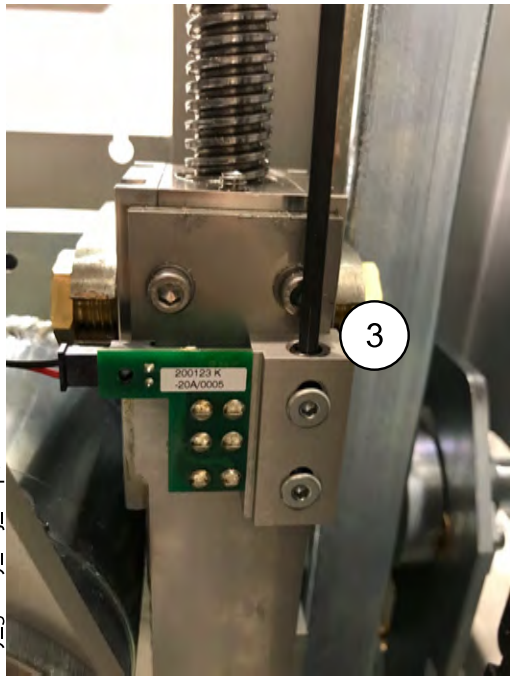


2. Loosen the microswitch holder screws **(2)**.



vrty_gantry_adj_2.eps

3. Adjust the microswitch holder position by turning the set screw **(3)**.



vrty_gantry_adj_3.eps

4. When adjusted, tighten the microswitch holder screws **(2)**.
5. Drive the gantry slowly against a force meter.
6. Make sure that the maximum force does not exceed the **30 kg** limit, readjust if needed.
7. Turn the set screw **(1)** so that it reaches the bottom, but **DO NOT** tighten the screw.

   Use low strength threadlocker to secure the set screw to it's place.

3.1.3 Unit general condition

3.1.3.1 Labels

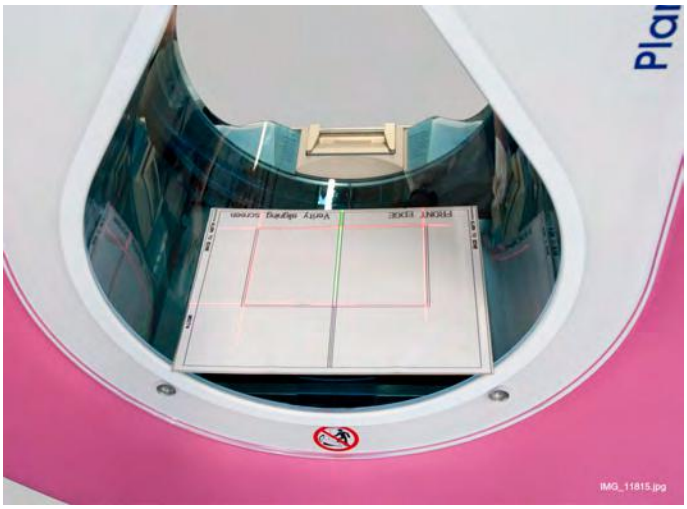
Check that no labels are detached or worn and that they are all legible. For more information on the labels and their positions, see section "Product labels" on page 9.

3.1.3.2 Joysticks

Check the operation of the joystick by driving all the directions and knobs.

3.1.3.3 Positioning lasers

Check that all the positioning lasers are functional and visually check the adjustment is correct with the aligning print.



3.1.3.4 Outer surfaces, plugs & other externals

- Check the condition of plugs, lead-in rubbers and gantry sealing rubber.
- Check the condition of the gantry bore plastic tube.

- Check the condition of weight-bearing stool, radiation protection screen and positioning trays.
- Check the condition of the vertical column roller shutter.

In case of wear or obvious breakage contact Planmed After Sales.

3.1.3.5 Touch screen control panel

Check the condition of the touch screen control panel. Check that the control panel moves properly.

3.1.3.6 Patient positioning tray

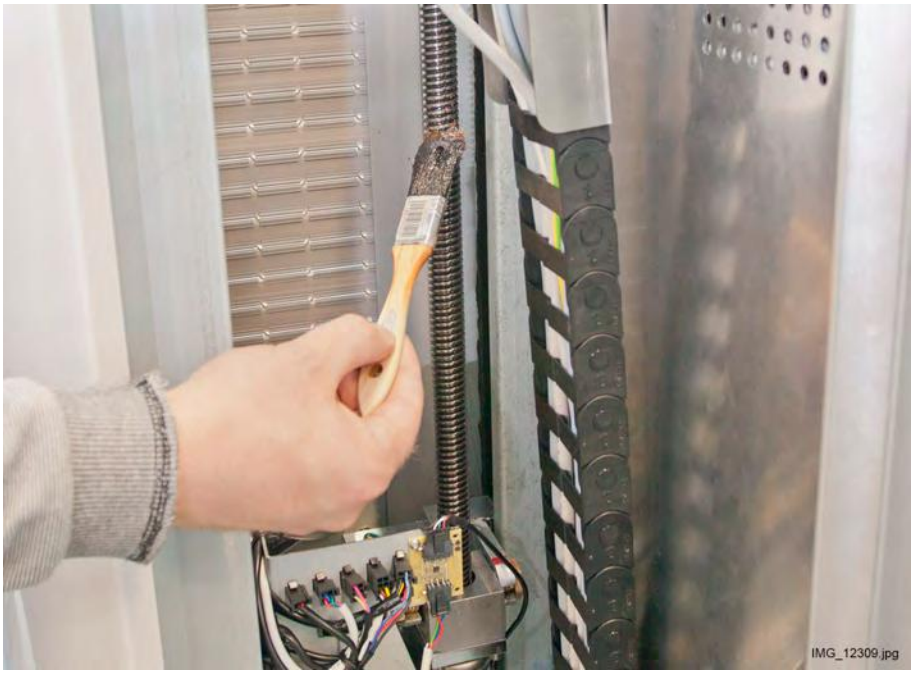
Check that the sideways movement of the tray end is max. 2 mm (0.1 in.).

3.1.3.7 USB connection

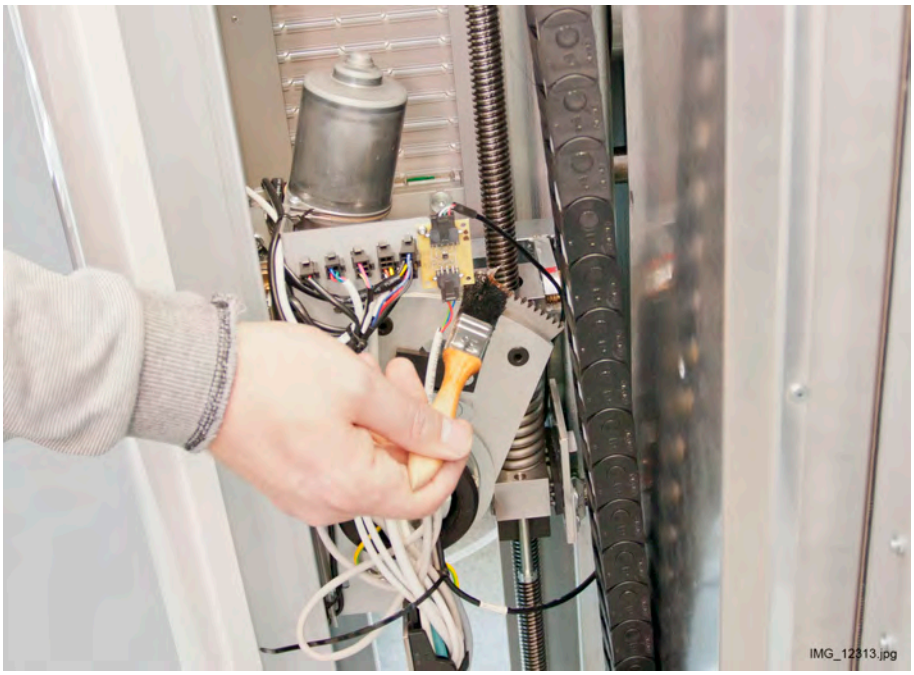
Check the operation of all three USB connections. One connection is located on the vertical column and two below the touch screen control panel.

3.1.4 Lift motor worm screw and gear sector

Spread a small amount of vaseline (for example, Shell Darina R2) with a brush to the worm screw length of approximately 300 mm.



Spread vaseline with a brush to the gear sector length of approx. 50 mm.



3.2 X-ray measurements

The electrical exposure parameters of the X-ray unit should be checked annually in order to ensure the accurate operation of the equipment.

There are no adjustments in the equipment because of its self-calibrating system - therefore no actual parameter trimming of the kV, mA and exposure time can be done. If one of the parameters to be checked is found to be beyond the limit allowed, the corresponding module is to be changed in whole, or a factory-type recalibration should be performed.

3.2.1 X-ray tube feedback system

The unit performs a complete check on the feedback system before every exposure. Any found errors or deviations are reported as error messages (exposure is prevented).

Therefore the actual need for this annual test is dictated by the local authorities and respective regulations. Please be sure to perform all tests required by the authorities.

There are two ways of doing most of the tests:

- Non-invasively (from the radiation beam)
- Invasively (from the unit's feedback signals)

Both are presented here. Please note that not all tests can be performed both ways.

CAUTION

Radiation is emitted during all these tests. Proper protection against unnecessary exposure to radiation must be considered.

3.2.2 Non-invasive testing

A non-invasive testing method (directly from the radiation) can be used for checking the kVp, radiation quality (half-value layer) and the exposure time. This method is efficient since no covers need to be opened, and it gives a “second” opinion on the measured parameters. However, care must be taken when selecting the appropriate non-invasive X-ray meter; older meters calculate the kVp avg based on the assumption that the kV waveform is AC. The Planmed Verity has DC high voltage with very small high frequency ripple, so the accurate measurement of kV waveform can be impossible if, for an example, the meter’s sampling frequency isn’t high enough. If in any doubt whether or not the meter is suitable for the Planmed Verity, please consult the meter manufacturer for additional information. Otherwise, please refer to the radiation meter manufacturers user manual of how to use the meter.

Peak tube potential (kVp) measurement

When a non-invasive meter is used for kVp measurement, following things should be noted:

1. The detector should be placed exactly in the middle of the X-ray field in both horizontal and vertical directions.
2. The detector distance from the focal spot should be as short as possible to maximise the signal / noise ratio.
3. The whole detector area must be within the radiation field.
4. The meter must be properly calibrated and, when necessary, appropriate calibration / correction factors must be used when interpreting the results.

The measured kVp must be within ±5% of the value displayed on the user interface.

Half-value layer measurement

There are different recommended procedures for measuring the HVL. The HVL is defined as the thickness of a specified material (generally expressed in mm Al) which attenuates x-radiation with a particular spectrum to an extent such that the value of air kerma (or exposure or absorbed dose) rate is reduced to one half of the value that is measured without the material. The simplest method to ensure that the unit complies with the requirement (the first permissible HVL must be at least 2.5mm Al at 84 kV) is to measure the air kerma rate first without any additional material in the radiation field, then add 2.5mm Al to the radiation field, measure the air kerma rate again and check that the air kerma rate with additional 2.5mm Al is more than one half of the one measured without the added material. That is,

(Dose rate with added 2.5mm Al eq filtration) / (Dose rate without added filtration) > 0.5
This is sufficient to ensure that the HVL is at least 2.5mm Al. Depending on the type of the radiation meter used, it is possible that a correction factor needs to be applied to the result measured with added material in the radiation field.

Exposure time measurement

Take an exposure and record the measured exposure time. The measured exposure time must be within ±10% of the exposure time displayed in the user interface.

3.2.3 Invasive testing

NOTE

The manufacturer does not require the invasive testing. The invasive test must only be performed if the local authorities require it.

An invasive testing method (directly from the units own feedback signals) should be used for checking the tube current (mA), and can be used for checking the kVp and exposure time. This method requires that the blue plastic cover is removed, and a special measurement adapter cable, Planmed order code 20008576, is connected to the connector J2 in the FBK PCB. The FBK PCB is permanently fastened to the front side of the tube head assembly. The analog feedback voltage signals can be measured with a calibrated multimeter from the adapter cable connectors (labelled kVpos, kVneg, mApos and mAneg). An oscilloscope is required if kV and mA waveforms need to be observed, for example when determining the exposure time.

NOTE

The feedback signals are differential, so measuring only one polarity signal (e.g. kVpos with respect to the X-ray units ground potential) will give false results. The feedback signals must always be measured differentially, kV feedback voltage = (kVpos – kVneg) and mA feedback voltage = (mApos – mAneg).

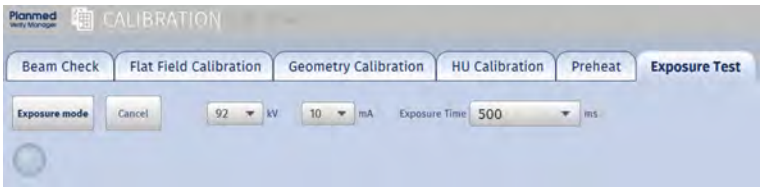
Exposure test

The exposure test is intended for measuring exposure time accuracy.

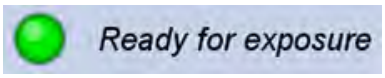
1. Tap the *Options* arrow on top of the window.

2. Select **Calibration**.

3. Tap the *Exposure Test* tab.
4. Select kV and mA values and the exposure time from the drop-down menus based on the test scope.



The exposure can be taken when the green indicator lights come on.

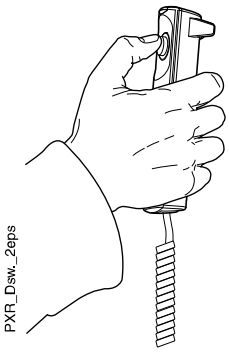


5. Touch the **Exposure mode** button.

CAUTION

When the exposure is taken, radiation will be generated. Protect yourself from radiation.

6. Press the exposure button to take an exposure.



Peak tube potential (kVp) measurement

Connect the kVpos plug of the Planmed measurement adapter to the positive terminal of the multimeter and the kVneg plug to the negative (ground) terminal of the multimeter. Select the appropriate DC voltage measurement range for 1 to 5 V signal level. Take an exposure with desired kV setting (selected mA value has no effect, however low mA should be used to minimise the amount of unnecessary radiation) and when the voltage reading has stabilized, record it. The actual tube voltage relates to the measured feedback signal as follows:

Actual tube voltage = 27 000 * measured feedback voltage (in volts)
The resulting tube voltage should be within ±5% of the voltage indicated in the user interface.

Tube current (mA) measurement

Connect the mApos plug of the Planmed measurement adapter to the positive terminal of the multimeter and the mAneg plug to the negative (ground) terminal of the multimeter. Select the appropriate DC voltage measurement range for 100mV to 5 V signal levels. Take an exposure with desired mA setting (selected kV value has no effect, but lowest possible kV

is recommended to minimise the amount of unnecessary radiation) and when the voltage reading has stabilized, record it. The actual tube current relates to the measured feedback signal as follows:

Actual tube current (in mA) = 5.06 * measured feedback voltage (in volts)
The resulting tube current should be within ±10% of the current indicated in the user interface.

Exposure time measurement

A calibrated oscilloscope is needed for invasive exposure time measurement. Connect oscilloscope channel 1 to kVpos, channel 2 to kVneg and oscilloscope ground to the tube head ground. Select differential signal (Ch1 – Ch2) from the oscilloscope math menu and take an exposure with desired values. The exposure time can be defined from the oscilloscope screen as the time interval during which the tube potential exceeds 70% of the peak tube potential. The exposure time must be within ±10% of the value displayed in the user interface.

Feedback signal offset measurement

The feedback signals have a small offset voltage that is used for internal self-testing of the equipment. In some cases, it can be useful to measure these offsets for troubleshooting purposes etc. The offset of all feedback signals (kVpos, kVneg, mApos and mAneg) should be 49 ± 2 mV with respect to the unit ground potential. The offsets should be measured in idle state (before exposure).

3.3 Quality control tests

Perform the quality control tests according to the instructions given in *Planmed Verity user's manual*.

4 Parts replacement

The following sections describe the procedures for removing and replacing different parts of the X-ray unit.

4.1 Removing and replacing covers

Disconnect the X-ray unit from mains and wait for a few minutes.

4.1.1 Vertical column covers

The following sections describe the procedures for removing the different covers on unit's vertical column.

4.1.1.1 Maintenance hatch

The vertical column maintenance hatch is attached with four attachment screws.

1. Drive the touch screen to its lowest point and swing it to its vertical position.
2. Detach the four cover plugs (component part 20007981, **1** in the picture below) and unscrew the attachment screws (**2**).

3. Open the maintenance hatch.

4.1.1.2 Vertical column back cover

1. Remove the plug from the attachment screw opening and unscrew the screw using a 3 mm Allen key.

2. Unscrew the attachment screw located on the wire housing.

3. Pull the cover outwards. Make sure that the collar of the handle securing ring comes with the cover.

4. Lift the cover first slightly upwards then outwards.

5. The cover can now be removed.

6. Replace the cover in reverse order.

4.1.1.3 Vertical column top cover

NOTE

Do not remove the vertical column top cover if it is not necessary.

1. Open the maintenance hatch according to the instructions given in section "Maintenance hatch" on page 107.

2. If it is necessary to remove the vertical column top cover, unscrew two attachment screws using a 2 mm Allen key.

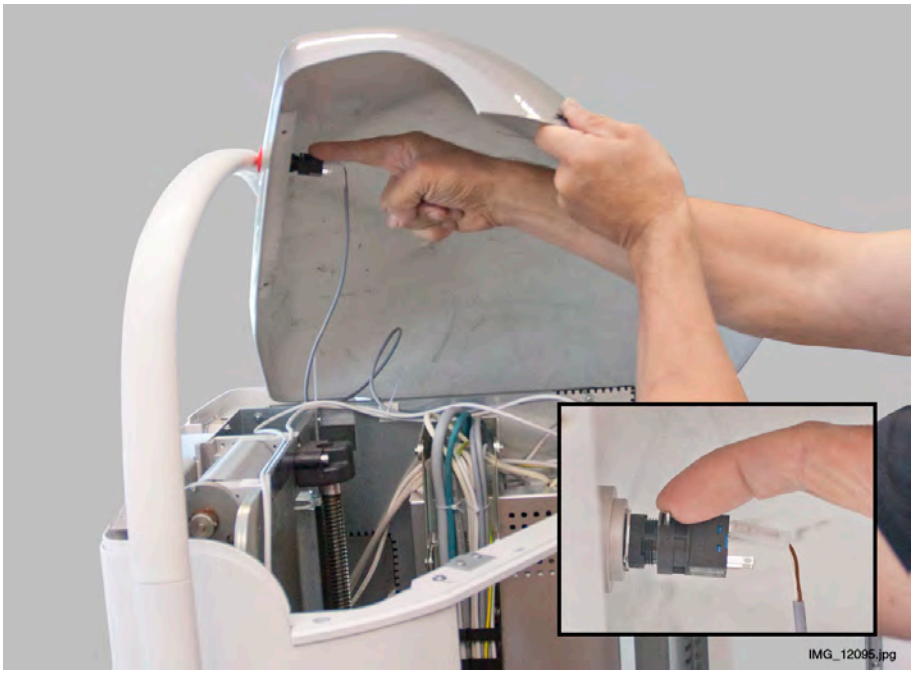
3. Open two attachment screws located on the gantry side using a 2 mm Allen key.

NOTE

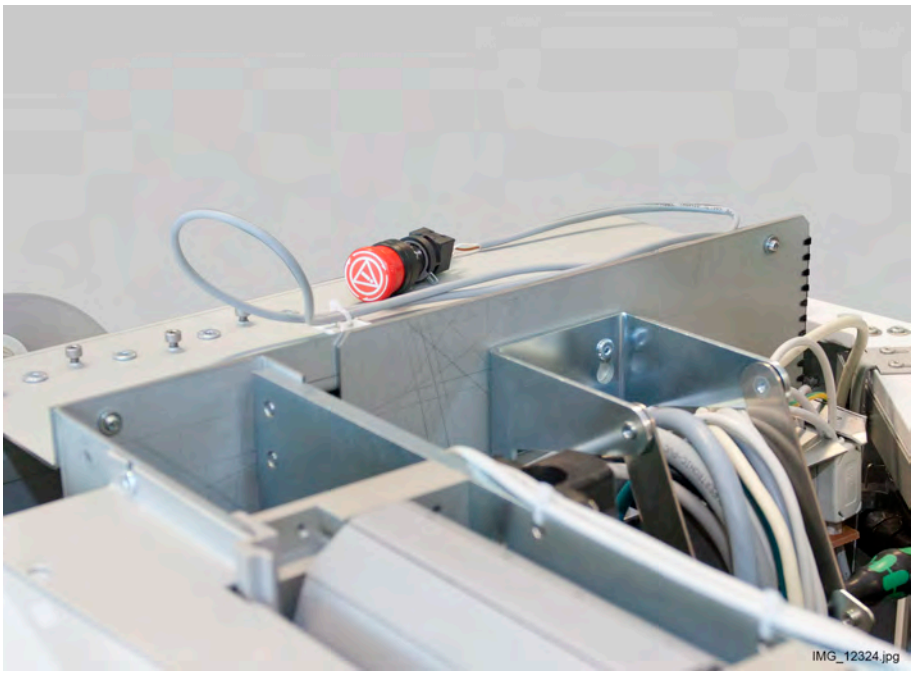
The attachment screws used on the gantry side are shorter than the ones used on the hatch side.

4. Lift the top cover away from its position.

5. Turn the locking lever of the emergency stop button cable and detach the cable.



6. Remove the upper part of the emergency stop button from the top cover and reconnect it with the cable.



The top cover can now be removed.

7. Replace the cover in reverse order, starting with the gantry side attachment screws.
8. After reassembly, test that the emergency stop button is working.

4.1.2 Gantry covers

The following sections describe the procedures for removing the different covers on unit's gantry.

4.1.2.1 Removing the gantry back cover

1. Drive the gantry to the uppermost position.
2. Switch off the X-ray unit.
3. Check that the support and multi-purpose handles are in rest positions.
4. Detach the four screw plugs.
5. Carefully detach the sealing rubber from its position using a screwdriver or similar. Leave the sealing rubber as shown (**1** in the figure below).

6. Unscrew four back cover attachment screws from the collar (**1** in the figure below).

NOTE

One of the screws is shorter than the other three.

7. Remove the back cover. The collar comes up from its position by lifting it up with the back cover.
8. Replace the cover in reverse order. Make sure that the collar is guided to its position properly. When replacing the cover place the rubber collar first to its position and then tighten the attachment screws. Do not tighten the screws too firmly.

4.1.2.2 Removing the gantry bore

Make sure that the detector is in its lowest position and the gantry back cover is removed.

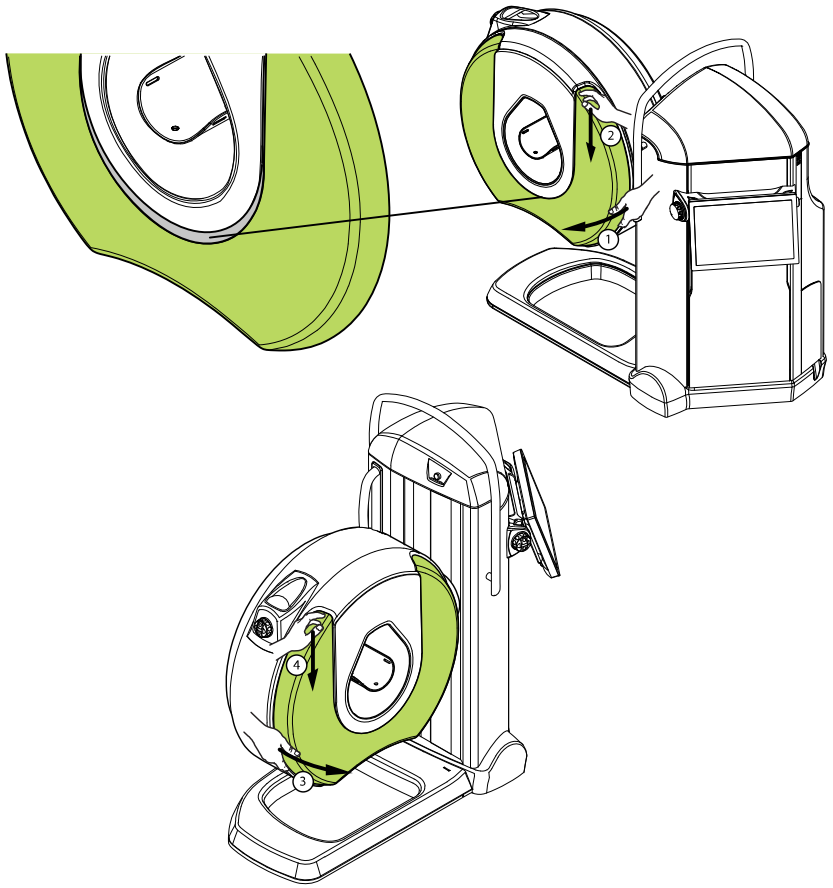
Remove the cushion as follows:

1. Pull both sides first slightly outwards.
2. Pull both sides downwards.

NOTE

Check that the edge of the cushion can be seen under the gantry front plate.

3. Raise the left side of the cushion forwards (apart from surface).
4. Carefully bend the cushion and at the same time pull it to left until it comes out from its holding groove under the front plate.
5. Perform the same on the right side. The cushion is now removed.

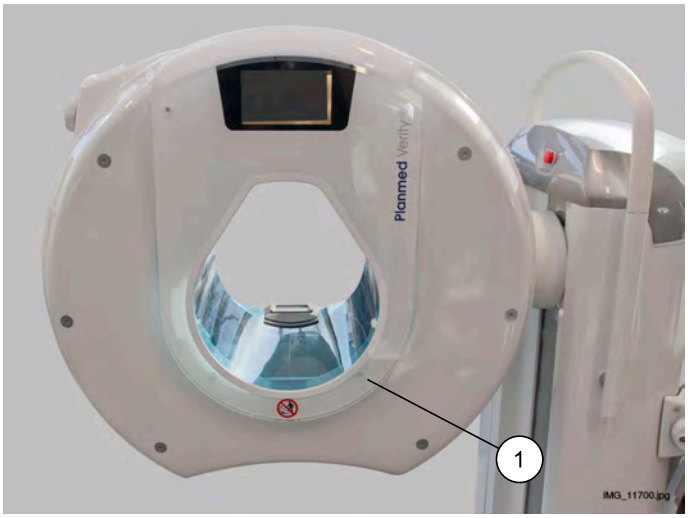


Check that the edge of the cushion can be seen under the gantry front plate

6. Use the special bore removal tool (20008639) that can be found behind the wire casing door.

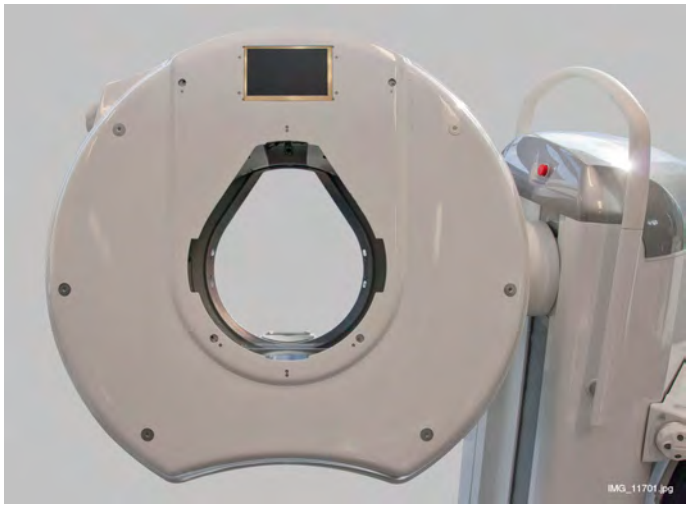
Bore removal tool (20008639)

7. Attach the tool to the multipurpose screwdriver or to the drilling machine. Unscrew the four attachment screws of the front plate **(1)** in the figure below.



8. Remove four M5x25 screws from the back side.

9. Carefully pull the gantry bore away from its position. Do not scratch the bore!



10. Replace the bore in reverse order. First attach the front screws using the bore removal tool (20008639). Then attach the back screws (M5x25).

NOTE

Stop tightening the screws just when the screw head reaches the mating surface.

NOTE

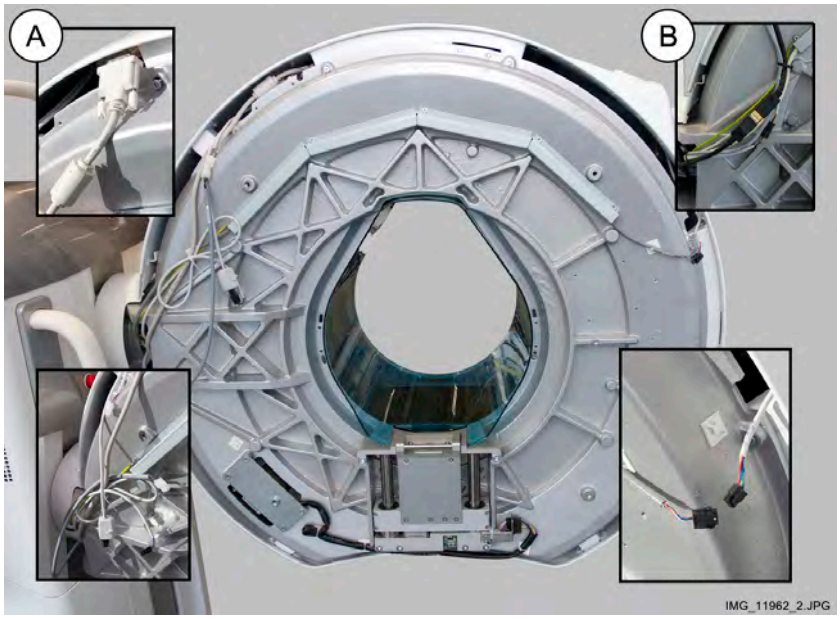
Make sure that the information screen is in the middle of the bore opening before tightening the screws.

4.1.2.3 Replacing the front housing

1. Disconnect the information screen and joystick cables.

   If the unit has a DVI connection option **(A)**, unscrew the connector screws and unplug from inside the unit rim as shown in the figure below.

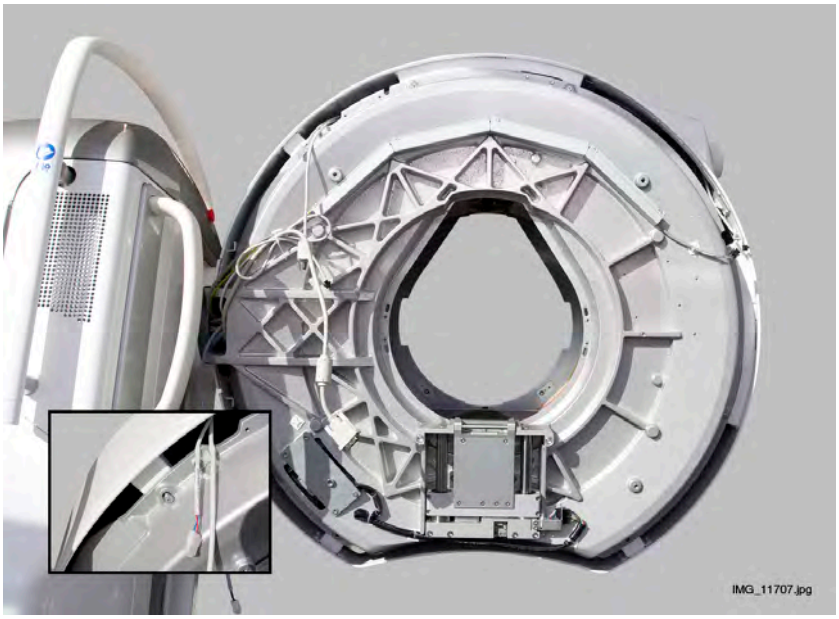
   If the unit has a display port cable connection option **(B)**, cut the cable ties and unplug from the connection point shown in the figure below.



2. Unscrew seven front housing attachment screws.

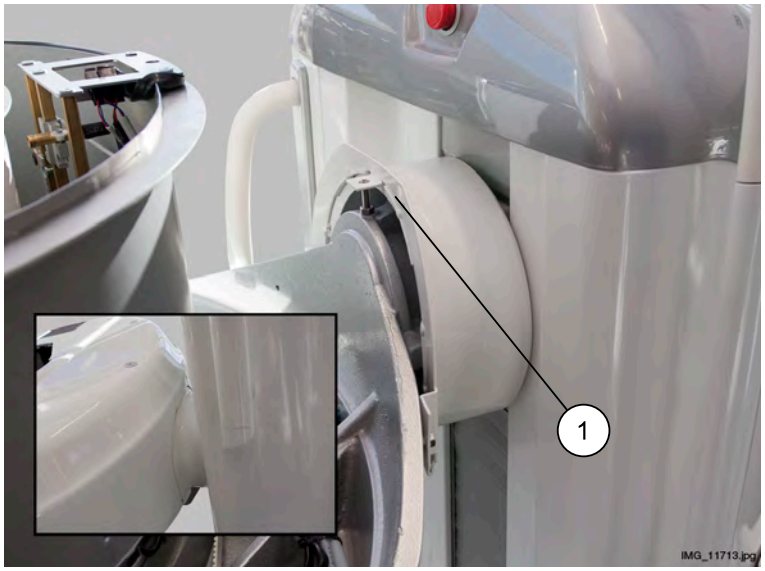
NOTE

It is easier to remove the screws when the gantry is slightly tilted. Be careful not to allow the cover to drop.

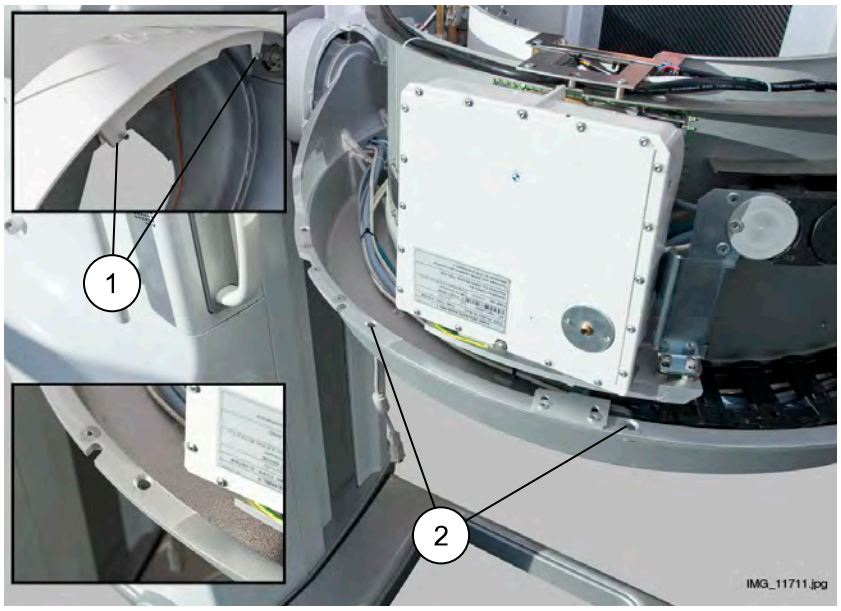


3. Lift the front housing away from its position.

4. Replace the housing in reverse order. When replacing the front housing make sure that the lifting adapter collar**(1)** is inside the housing.



5. Aim the attachment pins in the cover to the corresponding attachment holes in casting (7 pcs.).

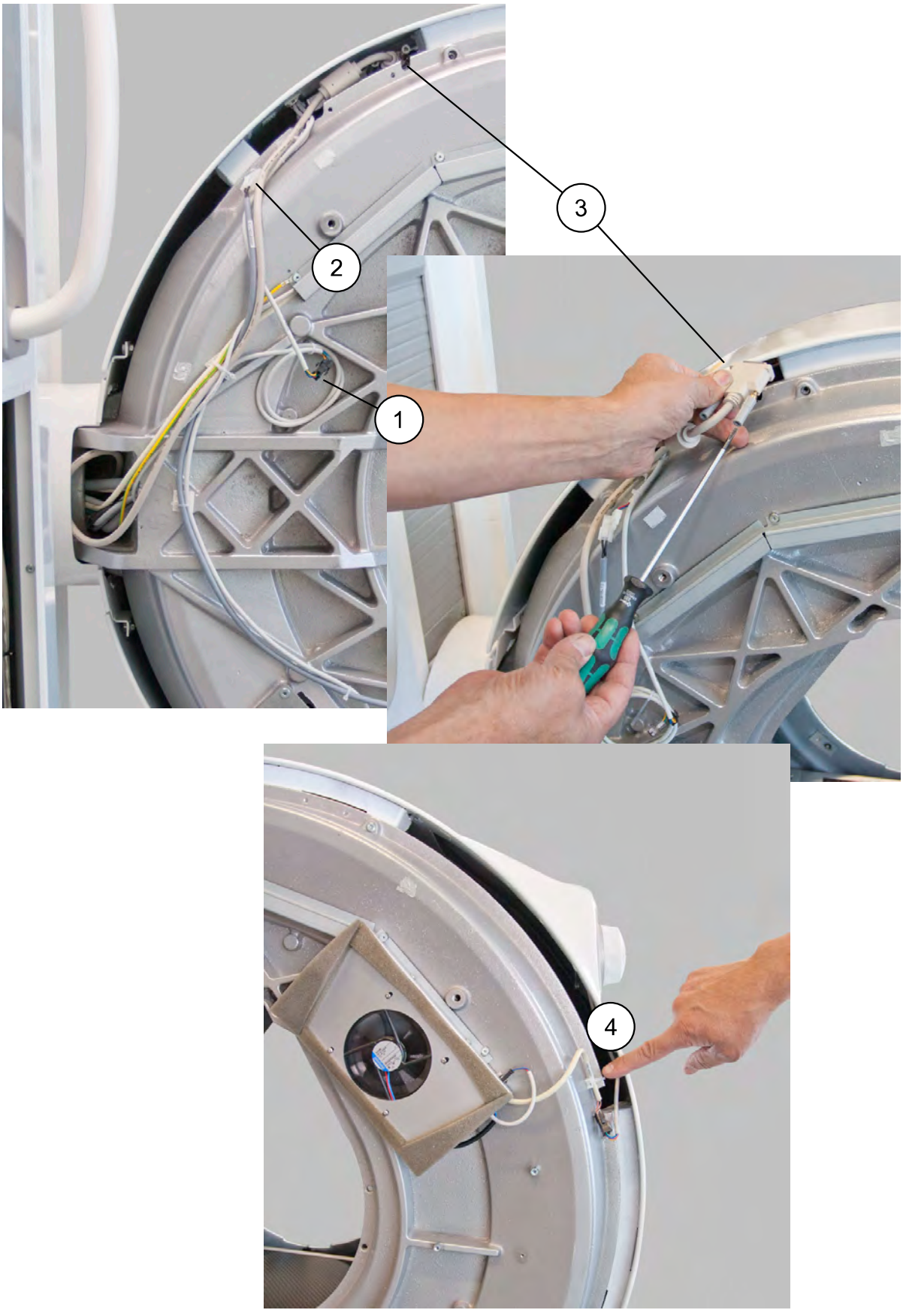


1 Attachment pins

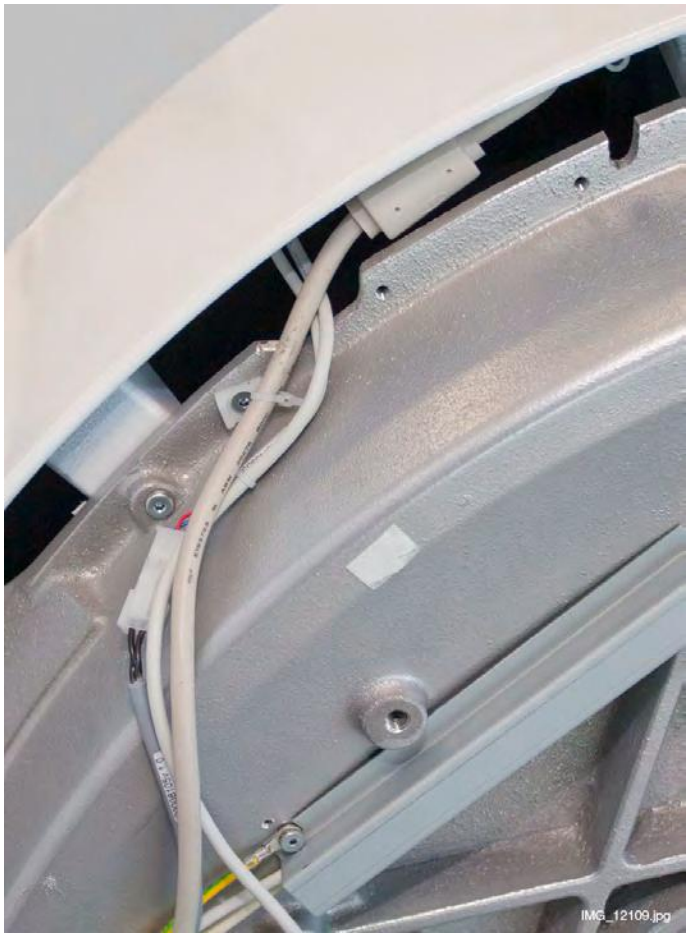
2 Attachment holes

6. Attach 1 - 2 screws partly first to keep the cover in position. Guide the rest of pins to the holes and attach the rest of the screws.

7. Connect the cables **(1 - 4)**.



8. Route and tie the cables as shown on the figure below.



4.1.2.4 Shadow screens

1. Unscrew the four attachment screws on each of the two shadow screens.

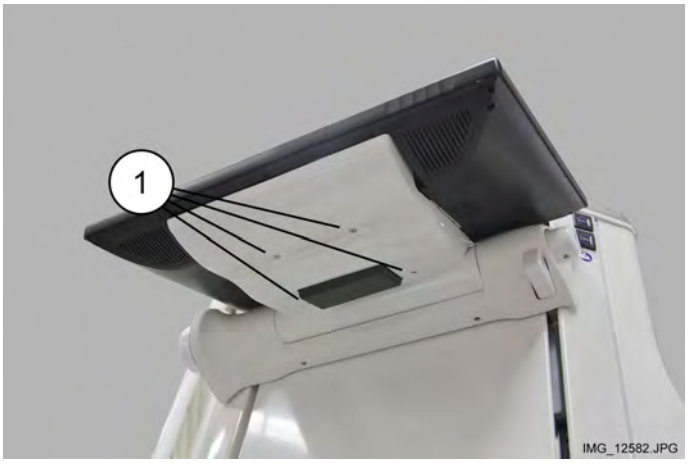
2. Detach the shadow screens.

NOTE

The screens can also be removed when the front cover is in position.

4.2 Replacing 21 inch control panel

1. Unscrew four lower cover attachment screws **(1)** using a 2 mm Allen key and remove the cover.



2. The control panel power supply is located below the lower cover and can be unplugged from the power cord as shown in the figure below.
3. Unscrew four control panel attachment screws using a 2 mm Allen key.

4. Turn the control panel upside down.

5. Disconnect the control panel cables and remove the control panel.
6. Replace the control panel in reverse order. When attaching the control panel to its position place the cable ferrites as shown on the figure below. Make sure that the cables are not across.

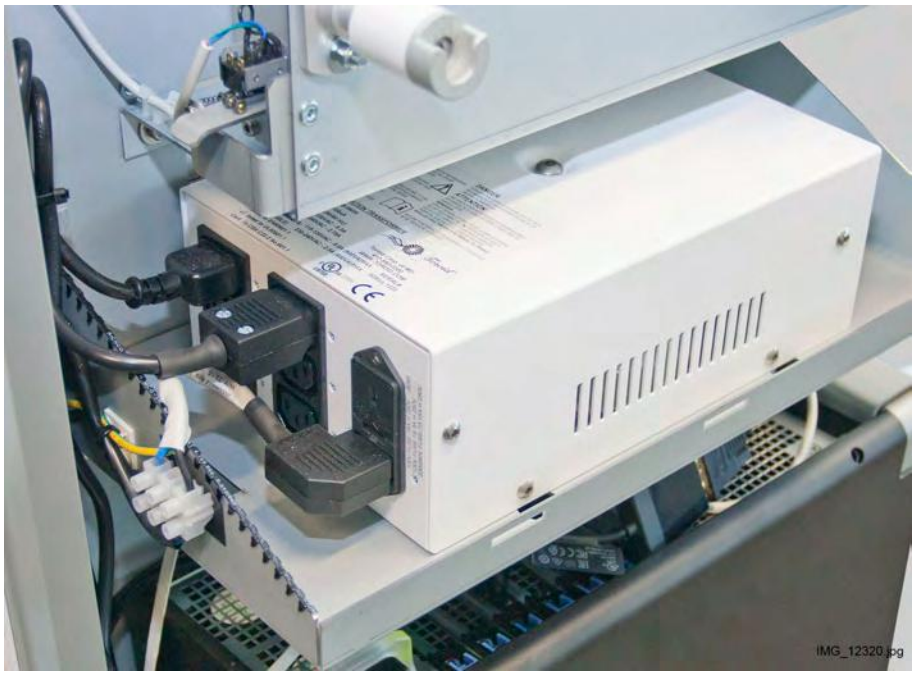
4.3 Replacing transformer

NOTE

Replace the transformer only using the correct approved spare part specified by Planmed.

1. Disconnect the X-ray unit from mains and wait for two minutes.
2. Remove the vertical column back cover as described in section "Vertical column back cover" on page 109.

3. Disconnect all cables from the transformer.



4. Remove the computer.
5. Unscrew the four transformer attachment screws using a crosshead screwdriver. The attachment screws are located at the bottom of the transformer.

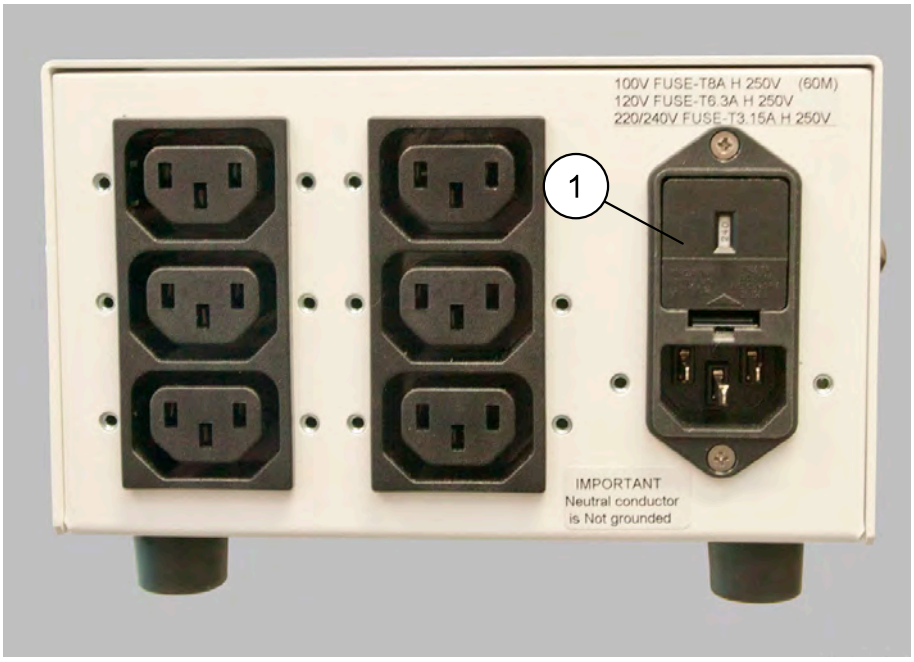
   NOTE

   Do not completely remove the transformer attachment screws until you have removed the computer.

6. Lift the transformer away from its position.

   Before installing the new transformer, check its voltage selection and fuse values as follows:

1. Check the voltage selection seen in the power entry module (**1**).

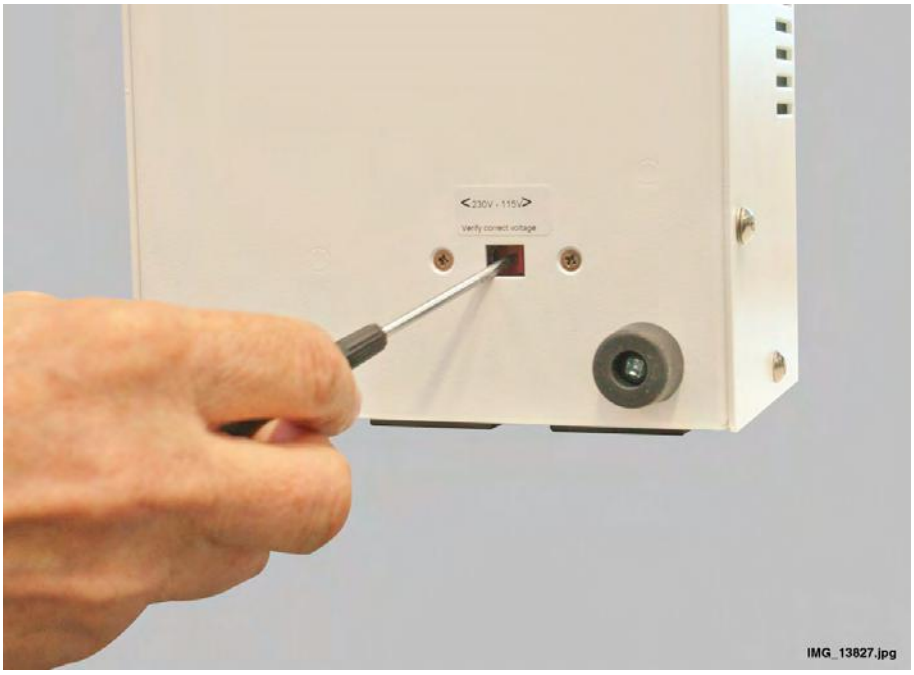


2. Lift and release the tab securing the fuse holder in position using a small screwdriver or similar. Remove the fuse holder.

3. Carefully remove the voltage selector card.

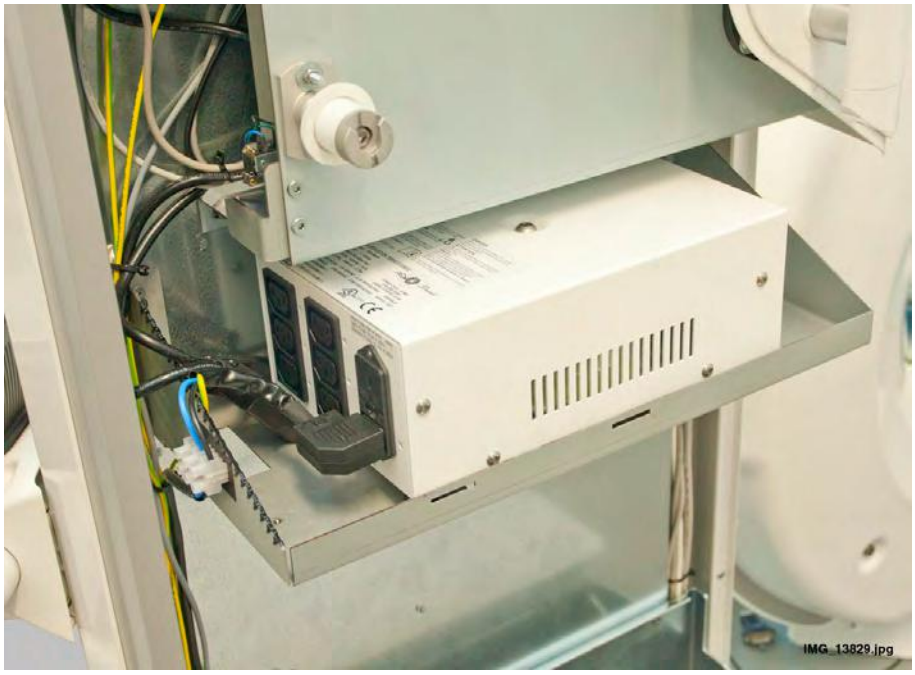
4. Select the input voltage you need. The selected number should be visible outward when the card is inserted to its position. Insert the card and push it to its position.
5. Make sure that you are using the correct fuses for voltage setting. See transformer or transformer manual for values needed and replace if necessary. Push the fuse holder back to its position.

6. Check the output voltage selection. Turn the transformer onto its side. The output voltage MUST be 115V.



7. Set the transformer ON/OFF switch to ON position.

8. Attach the transformer to its position. Connect the mains cord to the transformer and verify the output voltage by using a voltage meter.



9. Connect the other cables. Attach the removed parts.

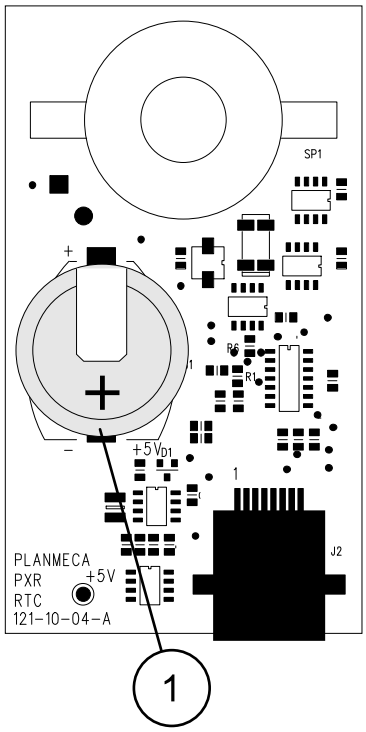
4.4 Replacing battery on RTC PCB

WARNING

Always turn the X-ray unit off before replacing the battery.

1. Turn off the unit from the mains switch.

2. Remove the old battery from its socket on the RTC PCB and place a new *20mm Lithium Coin Cell Battery 3V* (type CR2032, **1** in the figure below) to the battery socket.



4.5 Replacing tube head and collimator

Before replacement

Remove the unit covers and housings. For more information, see section "Removing and replacing covers" on page 107.

NOTE

While handling the collimator, be careful of the three collimator lasers to avoid damaging the lenses or mechanisms.

Removing collimator

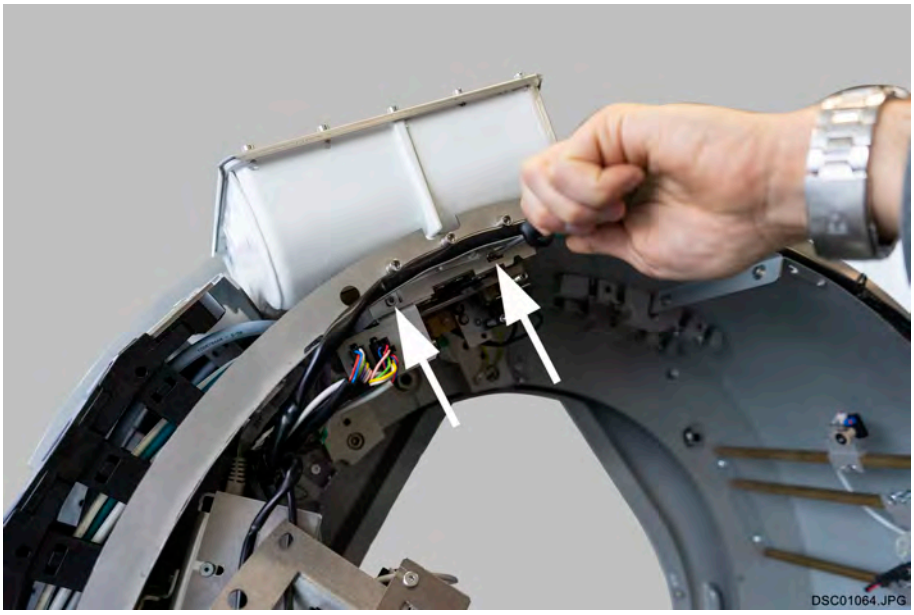
1. Unscrew the two camera and positioning lights assembly attachment screws.

2. Slide out the assembly.

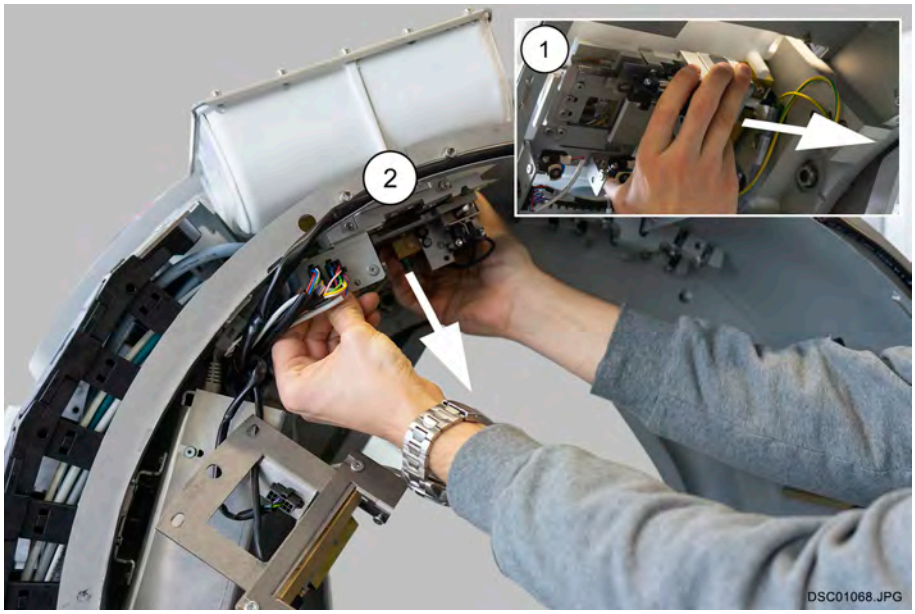
3. Turn the positioning lights assembly over, unscrew the attachment screws and slide the components apart.

   Carefully set aside both pieces.

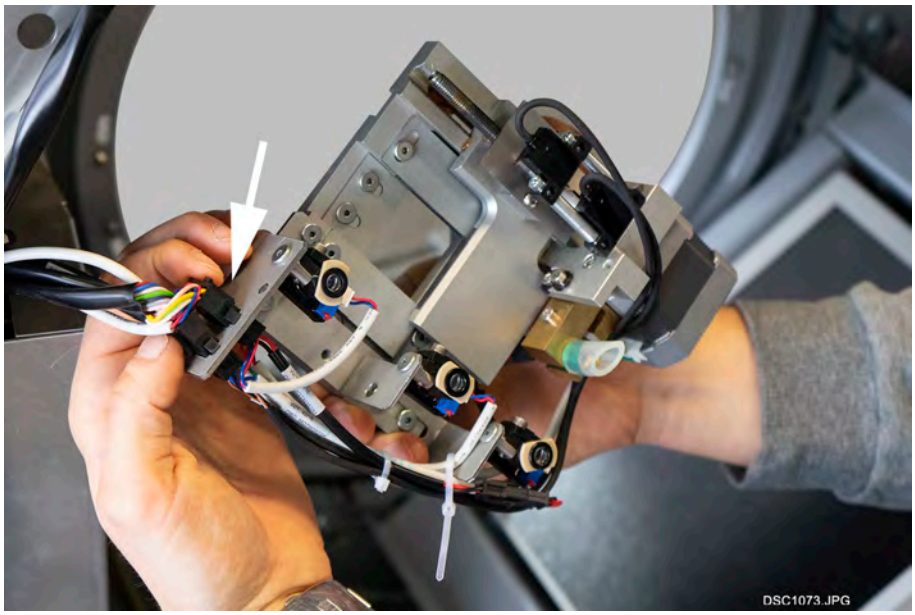
4. Unscrew the two collimator attachment screws.



5. Push the collimator assembly back (**1**) until the interlocked pieces can release. Remove the separate bar component and remove the collimator by lowering and then pulling the assembly out (**2**).



6. Disconnect the cables.

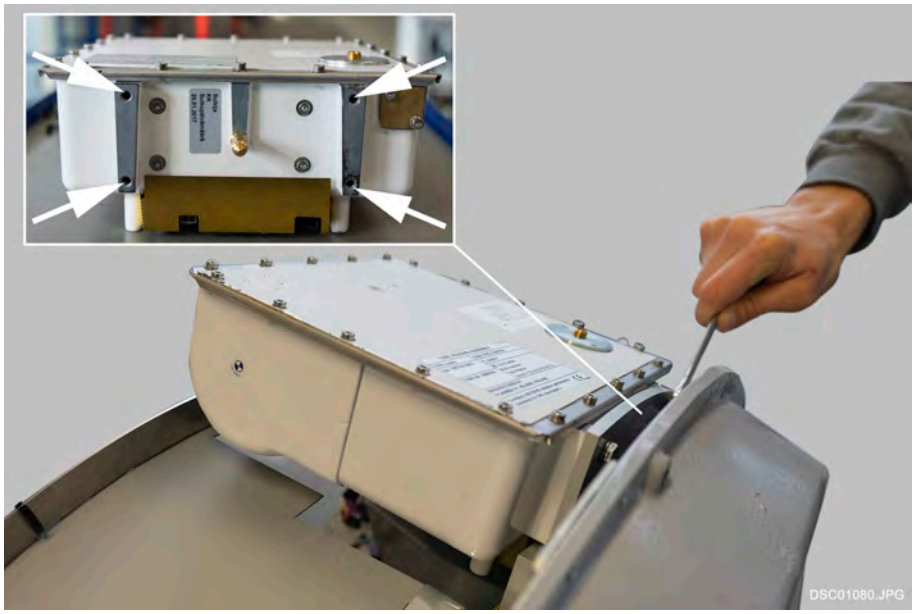


Removing tube head

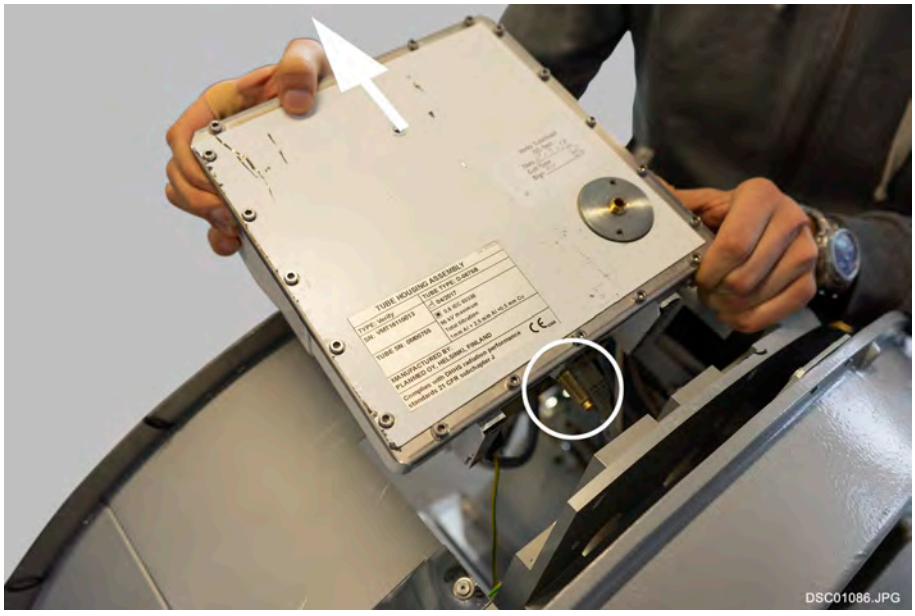
1. Make note of the original placement of the tube head using a marker pen.

2. Unscrew the grounding cable.

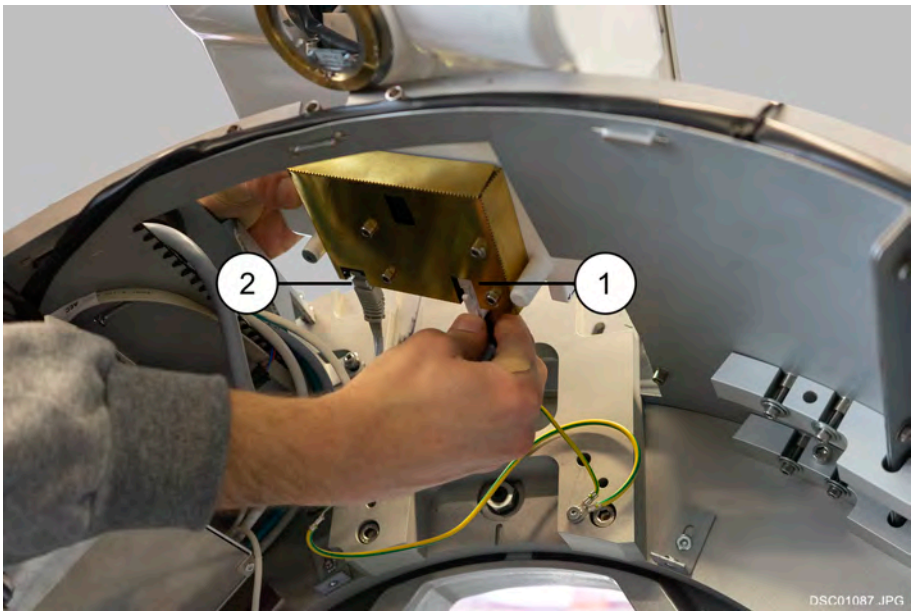
3. Unscrew the four tube head attachment bolts.



4. Slide the tube head carefully free of its position. Be careful not to force or damage the pin (indicated in the figure below).



5. Disconnect the cables (**1**, **2**).



Replacing components

Install the replacement parts in the reverse order provided in the instructions above.

After replacement

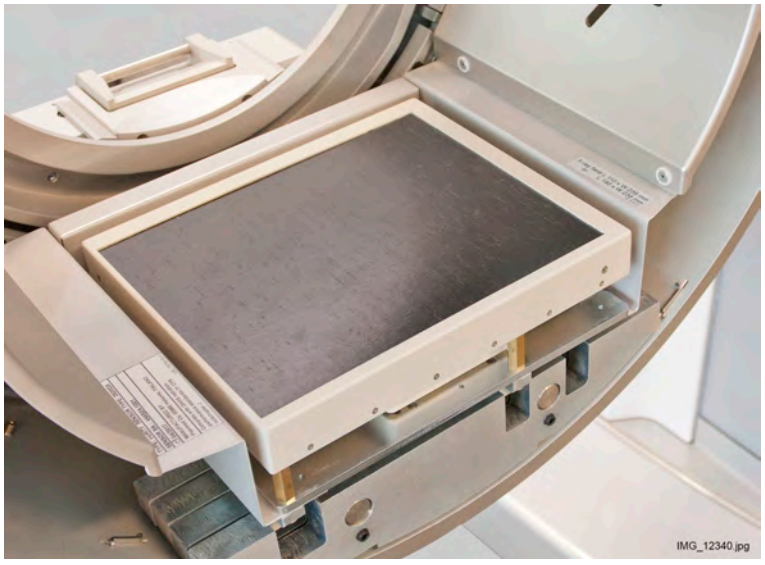
After the parts are installed, perform the necessary X-ray field calibrations. For more information, see section "Checking and adjusting X-ray field" on page 144.

4.6 Replacing detector

NOTE

The detector is maintenance-free. In case of malfunction replace the detector according to the instructions given in this section.

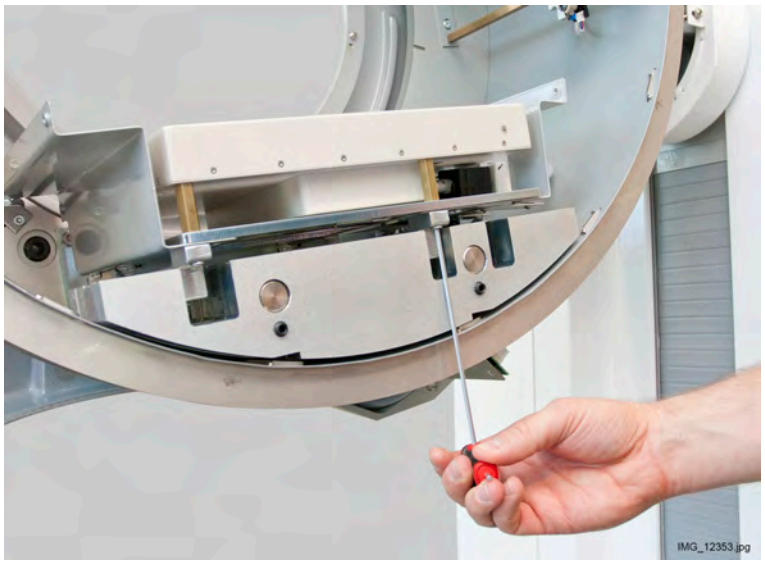
1. Remove the gantry covers according to the instructions given in section "Gantry covers" on page 114.



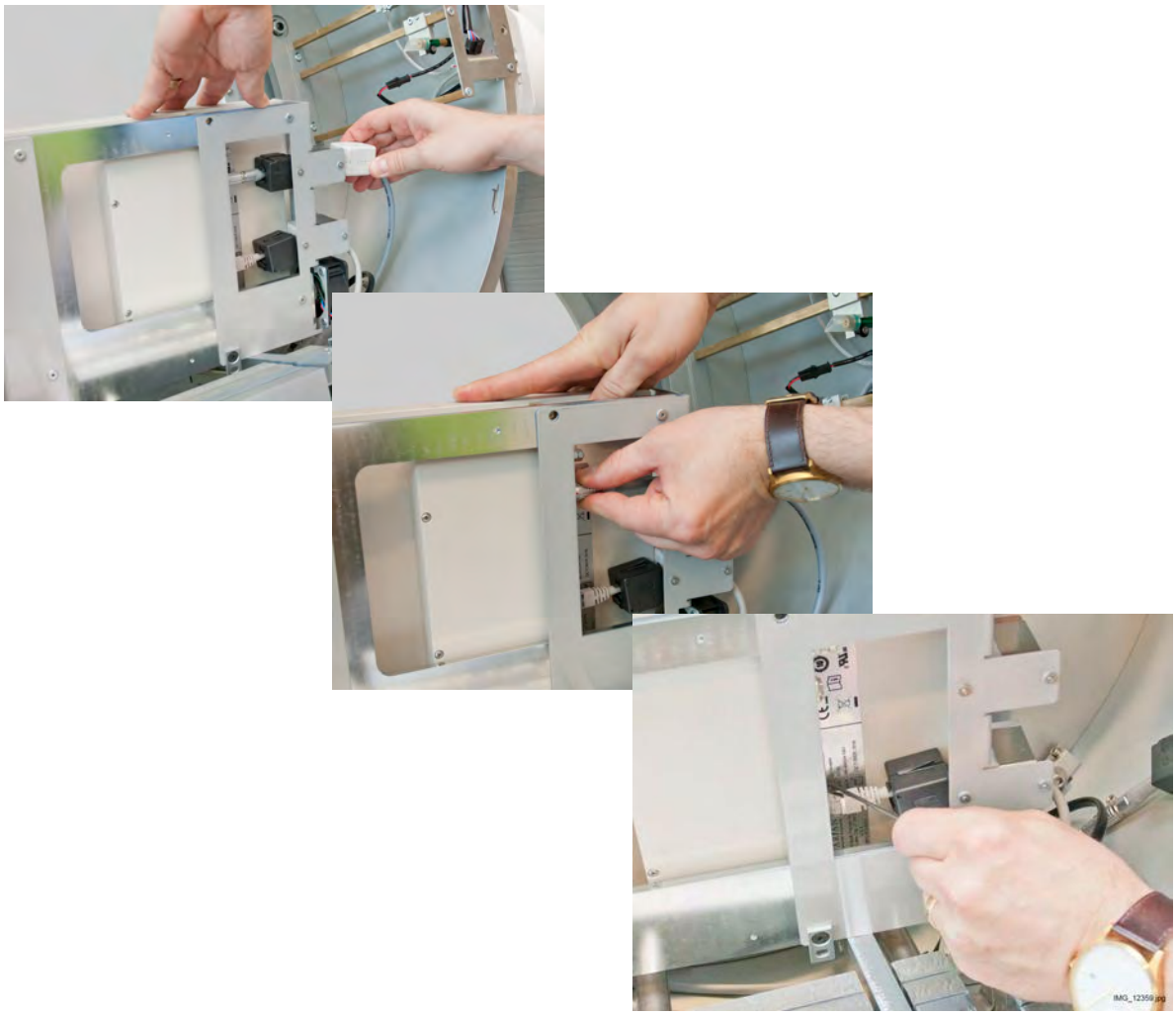
2. Remove the shadow screens. For more information, see section "Shadow screens" on page 122.

3. Loosen the detector back attachment screws.

4. Unscrew the front and back attachment screws.



5. Lift the detector and remove the ferrites, power cable and Ethernet cable.

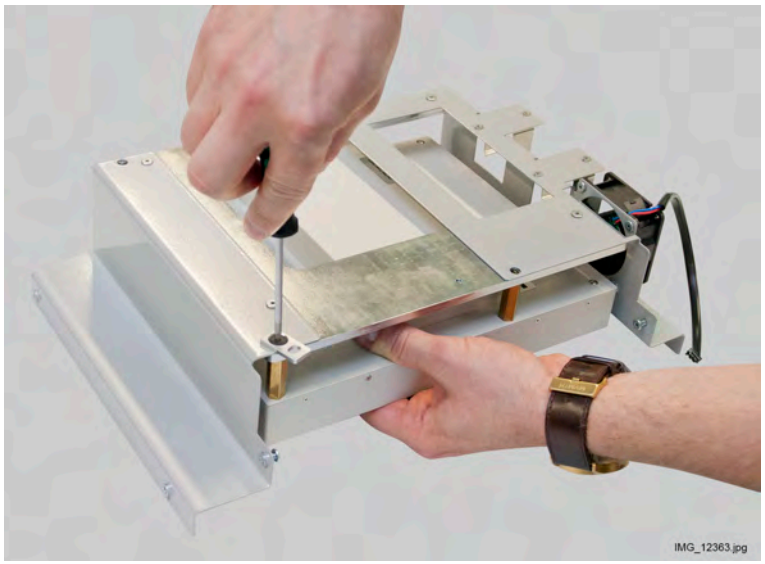


NOTE

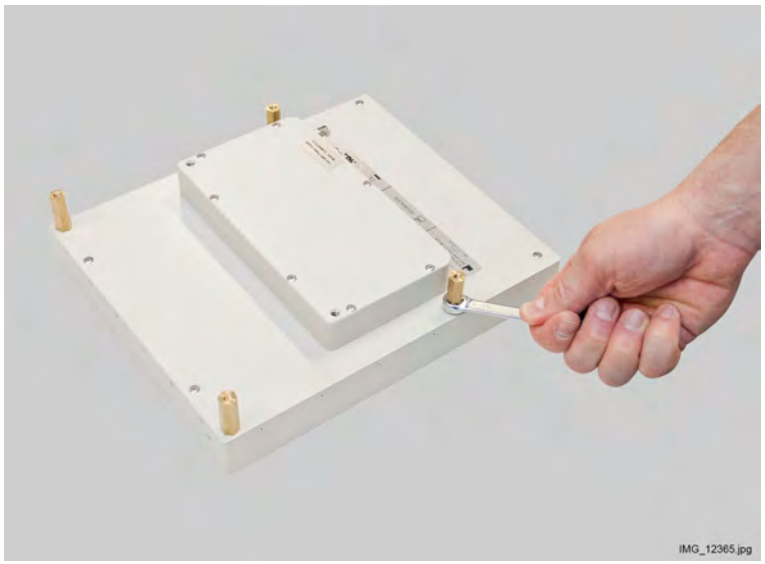
The Ethernet cable's fastening clip is located on the inside of the cable enclosure. Use an Allen key or similar tool to depress the clip and enable disconnection.

6. Disconnect the fan connector.

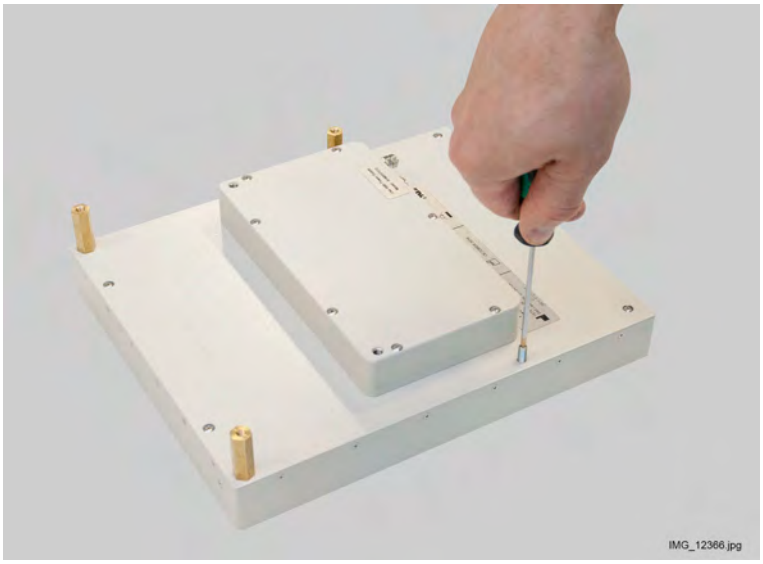
7. Remove the detector and place it on a stable work surface.
8. Remove the detector frame and base.



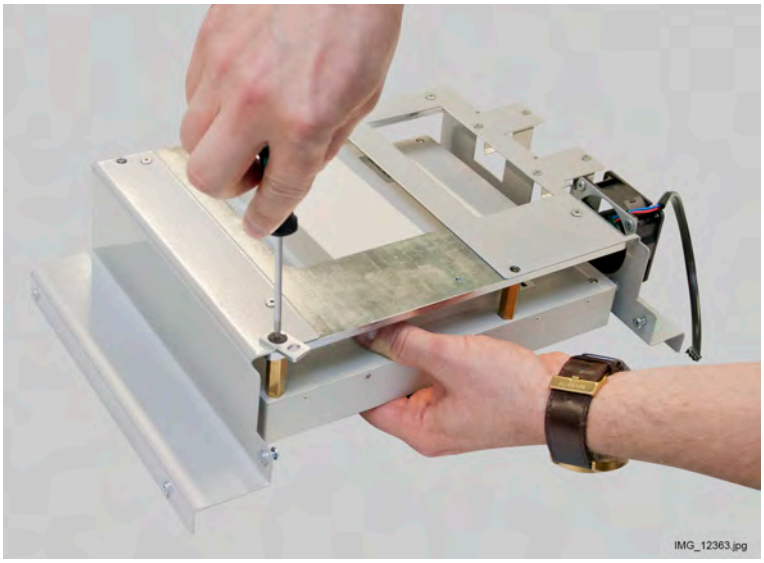
9. Remove the attachment bolts from the old detector.



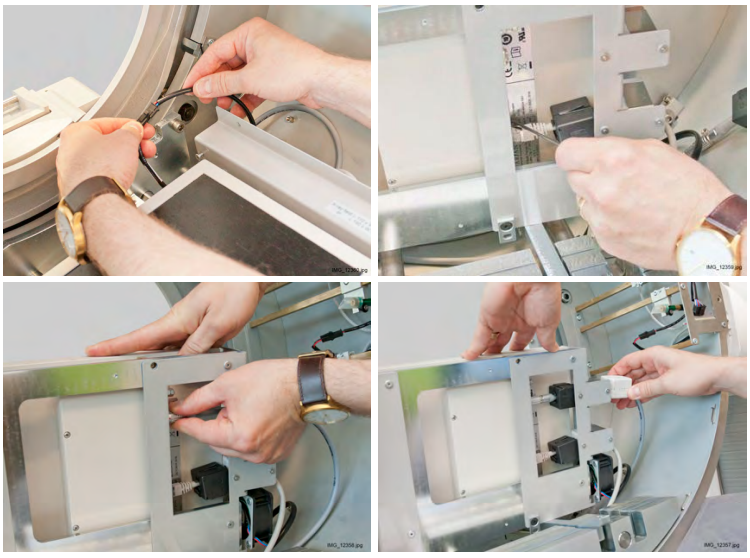
10. Remove the anchoring screws.
11. Fasten the attachment bolts to the new detector. Ensure that the anchoring screws are tight.



12. Replace the detector by reversing the steps as for the removal of the old detector.
    1. Reattach the detector to the frame and base.

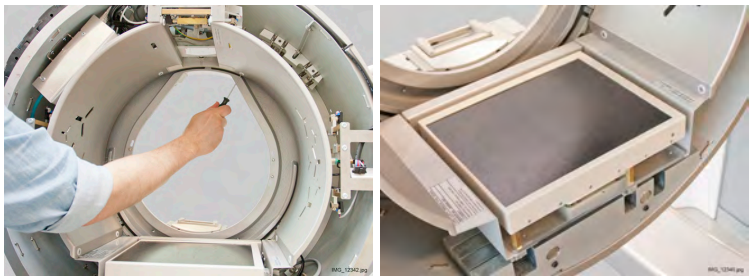


2. Reconnect the cabling.



3. Screw the detector into place.

4. Replace the shadow screens.



13. Attach the removed covers.

NOTE

After replacing the detector, there are few settings and calibrations to make before taking it into use, for more information refer to the technical information provided by Planmed After Sales.

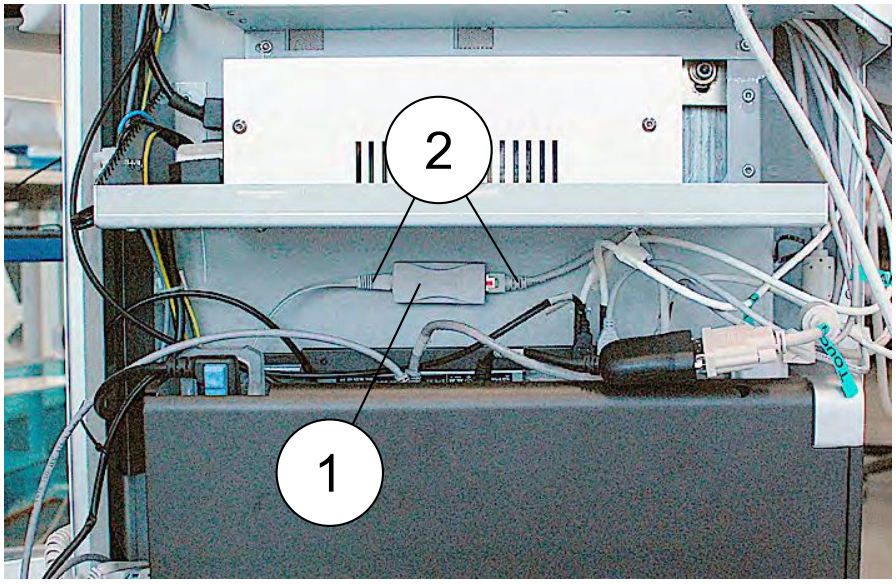
4.7 Replacing ethernet isolator

NOTE

Replace the Ethernet isolator only using the correct approved spare part specified by Planmed.

The Ethernet isolator (**1**) is attached to unit's frame with double-sided adhesive tape.

Disconnect the leads (**2**), remove the isolator and replace with an approved Planmed spare part.



5 Adjustments and calibrations

The following sections describe the different adjustment and calibration procedures for the X-ray unit.

5.1 Checking and adjusting X-ray field

When is it necessary

- If the RTC PCB has been replaced (perform back limiter adjustments only)
- If the tube head has been removed/replaced
- If the collimator assembly has been detached/replaced (perform collimator adjustments only)
- Possibly when the detector has been replaced

You need

- A step phantom 20008444
- A fluorescent screen and alignment sheet printed on transparent film
- A radiation protection screen with a glass window (recommended method)
- Other tools (Allen keys, screw drivers, adhesive tape, wrenches, etc.)

Before starting

Remove the gantry upholstery and the drop-shaped bore before performing the adjustment, see section "Gantry covers" on page 114.

5.1.1 Adjust tube head angle

NOTE

The intention of this procedure is to make coarse adjustments in the direction of the X-ray beam so that fine adjustment can be done.

NOTE

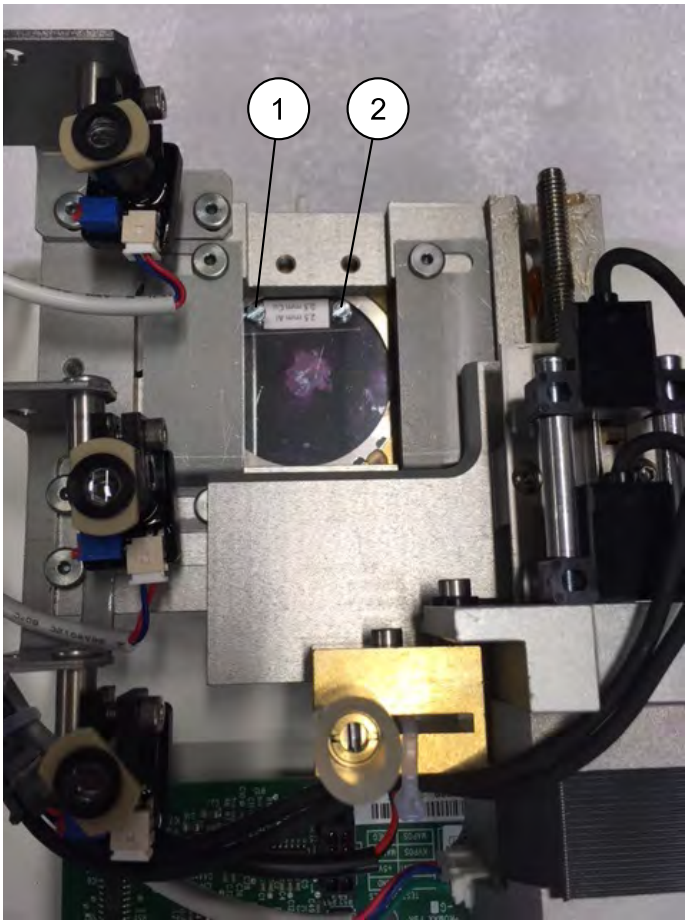
This adjusment is needed only when the tube head assembly is replaced / removed.

1. Drive the gantry to vertical position.
2. Put fluorescent screen on the surface of the detector.
3. Cut alignment sheet according to the instructions and put it on the fluorescent screen.
4. Align detector slot and alignment sheet to each other as well as possible
5. Verify that front and side limiters are pushed as far as possible from the beam hole.
6. Start Verity Manager and begin the beam check by clicking the arrow icon and selecting **Calibration**.

7. In the **Beam Check** tab, set the exposure values to **100ms**, **90-92 kV**, **7.0-10 mA**, **Collimation 0**.
8. Place the radiation protection screen (Pb 1mm) right in front of the C-gantry, darken the room and expose the entire exposure series.
9. Observe the glowing area on the screen, especially the left edge. The goal is that:
    1. The edge of the fluorescent area is visible in the left edge, about 0-2 mm from the line on the alignment sheet. If the area is on the right side of the line, loosen the 4 attachment screws of the tube head and turn the tube head manually.

       NOTE

       Use the green centre laser as a guide when estimating the amount to turn. Also observe the picture on the display. The edge must not be visible in the image on the screen. Tighten the tube head screws when done.
    2. The fluorescent left edge is parallel to the lines of the alignment sheet. A skewed edge indicates a skewed primary collimator. Rotate the primary collimator: open two screws **(1)**, **(2)** and rotate the primary collimator by pushing the screws sideways. Carefully tighten the screws. Expose and repeat the adjustment until the left edge is parallel to the lines in the alignment sheet.



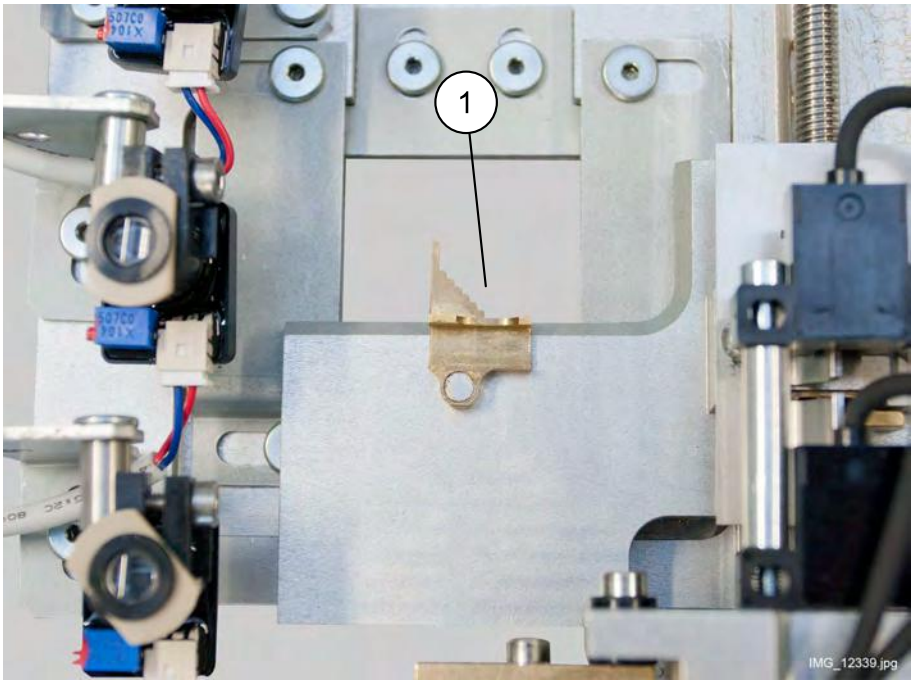
5.1.2 Aligning collimator with detector

1. Start Verity Manager and begin the beam check by clicking the arrow icon and selecting **Calibration**.

2. In the **Beam Check** tab, set the exposure values to **1**, **90-92 kV**, **7.0-10 mA**, **Collimation 0**.
3. Tap **Start beam check**.
4. Take exposure.
5. Check image.
6. If back limiter is not shown in the image, go to **Service > Diagnostics > Start monitoring**.
7. Increase the Coll. 0 open value, and the select **Stop monitoring**.
8. Go back to the beam check window and take new exposure.
9. Repeat until back limiter is shown in the image.
10. When back limiter is totally visible in the image, use a measurement tool on the display to make sure that difference of the edges is less than 1.5 mm.
11. If not, loosen 2 screws of the collimator and rotate the collimator in the corresponding direction.
12. Repeat until difference is less than 1.5 mm.

5.1.3 Adjust back limiter position

1. Tape the step phantom (20008444, **1** in the picture below) to the back limiter on the edge of the lead plate.



2. Take exposure in beam check mode.
3. All 6 little steps of the phantom should be visible. The long step should be almost totally visible in the image, but make sure that back limiter will not start to show in the image.
4. Go to **Service > Diagnostics > Start monitoring** and adjust Coll. 0 open value.

1. If back limiter is shown on the image decrease the number
2. If back limiter is not shown on the image increase the number

5. Repeat until at least half of the step height is visible.

5.1.4 Adjust front limiter

1. Attach the step phantom (20008444) to the front limiter with the built-in magnet so that the other edge of the phantom leans against one of the side limiters and the groove on the other side leans against the front limiter.
2. Take exposure.

   Check the image on the screen. Just as with the back limiter, the target is to have the long step almost totally visible in the image but ensure that the front limiter does not restrict the size of the image.
3. If the phantom is not shown totally, loosen the two front limiter screws and slide the limiter towards the beam opening so that the step phantom comes into image as shown in the following figure:

   If the front limiters start to show in the image, adjust the limiter in the opposite direction.
4. Check the alignment of the edge. The edge of the long step must be horizontal in the image.

5.1.5 Adjust side limiters

Adjust both sides in the same way as for the front limiter.

5.1.6 Adjust closed position

1. Start Verity Manager and begin the beam check by clicking the arrow icon and selecting **Calibration**.

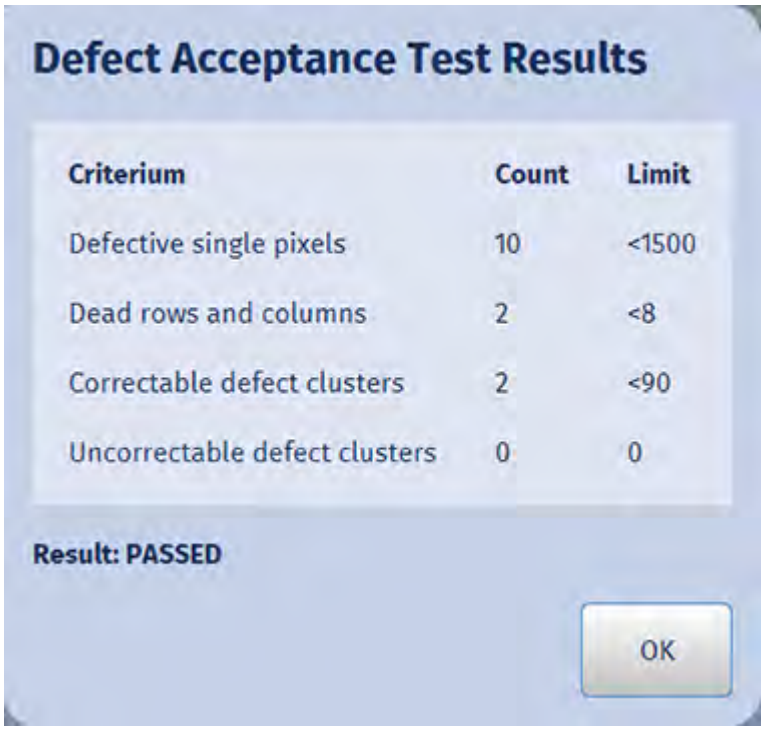
2. In the **Beam Check** tab, set the kV and mA values temporarily to their maximum values, and exposure numbers to 1.
3. Darken the room and tap **Start beam check**.
4. At the start of the exposure, carefully observe the front edge on the screen to see if a short "exposure" can be seen as a narrow streak of light. If anything is seen, increase the **Collimator 0 Closed** value (270), until no light can be seen at the front edge of the screen. The recommended value is 270.

5.1.7 Perform flat field calibration

1. Press Flat **Field Calibration > Start calibration**.
2. Expose an image and wait until the process is complete according to the instructions in the user's manual (publication number 20007788).

NOTE

Flat Field Calibration should only be done when you are certain that the entire detector area is exposed to radiation! Wait until the process is finished and select OK when the result of the flat field calibration is displayed on the display.



3. Take a new Beam check image and view the image on the display. The image must be homogenous and uniformly grey.
4. In Calibration mode, select **1 (small) collimator** from the Collimation tab.
5. Press Beam Check > start Beam Check.
6. Select **Collimation 1** from the drop-down list.
7. Finally check that the entire field is uniform. If there is fogging on the edges of the field, readjust and retry.

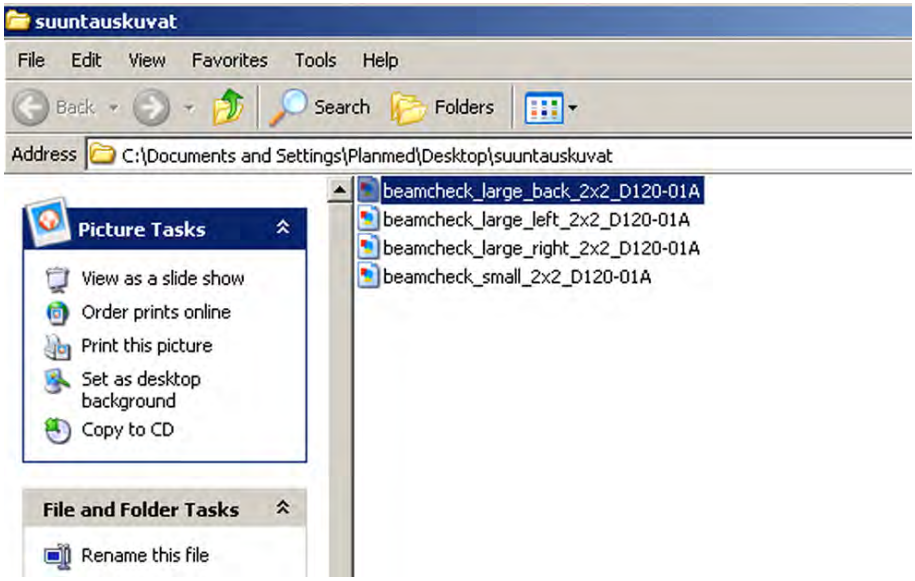
5.1.8 Save images

1. Attach the step phantom back to the back limiter. Take a new beam check image with small field size.
2. Attach a keyboard and mouse to the device
3. Press Windows+D to minimise the Verity Manager window.
4. Create a folder titled `alignment_images` on the desktop.
5. Open **My Computer**and navigate to folder `C:\Planmed\Temp images`, where the alignment image is saved as `beamcheck_2x2_serialnumber`, for example, `beamcheck_2x2_C699-06B`.

NOTE

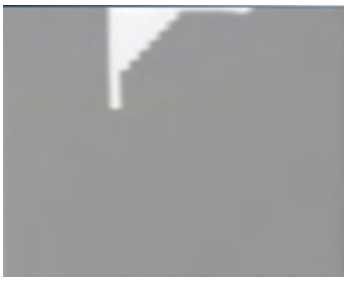
A new picture always replaces the earlier one.

6. Copy the picture into the `alignment_images` folder you created.
7. Rename the picture by adding an explanation to the filename. In this case, `_small`, because this is a small field image.



Example case: `Beamcheck_small_2x2_D120_01A.png`.

`Beamcheck_large_back_2x2_D120_01A`:



`Beamcheck_large_right_2x2_D120_01A`:

`Beamcheck_large_left_2x2_D120_01A`:

8. Switch to large field and place the step phantom in the front corner. Take a Beam Check image, copy it to the folder and rename it as above.
9. Image the other front corner and back edge following the instructions above, and copy the images. All in all, there will be 4 images in the folder. Naming examples are presented above.

5.2 Adjusting laser lights

When is it necessary

- If X-ray field is re-aligned according to previous chapter
- If lasers are changed

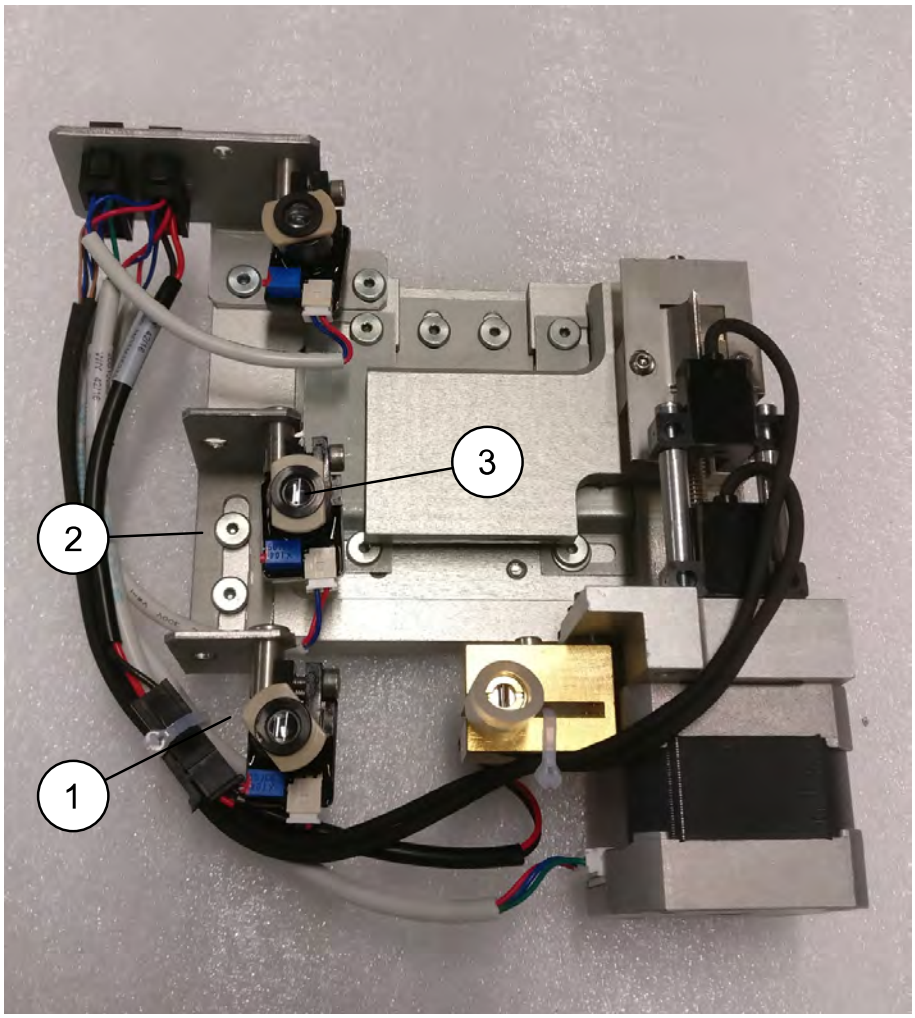
You need

- Alignment sheet 30007713 printed on paper
- Other tools (Allen keys, screw drivers, adhesive tape, wrenches, etc.)

Before starting

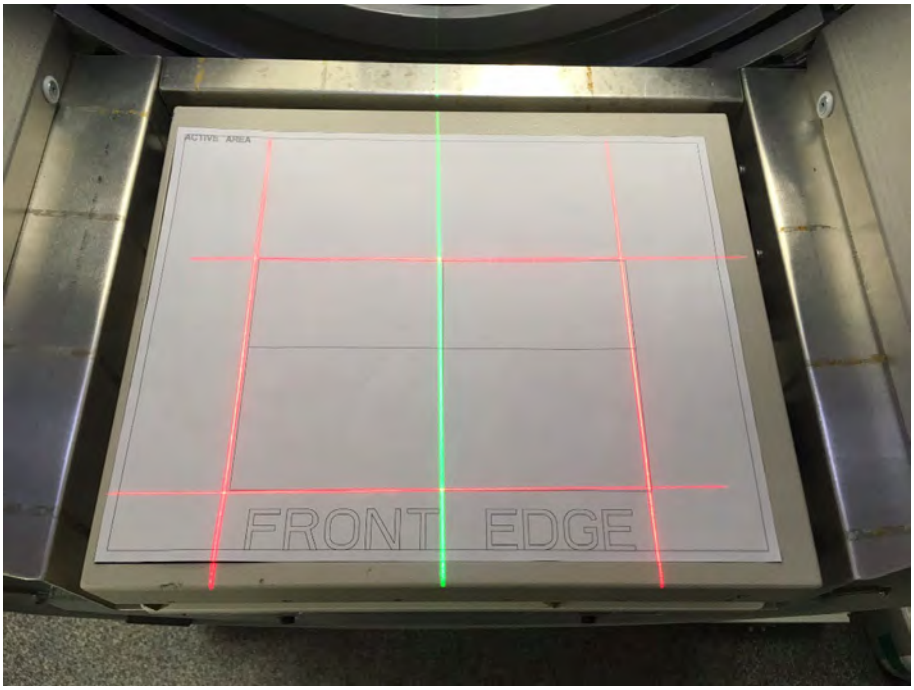
Remove the gantry upholstery and the drop-shaped bore before performing the adjustment, see section "Gantry covers" on page 114.

Adjustment procedure

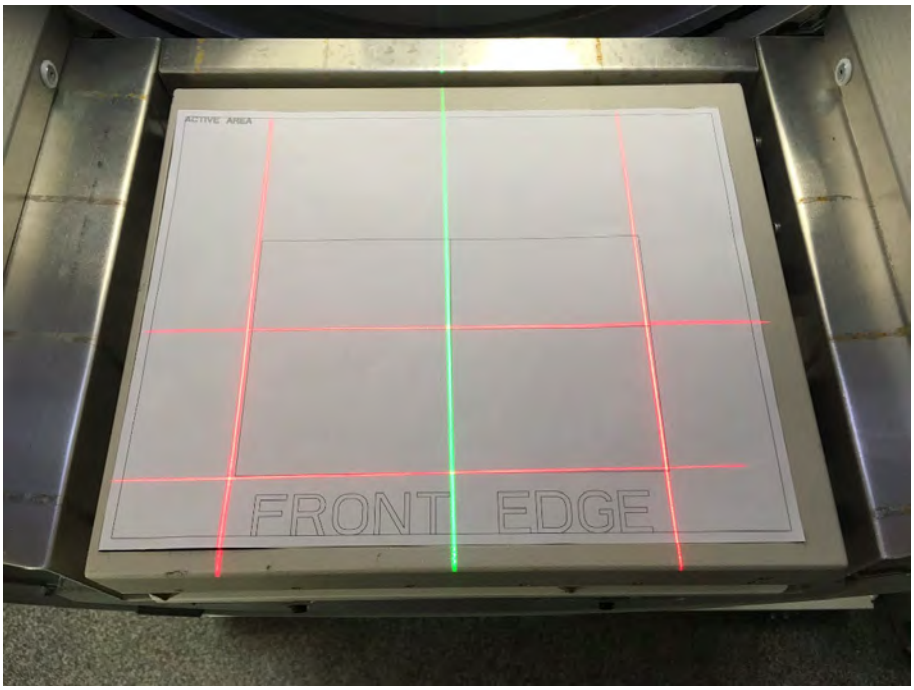


1. Drive the gantry to the vertical position.
2. Cut the alignment sheet 30007713 according to the instructions, and put it on the surface of the detector.
3. Adjust the green laser to point at the midline of the sheet.
4. Adjust back laser (**1**) of the large field roughly by moving the laser holder (**2**) and tighten both screws.

5. Fine-adjust the back laser of the large field (**1**) by carefully bending the laser holder.

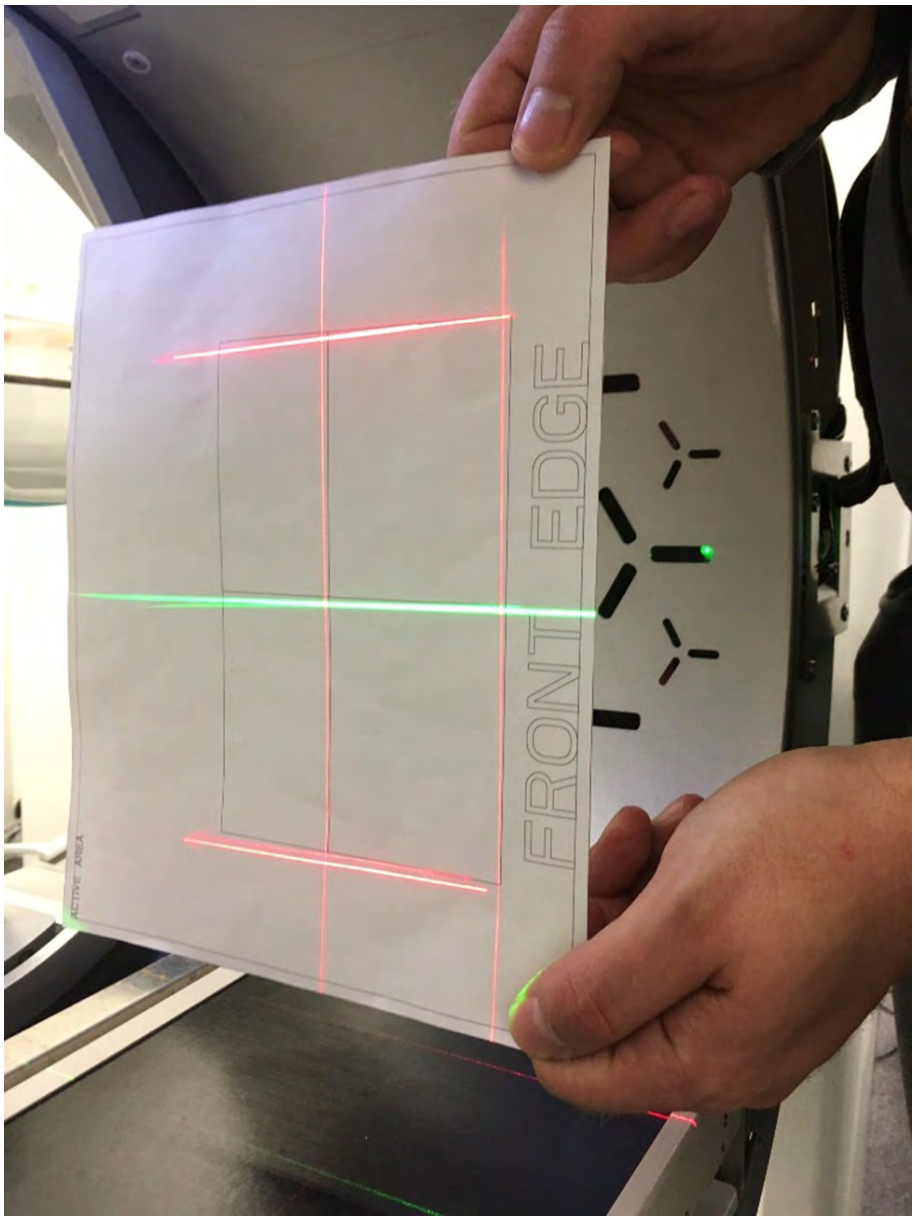


6. Switch collimation for small field and adjust the back laser of the small field (**3**) respectively.



7. Adjust front laser roughly by moving its holder. Tighten both screws. Fine adjust like the other lasers.
8. Adjust the alignment of the vertical side lasers.

9. Check the alignment of the side lasers, and adjust if needed.



10. Remove the screen cover from the machine, blow away any dust, and reassemble the gantry upholstery and drop-shaped bore.

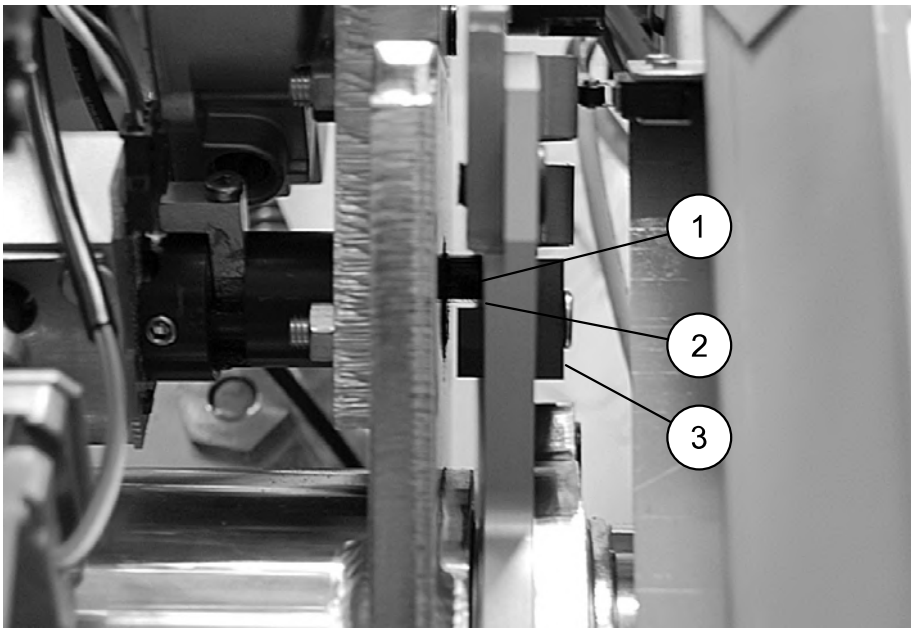
5.3 Gantry rotation adjustment

Perform the gantry rotation adjustment after:

- If the rotation position sensor has been detached or replaced
- If the cog wheel of the rotation position sensor has been detached or if it has rotated by any amount
- If the rotation motor has been detached or replaced
- If the meshing of the cog wheel of the rotation motor and the wheel ring has been adjusted
- If the RTC PCB has been replaced
- If the mechanical stop of weight-bearing imaging has moved
- If the counter part of tilt lock has been detached/replaced

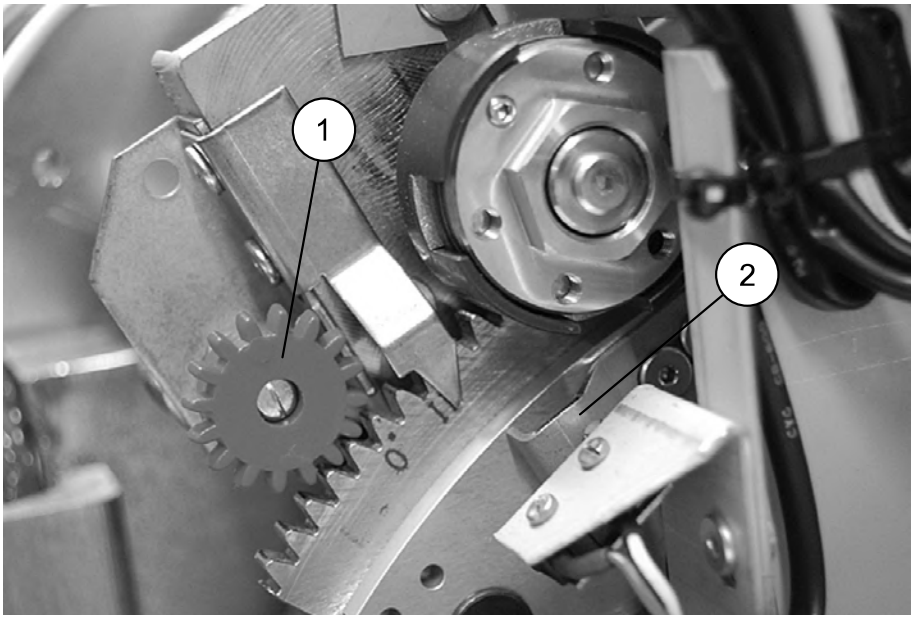
- if the microswitches at the ends have been detached/removed

The adjustment should begin with the adjustment of the weight-bearing imaging position. The rotation range should be +90/-15°. The gear ring has label/laser markings to help you estimate the range. Ensure that the counter part of tilt lock (20007776) has been adjusted so that it is 1-1.5 mm from the locking spindle.



1 Locking spindle
2 1-1.5 mm
3 Counter part of tilt lock

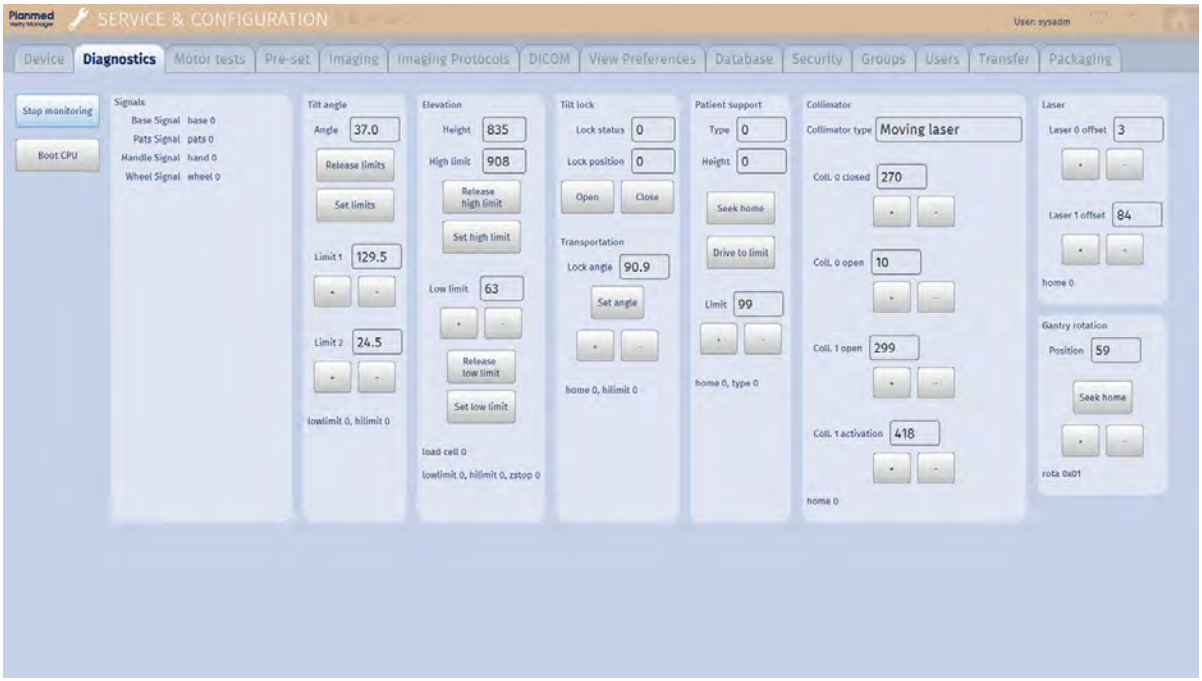
1. Remove the cog wheel from the position sensor that monitors the rotation and rotate the sensor to its counterclockwise stop. The figure below shows the sensor with the cog wheel attached (**1**). Ensure that microswitch does not hit its tumbler (**2**), move the microswitch temporarily further from the tumbler.



2. Use the touch panel to open Verity Manager and select **OK** when the device asks for username and password.

3. A triangle appears on the top part of the display. Press the triangle and in the next dialog, press the Service button.

   Select the *Diagnostics* tab and press the **Start Monitoring** button:



4. In the *Tilt angle* field, press the **Release limits** button (the motor will drive regardless of the limits).
5. Use the motor to rotate the gantry to weight-bearing imaging position against the mechanical stop.
6. Place a spirit level on the machined surface of the gantry and adjust the mechanical tilt- limiting screw (4 mm Allen key/13 mm socket wrench) against the stop in such a way that when the gantry is driven with the motor and stops against the screw, the spirit level indicates a weight-bearing imaging position. Close the tilt lock by pressing the Close button in the *Tilt Lock* field. The stress lock should close silently and the High Limit value in the Elevation field should change from 0 into 1. Open the lock with the Open command. Repeat this procedure a couple of times. Leave the lock in the locked position.
7. If the lock makes a sound as it closes, adjust the mechanical stop screw until the lock closes silently.

   ## NOTE

   Adjusting the tilt limiting screw causes that the gantry is no more exactly in weight-bearing imaging position. +/- 0.5° inclination is accepted. If the inclination is larger, contact Planmed After Sales.

8. Tighten the locknut of the mechanical stop and drive the arm into different angles/against the stop and lock/unlock it.
9. Also ensure that the lock can be easily opened/closed manually using the clutch rubber.
10. Rotate the position sensor until the value in the Limit 2 box is 20-25.0 and attach the red cog wheel to the sensor with the 2 screws.
11. Check the cog wheel play and move the sensor closer to the gear ring teeth if necessary.

12. Drive the arm a few times against the mechanical stop and ensure that the lock closes smoothly.
13. Push the Set limits button on the display (when in locked position) to set the Angle value to 0 and save it. At the same, the value in Limit 2 settles between 20-25.0.
14. Open the lock and drive the gantry into tilted position and weight-bearing imaging position a few times. In the weight-bearing imaging position, the Angle value must be 0...0.2. If the value is higher, decrease the Limit 2 value (For example, if Angle is 0.4 and Limit 2 is 25.4, change the latter to 25.0)
15. Check that the angle indicator is between the markings of the gear ring.
16. Open the lock (press Open)
17. Turn the gantry to a 2-3° angle with regards to the weight-bearing imaging position and adjust the microswitch in the gear ring so that it switches on at this position. In the Tilt Angle group, verify that the Hi Limit value of 0 turns into 1 as the microswitch turns on between 2-3°.
18. Ensure that the transport position counter part of tilt lock is 1-1.5 mm from the locking spindle. Adjust if necessary.
19. Use the motor to drive the gantry into transportation position. Verify that the degree value is exactly 90 and that the lock closes smoothly.
20. Use the control panel to tilt the gantry forwards, follow the markings in the gear ring (tilted 15° forwards), stop the gantry between the lines.
21. Check the angle with a spirit level. Press Start monitoring. The angle is ok if it is 15+/-2°. Check the Angle value; it should be 105+/-0.5.
22. If the angle differs from these values, adjust the Limit 1 value with the +/- buttons. (Example: if the Angle value is 105.2, and the Limit 1 value is 125.9, reduce the Limit 1 value to 125.7. The Angle value will then change to 125.0
23. Adjust the microswitch in the gear ring so that it switches on 2-3° later (at an angle of approximately 117°) (Notice the difference between this switch and the microswitch at the other limit that switches on before the software limit is reached)
24. Rotate the gantry manually to verify that the Low Limit value at the bottom of the Tilt Angle group changes from 0 to 1 when the microswitch turns on before the mechanical limit is reached.

5.4 Adjusting vertical movement

Adjustment the vertical movement in case:

- The upper or lower limit microswitch has been detached or replaced
- The vertical movement position sensor has been detached or replaced
- The cog wheel of the position sensor has been detached or replaced
- The vertical movement motor has been detached or replaced
- The RTC PCB has been replaced

  The vertical movement should be adjusted so that the movement stops automatically at 120+5 mm from the floor, measured from the rear edge of the lock in the positioning tray mechanism, while the gantry is in weight-bearing imaging position. In other positions, the software ensures that the arm cannot be positioned closer to floor than 120 mm

1. Open Verity Manager, touch the triangle on the top of the display, select **Service**, **Diagnostics**, and **Start Monitoring**.
2. Push the **Release high limit** button in the *Elevation* group.
3. Set the microswitches in the vertical column so far that they do not hit the ramp of tumbler.
4. Drive the vertical carriage upwards until it is approximately 10 mm from the mechanical stop of the high limit.

NOTE

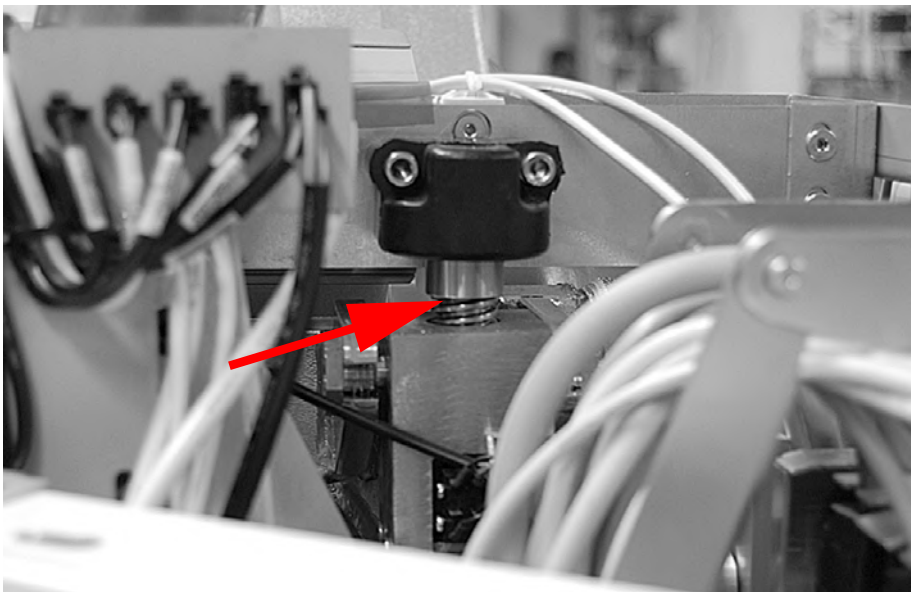
If the position sensor or gear was removed at some point, remove the cog wheel completely from the position sensor (breakage hazard!).

5. Check that the vertical movement position sensor is in the upper part of its opening and that the nut has been tightened (cog wheel removed).

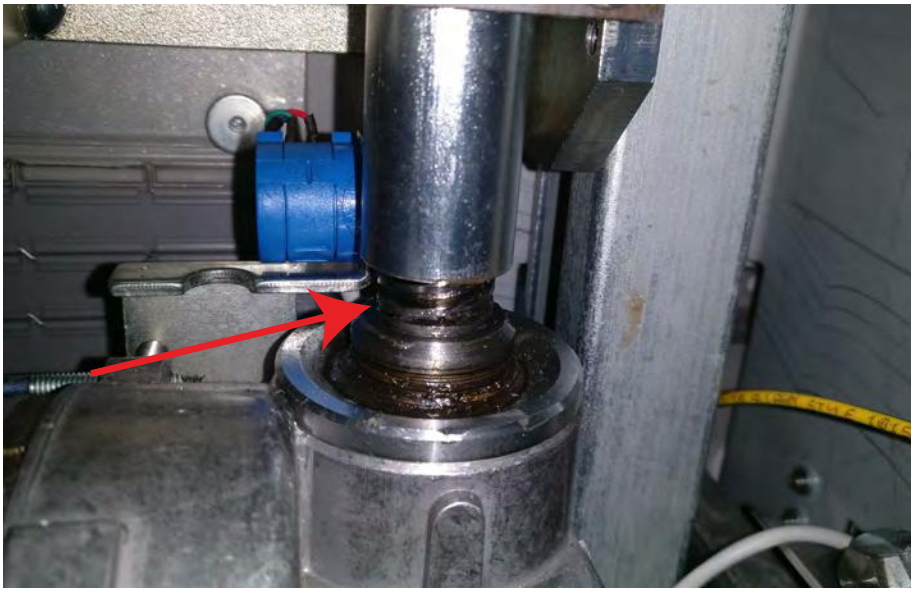
1 Sensor axle
2 Position sensor
3 Distance adjustment screw

6. Turn the sensor axle clockwise until it stops, see figure above.
7. Place the position sensor cog wheel (20007947) (24 teeth) on the axis.
8. Use the M6 set screw to adjust the distance so that you can feel a slight play when the cog wheel teeth are meshed with the motor spindle.
9. Rotate the sensor about 1/2 turn counterclockwise and lock the cog wheel gently to the axis with the M4 screws in the cog wheel (requires a 2 mm Allen key).
10. Push the **Set high limit** button. The value in the Height field should be between 850 and 880. Write the value down.
11. Use the motor to drive the vertical carriage downwards a little and then drive upwards, until the "software limit" stops the movement.

12. Check the distance to the mechanical limit, it should be 10-12 mm.



13. When a suitable distance (10-12 mm) has been achieved, tighten both set screws on the cog wheel.
14. Position the upper limit microswitch so that its roller is on the vertical carriage ramp and that it has enough room even if the ramp should drive past the microswitch and all the way to the mechanical limit.
15. Push the **Release high limit** button and drive upwards with the control panel. Verify that the High limit value in the Elevation group changes from 0 to 1 when the microswitch turns on, and that the motor reverses before the carriage hits the mechanical limit.
16. Drive the carriage again to 10-12 mm from the mechanical limit and push the **Set high limit** button.



17. Push the **Release low limit** button.

NOTE

Verify that the tilt angle is 0!

18. Drive the vertical carriage downwards (the gantry is in weight-bearing imaging position), until the lower mechanical limit is approx. 10-12 mm from the motor flange and push the **Set low limit** button.
19. Check the distance between the floor and the rear edge of the lock in the positioning tray mechanism, it should be 120+5 mm.
20. If the height is not correct, change the low limit +/- values on the display (in the elevation group).
21. Drive the vertical carriage upwards a little and then downwards, until the "software limit" stops the movement. Check that the distance is 120 +5 mm. (and 10-12 mm) The Low limit value should be 30-80. Write the value down.
22. Adjust the lower limit microswitch so that its roller is on the vertical carriage ramp (when driven down to the software limit until stopped) and that it has enough room even if the ramp should drive past the microswitch and all the way to the mechanical limit.
23. Push the **Release low limit** button and drive the gantry downwards.
24. Verify that the lower limit value changes from 0 to 1 when the microswitch turns on and that the motor reverses (the value changes back to 0). Verify that the stopper does not hit the mechanical stop.
25. Drive the height back to 10-12 mm, verify that the value in the low limit field matches the one written down in step 21 and press the Set low limit button.
26. The Height limit value should be between 880 and 960.

5.5 Adjusting exposure switch volume level

Before you begin

NOTE

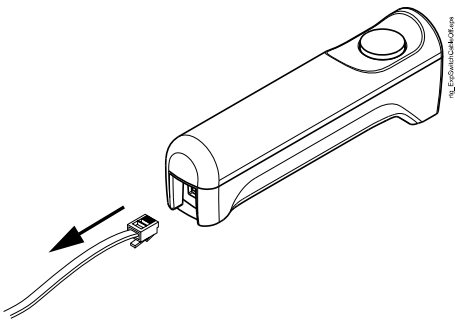
The exposure switch volume level adjusting is possible starting from version 121-43-E of the exposure PCB.

About this task

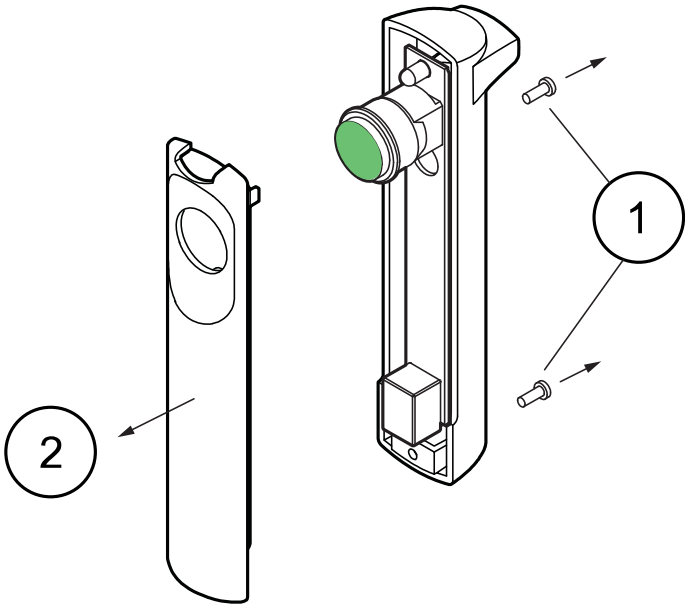
You can adjust the exposure indication sound volume level of the exposure switch, follow the steps below.

Steps

1. Switch off the X-ray unit.
2. Disconnect the exposure switch cable.



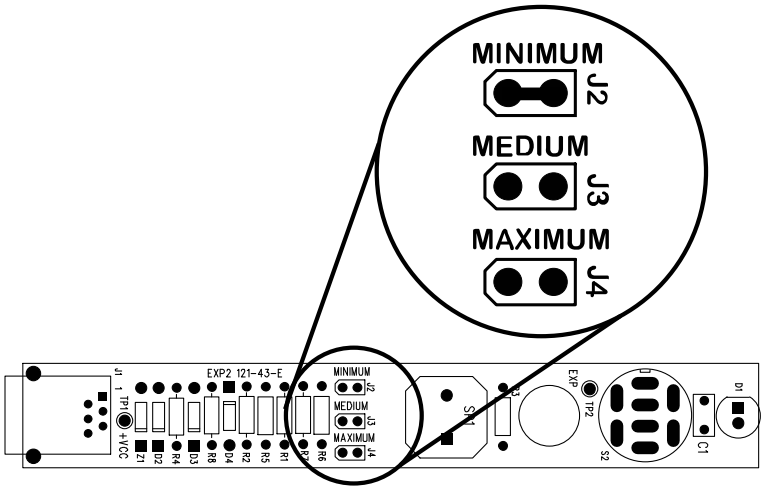
3. Remove the exposure switch cover.



3.a. Unscrew the two cover attachment screws **(1)**.

3.b. Remove the exposure switch cover **(2)**.

4. Set the dip switch **(J2, J3 or J4)** on the PCB to adjust the desired volume level.



J2 Minimum volume level

J3 Medium volume level

J4 Maximum volume level

5. Attach the exposure switch cover.
6. Connect the exposure switch cable.

5.6 Adjusting electronics box fan rotating speed

Before you begin

NOTE

The electronics box fan rotating speed adjusting is possible starting from version 7031-10-09-C of the CPU Connector PCB.

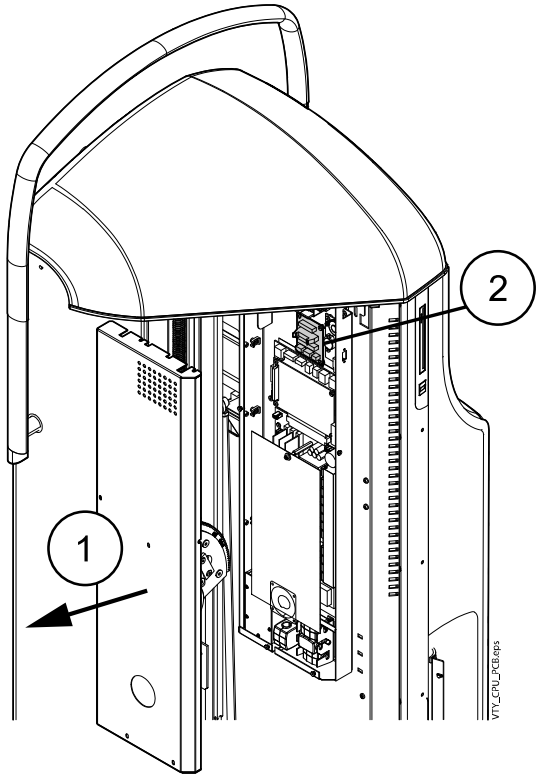
About this task

To adjust the electronics box fan rotating speed, follow the steps below.

Steps

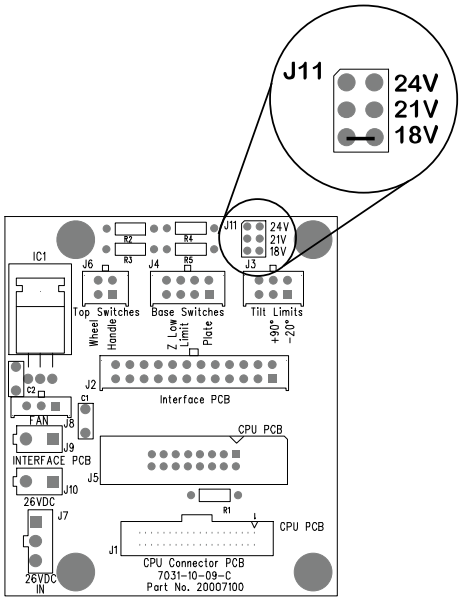
1. Switch off the X-ray unit.
2. Remove the maintenance hatch.

   For more information, see section "Maintenance hatch" on page 107.
3. Remove the PCB housing lid **(1)** and locate the CPU connector PCB on the top of the column PCB housing **(2)**.



4. Set the dip switch **J11** on the PCB to set the electronics box fan rotating speed.

   The dip switch changes the voltage feed to the electronics box fan rotating motor.



18V Minimum speed (default)

21V Medium speed

24V Maximum speed

NOTE

If no dip switch is attached, the maximum (24V) is active.

5. Attach the PCB housing lid.
6. Attach the maintenance hatch.

Planmed

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