

***Operating Instruction  
X-Ray Generator  
Provario HF 40/50/60/80***

***Version 06220028-EN  
Released May 2016***

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## History

Revision	Description of Change or Change Identifier
D	Cn 288 single phase generator
C	CN 15-01-018
B	CN 15-01-006
A	Initial version

# Contents

<b>1.1</b>	<b>List of Tables .....</b>	<b>5</b>
<b>1.2</b>	<b>List of Figures .....</b>	<b>5</b>
<b>1.3</b>	<b>CE Declaration of Conformity .....</b>	<b>6</b>
<b>2</b>	<b><i>DEFINITIONS AND NOTATIONS</i> .....</b>	<b>7</b>
<b>3</b>	<b><i>SAFETY</i> .....</b>	<b>8</b>
<b>3.1</b>	<b>General Notes .....</b>	<b>8</b>
3.1.1	Intended use .....	8
3.1.2	Electrical Safety .....	8
3.1.3	Connection of Examination Equipment .....	9
3.1.4	Responsibilities .....	9
3.1.5	Improper Operation .....	9
3.1.6	FDA Warning: .....	9
3.1.7	Explosion Protection .....	10
3.1.8	Notes on Electromagnetic Compatibility (EMC) .....	10
3.1.9	Declaration of Conformity .....	11
3.1.10	Maintenance .....	11
3.1.11	Legally Required Tests .....	11
3.1.12	Disposal .....	11
3.1.13	Classifications as per IEC60601-1 2 <sup>nd</sup> and 3 <sup>rd</sup> Edition .....	12
<b>3.2</b>	<b>Radiation Protection .....</b>	<b>12</b>
3.2.1	Protection for Personnel .....	12
3.2.2	Safety with Automatic Exposure Control .....	12
3.2.3	X-Ray Tube Duty Cycle Protection: .....	13
<b>3.3</b>	<b>Essential Performance .....</b>	<b>13</b>
<b>3.4</b>	<b>Copyright .....</b>	<b>13</b>
<b>4</b>	<b><i>TECHNICAL DATA</i> .....</b>	<b>14</b>
<b>4.1</b>	<b>Dimensions and Weights .....</b>	<b>14</b>
4.1.1	Dimensions and weights for the output cabinets .....	14
4.1.2	Dimensions and weights for the control desks .....	18
<b>4.2</b>	<b>Electrical Data .....</b>	<b>19</b>
<b>4.3</b>	<b>Essential requirements .....</b>	<b>20</b>
<b>4.4</b>	<b>Protection Against Electrical Shock: .....</b>	<b>21</b>
<b>4.5</b>	<b>EN 60601-1-2:2007 Directives and Manufacturer's Declarations .....</b>	<b>21</b>
4.5.1	Table 1 .....	21
4.5.2	Line Voltage .....	21
4.5.3	Input current .....	22
4.5.4	Table 2 .....	23
4.5.5	Table 3 .....	24
4.5.6	Table 4 .....	25

4.5.7	Requirements for supply- and connection-cables .....	25
<b>4.6</b>	<b>Ambient Conditions.....</b>	<b>26</b>
<b>4.7</b>	<b>Labeling.....</b>	<b>26</b>
4.7.1	Expected Service Life .....	30
<b>5</b>	<b>CONTROL PANEL DESCRIPTION .....</b>	<b>31</b>
<b>5.1</b>	<b>Workplace (Device).....</b>	<b>31</b>
5.1.1	Device selection with Interface box.....	31
5.1.2	Exposure Functions .....	32
5.1.2.1	General .....	32
5.1.2.2	Automatic Exposure Control.....	32
<b>5.2</b>	<b>Dose Measuring System .....</b>	<b>33</b>
<b>5.3</b>	<b>X-ray Tube Startup Unit.....</b>	<b>33</b>
5.3.1	Standard low speed starter .....	33
5.3.2	Option high speed starter.....	33
<b>5.4</b>	<b>RS232 Interfaces.....</b>	<b>34</b>
<b>6</b>	<b>X-RAY CONTROL PANEL AND DISPLAY .....</b>	<b>35</b>
<b>6.1</b>	<b>Switching Generator On and Off.....</b>	<b>35</b>
6.1.1	Display Overview .....	35
6.1.2	Special display modes using the VacuDAPduo chamber (optional) .....	37
<b>6.2</b>	<b>Selection of receptor / imaging devices, Keys 32, 39, 23.24.38.37 (Standard Key Assignment) .....</b>	<b>37</b>
<b>6.3</b>	<b>Selection of Focal Spot, Keys 14-15.....</b>	<b>38</b>
<b>6.4</b>	<b>Selection of X-ray Tube Power Factor, Keys 50-51 .....</b>	<b>38</b>
<b>6.5</b>	<b>Selection of Exposure Technique, Key 6 .....</b>	<b>39</b>
<b>6.6</b>	<b>Changing the Exposure Parameters, Keys 31/40;30/22;29/21;13/16 .....</b>	<b>39</b>
6.6.1	Changing X-ray Tube Voltage, Keys 31/40 .....	39
6.6.2	Changing current time Product, Keys 30/22 in 2-Point Technique .....	40
6.6.3	Changing of X-ray Tube Current, Keys 30/22 in 3-Point Technique .....	40
6.6.4	Changing of Exposure Time, Keys 29/21 in 3-Point Technique.....	40
6.6.5	Table of Stages for Exposure Parameters .....	40
<b>6.7</b>	<b>Operation with Automatic Exposure Control (AEC), Keys 13/16;8/5;4/12/20;28...42</b>	<b>42</b>
6.7.1	Activation .....	42
6.7.2	Selection of Measuring Field, Keys 4/12/20 .....	42
6.7.3	Selection of Darkness Correction, Keys 13, 16 .....	42
6.7.4	Selection of Film-Screen System, Keys 8, 5 .....	42
6.7.5	Confirmation of Incorrect Exposure, Key 28.....	43
<b>6.8</b>	<b>Activate X-ray Exposures.....</b>	<b>44</b>
6.8.1	Activation with Control Panel Switch X-Ray 1 and 3 .....	44
6.8.2	Activation with Hand Switch.....	44
6.8.3	Display Information, Key 3 .....	45
6.8.4	Feather Key "New Patient", Key 7 .....	45
<b>6.9</b>	<b>Working with Anatomically Programmed Radiography.....</b>	<b>46</b>
6.9.1	Calling Saved Settings.....	47

Key 01 .....	47
Key 03 .....	47
6.9.2 Saving Changed Parameters.....	50
<b>7 WARNING SIGNALS AND ERROR MESSAGES .....</b>	<b>54</b>
7.1 Acoustic Warning Signals.....	54
7.2 Visual Signals .....	54
7.3 Error/Warning Messages.....	54
<b>8 MAINTENANCE /CARE.....</b>	<b>58</b>
8.1 X-Ray Tube Seasoning.....	58
8.2 Cleaning .....	58
8.3 Disinfection.....	58
8.4 Maintenance.....	59
<b>9 CONTROL PANEL FOR PROVARIO HF .....</b>	<b>60</b>
<b>10 DIGITAL INTERFACE BOX FOR PROVARIO HF (OPTIONAL).....</b>	<b>61</b>
<b>11 CERTIFIED COMPONENTS AND ACCESSORY TO BE INSTALLED BY THE OPERATOR .....</b>	<b>62</b>
<b>12 APPENDIX .....</b>	<b>63</b>

### 1.1 List of Tables

Table 4-1: Provario HF Technical Data .....	20
Table 4-2: Line Voltage.....	21
Table 4-3: Input current.....	22
Table 6-1: Tube voltage stages (27 stages) .....	41
Table 6-2: Time / current product stages in 2-point-technique (32 stages) .....	41
Table 6-3: Tube current stages in 3-point-technique (19 Stages) .....	41
Table 6-4: Exposure time stages in 3-point technique (38 stages).....	41
Table 6-5: Explanation of display for correction if cast is present.....	48
Table 6-6: Tables for cm correction .....	49
Table 6-7: Parameters stored for automatic APR .....	50
Table 6-8: Recommendation for APR memory settings .....	53
Table 7-1: List of error messages .....	57

### 1.2 List of Figures

Figure 6-1: APR panel (standard key assignment) .....	47
Figure 9-1: Provario HF control panel.....	60
Figure 10-1: Interface Box Provario HF .....	61

### 1.3 CE Declaration of Conformity



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## CE- Declaration of Conformity

According Council Directive 93/42/EEC of 14.June 1993 concerning medical devices

Product **X-Ray Generator**

- EDITOR HFe 401
- EDITOR HFe 501
- EDITOR HFe 601
- EDITOR HFe 801

Classification **IIb according to EC-Directive 93/42/EEC Annex IX;  
Rule 10**

UMDNS-Number **16-602**

Manufacturer **Spellman High Voltage Electronic GmbH  
Josef-Baumann-Straße 23  
44805 Bochum  
Germany**

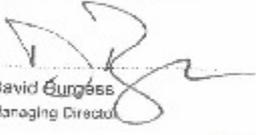
We herewith declare the conformity of above mentioned products according to EC-Directive 93/42/EEC Annex I (inclusive applicable harmonized standards) as well as Annex II (excl. section 4).

Notified Body **TÜV Rheinland LGA Products GmbH (Identification number 0197;  
Tillystraße 2  
90431 Nürnberg  
Germany**

EC-Certificate **SX 60106231-0001 valid until 15.December 2018**

Expiring date of this CE-  
Declaration of Conformity **15. December 2018**

Bochum, 04 January 2018

  
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Operating  
Instructions  
X-ray Generator  
Provario HF

Exclusively for



06220028-EN\_D

Page 6

## 2 Definitions and Notations

The documentation uses the following references for hazards and peculiarities:

### WARNING

This reference is used if a failure to obey the instructions, notes or procedures or a failure to follow them precisely can lead to injury or lethal accidents.

### CAUTION

This reference is used if a failure to obey the instructions, notes or procedures or failure to follow them precisely can lead to damage to the equipment or external accessories.

### NOTE

This reference is used to draw attention to peculiarities.



Warning symbol (yellow background) used to indicate a potential hazard to operators, service personnel or to the equipment.



This symbol (yellow background) is used to warn against hazardous electrical voltage



Mandatory to read the user/service manual, before servicing the generator

## 3 Safety

### 3.1 General Notes

The Provario HF X-ray generator is a medical product in Class IIb (Directive 93/42/EEC), satisfying all legal and technical safety requirements. However, safe work is only guaranteed if the following safety precautions are obeyed and the X-ray generator is used as intended for medical X-ray diagnosis only. The X-ray generator is a sub system and part of a Diagnostic X-ray system. It must be operated and maintained by qualified personnel to assure optimum performance of the X-ray system.

In case of a failure, you must not continue operating the X-ray equipment; this applies particularly in the case of any electrical, mechanical or radiation technology defects.

Depending on the field of operation (e.g. life critical applications) the facility should take backup systems into consideration.

#### 3.1.1 Intended use

Only authorized and properly trained individuals should operate this equipment. All individuals authorized to use this equipment must be aware of the danger of excessive exposure to radiation. The authorized personnel have to hold appropriate certificates which comply with the local regulatory standards to proof their qualification for operating x-ray equipment.

The product is intended to be used in medical X-Ray diagnostic / image guidance systems. It is one part of an X-ray system. It provides power to the x-ray tubes and provides interfaces for x-ray imaging systems.

The operation is only allowed by personnel with knowledge in X-ray imaging and after reading and understanding the user manual (In most countries a government certification is required).

The generator may only be used within medical x-ray rooms and within the rated ambient parameters (see Chapter 4.6)

The device may not be operated in areas where explosion may be a risk. It must not be operated near liquids, flammable anesthetics, disinfecting agents, aerosol spray, or in oxygen-rich environment.

#### 3.1.2 Electrical Safety

Even if the X-ray generator is switched off, power is present at the line connection and in the control circuits. For this reason, it is only permissible for trained technicians to open the generator cabinet or housings of connected controls. Before a trained technician operates on the generator or the system, the system must be free from electric tension and currentless. For this, X-ray rooms have an emergency stop button.

	<p><b>Operating Instructions X-ray Generator Provario HF</b></p>	<p><b>Exclusively for</b></p> 	<p><b>06220028-EN_D</b> Page 8</p>
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## **WARNING**

*Even if the generator is shut off, parts on the inside of the generator cabinet and connected controls are still powered! Ensure that only trained service personnel open the generator cabinet and the housing of connected devices, when the system is totally free from electric voltage and current less! To provide this, X-ray rooms must have a mains' power switch. The X-ray equipment should be switched off at the end of a working day using the mains' power switch. Improper handling may cause lethal hazards!*



## **CAUTION**

*Never block or cover the generator cabinet ventilation screen!  
Improper handling can lead to overheating and damage to the generator!*



### **3.1.3 Connection of Examination Equipment**

If the X-ray generator is to be connected to other devices or other assemblies, it is necessary to carefully check the compatibility and safety of such combinations. In cases of any doubt, contact the manufacturer for additional information or contact qualified service personnel. The safety of the patient and the user must be ensured under all circumstances.

### **3.1.4 Responsibilities**

Spellman GmbH Bochum may take the responsibility for the technical safety characteristics of its products only if maintenance, service and modifications are performed by personnel specifically authorized to perform such work.

No alteration or modification of any kind may be performed on the device. Connections and adjustment for installation and integration of a system must be made according to the service manuals by an authorized service technician.

The generator shall be used by operators with knowledge and training in X-ray imaging and after reading the operators manual.

### **3.1.5 Improper Operation**

Spellman GmbH Bochum shall not be held responsible for any malfunctions, damage or injuries to patients resulting from improper operation or maintenance of the X-ray generator by the operator and/or facility. This also includes disabling safety circuits, which prevent from switching on the X-ray beam in certain circumstances or opening the housings.

### **3.1.6 FDA Warning:**

Warning: This x-ray unit may be dangerous to patient and operator unless safe exposure factors, operating instructions and maintenance schedules are observed.

Only the radiography option applies to the FDA regulation.

	<b>Operating Instructions</b> <b>X-ray Generator</b> <b>Provario HF</b>	<b>Exclusively for</b>  <b>PROTEC</b> <small>TEAM   SPIRIT   ABILITY</small>	<b>06220028-EN_D</b> Page 9
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### 3.1.7 Explosion Protection

The Provario HF X-ray generator is not intended for operation in combustion gas areas. Please take the applicable regulations concerning formation of flammable hazardous gas mixtures into account during cleaning and patient treatment.

### 3.1.8 Notes on Electromagnetic Compatibility (EMC)

During operation, the Provario HF emits electromagnetic waves, which could interfere with other equipment. Further, the Provario HF can be disturbed by electromagnetic waves emitted by other equipment.

It is therefore necessary to observe the following precautions:

- Use of replacement parts other than those offered by the manufacturer can lead to increased emission or reduced immunity to interference of the system or device.
- Do not operate the Provario HF in the immediate vicinity of other equipment. If this is not possible, it is necessary to observe operation with other equipment in order to ensure proper operation of all equipment.
- The Provario HF is subjected to special precautions regarding EMC and must be installed and put into operation according to the EMC notes, which are contained in the accompanying documents.

### 3.1.9 Declaration of Conformity

The Provario HF X-ray generator of the Spellman High Voltage Electronics GmbH is a Medical Device that complies with the relevant regulations for Medical Devices.

The Provario HF complies with the following Medical Device standards, directives, and regulations:

Europe:

EN60601-1/IEC60601-1(3<sup>rd</sup> Edition and 2<sup>nd</sup> Edition)

EN60601-1-2/IEC60601-1-2

EN60601-1-4/IEC60601-1-4(2<sup>nd</sup> Edition)

IEC 60601-2-54 and EN 60601-2-7 / IEC 60601-2-7 (2<sup>nd</sup> Edition)

USA:

ANSI/AAMI/ ES60601-1:2005/A2:2010

FDA Center for Device and Radiological Health (CHDR)- 21CFR Chapter I subchapter J Radiological Health part 1010 and 1020 (Apply only to general radiography Provario HF Generators)

Canada:

CAN/CSA C22.2 # 60601-1:08

CE for Medical Device Directive MMD 93/42/EEC class II b Device

### 3.1.10 Maintenance

The Provario HF X-ray generator requires proper operation as well as regular care and annual maintenance/calibration by qualified service personnel familiar with the safety requirements. Please read also chapter 8 "Maintenance".

### 3.1.11 Legally Required Tests

Tests prescribed by law must be performed at the specified intervals.

### 3.1.12 Disposal

Spellman GmbH Bochum builds X-ray generators according to state of the art design of safety and environmental protection. If it is used and disposed properly, this equipment does not pose any hazard to humans or the environment.

Due to the materials used, the X-ray generator should never be disposed together with normal industrial or domestic waste.

Consult with your Spellman GmbH service partner for local code disposal instructions.



	<b>Operating Instructions X-ray Generator Provario HF</b>	<b>Exclusively for</b>  <b>PROTEC</b> <small>TEAM   SPIRIT   ABILITY</small>	<b>06220028-EN_D</b> Page 11
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### 3.1.13 Classifications as per IEC60601-1 2<sup>nd</sup> and 3<sup>rd</sup> Edition

- The Provario HF X-ray generator conforms to protection class 1.

	<p>Class I equipment <i>According to the class of equipment, the Provario HF X-ray generator must be referenced to an earth ground by a protective earth conductor. Failure to provide a separate earth ground can result in electrical shock hazard causing injury or death.</i></p>
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- There are no applied parts according to the standard.

FDA Warning:

**Warning: This x-ray unit may be dangerous to patient and operator unless safe exposure factors, operating instructions and maintenance schedules are observed.**

## 3.2 Radiation Protection

X-rays are dangerous to operator and others in the vicinity unless established safe exposure procedures are strictly observed.

### 3.2.1 Protection for Personnel

Ensure that all legally prescribed radiation protection precautions are taken. This applies to

- the structural configuration of the installation location,
- personal radiation protection for users,
- protection of patients against unnecessary radiation exposure.

### 3.2.2 Safety with Automatic Exposure Control

If the automatic exposure control feature is switched on, the generator has a monitoring system which provides comprehensive protection against uncontrolled radiation for the patient and the operator in the event of a malfunction or incorrect setting. This monitoring system interrupts the radiation if any of the following conditions are fulfilled:

- 3-point technique: If the set exposure time is reached,
- 2-point technique: If the set mAs product is reached,
- 1-point technique: Upon reaching the limit time of 3.2 seconds or reaching the mAs limit
- Max. AEC mAs In all AEC techniques maximum mAs is limited to 600 mAs
- All techniques: If an adjustable percentage (1% to 50%) of the anticipated switch-off dose is not achieved within the

first 50 ms of the exposure, the automatic exposure control device switches off the system.

### 3.2.3 X-Ray Tube Duty Cycle Protection:

The HFe generator has Duty Cycle limit built in for protection of the X-Ray Tube. It limits the duty cycle based on usage and energy dissipated on the X-Ray tube.

### 3.3 Essential Performance

In addition to the features that are required by the relevant standards for X-ray technology, the following major features are defined:

- The maximum output voltage must not exceed 150 kV +/-10%
- The output voltage and the output current must be within an accuracy of +/-10%
- The lower switching time should be at 5 ms

### 3.4 Copyright

Copyright © by Spellman High Voltage Electronics GmbH, Josef-Baumann-Straße 23, 44805 Bochum, Germany.

Upon delivery of the X-ray generator, including software, the user acquires a non-exclusive, non-transferable right to use the stored software in combination with the delivered X-ray generator.

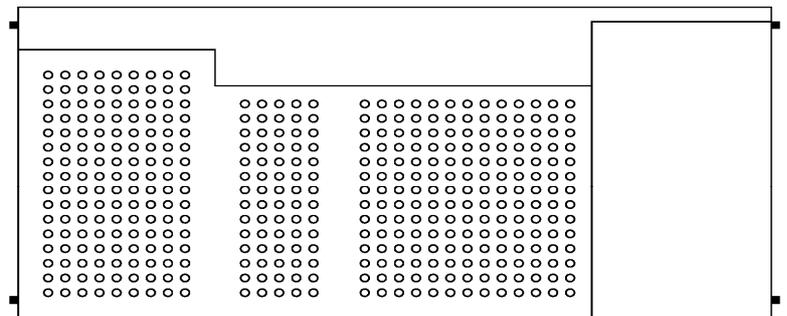
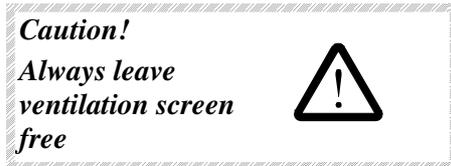
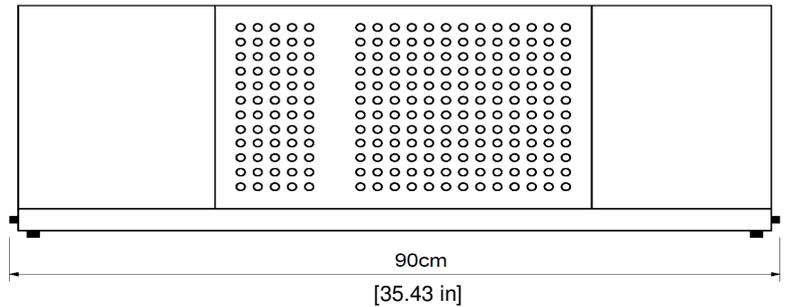
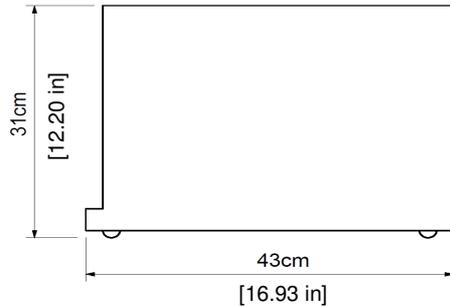
Changes to the software, use of the software on devices other than the X-ray generator supplied in this context by Spellman GmbH Bochum or taking copies even for data security purposes, require the prior explicit written permission of Spellman GmbH Bochum.

## 4 Technical Data

### 4.1 Dimensions and Weights

#### 4.1.1 Dimensions and weights for the output cabinets

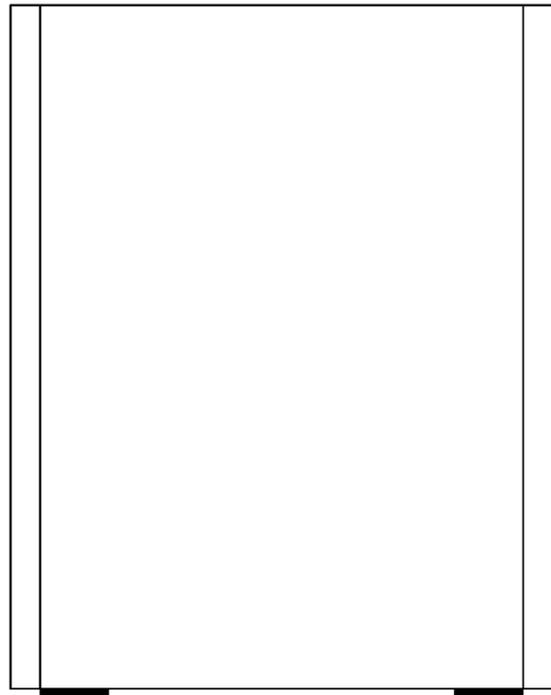
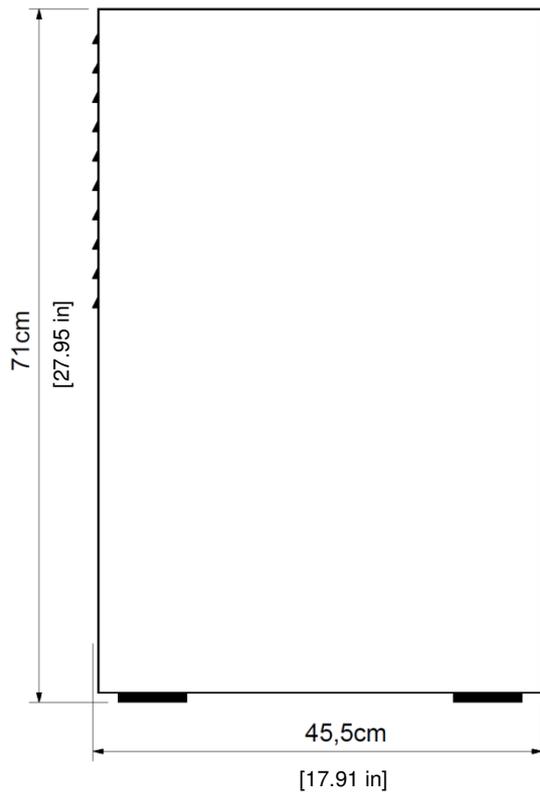
X-ray Generator cabinet under table:



Dimensions: [cm]			Weight [Kg]
Height:	Width:	Depth:	
30	90	43	75 [165.35 lb]

The weight values apply to the standard equipment without any options.

## X-ray Generator cabinet 70cm:



Dimensions: [cm]			Weight [Kg]
Height:	Width:	Depth:	
70	53	45	97 [213.85 lb]

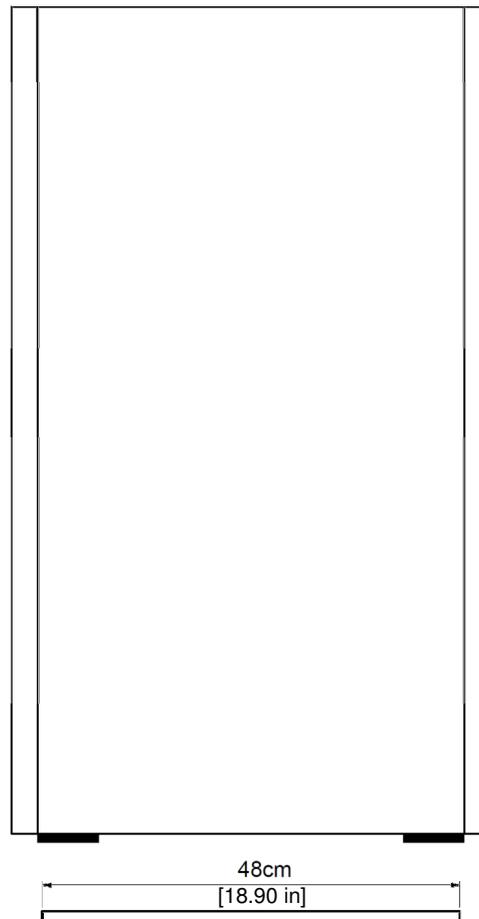
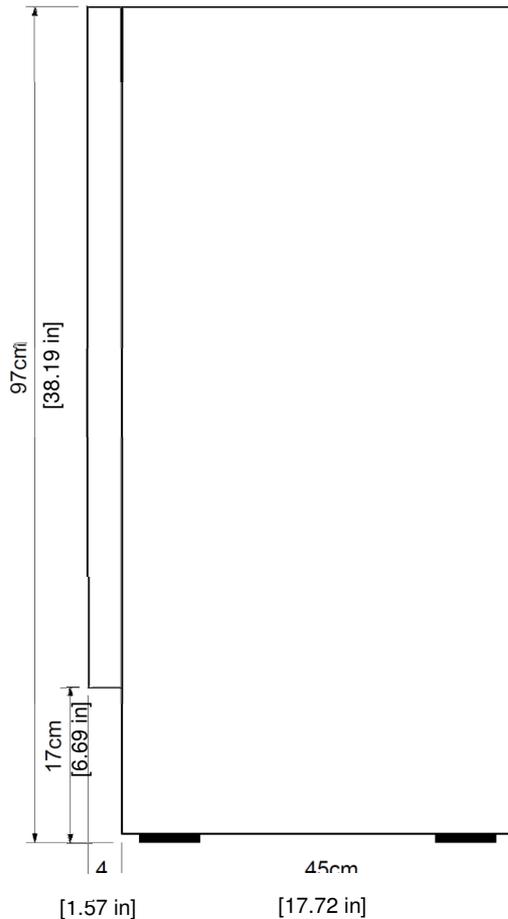
The weight values apply to the standard equipment without any options.

**Caution!**  
Always leave  
ventilation screen  
free



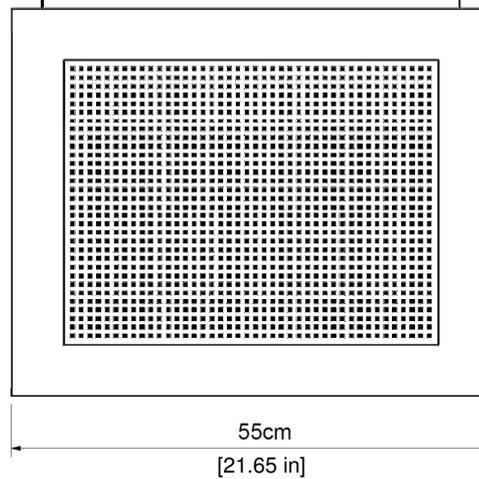
55cm  
[21.65 in]

## X-Ray Generator cabinet 97cm:



Dimensions: [cm]			Weight
Height:	Width:	Depth:	[Kg]
97	55	49	121 [266.76 lb]

The weight values apply to the standard equipment without any options.

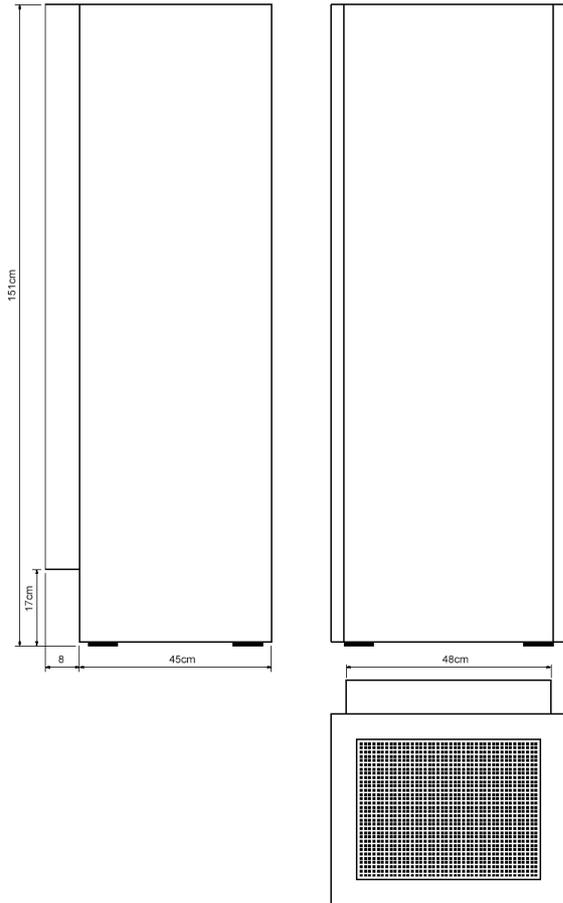


**Caution!**

*Always leave ventilation screen free*



## Röntgeneratorgehäuse 150cm



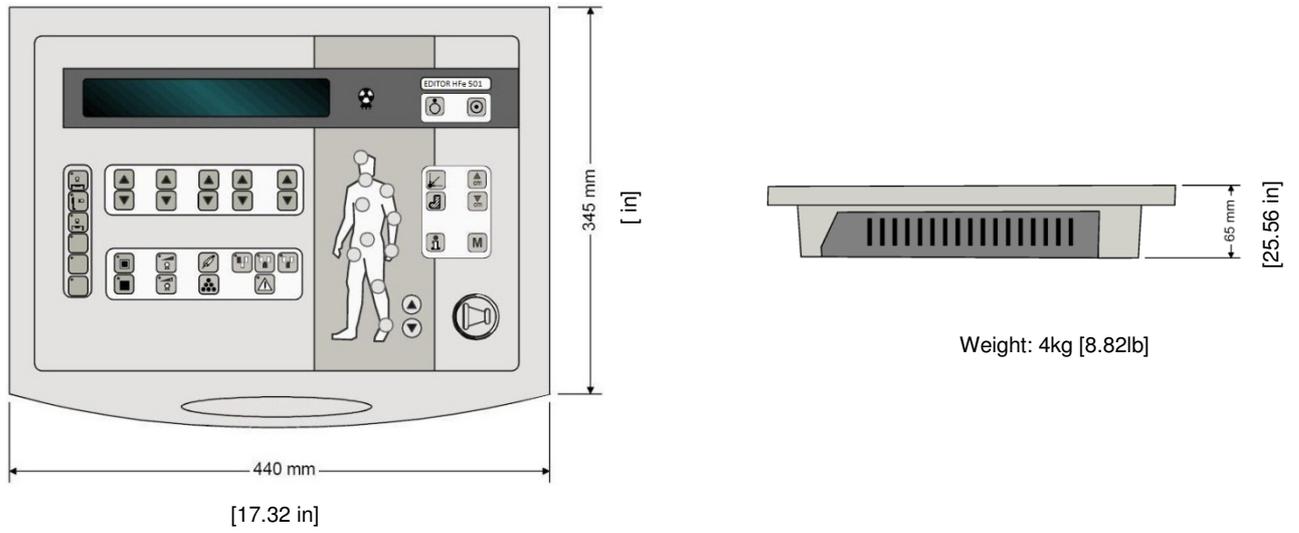
		Weight
Power cabinet without transformer	pre-	160 kg
Power cabinet with pre-transformer 208V – 400V		230 kg
Power cabinet with pre-transformer 420/440/480V – 400V		210 kg

**Caution!**  
*Always leave  
 ventilation screen  
 free*

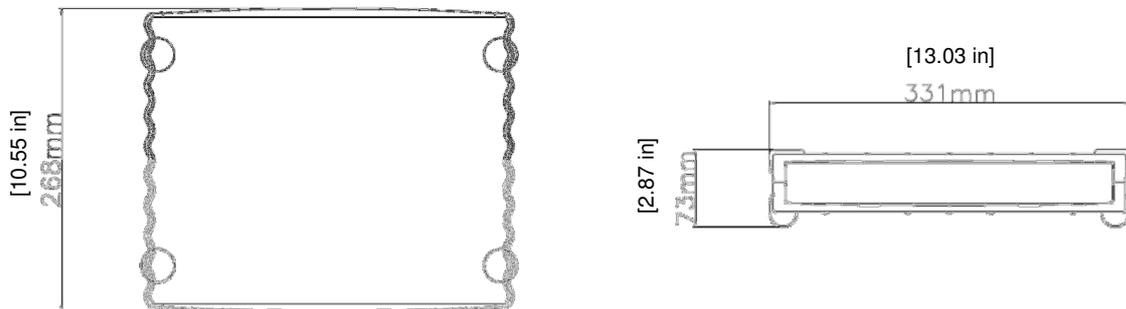


## 4.1.2 Dimensions and weights for the control desks

### Standard control Panel



### Option "Interface Box"



## 4.2 Electrical Data

Generator	Provario HF 40	Provario HF 50	Provario HF 60	Provario HF 80
Output Power	40 kW	50 kW	65 kW	80 kW
mA / kW @ 0,1s				
at 40 kV	400 / 16	400 / 16	400 / 16	400 / 16
at 60 kV	500 / 30	650 / 39	800 / 48	800 / 48
at 80 kV	500 / 40	625 / 50	800 / 64	800 / 64
<b>at 100 kV</b>	<b>400 / 40</b>	<b>500 / 50</b>	<b>650 / 65</b>	<b>800 / 80</b>
at 125 kV	320 / 40	400 / 50	520 / 65	640 / 80
at 150 kV	266 / 40	330 / 50	430 / 65	530 / 80
Continuous falling load (with AEC)	yes	yes	yes	yes
kV range for exposure in increments of or in	40 - 150 kV 1 kV 27 steps	40 - 150 kV 1 kV 27 steps	40 - 150 kV 1 kV 27 steps	40 - 150 kV 1 kV 27 steps
kV Accuracy	±(5%+1kV)	±(5%+1kV)	±(5%+1kV)	±(5%+1kV)
Pulsation	100 kHz	100 kHz	100 kHz	100 kHz
mA range for exposure in	10 - 500 mA 18 steps	10 - 650 mA 19 steps	10 - 800 mA 20 steps	10 - 800 mA 20 steps
mA Accuracy	±(6%+1mA)	±(6%+1mA)	±(6%+1mA)	±(6%+1mA)
max. mA @ max. kV	500mA @ 80kV	650mA @ 76kV	800mA @ 81kV	800mA @ 100kV
ms range for exposure in	1 - 6300 ms 38 steps	1 - 6300 ms 38 steps	1 - 6300 ms 38 steps	1 - 6300 ms 38 steps
ms Accuracy	±(4% +1ms) ±(10% +1ms) for ms≤10ms	±(4% +1ms) ±(10% +1ms) for ms≤10ms	±(4% +1ms) ±(10% +1ms) for ms≤10ms	±(4% +1ms) ±(10% +1ms) for ms≤10ms
mAs range in	0.5 - 600 mAs 32 steps	0.5 - 600 mAs 32 steps	0.5 - 600 mAs 32 steps	0.5 - 600 mAs 32 steps
mAs range (optional) in	0.5 - 1000mAs 34 steps	0.5 - 1000mAs 34 steps	0.5 - 1000mAs 34 steps	0.5 - 1000mAs 34 steps
mAs Accuracy	±(10%+0,2mAs) ±(20%+2mAs) for ≤10mAs	±(10%+2mAs) ±(20%+2mAs) for ≤10mAs	±(10%+2mAs) ±(20%+2mAs) for ≤10mAs	±(10%+2mAs) ±(20%+2mAs) for ≤10mAs
Automatic dose control	yes	yes	yes	yes
Max. image rate (pulse per sec.)	50	50	50	50
Automatic Exposure Control (AEC)	Optional	Optional	Optional	Optional
AEC mAs Range	0.5-600 mAs	0.5-600 mAs	0.5-600 mAs	0.5-600 mAs
Dose area product	Optional	Optional	Optional	Optional
Printer- und PC-Interface	RS232	RS232	RS232	RS232
High Speed Starter HSS1/HSS2*3	Optional	Optional	Optional	Optional
Standard AC Line voltage	400 V AC,	400 V AC,	400 V AC,	400 V AC,
AC Line frequency	50/60Hz	50/60Hz	50/60Hz	50/60Hz
AC Line Configuration	3N~	3N~	3N~	3N~
Other AC line input options:	See below (Paragraph 4.5.2)	See below (Paragraph 4.5.2)	See below (Paragraph 4.5.2)	See below (Paragraph 4.5.2)
Operating Control Console	Optional	Optional	Optional	Optional
Main resistance per phase	0,3 Ω	0,3 Ω	0,2 Ω	0,12 Ω



**Operating Instructions**  
**X-ray Generator**  
**Provario HF**

Exclusively for



06220028-EN\_D

Page 19

Power factor $\cos \varphi$	0.9	0.9	0.9	0.9
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\*1 Pulse mA current setting depends on pulse rate

\*2 Same parameters for AEC possible

\*3 HSS1/HSS2 Duty Cycle is 2 PREP or Exposures per minute on High Speed and 4 on Low Speed

Table 4-1: Provario HF Technical Data

### 4.3 Essential requirements

The X-ray generator Provario HF has the following essential requirements:

- Operation of the X-ray generator: Single generators via a control panel displaying the X-ray tube load factors, the operating status and any error message. Dual X-ray generators via a separate connected PC unit displaying the X-ray tube load factors of both generators. The operational status and any error messages of both generators is transferred via a parallel interface cable.
- Keeping the displayed X-ray tube loading factors.
- Observance of accuracy of X-ray tube loading factors:
  - o The error of the value of the X-ray tube voltage, in any combination of X-ray tube loading factors is not larger than 5%+1KV.
  - o The increment or decrement of the X-ray tube voltage between any two indicated settings is within 50% and 150% of the indicated change.
  - o The error of the value of the X-ray tube current, in any combination of X-ray tube loading factors is not larger than  $\pm(6\%+1\text{mA})$ . The current accuracy for 10mA and below is  $\pm(10\%+1\text{mA})$
  - o The accuracy of the X-ray tube loading time, in any combination of X-ray tube loading factors is not larger than  $\pm(4\% +1\text{ms})$ . If exposure time is equal or less than 10ms then the accuracy is  $\pm(10\%+1\text{ms})$
  - o The accuracy of the X-ray tube current time product is not larger than  $\pm(10\% +0,2\text{mAs})$ . If the exposure time is equal or less than 10ms, or mA is equal or less than 10mA mAs then the accuracy is  $\pm(20\%+0.2\text{mAs})$

#### 4.4 Protection Against Electrical Shock:

The equipment conforms to protection class I. All conductive parts which can be touched are connected to the ground connector on the line side.

#### 4.5 EN 60601-1-2:2007 Directives and Manufacturer's Declarations

##### 4.5.1 Table 1

Directives and manufacturer's declaration – Electromagnetic Emissions		
The Provario HF 40-80 X-ray generator is intended for operation in the electromagnetic environment specified below. Customers and/or users of the Provario HF 40-80 X-ray generator should ensure that it is used in such an environment.		
Emission measurements	Compliance	Electromagnetic environment - Directives
RF emissions according to CISPR 11	Group 1	The Provario HF 40-80 X-ray generator uses RF energy exclusively for its internal function. For this reason, its RF emissions are very low and interference with the use of electronic equipment is improbable.  The Provario HF 40-80 generator is intended for use in other than residential facilities and such facilities connected directly to public low voltage line supply which is also used for supply of residential buildings.
RF emissions according to CISPR 11	Class A	
Harmonics according to IEC 61000-3-2	Class A	
Voltage fluctuations/flicker according to IEC 61000-3-3	correspond with	

##### 4.5.2 Line Voltage

Generator Model	Provario HF 40	Provario HF 50	Provario HF 60	Provario HF 80
Output Power Rating	40kW	50 kW	65 kW	80 kW
With Autotransformer (3PN)	208V			Not available
Input Line Voltage Single Phase (1P)	208-240V	Not Available		
Input Line voltage, 3 Phase (3PN)	400 V			
Input Line Voltage 3 Phase (3P or 3PN)	400V /480 V			
With Autotransformer (3PN)	420 V, 440 V, 480 V			
Frequency	50 / 60 Hz			
Maximum Line Regulation	3 Phase 208V/ 400V /420V /440V/ 480V Single Phase 208V-240V Tested in a range of +/- 10%			

Table 4-2: Line Voltage

### 4.5.3 Input current

Input current at maximum output power rating per phase lasting for 0,2 sec

Generator type	Output power	Mains voltage	Pre-transformer	Momentary max. input current per line	Standby input current per line	AC Line Configuration	Momentary power consumption
EDITOR HFe 401	40kW	400V		92A	0,7A	3P+N+PE	62kVA
		420V	x	89A	0,7A	3P+N+PE	
		440V	x	86A	0,7A	3P+N+PE	
		480V	x	79A	0,7A	3P+N+PE	
		480V		79A	0.7A	3P+(N <sup>1</sup> )+PE	
		208V	x	160A	2,6A	3P+N+PE	
		230V		275A	0.6A	1P+(N <sup>1</sup> )+PE	
EDITOR HFe 501	50kW	400V		113A	0,7A	3P+N+PE	76kVA
		420V	x	110A	0,7A	3P+N+PE	
		440V	x	106A	0,7A	3P+N+PE	
		480V	x	97A	0,7A	3P+N+PE	
		480V		97A	0,7A	3P+(N <sup>1</sup> )+PE	
		208V	x	206A	2,6A	3P+N+PE	
EDITOR HFe 601	65kW	400V		144A	0,7A	3P+N+PE	96kVA
		420V	x	140A	0,7A	3P+N+PE	
		440V	x	136A	0,7A	3P+N+PE	
		480V	x	124A	0,7A	3P+N+PE	
		480V		124A	0,7A	3P+(N <sup>1</sup> )+PE	
		208V	x	288A	2,6A	3P+N+PE	
EDITOR HFe 801	80kW	400V		180A	0,7A	3P+N+PE	120kVA
		420V	x	173A	0,7A	3P+N+PE	
		440V	x	167A	0,7A	3P+N+PE	
		480V	x	154A	0,7A	3P+N+PE	
		480V		154A	0.7A	3P+(N <sup>1</sup> )+PE	

(N<sup>1</sup>): With or without Neutral

Table 4-3: Input current

#### 4.5.4 Table 2

Directives and manufacturer's declaration – Immunity to electromagnetic interference			
The Provario HF 40-80 X-ray generator is intended for operation in the electromagnetic environment specified below. Customers and/or users of the Provario HF 40-80 X-ray generator should ensure that it is used in such an environment.			
Interference test	IEC 60601 test level	Compliance level	Electromagnetic environment - Directives
Electrostatic discharge (ESD) according to IEC61000-4-2	±6kV contact discharge ±8kV air discharge	±6kV contact discharge ±8kV air discharge	Floors should consist of wood or concrete or be provided with ceramic tiles. If the floor is covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transient flash burst immunity test according to IEC61000-4-4	±2kV for power lines ±1kV for input and output lines	±2kV for power lines ±1kV for input and output lines	The quality of the power supply should conform to a typical business or hospital environment.
Surge immunity test according to IEC 61000-4-5	±1kV series mode voltage ±2kV common mode voltage	±1kV series mode voltage ±2kV common mode voltage	The quality of the power supply should conform to a typical business or hospital environment.
Voltage dips, short interruptions and voltage variations according to IEC 61000-4-11	<5% $U_T$ for % period (>95% dip) 40% $U_T$ for 5 periods (60% dip) 70% $U_T$ for 25 periods (30% dip) <5% $U_T$ for 5 s (>95% dip)	<3% $U_T$ for % period (>95% dip) 40% $U_T$ for 5 periods (60% dip) 70% $U_T$ for 25 periods (30% dip) <0% $U_T$ for 5 s (>95% dip)	The quality of the power supply should conform to a typical business or hospital environment. If the user of the Provario HF 40-80 X-ray generator requires continuous function after interruptions occurred in the power supply, we recommend supplying the power for the Provario HF 40-80 X-ray generator from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field immunity test according to IEC 61000-4-8	3 A/m	3 A/m	Magnetic fields at the line frequency should correspond to the typical values present in business and hospital environments.
Note: $U_T$ is the alternating line voltage before application of the test level.			

#### 4.5.5 Table 3

Directives and manufacturer's declaration – Immunity to electromagnetic interference			
The Provario HF 40-80 X-ray generator is intended for operation in the electromagnetic environment specified below. Customers and/or users of the Provario HF 40-80 X-ray generator should ensure that it is used in such an environment.			
Interference test	IEC 60601 test level	Compliance level	Electromagnetic environment - Directives
			Portable and mobile radio equipment should not be used at a distance to the Provario HF 40-80 X-ray generator including lines less than the recommended protection interval calculated according to the equation suitable for the transmission frequency. Recommended protection interval:
Immunity to conducted RF disturbances according to IEC61000-4-6	<b>3V<sub>eff</sub></b> 150 kHz to 80 MHz	<b>3V<sub>eff</sub></b> 150 kHz to 80 MHz	d = 1.2 VP
Radiated RF electromagnetic field immunity according to IEC61000-4-3	<b>3V/m</b> 80 MHz to 2.5 GHz	<b>3V/m</b> 80 MHz to 2.5 GHz	d = 1.2 A/P    80 MHz to 800 MHz d = 2.3 VP    800 MHz to 2.5 GHz
			Where P is the rated power of the transmitter in Watts (W) according to specifications of the transmitter manufacturer and d is the recommended protection interval in (m). The field strength of stationary radio transmitters is less than the compliance level at all frequencies according to an on-site test <sup>a</sup> . Interference is possible in the area of equipment marked with the following symbol
			
Note 1 The higher value applies at 80 MHz and 800 MHz.			
Note 2 This directive may not apply in all situations. The propagation of electromagnetic waves is affected by absorption and reflection from buildings, objects and humans.			
<sup>a</sup> The field strength of stationary transmitters, such as base stations for radio telephones and land mobile radio services, amateur stations, AM and FM radio and television stations cannot be determined precisely theoretically in advance. An onsite test is recommended for determination of the electromagnetic field resulting from stationary RF transmitters. When the field strength measured at the location of the Provario HF 40-80 X-ray generator exceeds the compliance level specified above, it will be necessary to observe the Provario HF 40-80 X-ray generator at all insulation locations in terms of its normal operation. If uncommon performance characteristics are observed, it may be necessary to take additional measures such as reorientation or movement of the Provario HF 40-80 X-ray generator.			
<sup>b</sup> The field strength is less than 3 V/m over the frequency range from 150 kHz to 80 MHz.			

#### 4.5.6 Table 4

Recommended protective intervals between portable and mobile RF telecommunications equipment and the Provario HF 40-80 X-ray generator			
The Provario HF 40-80 X-ray generator is intended for operation in electromagnetic environments with controlled RF interference values. Customers and users of the Provario HF 40-80 X-ray generator can help to prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF telecommunications devices (transmitters) and the Provario HF 40-80 X-ray generator – regardless of the output power of the telecommunication device as specified below.			
Rated power of transmitter in W	Protective interval depending on transmission frequency in m		
	150 kHz to 80 MHz	80 MHz to 800 MHz	800 MHz to 2.5 GHz
0.01	0.1	0.1	0.2
0.1	0.4	0.4	0.7
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters whose maximum rated power is not specified in the table above, the recommended protective interval  $d$  in meters (m) can be determined using the equation associated with the specific column, whereby  $P$  is the maximum rated power of the transmitter in Watts (W) according to specifications of the manufacturer of the transmitter.

#### 4.5.7 Requirements for supply- and connection-cables

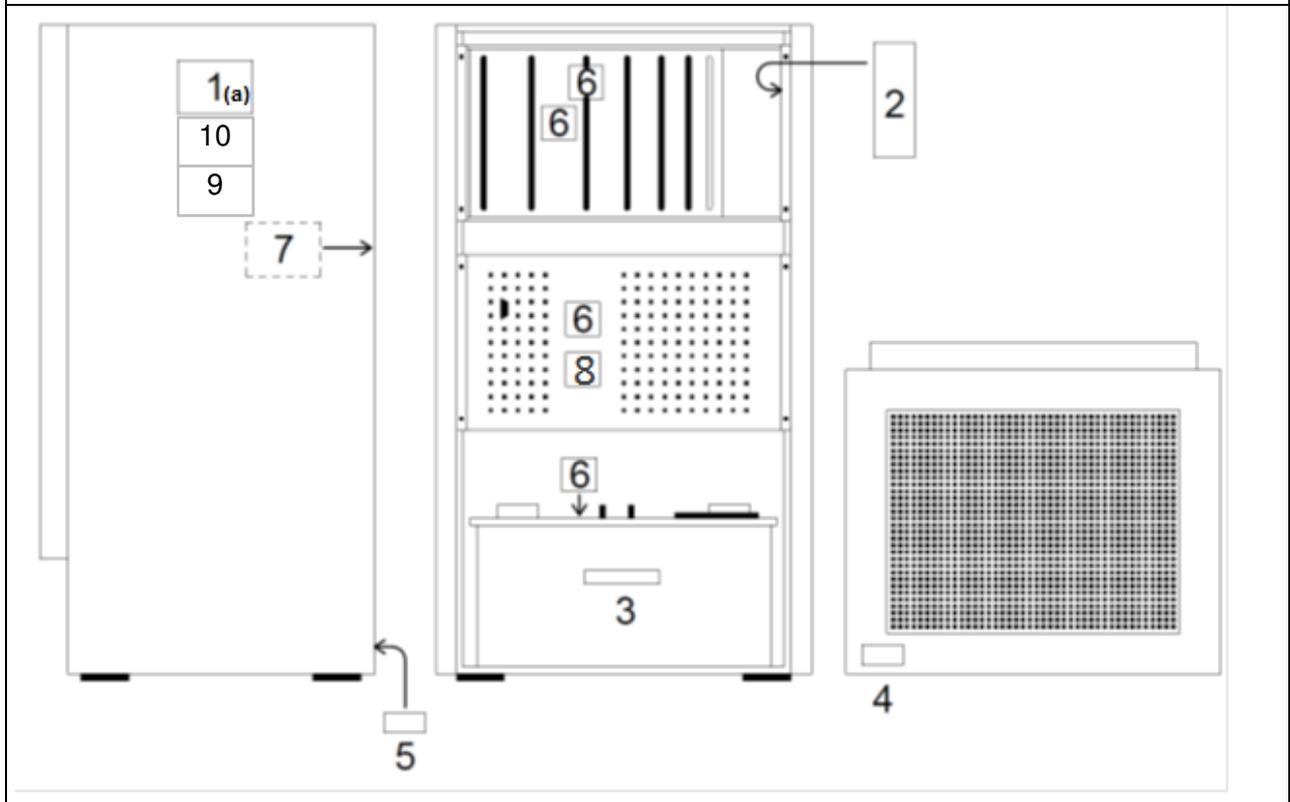
Requirements for supply- and connection-cables	
	The following types of cables for power supply and connecting lines are the minimum requirements to maintain compliance with electromagnetic compatibility.
None of the cables should exceed a length of 30m.	
<ul style="list-style-type: none"> <li>- Data cable for in and output signals (24V) for connection of the dual generator and the external control device               <ul style="list-style-type: none"> <li>o 25 wire data cable, fully insulated outer jacket, consistently shielded, D-Sub 25-pin connector to D-Sub 25-pin connector, the outer shield at both ends connected to the connector housing.</li> </ul> </li> <li>- Stator-cable               <ul style="list-style-type: none"> <li>o 6 wire standard cable 5G1 6*1,5mm<sup>2</sup>, shielded, U<sub>0</sub>/U: Ratings: min 300/500Vac.</li> </ul> </li> <li>- High voltage cables               <ul style="list-style-type: none"> <li>o Ratings: 75 kVp, same length and type of cable for anode and cathode connection. Connector types: 3-pin standard Federal connector type, Types II or III as per NEMA Standard XR 7-1979 (R 1984, 1990)</li> </ul> </li> <li>- Polyethylene PE cable               <ul style="list-style-type: none"> <li>o Flexible isolated, 6mm<sup>2</sup></li> </ul> </li> <li>- Mains cable               <ul style="list-style-type: none"> <li>o Unshielded, length and wire diameter has to be in compliance with the applicable electrical and local regulations.</li> </ul> </li> </ul>	

#### 4.6 Ambient Conditions

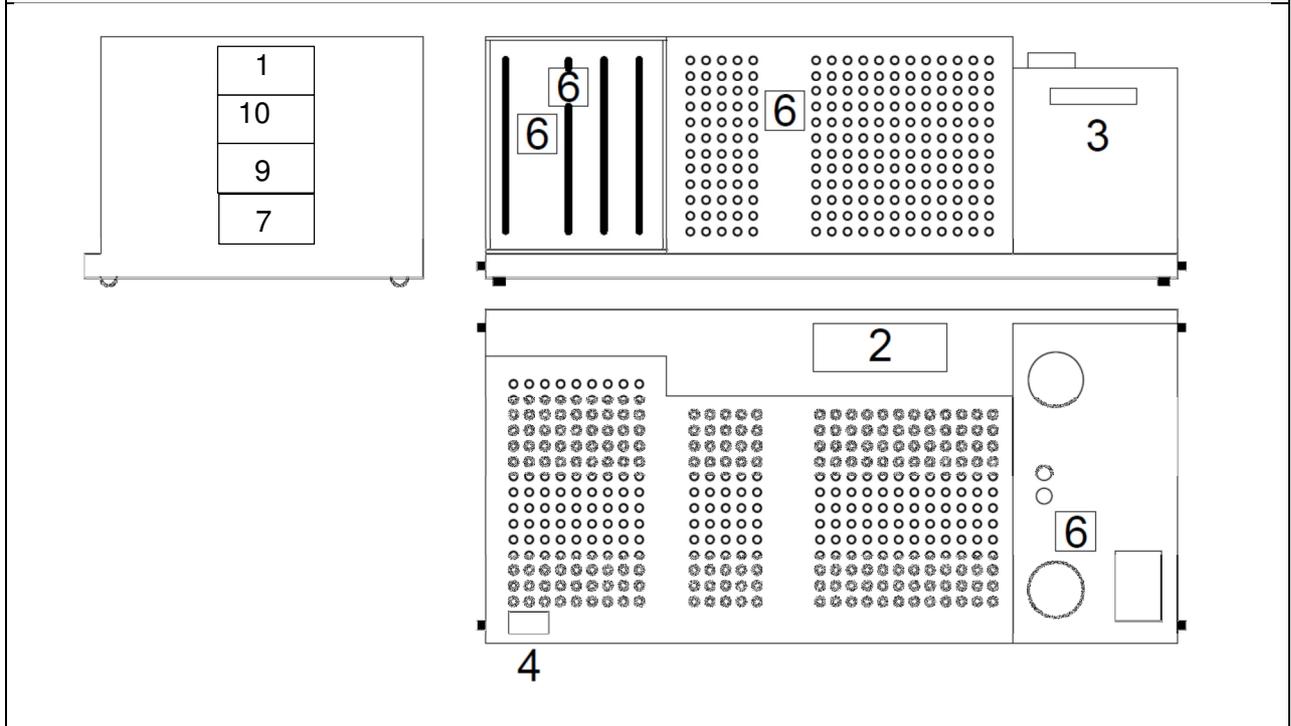
	Transport and storage conditions	Operating conditions
<b>Ambient temperature range:</b>	-15 °C to 50 °C	+10 °C to +40 °C
<b>Relative humidity:</b>	15%-95% non-condensing	15%-75% non-condensing
<b>Atmospheric pressure range:</b>	500 hPa-1060 hPa	700 hPa-1060 hPa
<b>Maximum Altitude</b>	--	Up to 3000 m

#### 4.7 Labeling

Label position 96cm Cabinet (other cabinets are labeled in the same manner)



Label position under table generator



Number	Type	Position on the generator cabinet
1	Name plate of the generator	Left, on the outside of the cabinet
1a	Label of the pretransformer variation and the mains voltage	Left, on the outside of the cabinet
2	Internal label with electrical data	Inside, on the right side behind the upper electronic rack.
3	Indication of the HV transformer	Inside, on front of the HV-transformer
4	Warning label	On the top
5	Warning label	Front wall of each single generator near the screws.
6	High voltage warning label	Converter, HV transformer, PCB boards
7	Label with reference to the fuse table inside of the technical manual	Inside the cabinet

Number	Label
1	<div style="display: flex; justify-content: space-between;">  <span>CE 0197</span> </div> <p><b>Josef-Baumann-Straße 23</b> D-44805 Bochum</p> <div style="display: flex; justify-content: space-around; align-items: center;">  <div style="text-align: center;"> <p><b>Röntgeneratoreur</b> <b>X-Ray Generator</b> <b>Générateur Radiologique</b> <b>Generador Radiológico</b></p> <p><b>Achtung ! Lebensgefahr !</b> <b>Attention ! Danger to life !</b> <b>Attention ! Danger de mort !</b> <b>Atención ! Peligro de muerte !</b></p> <p><b>Öffnen des Schrankes nur durch qualifiziertes Servicepersonal</b> <b>The cabinet may only be opened by qualified service personnel</b> <b>Overture de l'armoire autorisée uniquement par le personnel de service qualifié</b> <b>La apertura del armario solo podrá efectuarse por personal tecnico cualificado</b></p> </div>  </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <span>&lt;product name&gt; GGG  <b>150 kV</b>  , <b>800 mA</b> , PP KW</span> <span>Standby: 0.7A; max. current bbbb/ dddd</span> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div> <p>manufactured:  mm / yyyy</p> </div> <div> <p><b>SN</b> XXXXX</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div> <p><b>REF</b> ccccccc-cccc</p> </div> <div> <p><b>HOUSING</b> zzzzzzzz</p> </div> </div>
1a	<p>Cabinet only for pretransformer, without all labels inside of the cabinet</p> <div style="border: 1px solid black; padding: 10px; text-align: center;"> <p><b>0600xxxx</b></p> <div style="display: flex; justify-content: space-around;">   </div> <p><b>Provario HF</b></p> <p> <input type="checkbox"/> 40 <input type="checkbox"/> 50 <input type="checkbox"/> 60 <input type="checkbox"/> 80 </p> <p>  <b>Z3</b> ac 3N~50/60Hz, <b>Z4</b> Standby: <b>Z5</b> </p> <p><b>S/n: xxxxxx</b></p> </div> <p>S/n: serial number of the corresponding generator</p>
2	<div style="display: flex; justify-content: space-between;">  <div style="text-align: center;">  <p><b>Josef-Baumann-Straße 23</b> D-44805 Bochum</p> </div> <span>CE 0197</span> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div> <p>Röntgeneratoreur/X-ray generator/générateur à rayons-X : Produktnummer / product number / numéro du produit :</p> </div> <div style="border: 1px solid black; padding: 5px;"> <p>&lt;product name&gt; GGG</p> <p>ccccccc-cccc</p> <p>XXXXX</p> <p>mm / yyyy</p> <p>&lt;line input&gt;</p> <p>PP KW</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div> <p>manufactured:  mm / yyyy</p> <p> </p> </div> <div> <p><b>SN</b> XXXXX</p> </div> </div> <p style="text-align: right;">Made in Germany</p>
3	<p>Röntgeneratoreur/X-ray generator/générateur à rayons-X : Provario HF 60</p> <div style="display: flex; justify-content: center; margin-top: 5px;"> <div style="border: 1px solid black; padding: 2px;"> <p><b>SN</b> XXXXX</p> </div> </div>

Number	Label
4	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> <p>Bitte Lüftungsschlitze freihalten.</p> <p>Please keep free the venting slots.</p> <p>Attention, laissez les trous d'aération libres.</p> </div> 
5	<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px; width: 45%;">  <p><b>Attention!</b> Danger to life! The cabinet may only be opened by qualified personnel !</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;">  <p><b>Attention!</b> Danger de mort! L'armoire peut seulement être ouvert par du personnel qualifié!</p> </div> </div>
6	 <p>(yellow background) (against hazardous electrical voltage)</p>
7	<div style="border: 1px solid black; padding: 10px;"> <p><b>Fuses inside of the generator</b></p> <p>All fuse types and ratings are listed in chapter <b>8.3.2 Fuse Tables</b> of the technical manual 06220010</p> <p>Fuses may be only replaced with fuses of identical ratings.</p> </div>
8	 <p>ETL CLASSIFIED Conforms to Std. ANSI/AAMI ES60601-1, EN/IEC 60601-1 EN/IEC 60601-2-54 Certified to CAN/CSA Std. C22.2 No. 60601-1, C22.2 No. 60601-2-54</p> <p><b>Intertek</b> 4008454</p>
10	Complies with requirements applicable for HV-generators and X-ray controls given by CDRH Radiation Performance standards 21CFR1020.30. (21 CFR Subchapter J) as of date of manufacture.

symbolic description:

-  → manufacturing company
-  → serial number of the generator
-  → manufacturing date

#### 4.7.1 Expected Service Life

The expected useful service life of the Provario HF is 7 years.

## 5 Control Panel Description

There are major control panel types used with the Provario HF generator. The RAD control panel is to be used with the RAD generator. There are multiple control panels that can be used with the RAD generator.

The key numbers associated with the key functions refers to the standard control panel (Figure 9-1) For generator options without a standard control panel, please refer to additional documentation.



Warning: Prolonging use of radiography increases skin dose, and can cause injury to patient.

### 5.1 Workplace (Device)

Keys 32, 39, 23, 24, 38 and 37 on the control panel Figure 9-1 allow selection of examination equipment with associated tubes and surface dosimeters as well as automatic exposure controls with measuring chambers, depending on the generator equipment.

The following arrangement is a recommendation which can be modified during installation of the equipment. In each case, film changers and digital image processing devices with programmed exposure values can be connected.

no key selected	: Over table exposure
Key 32 selected	: Bucky table
Key 39 selected	: Bucky wall stand
Key 23 selected	: Tomograph
Key 24 selected	: Examination unit, conventional *
Key 38 selected	: Examination unit, remote controlled *
Key 37 selected	: Special unit *

\*Not used on standard RAD generators

#### 5.1.1 Device selection with Interface box

Figure 10-1: Interface Box shows a function description for the interface box. The “ON” and “OFF” buttons are described as well as the display setting.

The preparation and exposure will be initiated with an external hand switch.

All further needed parameter setting capabilities and indication required for control of the generator shall be provided by a Control Panel GUI

## 5.1.2 Exposure Functions

### 5.1.2.1 General

Various exposure techniques can be selected:

- With automatic exposure control
  - 1-point technique: Selection of tube voltage
  - 2-point technique: Selection of tube voltage and mAs product
  - 3-point technique: Selection of tube voltage, tube current and exposure time
- Free technique without automatic exposure control
  - 2-point technique: Selection of tube voltage and mAs product
  - 3-point technique: Selection of tube voltage, tube current and exposure time
- Anatomic Programmed Radiography (APR)

**!! WARNING !!**

***Ionizing radiation!***

***Exposure has to be accomplished only from the protected area!***



The external hand switch is used to make an exposure.

The manual hand switch has two stages. The first stage starts the preparation and the second stage makes an X-ray exposure.

#### **Note:**

An X-ray exposure can only be made after the generator has completed successfully all internal safety checks.

### 5.1.2.2 Automatic Exposure Control

An automatic exposure control (AEC) is available as an option. This feature processes the signals from 4 to 5 measuring chambers, depending on the version. The automatic exposure control is calibrated during installation according to the instructions in the service manual. Adaptation is possible for different film sensitivity/digital detector combinations.

There is no limitation in the loading factors (kV: 40-150kV; mA: 10-800mA dependent on the output power of the Provario HF) by using the AEC.

The shortest irradiation time usable in automatic exposure control (AEC) is 2.0ms.

The automatic exposure control is switched on or off by pressing the buttons 4, 12 or 20 on the Control Panel for Provario HF (see Figure 9-1: Provario HF control panel)

Readjustment of the automatic exposure control is required, if the circumstances affecting the switch off dose change (different film/foil system, modification of development process, change to digital image receiver, etc.)

The film darkness can be changed in  $\pm 4$  step values (with keys 13 and 16), whereby each step represents a change of one exposure point.

An acoustic signal and yellow warning light (in key No. 28) indicate a malfunction. Malfunctions can result from causes such as:

- Selection of the wrong workplace in relation to the selected measuring chamber
- High voltage selected too low
- mAs product selected in 2-point technique too small
- Time selected in 3-point technique too short
- Technical malfunction

## 5.2 Dose Measuring System

An optional Dose Area Productmeter (DAP) is available. The measured DAP value appears on the display in  $\text{cGycm}^2$ . The data can be transferred via a serial interface (e.g. to a printer) with date and time.

## 5.3 X-ray Tube Startup Unit

The generator is equipped with a startup unit for 3000 rpm as a standard feature. A detailed description is given in the technical manual. The generator can be equipped with an optional high-speed starter.

### 5.3.1 Standard low speed starter

The low speed starter boosts the X-ray tube anode rotation to approximately 3000 rpm upon pressing the preparation key on the control panel.

After the exposure is done, or if the preparation key is released, the X-ray tube anode is braked automatically.

### 5.3.2 Option high speed starter

The optional high-speed starter boosts the X-ray tube anode rotation to approximately 9000 rpm upon pressing the preparation key on the control panel. After starting the tube it will run for max. 30s on 9000rpm before the starter will reduce the anode rotation speed below 3000rpm.

#### **CAUTION**

*As long as the X-ray tube's anode is rotating at high speed, the generator must not be turned off while the generator is in preparation or exposure mode.*

*The high-speed device must slow the speed down before the generator can be turned off.*

*The bearings in the X-ray tube can be damaged, if the generator is switched off before the brake voltage is applied to the anode rotor.*



If the generator has accidentally been turned OFF during preparation mode or exposure, it should be turned on again immediately. The brake voltage will be applied automatically during power on to the X-Ray tube rotor.

The maximum number of high-speed starts is limited to 4 per minute by the generator. Upon exceeding this limit the error number E041 will be indicated.

The tube's maximum allowable number of high-speed starts per minute must not be exceeded.

#### **5.4 RS232 Interfaces**

Two RS232 interfaces are available; one on the generator and one on the control panel.

Both interfaces allow a service technician to program setup data, organ names and organ data which is then available for the APR.

The X-ray data collected within the course of an examination are transferred via the interface of the control panel. The following data is transferred depending on the selected output protocol:

- Date, time
- Dose area product in  $\text{cGycm}^2$
- Number of exposures
- Exposure time
- Exposure kV
- Exposure mA
- Exposure mAs

## 6 X-ray Control Panel and Display

This chapter explains the control keys on the control panel. See Figure 9-1 for RAD generator, it shows the keys and the display. Each key number corresponds to the following function description.

If keys are equipped with LEDs, illumination of the LED indicates that the key is in the active state.

### 6.1 Switching Generator On and Off

If the generator is switched on by the power button, a self test is performed on the generator and on the control panel. After the self test has been completed successfully, the parameters are shown which can be saved under organ number #0.

If an error message appears, please see chapter 0.

	Switching on generator	POW1 button
	Switching off generator	POW2 button

#### 6.1.1 Display Overview

After the generator has completed the startup phase without any errors, the following text appears on the display, for example:

- If exposure unit is selected:

```

                xxxxx . x cGycm2
R x : xxxkV  xxxmA  xxxms  xx  xxxFFS
    
```

- Or if an anatomic program is selected (see chapter 6.9):

```

Oxx: Organ name          xxcm
R x : xxxkV  xxxmA  xxxms  xx  xxxFFS
    
```

The first line shows the dose area product with APR.

Switchover by using key 

The second line shows the exposure parameters.

Definitions of first line:

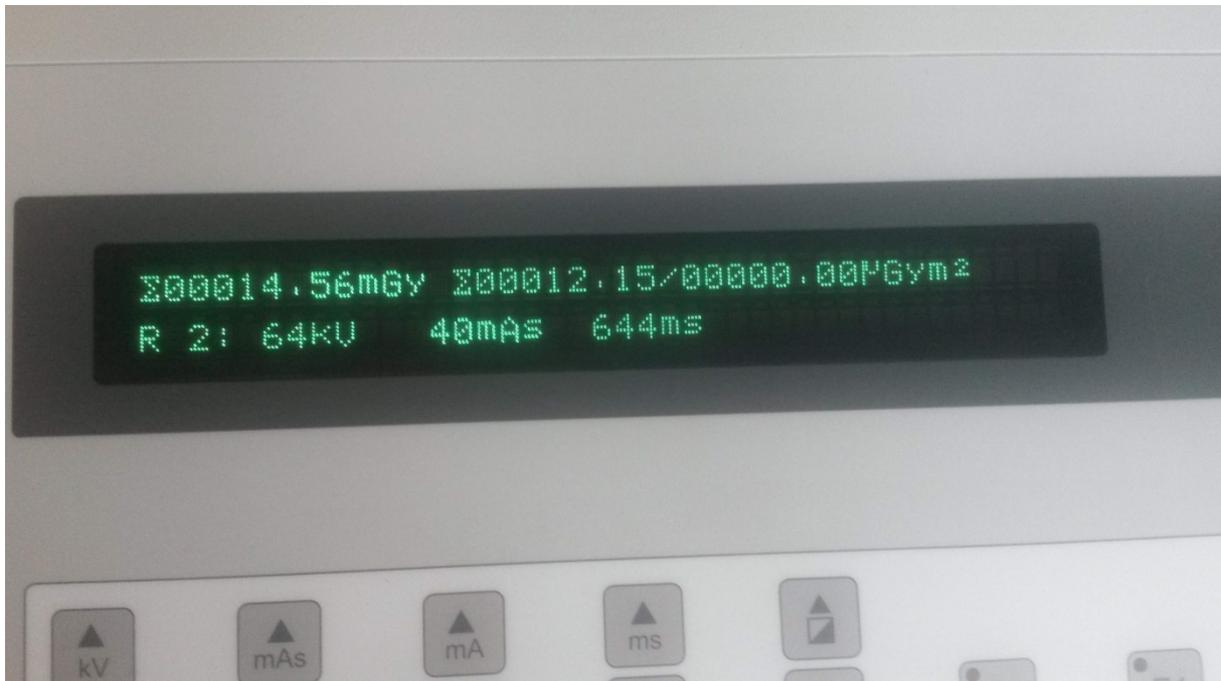
Display	Meaning	Displayed if
xxxxx.x cGycm <sup>2</sup>	Dose area product in cGycm <sup>2</sup> alternating with APR program text	Surface dosimeter installed

Definitions of second line:

Display	Meaning	Displayed if
Rx	Rx: Exposure technique R1 1-point technique (kV) R2 2-point technique (kV, mAs) R3 3-point technique (kV, mA, ms)	Switchover by using button  
xxxkV	Tube voltage in kV	1-point, 2-point, 3-point technique
xxxxmA	Tube current in mA	3-point technique:
xxxxms	Exposure time in ms	
or		
xxmA	Current/time product in mAs	2-point technique:
xx	Darkness point (+/-4)	Automatic exposure control active
xxxFFS	Film-screen system	
*	This "*" appears at the end of the display line to signalize that the preparation procedure has been finished and the generator is ready to start an exposure.	Preparation is completed
	Radiation display, illuminates if radiation is switched on	

### 6.1.2 Special display modes using the VacuDAPduo chamber (optional)

Using the VacuDAPduo chamber in radiography mode to display the following Parameters:  
The accumulated dose, the accumulated dose area product and the actual dose area product.



### 6.2 Selection of receptor / imaging devices, Keys 32, 39, 23.24.38.37 (Standard Key Assignment)

	Bucky table	Key No. 32
	Wall bracket	Key No. 39
	Tomography	Key No. 23
	Examination unit, conventional*	Key No. 24
	Examination unit, remote controlled*	Key No. 38
	Special unit*	Key No. 37

\*Not used on standard RAD generators

The assignments for keys 32, 39, 23, 24, 38 and 37 are variable, depending on the equipment

### 6.3 Selection of Focal Spot, Keys 14-15

	Selection of small X-ray tube focal spot	Key No. 14
	Selection of large X-ray tube focal spot	Key No. 15

### 6.4 Selection of X-ray Tube Power Factor, Keys 50-51

A factor can be entered in % during installation to which fraction the tube power can be reduced.

	100% tube power	Key No. 50
	≤ 100% tube power (default setting 70%)	Key No. 51

## 6.5 Selection of Exposure Technique, Key 6

	The exposure technique can be switched over from 1-point technique to 2-point technique to 3-point technique by pressing the key several times.	Key No. 6
---	---	-----------

The selected mode is shown on the display:

1-point technique: Display of tube voltage (kV) in the exposure line: (can only be selected if Automatic Exposure Control (AEC) is used). The tube voltage can be changed by the keys 31/40 (see below).

2-point technique: Display of tube voltage (kV) and mAs product in the exposure line; tube voltage (keys 31/40) and mAs product (keys 30/22) can be changed.

**NOTE:** *If the automatic exposure control is switched on optionally during this technique, it is necessary to set a higher mAs product than you would expect for the intended exposure. The automatic exposure control then has sufficient time to terminate the exposure at the right time.*

3-point technique: Display of tube voltage (kV), tube current (mA) and exposure time (ms) in the exposure line; tube voltage, tube current and exposure time can be changed by the keys 31/40, 30/22, 29/21.

**NOTE:** *If the automatic exposure control is switched on optionally with this technique, it is necessary to set a longer exposure time than would actually be expected for the intended exposure. The automatic exposure control then has sufficient time to terminate the exposure at the right time.*

## 6.6 Changing the Exposure Parameters, Keys 31/40;30/22;29/21;13/16

The keys for changing the X-ray parameters are located directly below the display. The following applies to the parameter selection keys: Pressing shortly changes the displayed value by one unit, holding down the key causes the value to change quickly.

### Note:

The Provario HF Generator automatic tube/generator protection feature only allows setting combinations of exposure parameter (kV, mA, Time, mAs) values which will not lead to an overload for the generator or tube, see Chapter 7.3 for error messages. Depending on the generator model the current and mAs are limited. (See Provario HF generator model specifications) Depending on tube model used on the system the generator limits kV, mA and time based on tube specs. (Tube limit charts are programmed into the generator)

### 6.6.1 Changing X-ray Tube Voltage, Keys 31/40

These keys are located directly below the display for kV.

	To increase the tube voltage in steps of 1 kV or stages according to Table 6-1 (active in 1, 2 and 3-point technique)	Key No. 31
	To reduce the tube voltage in steps of 1 kV or stages according to Table 6-1 (active in 1, 2 and 3-point technique)	Key No. 40

### 6.6.2 Changing current time Product, Keys 30/22 in 2-Point Technique

These keys are located directly below the display for mAs.

In 2-point technique, the display appears above the keys 30 and 22

	To increase the mAs product in stages according to table 6-2 (active in 2-point technique)	Key No. 30
	To reduce the mAs product in stages according to table 6-2 (active in 2-point technique)	Key No. 22

### 6.6.3 Changing of X-ray Tube Current, Keys 30/22 in 3-Point Technique

These keys are located directly below the display for mA.

The tube current display always appears above keys 30 and 22

	To increase the tube current in stages according to table 6-3 (active in 3-point technique)	Key No. 30
	To reduce the tube current in stages according to table 6-3 (active in 3-point technique)	Key No. 22

### 6.6.4 Changing of Exposure Time, Keys 29/21 in 3-Point Technique

These keys are located directly below the display for ms.

The exposure time display always appears above keys 29 and 21

	To increase the exposure time in stages according to table 6-4 (active in 3-point technique)	Key No. 29
	To decrease the exposure time in stages according to table 6-4 (active in 3-point technique)	Key No. 21

### 6.6.5 Table of Stages for Exposure Parameters

Stage	kV	Stage	kV	Stage	kV
0	40	10	60	20	102
1	41	11	63	21	109
2	42	12	66	22	117
3	44	13	70	23	125
4	46	14	73	24	133
5	48	15	77	25	141
6	50	16	81	26	150
7	52	17	85		
8	55	18	90		
9	57	19	96		

KV increments if stage selection is activated, otherwise individual steps of 1 kV

Table 6-1: Tube voltage stages (27 stages)

Stage	mAs	Stage	mAs	Stage	mAs	Stage	mAs
0	0,5	10	5,0	20	50	30	500
1	0,63	11	6,3	21	63	31	600
2	0,8	12	8,0	22	80		
3	1,0	13	10	23	100		
4	1,3	14	13	24	125		
5	1,6	15	16	25	160		
6	2,0	16	20	26	200		
7	2,5	17	25	27	250		
8	3,2	18	32	28	320		
9	4,0	19	40	29	400		

Table 6-2: Time / current product stages in 2-point-technique (32 stages)

Stage	mA	Stage	mA
0	10	10	100
1	13	11	125
2	16	12	160
3	20	13	200
4	25	14	250
5	32	15	320
6	40	16	400
7	50	17	500
8	63	18	650* <sup>1</sup>
9	80	19	800* <sup>2</sup>

\*<sup>1</sup> Provario HF 50 / \*<sup>2</sup> Provario HF 60

Table 6-3: Tube current stages in 3-point-technique (19 Stages)

Stages	ms	Stages	ms	Stages	ms	stages	ms
0	1	10	13	20	130	30	1250
1	2	11	16	21	160	31	1600
2	3	12	20	22	200	32	2000
3	4	13	25	23	250	33	2500
4	5	14	32	24	320	34	3200
5	6	15	40	25	400	35	4000
6	7	16	50	26	500	36	5000
7	8	17	63	27	630	37	6300
8	10	18	80	28	800		
9	11	19	100	29	1000		

Table 6-4: Exposure time stages in 3-point technique (38 stages)

## 6.7 Operation with Automatic Exposure Control (AEC), Keys 13/16;8/5;4/12/20;28

### 6.7.1 Activation

The automatic exposure control can be activated by selecting an AEC measuring field. A combination of a number of measuring fields is possible. The selected measuring field is indicated by an illuminated LED. The AEC control keys are active only when the AEC option is installed on the generator.

If the automatic exposure control is activated, additional information on the selected darkness correction and film-screen system appears in the exposure line.

If exposures are controlled by the automatic exposure control, the exposure parameters mAs product and exposure time must be set to values larger than expected in 2 and 3-point technique in order to provide the automatic exposure control with enough time necessary for switching off the exposure.

### 6.7.2 Selection of Measuring Field, Keys 4/12/20

When selecting the AEC field, the button selected will light. If there are no LED lights from these buttons, this tells the operator that AEC has not been activated.

	Left measuring field ON/OFF	Key No. 4
	Center measuring field ON/OFF	Key No. 12
	Right measuring field ON/OFF	Key No. 20

### 6.7.3 Selection of Darkness Correction, Keys 13, 16

These keys are active only if the automatic exposure control is switched on by selecting at least one measuring field. The darkness points then appear simultaneously on the control panel.

	Increasing darkness by 1 exposure point, max. + 4 exposure points	Key No. 13
	Decreasing darkness by 1 exposure point, min. - 4 exposure points	Key No. 16

### 6.7.4 Selection of Film-Screen System, Keys 8, 5

Up to 5 screen systems can be selected depending on the equipment. These keys are active only if the automatic exposure control is switched on by selecting at least one measuring field.

	Selection of film screen system, page up	Key No. 8
	Selection of film screen system, page down	Key No. 5

### 6.7.5 Confirmation of Incorrect Exposure, Key 28

If the exposure is interrupted by the monitoring unit or by releasing the exposure switch, an incorrect exposure is indicated. The LED in key 28 illuminates and an acoustic signal sounds.

The next exposure is inhibited until the incorrect exposure has been confirmed by pressing key 28.

**NOTE:** It is necessary to change the cassette before making a new exposure! Other error states are also indicated by key No. 28.

	Incorrect exposure confirmation	Key No. 28
---	---------------------------------	------------

## 6.8 Activate X-ray Exposures

**!! Warning!!**

***Ionizing radiation!***

***Exposure has to be accomplished only from the protected area!***



### 6.8.1 Activation with Control Panel Switch X-Ray 1 and 3

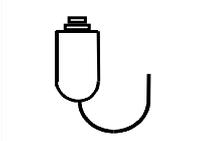
	1. Stage: Preparation ON 2. Stage: Exposure ON	Key No. X-ray 1, 3
---	---	--------------------

The exposure control switch has got a two stage construction. When it is pressed half way, it is Preparation ON. When it is pressed full way, it is Exposure ON. If the switch is released during the exposure, the exposure is terminated instantaneously (dead man switch).

### 6.8.2 Activation with Hand Switch

An exposure can also be done by using the two-stage hand switch. The first stage initiates the preparation phase and the second stage starts the exposure.

**NOTE:** The hand switch should be mounted on the wall in the radiation protected area!

	1. Stage: Preparation ON 2. Stage: Exposure ON	
---	---	--

If the hand switch is released during the exposure, the exposure is terminated instantaneously (dead man switch).

The exposure is terminated under the following conditions:

- When the set mAs product is reached (Manual Mode)
- When the set exposure time is reached (Manual Mode)
- When the automatic exposure control terminates the exposure

The X-ray exposure is not terminated successfully because of the following conditions:

- Automatic exposure control (AEC) mode
  - A fault occurs in the AEC
  - The initial dose is too high or too low
  - At maximum exposure time of 3.2 seconds using 1-point technique
  - When the maximum mAs product of 600 mAs is reached in 1, 2 or 3 point technique
- Manual Mode:
  - The maximum permissible exposure time of 6.3 seconds is exceeded (safety switch off)
  - When the maximum mAs product of 600 mAs is reached in 1, 2 or 3 point technique
- When the door contact is activated

### 6.8.3 Display Information, Key 3

	The first line on the display switches between between APR memory display and dose area display	Key No. 3
---	---	-----------

```
Oxx: Organ name                xxcm
A x: xxxkV  xxxmA  xxxms  xx  xxxFFS
```



```
xxxxx . xGycm2
A x: xxxkV  xxxmA  xxxms  xx  xxxFFS
```

Display	Meaning	Displayed if
xxxxx.x cGycm <sup>2</sup>	This line shows the dose area product in cGycm <sup>2</sup> alternating with the anatomic program text *	Surface dosimeter installed

### 6.8.4 Feather Key "New Patient", Key 7

	The "Feather" key transfers the data collected during the treatment to the serial interface according to the output protocol. The data is deleted automatically.	Key No. 7
---	--	-----------

The data collected during the examination can be transferred to a printer (optional) or to a PC.

## 6.9 Working with Anatomically Programmed Radiography

With Anatomically Programmed Radiography (APR) it is possible to save 100 settings (memory location 00 – 99) for various anatomical groups. Group number #1 is reserved for settings to be made after switching on (warm-up).

Texts for group names can be transferred with the aid of a PC, cf. Service Manual. The parameters for exposures can be adapted at any time to the examination situation and patient.

**Note:** Depending on equipment:  
If workplaces (devices) are programmed in the automatic anatomic program control, which cannot be selected, the error message "Device not ready (CAN)" appears. This can be eliminated by connecting the anatomic program to an enabled device.

**Oxx: ORGAN NAME (max. 29char.)      yycmV**  
**A x: xxxkV    xxxmA    xxxms    xx    xxxFFS**

Display	Meaning	Displayed if
Oxx:	Group memory number ('O' changes to 'o' if the program changes)	APR selected
Group name	Designation of group name (29 characters)	Names defined in setup
yy	Irradiation thickness in cm (<yy or >yy is displayed for cm change with keys 34/33)	APR selected
V	Cast	if selected by key 35

### 6.9.1 Calling Saved Settings

The APR can be operated by the keys shown in Figure 6-1

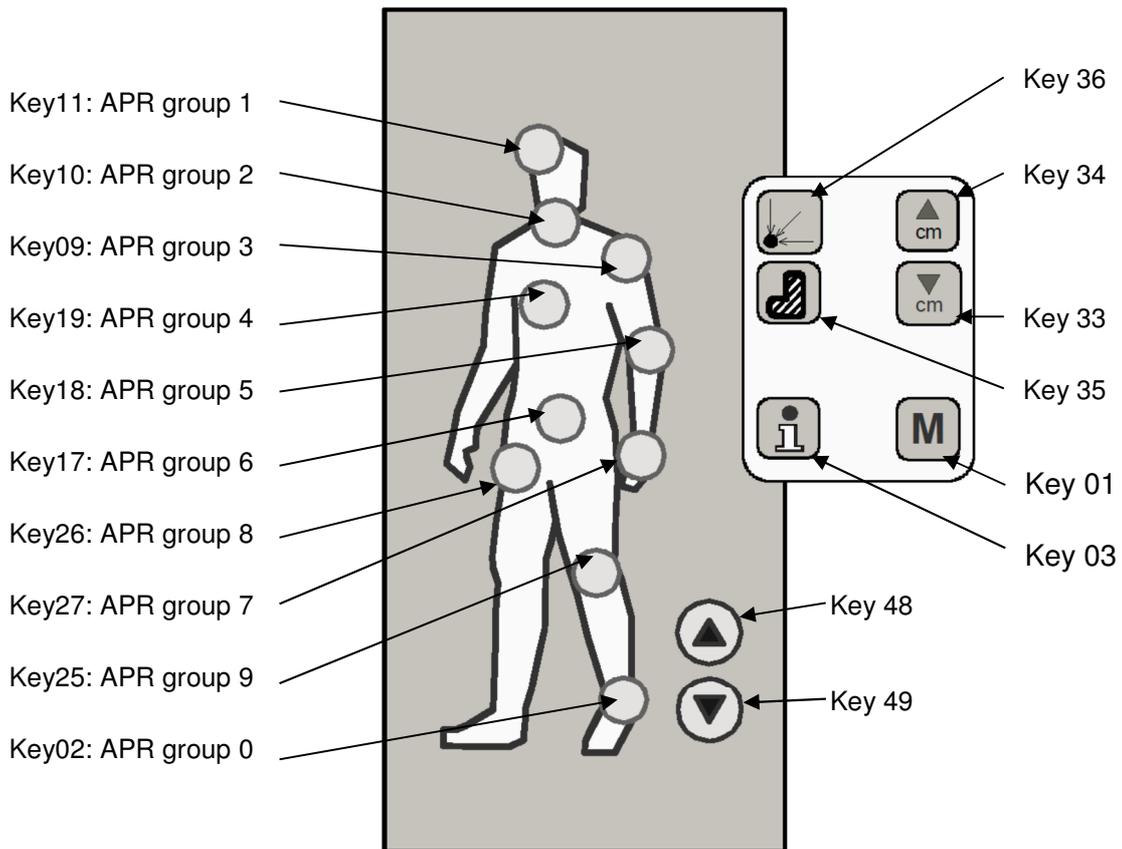


Figure 6-1: APR panel (standard key assignment)

	APR group selection	Key No. 9 – 11 17 – 19 25 – 27 and 2
--	---------------------	---

The upper line displays the designation of the anatomy in this group; the generator settings are set to the stored parameters.

	Page up/down in APR group	Key No. 48, 49
--	---------------------------	----------------

	Patient thickness adjustment.	Key No. 34, 33
--	-------------------------------	----------------

If one of these keys is pressed, ">xxcm" or "<xxcm" is displayed after the anatomy name. Simultaneously the parameters kV and mAs are changed by one step per cm. The change follows one of the five region body tables listed below. During installation, it is necessary to connect one of these tables to each APR group.

The adjustment range of cm is  $\pm 10$  cm. Within this  $\pm 10$  cm, the kV and mAs increments are changed as described in Table 6-6. Outside of  $\pm 10$  cm other steps are used. If the parameters are outside of the limits for the tube or generator, they cannot be set.

If the stored values for the exposure parameters are already close to the generator limits, it may not be possible to fully utilize this range.

	Adaptation of parameters if cast is present.	Key No. 35
--	--	------------

If this key is pressed, the type of cast present appears on the display after the organ name. Pressing this key a number of times scrolls through the settings similarly to the selection of the exposure technique.

Display	Meaning
No display	Cast not present
T	Half shelf, dry
N	Half shelf, wet
°V	Full cast, dry
K	Plastic half shelf

Table 6-5: Explanation of display for correction if cast is present

Here, the parameter kV is increased by the number of kV points defined for the various types of casts during installation.

	Reset manually changed exposure parameters	Key No. 36
--	--	------------

Region body table (Table 1-5):

Table 1	Change of	
	cm	kV mAs
+10	+1	
+9		+1
+8	+1	
+7		+1
+6	+1	
+5		+1
+4	+1	
+3		+1
+2	+1	
+1		+1
0		
-1		-1
-2	-1	
-3		-1
-4	-1	
-5		-1
-6	-1	
-7		-1
-8	-1	
-9		-1
-10	-1	

Table 2	Change of	
	cm	kV mAs
+10		+1
+9	+1	
+8		+1
+7		+1
+6	+1	
+5		+1
+4		+1
+3	+1	
+2		+1
+1		+1
0		
-1		-1
-2		-1
-3	-1	
-4		-1
-5		-1
-6	-1	
-7		-1
-8		-1
-9	-1	
-10		-1

Table 3	Change of	
	cm	kV mAs
+10		+1
+9		+1
+8	+1	
+7		+1
+6		+1
+5		+1
+4	+1	
+3		+1
+2		+1
+1		+1
0		
-1		-1
-2		-1
-3		-1
-4	-1	
-5		-1
-6		-1
-7		-1
-8	-1	
-9		-1
-10		-1

Table 4	Change of	
	cm	kV mAs
+10		+1
+9	+1	
+8	+1	
+7		+1
+6	+1	
+5	+1	
+4		+1
+3	+1	
+2	+1	
+1		+1
0		
-1		-1
-2	-1	
-3	-1	
-4		-1
-5	-1	
-6	-1	
-7		-1
-8	-1	
-9	-1	
-10		-1

Table 5	Change of	
	cm	kV mAs
+10	+1	
+9		+0.5
+8		+0.5
+7		+0.5
+6		+0.5
+5	+1	
+4		+0.5
+3		+0.5
+2		+0.5
+1		+0.5
0		
-1		+0.5
-2		+0.5
-3		+0.5
-4		+0.5
-5	+1	
-6		+0.5
-7		+0.5
-8		+0.5
-9		+0.5
-10	+1	

Table 6-6: Tables for cm correction

## 6.9.2 Saving Changed Parameters

First it is necessary to select a group and then the anatomy, for which the new exposure parameters are to be saved.

The new parameters can then be set. Pressing the „M“ key twice saves them.

The following parameters are saved in an APR memory:

Parameter	Key setting
Selected device	32/39/23/24/38/37
Darkness correction	13/16
Focal spot	14/15
Exposure technique	6
Object cm	34/33
Film-screen system	8/5
Measuring fields	4/12/20
kV exposure	31/40
mAs exposure	30/22
mA exposure	30/22
ms exposure	29/21
Tube power	50/51

Table 6-7: Parameters stored for automatic APR

	Group selection (regions)	Key No. 9 – 11 17 – 19 25 – 27 and 2
	Scroll up/down in group until desired anatomy is displayed	Key No. 48, 49
	Changing exposure parameters	
	Save Key: Pres „M“ key Save for approx. 2 sec. to save	Key No. 1
	Press key again within 2 sec. to save parameters	Key No. 1

The anatomical names, the sequence of names and the number of names in a group can be changed only in the generator service mode. In such cases, please contact your Service Partner.

A table of examples with settings for the APR is given below. This table contains **recommendations only!** The stored data can be changed at any time depending on film/digital detector used. The programmed values may deviate from the values in this list. In case of a change of the values by the operator / Service Partner, an empty table for changed APR memory settings is provided in the appendix of this document.

The operator shall make a printout of the current APR settings and make sure that this list is visible for the operator during operation.

No.	description	Technique	kV	mAs	mA	ms	Focus	film	AEC field	device
00	Warm up	3	70		100	100	large		/	0
01	Ankle a.p.	2	55	10			small	400	/	0
02	Ankle lateral	2	53	10			small	400	/	0
03	Hell bone axial	2	55	6.2			small	400	/	0
04	Heel bone lateral	2	52	8.0			small	400	/	0
05	Metatarsus d.pl.	2	50	6.2			small	400	/	0
06	Metatarsus oblique	2	50	6.2			small	400	/	0
07	Foot lateral	2	55	8.0			small	400	/	0
08	Forefoot	2	48	6.2			small	400	/	0
09	Toes a.p./oblique	2	46	5.0			small	400	/	0
10	Skull survey p.a./a.p.	1	77				small	400	M	2
11	Skull oblique	1	73				small	400	M	2
12	Skull axial	1	85				small	400	M	2
13	Os petrosa sagittal	1	77				small	400	M	2
14	Os petrosa Stenvers	1	77				small	400	M	2
15	Optical foramen Rhese	1	73				small	400	M	2
16	Sinuses p.a.	1	77				small	400	M	2
17	Nasal bone lateral	2	44	1.6			small	400	/	0
18	Mandible lateral	2	63	10			small	400	/	0
19										
20	Cervical vertebrae 1-4 ap Dens	1	66				large	400	M	2
21	Cervical vertebrae 4-7 a.p.	1	70				large	400	M	2
22	Cervical spine lateral	1	73				large	400	M	2
23	Cervical spine oblique	1	73				large	400	M	2
24	Thoracic spine a.p.	1	77				large	400	M	2
25	Thoracic spine lateral	1	81				large	400	M	2
26	Thoracic spine oblique	3	81		16	3200	large	400	M	1
27	Oesophagus oblique	1	90				large	400	M	2
28										
29										
30	Shoulder joint a.p.	1	66				large	400	M	2
31	Shoulder joint axial	1	66				large	400	M	2
32	Scapula p.a.	1	68				large	400	M	2

No.	description	Technique	kV	mAs	mA	ms	Focus	film	AEC field	device
33	Scapula lateral	1	73				large	400	M	2
34	Shoulder transthorakal	1	90				large	400	M	2
35	Shoulder no shutter	2	66	6.2			large	400	/	0
36	clavicle tangential	1	66				large	400	M	2
37										
38										
39										
40	1.-7. Rib p.a.	1	70				large	400	M	2
41	8.-12. Rib p.a.	1	73				large	400	M	2
42	Sternum p.a.	3	77		10	3200	large	400	M	2
43	Sternum lateral	1	85				large	400	M	2
44	Sternum lat. no shutter	2	85	20,			large	400	/	0
45	Lungs p.a.	1	125				small	400	L+R	2
46	Lungs lateral	1	125				small	400	M	2
47	Lungs a.p. with gridcassette	2	125	2.5			small	400	/	0
48	Lungs a.p. bed	2	85	3.2			small	400	/	0
49	Lungs lateral (child up to 7)	2	70	1.6			small	400	/	0
50	Upper arm a.p.	2	66	5.0			small	400	/	0
51	Elbow v.d.	2	55	5.0			small	400	/	0
52	Elbow lateral	2	55	6.2			small	400	/	0
53	Forearm v.d.	2	52	3.2			small	400	/	0
54	Forearm lateral	2	52	4.0			small	400	/	0
55										
56										
57	Constance 70kV bucky tab. auto	1	70				large	400	M	1
58	Constance 70kV bucky tab. man.	2	70	32			large	400	/	1
59	Constance 100kV wall stand aut	1	100				small	400	M	2
60	Lumbar vertebrae 1-4 a.p.	1	77				large	400	M	2
61	Lumbar vertebrae 1-4 lateral	1	90				large	400	M	2
62	Lumbar vertebrae 1-4 oblique	1	81				large	400	M	2
63	Childs lumbar vertebrae a.p.	1	72				large	400	M	2
64	Childs lumbar vertebrae lat.	1	80				large	400	M	2
65	Spine panorama	2	77	160			large	400	/	0
66	Spine function	2	77	160			large	400	/	0
67	Abdomen survey horizontal	1	85				large	400	L+R	1
68	Abdomen survey vertical	1	87				large	400	L+R	2
69	Abdomen survey lat. Position	1	90				large	400	M	1
70	Wrist d.v.	2	48	8.0			small	400	/	0
71	Wrist lateral	2	48	10,			small	400	/	0
72	Wrist d.v. plaster	2	52	13,			small	400	/	0
73	Wrist lateral plaster	2	52	16,			small	400	/	0
74	Hand d.v.	2	46	6.2			small	400	/	0



**Operating  
Instructions  
X-ray Generator  
Provario HF**

**Exclusively for**



**06220028-EN\_D**  
Page 52

No.	description	Technique	kV	mAs	mA	ms	Focus	film	AEC field	device
75	Hand lateral/oblique	2	48	8.0			small		/	0
76	Finger lateral/oblique	2	46	6.2			small	400	/	0
77	Finger baby	2	43	3.2			small		/	0
78										
79										
80	Hip a.p., axial	1	77				large		M	1
81	Pelvis	1	77				large		L+R	2
82	Sacrum, coccyx a.p.	1	77				large		M	2
83	Sacrum, coccyx lateral	1	90				large		M	2
84	Urinary bladder a.p.	1	81				large		M	2
85	Urinary bladder axial	1	85				large		M	2
86										
87										
88										
89										
90	Femur upper ap	1	73				large		M	2
91	Femur lower se	1	73				large		M	2
92	Knee a.p.	1	66				large		M	2
93	Knee lateral	1	66				large		M	2
94	Knee-joint	1	63				large		M	2
95	Patella p.a.	1	65				large		M	2
96	Patella axial	1	63				large		M	2
97	Lower leg a.p.	1	57				large		M	1
98	Lower leg lateral	1	57				large		M	1
99	Leg panorama	2	77	63			large		/	0

Table 6-8: Recommendation for APR memory settings

## 7 Warning Signals and Error Messages

### 7.1 Acoustic Warning Signals

Particular states are indicated to the user by a built-in buzzer.

- Preparation can be indicated by a slow sequence of tones (must be activated in generator service mode).
- There is a 500 msec tone at the end of the X-ray exposure. Errors are indicated by a rapid series of tones.

### 7.2 Visual Signals

The following visual signals are used:

- When X-ray is ON, the X-ray exposure radiation indicator on the control panel illuminates continuously.
- In the event of an incorrect exposure, the yellow LED in key No. 28 illuminates.
- If key 47 'High dose' is activated, the yellow LED illuminates.
- The other keys have green LEDs, which indicate the activated state.

### 7.3 Error/Warning Messages

Please obey the instructions/actions for each specific error. If actions are not taken by the operator, additional damage can be caused to the generator.

#### **CAUTION**

***Even if the generator is switched off, parts on the inside of the generator cabinet and connected controls are powered! Only allow trained service personnel to open the generator cabinet or housing of connected controls! Improper handling may cause lethal hazards!***



<b>Error No.:</b>	<b>Display:</b>	<b>Explanation:</b>	<b>*</b>
1	tube kV max	Tube voltage too high (>166 kV/132 kV)	2
2	control A max	Load current too high (> 250 A)	2
3	tube mA max	Tube current too high (> 900 A)	2
4	tube +-kV diff	Tube voltage difference between +URist and -URist > 15kV	2
5	tube +-mA diff	Tube current difference between +IRist and -IRist > 100mA	2

<b>Error No.:</b>	<b>Display:</b>	<b>Explanation:</b>	<b>*</b>
6	ROM test	ROM test checksum error	1
7	RAM test	RAM test error	1
8	unknown	unknown error	2
9	no Tube kV	Tube voltage < 10kV after 1ms or < 50% after 30ms	2
10	tube kV too high	Tube voltage > rated voltage + 25%	2
11	inverter overload	Converter overload ( > 150000WS)	2
12	send timeout	Serial interface transmit timeout	2
13	E <sup>2</sup> Prom checksum	E <sup>2</sup> PROM checksum error	1
14	watchdog	Watchdog error	2
15	receive timeout	Serial interface receipt timeout	2
16	E <sup>2</sup> Prom wait timeout	E <sup>2</sup> PROM access timeout	1
17	filament system	Heater fault	2
18	DAP system	Area dose measuring system self test error	1
19	filament parameter	Deviating heating parameters in E <sup>2</sup> PROM	1
20	+/-15V low	+/-15V outside tolerance	2
21	+5V low	+5V outside tolerance	2
22	key is on :	Key on control panel has been pressed during switch-on	2
23	XRAY key is on :	Exposure key has been pressed during switch-on	2
24	mAs max	Current time product in mAs has reached its limit	3
25	exposure too short	Not used	2
26	generator not ready	Tube switchover error	2
27	service	Service interval for maintenance	1
28	no Tube mA	Tube current < 50% after 30 ms	2
29	tube > 70°C	Tube housing temperature > 70°C	2/3
30	to save data push 'M'	-Warning to save APR technique	
31	'NOT' signal	'EMERGENCY' safety signal active	2
32	door open	Door contact open	3
33	exp. time > 6.3s	Exposure time > 6.3 sec	3
34	exp. time > 3.2s	Exposure time > 3.2 sec (automatic exposure control)	2/3
35	exp. time < 2ms	Exposure time < 2 msec (automatic exposure control)	2/3
36	AEC exposure break	Exposure aborted by operator (automatic exposure control)	3
37	dose too low after 50ms	Dose too small after 50 ms (automatic exposure control)	3

<b>Error No.:</b>	<b>Display:</b>	<b>Explanation:</b>	<b>*</b>
38	pulse delay too long	Exposure pause between 2 pulses > 2 sec (automatic exposure control)	2
39	exp. prepare timeout	Exposure preparation timeout	3
40	device ready timeout	Device ready timeout	2
41	starter timeout	Normal speed starter timeout	2
42	grid is on	Grid active in idle state	2
43	RTC checksum, Batt. low	RTC (real time clock) error, RTC battery discharged	1
44	starter system	Normal speed starter fault current	2
45	no main current	Load current < 4A after 0.5 ms	2
46	exposure stopped by user	Exposure aborted by operator	3
47	controller - E <sup>2</sup> prom verify	Cpu-E <sup>2</sup> Prom alignment	1
48	Wrong tube position	Tube position sensor	2/3
49	Tube mA too high	Tube current outside tolerance	2
50	Device not ready (CAN)	Device or device interface not ready	2
51	No BUS-Signal from AEC	No stop signal from automatic exposure control	1
52	FLXIS not ready	No communication to TV chain	1
53	! Anode heat content >100% !	Max Tube heat storage capacity, cool down the tube	2
55	Temperature Error	The internal temperature of the generator has reached its limit	3
56	Dose rate too high	The dose rate applied to the patient is too high	3
61	Receiver overflow	Serial interface receive buffer overflow	2
62	Transmitter overflow	Serial interface transmit buffer overflow	2
63	Transfer system	Serial interface controller error	2
64	CAN system	CAN bus transfer error	2
65	BUS system	CAN bus transfer is highly interfered or interrupted	1
67	SCB transfer timeout	Storz bus system timeout	2
68	SCB false version	Storz bus version error	1
90	HSS2 fault		1
91	HSS2 Low Voltage Power Supply	Low voltage powers supply failure	1
92	HSS2 output short or heavy load	Possible short on wires or tube	1
93	HSS2 phase over current	Heavy load on HSS2 output	1
94	HSS2 phase under current	Loss wire in HSS2	1
95	HSS2 DC bus under voltage	Possible low AC line	1
96	HSS2 excessive run timeout	Turn HSS2 off	2
97	HSS2 configuration error	Error is settings of HSS2	1

<b>Error No.:</b>	<b>Display:</b>	<b>Explanation:</b>	<b>*</b>
	* Action taken by operator 1* = Notify service 2* = Notify service on frequent occurrence 3* = Warning, can be eliminated by operator		

Table 7-1: List of error messages

## 8 Maintenance /Care

### 8.1 X-Ray Tube Seasoning

The X-Ray tube needs to be warmed-up daily in order to extend the life of the tube and prevent tube arcs. (Especially when the X-Ray tube was not used for a long period) The seasoning procedure shall be done upon turning on the generator for the first time.

Follow X-Ray tube manufacturer's recommended seasoning procedure.

If X-ray tube manufacturer's seasoning procedure is not available, then use the following procedure:

Set Provario HF Generator: large focal spot, 200 mA, 40mAs.

Take 8 exposures starting at 50kV and increment the kV in steps of 10KV up to 120kV (Exposure every 30 seconds, otherwise tube may arc)

### 8.2 Cleaning

**Make sure the X-ray generator is OFF before cleaning the enclosures.**

Never use abrasive cleaning agents, organic solvents or cleaning agents containing solvent.

Clean the generator with a moist rag.

Ensure that liquids do not get into the generator. This can cause short circuits. Do not spray X-ray generator with liquids.

### 8.3 Disinfection

The method used for disinfection must satisfy the legal regulations and guidelines (disinfection, explosion protection).

#### **NOTE:**

**Make sure the X-ray generator is OFF before cleaning the enclosures.**

**If you use a disinfectant, which can form explosive gas mixtures, switch the generator back on only after these have been evaporated.**

**If any liquid was spilled on the operating console do not turn on the generator until the liquid dried out.**

Disinfect generator and connected control panels only by wiping.

Never use disinfection sprays, because the spray could get into the inside of the equipment.

If room disinfection is necessary by means of fumigation, ensure that the generator is cooled down and covered carefully with foil.

## 8.4 Maintenance

### NOTE:

**Always perform legally prescribed tests at the specified intervals.**

Qualified service personnel should accomplish a safety test at least once a year. The following maintenance and service work should be performed.

- Visual check for recognizable damage, defects or wear:  
Replace damaged or worn parts.
- Check monitoring devices:  
Monitoring timer for exposure with and without automatic exposure control
- Proper function of display, signaling and warning devices:  
Display, radiation indicator, acoustic signals
- Check consistency and linearity of radiation:  
If deviations are present, check tube alignment
- Check image quality
- Check masking of radiation field (collimator)
- Clean high-voltage plug on tube and transformer and plug back in using new insulation according to the recommendation of the high voltage cable supplier.
- Electrical connection for power supply
- Terminals on plugs and cables
- Clean cabinet ventilation screens
- Perform the test annually according service manual chapter 8.2 and if needed calibrate the generator based on instructions in service manual.
- Log the test results properly.

## 9 Control Panel for Provario HF

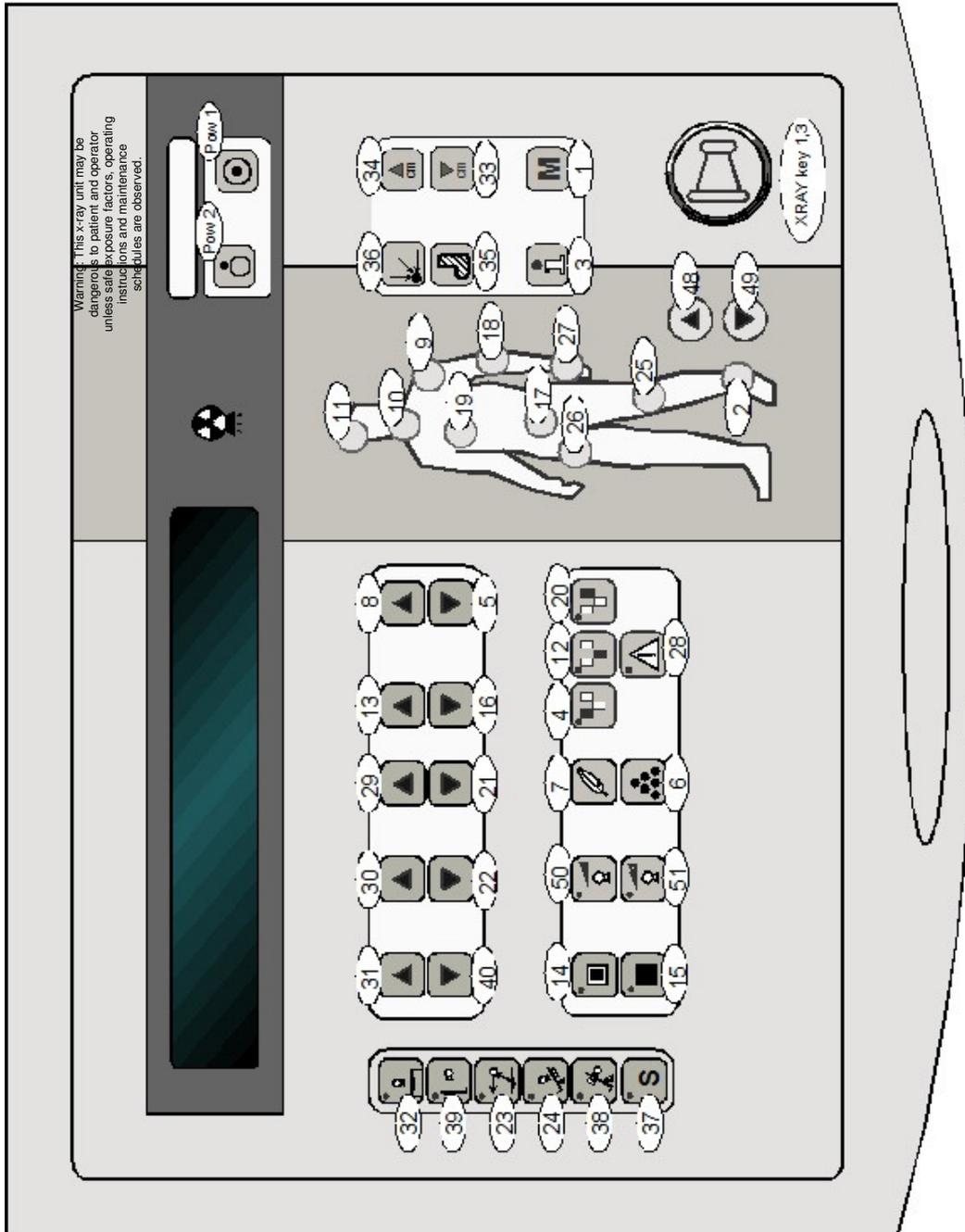


Figure 9-1: Provario HF control panel

The assignments for the keys 32, 39, 23, 24, 38 and 37 are variable, depending on the equipment



Hand switch

## 10 Digital Interface Box for Provario HF (optional)

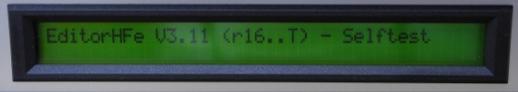
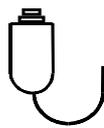
	<p>Stand by state</p> <p>The red LEDs inside of the OFF button show the standby state when the generator is switched off and the mains power is on.</p>
	<p>Wait state</p> <p>After switching on with the ON button, the green LEDs inside of the ON button show the "Wait state" of the Interface box. The message "Generator 1 ready" is displayed. The generator is switched on but is inactive. A software command from the remote software will start the generator.</p>
	<p>Inactive wait state</p>
	<p>Selftest after the start command is send</p>
	<p>Active state</p> <p>The generator is in active state after selftest and shows the exposure parameters.</p>
	<p>Error state</p> <p>The error number and the error text is shown in the display if an error occurs</p>

Figure 10-1: Interface Box Provario HF



Hand switch (option)

## 11 Certified Components and Accessory to be installed by the operator

Following components and accessory is released to be installed by the user on the Generator Provario HF. Please note that a system assembly and set-up is only allowed by an authorized service technician.

Accessory parts that can be replaced by the operator:

Nr	Manufacturer	Type	Spellman Part no.
1	Hand switch, OMRON	CU2	61000300
2	Foot switch, ASA- Schalttechnik GmbH	FS2 SU1/SU1 U	05220323
3	Standard control Panel		05220620
4	Fluoroscopy Control Panel		05220621
5	Control Panel TV Chain		05220623
6	Touch Panel		05220635
7	Interface Box		06000600
8	Mini Console		408267-001

## 12 Appendix

No.	description	Technique	kV	mAs	mA	ms	Focus	film	AEC field	device
00										
01										
02										
03										
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
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31										
32										
33										
34										
35										
36										
37										
38										
39										



**Operating  
Instructions  
X-ray Generator  
Provario HF**

**Exclusively for**



**06220028-EN\_D**

Page 63

No.	description	Technique	kV	mAs	mA	ms	Focus	film	AEC field	device
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
51										
52										
53										
54										
55										
56										
57										
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72										
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74										
75										
76										
77										
78										
79										
80										
81										
82										
83										



**Operating  
Instructions  
X-ray Generator  
Provario HF**

**Exclusively for**



**06220028-EN\_D**

Page 64

No.	description	Technique	kV	mAs	mA	ms	Focus	film	AEC field	device
84										
85										
86										
87										
88										
89										
90										
91										
92										
93										
94										
95										
96										
97										
98										
99										