



ODYSSEY HF Series™ X-ray Generators

Operator's Manual



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Revision History

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Chapter

1

SAFETY NOTICES



Chapter 1 Safety Notices

GENERAL SAFETY INFORMATION

Quantum products are designed to meet stringent safety standards. All medical electrical equipment requires proper installation, operation, and maintenance (particularly with regard to safety).

It is vital that the user read, understand, note, and where applicable, strictly observe all Warnings, Cautions, Notes and Safety markings within this document and on the equipment, and that the user strictly follow all safety directions in this manual to help ensure the safety of users and patients.

Every reasonable precaution has been taken during manufacture to safeguard the health and safety of persons who will operate this equipment. The following precautions must be observed at all times.

WARNINGS, CAUTIONS, NOTES

The following samples show how warnings, cautions, and notes appear in this document. The text explains their intended use.



WARNING Indicates injury or death is possible if the instructions are not obeyed. Instructs users to refer to documentation if displayed without warning text.



CAUTION Indicates that damage to equipment is possible if the instructions are not obeyed.



NOTE Notes provide advice and highlight unusual points. A note is not intended as an instruction.

The purpose of safety icons, such as those shown below, is to indicate at a glance the type of caution, warning or danger.



WARNING Ionizing radiation: indicates the possibility of increased levels of radiation.



WARNING Dangerous voltage: indicates the presence of high voltage.



WARNING Warning, hot surface.

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WARNING

Quantum Medical Imaging, LLC disclaims all responsibility from any injury resulting from improper application of this equipment.

This equipment is sold to be used exclusively under the prescribed direction of a person who is licensed by law to operate equipment of this nature. This equipment must be used in accordance with all safety procedures described in this manual and must not be used for purposes other than those described herein. In the United States, Federal law restricts this device to sale, distribution, and use by or on order of a licensed physician.

Quantum Medical Imaging, LLC cannot assume responsibility for any malfunctioning of this equipment resulting from improper operation, maintenance, or repair, or from damage or modification of its components.

Failure to observe these warnings may cause serious injuries.



WARNING

X-rays are hazardous to both patient and operator unless established safe exposure factors and operating instructions are observed.

Only qualified and authorized personnel shall operate this system. In this context, qualified means those legally permitted to operate this equipment in the jurisdiction in which the equipment is being used, and authorized means those authorized by the authority controlling the use of the equipment. Full use must be made of all radiation protection features, devices, systems, procedures and accessories.

It is important that everyone having anything to do with x-radiation be properly trained and fully acquainted with the recommendations of the National Council on Radiation Protection and Measurements as published in NCRP Reports available from NCRP Publications, 7910 Woodmont Avenue, Suite 800, Bethesda, Maryland 20814-3095 (www.ncrp.com), and of the International Commission on Radiological Protection (www.icrp.org), and take adequate steps to protect against injury.



WARNING

X-ray equipment may cause injury if used improperly. The instructions contained in this manual must be read and followed when operating this unit. Personal radiation monitoring and protective devices are available. You are urged to use them to protect against unnecessary X-ray exposure.

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REGULATORY COMPLIANCE

This certified Quantum Medical Imaging, LLC medical device has been designed, manufactured, and calibrated to comply with governing Federal Regulations 21 CFR Subchapter J and the performance standards attendant thereto. Upon installation, all certified products require the filing of Form FD-2579 "Report of Assembly of a Diagnostic X-ray System" by the assembler (i.e., the installer) with the appropriate agencies; the "Installation Quality Assurance Checklist" must also be completed and properly distributed upon installation. A copy of each form (pink copy) is provided to the user. The installation report is completed by the installer and returned to Quantum Medical Imaging, LLC.

Those responsible for the planning of X-ray equipment installations must be thoroughly familiar and comply completely with NCRP Report No. 49, "Structural Shielding Design and Evaluation for Medical Use of X-rays and Gamma Rays of Energies up to 10 MeV", as revised or replaced in the future. Those authorized to operate, test, participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the currently established safe exposure factors and procedures described in publications such as Subchapter J of Title 21 of the Code of Federal Regulations, "Diagnostic X-ray Systems and Their Major Components," and NCRP Report No. 102, "Medical X-ray, Electron Beam and Gamma Ray Protection for Energies Up to 50 MeV—Equipment Design and Use" as revised or replaced in the future.

The ODYSSEY™ High-Frequency (HF) Series X-ray Generator, hereinafter referred to as the HF Series X-ray Generator, must only be used in rooms that comply with all applicable laws or regulations that have the force of law, concerning electrical safety for this type of equipment.

Scheduled maintenance is essential to the assurance of continued integrity of this equipment with respect to regulatory compliance. The continuance of certified performance to the regulatory standard is incumbent upon the user's diligent conformance to recommended maintenance instructions. Do not use this equipment until you are sure that the planned maintenance program is up to date.

CLASSIFICATION











This product has been classified as Class I by Underwriters Laboratories, Inc. Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or with nitrous oxide. Protection against Harmful Ingress of Water (Ordinary), enclosed equipment without protection against ingress of liquids.



MEDICAL ELECTRICAL EQUIPMENT
WITH RESPECT TO ELECTRIC SHOCK, FIRE,
MECHANICAL HAZARDS ONLY
IN ACCORDANCE WITH UL 60601-1 AND
CAN/CSA C22.2 NO. 601.1
98UA

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The following symbols may be used for marking on this equipment or equipment documentation:

	Earth (ground)		Dangerous Voltage
	Protective Earth (ground)		Attention, consult accompanying documents
	Power ON (part of equipment)		Power OFF (part of equipment)
	Stand By		Non-ionizing radiation
	Ionizing radiation		Alternating current

COMPATIBILITY

The equipment described in this manual must only be used in combination with other equipment or components if these are expressly recognized by Quantum Medical Imaging, LLC as compatible.

INTENDED OPERATOR

The HF Series X-ray Generator is intended to be installed, used and operated only in accordance with the safety procedures given within this manual for the purpose for which it was designed. Before attempting to work with this equipment, read, understand, note and strictly observe all warnings, cautions and safety markings on the equipment.

Users include those persons who actually handle the equipment and those who have authority over the equipment.

TRAINING

Users of HF Series X-ray Generator shall have received adequate training on its safe and effective use before attempting to work with the equipment. Training requirements may vary from country to country. The User shall make sure that training is received in accordance with local laws or regulations that have the force of law.

Chapter 1 Safety Notices

ACCOMPANYING DOCUMENTATION

The documentation consists of a User manual (this document) and related documentation:

- Service Manual P/N DC30-011: Contains technical and service documentation for this product, including installation and configuration instructions to be performed by qualified persons

The documentation shall be kept with the system for easy reference.

APPLICABLE STANDARDS

HF Series X-ray Generators comply with the following regulatory standards:

- FDA Center for Devices and Radiological Health (CDRH) - Title 21 CFR Subchapter J
- EN 60601-1: 1990 + A1:1993 + A2:1995 + A13:1996
- IEC 60601-2-7: 1998(E)
- CAN/CSA-C22.2 No. 601.1-M90, 2005 (Medical Electrical Equipment, part 1: General Requirements for Safety)
- UL 60601-1, 1st Edition, 2006-04-26 (Medical Electrical Equipment, part 1: General Requirements for Safety)
- IEC 60601-1 Medical electrical equipment, Part 1: General requirements for safety
- IEC 60601-1-2: 2007
- EC Directive 93/42/EEC for Medical Devices

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Chapter 1 Safety Notices

DISPOSAL OF BATTERIES AND ACCUMULATORS (DIRECTIVE 2006/66/EC)



In accordance with the European Directive 2006/66/EC, batteries and accumulators are labeled to indicate that they are to be collected separately and recycled at end of life. The label on the battery may also include a chemical symbol for the metal concerned in the battery (Pb for lead, Hg for mercury and Cd for cadmium). Users of batteries and accumulators must not dispose of batteries and accumulators as unsorted municipal waste, but use the collection framework available to customers for the return, recycling, and treatment of batteries and accumulators. Participation is important to minimize any potential effects of batteries and accumulators on the environment and human health due to the potential presence of hazardous substances.

ELECTROMAGNETIC COMPATIBILITY (EN 60601-1-2:2007/IEC 60601-1-2:2007)

The HF Series X-ray Generator is intended for use in the electromagnetic environment specified below. As such, the generator must be installed and put into service according to the information provided in the accompanying Service Manual.

The HF Series X-ray Generator complies with the requirements of applicable EMC standards. Portable and mobile RF communications equipment can affect medical electrical equipment. It is therefore recommended that the operation of equipment of this type, such as mobile telephones, cordless microphones and other similar mobile radio equipment, be restricted from the vicinity of this device.

Use of accessories, transducers and cables, other than those specified in the accompanying documents, may result in increased emissions or decreased immunity of the equipment.

Guidance and manufacturer's declaration - electromagnetic emissions		
<i>The HF Series X-ray Generator is intended for use in the electromagnetic environment specified below. The customer or the user of the HF Series X-ray Generator should assure that it is used in such an environment.</i>		
Emissions test	Compliance	Electromagnetic environment - guidance
RF emissions CISPR 11	Group 1	The HF Series X-ray Generator uses RF energy only for their internal functions. Therefore, the RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.

Chapter 1 Safety Notices

Guidance and manufacturer's declaration - electromagnetic emissions		
RF emissions CISPR 11	Class A	The HF Series X-ray Generator is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Chapter 1 Safety Notices


Guidance and manufacturer's declaration - electromagnetic immunity

The HF Series X-ray Generator is intended for use in the electromagnetic environment specified below. The customer or the user of the HF Series X-ray Generator 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	±6 kV contact ±8 kV air	±6 kV contact ±8 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 differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruption, and voltage variations on power supply input lines IEC 60601-4-11	< 5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) < 5% U_T (> 95% dip in U_T) for 5 s	< 5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) < 5% U_T (> 95% dip in U_T) for 5 s	Mains power quality should be that of a typical commercial or hospital environment. If the user of the HF Series X-ray Generator requires continued operation during power mains interruptions, it is recommended that the HF Series X-ray Generator be powered from an uninterruptible power supply or battery.
Power frequency (50/60 Hz) IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment

NOTE: U_T is the A.C. mains voltage prior to application of the test level.

Chapter 1 Safety Notices

Guidance and manufacturer's declaration - electromagnetic immunity			
<p><i>The HF Series X-ray Generator is intended for use in the electromagnetic environment specified below. The customer or the user of the HF Series of X-ray generators (including TechVision option) should assure that it is used in such an environment.</i></p>			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
<p>Conducted RF IEC 61000-4-6</p> <p>Radiated RF IEC 61000-4-3</p>	<p>3 Vrms 150 kHz to 80MHz</p> <p>3 V/m 80 MHz to 2,5 GHz</p>	<p>3 Vrms</p> <p>3 V/m</p>	<p>Portable and mobile RF communications equipment should be used no closer to any part of the HF Series X-ray Generator, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</p> <p>Recommended separation distance</p> $d = 1,2\sqrt{P}$ $d = 1,2\sqrt{P} \quad , \quad 80 \text{ MHz to } 800 \text{ MHz}$ $d = 2,3\sqrt{P} \quad , \quad 800 \text{ MHz to } 2,5 \text{ GHz}$ <p>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).</p> <p>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:</p> <div style="text-align: center;">  </div>

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Guidance and manufacturer's declaration - electromagnetic immunity

NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2 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 HF Series X-ray Generator is used exceeds the applicable RF compliance level above, the HF Series of X-ray generators (including TechVision option) should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the HF Series X-ray Generator.

^b Over the frequency range 150 kHz to 80 kHz, field strengths should be less than 3 V/m.

Chapter 1 Safety Notices

Recommended separation distances between portable and mobile RF communications equipment and the HF Series X-ray generators (including TechVision option)

The HF Series X-ray Generator is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the HF Series X-ray Generator can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the HF Series X-ray Generator 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 $d = 1,2\sqrt{P}$	80 MHz to 800 MHz $d = 1,2\sqrt{P}$	800 MHz to 2,5 GHz $d = 2,3\sqrt{P}$
0,01	0,12	0,12	0,23
0,1	0,38	0,38	0,73
1	1,2	1,2	2,3
10	3,8	3,8	7,3
100	12	12	23

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 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Chapter 1 Safety Notices

ABBREVIATION DEFINITION

The following abbreviations and acronyms may be found in this document. Their definition is explained below.

ADC	Analog-to-digital converter
AEC	Automatic Exposure Control
APR	Anatomical Programmed Region
cm	Centimeters (thickness)
HF	High Frequency
HSS	High-speed starter
kVp	Tube voltage (kilovolts peak)
LCD	Liquid crystal display
m	meters
mA	Tube current (milliampere)
mAs	Time-current product
MHz	MegaHertz
OCP	Operator Control Panel
RF	Radiofrequency
SE	Stored Energy
sec	Expose on time (seconds)
W	Watts

Chapter

2

GENERAL INFORMATION



Chapter 2 General Information

OVERVIEW



NOTE: The user should read this manual in its entirety prior to using this equipment. It should be kept in a location near the equipment and be readily accessible to those who operate it.

This document is intended to assist users in the safe and effective operation of the equipment described herein. Pay special attention to all the information described in the Safety section (refer to Chapter 1, SAFETY NOTICES).

This manual is written for trained users of the ODYSSEY™ High-Frequency (HF) Series X-ray Generator, hereinafter referred to as the HF Series X-ray Generator, and for authorized field service personnel. Quantum Medical Imaging, LLC assumes no liability for use of this document if any unauthorized changes to the content or format have been made.

The HF Series X-ray Generator, includes the following models:

- Model QG-32: 32 kW, 208 - 260 VAC single-phase input configuration
- Model QG-32-SE: 32 kW, "STORED ENERGY" 115/230 VAC single-phase input configuration
- Model QG-32-2: 32 kW, 208 - 240 VAC three-phase input configuration
- Model QG-32-3: 32 kW, 380 - 480 VAC three-phase input configuration
- Model QG-32-5: 32 kW, 380 - 480 VAC single-phase input configuration
- Model QG-40: 40 kW, 208 - 260 VAC single-phase input configuration
- Model QG-40-SE: 40 kW, "STORED ENERGY" 115/230 VAC single-phase input configuration
- Model QG-40-2: 40 kW, 208 - 240 VAC three-phase input configuration
- Model QG-40-3: 40 kW, 380 - 480 VAC three-phase input configuration
- Model QG-40-5: 40 kW, 380 - 480 VAC single-phase input configuration
- Model QG-50-SE: 50 kW, "STORED ENERGY" 115/230 VAC single-phase input configuration
- Model QG-50-3: 50 kW, 380 - 480 VAC three-phase input configuration
- Model QG-50-2: 50 kW, 208 - 240 VAC three-phase input configuration
- Model QG-65: 65 kW, 380 - 480 VAC three-phase input configuration
- Model QG-80: 80 kW, 380 - 480 VAC three-phase input configuration

This product is intended to be used and operated only in accordance with the safety procedures given within this manual for the purpose for which it was designed. The intended use is given below. Nothing stated in this manual reduces user's professional responsibilities for sound judgment and best practice.

Chapter 2 General Information

INTENDED USE

The HF Series X-ray Generator is a diagnostic X-ray high-voltage generator. It is intended to supply and control the electrical energy applied to a diagnostic X-ray tube for medical/veterinary radiographic examinations.

Use of the equipment for purposes other than those intended and expressly stated by the manufacturer, as well as incorrect use or operation, may relieve the manufacturer or his agent from all or some of the responsibility for resultant non-compliance, damage or injury.

KEY FEATURES

It is imperative that all safety procedures described in this manual be strictly adhered to in order to ensure the safety of both patient and user.

The significant physical and performance characteristics of the HF Series X-ray Generators are as follows:

- Ultra high-frequency (up to 120 kHz) voltage waveform for highly efficient X-ray production
- Manual, AEC (optional), and automatic (APR) modes of operation
- Anatomic Programmability (APR) - pre-defined and customized technique selection
- Wall/table/none image receptor selection
- Multi-language display capability
- Optional pedestal/wall mount control console
- Compact generator cabinet design

Chapter 2 General Information

PERFORMANCE SPECIFICATIONS

Refer to Table 2-1 for performance specifications of single-phase (non-stored energy) HF Series X-ray Generators.

Table 2-1. HF Series Single-Phase Generator Performance Specifications

	N/A	Models QG-32, QG-32-5 (Catalog No. QG-QG-3200)	Models QG-40, QG-40-5 (Catalog No. QG-4000)
Maximum kW	N/A	32	40
mA Stations; Small Focus (S) Large Focus (L)	N/A	25S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L	25S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L
mA Accuracy	N/A	5% +1mA	5% +1mA
kVp Range (kVp)	N/A	40-125	40-125
kVp increments (kVp/ step)	N/A	1.0	1.0
kV Accuracy	N/A	4%	4%
150 kVp optional	N/A	Yes	Yes
Time Range (sec.)	N/A	0.001 - 6.3	0.001 - 6.3
Time Accuracy*	N/A	1 mS +0.5%*	1 mS +0.5%*
Minimum Exposure Time (seconds)	N/A	0.001	0.001
mAs Range**	N/A	0.025-600	0.025-600
High-Speed Starter	N/A	No	No
Ripple Voltage (output)	N/A	5%	5%

* Time measured at 75% of the peak kVp waveform; For exposure times from 1.0 mS to 49 mS, time accuracy is 2% + 1 mS; for exposure times from 50 mS to 100 mS, time accuracy is 1% + 1 mS
NOTE: AEC TECHNIQUES SHOULD HAVE EXPOSURE TIMES EXCEEDING 8 MILLISECONDS.

** mAs is tube dependent; the generator may not reach maximum mAs due to tube type.

Chapter 2 General Information

Refer to Table 2-2 for performance specifications of single-phase stored energy (SE) HF Series X-ray Generators.

Table 2-2. HF Series Single-Phase Stored Energy Generator Performance Specifications

	N/A	Model QG-32-SE (Catalog No. QG-3200-SE)	Model QG-40-SE (Catalog No. QG-4000-SE)	Model QG-50-SE (Catalog No. QG-5000-SE)
Maximum kW	N/A	32	40	50
mA Stations; Small Focus (S) Large Focus (L)	N/A	25S, 50S, 75S, 150S 100L, 160L, 200L, 250L, 320L, 400L	25S, 50S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L	25S, 50S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L, 600L
mA Accuracy	N/A	5% +1mA	5% +1mA	5% +1mA
kVp Range (kVp)	N/A	40-125	40-125	40-125
kVp increments (kVp/ step)	N/A	1.0	1.0	1.0
kV Accuracy	N/A	4%	4%	4%
150 kVp optional?	N/A	No	No	No
Time Range (sec.)	N/A	0.001 - 6.3	0.001 - 6.3	0.001 - 6.3
Time Accuracy*	N/A	1 mS +0.5%*	1 mS +0.5%*	1 mS +0.5%*
Minimum Exposure Time (seconds)	N/A	0.001	0.001	0.001
mAs Range**	N/A	0.025-400	0.025-400	0.025-400
High-Speed Starter	N/A	No	No	No
Ripple Voltage (out- put)	N/A	5%	5%	5%

* Maximum exposure time is a function of kV and mAs settings and the age of the batteries; Time measured at 75% of the peak kVp waveform. For exposure times from 1.0 mS to 49 mS, time accuracy is 2% + 1 mS; for exposure times from 50 mS to 100 mS, time accuracy is 1% + 1 mS
NOTE: AEC TECHNIQUES SHOULD HAVE EXPOSURE TIMES EXCEEDING 8 MILLI-SECONDS.

** mAs is tube dependent; the generator may not reach maximum mAs due to tube type.

Chapter 2 General Information

Refer to Table 2-3 for performance specifications of three-phase HF Series X-ray Generators.

Table 2-3. HF Series Three-Phase Generator Performance Specifications

	Model QG-32-2, QG-32-3	Model QG-40-2, QG-40-3	Model QG-50, QG-50-2	Model QG-65	Model I QG-80
	Cat. No. QG-3200-2, QG-3200-3	Cat. No. QG-4000-2, QG-4000-3	Cat. No. QG-5000	Cat. No. QG-6500	Cat. No. QG-8000
Maximum kW	32	40	50	65	80
mA Stations; Small Focus (S) Large Focus (L)	25S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L	25S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L	25S, 75S, 150S 100L, 200L, 320L, 400L, 500L, 650L	25S, 75S, 150S 100L, 200L, 320L, 400L, 500L, 650L, 800	25S, 75S, 150S 100L, 200L, 320L, 400L, 500L, 650L, 800
mA Accuracy	5% +1mA	5% +1mA	5% +1mA	5% +1mA	5% +1mA
kVp Range (kVp)	40-125	40-125 (40-150 with QG-150 option)	40-125 (40-150 with QG-150 option)	40-150	40-150
kVp increments (kVp/step)	1.0	1.0	1.0	1.0	1.0
kV Accuracy	4%	4%	4%	4%	4%
150 kVp optional?	Yes	Yes	Yes	Standard	Standard
Time Range (sec.)	0.001 - 6.3	0.001 - 6.3	0.001 - 6.3	0.001 - 6.3	0.001 - 6.3
Time Accuracy*	1 mS +0.5%*	1 mS +0.5%*	1 mS +0.5%*	1 mS +0.5%*	1 mS +0.5%*
Minimum Expo- sure Time (sec.)	0.001	0.001	0.001	0.001	0.001
mAs Range**	0.025-600	0.025-600	0.025-800	0.025-800	0.025-800
High-Speed Starter***	No	Option	Option	Yes	Yes
Ripple Voltage (output)	5%	5%	5%	5%	5%

* Time measured at 75% of the peak kVp waveform; For exposure times from 1.0 mS to 49 mS, time accuracy is 2% + 1 mS; for exposure times from 50 mS to 100 mS, time accuracy is 1% + 1 mS
NOTE: AEC TECHNIQUES SHOULD HAVE EXPOSURE TIMES EXCEEDING 8 MS.

** mAs is tube dependent; the generator may not reach maximum mAs due to tube type. In AEC mode, the mAs is limited to 600.

*** High-Speed Starter Duty Cycle: are not to exceed two activations within any one minute period

Chapter 2 General Information

ELECTRIC OUTPUT DATA

Table 2-4. Electric Output Data

OUTPUT PARAMETER	MODEL (CAT. NO.)	LOADING FACTOR
Nominal X-ray tube voltage and highest X-ray tube current obtainable at that voltage	N/A	N/A
	QG-32, QG-32-2, QG-32-3, QG-32-5 (QG-3200, QG-3200-2, QG-3200-3, QG-3200-5)	125 kV, 250 mA (150 kV, 200 mA with QG-150 option)
	QG-40, QG-40-2, QG-40-3, QG-40-5 (QG-4000, QG-4000-2, QG-4000-3, QG-4000-5)	125 kV, 320 mA (150 kV, 250 mA with QG-150 option)
	N/A	N/A
	QG-32-SE (QG-3200-SE)	125 kV, 250 mA
	QG-40-SE (QG-4000-SE)	125 kV, 320 mA
	QG-50, QG-50-2 (QG-5000, QG-5000-2)	125 kV, 400 mA (150 kV, 320 mA with QG-150 option)
	QG-50-SE (QG-5000-SE)	125 kV, 400 mA
	QG-65 (QG-6500)	150 kV, 800 mA
	QG-80 (QG-8000)	150 kV, 800 mA
Maximum X-ray tube current and highest X-ray tube voltage obtainable at that current	N/A	N/A
	QG-32, QG-32-2, QG-32-3, QG-32-5 (QG-3200, QG-3200-2, QG-3200-3, QG-3200-5)	500 mA, 64 kV
	QG-40, QG-40-2, QG-40-3, QG-40-5 (QG-4000, QG-4000-2, QG-4000-3, QG-4000-5)	500 mA, 80 kV
	N/A	N/A
	QG-32-SE (QG-3200-SE)	400 mA, 80 kV
	QG-40-SE (QG-4000-SE)	500 mA, 80 kV
	QG-50, QG-50-2 (QG-5000-2)	650 mA, 76 kV
	QG-50-SE (QG-5000-SE)	600 mA, 83 kV
	QG-65 (QG-6500)	800 mA, 81 kV
QG-80 (QG-8000)	800 mA, 100 kV	

Chapter 2 General Information

Table 2-4. Electric Output Data

OUTPUT PARAMETER	MODEL (CAT. NO.)	LOADING FACTOR
Combination of X-ray tube current and X-ray tube voltage resulting in highest output power (Note: All mA stations below those listed)	N/A	N/A
	QG-32, QG-32-2, QG-32-3, QG-32-5 (QG-3200, QG-3200-2, QG-3200-3, QG-3200-5)	320 mA, 100 kV 400 mA, 80 kV 500 mA, 64 kV
	QG-40, QG-40-2, QG-40-3, QG-40-5 (QG-4000, QG-4000-2, QG-4000-3, QG-4000-5)	400 mA, 100 kV 500 mA, 80 kV
	N/A	N/A
	QG-32-SE (QG-3200-SE)	320 mA, 100 kV 400 mA, 80 kV
	QG-40-SE (QG-4000-SE)	320 mA, 125 kV 400 mA, 100 kV 500 mA, 83 kV
	QG-50, QG-50-2 (QG-5000, QG-5000-2)	400 mA, 125 kV 500 mA, 100 kV 650 mA, 76 kV
	QG-50-SE (QG-5000-SE)	400 mA, 125 kV 500 mA, 100 kV 600 mA, 83 kV
	QG-65 (QG-6500)	500 mA, 130 kV 650 mA, 123 kV 800 mA, 81 kV
	QG-80 (QG-8000)	650 mA, 123 kV 800 mA, 100 kV

Chapter 2 General Information

Table 2-4. Electric Output Data

OUTPUT PARAMETER	MODEL (CAT. NO.)	LOADING FACTOR
Highest constant output power at 100 kV, 0.1 second (s)	N/A	N/A
	QG-32, QG-32-2, QG-32-3, QG-32-5 (QG-3200, QG-3200-2, QG-3200-3, QG-3200-5)	32 kW (320 mA, 100 kV, 0.1 s)
	QG-40, QG-40-2, QG-40-3, QG-40-5 (QG-4000, QG-4000-2, QG-4000-3, QG-4000-5)	40 kW (400 mA, 100 kV, 0.1 s)
	N/A	N/A
	QG-32-SE (QG-3200-SE)	32 kW (320 mA, 100 kV, 0.1 s)
	QG-40-SE (QG-4000-SE)	40 kW (400 mA, 100 kV, 0.1 s)
	QG-50, QG-50-2 (QG-5000-2)	50 kW (500 mA, 100 kV, 0.1 s)
	QG-50-SE (QG-5000-SE)	50 kW (500 mA, 100 kV, 0.1 s)
	QG-65 (QG-6500)	65 kW (650 mA, 100 kV, 0.1 s)
	QG-80 (QG-8000)	80 kW (800 mA, 100 kV, 0.1 s)
Nominal shortest irradiation time (AEC exposures)	All models	0.008 second
Lowest mAs	All models	0.025 mAs (25 mA, 1.0 mS)

MAIN COMPONENTS

See Figure 2-1. The HF Series X-ray Generator is comprised of:

- 1 Generator Cabinet - Contains the electronics for high voltage generation and control.
- 2 Operator Console - Contains the operator control panel, which has all generator operator controls and indicators; all aspects of X-ray techniques are entered at the operator control console.
- 3 The operator console may be mounted on a shelf (QG-WM option), table top, or on a pedestal (QG-PDL option, as shown in Figure 2-1).

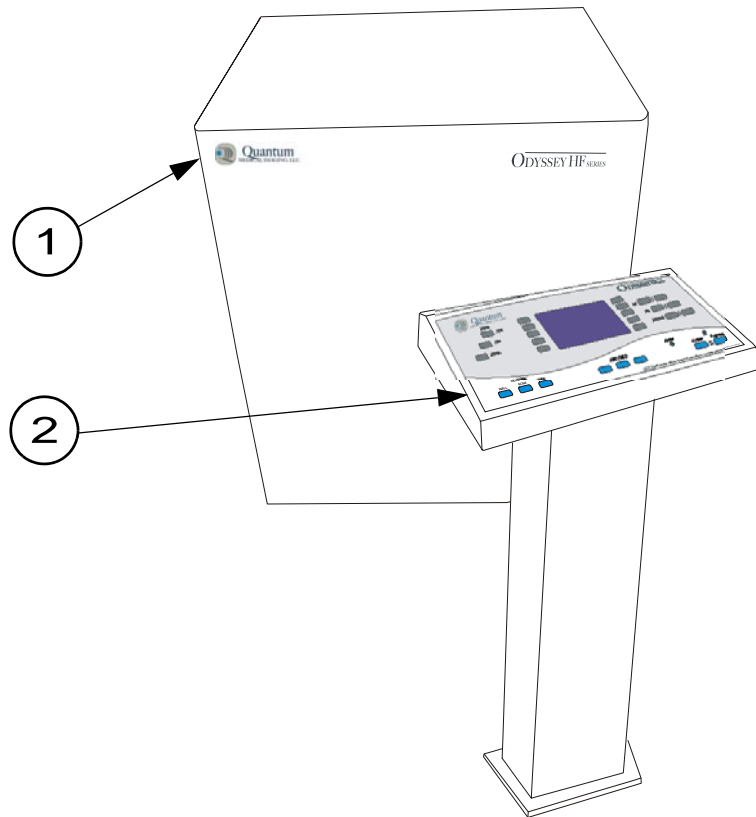


Figure 2-1. HF Series X-ray Generator - Main Components

Chapter 2 General Information

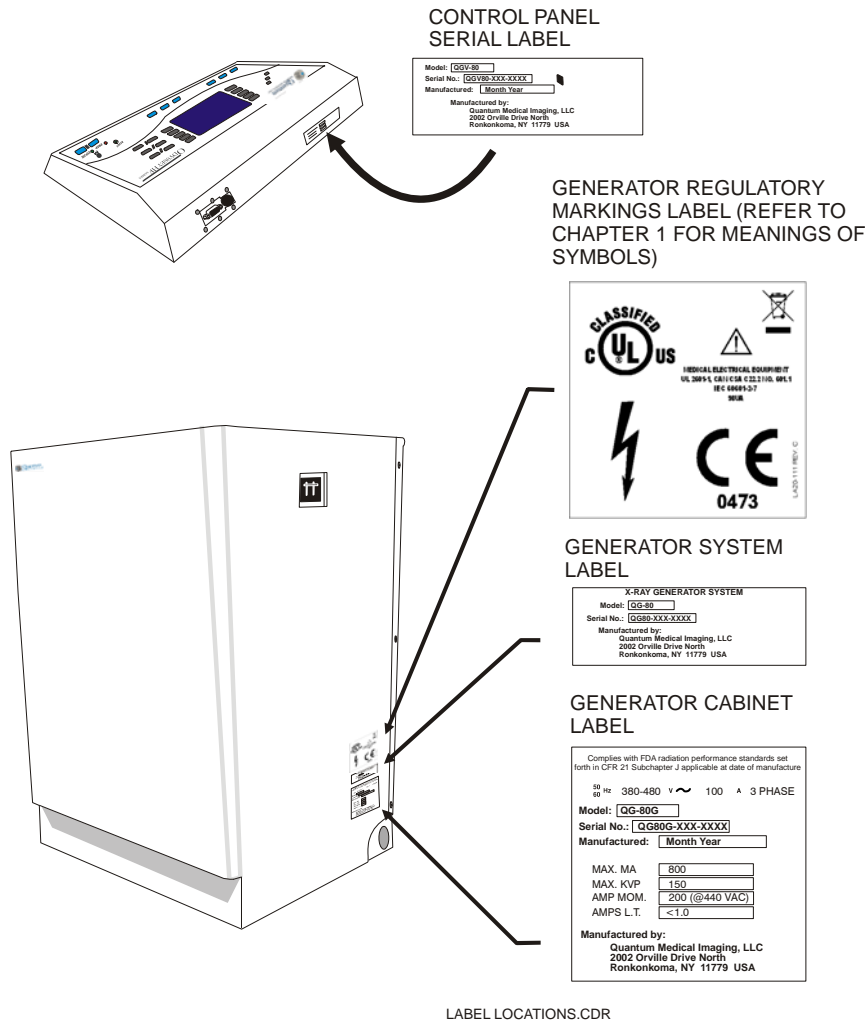


Figure 2-2. Generator - Label Locations

ACCESSORIES

Equipment described in this manual shall only be used in combination with other equipment or components if these are expressly recognized by Quantum Medical Imaging, LLC as compatible. A list of such equipment and components is available from Quantum Medical Imaging, LLC on request.

CONTROLS AND INDICATORS

The operator controls and indicators on the HF Series X-ray Generator are divided into two basic groups:

Chapter 2 General Information

- Generator Cabinet and Operator Console Power Switches (see Figures 2-3 and 2-4)
- Operator Control Panel - Operator Controls and Indicators (see Figure 2-5 and refer to Table 2-5 for descriptions).

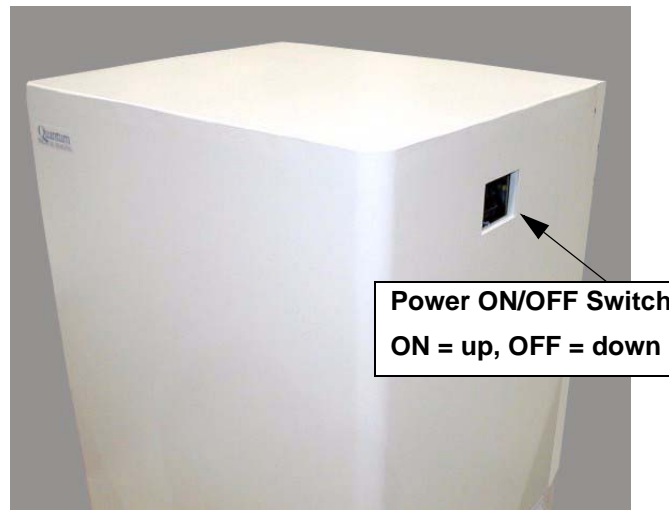


Figure 2-3. Generator Cabinet Power On/Off Switch



Figure 2-4. Operator Console Power ON/OFF Switch

Chapter 2 General Information

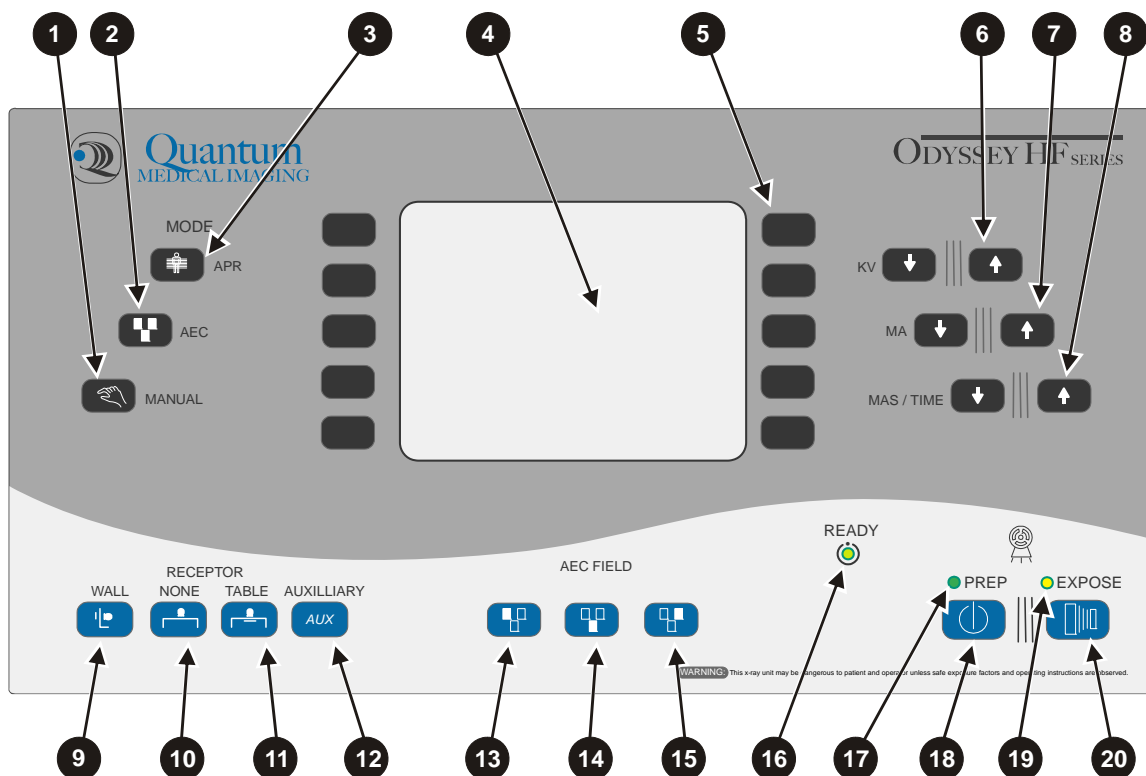



Figure 2-5. OperatorControl Panel Controls and Switches








Table 2-5. Operator Control Panel Controls and Indicators

Item	Symbol	Function	Type	Description
1		Selects Manual mode of operation	Control - Push button	Enables manual selection of kVp, mA, mAs, and time settings for exposure.
2		Selects Automatic Exposure Control mode of operation. (Only functional if AEC option is installed.)	Control Push button	System automatically sets required mAs for achieving proper optical density with compensation for programmable film/screen speeds.

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Item	Symbol	Function	Type	Description
3		Selects Anatomical Programmed Regions (APR) mode of operation	Control -Push button	Enables technique selection from pre-programmed anatomical regions and radiographic projections. <i>Note: When in APR Mode, pressing the AEC key on the Operator Control Panel toggles between APR/AEC mode and APR/Patient Type mode.</i>
4	N/A	LCD screen	Indicator	Displays various system screens, menus and messages. The LCD screen viewing angle is adjustable for maximum visibility.
5	N/A	Selects the field adjacent to the Display Function button pressed	Control - Push button	The functions activated by the Display Function buttons depend on the information displayed on the LCD. Some fields are toggle fields (i.e., there are only two choices, such as Yes/No). Other fields may contain multiple selections; the choices are sequenced (scrolled) each time the button is pressed.
6	N/A	kVp increment/decrement	Control -Push button	Adjusts the tube voltage (kVp) value from minimum of 40 kVp to maximum of 125 kVp, in 1 kVp increments (150 kVp maximum available in systems equipped with 150 kVp option).
7	N/A	mA increment/decrement	Control -Push button	Sets the tube current (mA) value; mA stations that are available for selection are model dependent.
8	N/A	mAs/Time increment/decrement	Control - Push button	Adjusts the exposure time or current-time (mAs) value.

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Item	Symbol	Function	Type	Description
9		Selects wall receptor	Control - push button	Used for examinations where wall receptor and AEC are selected (AEC feature is optional); patient is positioned in front of wall receptor. Pressing this button will toggle between WALL 40" and WALL 72" settings.
10		Disables wall and table receptors	Control -Push button	Used for examinations where neither table nor wall image receptor is required, such as table top and off table techniques.
11		Selects table receptor	Control -Push button	Used for examinations where table receptor and AEC are selected (AEC feature is optional); patient is positioned on tabletop.
12		Selects auxiliary receptor(s)	Control - Push button	On systems equipped with more than two image receptors; press this key once to select third receptor (default assignment is WALL2), press again to select a fourth receptor (default assignment is AUX). Used for examinations when a typical wallstand or table bucky is not desired, such as portable digital receptor applications.
13		Selects top left ion chamber detector location	Control -Push button	Turns on/off ion chamber's top left detector for AEC exposures.
14		Selects middle ion chamber detector location	Control -Push button	Turns on/off ion chamber's middle detector for AEC exposures.
15		Selects top right ion chamber detector location	Control -Push button	Turns on/off ion chamber's top right detector for AEC exposures.

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Item	Symbol	Function	Type	Description
16	N/A	Ready	Indicator	When lit, indicates generator is ready for exposure. When blinking, indicates one of the following conditions: <ul style="list-style-type: none"> • tube heat limit will be exceeded by the next exposure • On stored energy systems, the batteries are re-charging, blinking stops when fully charged. • On non-stored energy systems, 400V capacitors are re-charging
17	N/A	Prepped	Indicator	When the PREP LED is illuminated green, indicates tube rotor and filament are prepared for exposure.
18	N/A	PREP button - prepares generator for exposure; release to inhibit exposure	Control - Push button	When pressed, initiates rotor acceleration and X-ray tube filament pre-heating.
19	N/A	Exposure On	Indicator	During the production of X-rays, the EXPOSE LED is illuminated yellow.
20	N/A	EXPOSE button - initiates exposure	Control - Push button	"Dead-man" type switch (i.e., requires continuous switch activation throughout entire exposure cycle). Initiates the exposure. If preparation cycle (PREP) is not complete, initiates preparation cycle.

Chapter 2 General Information

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Chapter

3

OPERATION



OVERVIEW

This chapter provides the information necessary to operate the generator. The following operating procedures are outlined and described in detail:

- Power on/off procedures
- X-ray tube seasoning procedure
- Operating instructions



WARNING! This equipment must be operated with reasonable care. Manufacturer's equipment recommendations described in this manual must be observed.



WARNING! Do not operate the generator if water has leaked into or around the generator cabinet. Call service before applying power to the system.

POWER ON/OFF PROCEDURES



NOTE: On STORED ENERGY (SE) models, after long periods of non-usage, allow system to re-charge batteries for approximately four hours prior to using (disable AUTO SHUTOFF for continuous charge and turn on system; refer to "Generator Timeout Setting" paragraph in this chapter for instructions). It is recommended the system be turned on at least once a week to maintain battery charge.

The following procedures describe the steps necessary to perform system power on and power off (shut down).

Power On Procedure

1. Verify the main circuit breaker on the generator cabinet is set to the ON position.
2. Set the power on/standby switch on Operator Control Panel (OCP), to the on (⊙) position. If the switch is already in the on position, it means the system shut itself down automatically due to inactivity (refer to "Automatic Power Stand By Mode" paragraph in this chapter). In this case, set the power on/standby switch to the standby (⊙) position, wait five seconds, then set switch to the on (⊙) position.

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3. The system automatically runs a series of self-checks for approximately three to six seconds to ensure proper operation. "Quantum Medical Imaging" and the OCP software revision level appears on the display.
4. Upon successful completion of self-tests, the Manual or APR mode menu is displayed, depending on the operating mode used when the system was last shut down.

Power Off Procedure

For Short Periods Of Time

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Ensure OCP is dark. System is now shut down.

For Long Periods Of Time

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Locate the main circuit breaker on the generator cabinet (see Figure 2-2) and set to the OFF position. System is now shut down.
3. If shut down period is anticipated to be longer than 15 days, set the facility main power disconnect switch to the OFF position.

Automatic Power Standby Mode

To help save power and protect system electronics when left unattended, the generator is equipped with an automatic power-off feature that places the system in "stand by" mode (i.e., system low voltage state). After a user-defined period of inactivity (selectable from 0, 30, 60, 90, 120, 150, or 180 minute delay settings), the system will automatically enter a low power state through software control, leaving all power switches in the on position.



NOTE: The power standby period must be set during generator configuration by the service technician. Setting the Generator Timeout to "0" will disable the system from entering Automatic Power Stand By Mode.

(Refer to the paragraph entitled "Generator Timeout Setting" in Chapter 5, USER MAINTENANCE, for instructions on setting the automatic shut-off time.) To avoid entry into Automatic Power Stand By mode, press any key on the operator control panel before the delay setting expires, or set the Auto Shut-off time to "0". To re-start after Automatic Shut Down, refer to Power-On Procedure.

DAILY TUBE WARM-UP PROCEDURE

All tube manufacturers recommend X-ray tube seasoning following installation and daily prior to use. Systems used infrequently should have the tube seasoned on a daily basis. It is important that these procedures be performed to maintain both the tube manufacturer's and Quantum Medical Imaging, LLC's warranties. A typical daily seasoning procedure is provided below. If the system has not been used for several days, or upon installation, refer to the tube manufacturer's instructions. Proceed as follows:

1. Select MANUAL mode from the Operator Control Panel.
2. Take exposures listed in Table 3-1 using a 200L mA focal spot and allow 30-seconds between exposures.
3. The system is ready for operation.

Table 3-1: Daily X-ray Tube Seasoning Exposures

EXPOSURE	KVP	TIME (SECONDS)
1	50	0.1
2	60	0.1
3	70	0.1
4	80	0.1
5	90	0.1
6	100	0.1
7	110	0.1
8	120	0.1



NOTE: "Exposure 8" X-ray Tube seasoning settings applies only to generators capable of 150kV.

Chapter 3 Operation

SETTING UP TO TAKE EXPOSURES

Before taking an exposure, the operator must prepare the system as follows:

- Select Receptor
- Select Mode
- Select/verify exposure factors

RECEPTOR SELECTION

In any operating mode, use the RECEPTOR selection keys (see Figure 3-1) to select the appropriate image receptor. Select "NONE" if not using a table or wall receptor. The currently selected receptor is indicated in the window at the bottom center of the operator control panel display screen.

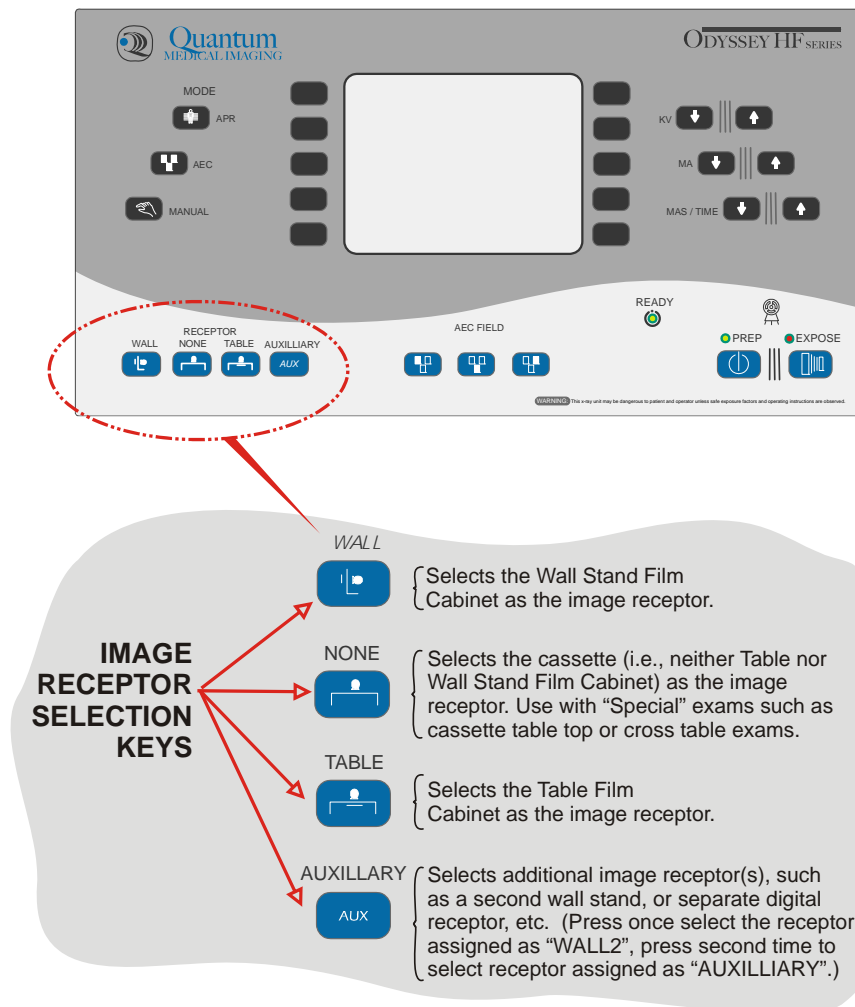


Figure 3-1. Receptor Selection

Chapter 3 Operation

The available receptor choices are dependent on the mode of operation (Manual, AEC, or APR), whether or not the system is equipped with AEC, and if so, the type of AEC ("standard" or "universal" AEC). Standard AEC provides for the selection of up to two separate receptors (WALL and TABLE). Universal AEC provides for the selection of up to four separate receptors (WALL, TABLE, WALL2 and/or AUX).

Table 3-2. Receptor Selection Options

RECEPTOR KEY PRESSED	STANDARD AEC OPTION			UNIVERSAL AEC OPTION		
	MANUAL	AEC	APR	MANUAL	AEC	APR
WALL	WALL	WALL40* WALL72*	WALL40* WALL72*	WALL	WALL40* WALL72*	WALL40* WALL72*
NONE	NONE	NONE	NONE	NONE	NONE	NONE
TABLE	TABLE	TABLE40	TABLE40	TABLE	TABLE40	TABLE40
AUX	NOT ENABLED	NOT ENABLED	NOT ENABLED	WALL2* AUX*	WALL2* AUX*	WALL2* AUX*

Table 3-2 shows the various receptor selection options. The receptors shown with an asterisk are selected by "toggling" the indicated receptor key (e.g., there is a choice of two SID's for the wall receptor (WALL40" or WALL72") when in AEC or APR mode).

Chapter 3 Operation

MODE SELECTION

The generator has three operational modes:

- Manual
- AEC (optional)
- Anatomical Programmed Regions (APR)



NOTE: AEC mode can be used either as a stand-alone mode or in conjunction with APR mode.

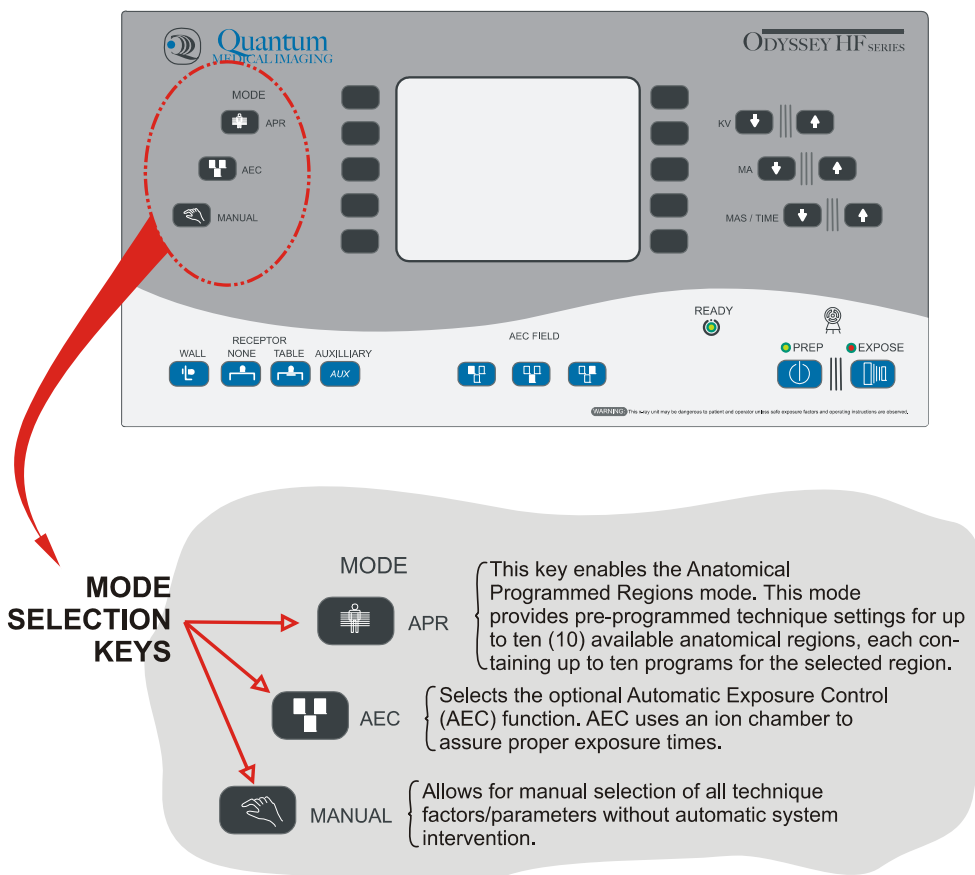


Figure 3-2. Mode Selection

- **ANATOMICAL PROGRAMMED REGIONS (APR) MODE:** After a thickness measurement is entered, prior to exposure, the system

automatically sets programmed X-ray techniques and exposure factors, including AEC mode (if available), bucky selection, kVp, mA, time, initial anatomical thickness, and AEC density. Pre-programmed APR settings can be modified at any time through the operator control panel, either in the actual stored program or for the current exam (i.e., temporarily). During exposure, AEC (optional) works in conjunction with APR to provide uniform, repeatable, high-quality images with the smallest variation of optical density between patients. Additionally, a "Patient Type" sub-mode is provided for APR selections that are configured for manual exposure control (i.e., non-AEC). When this sub-mode is accessed, the patient type is initially set for average (i.e., typical "cm") setting. The PATIENT TYPE up/down keys provide quick time/mAs compensation ($\pm 25\%$ and $\pm 50\%$ settings) in accordance with physical characteristics of patient (i.e., muscular, thin, heavy, etc.), or exposure parameters are adjusted by selecting cm or setting individual exposure factors.



NOTE: On systems equipped with AEC option, all techniques may be toggled between AEC and non-AEC modes using the AEC mode button.

- **AEC MODE:** Automatic Exposure Control (optional) uses an ion chamber to ensure proper optical density with compensation for programmable film/screen speeds. (If AEC option is not installed, AEC mode is inaccessible to operator.)
- **MANUAL MODE:** enables manual selection of kVp, mA, and mAs or time settings for exposures

For detailed operating instructions for each of the above modes, proceed to the required procedure (MANUAL, AEC, or APR [with or without AEC]) on the following pages.



NOTE: In the sample screens that follow, displayed values are for illustrative purposes only and do not necessarily reflect valid techniques.

Chapter 3 Operation

Manual Mode

When operating in Manual mode, all X-ray techniques and exposure factors must be set by the operator. To make manual exposure settings, see Figure 3-3 and proceed as follows:

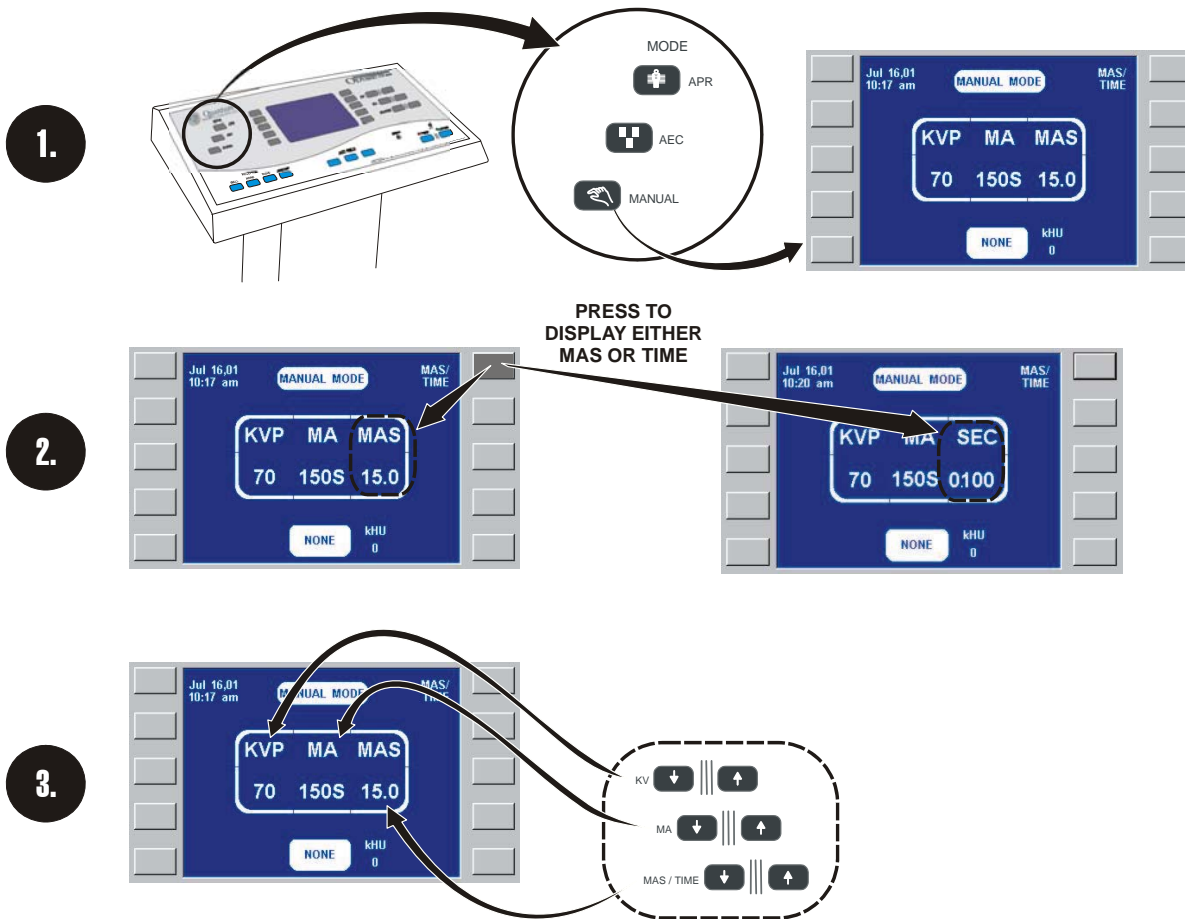


Figure 3-3. Making Manual Mode Exposure Settings

1. Press the MANUAL mode key on the operator control panel. The system displays the MANUAL MODE screen.
2. Press the MAS/TIME key to toggle display between mAs and time settings.
3. Verify exposure (technique) settings are correct. Modify technique using the KV, MA, or MAS/TIME increment/decrement keys as required.

AEC Mode

When operating in AEC mode, the system automatically sets required mAs or time for achieving proper optical density with compensation for programmable film/screen speed. To make AEC exposure settings, see Figure 3-4 and proceed as follows:

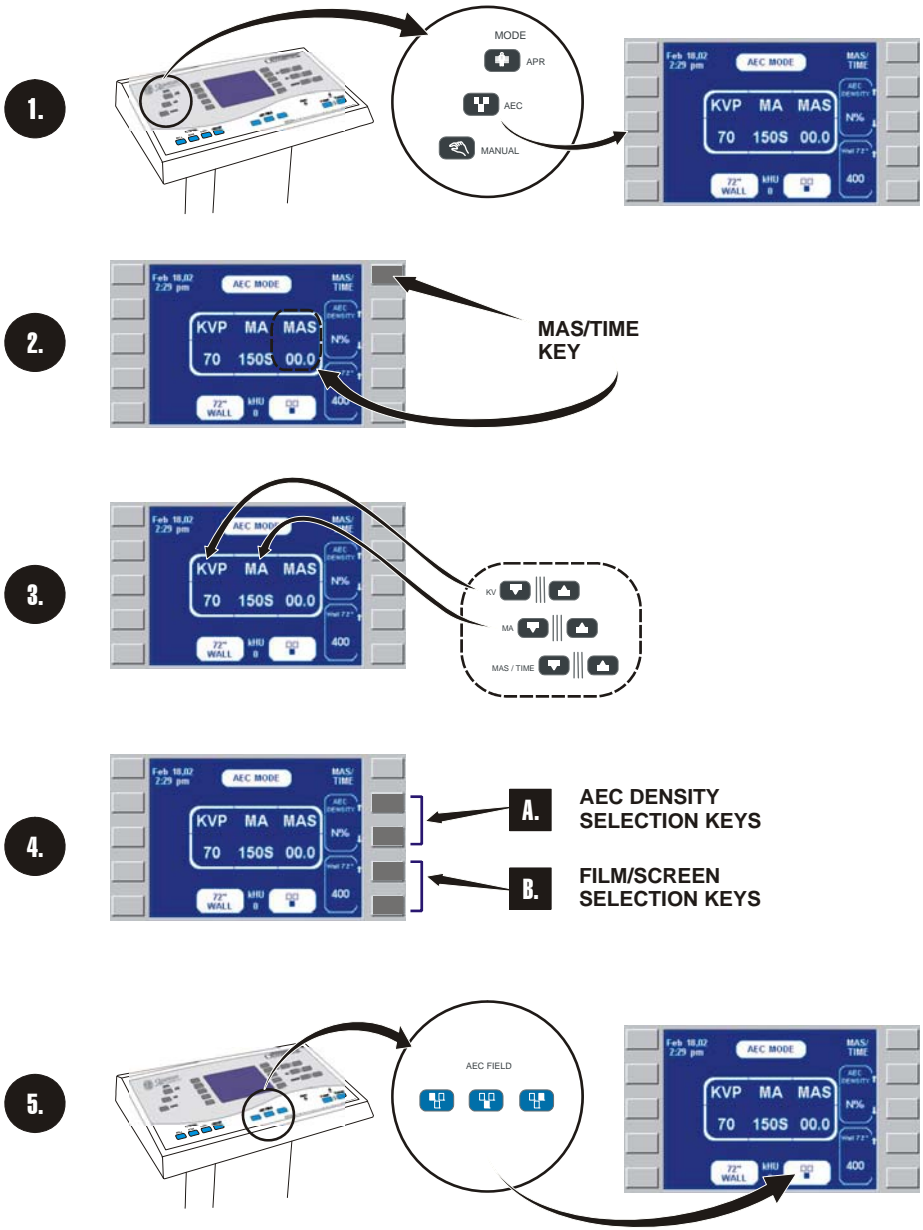


Figure 3-4. Making AEC Mode Exposure Settings

Chapter 3 Operation

1. Press the AEC mode button on the operator control panel. The system displays the AEC MODE screen.
2. Press MAS/TIME key to choose between display of mAs or time value on AEC mode screen at end of exposure.
3. Verify the technique selections are correct. Modify technique settings using the KV and MA increment/decrement keys as required (see Figure 3-6).
4. Verify AEC (film) density and film/screen combination selections are correct. If necessary, modify film density and/or film/screen combination settings using the increment (up) and decrement (down) keys adjacent to each field. Available choices are:
 - AEC Density - Each step increases/decreases mAs 15% above and below nominal (N%). There are a total of eleven available steps (-75, -60, -45, -30, -15, nominal, +15, +30, +45, +60, +75)
 - Film Screen - choices are WALL 72", WALL 40", TABLE 40", 100 Speed, 200 Speed, 800 Speed, and FILM/Screen7. If the Digital Receptor setting in Service Configuration Menu is enabled, an eighth option entitled "Canon Digital" will be also be selectable. (Note: These are the system default film/screen combination names, however each can be edited by user as necessary).



NOTE: Ensure that the appropriate RECEPTOR (i.e. WALL 40", WALL 72" or TABLE 40") is selected prior to AEC FIELD selection.

5. Select the desired ion chamber field combination using the three AEC field keys on the operator control panel. A configuration of three boxes (representing AEC chamber detectors) is depicted on the display screen. A shaded box indicates that a field is selected for use. To select a different AEC field configuration, press the left, center and right AEC FIELD select keys until the desired configuration is displayed. There are a total of eight possible configurations.

APR Mode

When APR mode is selected, X-ray techniques and exposure factors are automatically set according to your specific program.

1. Press the APR mode key on the operator control panel. The system displays the APR MODE ANATOMICAL REGION screen (displays up to 10 anatomical regions).
2. Select an anatomical region by pressing the corresponding key. The system displays the APR MODE ANATOMICAL VIEW screen (displays up to 10 anatomical views).
3. Select an Anatomical View by pressing the corresponding key. The system displays the APR screen for the selected anatomical view (see Figure 3-5).
 - a. On systems equipped with optional AEC:
If AEC exposure control is enabled for this procedure, but the operator wants to switch to manual (non-AEC) exposure mode, press the AEC button on the operator control panel.
 - b. To switch back to AEC mode, press the AEC button on the operator control panel once again.
4. Verify the patient size (thickness) is correct. To increase or decrease this value, press the keys next to the PATIENT SIZE up/down fields to adjust the thickness value (the system automatically adjusts all techniques according to pre-programmed techniques for the selected patient thickness value).
5. Verify/Select Exposure Factors - In APR mode, exposure factors (kVp, mA, and mAs/time) are pre-programmed. Displayed exposure factor values can be modified using the KV, MA, or MAS/TIME increment/decrement keys to select the required value. The system displays an up or down arrow indicator (up to indicate the value was increased from the initially programmed setting, down to indicate the value was decreased from the initially programmed setting) above any technique that is modified from the original APR setting. The MAS/TIME key allows you to select either mAs or time for display and adjustment.

Chapter 3 Operation

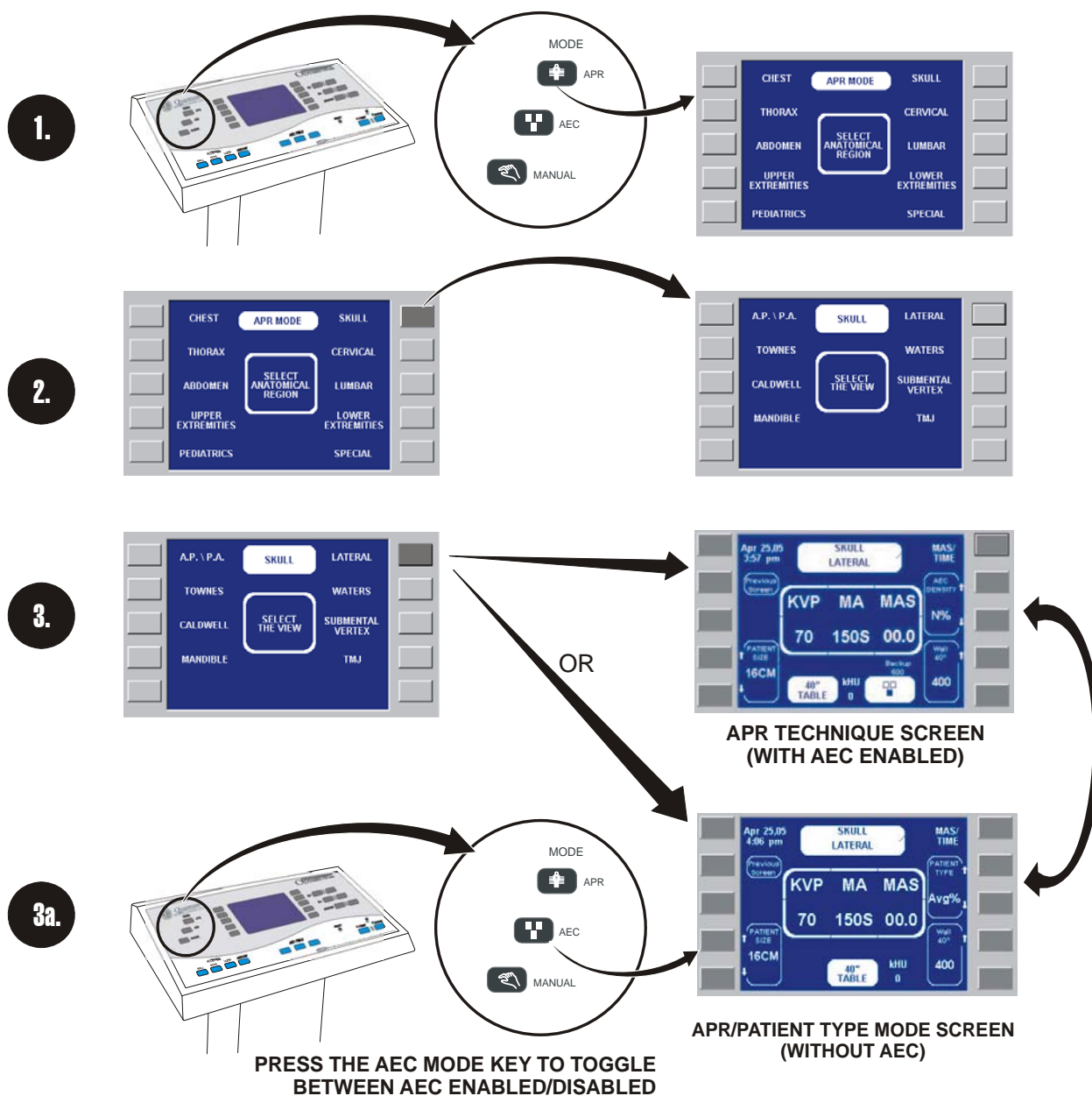


Figure 3-5. Accessing APR Technique Screen

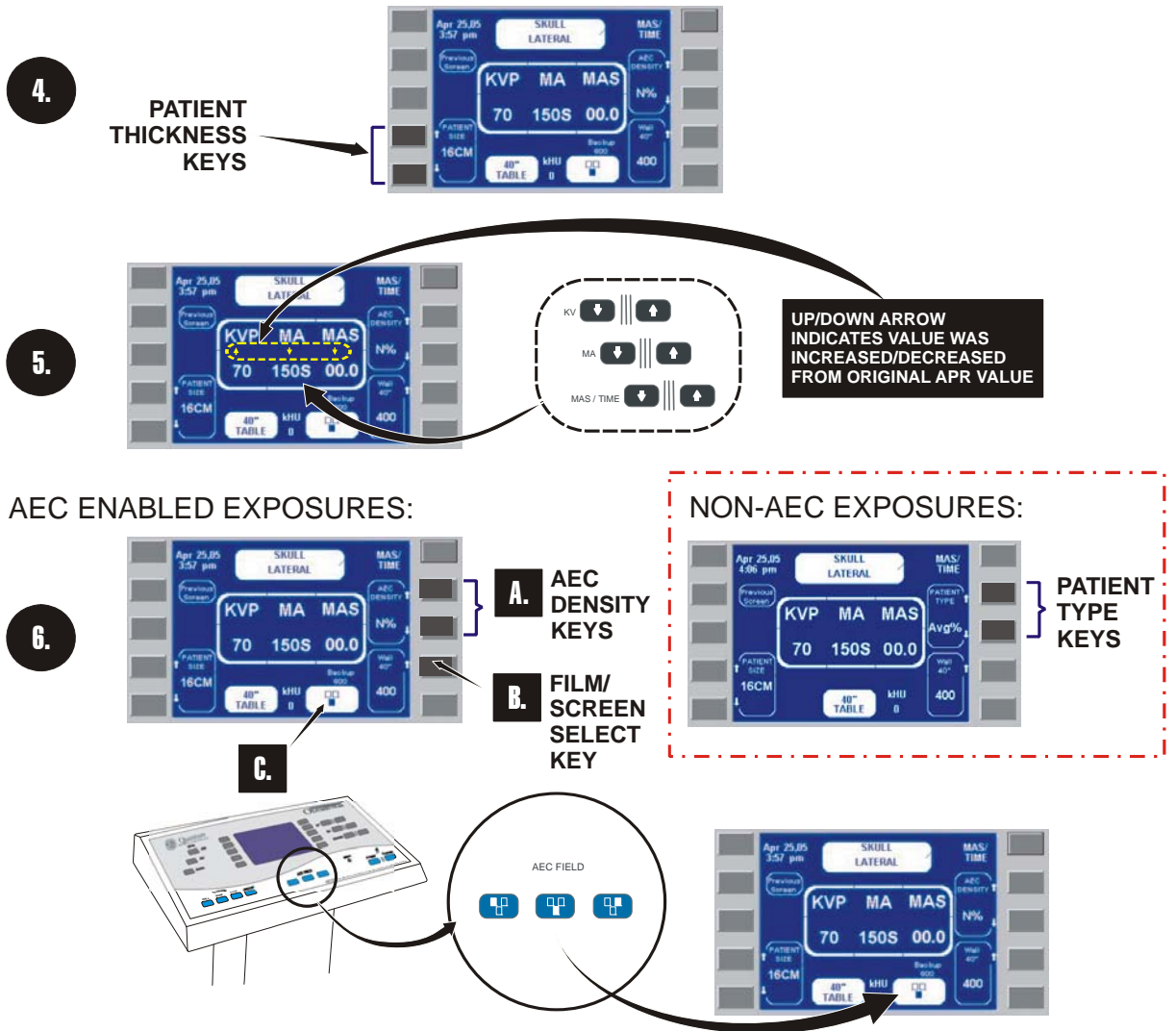


Figure 3-6. Making APR Mode Exposure Selections

- AEC enabled exposures only: Verify AEC (film) density or Patient Type (non-AEC exposures only), film speed, anatomical thickness, and ion chamber field combinations selections are correct. If required, these settings may be adjusted as follows:

Chapter 3 Operation

- a. The default AEC density setting may be modified using the AEC DENSITY increase (up arrow) and decrease (down arrow) keys adjacent to the Density field. Each step adjusts density up/down by 15% relative to the average setting. For APR manual (non-AEC) exposures, the PATIENT TYPE setting changes the time/mAs value in 25% increments. Modify the patient type setting using the increase (up arrow) and decrease (down arrow) keys adjacent to the PATIENT TYPE field.
- b. Film Screen - choices are WALL 72", WALL 40", TABLE 40", 100 Speed, 200 Speed, 800 Speed, and FILM/Screen7. If the Digital Receptor setting in Service Configuration Menu is enabled, an eighth option entitled "Digital" will also be selectable. (Note that these are the factory default film/screen combination names. However, each can be edited as necessary by user).



NOTE: In the event "light" films are produced, verify the correct film/screen combination is selected.

- c. For AEC exposures, select the desired ion chamber field combination using the three AEC field keys on the operator control panel. *Ensure that the appropriate RECEPTOR (i.e. WALL 40", WALL 72" or TABLE 40") is selected prior to AEC FIELD selection.* A configuration of three boxes (representing AEC detectors) is depicted on the LCD. A shaded box indicates an enabled AEC detector. To select a different AEC detector, press the corresponding AEC FIELD select key until the desired detector(s) is enabled. There are seven possible combinations of AEC detector configurations.

OPERATION WITH TOMOGRAPHY SYSTEM (WHEN INTERFACED)

The HF Series X-ray Generator has been designed for seamless operation with either Siemens' MULTIX TOP Tomographic System or the Pausch CS 2000 Micro-tome Tomography System. The tomographic exposure settings are set and controlled using the tomography system's controls, with the generator providing a display of angle/time setting. The kV, mA, etc., are made using the generator's operator control panel in the same manner as for any radiographic procedure.



NOTE: On Siemens Tomography Systems: If $30^{\circ}/0.8s$ is selected on the Siemens system, the generator display will indicate $8^{\circ}/0.8s$. Disregard the 8° angle indication, it is not the value used to determine sweep angle. However, the time setting ($0.8s$) is the actual value used to determine the exposure time.

Refer to the operator's manual provided with the tomography system for complete tomography system operation instructions.

Tomographic Mode

The HF Series X-ray Generator Operator Control Panel (OCP) display will automatically switch between "radiographic" exposure mode to "tomographic" exposure mode when the following operator actions are taken:

- A valid tomographic combination selection is made using the tomography system's angle/time keys and
- The tomography system table receptor is selected (usually this receptor is selected using the "TABLE" receptor key) on the HF Series X-ray Generator operator control panel.

If the generator is in either Manual or AEC mode and tomo mode is activated, the Manual Tomo Mode screen will appear, as shown below:



Figure 3-7. Manual Tomo Mode Screen

Chapter 3 Operation

If the generator is in APR mode and tomo mode is activated, the APR Tomo Screen will appear, as shown below:

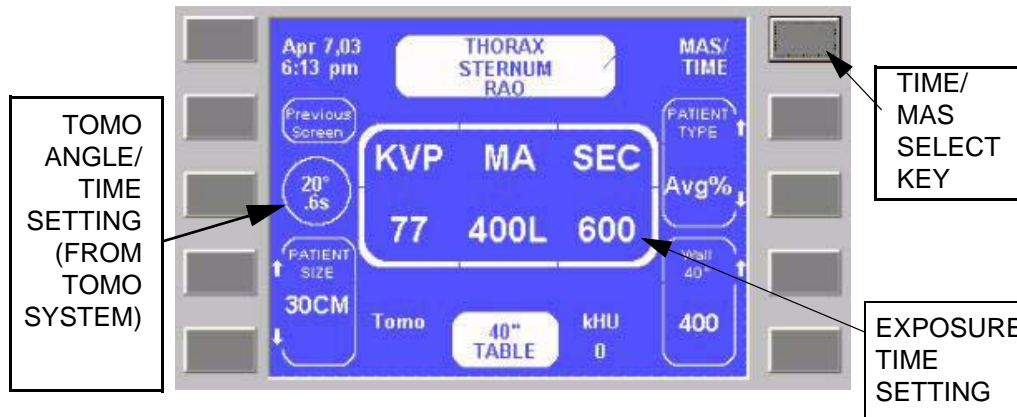


Figure 3-8. APR Tomo Mode Screen

The tomo sweep time appears in the APR Tomo Mode screen, depending upon whether "TIME" or "MAS" display mode is selected. If the sweep time is changed by selecting a different angle/time key on the tomography system control panel and the generator is in tomography mode, the exposure time updates instantly and the generator is properly set up for the changed selection, but the angle and time displayed in the "circle" will not automatically update and remains with the original sweep time selection. This indication can be updated by a) exiting out and then back in to tomo mode or b) selecting a different receptor (or NONE), then re-selecting the correct tomo receptor.



NOTE: If a change in the time setting is made on the generator OCP after the tomography system sets the time, the sweep time will not match what the tomography system expects and, therefore, the exposure will not be correct.



NOTE: On Pausch tomography systems, press PREP key on the operator control panel to reset the tomo back to its initial position.

Returning to Radiographic Mode

The OCP display will automatically switch from tomography mode to radiography mode when:

- the "radiographic mode select" button on the tomography system's control panel is pressed

- any other occurrence that takes the tomography system out of tomographic mode, such as selecting a receptor that is not enabled for Tomo



NOTE: If the generator was in Manual Tomo mode (Figure 3-7) when tomography mode was de-selected, the Manual mode screen appears (see Figure 3-3). Conversely, if the generator was in APR Tomo mode (shown in Figure 3-8) when tomography mode was de-selected, the APR Manual mode screen appears (see Figure 3-4). The time for the last sweep selected will remain displayed on the screen.

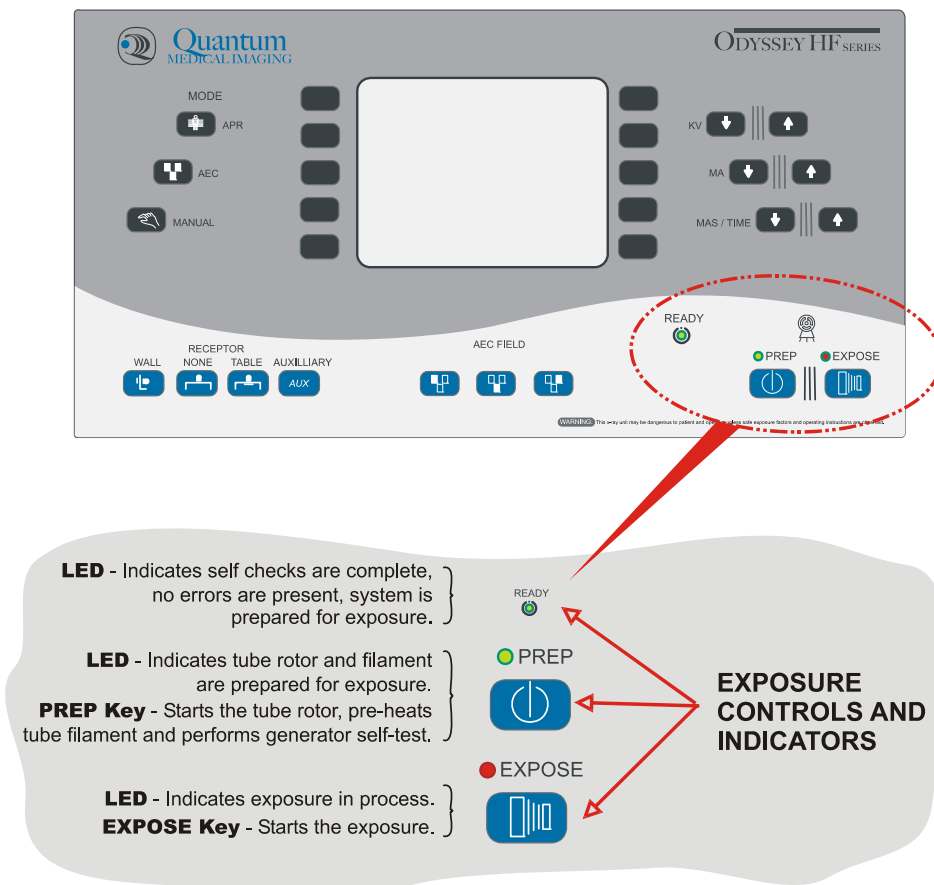
Chapter 3 Operation

TAKING AN EXPOSURE



WARNING: Ionizing radiation can lead to radiation injuries if handled incorrectly. When radiation is applied, the required protective measures must be complied with.

These procedures are identical for all operating modes. After verifying or adjusting techniques and exposure factors, ensure that all other X-ray exposure precautions are met.



NOTE: AN AUDIBLE TONE IS EMITTED DURING EXPOSURE; IT STOPS TO INDICATE END OF EXPOSURE. EXPOSE KEY MUST REMAIN PRESSED THROUGHOUT EXPOSURE PERIOD, OTHERWISE EXPOSURE WILL BE TERMINATED.

Figure 3-9. Exposure Controls

Exposures

Press and hold the EXPOSE key switch until the exposure is complete. The amber EXPOSE indicator will light (X-ray beam is on) and a single audible tone will sound during the exposure.

Instantaneous Exposures

1. Press and hold PREP until the green PREP indicator lights.
2. Press and hold EXPOSE until the exposure is complete. The amber EXPOSE indicator will light (X-ray beam is on) and a single audible tone will be emitted during the exposure.

HEAT UNIT COMPUTER

Anode heat units are computed and displayed continuously on screen, thereby monitoring the dissipation of heat between exposures. (The amount of tube anode heating, expressed in thousands of heat units, is the KHU value, or expressed in thousands of Joules as the kJ value.) Built-in tube protection alerts the operator prior to a subsequent exposure until sufficient heat has dissipated from the tube to allow the next exposure without exceeding tube limits. If the heat units exceed the maximum heat limit, the READY LED will blink on and off. The READY LED will only stop blinking when the tube has cooled down sufficiently such that the heat produced by taking an exposure at the current kV, mA, and time/mAs setting will not exceed tube maximum heat unit limit.

FAULT MESSAGES

Under certain conditions the HF Series X-ray Generator shows a dialog box in the top center of the screen containing a message. This message informs the user that either a problem has occurred or that a requested action cannot be performed.

The user must read these messages carefully. They will provide information on what to do from then on. This will be either performing an action to resolve the problem or to contact the technical service/support organization. Many minor problems can be corrected without a service technician. To clear an error message, press any key on the operator control panel, except for the **PREP** and **EXPOSE** keys. Refer to the HF Series X-ray Generators Service Manual for system faults that require the attention of a technical service/support representative.



NOTE: If the READY light on the operator control panel is off or flashing, this indicates a fault has occurred. Press any key on the operator control panel to display a message describing the cause of the fault.

When the system will not initiate an exposure, an audible alert will sound and a "fault message" will appear on the Operator Control Panel's LCD screen.

Chapter 3 Operation

Refer to the following descriptions for assistance in interpreting the fault message:

Table 3-3. Fault Messages

MESSAGE/ INDICATION	MESSAGE TYPE	DESCRIPTION	REQUIRED ACTION
AEC No Bucky	ERROR	AEC mode has been selected without selecting a receptor (WALL or TABLE), or no ion chamber detectors selected	<ol style="list-style-type: none"> 1. Verify that "WALL" or "TABLE" receptor is selected at OCP. 2. Verify that at least one ion chamber detector is selected.
AEC Not Installed	ERROR	AEC mode was selected on system not configured with AEC.	Do not select AEC mode. (Note: If this message appears on a system equipped with AEC option, AEC must be enabled in Service mode (contact service).
Anode Heat or Housing Heat (READY lamp flashing)	WARNING	Indicates that the tube maximum heat load capacity will be exceeded by next exposure.	Reduce technique factor(s) and/or wait until tube cools sufficiently. Re-take exposure.
Anode Volt	ERROR	Indicates that there is a problem with the anode kVp circuit, high voltage transformer, or Power Driver Module.	Call Technical Service/Support.
Backup	WARNING	Applicable in AEC mode only: Backup time was reached based on current technique factors. This includes exceeding the maximum output capacity of either the x-ray tube or the x-ray generator model.	<ol style="list-style-type: none"> 1. Reduce technique factor(s). Re-take exposure. 2. Verify the preset backup setting (displayed on APR screen) is sufficient. This setting is configurable using APR Edit function (refer to Chapter 4 for instructions). 3. Verify appropriate receptor is selected.
Battery Discharged	ERROR	Faulty stored energy cell in top battery tray (Cathode on two tray systems) or Line Monitor/Charger board not adjusted correctly.	Call Technical Service/Support.

Chapter 3 Operation

Table 3-3. Fault Messages

MESSAGE/ INDICATION	MESSAGE TYPE	DESCRIPTION	REQUIRED ACTION
Battery 2 Discharged	ERROR	Faulty stored energy cell in bottom battery tray (Anode on two tray systems) or Line Monitor/Charger board not adjusted correctly.	Call Technical Service/Support.
Battery NotRdy	WARNING	Battery voltage is too low. (This warning message applies only to stored energy generators.)	Wait until READY light on Operator Control Panel is steady before taking exposure.
Battery Overcharged, Battery 2 Overcharged	ERROR	Line Monitor/Charger board not adjusted correctly.	Call Technical Service/Support.
Calibration	ERROR	Generator kV, mA, and/or filament calibration settings are outside of acceptable limits for normal system operation.	Call Technical Service/Support.
Cathode Volt	ERROR	The filtered cathode volts are outside of preset limits at any time.	Call Technical Service/Support.
Collimator	ERROR	Automatic collimator not responding (only appears on systems using an automatic collimator).	Call Technical Service/Support.
Door	WARNING	Entrance door to x-ray room is open.	Verify x-ray room door is closed and re-take exposure.
Early Term	WARNING	Exposure terminated prematurely because EXPOSE key was released before exposure was completed.	Press any key on Operator Control Panel to clear warning message. Re-take exposure.
Expose WDT	ERROR	Exposure sequence disabled due to loss of communication with EXPOSE watchdog timer.	Call Technical Service/Support.
Filament Curr	ERROR	Indicates a problem with the filament control regulator circuit voltage.	Call Technical Service/Support.

Chapter 3 Operation

Table 3-3. Fault Messages

MESSAGE/ INDICATION	MESSAGE TYPE	DESCRIPTION	REQUIRED ACTION
Filament Prog	ERROR	The filtered Filament Amps are outside of preset limits at any time.	Call Technical Service/Support.
Filament Too Low	ERROR	The OCP sent a request to the Generator to set a PREP value that is too low.	Call Technical Service/Support.
Flash	ERROR	Flash memory returned incorrect checksum.	Call Technical Service/Support.
Flash Not Loaded	ERROR	Flash Memory (U2) on OCP Control Board A16 (AY40-004S1) not loaded with program that corresponds with the version of the Microcontroller program in the OCP; Flash Memory is experiencing a read problem.	Call Technical Service/Support.
Generator Comms	ERROR	Received communication message not valid.	Press any key on Operator Control Panel to clear warning message. Re-take exposure.
Generator Not Ready	ERROR	<ol style="list-style-type: none"> 1. No operator activity for over 60 minutes. 2. Failed communication between generator cabinet and operator control panel. 3. Wrong program loaded into OCP Control Board A16U3 	Call Technical Service/Support.
Hold Button	WARNING	Exposure terminated prematurely because the EXPOSE key was released before the exposure was completed.	Re-take exposure making sure EXPOSE key is continuously pressed throughout entire duration of exposure.
HSS Detected	ERROR	A High Speed Starter has been detected when none is selected.	Call Technical Service/Support.
Keybrd	ERROR	Indicates a key on the Front Panel is stuck on.	<ol style="list-style-type: none"> 1. Verify a switch on the keyboard was not accidentally depressed during power up. 2. If not the above, call Technical Service/Support.

Chapter 3 Operation

Table 3-3. Fault Messages

MESSAGE/ INDICATION	MESSAGE TYPE	DESCRIPTION	REQUIRED ACTION
KVP Error	ERROR	<ol style="list-style-type: none"> 1. The anode and cathode KV are sufficiently different to cause an error. 2. The anode or cathode voltage sense is exceeding 15% of program voltage. 3. Communication between OCP Control Board A16 (AY40-004S1) and Logic Board A1 (AY40-006S) was interrupted. 4. Arc in system (H.V. Transformer, x-ray tube, or high-voltage cables). 5. Faulty/missing J1 connection on KVP Control Board A2 (AY40-003S). 	Call Technical Service/Support.
KVP Volts	ERROR	Indicates the exposure kVp voltage is out of range.	Call Technical Service/Support.
LBMastMicro	ERROR	Logic Board master microprocessor A1U9 returned incorrect checksum.	Call Technical Service/Support.
LBSlaveMicro	ERROR	Logic Board slave microprocessor A1U10 returned incorrect checksum.	Call Technical Service/Support.
Line/400V Anode	ERROR	Missing or incorrect anode sensing voltage (Vsense A) value returned.	Call Technical Service/Support.
Line/400V Cathode	ERROR	Missing or incorrect cathode sensing voltage (Vsense C) value returned.	Call Technical Service/Support.
Long Prep	WARNING	PREP time exceeded the eighteen-seconds limit	Press any key on Operator Control Panel to clear warning message. Re-take exposure.
Lost Prep	ERROR	Exposure sequence disabled due to missing PREP hardware line or PREP signal interruption during PREP cycle.	Call Technical Service/Support.

Chapter 3 Operation

Table 3-3. Fault Messages

MESSAGE/INDICATION	MESSAGE TYPE	DESCRIPTION	REQUIRED ACTION
Lost Expose	WARNING	Exposure terminated prematurely because EXPOSE key was released before exposure was completed.	Press any key on Operator Control Panel to clear warning message. Re-take exposure.
MA Current	ERROR	Indicates the exposure mA current is out of range.	Call Technical Service/Support.
Minus 15V	ERROR	Missing or incorrect -15 VDC supply voltage.	Call Technical Service/Support.
Model Limits	ERROR	PREP was pressed while a combination of the selected parameters is outside of the limits of the generator model or tube type.	Call Technical Service/Support.
No HSS Connected	ERROR	No High Speed Starter detected when selected.	Call Technical Service/Support.
No HV	ERROR	High-Voltage transformer or Power Module not functioning properly.	Call Technical Service/Support.
Not Rotating	ERROR	Tube rotor or generator rotor drive/high-speed starter (HSS) unit not functioning properly.	Call Technical Service/Support.
NVRam	ERROR	Non-volatile random access memory (NVRAM) returned incorrect checksum.	Call Technical Service/Support.
OCP Micro	ERROR	Operator Control Panel micro-processor (A16U3) returned incorrect checksum.	Call Technical Service/Support.
Phase Missing	ERROR	Hardware has detected that at least one phase of a three-phase generator is not present.	Call Technical Service/Support.
Please Wait	WARNING	Operator attempted to take exposure but system not yet ready	Allow more time for system to reach its ready state before taking next exposure. <i>Note: The system will not allow more than two high-speed tube starts within a one minute time period.</i>

Chapter 3 Operation

Table 3-3. Fault Messages

MESSAGE/ INDICATION	MESSAGE TYPE	DESCRIPTION	REQUIRED ACTION
Plus 15V	ERROR	Missing or incorrect +15 VDC supply voltage.	Call Technical Service/Support.
Plus 24V	ERROR	Missing or incorrect +24 VDC supply voltage.	Call Technical Service/Support.
Plus 5V	ERROR	Missing or incorrect +5 VDC supply voltage.	Call Technical Service/Support.
Prep WDT	ERROR	Exposure sequence disabled due to loss of communication with PREP watchdog timer.	Call Technical Service/Support.
Receptor Not Ready	ERROR	The signal on the Receptor Ready terminal of the Digital Interface Board A9 (AY40-034T) is not ready within 500 ms from the time PREP was initiated.	Call Technical Service/Support.
Rotor Current	ERROR	Tube rotor is not getting correct current to start.	Call Technical Service/Support.
Rotor Overrun	ERROR	Tube has been rotating for longer than 30 continuous seconds.	Call Technical Service/Support.
Rotor Temp	WARNING	Tube rotor is too hot.	Allow tube to cool for thirty minutes and then re-take exposure.
Table Bucky	ERROR	The table bucky has been selected but did not return the ready signal to start exposure. (This may take up to five seconds after exposure is requested.)	Verify that "TABLE" receptor was not selected at OCP with system not having table receptor.
Tube Limits	WARNING	Backup time was reached based on current AEC technique factors exceeding tube exposure limits.	Reduce technique factor(s). Re-take exposure.

Chapter 3 Operation

Table 3-3. Fault Messages

MESSAGE/ INDICATION	MESSAGE TYPE	DESCRIPTION	REQUIRED ACTION
V24 Brake	ERROR	Missing or incorrect +24 VDC supply voltage (supplies voltage for operation of external equipment, e.g., tube stand, wall stand, etc.).	Call Technical Service/Support.
Vref+	ERROR	Missing or incorrect positive voltage reference (Vref+) value returned.	Call Technical Service/Support.
Vref-	ERROR	Missing or incorrect positive voltage reference (Vref-) value returned.	Call Technical Service/Support.
Wall Bucky	ERROR	The wall bucky has been selected but did not return the READY signal to start exposure. (This may take up to five seconds after exposure is requested.)	Verify that "WALL" receptor was not selected at OCP with system not having wall receptor.

Chapter

4

APR EDITOR



OVERVIEW

This chapter provides instructions for creating and editing Anatomical Programmed Region (APR) technique screens. The HF Series X-ray generator has the capability of recalling up to 5000 pre-programmed APR screens by storing up to 10 views (techniques) in each of the 10 anatomical regions, with each view having up to 50 thickness (cm) selections. Any of the existing X-ray techniques can be edited to suit the individual needs of your practice.

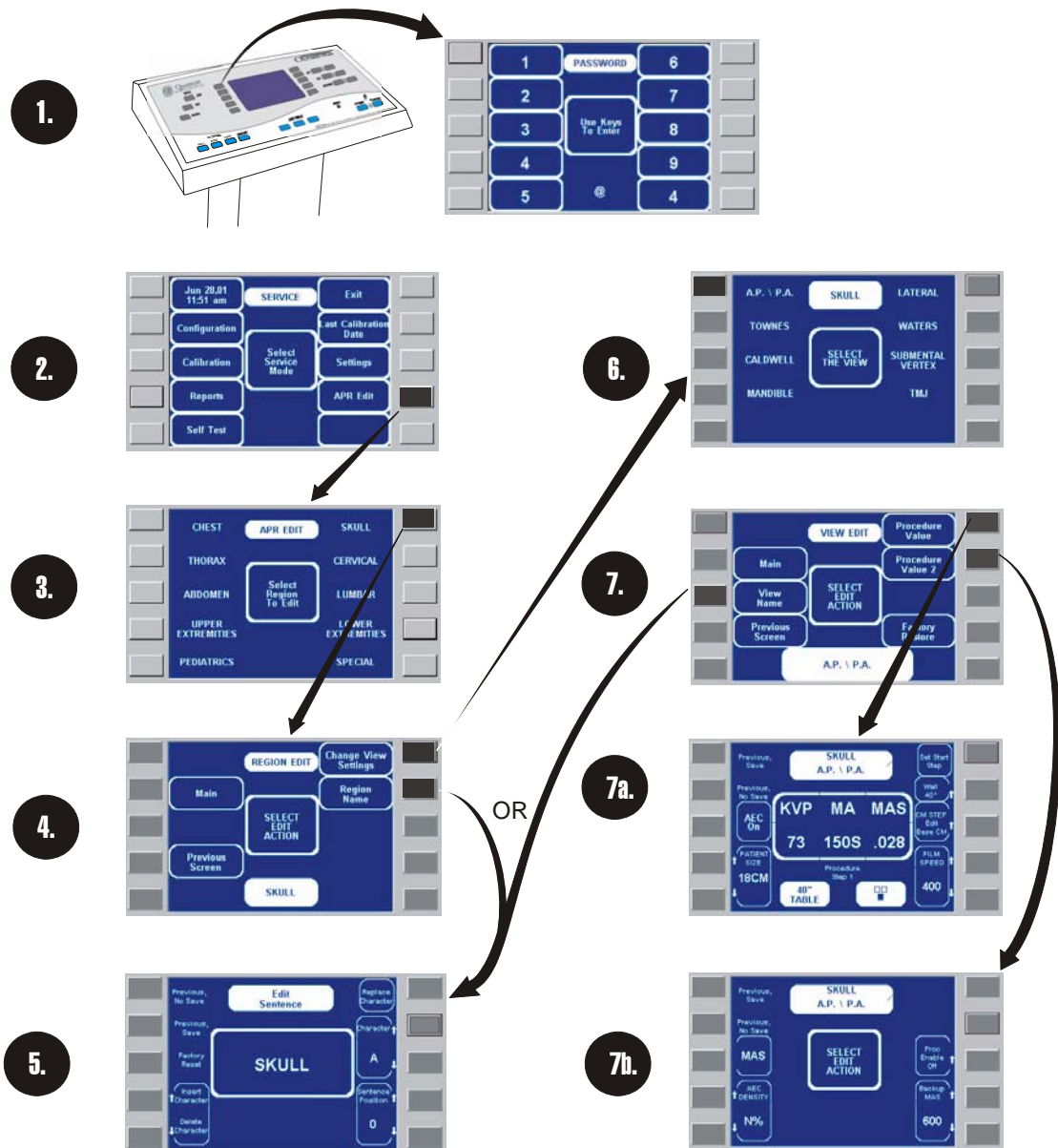


Figure 4-1. APR Edit Mode Screens

Chapter 4 APR Editor

Figure 4-1 provides an overview for accessing the various APR edit mode screens. Each screen is described in detail in the paragraphs that follow.

ACCESSING THE APR EDIT MODE

APR Edit mode is accessed through the Service Mode. To gain access to the Service Mode, password entry is required. This is to prevent unintended and/or unauthorized changes to system and/or APR screen settings. To access the APR Edit mode, proceed as follows:

1. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
2. Set the power on/standby switch on the Operatorback of the E-ZVET Control Panel (OCP) to the standby (⓪) position, then to the on (Ⓢ) position.
3. The system begins the start up sequence (the "Welcome Screen" is displayed and "Testing. Standby..." is flashing) as shown in Figure 4-2.



4. **Welcome Screen** Within five seconds of start up, press the upper left field select key as shown in Figure 4-3. The Password menu displays:

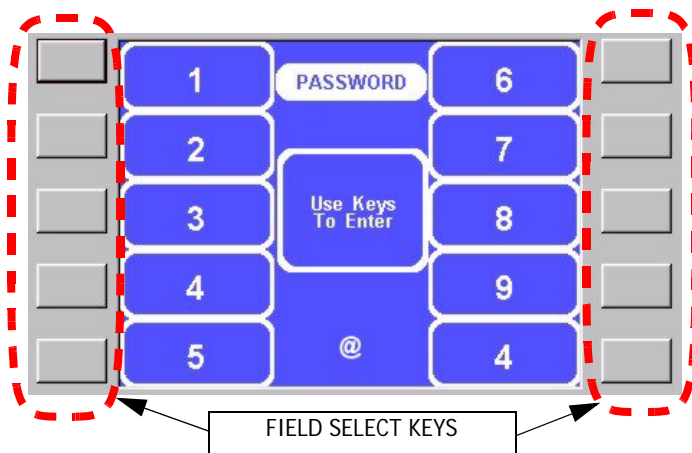


Figure 4-2. Password Menu

5. In the Password menu, enter the default system password (**3497**) using the field select keys next to the corresponding numbers.
6. Upon validation of the password, the Service Menu displays:

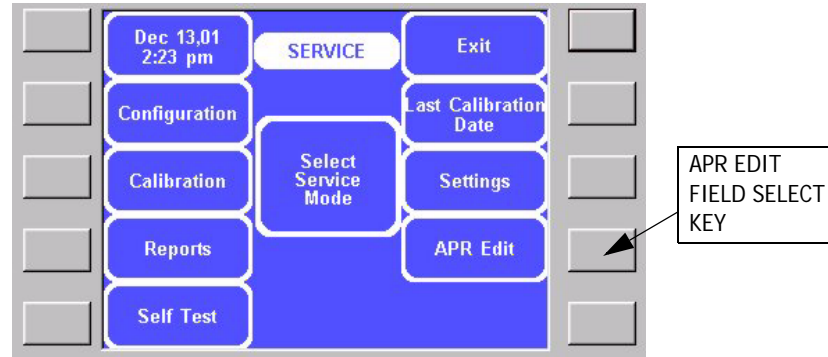


Figure 4-1. Service Menu

7. In the Service Menu, press the key next to the **APR Edit** field. The APR Edit mode screen appears (see Figure 4-5). The system accommodates up to 10 user-configurable preset region names, as shown in the sample screen below. Each region can have up to 10 selectable views, which appear upon selection of the region. Each view contains pre-programmable technique factors that are configurable according to the facility's particular requirements and/or preferences.

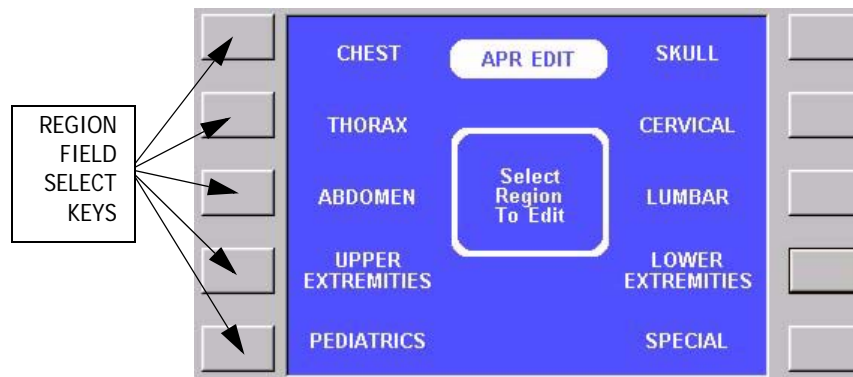


Figure 4-2. APR Edit Mode Screen (Region)

APR EDIT MODE

APR Edit mode provides editing utilities for adding, modifying, duplicating or deleting the name of a view, and for modifying the programmable exposure settings associated with a particular view.

Chapter 4 APR Editor

Editing a Region Name

In the APR Edit Screen, select a "region" to edit by pressing the corresponding field select key.

For example, to edit the **SKULL** region (see Figure 4-5), press key adjacent to the **SKULL** field. The APR Region Edit screen appears:

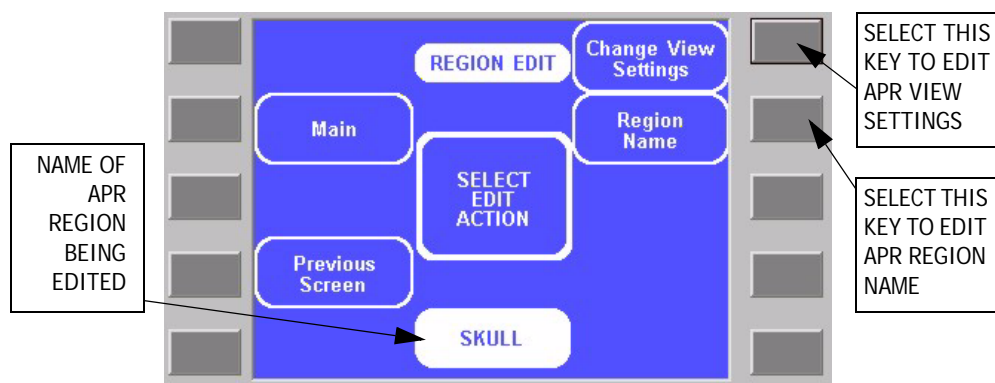


Figure 4-3. APR Region Edit Screen

1. To edit the name of the view ("SKULL" in the example shown in Figure 4-6), press the key adjacent to the **Region Name** field (if you do not want to edit the region name, skip to step 4). The APR Region (or View) Name Edit screen appears:

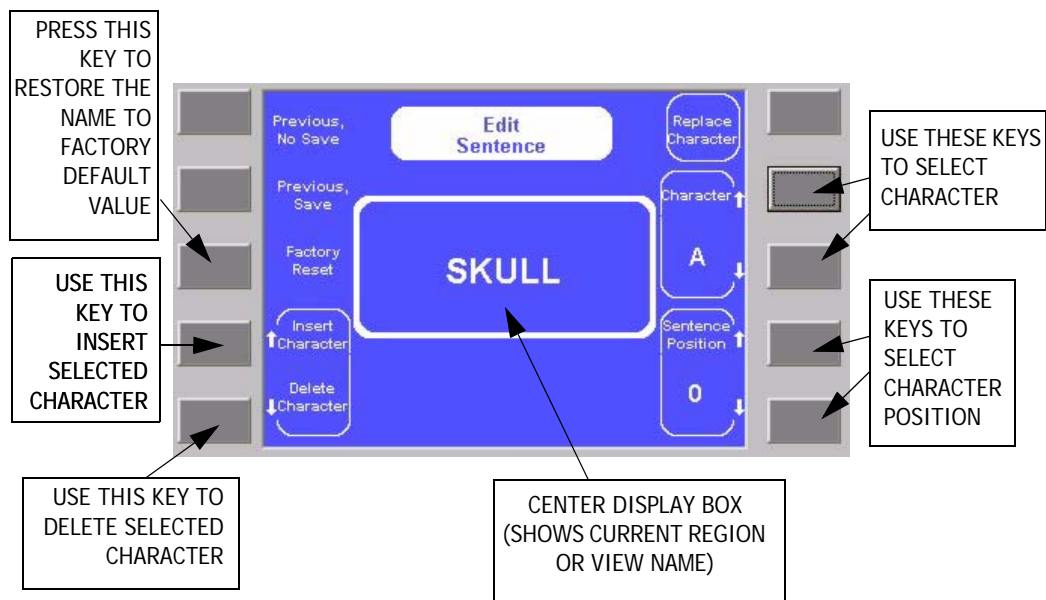


Figure 4-4. APR Region (or View) Name Edit Screen

2. The APR Region (or View) Name Edit screen allows you to edit the name of the selected Region (or View) Name as it appears on the APR screen or, if no existing Region (or View) Name has been created, it allows one to be created. The text string being modified (if one exists) appears in the center display box as shown in Figure 4-7. Names of regions or Views are limited to 49 characters. The APR Region (or View) Name Edit screen provides three ways to edit text:

- Insert a new character
- Delete an existing character
- Change an existing character

The following steps explain each method.

Inserting a New Character

- a. Use the up and down keys next to the **Sentence Position** field to select the location to insert the new character in the text string (the new character is always inserted to the left of the selected character, pushing existing text to the right). For example, if the text string "SKULL" is displayed in the center display box, choosing character position number "0" will place a character before the letter "S", position "1" will place a character before the "K", and so on. Note that the character in the selected position appears in the **Character** field.
- b. Use the up and down keys next to the **Character** field to scroll through all available alphanumeric characters (begins with a "no character" or blank space) until the character you want to insert appears in the **Character** field window.
- c. To insert the selected character in the position chosen in step a, press the key next to the **Insert Character** field. The selected character will now appear in the designated position of the text string.

NOTE: THIS CHARACTER IS A BLANK SPACE

NOTE: THIS CHARACTER IS A LINE RETURN. USE IT TO START NEW LINE BELOW THE CURRENT LINE.

□, "space", !, ", #, ↓, %, &, ', (,), *, +, ,, -, ., /, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, :, ;, <, =, >, ?, @, A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, [, \,], ^, _ , ` , a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, {, }, ~, ¡, ¢, £, ¤, ¥, ¦, §, ¨, ©, ª, «, ¬, ®, ¯, °, ±, ², ³, ´, µ, ¶, ·, ¸, ¹, º, » ¼, ½, ¾, ¿, À, Á, Â, Ã, Ä, Å, Æ, Ç, È, É, Ê, Ë, Ì, Í, Î, Ï, Ð, Ñ, Ò, Ó, Ô, Õ, Ö, ×, Ø, Ù, Ú, Û, Ü, Ý, Þ, ß, à, á, â, ã, ä, å, æ, ç, è, é, ê, ë, ì, í, î, ï, ð, ñ, ò, ó, ô, õ, ö, ÷, ø, ù, ú, û, ü, ý, þ, ÿ

Removing an Existing Character

- a. Use the up and down keys next to the **Sentence Position** field to select the character to remove from the text string. For example, if the text string "SKULL" is displayed in the center display box, choosing character position number "0" selects the letter "S" for removal, position "1" selects the letter "K" for removal, and so on. Note that the character in the selected position appears in the **Character** field.
- b. Pressing the key next to the **Delete Character** field deletes the selected character. Note that when the character is deleted, any characters to the right of the deleted character will shift to the left one space thereby "closing up" the deleted character's space.

Replacing an Existing Character

- a. Use the up and down keys next to the **Sentence Position** field to select the character to replace. For example, if the text string "SKULL" is displayed in the center display box, choosing character position number "0" selects the letter "S" for replacement, position "1" selects the letter "K" for replacement, and so on. Note that the character in the selected position appears in the **Character** field.
 - b. Use the up and down keys next to the **Character** field to scroll through all available alphanumeric characters (beginning with a "no character" or blank space) until the desired character appears in the **Character** field window.
 - c. To replace the character in the position chosen in the previous step, press the key next to the **Replace Character** field. The new character will now appear in the selected position of the text string.
3. When done editing the Region or View name, you may select **Previous, Save** to save the new settings and return to the previous screen (Region Edit or View Edit screen) or select **Previous, No Save** to ignore the changes and return to the previous screen (Region Edit or View Edit screen). To restore region (or view) name to the factory default settings, press the key next to the **Factory Reset** field.

Editing a View Name

Subordinate to each region, there may exist up to 10 individual "view names". To change the name of a view or create a new view (where there is currently a blank field), proceed as follows:

- a. Access the APR Region Edit screen as described previously (see Figure 4-6).
- b. In the APR Region Edit screen, press the key adjacent to the **Change View Settings** field. The APR View Selection screen appears:

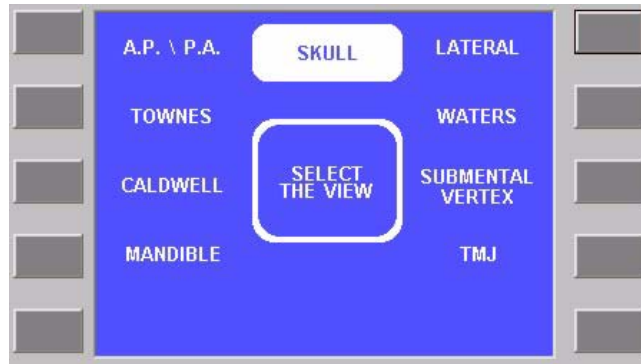


Figure 4-5. APR View Selection Screen

- c. Select a "view" to edit by pressing the corresponding field select key. For example, to edit the **A.P. \ P.A.** view (see Figure 4-8), press key adjacent to the **A.P. \ P.A.** field. The APR View Edit screen appears:

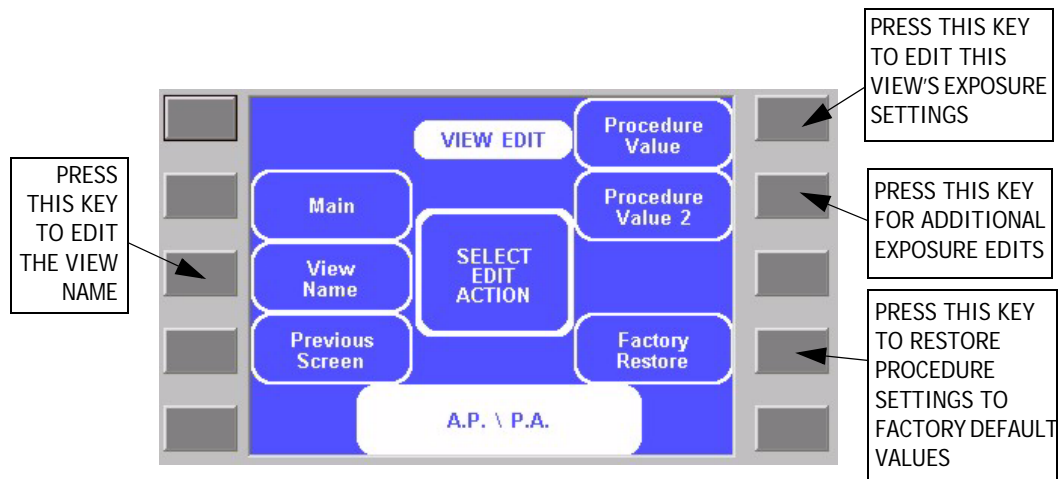


Figure 4-6. APR View Edit Screen

- d. Press the key adjacent to the **View Name** field. The APR Region (or View) Name Edit screen appears (see Figure 4-7) with the View name displayed in the center display box. The method for editing the View name is the same as for editing a Region name as described previously in the "Editing a Region Name" procedure.

Chapter 4 APR Editor

- e. To modify programmed exposure settings for the selected view (e.g. view "SKULL A.P. / P.A." as shown in Figure 4-9), select the **Procedure Value** key (or **Procedure Value 2** key for additional programmable exposure parameters). Proceed with instructions in the next paragraph.

Editing Programmable Exposure Settings

Each procedure (view) has programmable exposure factors (settings). To accommodate the operator in providing maximum system flexibility, two separate screens are provided containing all of the configurable exposure settings for each programmable procedure; The APR Procedure Value Screen (see Figure 4-10) and the APR Procedure Value 2 Screen (see Figure 4-11).

APR Procedure Value Screen - Includes the kV, mA, time or mAs, anatomical thickness range and initial thickness setting, image receptor selection, AEC on/off, film/screen combination, film speed (only functional with non-AEC exposures), and active ion chamber detector settings.

APR Procedure Value 2 Screen - Includes the time/mAs default, AEC Density, Proc (procedure) Enable On/Off, and backup mAs settings.

To edit a view's programmed exposure settings, proceed as follows:

1. Access the APR View Edit screen (see Figure 4-9) as described in the "Editing a View Name" procedure.
2. Press the key adjacent to the **Procedure Value** field. The APR Procedure Value screen is displayed:

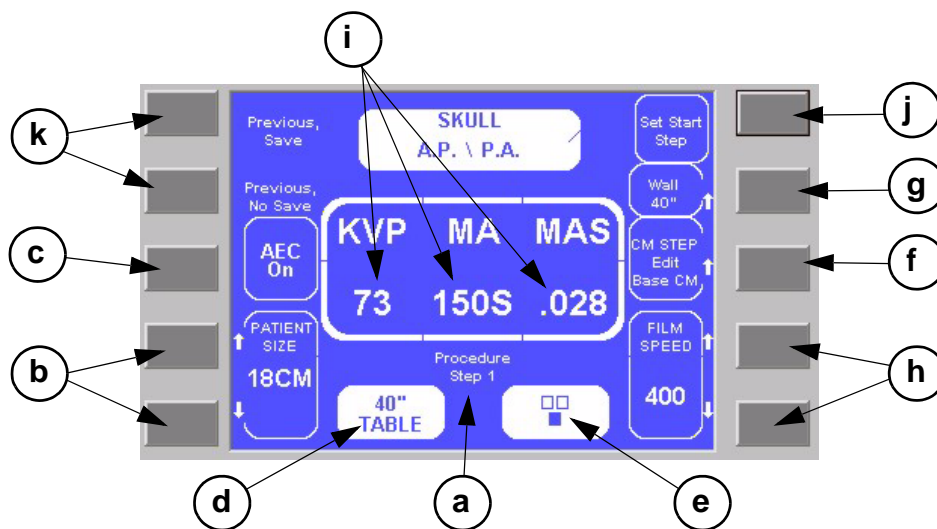


Figure 4-7. APR Procedure Value Screen

- a. **Procedure Step 1** is displayed directly below the center display box (Figure 4-10, item a). The system provides 10 "Procedure Steps" or patient size (thickness) set points for a procedure; each set point can be programmed with particular exposure factors (i.e., kV, mA, time/mAs). When programmed appropriately, the ten steps or set points allow you to vary the exposure factors to correspond with increasing patient size (thickness) settings across the range of selectable size settings. The "Procedure Step 1" set point is used to set the minimum thickness value (i.e., the lowest limit of the thickness range) that the technologist will be able to achieve when using this particular procedure.



IMPORTANT: The following step is only required if you are configuring the procedure for the first time or to change the thickness range; it is not required when changing exposure values for a particular thickness set point(s). To edit exposure values for a particular set point, press the PATIENT SIZE up or down keys until the desired set point (e.g., "32 CM") is displayed, then edit kVp, mA and/or time/mAs values as necessary.

- b. Set the **CM STEP** field (Figure 4-10, item f) to "Edit Base CM".
- c. Using the up/down arrow keys next to the **PATIENT SIZE** field (Figure 4-10, item b), set the CM value to the minimum thickness setting required for this procedure (referred to as the "Base CM" value).
- d. Select the AEC On/Off setting by pressing the key next to the **AEC On/Off** field (Figure 4-10, item c). (Note: AEC is only functional on generators equipped with AEC option). When this field is set to "AEC On", automatic exposure control will be enabled for this procedure. When set to "Off", the procedure is configured for non-AEC (or manual) exposure mode of operation. *Note: When set to "AEC On", the operator during normal operation can switch between AEC and non-AEC modes using the AEC mode button.*
- e. Select image receptor setting by pressing the appropriate image receptor keys (WALL 40", WALL 72", NONE, or TABLE 40"). (See Figure 4-10, item d.) For AEC-enabled exposures, either the WALL or TABLE receptor must be selected.

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NOTE: The AUX receptor is functional on systems equipped with the "Universal AEC" option; it is usually reserved for Tomo receptor selection.

- f. For AEC-enabled exposures, select the desired ion chamber field combination using the three AEC field keys on the operator control panel. A configuration of three boxes (representing AEC chamber detectors) is depicted on the LCD (see Figure 4-10, item e). A solid box indicates that a field is selected for use.



IMPORTANT: Do not change the CM STEP value setting if you are only reviewing procedure values or if you only want to change one or more of the procedure's exposure values. Doing so will change the relationship between patient thickness and corresponding exposure factors.

- g. The **CM STEP** field (Figure 4-10, item f) sets the "thickness step size value"; this value determines the size, in centimeters (CM), between each of the ten patient size (thickness) set points for this procedure. The displayed value is the current thickness step size setting. Using Figure 4-10 as an example, the CM STEP value indicated is "4". Therefore, if the minimum or "Base CM" value is set to "10 CM", this configuration establishes the following series of patient size (thickness) set points at which the exposure values can be programmed:

- 10 CM
 - 14 CM
 - 18 CM
 - 22 CM
 - 26 CM
 - 30 CM
 - 34 CM
 - 38 CM
 - 42 CM
 - 46 CM
- } CM STEP VALUE = 4
46 CM - 10 CM = 36 CM RANGE

As shown in the example above, starting at 10 CM, there are nine 4-CM "steps". The "CM STEP" value and number of steps (9) determine the total thickness (CM) range for the procedure ($9 \times 4 = 36$).



NOTE: The "CM Step" value you set in the APR Edit procedure is only used to establish the number of CM steps between programmed set points. When the system is in actual APR mode of operation, pressing the CM increase/decrease keys will change the CM value in increments of one.

The kVp, mA and mAs (or time) values between each of the ten thickness set points will have interpolated values based on the lower set point's exposure settings. For example, suppose at 10 CM's the kVp value is set to 50, the CM increment value is set to 4, and the next (14 CM) thickness set point's kVp value is set to 54. When the operator chooses this view and selects a thickness of 11 CM's, the system automatically adjusts the kVp for 51, and at 12 CM's it will be 52, and so forth up to 54.

- h. Select the appropriate film/screen combination to be used for this procedure. (Ensure the selected film/screen combination has been previously calibrated). Pressing the key adjacent to the **Film/Speed Combination** field (see Figure 4-10, item g) sequences through the available film/screen combination choices. The factory default choices are: WALL 40", WALL 72", TABLE 40", 100 Speed, 200 Speed, 800 Speed, and Film/Screen7. If the Digital Receptor setting in Service Configuration Menu is enabled, an eighth option entitled "Digital" is also provided. Note that selection of film/screen combination is the only method to select a film speed for APR procedures. **Only select film/screens that have been calibrated.**
- i. The **FILM SPEED** field (see Figure 4-10, item h) displays the "base" film speed setting. The "base" film speed is the speed used to formulate the APR procedure.
- j. Select the appropriate kVp, mA and mAs (or time) values for Procedure Step 1, (see Figure 4-10, item i). These values are the settings that will appear automatically when the operator accesses this APR anatomical view at minimum thickness selection. (Note: During normal APR operation, any pre-programmed kVp, mA or mAs/time value can be manually modified (i.e., overridden) by the operator without returning to APR edit mode.)

Chapter 4 APR Editor

- k. When all exposure factors for Procedure Step 1 are correct, press the **PATIENT SIZE** up key (see Figure 4-10, item b) to advance to the next procedure step (i.e., "Procedure Step 2").
 - l. Modify exposure factors as required for this thickness set point and continue until all ten procedure steps have been configured.
 - m. Using the **PATIENT SIZE** up/down keys (see Figure 4-10, item b), select the procedure step as the "default" setting that will appear when the operator initially accesses this procedure using APR mode. When the desired procedure step is selected, press the **Set Start Step** key (see Figure 4-10, item j) to set this step as the default. Note that the **Set Start Step** field should now match the **Procedure Step** number as a confirmation the setting was made.
 - n. Press the **Previous, Save** key (see Figure 4-10, item k) to save the modifications and return to the APR View Edit Screen (see Figure 4-9) or press the **Previous, No Save** key to ignore the changes and return to the APR View Edit screen.
1. Access the APR View Edit screen (see Figure 4-9) as described in the "Editing a View Name" procedure.
 2. Press the key adjacent to the **Procedure Value 2** field. The APR Procedure Value 2 screen is displayed:

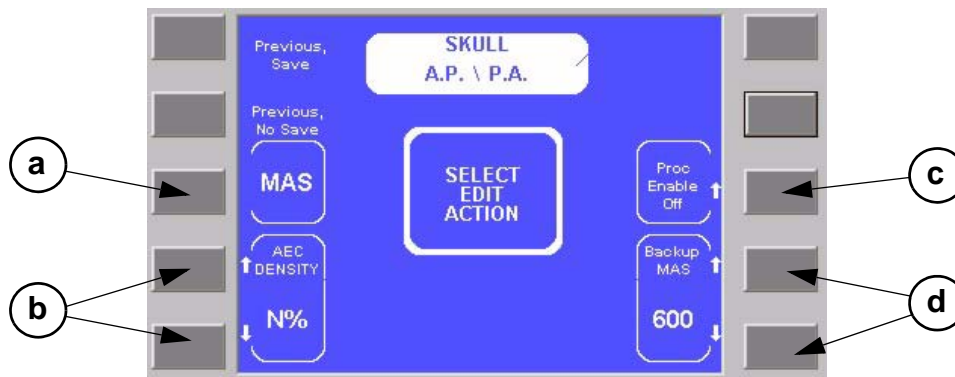


Figure 4-8. APR Procedure Value 2 Screen

- a. The setting in the **MAS/SEC** field (see Figure 4-9, item a) determines the unit of measure of the exposure duration in terms of either time (SEC) or mA-seconds (mAs). Pressing the key next to this field toggles between these two settings.

- b. The **AEC DENSITY** field (see Figure 4-10, item b) sets the default AEC Density for the procedure. Select the AEC Density setting using the increment (up) and decrement (down) keys adjacent to the **AEC DENSITY** field. Each step of this setting adjusts the optical density 15% above and below nominal (N%) for a total of eleven available settings (-75, -60, -45, -30, -15, nominal, +15, +30, +45, +60, +75).
- c. The **Proc Enable** field (see Figure 4-10, item c) setting enables or disables the selection of this particular programmed procedure (view) in the APR View Selection Screen (see Figure 4-8). In the example shown in Figure 4-8, the system's default programmed procedures, such as "P.A. (GRID)" are selectable since the **Proc Enable** setting for each of these views has been set to "On" at the factory. Note, however, the blank fields that appear in the APR View Selection screen (see Figure 4-8) are views that have been disabled because their **Proc Enable** setting is set to "Off", and the "view names" have been edited to all blank spaces (refer to "Editing a View Name" procedure on the preceding pages of this chapter. The result is that when the user presses the key adjacent to any of the blank fields, there is no response by the system. In the event that you need to activate a currently "inactive" procedure, change the **Proc Enable** setting to "On"; the view is now enabled for selection by the user in the APR View Selection Screen.
- d. The **Backup MAS** field (see Figure 4-11, item d) sets the procedure-specific AEC backup mAs limit. The mAs limit range is configurable from 10 to 600 mAs in 10 mAs increments. *Note: The procedure-specific backup mAs setting is independent of the system-wide system backup mAs setting described in Chapter 5, User Maintenance. The lower of the two backup settings will take precedence when set to unequal values.*

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Chapter

5

USER MAINTENANCE



Chapter 5 User Maintenance

OVERVIEW

This chapter is designed to assist the system user in maintaining the proper operation of the generator. Also included in this chapter are instructions for making changes to the system's user-configurable settings, such as setting the date and time, and language and automatic power shut-off settings.

This product has been factory tested to assure its required performance in an X-ray system. The user is responsible for performing routine maintenance and inspection procedures to ensure proper equipment operation. Aside from routine maintenance, any abnormal noise, vibration, or unusual performance should be investigated by a qualified service representative. Preventive maintenance or any repair service should be performed only by qualified service personnel.



WARNING! Failure to follow manufacturer's or service personnel's recommendations may result in serious injury.



Only qualified and authorized persons shall work on this equipment. In this context, qualified means those legally permitted to work on the equipment, and authorized means those specifically authorized by local management.



Changes, additions or maintenance to the equipment carried out by persons without appropriate qualifications and training and/or using unapproved spare parts may lead to serious risk of injury and damage to the equipment as well as making the warranty void.

USER MAINTENANCE

The system user is responsible for the basic cleanliness of the equipment. On a regular basis (at least every six months) painted metal surfaces should be cleaned using a clean cloth slightly moistened in warm soapy water (use mild soap). Wipe the operator control panel with a clean wet cloth, then dry. Never use strong cleaners, solvents, or abrasive polish on this equipment.



WARNING! Always disconnect the equipment from the main power supply prior to any cleaning.



WARNING! Electric shock hazard! The HF Series X-ray Generator contains no user serviceable components. Do not attempt to disable these components or remove any trim covers. Refer service to qualified service personnel.

Chapter 5 User Maintenance

SYSTEM SETTINGS

There are several operational parameters that can be set by the user. These settings include setting the date and time, date/time format, language, AEC back up time/MAS, generator automatic shut off delay time setting, and default film/screen designations for AEC mode. The following paragraphs describe access to and selection of the various system settings

ACCESSING SERVICE MODE

The system settings screens are accessed by entering the X-ray generator's Service Mode. To gain access to the Service Mode, password entry is required. This is to prevent unintended and/or unauthorized changes to system settings. To access the Service Menu, proceed as follows:

1. Verify the ON/OFF circuit breaker CB1 on the generator cabinet is set to the ON position.
2. Set the power on/standby switch on the Control Panel (OCP) to the standby (⦿) position, then to the on (⦿) position.
3. The system begins the start up sequence (the "Welcome Screen" is displayed and "Testing. Standby." is flashing). (See Figure 5-1.)



Figure 5-1. Welcome Screen

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4. Within five seconds of start up, press the upper left field select key as shown in Figure 5-1).
5. The Password menu displays:

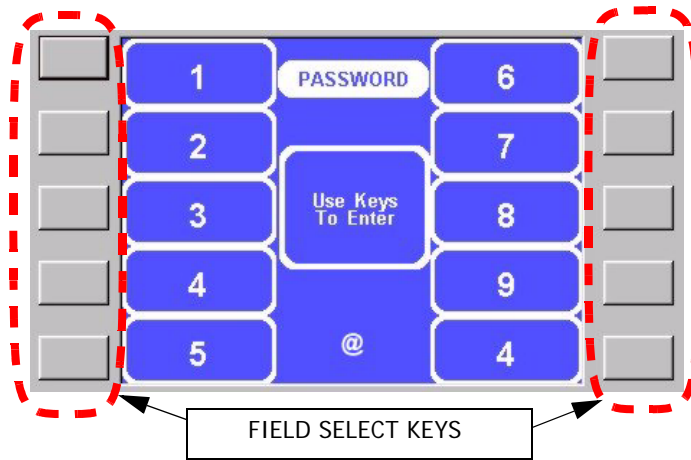


Figure 5-2. Password Menu

6. In the Password menu, enter the default X-Ray Technician password (3497) using the field select keys next to the corresponding numbers. (This password enables access to Service Mode for modification of system settings and for access to the APR Edit utility.)
7. Upon validation of the password, the Service Mode Menu displays:

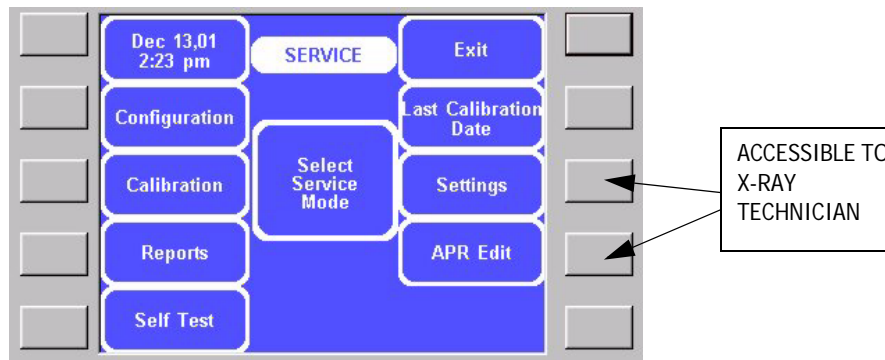


Figure 5-3. Service Menu

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The Service Menu offers a selection of service-oriented system utilities, each of which is described briefly below:

- **Configuration** utility: *Access limited to authorized service technician only.* Provides access to system configuration settings, such as AEC enable/disable, rotor drive, and tube type settings, etc. In addition, it provides the "Edit Welcome" utility that enables the user to change the name of the Facility (e.g., "General Hospital") and Dealer contact information as it appears on the Welcome Screen (see Figure 5-1).
- **Calibration** utility: *Access limited to authorized service technician only.* Provides access to system calibration functions, such as filament, mA, kVp calibration and analog-to-digital (A-D) conversion calibrations.
- **Reports** utility: *Access limited to authorized service technician only.* Provides access to Service Reports menu, which provides Generator, Tube, Error Warnings, and Diagnostic reports.
- **Self-Test** utility: *Access limited to authorized service technician only.* Performs various system self-tests.
- **Last Calibration Date:** *Access limited to authorized service technician only.* Provides the date on which calibration was last performed.
- **Settings** utility: Provides access to system settings, such as the language, date, time, date format (international or U.S.), wall and table film/screen designations, generator automatic shut-off time delay setting, and system-wide AEC backup time/mAs setting.
- **APR Edit** utility: Used to edit existing APR screens or use to create new screens (refer to Chapter 4, APR Editor for details).

Chapter 5 User Maintenance

SYSTEM SETTINGS - GENERAL DESCRIPTIONS

In the Service Menu (see Figure 5-4), press the key next to the **Settings** field to access the Service Settings Menu, shown below:

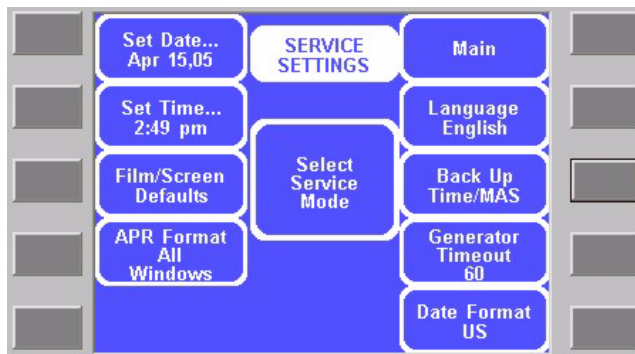


Figure 5-4. Service Settings Menu

The Service Settings Menu provides access to various system settings. The following briefly describes the various Service Settings Menu selections:

- **Set Date** setting: Accesses the Set Date Screen for setting current date
- **Set Time** setting: Accesses the Set Time Screen for setting current time
- **Film/Screen Defaults**: Accesses the Film/Screen Defaults Screen, which is used to configure the default film/screen combination for the various image receptors used with the generator
- **APR Format**: Press the key next to the APR Format field to scroll through available APR Procedure Screen format options:
 - All Windows* - APR Procedure Screens will display both Film Speed and CM (thickness) screen fields
 - No CM* - APR Procedure Screens will not display the CM (thickness) screen field
 - No FS* - APR Procedure Screens will not display the film speed screen field
 - No FS, No CM* - APR Procedure Screens will not display the film speed nor the CM (thickness) screen fields
- **Main**: returns the system to the Service Menu
- **Language** setting: Sets language used for operator control panel display screens/menus (i.e., English, French, Spanish, German, or Italian)

Chapter 5 User Maintenance

- **Back Up Time/MAS** setting: Displays current AEC exposure back up mAs setting (only functions on systems equipped with QG-AEC option). The system allows for selection of a mAs setting between 10 and 600 mAs (in 10 mAs increments).
- **Generator Timeout**: Sets the delay time for generator to automatically shut down if no keys are pressed on operator control panel (selectable in 30 minute increments; between 0 minutes (automatic shutdown disabled) up to 180 minutes).
- **Date Format** setting: Sets date/time format (options are "US" or "International")

SYSTEM SETTINGS - DETAILED DESCRIPTIONS

To change a setting, press the key next to the system setting you want to change. After all system settings are set appropriately, press the key next to the **Main** field. The system settings are saved in non-volatile read-only memory (NVRAM) and the system returns to the main Service Menu (see Figure 5-3).

The following paragraphs provide specific instructions for configuring each of the above system settings.

Set Date Screen

The Set Date screen, shown below, displays the current date setting. To change the date setting, proceed as follows:



Figure 5-5. Setting the Date

1. Adjust the month, date or year setting using the appropriate keys as shown in Figure 5-5, above, until desired date is displayed.
2. To exit the screen and return to the Start Up Screen, press the key next to the **Main** field.

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Set Time Screen

The Set Time screen, shown below, displays the current time setting. To change the time setting, proceed as follows:

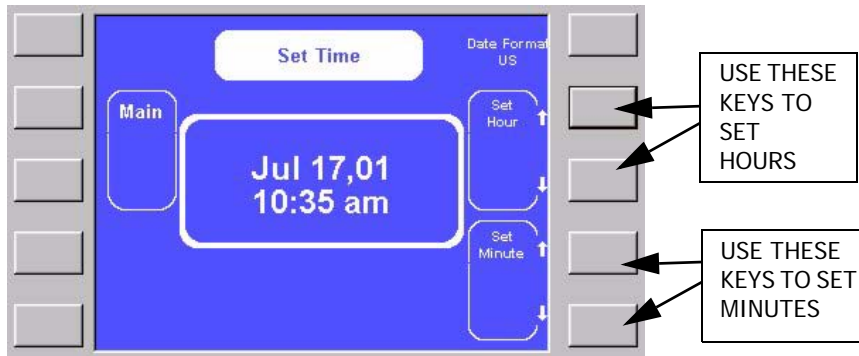


Figure 5-6. Setting the Time

1. Adjust the hours or minutes setting using the appropriate keys as shown in Figure 5-6, above until desired time is displayed.
2. To exit the screen and return to the Start Up Screen, press the key next to the **Main** field.

Film/Screen Defaults Screen

The Film/Screen Default Screen (see Figure 5-7) is used to configure the default film/screen combination for the various image receptors used with the generator. This setting applies to AEC and APR AEC mode exposures only. If the selected film/screen combination has not already been calibrated, it must be calibrated according to the AEC Calibration procedures later in this chapter using the selected film/screen combination setting.

The generator has been pre-configured with seven different film/screen combination selections designated "Wall 40\"", "Wall 72\"", "Table 40\"", "100 Speed", "200 Speed", "800 Speed", and "Film/Screen7". If the Digital Receptor setting in Service Configuration Menu is enabled, an eighth option entitled "Digital" will be also be selectable. Note that the factory default film/screen combination names may be changed using the film/screen combination name edit utility as described in Service Manual.

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The Film/Screen Defaults screen, shown below, displays the current receptor film/screen combination settings. To change the default film/screen settings, proceed as follows

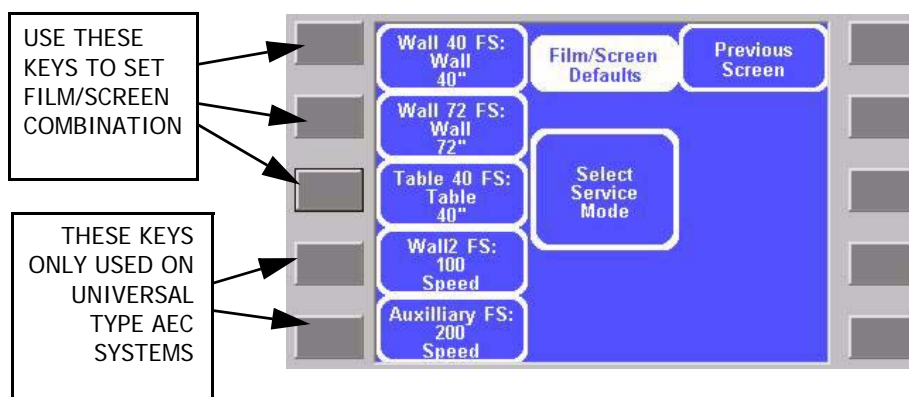


Figure 5-7. Film/Screen Defaults Screen



NOTE: The "default" film/screen combination settings automatically link specific calibrated film/screen combinations that will be used in non-APR and APR exposures that use AEC. However, the operator may choose any available calibrated film/screen combination using the Film/Screen selection keys provided in the AEC and APR mode screens.

1. **Wall 40 FS** setting: Press the key next to the **Wall 40 FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "WALL 40" image receptor is selected for exposures using AEC and APR AEC mode exposures.
2. **Wall 72 FS** setting: Press the key next to the **Wall 72 FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "WALL 72" image receptor is selected for exposures using AEC and APR AEC mode exposures.
3. **Table 40 FS** setting: Press the key next to the **Table 40 FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "TABLE" image receptor is selected for exposures using AEC and APR AEC mode exposures.
4. **Wall2 FS** setting (enabled only generators equipped with "Universal" type AEC [i.e., AEC Board A11 AY40-027S is installed]): Press the key

Chapter 5 User Maintenance

next to the **Wall2 FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "WALL2" (AUX) image receptor is selected for exposures using AEC and APR AEC mode exposures.

5. **Auxiliary FS** setting (enabled only generators equipped with "Universal" type AEC [i.e., AEC Board A11 AY40-027S is installed]): Press the key next to the **Auxiliary FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "AUX" image receptor is selected for exposures using AEC and APR AEC mode exposures.

Language Setting

The Service Settings Menu, shown below, displays the current language setting. The default language setting is English. To change the language setting, proceed as follows:

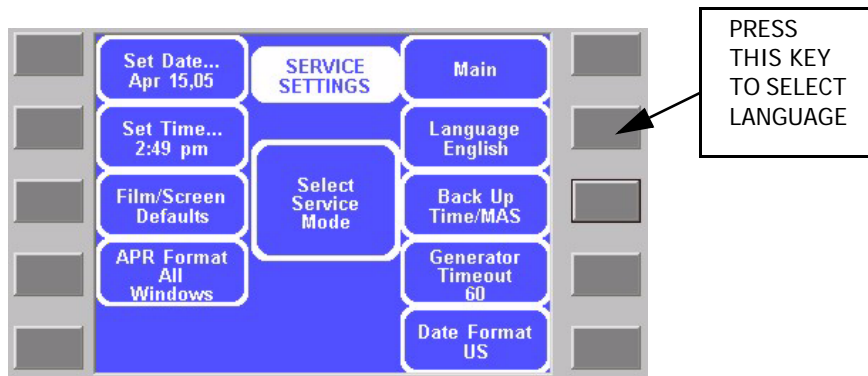


Figure 5-8. Choosing Language and Date Format Settings

Press the key next to the **Language** field to scroll through available languages (English, French, Spanish, German, Italian, etc.) until desired language is displayed.

AEC Backup Setting

The AEC Backup Setting screen, shown below, displays the current AEC backup mAs setting. Note that this is the system-wide backup mAs setting, and as such, will be effective on all AEC exposures. The procedure-specific back up time is set using the APR Edit function (refer to APR Edit chapter in the Operator Manual for instructions on setting individual procedure backup mAs). Note: The lower of the two backup settings will take precedence when set to unequal values.

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To change the system-wide backup mAs setting, proceed as follows:

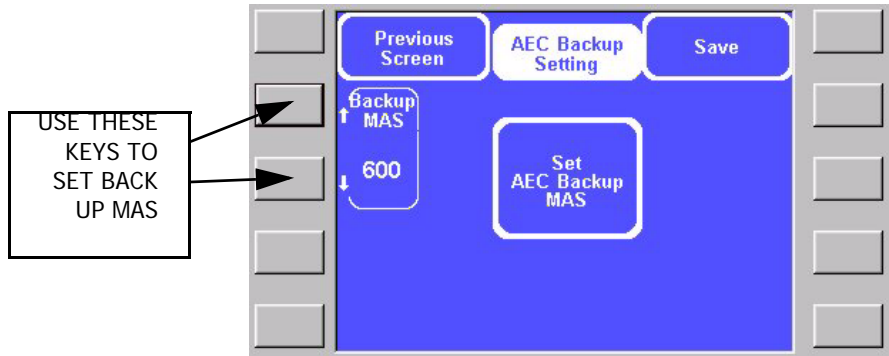


Figure 5-9. Choosing a Back Up Time/MAS Setting

1. Adjust the backup mAs setting using the appropriate keys as shown in Figure 5-9, above until desired back up mAs is displayed.
2. To save the indicated back up mAs setting and return to the Service Settings Menu, press the key next to the **Save** field or the **Previous Screen** field.

Generator Timeout Setting

The Service Settings Menu, shown below, displays the current automatic generator power shutdown setting. The time period selected represents the amount of delay time, after which if no user activity is detected, the system automatically enters Automatic Power Stand By mode. This mode is entered to help reduce power consumption while protecting system electronics. To set the generator timeout setting, proceed as follows:

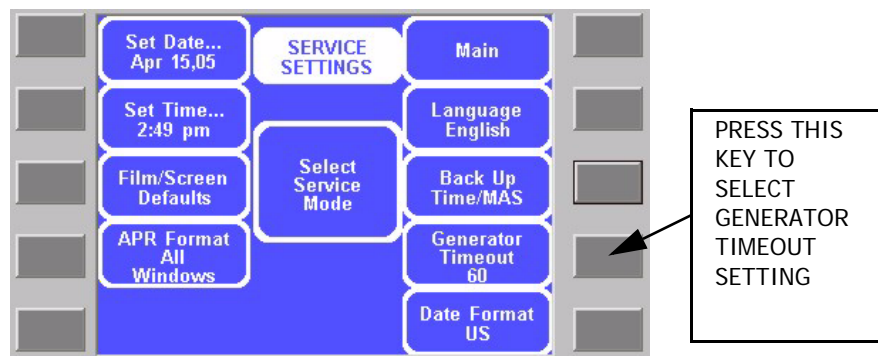


Figure 5-10. Choosing Language and Date Format Settings

Press the key next to the **Generator Timeout** field to scroll through available time period settings [0 (timeout disabled), 30, 60, 90, 120, 150, 180 minutes] until desired setting is displayed.

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Date/Time Format Setting

The Date Format field (see Figure 5-10) displays the current date/time format setting. To change the date/time format setting, proceed as follows:

1. Press the key next to the **Date Format** field to select either "US" (e.g., JUN 11,01 2:00 pm) or Int'l (e.g., 11 JUN 01 14:00) date/time format used for display of date and time on all applicable system screens.
2. To exit the screen and return to the Service Menu, press the key next to the **Main** field.

Chapter

6

WARRANTY INFORMATION



Chapter 6 Warranty Information

WARRANTY STATEMENT

Quantum Medical Imaging, LLC (herein known as "QMI") warrants to buyer that any new product manufactured by QMI will be free from defects in material and manufacturing and conform substantially to applicable specifications in effect on the date of shipment when subjected to normal, proper and intended usage by properly trained personnel. QMI will act as the sole judge in determining whether equipment or part is defective by reason of manufacture.

All QMI products shall be warranted for a period of 12 months from the original installation, the date of which will be determined by a completed, returned warranty card, which must be returned to QMI headquarters within 30 days of system installation. In no case shall the warranty exceed 15 months from the date of shipment. If the warranty card is not returned to QMI, then the warranty period will begin immediately on the date of shipment (invoice date) and last for twelve months. Buyers should complete only one (1) form per system or component.

WARRANTY CARD

Cut along dashed line



Name of Owner _____		
Name of Facility _____		
Address 1 _____		
Address 2 _____		
City _____		State _____
Country _____		Zip _____
Phone _____		
e-mail _____		
Name of Distributor _____		
Installation Date _____		
Check Type of Equipment and Provide ID No.'s:		
	<u>Model No.:</u>	<u>Serial No.:</u>
<input type="checkbox"/> Hi-Freq. Generator	_____	_____
<input type="checkbox"/> Table	_____	_____
<input type="checkbox"/> Collimator	_____	_____
<input type="checkbox"/> Hi-Tension Cable	_____	_____
<input type="checkbox"/> Tube	_____	_____
<input type="checkbox"/> Tube Stand	_____	_____
<input type="checkbox"/> Wall Stand	_____	_____
<input type="checkbox"/> Other	_____	_____

Chapter 6 Warranty Information

Fill in and mail Warranty Card promptly to:

Quantum Medical Imaging, LLC
2002-B Orville Drive North
Ronkonkoma, NY 11779-7661 USA

Any component furnished without charge to Buyer/Dealer during the warranty period to correct a warranty failure shall be warranted only to the extent of the unexpired term of the warranty of the original product. This warranty extends only to the original purchase and is not transferable unless authorized in writing by Quantum Medical Imaging, LLC.

Products manufactured by parties other than QMI, where QMI acts solely as distributor or reseller, will carry their respective manufacturers' warranties, including each of their independent terms and conditions.

Warranty consideration will be given only for defective QMI products properly returned to the factory in accordance with QMI's Returned Materials Procedure (refer to Dealer Price Book or contact QMI customer service).

WARRANTY EXCLUSIONS

The foregoing warranties are exclusive and in lieu of all other warranties, whether written, oral, express, implied or statutory. **NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE SHALL APPLY.** Quantum Medical Imaging, LLC (QMI) Warranty is exclusive of:

- 1) Failure of Buyer/Dealer to prepare the site or provide power requirements or operating environmental conditions in compliance with any applicable instructions or recommendations of QMI.
- 2) Failure of Buyer/Dealer to provide the proper incoming power required to support the equipment in accordance with the recommendation of QMI.
- 3) Any modification of product performed by a party other than QMI.
- 4) Combining products deemed by QMI to be incompatible.
- 5) Improper or extraordinary use of the Product, improper maintenance of the Product, or failure to comply with any applicable instructions or recommendations of Quantum Medical Imaging, LLC.
- 6) Misuse, tampering or, negligent storage/handling of the Product by Buyer, its employees, agents or contractors.
- 7) Fuses, glassware, high voltage cables and other items deemed by QMI to be expendable.
- 8) Acts of God, acts of civil or military authority, fires, floods, power failure or electrical power surges, strikes or other labor disturbances, war riots or other causes beyond the reasonable control of Quantum Medical Imaging, LLC.
- 9) Installation, troubleshooting or repair service are not included in this warranty. Technical service and maintenance is the responsibility of the dealer selling the equipment.
- 10) The Manufacturer is relieved of any responsibility for damage during shipment after the freight carrier picks up and begins transport of the unit for delivery.

Chapter 6 Warranty Information

BUYER'S REMEDIES

If Quantum Medical Imaging LLC determines that any Product fails to meet any warranty during the applicable warranty periods, Quantum Medical Imaging, LLC shall correct any such failure as follows:

- A) By repairing, adjusting, or replacing any defective or non-conforming Parts or Products.
- B) By making available any necessary repaired or replacement parts or assemblies.

Quantum Medical Imaging shall have the option to furnish either new or exchange replacement parts or assemblies. All returned parts shall become the property of Quantum Medical Imaging if said parts have been determined by QMI to be defective by reason of manufacture.

The preceding Paragraphs set forth Buyer's Remedies and Quantum Medical Imaging's sole liability for claims based upon failure of the product to meet any warranty, whether the claim is on contract, warranty, Tort (including negligence and strict liability) or otherwise, and however instituted. And upon the expiration of the applicable warranty period, all such liability shall terminate. In no event shall Quantum Medical Imaging be liable for special or consequential damages arising out of the use or ability to use its equipment whatsoever.

The warranties and remedies available to the buyer are conditioned upon all claims under this warranty being made in accordance with the aforementioned warranty statement.

WARRANTY RETURN PROCEDURE

A fully completed Field Returned Material Evaluation Form must be returned with any defective product or any returned item. All returns must have the Serial Number of the Equipment and/or the Specific Part, written on the Field Returned Material Evaluation Form. All freight charges resulting from Warranty Returns are the responsibility of the Buyer or Dealer.

EQUIPMENT IN TRANSIT

QMI cannot assume responsibility for any equipment damaged in transit. To protect the buyer/dealer, the receiver of any equipment should examine all cartons and crates carefully at time of delivery. If damage is apparent, make a notation on the delivery receipt, request an inspection by the freight carrier, and if applicable, file appropriate carrier claim. Should concealed damage be detected, immediately notify the freight carrier and request an inspection. The purchaser (dealer/customer) is fully responsible for the filing of freight damage claims to the freight carrier.

Quantum Medical Imaging, LLC is not responsible for any loss or damage to products once they have been shipped from our factory. The dealer or customer is responsible for full payment to Quantum Medical Imaging, LLC for all invoices, as per our standard payment terms, regardless of freight damage or processing of an insurance claim, by the dealer or customer.

Chapter 6 Warranty Information

VOIDING WARRANTY

Any installation, maintenance, repair, service, relocation or alteration to or of, or any other tampering with the product, performed by any person or entity other than Quantum Medical Imaging or a certified Quantum Medical Imaging dealer without the written approval of an authorized person at Quantum Medical Imaging, shall immediately void and cancel all warranties with respect to the affected product.