BodyTom 64®

User Manual

1-NL4100-060 Revision 04

NeuroLogica Corporation

14 Electronics Avenue, Danvers, MA 01923 USA

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Intended use of the system

The BodyTom 64 system is intended to be used for x-ray computed tomography applications for anatomy that can be imaged in the 85cm aperture. The CT system is intended to be used for both pediatric and adult imaging and as such has preset dose settings based on weight and age. The CT images can be obtained either with or without contrast.

The BodyTom 64 system can be used for low dose lung screening. The screening must be performed in compliance with the approved and established protocols as defined by professional medical societies.

*Please refer to clinical literature, including the results of the National Lung Screening Trial (N. Engl J Med 2011;365:395-409) and subsequent literature for further information.

BodyTom 64 Clinical benefit

Computed Tomography (CT) provides real time imaging of bone, soft tissue and blood vessels that can provide detailed information to diagnose, plan treatment for, and evaluate many conditions in adults and children. Additionally, the detailed images provided by CT scans may eliminate the need for exploratory surgery.

Consumer information

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Legal disclaimer

This user manual is intended as a guide for material supplied by NeuroLogica Corp. It provides the operator with necessary information to carry out specific procedures and maintain NeuroLogica produced equipment. Use this manual in conjunction with instruction and training supplied by qualified NeuroLogica personnel.

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This user manual, though complete and accurate, may not provide answers to undocumented changes or unexpected results that could occur from system anomalies.

Contact information

Keep user information readily available to contact **Customer Service** about general assistance or reporting on serious incidents (should they occur).

In the case of a serious incident or adverse event, please notify NeuroLogica at the below contact information and establishments local competent authorities.

To provide any comments, suggestions, or corrections to this user manual, write to and include chapter title and page number:

NeuroLogica Corporation	
Customer Service	14 Electronics Avenue, Danvers, MA 01923 USA
USA and Canada	1-888-564-8561
International	1-978-564-8561
Email	support@neurologica.com

If you have any questions about faults or errors on the system, battery or charge issues, or mechanical issues with the scanner, contact a **Technical Representative**.

If you have questions about the clinical use of your system, building protocols, creating MPRs, imaging artifacts, creating a clinical workflow or process, logging in or access issues, and general usage of the system, contact **Customer Service**.

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Europe Bergerweg 18 6085 AT Horn The Netherlands +31 (0)475 582285 Tel +31 (0)475 582278 Fax EC REP CE 2862	Level 8/15 Talavera Road PO Box 646 North Ryde NSW 2113 Australia M +61 (0)412 563 016 Tel T +61 (0)2 8114 1535 Tel F +61 (0)2 8114 1599 Tel Customer Service: 1-800 060 168	VR Medical Importadora e Distribuidora de Produtos Médicos Ltda Rua Batataes, 391, conjs. 11, 13 e 8º andar CEP: 01423-010 – São Paulo CNPJ: 04.718.143/0001-94 Resp. Técnica: Dra. Cristiane Aparecida de Oliveira Aguirre- CRF-SP 21079 Registro ANVISA nº: 80102511464

Damage in transportation

Closely examine all packages at the time of delivery. If you see damage, notate **"damage in shipment"** on all copies of the freight bill ***before*** you accept or sign for delivery (by the facility receiving agent).

Whether damage is noted immediately or concealed (noticed after delivery), damage ***must*** be reported to carrier ***immediately*** upon discovery, or within 14 days after receipt, and content and containers held for inspection by carrier.

Keep in mind – the transportation company ***will not*** pay a claim for damage if an inspection is not requested within the 14-day period.

User requirements

The equipment can *only* be operated by users who have received professional medical education and training, such as radiologic technologists, physicians, radiologists, and other medical specialists.

Users should be trained professionals who are certified to operate such systems ***before*** scanning or diagnosing patients. This training must include medical and x-ray education, as well as NeuroLogica applications training.

Everyone that uses this equipment must read, understand, and follow all instructions, precautions, and warnings.

Keep this user manual near the equipment. It is important to review the procedures and safety precautions periodically.

Essential Performance

The BodyTom 64 has the following essential performance factors mitigated by design:

- Over Radiation protection
- Re-scan prevention
- Stray Radiation exposure prevention
- Diagnostic performance

About this user manual

The instructions in this user manual describe how to use the NeuroLogica BodyTom 64 Computed Tomography (CT) system, manufactured by NeuroLogica Corp. BodyTom 64 is the trade name for the CT system and NL4100 is the device model.

This user manual ***does not*** provide medical explanations but does suggest potential applications for some of the software features. This user manual describes potential safety problems and how to avoid them.

Anyone who operates this system should have received training ***before*** attempting to scan or diagnose patients, to include medical and x-ray education, as well as NeuroLogica applications training.

This manual is made available in electronic format to the customer as part of each product delivery.

For electronic manuals, please go to: Forms.samsungneurologica.com.

Click on “Downloads” and choose “CT Manuals”. The site will ask for the serial number of your product and a password. The password can be provided from Field Service.

Translation of this manual is available for any country that does not allow for English labeling. Please reach out to NeuroLogica directly if translation is required.

Identified symbols and system classifications

The specifications and details of this user manual may change to improve the product or to enhance its performance.

Throughout this user manual, a yellow triangle with a black border and exclamation point is used to draw attention to those conditions or situations that fit one or more of the following criteria, which are definitions from ANSI Z535.5:

DANGER Indicates a hazardous situation, which if not avoided ***will*** result in death or serious injury.

WARNING Indicates a hazardous situation, which if not avoided ***could*** result in death or serious injury.

CAUTION Indicates a hazardous situation, which if not avoided ***could*** result in minor or moderate injury.

Conventions used in this user manual

Table 1: Conventions used in this user manual

Convention	Use
Commands to perform actions	To perform a string of commands, this user manual will present them as follows: **Customize > System**. This means click **Customize** and then click **System**.
Bold	When content refers to commands, windows, screens, dialog boxes, popups, tabs, buttons, options, keyboard keys, statuses, and modes, these items appear in **bold** for faster identification, especially in a procedure.
Italic	Identifies a word that is emphasized for your attention.

Convention	Use
Numbered steps	Numbered paragraphs represent sequential steps that require you to take the action ***in the sequence*** provided – unless otherwise instructed. Procedures that are numerical mean that the sequence is important to follow. You may perform some procedures out of the recommended sequence; however, the results may vary.
Note	The appearance of a note is as such: **Note** Indicates additional information to help you operate this product.
Hyperlink (an electronic cross-reference)	A cross reference appears in the electronic (.pdf) user manual as a hyperlink. To retrieve an electronic copy of this user manual (in .pdf), click **Help > User Manual** from the workstation. A **hyperlink** is a quick way to go to another area of the user manual with a simple click. Hyperlinks appear like this: "Understanding the types of users" on page 98. In this case, hover the mouse pointer over the gray hyperlink text. Hold the **Ctrl** key on your keyboard and click the mouse button. After you click the hyperlink, the hyperlink takes you to the referenced area in the user manual.
Click vs right-click	In this user manual, click means to press the left mouse button. This user manual never says 'left click' as it is assumed that is the traditional way to click; however, it does point out when to right click the mouse button.

Understanding the use of "you" in this user manual

Unless specifically noted, the implied "you", in this user manual, is the user/operator. It is assumed users/operators are certified and medically trained personnel, qualified to use these systems.

The following identifies those actions each user is permitted to perform:

Administrator	Full access to the system and its configurations. Can create protocols, User ID's, and passwords, as well as access all functions of the system.

Limited operator	Modified access to the system. Users with Limited access can modify protocols during scanning but cannot create and save protocols; has no access to system configurations.
Restricted operator	Users with Restricted access can scan with the system but are unable to make any changes to protocol parameters while scanning, they also have no access to system configurations.

Active and inactive objects

When a menu command, option, button, tab, field, is gray, the item is not active or enabled. When an item is gray, it can mean additional or required tasks must be completed first or you do not have permission to access that option. An active menu command, option, button, tab, and field means you can use the item to perform an action. Active items are green and/or highlighted.

Chapter 1 Compliance and Safety Requirements

It is important that you are aware of and familiar with compliance and safety requirements to ensure you, the patient, and the systems are safe at ***all*** times.

IEC classification and symbols

In accordance with International Safety Standard IEC 60601-1, the BodyTom 64 CT scanner is classified as Type B equipment; Class 1 equipment, internally powered equipment, and continuous connection to the supply mains in standby state and for specified loading.

Type B equipment provides an adequate degree of protection against shock, regarding:

- Allowable leakage current.
- Reliability of the protective earth connection.
- (In accordance with the International Safety Standard IEC 60601-1), the manufacturer is not responsible for any consequences caused by the unauthorized modification of this equipment.
- Earth leakage current.

WARNING Equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.

WARNING Equipment is not suitable for use with oxygen or oxygen enriched atmospheres.

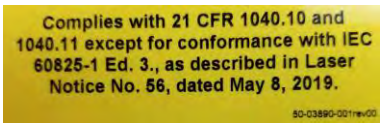
BodyTom 64 Computer Tomography systems comply with Class I- Type B equipment as defined in IEC 60601-1 standard.

Mode of operation is a continuous connection to the supply mains in standby state and for specified loading conditions.

The BodyTom 64 CT scanner is patient-environment equipment.

Table 2: Applicable symbols

Symbol	Description
	Alternating current
	Protective earth (ground)

Symbol	Description
	Functional Earth
	Caution: consult accompanying documents
	Caution: risk of electrical shock
	Electrostatic sensitive devices
	Type B equipment
	X-ray warning
	X-ray source assembly emitting
	Non-ionizing radiation
	Warning: laser in use
	Warning: Laser Radiation Do Not Stare into Beam Class 2 Laser Product Laser Output and Standards Information Label
	Warning: FDA Laser Information
	Warning: high temperature
	Emergency switch
	Crush warning
	Foot/toe crush warning when lowering machine
	System up

Symbol	Description
	System down
	Temperature limits
	Keep away from rain for packaging
	Humidity limit for packaging
	Warning: battery charging
	Fuse usage
	Refer to instruction in user manual/booklet
MD	Medical Device Symbol
	Legal Manufacturer Symbol
ETL CLASSIFIED Intertek	Intertek ETL (Edison Testing Laboratories) Mark
EC REP	European Authorized Representative Symbol
CE 2862	CE Mark or Conformité Européenne ; number below CE represent Notified Body number

WARNING This x-ray unit may be dangerous to patient and operator unless safe exposure factors and operating instructions are observed.

Environmental specifications

CAUTION The specified environment must be constantly maintained: 24-hours a day, seven days a week.

Table 3: Operating environment

Operating	
Ambient temperature	15º C to 35º C (59ºF to 95º F)
Relative humidity	20% to 80% (non-condensing)
Altitude	0-3048m (0-10,000 ft.)
Storage	
Temperature	-25º C to 70º C (-13º F to 158º F)
Relative humidity	20% to 85% (non-condensing)
Transport	
Temperature	-20º C to 60º C (-4º F to 140º F)
Relative humidity	20% to 85% (non-condensing)
Powering system	
Time period prior to powering the system	24 hours[1]
Floor	
Flatness	<+/1 0.120in. (3mm) per 10ft. (3.048m)
Recommended minimum scan area	10ft. x 15ft. (3.048m x 4.572m)

Note For good image quality, the recommended practice is to keep the system free from vibration and to maintain the flatness specification noted.

If the system is in a facility outside the noted operating temperature, it is recommended to allow the noted time for the system to acclimate to the environment.

Table 4: System operating parameters and specifications

Phase	120V~ Single	240V~ Single
Voltage range	100-120V~±10%	208-240V~ ±10%
	Nominal voltage for U.S. 120, 240	
Circuit protection	20 amps	30 amps
Facility outlet	NEMA 5-20R	NEMA 6-30R
	Outline of outlet:	

Phase	120V~ Single	240V~ Single
		
Frequency	50 or 60Hz	50 or 60Hz
Battery capacity	Fully charged, 12 hours typical	
Typical usage	110-120V~ 60Hz	230-240V~ 50Hz
Wiring	125V, 2 pole, 3 wire grounding	250V, 2 pole, 3 wire grounding
Main power supply's apparent resistance	0.105Ω	
Heat dissipation (when system is not idle)	55kW	

Considerations when preparing gantry for use

CAUTION Check for obstructions before moving and system setup.

CAUTION Monitor scanner motion to prevent collision with surrounding environment and foreign objects.

CAUTION Press the red **EMERGENCY STOP** button immediately in case of abnormal or unexpected motion.

WARNING Verify scanner is on its centipedes (fully down position) prior to positioning patient at scanner entrance.

WARNING Make sure all extremities are not under scanner while lowering or raising it.

WARNING In the case of a single pendant failure, the additional pendant is available for use to prevent loss of system function.

WARNING Always keep patient in view. Ensure that the patient can be seen when the operator is near the scanner control panel and **EMERGENCY STOP** button. Never leave patient unattended when the patient is in the gantry.

- NeuroLogica advises complying with local regulations and/or site recommendations as specified by the facility physicist or certified representative for the following:

- Use mobile x-ray protective-shielding devices. Technologists should be at the correct location and consider wearing personal radiation protective equipment.
- A radiation safety plan in the working area boundaries, to optionally include as needed, mobile x-ray protective shielding devices. Otherwise assign a larger, working area to avoid radiation to the public. Effective dose for people outside the working area should be less than 0.25mSv annually (equals to 5 uSv weekly). The air kerma rate 0.3 meters away from the working area will be smaller than 2.5 uGy/h. Have monitoring and personal dose management for occupational exposure and related public health care personnel.
- There should be a working plan before scanning. The plan should include CT condition, time, location, working area, scanning plan, and site-clearing method; clearly state the responsibilities of working, protection, and management personnel. Keep a good record of the whole process.
- Restrict the working control and monitor area. Place obvious warning signs at the control-area boundaries to prevent unauthorized personnel from entering. Installation of a working status indication light is recommended.
- In accordance with the safety plan, self-monitor during the scanning process. A certified radiation representative should monitor the working area and take measurements immediately if abnormal circumstances are detected. Additionally, this should be reported to the local environmental administrative and health departments. There should be a public notice at the working area, to include the nature of work, time, location, control area, name of the working department, person in charge of the project, contact telephone number, radiation report telephone number.

Site specification

Table 5: System operating parameters

Operating voltage	100-240 VAC~
Operating frequency	50Hz-60Hz
Apparent resistance of supply mains at 120VAC	0.3 ohms
Operating current at 120VAC	13 amps
Heat dissipation	1672 watts

CAUTION For domestic purposes, scanner can be powered using either 120V~ or 240V~. If the scanner is using 120V~, the facility's circuit must be capable of providing 20 amps (single phase). If the scanner is using 240V~, the facility's circuit must be capable of providing 30 amps (single phase). If other devices are connected to the same circuit, the facility's circuit breaker may trip and, therefore, prevent the scanner from being ready when needed.

Table 6: Battery operating parameters

Operating voltage	480 to 585 VDC
Output current (peak)	100 amps

Site specification for enclosed CT room

Table 7: Site specification

Issue	Comment
Receiving area	Secured
Packing material and waste	Near availability of a trash receptacle for dunnage
Room dimensions for use	12ft. x 15ft. room with a finished level floor; recommended the room be well lit
Power availability	120VAC/20amp wall outlets (2x)
Floor flatness	<± 0.120in. (3mm) per 10ft.
Floor strength	Site must be able to support product weight

Note Not all beds are compatible with this system. Please contact **Customer Service** for assistance.

- NeuroLogica advises complying with local regulations and/or site recommendations as specified by the facility physicist or certified representative for the following:
- There should be enough space inside the CT room. The area should not be less than 30m^2. Any side should not be less than 4m. Leaving any unnecessary items inside the room is prohibited.
- Carpet and soft material cannot be used on the floor. There should not be obstacles on the floor. Ensure flat surface area no less than 12ft. x 15ft. level degree <±3mm per 10ft.
- Appropriate protection measures should be taken to protect staff and to ensure annual-dose-rate is less than 0.25mSv (equals to 5 uSv weekly).

Hazardous substances

Table 8: Hazardous substances

Substance/material	≅ Weight/system
Lead	7.69 kg (17.0lbs.)
Cadmium	0.036kg (0.079lbs.)
Mercury	0kg (0lbs.)
Hexavalent chromium	0kg (0lbs.)
PolyBrominated Biphenyls (PBB)	<0.46kg (1lb.)
PolyBrominated Diphenyl Ethers (PBDE)	<0.46kg (1lb.)

Part numbers and product-marking plates

Table 9: Core-system-component part numbers and product-marking plate locations

Component	Part number	Product-marking plate locations
BodyTom 64 gantry	0-NL4100-000 10-00345-0001	Near the main input plug or on the side of the system. See Figure 1: Product-marking plate on scanner below.
BodyTom 64 workstation	40-00157-000	On the back of the workstation.
QA phantom	10-00268-001	On the back of the phantom.

Note The applicable components making up the BodyTom 64 CT scanner is identified with the nameplate statement "This product complies with radiation performance standards, 21 CFR sub-chapter J."

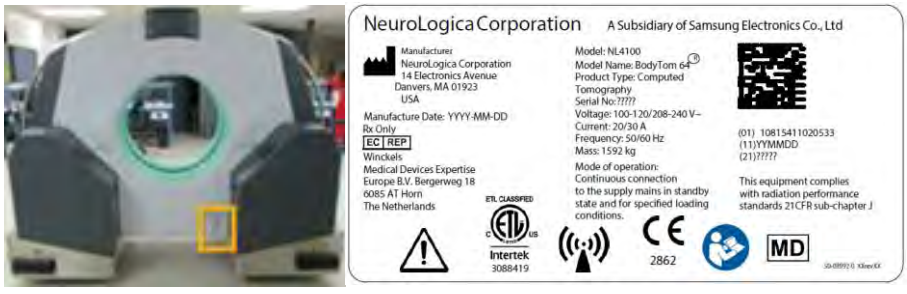


Figure 1: Product-marking plate on scanner

Table 10: Core-system component dimensions

Component / mode		Size L x W x H	Weight
BodyTom 64 NL4100	Scan	256.5cm x 104cm x 199cm	3510 lbs. 1592 kg
		101in. x 41in. x 79in.	
	Transport	256.5cm x 104cm x 205.7cm	
		101in. x 41in. x 81in.	
	Bore	85cm	
		33in.	

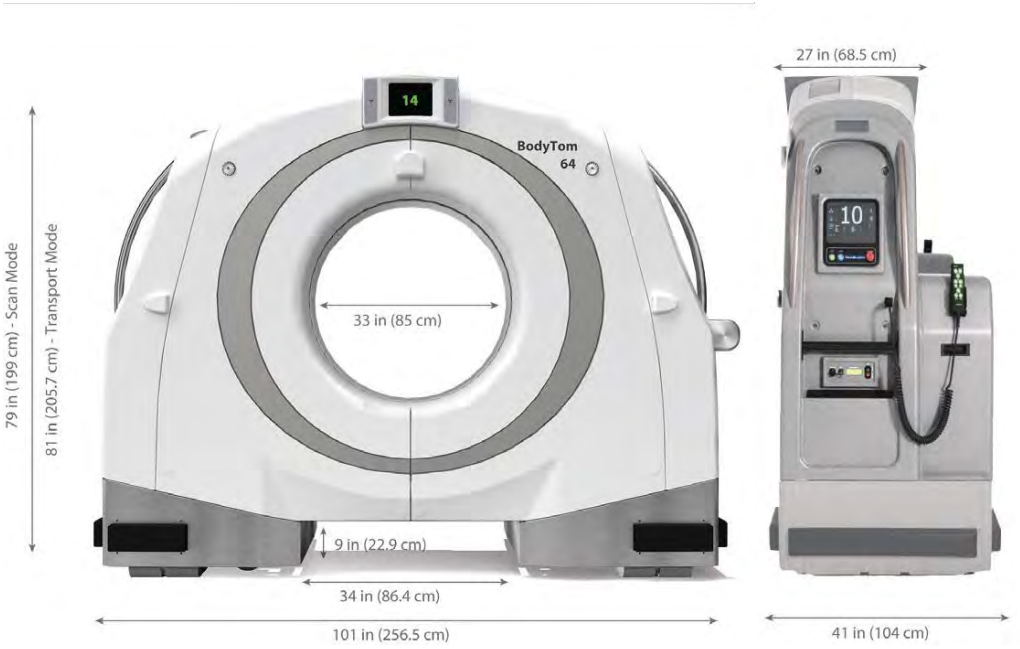


Figure 2: Scanner dimensions including drive bar

Table 11: Workstation dimensions

Component	Size (inches) L x W x H	Size (centimeters) L x W x H	Weight (lbs)	Weight (kg)
BodyTom 64 Workstation Cart	26.3 x 24.4 x 79.8	66.8 x 62.0 x 202.7	207	94

Class 1 Type B medical devices

This equipment generates, uses, and can radiate radio-frequency energy. The equipment may cause radio-frequency interference to other medical and non-medical devices and to radio communications. To provide reasonable protection against such interference, this product complies with emission limits for Class 1 medical devices as stated in EN 60601-1-2.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment is found to cause interference (which can be determined by switching the equipment on and off), the user should attempt to correct the problem using one or more of the following measures:

- Re-orient or relocate the affected device(s).
- Increase the separating space between the equipment and the affected device.
- Power the equipment from a source different from that of the affected device.
- Consult the point of purchase or the service representative for further suggestions.

  NeuroLogica Corp. is not responsible for any interference caused either by the use of interconnect cables other than those recommended or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

To comply with the regulations applicable to an electromagnetic interface for a **Group 1 Class A** medical device, note the following:

- All interconnect cables to peripheral devices ***must be*** shielded and properly grounded.
- Use of cables not properly shielded and grounded may result in the equipment causing radio-frequency interference in violation of the European Union's Medical Device Directive and FCC regulations.

CAUTION Ensure there is no potentially detrimental interaction of system's irradiation with a patient's active and implantable medical devices and/or body-worn and active medical devices.

CAUTION Do not use devices that intrinsically transmit radio waves, such as a cellular phone, radio transceiver, mobile radio transmitter, radio-controlled toy, and so on. Use of these devices near this equipment could cause this equipment to malfunction. Keep power of these devices turned off when near this equipment. Medical staff in charge of this equipment is required to instruct technologists, patients, and other people who may be around this equipment to fully comply with the above regulation.

- Medical staff in charge of this equipment are required to instruct technologists, patients, and other people who may be around this equipment to fully comply with the above regulations.

Focal spot

Nominal size is: ~1.2 x 1.4mm

Size limit is: ~1.2 to 1.7mm width and ~1.4 to 1.9mm length.

Testing standard for reference is as follows:

- IEC 60336:2005

Focal spot centering is within 1mm of center of bolt pattern. Maximum motion due to gravity in X, Y, and Z axis is 0.1mm.

Maximum motion from anode rotation is 0.1mm.

Maximum motion from anode heating in X axis is 0.1mm. Maximum motion from anode heating in Z axis is 0.3mm.

Anode input power

The maximum anode cooling rate is 8,750W (12,250 HU/sec).

The maximum anode heat dissipation is 3,400W (4,760 HU/sec).

The nominal anode input power is 42kW.

Continuous anode input power when applied at the nominal, x-ray, tube-voltage is 150kV, 23mA.

Filtration

Table 12: Filtration

Tube Voltage (kV)	100	120	140
Half-value layer (aluminum equivalent)	6mm	7mm	8mm
Filters consist of 0.0014in. [0.036mm] of copper and 0.086in. [2.18mm] of aluminum, along with a variable thickness bowtie filter made from Teflon®.			
X-ray tube's total filtration of irremovable layers is 1.0mm of equivalent aluminum.			

Source to Detector distance (SID)

The SID value is 1041.9mm.

Compliance statement

Note All editions and years of revisions for standards noted in this chapter are static as of Revision 00.

The BodyTom 64 system complies with the regulatory requirements of the following:

- AAMI ES60601-1 Issue: 2005 Version - Medical Electrical Equipment, Part 1: General Requirements for Basic Safety and Essential Performance; Amendment No. 2: 2010/05/30.
- CAN/CSA-C22.2 No. 601.1-M90(R2005) Issued: 2003/11/01 Medical Electrical Equipment – Part 1: General Requirements for Safety; General Instruction No. 1: 1990, Supplement 1: 1994, Amendment 2: 1998, General Instruction No. 2: 2003.
- CENELEC EN 60601-1 2nd Edition, Medical Electrical Equipment - Part 1: General Requirements for Safety, includes Amendment A1:1993 and A2:1995.
- CENELEC EN 60601-1 3rd Edition, Medical Electrical Equipment - Part 1: General Requirements for Safety.
- CSA C22.2#60601-1 Issued: 2008/02/01 Ed 3 Medical Electrical Equipment - Part 1: General Requirements for Basic Safety and Essential Performance.
- IEC 60601-1 Issued: 2005/01/01 Ed 3 Medical Electrical Equipment Part 1: General Requirements for Basic Safety and Essential Performance.
- IEC 60601-1-1 (2000) 2nd Edition: Medical Electrical Equipment, Part 1: General Requirements for Safety - Collateral Standard: Safety Requirements for Medical Electrical Systems.
- IEC 60601-1-2:2014 Ed4.0 Medical Electrical Equipment - Part 1-2: General Requirements for Basic Safety and Essential Performance - Collateral Standard: Electromagnetic Disturbances
- IEC 60601-1-3 (2008), Medical Electrical Equipment Section 1-3: General Requirements for Safety. Collateral Standard: General Requirements for Radiation Protection in diagnostic X-ray Equipment.
- IEC 60601-1-4 (2005), 3rd Edition Consolidated Edition, Medical Electrical Equipment Part 1-4: General Requirements for Safety – Collateral Standard: Programmable Electrical Medical Systems.
- IEC 60601-1-6 Issued: 2008/12/08 Ed 2 Medical Electrical Equipment - Part 1-6: General Requirements for Safety. Collateral standard: Usability.
- IEC 60601-2-28 (1993) Medical Electrical Equipment, Part 2: Particular Requirements for the Safety of X-ray Source Assemblies and X-ray Tube Assemblies for Medical Diagnosis.
- IEC 60601-2-32 (1994) Part 2-32, Particular Requirements for Safety sections 2.32 Specification for Associated Equipment of X-ray Equipment.

- IEC 60601-2-44 (2009) Medical Electrical Equipment -Part 2-44: Particular Requirements for the Safety of X-ray Equipment for Computed Tomography.
- IEC 60825-1:2007 Safety of Laser Products - Part 1: Equipment Classification, and Requirements 2nd Ed.
- International Electrotechnical Commission (IEC) International Standards Organization, when applicable.
- Intertek Testing Service (ITS), an independent testing laboratory.
- Medical Device Good Manufacturing Practice Manual issued by the FDA (Food and Drug Administration). Department of Health, USA.
- NeuroLogica Corporation is ISO 13485:2016 and MDSAP certified.

EMI/EMC terms

Electromagnetic Compatibility

Electromagnetic Compatibility (**EMC**) is the branch of electrical sciences that studies the unintentional generation, propagation, and reception of electromagnetic energy with reference to the unwanted effects (**Electromagnetic Interference** (**EMI**)) that such energy may induce. The goal of EMC is the correct operation, in the same electromagnetic environment, of different equipment, which use electromagnetic phenomena and the avoidance of any interference effects.

To achieve this, EMC pursues two different kinds of issues. Emission issues are related to the unwanted generation of electromagnetic energy, to the countermeasures that should be taken to reduce such generation, and to avoid the escape of any remaining energies into the external environment. Susceptibility or immunity issues, in contrast, refer to the correct operation of electrical equipment in the presence of unplanned electromagnetic disturbances.

Interference, or noise, mitigation, and hence EMC is achieved by addressing both emission and susceptibility issues, that is., quieting the sources of interference, making the coupling path between source and victim less efficient, and making the potential victim systems less vulnerable.

Electromagnetic Interference (EMI)

Electromagnetic Interference (**EMI**), also called **Radio Frequency Interference** (**RFI**) is an unwanted disturbance that affects an electrical circuit due to electromagnetic radiation emitted from an external source. The disturbance may interrupt, obstruct, or otherwise degrade or limit the effective performance of the circuit. The source may be any object, artificial or natural, that carries rapidly changing electrical currents, such as an electrical circuit, the sun, or the northern lights.

Susceptibility

Susceptibility is the capability of an electronic system to respond to unwanted electrical energy.

EMI/EMC compliance

This equipment complies with IEC 60601-1-2 EMC standard for medical devices.

The BodyTom 64 system is suitable to be used in an electromagnetic environment, as per the limits and recommendations described in the tables hereafter:

- Emission Compliance level and limits (see Table 14).

Note This system complies with the above-mentioned EMC standard when used with supplied cables. If different cable lengths are required, contact a qualified service representative for advice.

Table 13: Acronyms and abbreviations

Acronym and abbreviation	Definition
AEC	Automatic Exposure Control
CBF	Cerebral Blood Flow
CBV	Cerebral Blood Volume
CT	Computed Tomography
CTA	CT Angiography
CTP	CT Perfusion
$CTDI_{vol}$	Volume Computed Tomography Dose Index
$CTDI_{w}$	Weighted average Computed Tomography Dose Index
DICOM	Digital Imaging Communication in Medicine
DLP	Dose Length Product (DLP)
DHCP	Dynamic Host Control Protocol

Acronym and abbreviation	Definition
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FOV	Field Of View
HIS	Hospital Information System
HU	Hounsfield Unit
IBC	Iterative Bone Correction
MAR	Metal Artifact Reduction
MIP	Maximum Intensity Projection
MPPS	Modality Performed Procedure Step
MPR	Multi-Planar Reformation, sometimes referred to as Multi-Planar Reconstruction
MTT	Mean Transit Time
PACS	Picture, Archiving, and Communication System
QA	Quality Assurance
RIS	Radiology Information System
RSO	Radiation Safety Officer
RFI	Radio Frequency Interference
SCP	Service Class Provider
SCU	Service Class User

WARNING Medical, electrical equipment needs special precautions regarding EMC and needs to be installed and put into service according to EMC information provided in accompanying documents.

CAUTION Portable and mobile RF communications equipment can affect medical electrical equipment.

CAUTION Do not use or stack the equipment or system with other equipment and if adjacent or stacked use is necessary, the equipment or system should be observed to verify normal operation in the configuration in which it will be used.

Note The EMC tables and other guidelines included in this user manual provide information to the user essential in determining the suitability of the equipment or system for the electromagnetic environment of use, and in managing the electromagnetic environment of use; to permit the equipment or system to perform its intended use without disturbing other equipment and systems or non-medical electrical equipment.

Note The EMISSIONS characteristics of this equipment make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the equipment.

Table 14: Emission declaration for BodyTom 64 systems

BodyTom 64 system is intended for use in electromagnetic environment specified below. The user of the BodyTom 64 system should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment guide**
RF emissions CISPR 11	Group 1	BodyTom 64 systems use RF energy only for internal function. Therefore, RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11 Harmonic emissions, IEC 61000-3-2 Voltage fluctuations/flicker emissions, IEC 61000-3-3	Class A Class A Complies	BodyTom 64 systems are predominantly intended for use in non-domestic environments, and not directly connected to the Public Mains Network. BodyTom 64 systems are predominantly intended for use (for example, in hospitals) with an appropriate power supply (see operation manual) and recommended shielding for portable use.

Table 15: EMC Immunity declaration for BodyTom 64 systems

BodyTom 64 systems are intended for use in the electromagnetic environment specified below. The customer or user of an BodyTom 64 system should assure that it is used in such an environment.			
Immunity test	**IEC 60601-1-2 test level**	**Compliance level**	**Electromagnetic environment guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±8kV contact ±2kV, ±4kV, ±8kV, 15kV air	±8kV contact ±2kV, ±4kV, ±8kV, 15kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, relative humidity should be at least 30%.

BodyTom 64 systems are intended for use in the electromagnetic environment specified below. The customer or user of an BodyTom 64 system should assure that it is used in such an environment.			
Immunity test	IEC 60601-1-2 test level	Compliance level	Electromagnetic environment guidance
Electrical fast transient/burst IEC 61000-4-4	±2kV for power supply lines ±1kV for input/output lines	±2kV for power supply lines ±1kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1kV line-line ±2kV line-ground	±1kV line-line ± 2kV line-ground	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions, and voltage variations on power supply input lines IEC 61000-4-11	0% UT; 0.5 cycle At 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0% UT; 1 cycle 70% UT; 25/30 cycles 0% UT; 250/300 cycles	0% UT; 0.5 cycle At 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0% UT; 1 cycle 70% UT; 25/30 cycles 0% UT; 250/300 cycles	Mains power quality should be that of a typical commercial or hospital environment. If the user of a BodyTom 64 system requires continued operation during power interruptions, it is recommended that the BodyTom 64 system be powered from its internal batteries.
Immunity test	IEC 60601-1-2 Test Level	Compliance level	Electromagnetic environment guidance.
Power frequency (50/ 60Hz) magnetic field IEC 61000-4-8	30 A/m, 50Hz or 60Hz	30 A/m, 50Hz or 60Hz	Power-frequency magnetic-fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Clause 8.10	Table 17	Per Table 17	IEC 60601-1-2:2014
Clause 8.11	Table 18	Per Table 18	IEC 60601-1-2 ed4.1:2020

BodyTom 64 systems are intended for use in the electromagnetic environment specified below. The customer or user of an BodyTom 64 system should assure that it is used in such an environment.

Immunity test	IEC 60601-1-2 test level	Compliance level	Electromagnetic environment guidance
Conducted RF IEC 61000-4-6	3 Vrms 150kHz to 80MHz 6 Vrms in ISM band 150kHz to 80MHz 80% AM at 1kHz	3 Vrms 6 Vrms 80% AM at 1kHz	Portable and mobile RF communications equipment should be used no closer to any part of the BodyTom 64 system, including cables, than recommended separation distance calculated from the equation appropriate for transmitter frequency. Recommended separation distance: See Table 16.
Radiated RF IEC 61000- 4-3 (alternative method: IEC 61000-4-21)	3 Vrms 80MHz to 2,7GHz 80% AM at 1kHz	E1 = 3 V/m 80% AM at 1kHz	Interference may occur in vicinity of equipment marked with the following symbol: 

Note: The wireless receiver operates within the following bands.
2.412 to 2.462 GHz (11 channels)
5.180 to 5.240 GHz (4 channels)
5.260 to 5.320 GHz (4 channels)
5.500 to 5.700 GHz (8 channels, excluding 5.600 to 5.640 GHz)
5.745 to 5.825 GHz (5 channels)

The preferred frequency band is 5.189 to 5.240 GHz at 40MHz bandwidth.
The wireless transmitter operates within the following frequency bands and power.
802.11b:
Typ. 26±1.5 dBm @ 1 Mbps, Typ. 26±1.5 dBm @ 2 Mbps
Typ. 26±1.5 dBm @ 5.5 Mbps, Typ. 25±1.5 dBm @ 11 Mbps
802.11g:
Typ. 23±1.5 dBm @ 6 to 24 Mbps, Typ. 22±1.5 dBm @ 36 Mbps
Typ. 20±1.5 dBm @ 48 Mbps, Typ. 19±1.5 dBm @ 54 Mbps
802.11n (2.4 GHz):
Typ. 23±1.5 dBm @ MCS0/8 20 MHz,

Typ. 18±1.5 dBm @ MCS7/15 20 MHz
Typ. 23±1.5 dBm @ MCS0/8 40 MHz,
Typ. 17±1.5 dBm @ MCS7/15 40 MHz
802.11a:
Typ. 23±1.5 dBm @ 6 to 24 Mbps, Typ. 21±1.5 dBm @ 36 Mbps
Typ. 20±1.5 dBm @ 48 Mbps,Typ. 18±1.5 dBm @ 54 Mbps
802.11n (5 GHz):
Typ. 23±1.5 dBm @ MCS0/8 20 MHz,
Typ. 18±1.5 dBm @ MCS7/15 20 MHz
Typ. 23±1.5 dBm @ MCS0/8 40 MHz,
Typ. 18±1.5 dBm @ MCS7/15 40 MHz

The device includes 4 dBi gain antennas

Countermeasures against EMC related issues

Generally, it is very difficult to grapple with issues related to EMC. It may take a variable amount of time and cost to identify issues causing interference.

General countermeasures of electromagnetic interference with other equipment:

- Electromagnetic interference may be alleviated by positioning other equipment far from the system.
- Electromagnetic interference may be mitigated by changing relative location (installation angle) between system and other equipment.
- Electromagnetic interference may be eased by changing wiring locations of power/signal cables of other equipment.
- Electromagnetic influence may be reduced by altering the power-supply path of other equipment.
- Electromagnetic environment specified (see Table 15 on page 45).

Table 16: Recommended separation distances

Recommended separation distances between portable and mobile RF communications equipment and the BodyTom 64 system			
BodyTom 64 system is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The user of the BodyTom 64 system can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the BodyTom 64 system as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output Power (P) if transmitter Watts (W)	150kHz to 80MHz Separation distance meters[1]	80MHz to 800MHz Separation distance meters[1]	800MHz to 2,5GHz Separation distance meters [1]
0.01	.12	.12	.23
0.1	.38	.38	.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 separation distance is estimated using the equation in the corresponding column, where P is the maximum output power rating of the transmitters in Watts (W) according to the transmitter manufacturer.			
Note At 80MHz and 800MHz, separation distance for higher frequency range applies. **Note** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.			

[1] Separation distance according to frequency of transmitter (m)

Table 17: Test specifications for ENCLOSURE PORT IMMUNITY to RF wireless communications equipment

Test Frequency (MHz)	Band [a]	Service [a]	Modulation [b]	Max Power (W)	Distance (m)	Immunity Test Level (V/m)
385	380-390	Tetra 400	Pulse Modulation [b] 18Hz	1.8	0.3	27
450	430-470	GMRS 460, FRS 460	FM [c] ±5kHz deviation 1 kHz sine	2	0.3	9
710	704-787	LTE Band 13,17	Pulse Modulation [b] 217Hz	0.2	0.3	9
745						
780						
810	800-960	GSM 800/900, TETRA 800, iDEN 820, CMDA 850, LTE Band 5	Pulse Modulation [b] 18Hz	2	0.3	28
870						
930						
1720	1700-1990	GSM 1800; CMDA 1900; GSM 1900;	Pulse Modulation [b] 217Hz	2	0.3	28
1845						
1970						

Test Frequency (MHz)	Band [a)]	Service [a)]	Modulation [b)]	Max Power (W)	Distance (m)	Immunity Test Level (V/m)
		DECT; LTE Band 1, 3, 4, 25; UMTS				
2450	2400-2570	Bluetooth, WLAN, 802.11 b/g/n, RFID 2450, LTE Band 7	Pulse Modulation [b)] 217Hz	2	0.3	28
5240	5100-5800	WLAN 802.11 a/n	Pulse Modulation [b)] 217Hz	0.2	0.3	9
5500						
5785						

Table 18: Test specifications for ENCLOSURE PORT IMMUNITY to proximity magnetic fields

Test Frequency (MHz)	Modulation	Immunity Test Level (A/m)
134.2 kHz	Pulse modulation 2.1 kHz	65
13.56 MHz	Pulse modulation 50 kHz	7.5

Use recommendations

This product complies with IEC 60601-1-2 standard for medical devices and with radio frequency emission requirements per CISPR11 Group 1 Class A standard limits. The BodyTom 64 system is predominantly intended for use in hospitals.

Do not use devices that intentionally transmit RF signals (cellular phones, transceivers, or radio-controlled products) in the vicinity of this equipment as it may cause performance outside the published specifications. Keep the power to these types of devices turned off when near this equipment.

Adhering to the distance separation (recommended in Table 16 on page 49) between 150kHz and 2.5GHz, will reduce disturbances recorded at the image level, but may not eliminate all disturbances; however, when installed and operated as specified herein, the system will maintain its essential performance by continuing to safely acquire controlled, radiological, x-ray exposures in a mobile radiography environment. For example, a 1W mobile phone (800MHz to 2.5GHz carrier frequency) is put 2.3 meters apart from the BodyTom 64 system (to avoid image interference risks).

The use of accessories, transducers, and cables, other than those specified, may result in degraded, electromagnetic compatibility of the BodyTom 64 system.

The medical staff in charge of this equipment is required to instruct technologists, patients, and other people who may be around this equipment to comply fully with the above equipment requirements.

Installation recommendations

This system complies with above-mentioned EMC standard when used with supplied cables. To minimize interference risks, the following requirements apply.

Cable shielding and grounding

All interconnect cables to peripheral devices must be shielded and properly grounded. Use of cables not properly shielded and grounded may result in the equipment causing radio-frequency interference.

Adjacent components and equipment

BodyTom 64 system should not be used adjacent to or stacked with other equipment; if adjacent or stacked use is necessary, the BodyTom 64 system should be tested and verified to make sure normal operation in the configuration in which it is used. Consult NeuroLogica and Facility **Technical Support** staff regarding device/system configurations.

Static magnetic field limits

To avoid interference on the BodyTom 64 system, static-field limits from the surrounding environment are specified. The static field is specified as less than <1 Gauss around the unit.

Electrostatic discharge environment and recommendations

- To reduce electrostatic-discharge interference, install a charge-dissipative floor-material to avoid electrostatic charge-buildup.
- The relative humidity must be at least 30 percent.
- The dissipative material must be connected to the system ground-reference.

Facility IT-NETWORK

The BodyTom 64 system utilizes the IT-NETWORK for the customer (as applicable) to communicate with the modality worklist and for supplemental, image-storage space. As part of the installation, the applicable IT-NETWORK is reviewed to create the appropriate setup for the system. Setup is done to ensure no potential concerns arise with the system.

CAUTION It is possible that the IT-NETWORK connection from the system could result in previously unidentified issue(s) to the respective population. Should this occur, contact Customer Service right away to identify, analyze, evaluate, and resolve the issue(s).

CAUTION It is possible that any changes to the IT-NETWORK made by the facility could introduce a new issue where Customer Service needs to be contacted to address the concern, right away.

Changes to the IT-NETWORK include – but are not limited to the following:

- Changes in network configuration
- Connection to additional items
- Disconnection to items
- Updating equipment

- Upgrading equipment.

Hazard information

Review this material before using the system and observe basic, common-sense safety rules when operating this scanner.

General safety considerations and statements

Review the following before using the system (Scanner and Workstation (as applicable)) to observe basic, common-sense safety rules when operating the scanner:

- Become familiar with the functional hardware to help recognize serious problems.
- Do not use scanner or workstation if it appears damaged or fails.
- Wait for qualified personnel to correct any problem.

Note The scanner is provided with a video-camera monitoring-system to help navigate the unit while being transported within a facility.

WARNING The health software is installed on a medical device and is required for its operation. In order to securely remove the software from use, the system must be decommissioned.

WARNING Modification of this equipment is ***not*** allowed.

WARNING Equipment maintenance of non-medical electrical equipment should not be performed in the patient environment.

CAUTION All non-medical electrical equipment will comply with relevant IEC and ISO safety standards.

CAUTION Federal law restricts the use of this device without a prescription by a physician.

CAUTION Always store and/or use unit in a well-ventilated area. Keep air pollution to a minimum. Keep floor clean at all times.

CAUTION Do not touch parts of non-medical electrical equipment in patient environment and patient simultaneously.

CAUTION For disposal of any material emanating from the system; follow local regulations.

CAUTION This system was designed for use by individuals trained in CT system operation. The user should be familiar with this user manual before scanning patients.

CAUTION It is the user's responsibility to make sure that after installation or subsequent modification, the system is in compliance with the requirements of collateral standard IEC 60601-1.

WARNING Installation of this product is performed in accordance with Installation Manual (1-NL4100-059). All installation processes and qualified personnel are outlined in that document.

WARNING Proper disposal of batteries is required to ensure compliance with environmental safety guidelines. Contact authorized NeuroLogica representative for instructions.

WARNING Observe safety-exposure factors and operating procedures to protect patient from physical harm during contact with this x-ray scanner.

WARNING Observe safety requirements to prevent excessive dose exposure to patient and/or operator.

CAUTION Improper system (including workstation) usage could endanger patients and/or users and void the warranty if not operated correctly.

CAUTION Should the workstation encounter a computer related virus, be sure to contact Technical Support for assistance with removing said virus from the equipment.

CAUTION Radiation dose exposure to patients should not exceed maximum of 1Gy CTDI.

CAUTION For proper disposal of material at equipment's end-of-useful life; contact NeuroLogica for instructions.

WARNING Equipment in which protection against electric shock relies on basic insulation *only,* should not be used in this system.

WARNING If the system fails to move due to loss of power, the patient can be easily removed from the scanner by moving the patient bed.

Four, foot crush hazard labels are affixed to the scanner in four places, above the four soft bumpers. The following shows a safety label:

Figure 3: Identifying the scanner's safety label(s) – foot-crush-hazard label(s)

Laser safety

There are four lasers used with the BodyTom 64 system as indicated in Figure 4 on page 57: 1 laser (Sagittal) at position **1**, 1 laser (Axial or Transverse) at position **2** (which is mounted internally and spins within the system's bore), and 1 set of external lasers (Coronal and Transverse/Axial) at position **3**.

WARNING Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within 100mm may pose an eye hazard.

WARNING Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.

Laser parameters

- Lasers **1** and **3** (see Figure 4):
  - Wavelength = 650nm
  - Output Power = 1mW
- Laser **2** (see Figure 4):
  - Wavelength = 650nm
  - Output Power = 4mW

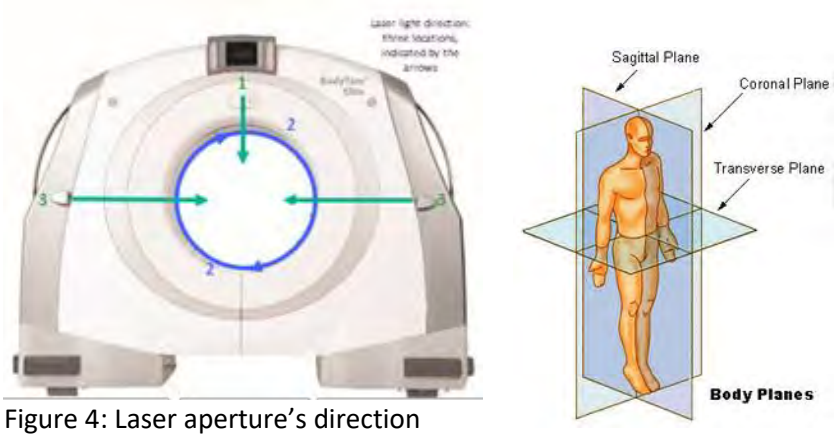


Figure 4: Laser aperture's direction

CAUTION Instruct the patient to close his/her eyes before turning **ON** the alignment light.

CAUTION Closely monitor infants and infirm patients to prevent them from accidentally staring into the beam.

CAUTION Class 2 laser radiation when open. ***Do not*** *stare into the beam* or view directly with optical instruments.

CAUTION Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

CAUTION The warning label for "laser in use" is located on the front of the scanner cover and inside the scanner to identify the presence of a laser.

Scanner mobility safety

CAUTION Due to the mobility of the system, an external interlock is not available; however, a prescribed scan can, at any time, be terminated from the scanner or the workstation. When the user activates the scan, a 10-second, countdown-clock, scan delay (adjustable to 99 seconds) triggers. This countdown allows the user time to perform needed tasks before the scan begins.

CAUTION To prevent healthcare provider injuries, a single healthcare professional should not move the scanner and workstation. Although one person can drive the BodyTom 64 when moving the scanner about the facility, NeuroLogica recommends two people move the scanner (lengthwise, only) to ensure no collisions occur when maneuvering through tight hallways and around corners. Be especially cautious when moving the system about an inclined floor.

WARNING To prevent involuntary movement, do not position scanner on an incline while in **Transport** mode.

WARNING Do ***not*** move the system right or left if transport on an incline becomes necessary. Always keep the system in a straight motion.

WARNING Contact **Technical Support** for assistance when movement is required on an incline.

Note Be sure there are no obstacles in front of the scanner while you move the scanner.

If the system needs to be moved over a threshold it is critical that the scanner be oriented so that it is driven in the forward or reverse direction. The scanner does not have the capability of moving laterally over thresholds.

CAUTION Check to ensure proper clearance is provided to allow removal of patient from scanner in case of a power failure. This is accomplished by moving patient's support (after unlocking wheel-locks) away from scanner.

CAUTION To prevent patient entrapment or entanglement with accompanying equipment, slowly move scanner away from patient by using control panel switches or pendant controls while observing patient.

CAUTION The scanner is equipped with a video camera to help the operator prevent collisions when transporting system to different locations that could otherwise result in personal injury or facility damage.

CAUTION Do not station or operate the system on an uneven floor. The flatness requirement is 0.12in. over 10ft. or 3mm over 305cm.

CAUTION Prior to transporting the scanner, verify that the power cord is unplugged from wall to avoid damage to cord and outlet, and avoid tripping. Verify that the ethernet cable is unplugged from the workstation to avoid damage to the cable and connector.

Floor level

For proper operation, the system must be operated on an even, level, hard surface.

Carpeting

Do not use the system on a carpeted floor. Poor image quality could result due to unevenness of the floor.

Electrical safety

WARNING The system's external AC power cord should be checked prior to use to verify there are no exposed wires or damaged insulation/prongs. Damaged prongs could result in sparking and fire. In case of such damage, contact Customer Service, immediately.

WARNING To separate the device from AC power simply disconnect the power cord from the wall and turn off the main breakers, located on the same side of the scanner as the power cord.

WARNING Access to the main breaker is critical for safety. Do not position the scanner so that the access to the breaker is diminished.

CAUTION Check to ensure the AC outlet is working properly before plugging in the system's AC power cord. NeuroLogica recommends using a dedicated outlet for powering the BodyTom 64 system, *only*.

WARNING To prevent electrical shock, do not connect items that are not specified as part of the system, including the workstation.

WARNING To prevent electrical shock, do not remove the covers from the equipment. The covers protect the user and the patient from moving parts or electrical shock. Hazardous voltages are present within this equipment. The covers provide protection from radiation exposure given off from the x-ray tube. The covers also protect the equipment.

WARNING An electrical shock hazard: no user should apply serviceable parts; refer to qualified service personnel for any service.

WARNING Always electrically isolate this equipment from the main electrical supply before cleaning and disinfecting it to prevent short-circuiting or possible electrical shock.

WARNING Never position the mobile system and/or workstation in a manner that prohibits access to unplugging it or prohibits pressing the **EMERGENCY STOP** button.

WARNING To minimize shock hazard, the system chassis must be connected to an electrical ground. The system is grounded through the ground conductor of the supplied, three-conductor power cord. The power cord must be plugged into a three-conductor electrical outlet receptacle. Do not alter the ground connection.

WARNING Avoid all contact with any electrical conductor as follows:

- Allow only qualified personnel who know the proper procedures and use the proper tools to install, adjust, repair, or modify the equipment.
- Only use this equipment in rooms or areas that comply with all applicable laws (or regulations having the force of law) concerning electrical safety for this type of equipment.
- Always electrically isolate this equipment from the main electrical supply before cleaning and disinfecting it.
- The detachable cord is the disconnecting device, which is used to remove mains power from the wall socket.
- The system is internally powered.

WARNING For Class 1 equipment (for example, the workstation, AC power cord, and so on) using an alternate internal source: a warning to use the alternate source if the integrity of the protective earth conductor is in doubt.

WARNING Do not position the system so that it is difficult to access the AC power cord.

CAUTION Protect the system power cord against mechanical damage.

Where the integrity of an external, protective conductor, in the installation or its arrangement, is in doubt, equipment is operated from its internal, electrical power source.

Parts of non-medical electrical equipment in the patient environment that, after removal of covers, connectors, and so on, without the use of a tool, may be contacted by the operator during routine maintenance and calibration, will operate at a voltage not exceeding 25VAC or 60VDC or peak value supplied from a source that is separated from the supply mains in accordance with one of the methods described in IEC 60601-1.

CAUTION All systems within the patient environment will provide the same level of safety as medical equipment complying with IEC 60601-1.

CAUTION To help prevent tripping hazards, use care in the arranging of any cords (for example, AC cord, ethernet cable, and so on) when connecting to the system/workstation.

CAUTION To prevent damaging electrical outlet cords, check to ensure they have been removed and properly stored before transporting the scanner.

WARNING The BodyTom 64 CT scanner contains high-voltage circuits for generating x-rays. Only trained and qualified personnel should be permitted access to the internal parts of this equipment.

CAUTION Use the **Universal Serial Bus** (**USB**) terminal located near the **EMERGENCY-STOP** (**E-STOP**) button for archiving to USB, *only*. ***Do not*** use the USB terminal located near the **E-STOP** for connecting any other device to equipment.

CAUTION For proper disposal of material at the end of the useful life of the equipment, contact NeuroLogica for instructions.

Mechanical safety

WARNING In case of unwanted movement or motion, press the **EMERGENCY STOP** (**E-STOP**) button.

WARNING Physically assist all patients on and off the bed and into position on the scan board. Adjust the bed to the specified height for patient loading and unloading (see "Positioning the patient" on page 94).

WARNING Adjust scanning platform to specified height for patient loading and unloading; see "Positioning the patient" on page 94.

WARNING When positioning the scanning platform, be careful when moving the scan table to avoid having it hit the scanner covers.

WARNING Position any lines (IVs and so on) attached to the patient so the lines cannot catch on the scanner during scanner travel.

CAUTION Prevent pinching or crushing of the patient's extremities. Keep patient's hands on the side of his/her body. Always watch the patient and equipment carefully during scanner movement.

CAUTION To prevent pinching or crushing of the operator's feet/toes, be sure extremities are not positioned under the scanner when it is being lowered from **Transport** mode to **Scan** mode.

WARNING Equipment maintenance of non-medical electrical equipment should not be performed in the patient environment.

WARNING Maintenance checks and all service must be performed by NeuroLogica trained service personnel.

CAUTION Ask patient to scoot up into universal scan board or manually aid them into position.

CAUTION When the scan board is in place, be especially careful when moving the bed to avoid driving it into the gantry covers.

CAUTION Periodically check all accessories for damage and remove them from service if damaged or cracked.

Radiation safety

Two **Dangerous to patient and operator** labels are affixed to both sides of the scanner, just above the operator controls. See Figure 5 on page 63.

Figure 5: Dangerous-to-patient/operator safety-warning label location (left) and label (close-up, right)

⚠	**WARNING**	Improperly used x-ray equipment may result in unwanted radiation exposure. Read and understand the instructions in this user manual before attempting to operate this equipment.
⚠	**CAUTION**	Use technique factors prescribed by the radiologist or diagnostician. Use a dose that produces the best diagnostic results with the least x-ray exposure.
⚠	**CAUTION**	All persons authorized to use the equipment must understand the dangers posed by excessive x-ray exposure. NeuroLogica recommends use of protective materials and devices.
⚠	**WARNING**	Everyone having anything to do with x-ray must take adequate steps to insure protection against injury.
⚠	**CAUTION**	The use of this device requires its users to receive proper training in accordance with local and national laws.
⚠	**CAUTION**	***Never*** perform calibration with patients in the scanner or while personnel are present in the vicinity of the scanner to prevent exposure to unwanted radiation.
⚠	**CAUTION**	Amber indicator lights (on the top of the scanner) illuminate during x-ray exposure.

CAUTION Ensure that there is no potential for detrimental interaction of the system's irradiation with a patient's active implantable medical devices and/or body-worn, active, medical devices.

X-rays can only be produced during the following conditions:

- The scanner is in the **Scan** mode position.
- The workstation is connected.
- The **START** button is activated when the patient is registered, the protocol is selected, the **Begin** button is clicked, and the protocol is prepared. The **START** button on the scanner's control panel illuminates when the scanner is ready to begin. See Figure 7 on page 65 to identify the **START** button.

Fire and explosion safety

DANGER This equipment is not suitable for use in presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.

DANGER This equipment is not suitable for use in the presence of oxygen or oxygen-enriched atmosphere.

- Fire regulation for the type of medical area being used should be fully applied, observed, and enforced. Fire extinguishers should be provided for both electrical and non-electrical fires.
- All operators of the BodyTom 64 scanner should be fully aware of and trained in the use of fire extinguishers and the firefighting equipment, and in local fire procedures.

WARNING Only use extinguishers on electrical or chemical fires that are specifically labeled for those purposes. Using water or other liquids on an electrical fire can lead to fatal or other serious injury.

If it is safe to do so, attempt to isolate the equipment from electrical and other supplies before attempting to fight a fire. This will reduce the risk of electrical shocks.

EMERGENCY STOP button

CAUTION Check the **EMERGENCY-STOP** (**E-STOP**) button at least one time a month to ensure proper function.

CAUTION Every user should take a few minutes to locate the **E-STOP** before scanning the first patient.

CAUTION In case of emergencies, stop scanner movement immediately by pressing the **E-STOP** red push-button located on the scanner, below the control panel.

Figure 6: BodyTom 64 E-STOP locations (right and left)

Figure 7: Close-up of the scanner control panel and the E-STOP button

Note When the **E-STOP** button is activated, the moving gantry may overrun by less than 10mm.

Battery safety and information

The **System battery capacity** icon shows an indication of the scanner's battery capacity, which is identical to the indicator on the scanner. The user should always check the indicator on the scanner to verify the batteries' status; there are 145 lithium-ion batteries in the scanner; 144 are used for scanning and the remaining battery is used for moving the scanner while in transport mode.

CAUTION The system unit contains batteries and will always be charging when plugged into AC mains.

CAUTION In case of battery leakage, do not handle the batteries themselves nor continue to operate the system. Contact NeuroLogica for service. See "Contact information" on page 24.

Battery replacement and disposal

WARNING Battery replacement is to be performed by authorized and trained NeuroLogica service personnel, to ensure proper disposal of hazardous material.

WARNING Dispose batteries in accordance with federal, state, and local regulations.

WARNING Do not incinerate batteries.

WARNING Contact an authorized NeuroLogica representative for appropriate, product-disposal instructions.

Scanner battery capacity

The range is 0 to 100. Battery voltage and current are used to calculate the system's battery capacity based on charging state.

Figure 8: Scanner battery capacity icon

Run time operation

During normal, run-time operation, the battery capacity is calculated one time, per second. The **battery capacity** indicator is updated on the scanner's **display screen** as well.

Note The battery capacity indicator on the scanner's display screen is displayed in 5% increments when above 10%. When 10% and below, the displayed capacity is in 1% increments. That is, above 10% capacity, the displayed value is always rounded to the closest multiple of 5 (for example, 93 gets rounded to 95, 42 gets rounded to 40, 47 gets rounded to 45, and so on).

State changes

After each periodic update, capacity is checked to make sure it does not fall below certain thresholds, as follows:

- Low voltage alarm state
  When battery capacity goes below 25%, a periodic alarm will sound. It will remain in this state until the battery capacity has gone back up to 27% or higher. The **Start** and **Cancel** buttons when scanning will not illuminate if the battery is too low.
- Low voltage lock-out state
  When the battery capacity goes below 1%, the scanner screen-display buttons are disabled and starting a scan is prohibited; for example, the ability to move the scanner and certain protocol buttons are disabled. It will remain in this state until the battery capacity has gone back up to 2% or higher. The low voltage alarm will continue to be active in this state.

Predictive scanning

Before each scan, battery usage for that scan is predicted based on the selected load factors (for example, kV, mA, scan time) and is compared against the available battery capacity. If there is not enough battery capacity to scan, a popup appears on the workstation screen. The user can cancel the scan at that time or continue the scan, with the understanding that the scan may abort due to a low-power fault.

Under voltage protection

When the **system battery voltage** drops below the low-voltage cutout-level while unplugged, a system power-down sequence is initiated.

Workstation

The **Workstation battery capacity** icon shows an indication of the workstation's battery capacity. On the workstation's main screen, place the mouse pointer over the battery icon to see the capacity of the battery, ranging from 0 to 100%. The user should always check the screen to verify the status of the batteries.

Figure 9: Workstation battery capacity icon

Note The workstation does not report proper battery capacity and status if a network connection is not made.

If the scanner's **display screen** is black, the system is not charging and/or the batteries are permanently damaged. A service call is required.

CAUTION In newer workstations, the workstation reports battery capacity on the workstation remote power display (under the monitor). The battery system is designed to be replaced by authorized and trained NeuroLogica service personnel, *only*.

CAUTION The workstation will not report the proper battery capacity and status if a network connection is not made.

CAUTION The system can only be charged from a correctly rated wall outlet. A rating information plate is located on the product system label (lower backside panel or lower left side panel, see Figure 1: Product-marking plate on scanner on page 37).

CAUTION The system (including the workstation) should be plugged in at all times, when not in **Transport** mode, being transported or in scanning use, to help maintain battery life and proper system operation. Failure to do so could result in permanent battery damage, which will require a service technician to repair.

CAUTION The system may not complete a scan when below 25% battery capacity while unplugged.

CAUTION If the system is unplugged and battery capacity reports to be 0%, permanent battery damage can occur.

CAUTION The power cord selection must not be less than 110v/12A (USA) and 220v/7.5A (EU and Asia), made of 2.08mm (diameter) copper wire in accordance with local power supply cable standards.

Note Medical grade power cords should be used at all times.

Scanner X-ray tube capacity

The percentage of the tube capacity required for a scan = ((kV x mA x scan time(s))/180000) x 100%. Approximately 0.11% capacity is regained each second during cooling.

Figure 10: Scanner X-ray tube capacity icon

Maintenance and service

WARNING Equipment maintenance of non-medical electrical equipment should not be performed in the patient environment.

WARNING Maintenance checks and all service must be performed by NeuroLogica trained service personnel. Service personnel use Service manual (1-NL4100-062) to effectively perform needed service and preventive maintenance and inspection of the system. See "Contact information" on page 24 for NeuroLogica's contact information.

WARNING The only calibration performed by the user on this system is called **daily calibration** and is described in detail later in this user manual. All other calibration needs that arise must be performed by trained service personnel at NeuroLogica Corp. See "Contact information" on page 24 for NeuroLogica's contact information.

CAUTION Service personnel must complete training at NeuroLogica Corp. for the system and its accessories prior to conducting any service activities.

Users are not to perform service or maintenance on the system at any time. This includes battery maintenance.

Note NeuroLogica recommends that a quarterly preventive maintenance be conducted by NeuroLogica's service personnel/trained facility bioengineer.

Instructions for replacing serviceable parts are identified in the Service Manual (1-NL4100-062).

Cybersecurity

WARNING Upon detection of a cybersecurity threat to the system or workstation, do the following:

- Immediately contact Technical Support.
- Discontinue use of system (enabling the **EMERGENCY-STOP** if needed).
- Remove any ethernet and/or wireless connection that has been made with the facilities' IT-network.

Continued use of the system can occur after Technical Support has assessed the situation and provided the go-ahead to do so.

Note NeuroLogica Corp. recommends the customer facility utilize an IT-network that provides sufficient means of cybersecurity control to help maintain the requirements of HIPAA.

Contraindication(s)

There are no contraindications associated with CT scanning.

Personnel privileges and terminology

Qualified operator

The operator as determined by the healthcare facility and assigned by a user with administrative privileges – who by their education, certification, experience, and training, are sufficiently qualified to competently perform clinical scans on the CT system. See "Understanding the types of users" on page 98 for a description of the types of users.

Operator of record

The operator of record is an operator or health care professional currently logged onto the CT system with a unique User ID and password identifier.

Scanning privileges

Scanning privileges are granted to a qualified operator, assigned by a user with administrative privileges, to conduct clinical scans on the CT system. This privilege level allows use of all clinical protocols to scan the patient.

Protocol privileges

Protocol privileges are granted to a qualified healthcare professional, as determined by the healthcare facility, and assigned to users with administrative privileges, who by their education, certification, experience, and training, is sufficiently qualified to competently save or modify clinical protocols on the CT system. A healthcare professional with protocol privileges does not necessarily need scanning privileges on the CT system.

Administrative privileges

Administrative privileges are granted to qualified healthcare professionals as determined by the healthcare facility who by their education, certification, experience, and training, are sufficiently qualified to competently assign, maintain, and oversee the assignment of personnel to scanning privileges and/or protocol privileges on the CT system they administer. Healthcare professionals with administrative privileges do not necessarily need scanning privileges or protocol privileges on the CT system.

Clinical operation

CT system operation that involves scanning patients and/or creating or editing protocols intended for use on patients.

Clinical scanning

CT system operation that involves scanning of patients.

Clinical protocol

A protocol on the system intended for use on patients.

Kernel

The kernel or filter is defined as the reconstruction algorithm or mathematical equation used for convolution of the attenuation profiles and reconstruction of the CT images. The choice of the kernel determines the noise level and the contrast resolution of the reconstructed images.

Chapter 2 System Overview

The BodyTom 64 CT system lets you scan patients in a room or ward, an Emergency Room (ER), Operating Room (OR), Radiology, and procedure rooms.

This chapter provides a brief introduction to the BodyTom 64 system. You will learn how to use the BodyTom 64 system (to see an illustration, see Figure 11 on page 73) – in subsequent chapters.

Note Whether you turn on the scanner or the workstation first does not matter; however, it is advised to power up the BodyTom 64 system hardware first, to allow time for the scanner to warm up.

BodyTom 64 system

The BodyTom 64 is a 64-slice, mobile, battery-operated CT scanner and software system with **Axial**, **Helical**, and **Dynamic**, capabilities.

The BodyTom 64 core system consists of the scanner, the workstation, and the phantom holder. Consider the following:

- The scanner and workstation communicate using a wireless connection. They communicate using an ethernet connection, if necessary.
- The BodyTom 64 workstation is a computer with custom software that allows the user to employ pre-defined, system protocols or devise unique protocols for performing patient studies. It also allows the user to update patient information and store images. The viewing portion of the BodyTom 64 workstation allows the user to view images in more detail and includes tools to help facilitate diagnosis by a physician.
- The maximum scout length is 2000mm.
- The scanner can create a slice-thickness of 0.6mm, 1.2mm, 2.4mm, 4.8mm, and 9.6mm in **Axial** mode.
  - In **Axial** mode, the BodyTom 64 scans 9.6mm of anatomy with each rotation.
  - The maximum scan-range in **Axial** mode is 900mm.
- The scanner can create a slice-thickness of 0.6 x 0.6, 1.2 x 0.6, 1.2 x 1.2, 2.4 x 1.2, 2.4 x 2.4, 4.8 x 2.4, and 4.8 x 4.8 in **Helical** mode.
  - In **Helical** mode, the BodyTom 64 scans 30.7mm of anatomy at a pitch of 0.8.
  - The maximum scan-range in **Helical** mode is 2000mm.

- In **Dynamic** mode, the BodyTom 64 scans 38.7mm of anatomy.
- The scanner is compatible with surgical navigation, **HIS**, **RIS**, and **PACS**.

1 QA stand and phantom
2 BodyTom or gantry
3 BodyTom workstation
4 Bed with patient near bore

Figure 11: BodyTom 64 system configuration

For information on cleaning and storing the scanner, see "Cleaning the scanner and workstation" on page 346 and/or "Storing the system" on page 348.

Overview of the scanner control panels

Control panels appear on the right and left side of the scanner. The **scanner control panel** allows the operator to start and stop a scan. All motion and x-ray generation can also be quickly stopped using the **EMERGENCY STOP** button. After the patient is registered and you select a protocol, you must start the scan from the **scanner control panel**, which is located under the scanner's display screen. The **operator control panel** lets you power on the scanner, lift, and lower the scanner, and lock scanner functions.

Note To determine where personnel should stand during a scan, consult with the hospital physicist. See "Scatter radiation" on page 236.

Controls on the left end of the scanner

Figure 12: Left end of the scanner

Table 19: Left end of the scanner

Scanner control	Description
	**Video camera** shows what is in front of the scanner during transport.
	The **scanner's display screen** shows the status of the scanner and workstation (see Table 25 on page 112 for a list and description of each status symbol).

Scanner control	Description
	**START** and **CANCEL** buttons (to the left) and the **EMERGENCY-STOP** (**E-STOP**) button (to the right) on the scanner control panel.
	**Ethernet port** to connect to the workstation, and four additional **data-access ports** on the data interface panel.
	120VAC/20A and 240VAC/30A plugs.
	The **pendant**; see "Overview of the pendant" on page 79 for more information.

Controls on the right end of the scanner

Figure 13: Right end of the scanner

Table 20: Right-end of the scanner

Scanner control	Description
	The **scanner's display screen** shows what the **video camera** captures and where the scanner is moving during transport. It also shows the status of the scanner and workstation (see Table 25 on page 112 for a list and description of each status symbol).

Scanner control	Description
	**START** and **CANCEL** buttons (to the left) and the **EMERGENCY-STOP** (**E-STOP**) button (to the right) on the scanner control panel.
	**Drive bar** and **enable bar** (arrow).
	**Key lock, the Power-ON** and **Power-OFF** buttons for scanner, and the Rocker-Switch-Lift **Up** and **Down** buttons on the operator control panel.
	The **pendant**; see "Overview of the pendant" on page 79 for more information.

Identifying operator control panel buttons

Figure 14: Operator control panel buttons and indicators

Table 21: Operator control panel buttons and indicators

Operator control panel buttons and indicators	Name	Description
	**LOCK**	Use the key to lock or unlock the operator control panel buttons. If the key is in the locked position all scanner buttons are disabled. If the key is in the unlocked position all scanner buttons are enabled.
	**OFF**	Press to power down the entire scanner. During shutdown, the light blinks until the shutdown task is complete.
	**TRANSPORT**	Press to activate **Transport** mode. Use the Rocker-Switch-Lift **Up** and **Down** buttons to put the scanner in **Transport** mode and the drive bar to transport the scanner.
	**ON**	Press to power up the scanner. During power-up, the light blinks until power-on task is complete.
	**BATTERY BARS**	Indicates the scanner's battery charge level. Each bar represents 10% of charge. If plugged into an AC outlet, the last bar blinks indicating the system batteries are charging.

Operator control panel buttons and indicators	Name	Description
	Rocker-Switch-Lift **Up** and **Down** buttons	Press and hold the **UP** or **Down** Rocker-Switch-Lift button to raise or lower the scanner. Lowering the scanner to floor level makes the scanner ready to scan. Raising the scanner makes the scanner ready for transport. When the button is inactive, it is dim; when the button is active it is illuminated.

Overview of the pendant

The pendant lets you move the scanner, turn on and off the lasers, zero reference the scanner, and program scan and rest positions for the scanner. See Table 22 for a list of what each button activates.

Table 22: Pendant buttons

Pendant	Button	Description	Action
		**POWER**	Illuminates when power is supplied to pendant.
		**LASER**	Turns on all positional lasers. While the lasers are on, the scanner spins for the internal laser to be seen within the scanner opening.
		**GO TO SCAN PLANE**	Moves the scanner forward approximately 30cm. This is the distance between the internal and external lasers.

Pendant	Button	Description	Action
		**ZERO REFERENCE**	Sets the scanner to zero before starting a scout or a scan.
		**MOVE BACKWARD (slow)**	Pressing and holding moves the scanner backward 10mm per second.
		**MOVE FORWARD (slow)**	Pressing and holding moves the scanner forward 10mm per second.
		**MOVE BACKWARD (fast)**	Pressing and holding moves the scanner backward 60mm per second.
		**MOVE FORWARD (fast)**	Pressing and holding moves the scanner forward 60mm per second.
		**SET MEMORY**	Allows the user to program **Scan** and **Rest** positions for the scanner.
		**SCAN POSITION**	Moves the scanner to the **Scan Position** saved using the Set Memory feature.
		**REST POSITION**	Moves the scanner to the **Rest Position** saved using the **Set Memory** feature.

 **DANGER** Store the pendant in its holder when not in use to prevent accidental and/or unintentional contact by patient and/or users.

Figure 15: BodyTom 64 remote-control pendant

The scanner's position appears on the **positional display** on the front of the scanner. You can use the pendant to zero reference the scanner. The display shows a positive or negative positional number.

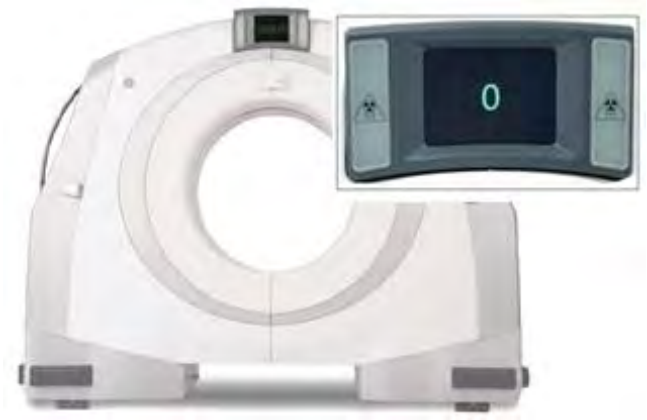


Figure 16: Scanner's positional display

Note The two light panels on either side of the scanner's position indicate x-ray is active, when lit. The scanner produces an audible alert during scanning.

Overview of the workstation

Figure 17: Workstation with leaded-glass shield (optional installation)

The **workstation** is an accompanying part of the scanner; it is the computer and control unit that operates most functions of the system. All basic information related to the workstation (for example, operating distance, warnings and cautions, connectivity, functionality, etc.) appear in Chapter 4 Basic Workstation Operations. The workstation includes the computer, monitor, ethernet connections, and the remote controls. The workstation also includes the **Uninterruptable Power Supply** (**UPS**). The workstation can be installed with an optional leaded-glass shield (shown in Figure 17) for additional protection.

The workstation enables you to easily move it wherever you need it to go. The workstation is designed to let you navigate in and out of elevators, over doorway thresholds, or on any type of floor including carpet, with ease.

The workstation can be set up either wirelessly or hardwired to the scanner. The administrator makes sure wireless is enabled before you create a wireless connection between the workstation and the scanner (with **System Configuration > Scanner Setup**). See "Remote Support Setup" on page 130 to learn how the administrator enables the wireless connection.

Note Wireless connections can be slower than a hardwired connection. If an unexpected delay or disconnection, due to environmental/bandwidth interference, occurs when using wireless, it is recommended to hardwire an ethernet cable to the scanner for continued communication.

After respective peripherals are properly plugged in, make sure all applicable power switches are in the on position before using the system.

For any devices connected to an AC outlet, make sure the outlet is providing required power.

CAUTION When not in use, the scanner and workstation should always be plugged into power outlets to ensure maximum efficiency.

The system should be stored in an area with limited access to prevent inadvertent damage.

See "Powering on and off the BodyTom 64 system" on page 87.

Note Be sure to keep the workstation plugged in when it is not in use to charge the battery. Charge time while off is ~ (approximately) 2 hours; while in use, charge time is ~ 8 hours.

CAUTION Verify that the ethernet cable is unplugged from the workstation to avoid damage to the cable and outlet during transport.

Note Before using the workstation, be sure to read and understand how to clean and maintain it. See "Cleaning the scanner and workstation" on page 346.

The product safety coverage of the workstation (Safety Certified to IEC 60950 standards) was evaluated and deemed acceptable for use with the BodyTom 64 to appropriate IEC 60601-1 and/or IEC 60601-1-1 harmonized national standards.

The workstation will be kept outside the patient environment as defined by IEC 60601-1-1. BodyTom 64 is suitable for use inside a patient environment.

CAUTION ***Do not*** connect or use equipment beyond what is specified by NeuroLogica Corp.; this practice may lead to a reduced level of system safety.

The recommended distances, provided in Figure 18, relate *only* to distances specified by IEC 60601-1 and ***do not*** relate to specific distances required for ionizing radiation and/or stray radiation protection for operators and bystanders.

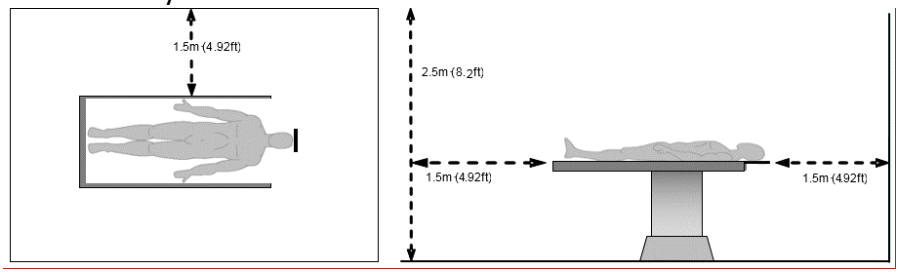


Figure 18: Workstation safe distance location (two views)

Workstation remote power controls

The following are found on the workstation:

- Remote power controls
- Microphone and controls
- Speaker and controls

Figure 19: The remote power display

See "Using the workstation" on page 98.

Note The microphone and speaker are plugged in to the USB port on the back of the monitor. If the port is changed, you will need to reboot the workstation.

Workstation UPS

The workstation uses an **Uninterruptable Power Supply** (**UPS**) to supply power to the workstation for approximately (~) 6-8 hours when the workstation is unplugged. The **UPS** is located inside the workstation. This feature allows the new workstation to run when it is not plugged in to a wall outlet.

Workstation considerations before use

Before using the workstation, consider the following:

- If a problem is detected with the workstation, make sure repairs or adjustments are made to it ***before*** using it.
- Make sure the workstation operates easily and freely, and all parts work smoothly.
- Check for excess noise, vibration, or a change in the ease-of-use.
  - Noise, vibration, or change in ease-of-use can be signs of a problem and a need for servicing.
- Be sure to read its warnings carefully and completely ***before*** using the workstation. Do not attempt to service the workstation. Only skilled service personnel are permitted to service the workstation. See "Hazard information" on page 54.

CAUTION Users are not to perform service or maintenance on the system at any time. This includes battery maintenance.

CAUTION Failure to heed these warnings may cause injury to the user, to others, or damage to the equipment.

Note NeuroLogica recommends that a quarterly preventive maintenance be conducted by NeuroLogica's service personnel/trained facility bioengineer.

Instructions for replacing serviceable parts are identified in the Service Manual (1-NL4100-062).

Keyboard and mouse

The workstation comes with a keyboard and a mouse (**1** for left-mouse button; **2** right-mouse button).

Figure 20: Workstation keyboard and mouse

Workstation power cord

The power cord lets you power up the workstation.

Consider the following:

- Plug style will vary depending on factory installed elements based on geographic location and voltage requirements.

CAUTION The power cord selection must not be less than 110v/12A (USA) and 220v/7.5A (EU and Asia), made of 2.08mm (diameter) copper wire in accordance with local power supply cable standards.

Note Medical grade power cords should be used at all times.

Parts that potentially come into contact with the patient

While you use the system, be mindful that the patient may come into contact with the following parts:

- The BodyTom 64 system, especially the painted, external surfaces of the system's covers.
- Universal transfer board, if purchased.

Chapter 3 Basic Scanner Operations

Basic scanner skills include powering on and off the scanner, learning how to use and navigate the operator and scanner control panels, how to use **E-STOP,** and how to use the Rocker-Switch-Lift **UP** and **DOWN** buttons to lift and lower the scanner.

Scanning basics you should know before scanning a patient include how your system should be set up, how to position the scanner and the patient before the scan, and how to start a scan from the operator control panel.

Note It is recommended that the scanner is on for at least 60-90 minutes prior to performing the daily air calibration or scanning patients.

It is recommended practice that the scanner is plugged in and turned on even when it is not in use.

Powering on and off the BodyTom 64 system

The BodyTom 64 is not intended to be turned on and off; however, if the system should lose power, ***it is advised*** to power on the scanner first, to allow time for the scanner to power up.

To power up the scanner

1. Press the Scanners **Power-On** until the green light blinks.

Figure 21: Scanner Power On button

2. Wait until the scanner is fully powered up, prior to powering up the workstation.

To power down the scanner

1. Press and hold the scanners **Power-Off** button until the greenlight blinks.

Figure 22: Scanner Power Off button

Note The Scanner's tube heat must be below 20% before the scanner powers down. If the tube is too hot, a message will display on the LCD scanner control panel instructing you to wait until the tube heat is low enough to safely power off the scanner.

Consider the following:

- Make sure the scanner is properly plugged in whenever possible; be sure the outlet(s) provide the required power. Plugging the electrical cord into the wall charges the batteries; the batteries are the only power source that allows the scanner to perform scans.
- When plugging in the scanner, make sure the cable lays flat on the floor to ensure the safety of hospital personnel. In addition, make sure that the floor behind the scanner is free of any obstructions or debris that could interfere with the centipedes during scanning.

Figure 23: AC cord and storage on scanner (120V left plug in or 240V right plug out)

Figure 24: Scanner's power cord receptacle for 120VAC and 240/VAC

Be sure to keep the workstation plugged in when it is not in use to charge the battery. Charge time while off is ~2 hours; while in use, charge time is ~8 hours.

Checking a connection between the workstation and the scanner

To check if a wireless connection exists between the scanner and the workstation, look for the **Wireless connection** icon on the scanner's display screen: .

Note You must be logged into the workstation before this icon is visible on the scanner's display screen.

If the workstation is connecting to the scanner by hardwire, check if the supplied ethernet cable is connected between the workstation and scanner.

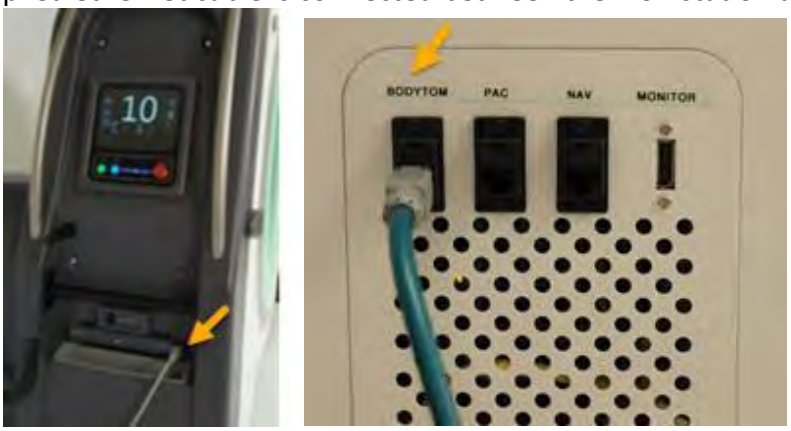


Figure 25: Scanner hardwired to the workstation with an ethernet cable to data-access ports

The administrator makes sure wireless is enabled when creating a wireless connection between the workstation and the scanner (with **System Configuration > Scanner Set U**p, through the workstation). See "Remote Support Setup" on page 130.

Note Make sure that the wireless setup in System Configuration has been done before making a wireless connection between the workstation and the scanner. See "Scanner Setup" on page 129 and "Remote Support Setup" on page 130.

Wireless connections can add lag time when compared with a hardwired setup. If an unexpected delay or disconnection occurs when using wireless, it is recommended to hardwire an ethernet cable to the scanner for continued communication.

Moving and transporting the scanner

To move the scanner, the scanner must be in **Transport** mode. The Rocker-Switch-Lift **UP** and **DOWN** buttons are located on the side of the scanner, on the operator control panel. These **UP** and **DOWN** buttons prepare the scanner to move up for transporting or down for positioning the scanner before scanning a patient. To set the scanner in **Transport** mode, go to the operator control panel and follow the procedure below.

Note If the scanner has been calibrated for multiple rooms, you must select the room prior to scanning to ensure the correct floor-calibration file is loaded. See "Selecting a room for the BodyTom 64 " on page 184.

CAUTION Before transporting the scanner, verify that the ethernet cable is unplugged from the workstation to avoid damage to cable and receptacle. Verify that the power cable is unplugged from the wall to avoid damage to the cord and outlet.

1. Press the **Transport** button.

Figure 26: Transport button on the operator control panel

2. Press and hold the Rocker-Switch-Lift **UP** button to raise the scanner off the centipedes for transport.

Figure 27: Rocker-Switch-Lift UP (top) and DOWN (bottom) button

Note Hold the top Rocker-Switch-Lift **UP** button until the scanner is completely raised and on its castor wheels. The top Rocker-Switch-Lift **UP** button illuminates when it is in the up position as shown in Figure 27.

3. Grip the **drive bar** with both hands.

Figure 28: Drive bar front

Figure 29: Drive bar

Note The **drive bar** is equipped with an **enable bar**. The **enable bar** is a darker soft rubber material located on front of the **drive bar.** While holding the **drive bar,** squeeze the **rubberized enable bar** to activate system motion. If you let go of the **enable bar**, the scanner stops.

4. Move the scanner.

   The following points explain how to hold the **drive bar** to move it forward, backward, left, and right:

   - Push forward with both hands and use equal pressure to move the scanner forward.
   - Push with the right hand to turn the scanner left; push with left hand to turn the scanner right.
   - Pull back on the **drive bar** to move the scanner in reverse.

Note A three-point driving technique is required to turn in smaller spaces.

CAUTION NeuroLogica recommends two people move the scanner within the facility: one to steer and another, in front of the scanner, to insure there are no obstacles. Two people ensures there are no collisions while maneuvering through tight hallways and around corners.

WARNING If a loss of control is encountered while moving the system, release the **enable bar** to stop ***ALL*** movement.

WARNING When transporting, use the video camera and scanner's display screen as guides to avoid hitting objects.

CAUTION To prevent potential for injury from overbalancing and/or tipping, ***do not*** attempt to turn this system on an incline during transportation.

WARNING ***Do not*** move the system right or left if transporting on an incline becomes necessary. ***Always*** keep the system in a straight motion. Contact **Technical Support** for assistance when movement is required on an incline.

CAUTION The BodyTom 64 scanner is larger than most medical equipment. Therefore, NeuroLogica recommends proper training and practice.

Drive direction of scanner

Figure 30: Scanner drive direction (right side view)

Safety bumper system

The scanner's transport system is equipped with an active, **safety-bumper** system. Each safety bumper is electronically controlled to terminate motion in the direction in which the system is moving when the bumper is activated. If a bumper is pressed due to a collision, the drive system is disabled in that direction. All other directions are still enabled to allow you to reposition the scanner away from any impact area. The activation force needed to trigger the bumper system is approximately 7lbs.

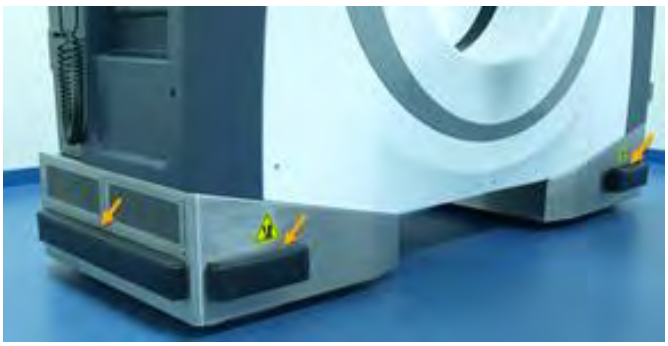


Figure 31: Bumper system

Positioning the scanner before a scan

WARNING **Never** raise or lower the scanner when the patient is positioned in the system's bore. ***Always*** move the patient and table away from the bore before raising or lowering the system itself.

1. Ensure the scanner is in **Scan** mode.

   To move the scanner, see "Moving and transporting the scanner" on page 90. See also "Performing a scan" on page 255.

2. To lower the scanner, press and hold the Rocker-Switch-Lift **DOWN** button until the scanner is completely lowered on its centipedes.
   The Rocker-Switch-Lift **DOWN** button illuminates when the scanner is completely lowered on the centipedes.

3. Align the patient and table with the scanner, ensuring the patient is in the center of the **Field Of View** (**FOV**), also ensure that the scanner will not collide with the patient, patient support and/or any life supporting devices prior to scanning.

Note Be sure the floor is clear of debris or anything that can cause interference with the scanner's centipedes.

4. Make sure the patient scan table is locked.

CAUTION Make sure to lock the patient bed or scan table to prevent it from moving during the scan.

5. Adjust the scan table height so that the patient is centered within the bore.

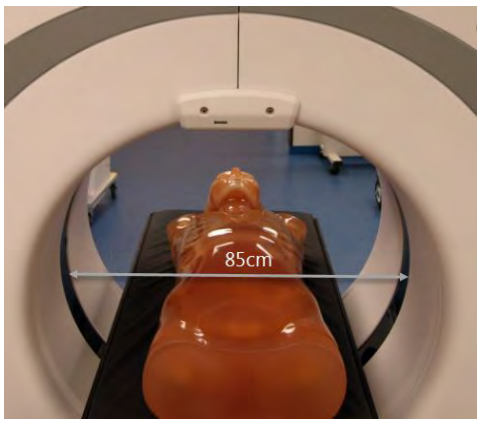


Figure 32: Patient centered in bore (height positioning)

Positioning the patient using the laser lights

WARNING Before scanning, position the patient in such a way that extremities, hair, life-support equipment, etc. have sufficient clearance to prevent contact with scanner and or when used with accessories and options, such as head frames, scan boards, etc.

WARNING Make sure the patient is supported properly when positioned (both height and alignment) to prevent injury during scanning.

WARNING Make sure the foot pedal brake on the scan table/bed is engaged to prevent it from moving during the scan.

WARNING ***Never*** raise or lower the scanner buttons on the operator control screen when a patient is positioned in the system's bore. ***Always*** slide the scan table away (by disengaging its brake) from the system before raising or lowering the system itself.

CAUTION The following-instructions for patient positioning should be performed in accordance with NeuroLogica Corp.'s clinical training.

CAUTION If the patient becomes nauseated or is unable to be still (motionless), stop the scanner immediately using the **E-STOP** button.

Note To determine where personnel should stand during a scan, consult with the hospital physicist. NeuroLogica recommends a distance of 8-10 feet.

The scanner provides a rotating laser-light to guide you to properly position the patient. The laser indicates the center of the scan plane. The laser light is always centered on the actual x-ray beam. For multi-slice protocols, this means that the laser light will indicate the middle position of all simultaneous acquisitions being acquired. There is no offset between the laser-light plane and the actual scan-plane. The accuracy of the position of the laser plane, with respect to the scan plane, should be +/- 2mm.

There are four laser lights: one **Sagittal**, one **Axial** or **Transverse** (which is mounted internally and spins within the system's bore) and one set of external **Coronal** and **Transverse/Axial** lasers. Keep the following in mind:

- To adjust vertical or horizontal positions, use table and bed controls, *only*.
- To adjust Z axis, walk the scanner to position using the pendant.

See "Overview of the pendant" on page 79 to see how buttons act.

1. Position the patient on the bed.

2. Align the bed to the scanner and make sure there is sufficient clearance around the patient by positioning the patient in the center of the **FOV.**

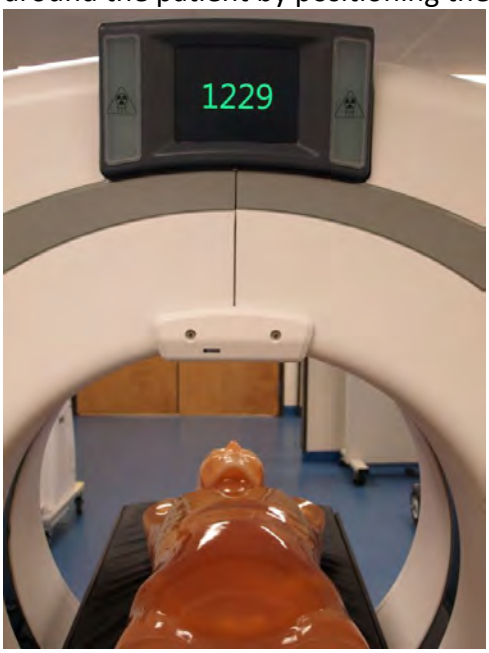


Figure 33: Phantom positioned in center of FOV

3. Use the pendant positioning buttons to center the patient within the bore.

Figure 34: Pendant use for positioning lasers upon patient

4. On the pendant, press the **LASER** button to turn on all positional lasers.

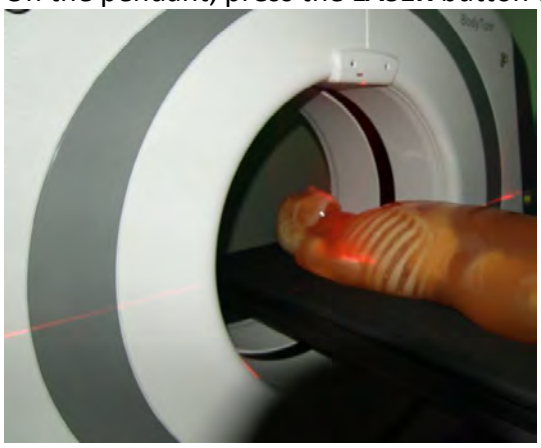


Figure 35: Positioning lasers upon patient

See the laser precautions in "Laser safety" on page 56.

5. Use the scanner's positional display to identify the position of the scanner.

Figure 36: Positional display

6. Consider the following:
   - If the patient is conscious, request the patient remain still with eyes closed throughout the entire scan.
   - If the patient is unconscious, secure the patient.
   - Follow the appropriate facility guidelines when scanning unconscious patients if the patient's eyes remain open.

Operating the E-STOP button

Figure 37: BodyTom 64 E-STOP locations (right and left)

Figure 38: E-STOP button on the scanner control panel on both the left and right sides of the scanner

1. Press the **E-STOP** button to perform the following:
   - Stop the system (if it loses control).
   - Stop all system motion and x-ray.
   - Remove power to the gantry drives and x-ray system.
   - If the scanner starts to move unexpectedly.

2. Make sure to resolve the situation.

Note When **E-STOP** is activated, the moving gantry may overrun by less than 10mm.

Restoring the system from E-STOP

If you have pressed the **E-STOP** button to stop the system, follow these steps to restore the system, using **E-STOP.**

1. Make sure any hazard is removed.

2. Twist the **E-STOP** button clockwise until the button pops out to restore the system after pressing the **E STOP** button.

Chapter 4 Basic Workstation Operations

Basic workstation information includes understanding the different kinds of user access, learning how to power on and off the workstation, and getting familiar with the workstation screen, its menus, and tabs.

Note Whether you turn on the scanner or the workstation first (see Chapter 4) does not matter; however, it is advised to power up the BodyTom 64 system hardware first, to allow time for the scanner to warm up.

Understanding the types of users

There are three **User Levels** available on the workstation: administrator, limited operator, and restricted operator. User ID's and passwords can be created for individual users, and specific **User Levels** can be assigned to each user. The following define the access levels for each User Level.

Administrator	Full access to the system and its configurations. Can create protocols, User ID's, and passwords, as well as access all functions of the system.
Limited	Modified access to the system. Users with Limited access can modify protocols during scanning but cannot create and save protocols; has no access to system configurations.
Restricted	Users with Restricted access can scan with the system but are unable to make any changes to protocol parameters while scanning, they also have no access to system configurations.

Using the workstation

The workstation uses an **Uninterruptable Power Supply** (**UPS**) to supply power to the workstation for ~6-8 hours when the workstation is unplugged. The workstation includes a computer, the remote power display, and a microphone and speaker.

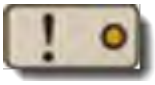
Identifying the workstation's remote power display

The **Power On** button on the remote power display allows you to power on the workstation.

Figure 39: Workstation remote power display

The following describes the action of each workstation power-control button.

Table 23: Workstation power-control buttons

Workstation power-control button	Button or indicator name	Description
	**UPS battery level**	Shows the battery usage; each LED represents 20 percent of battery power.
	**Power-On**	When the system has power, the LED light illuminates.
	**Alarm**	When the system is at or less than 20 percent battery power, an alarm sounds, and the LED light illuminates to warn you.
	**Power-On and Power-Off**	Press and hold the **Power-On** / **Power-Off** button for 3-5 seconds to turn on and off the workstation.
	**Mute**	Press this button to silence the alarm.

Identifying the microphone, speaker, and controls

Figure 40: Microphone, speaker, and controls

Table 24: Speaker control buttons

Microphone button	Name	Description
	**Microphone mute**	Press the **Mic Mute** button to mute the microphone. NeuroLogica recommends using the **Mute** button located on the bottom right of the workstation screen.
	**Mute**	Click the **Mute** button, on the bottom right of the workstation screen to mute the microphone and speaker.
	**Speaker**	The **Speaker** button appears on the bottom right of the workstation screen when the speaker is activated to hear the patient.
	**Volume**	Press the “-“ button on the left side of the speaker to decrease the volume, press the “+” button on the right side of the speaker to increase the volume. The speaker has illuminated volume lights to indicate volume level.

Powering the workstation

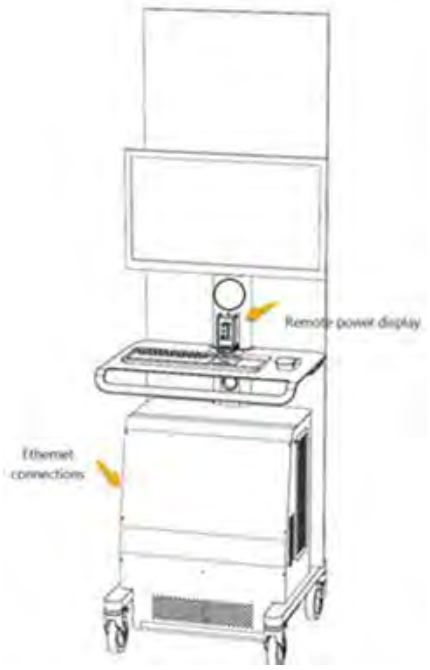


Figure 41: Remote power display on workstation

Note Depending on the workstation, the **Power-On** and/or **Power-Off** button may not be in this location.

To power up the workstation

1. Press and hold the workstation's **Power-On**/**Power-Off** button on the remote power display until the green light blinks.

To power down the workstation

1. Press and hold the workstations **Power-On/Power-Off** button on the remote power display until the green light blinks.

Note The workstation does not allow you to wait for the computer to shut down before communicating to the workstation to shut down; this is because the workstation sends a toggling signal to the computer. If the computer is off, it will turn back on. The workstation must already be in the process of shutting down by the time the computer is fully turned off.

Logging in to the workstation

To gain access to the workstation application, you must provide the system with credentials. These credentials consist of a **User ID** and **password**. Make sure you have a valid User ID and password before you log into the system.

If you do not have a valid User ID and password, ask your supervisor or administrator for one.

1. Click the User ID dropdown and select your User ID.

Figure 42: User ID dropdown box

Figure 43: User ID dropdown list

2. Click in the **Password** field and type your password. Passwords are case sensitive.

Figure 44: Password text box

3. Click the **Login** button.
   If the User ID and/or password are invalid, a prompt appears to re-enter the information.

Note You have a limited number of login attempts before the system locks the account. An administrator can unlock the account. See "System and User Configuration and Setup" on page 117 for more details about unlocking an account.

When the User ID and password are verified, you are logged into the system.

The main screen to the workstation software appears with the **Patient Registration** tab open.

Figure 45: Patient Registration tab

4. Verify that the correct User ID appears at the top center of the screen.

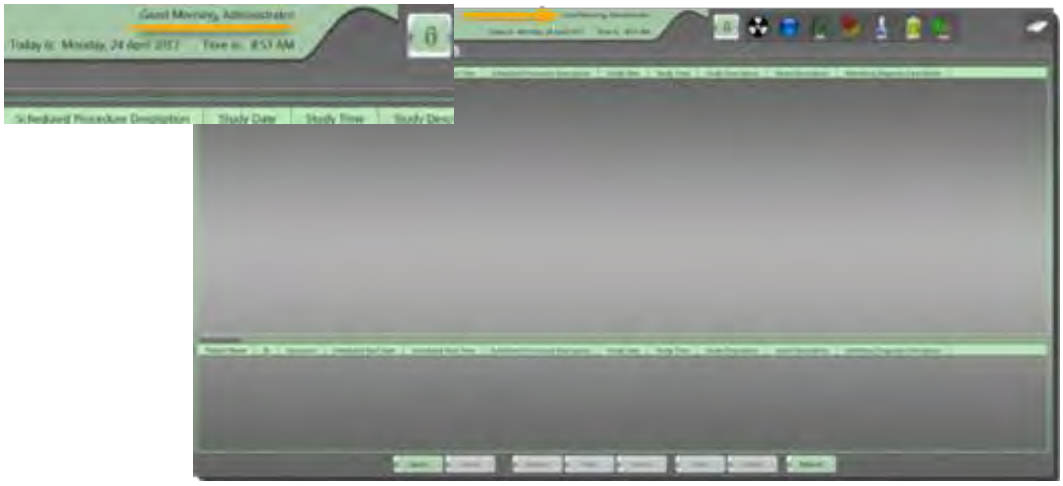


Figure 46: User ID, current date, and time

If the correct User ID ***does not*** appear, contact your supervisor or administrative user to verify the account.

Locking and unlocking the workstation

The **Lock** button indicates whether your system is in **Lock** or **Unlock** mode. This button is a toggle, if the workstation is locked, the **Unlock** button shows, if the workstation is unlocked, the **Lock** button shows.

To prevent unwanted personnel from accessing the system, you should lock the workstation if you intend to leave the area for any period. When you lock the workstation, it remains **on**, but no one can access it without supplying a User ID and password.

Using Lock if you need to step away from the workstation

1. Click the **Lock** button located at the top-and center of the workstation screen.

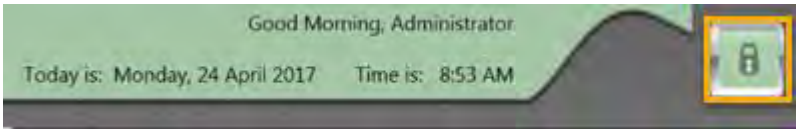


Figure 47: System Lock button

The **Lock/Unlock System** popup appears.

Figure 48: Lock/Unlock System popup to lock the workstation

2. Enter the User ID and password by selecting the option from the dropdown and entering information in the **Password** field.

3. Do one of the following:
   - Click the Lock button to lock your system.
     When you select this option the **Lock** button changes to the **Unlock** button.
   - Click the **Cancel** button to return to your work.

Using Unlock to view your work

1. Click the **Unlock** button.

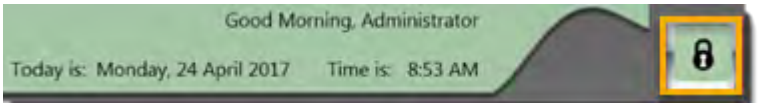


Figure 49: Unlock button

The **Lock/Unlock System** popup appears.

Figure 50: Lock/Unlock System popup to unlock the workstation

2. Enter the User ID and password by selecting the options from the dropdown and entering information in the **Password** field.

3. Do one of the following:
   - Click the Unlock button to unlock your system.
     When you select this option, the button changes to the **Lock** button.
   - Click the **Cancel** button to return to your work.

Navigating around the workstation's main screen

The workstation screen shows similar information, even if the screen elements change when you perform different actions. These constant screen elements are as follows:

Main menu options	Appears in the top left corner of the screen and shows the **File**, **Tools**, **Customize**, and **Help** commands.
User, date, and time	Appears in the center of the screen and displays a greeting for the user, the signed-in user's name, the current date, and time.
Scanner and workstation status	Appears in the top right corner of the screen and displays status information for both the scanner and workstation.

The main screen to the workstation software always opens with the **Patient Registration** tab.

Brief overview of the main menu

The main menu provides you access to the basic functions from the commands: **File**, **Tools**, **Customize**, and **Help**.

The main menu appears on every screen and is always located in the same location, regardless of what you are doing.

Figure 51: Main menu

Note To select commands, click the first command and the subsequent commands. For example, if you see **Customize > System** that means, click **Customize** from the main menu and then click **System**.

Brief overview of the File menu

When you log off, restart, or shutdown the application and/or the workstation, you must use your User ID and password to log back in.

Logging off the system

1. Click **File** from the main menu.

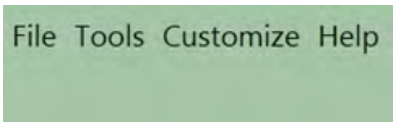


Figure 52: File menu

The **File** dropdown appears.

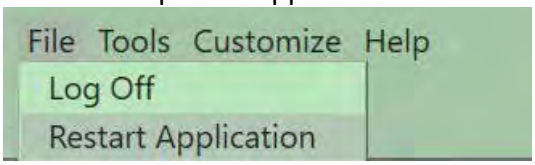


Figure 53: File > Log Off

2. Click **Log Off** from the dropdown to Log Off the workstation software. The **Login** popup appears.

Figure 54: Login popup

This is also the login and shutdown portal. You can login or shutdown the workstation from this popup.

Restarting the application

You can restart the application software using the following steps.

1. Click **File** from the main menu.

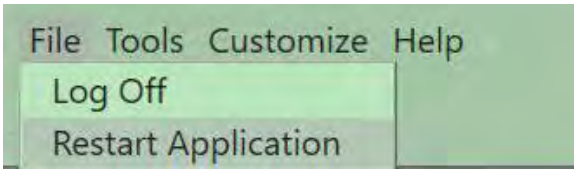


Figure 55: File dropdown menu

2. Click Restart Application.

   The following **Restart Application** popup appears.

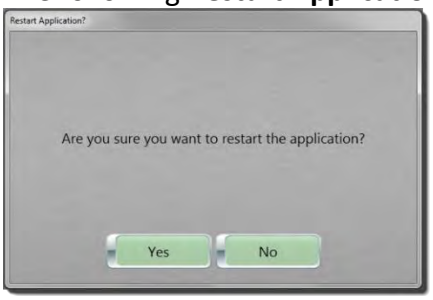


Figure 56: Restart Application popup

3. Perform one of the following:
   - Click the Yes button to restart the application software.
   - Click the No button to return to the screen.

Brief overview of the Tools menu

This menu provides you with tools to store and print, set up protocols, and test your system to ensure it is operating as specified.

Figure 57: Tools dropdown menu

1. Click **Tools** from the main menu.

2. Click one of the following from the dropdown:

Store/Print Queue	The **Store/Print Queue** displays the status of studies being archived. You will learn more about how to store to various media later in this user manual; see page 117.
Protocol Manager	Allows users with **Administrative** privileges to create, modify, delete, and/or upload protocols to the scanner. You will learn more about how to use Protocol Manager later in this user manual; see page 185.
Quality Assurance (QA)	The tool that verifies the system is at its optimum performance. You will learn more about QA later in this user manual see page 216.

Brief overview of the Customize menu

This menu provides you with tools to set up the system as well as define user profiles.

Figure 58: Customize dropdown menu

1. Click **Customize,** then one of the following sub commands from the drop-down list:

System	Allows users with Administrative privileges to customize site-related settings; see "Chapter 5 System and User Configuration and Setup" on page 117.
User	Allows you to customize layouts in the system as well as set the password. See "Chapter 5 System and User Configuration and Setup" on page 117.

Select Room	Allows you to identify and select the room the scanner will be used in. See "Selecting a room for the BodyTom 64Selecting a room for the " on page 184.

Getting Help from the Help menu

NeuroLogica Help includes an online user manual and information about the system. It also provides remote support from NeuroLogica **Technical Support** for file transfer, remote upgrades, or system review and support. When you enter a six-digit number, **Technical Support** will take control of the system to retrieve files or review the issue in question.

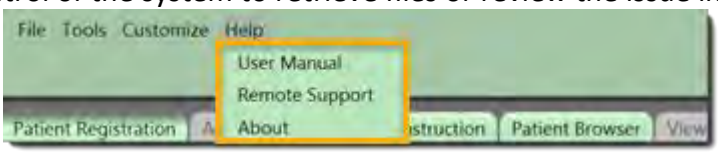


Figure 59: Help dropdown menu

Getting an online user manual

To open a .pdf version of this user manual:

1. Click **Help** from the main menu.
2. Click **User Manual** from the dropdown list.
   A PDF version of this manual will be opened.

Getting remote support

1. Click **Help** from the main menu**.**
2. Contact NeuroLogica **Technical Support**.
   See “Contact information” on page 24.
3. Click **Remote Support** from the dropdown list.
   The **Support Connection** window appears.

Figure 60: Support Connection browser window

When connected to **Remote Support**, a NeuroLogica **Technical Support** representative will supply a six-digit code to start a remote support session, which allows the support representative to review your system and troubleshoot the issue.

Getting information about the product and NeuroLogica

To get additional information about the product and NeuroLogica:

1. Click **Help** from the main menu.

2. Click **About** from the dropdown list.
   The **About Us** popup appears.

Figure 61: About Us popup

The following information is found:

Version(s)	Identifies the current software versions for the system.

Licensed To	Identifies who the product is licensed to.
Station AE Title	Identifies the title for your workstation (for **PACS** purposes).
Licensed Packages	Identifies any licensed packages available on the system.

Getting to know the status bar

The status bar appears in the top-right portion of the screen. The status bar provides a quick view of the system's current state. Details for the icons on the status bar are in the tables below.

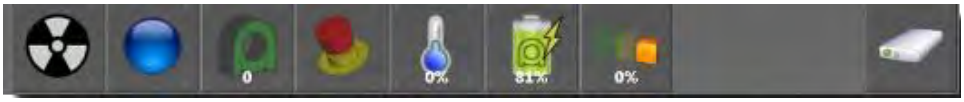


Figure 62: Scanner and workstation status bar

Table 25: Status bar icons

Status bar icon	Status bar icon name	Status description
	**Radiation status**	Identifies x-ray as on or off. The icon changes from a gray/black icon when x-ray is off, to a rotating yellow/black icon when x-ray is on.
	**System state**	Identifies the system's current state. The orb changes color depending on the state the system is in. See Table 26 on page 114 for a list of the different orb colors and system states they identify.
	**Scanner position**	Identifies the system's current position relative to its zero reference.
	**System E-STOP status**	Identifies when **E-STOP** is engaged. The icon will flash when **E-STOP** is pressed.

Status bar icon	Status bar icon name	Status description
	**System tube heat status**	Indicates the current X-Ray tube heat status. The values are color coded as follows: Blue 0% - 19% Yellow 20% - 50% Orange 51% - 75% Red 76% - 100% **NOTE:** The scanners tube heat must be below 20% before the scanner powers down. If the tube is too hot, a message will display on the LCD scanner control panel instructing you to wait until the tube heat is low enough to safely power off the scanner.
	**Scanner battery capacity status**	Indicates the remaining scanner battery percentage available. The capacity values are color coded as follows: Green 100% - 51% Yellow 50% - 25% Red 24% - 0%
	**System air freshness status**	Indicates the air freshness status; it is recommended that an air calibration be performed: • Every eight (8) hours. • When the air freshness status falls below 50%. • If the scanner is moved to an area with a dramatic change in humidity and/or temperature. The calibration status values are color coded as follows: Green 100% - 51% Yellow 50% - 25% Orange 24% - 0% After calibration it returns to 100%.

Status bar icon	Status bar icon name	Status description
	**Workstation battery capacity status**	Indicates the remaining workstation battery capacity available. The capacity values are color coded as follows: Green 100% - 21% Yellow 20% - 11% Red 10% - 0% You will be prompted to plug the workstation into an outlet to charge if the battery capacity is low; a scan cannot complete when the battery capacity is 10% or lower. When the workstation reaches the red capacity range, the system will shut down. A message informs you that the system will shut down due to low battery. The lightning bolt icon signifies that the workstation is currently charging and goes away when unplugged.
	**Image storage space status**	Indicates the available disk space for image storage. The available space values are color coded as follows: Green 100% - 51% Yellow 50% - 20% Red 19% - 0%

The system changes states as it performs different actions. The following table indicates what state the system is in and the colored orb that correlates to that state.

Table 26: System state orbs

Orb	Color	State
	Dark gray	The system is in an unknown state.
	Light gray	The system is powering up or down.

Orb	Color	State
	Dark purple	The system is busy.
	Purple	The system is completing air calibration.
	Light purple	The system is archiving.
	Blue	The system is idle.
	Green	The system is ready to perform a scan.
	Light yellow	The system is planning.
	Dark yellow	The system is preparing.
	Light orange	The system is reconstructing.
	Dark orange	The system is scanning.
	Pink	The system is not ready.
	Red	The system is in fault.

The workstation tabs

To perform a patient examination, you will use the following five tabs on the workstation:

Figure 63: Workstation tabs to perform a patient examination

The tabs include active tabs which will be green, and inactive tabs which will appear gray. The active tabs are **Patient Registration**, **Post Reconstruction**, and **Patient Browser**. The **Acquisition** and **Viewing** tabs require additional steps to be performed before they become active.
The following actions are available in each tab:

Patient Registration	Allows you to register a patient either manually or from the hospital's database sites.

Acquisition	Allows you to select a protocol and perform the examination. This tab is inactive until a patient is registered.
Post Reconstruction	Allows you to manipulate raw data in different parameters and settings after your scan is completed.
Patient Browser	Allows you to view, manipulate, and archive scans already performed.
Viewing	Allows you to view patient images. This tab is inactive until a study is loaded from Patient Browser.

In the following chapters, you will learn how to perform necessary steps to conduct a patient examination and learn how to manipulate and store the data you acquire.

Chapter 5 System and User Configuration and Setup

A user with administrative privileges must set up the BodyTom 64 system configurations for other users. System configuration is used to set up the scanner to meet site-specific needs. Most windows contain self-explanatory instructions and refer to elements that are known to the administrative user with radiological education and training.

Configuration includes setting up user permissions, or access privileges to manage other users, as well as servers, what is available through settings, presets, and other preferences for the use of the system at a site. Many system configurations are permissible to the administrator, *only*. While other configurations are permissible to users without administrator access.

Note You must have administrative access privileges and be logged in as an administrator to set configurations for the site.

Incorrect changes to the system configuration may make the system inoperative.

The following table shows the **System Configuration** options that appear when you click **Customize > System** and provides a brief description of each.

Table 27: System configuration tabs

Tab name	Description
General Settings	Allows the administrator to set system configurations such as hospital name, wireless settings, and dose report settings.
User Accounts	Allows the administrator to create and edit user accounts and permissions.
DICOM Servers	Allows the administrator to set up DICOM servers for archiving, such as PACS or HIS/RIS.
DICOM Setting	Allows the administrator to view and configure DICOM tags for HIS/RIS, MPPS, and Patient, Study, Series, and Image modules.
Audio Configuration	Allows the administrator to upload default audio files with protocols; also lets the administrator record, play, and remove audio files.
Dose Configuration	Allows the administrator to set up dose notifications, dose alerts, and configure dose limits for specific scans.
Windowing Presets	Allows the administrator to view and modify kernel and window width and window center presets.

Tab name	Description
Audit Trail Viewer	Allows the administrator to view and log all changes as well as actions in the system, including user logins, patient registrations, and series updates.
Image Orientation	Allows the administrator to view and modify how images are oriented in the system.
Filter Kernels	Allows the user to activate custom kernel options for both Axial and Helical scans.

Setting user accounts

Only a user with administrative access can update another user's account, add a new user, delete a user, and lock or unlock a user's access.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **User Accounts** tab.

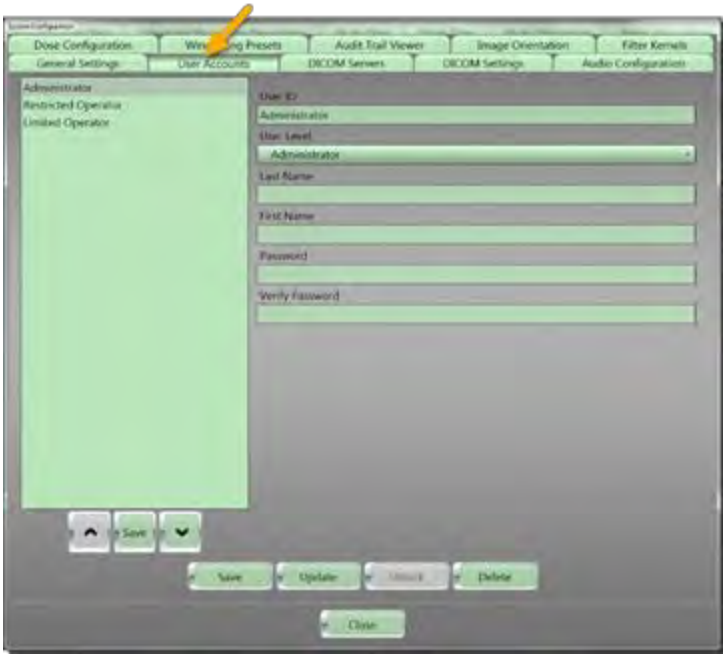


Figure 64: User Accounts tab

3. For the **User ID** field, enter the User ID name.

4. For the **User Level** field, enter one of the following user levels:

Administrator	Full access to the system and it's configurations. Can create protocols, User ID's, and passwords, as well as access all functions of the system.

Limited operator	Modified access to the system. Users with Limited access can modify protocols during scanning but cannot create and save protocols; has no access to system configuration.
Restricted operator	Users with Restricted access can scan with the system but are unable to make any changes to protocol parameters while scanning, they also have no access to system configuration.

5. For the **Last Name** field, enter the user's last name.
6. For the **Enter First Name** field, enter the user's first name.
7. For the **Password** field, enter the user's password.

Note The password must contain 8 to 12 characters, and must include one number, one symbol and one letter.

8. For the **Verify Password** field, re-enter the user's password to confirm the password.

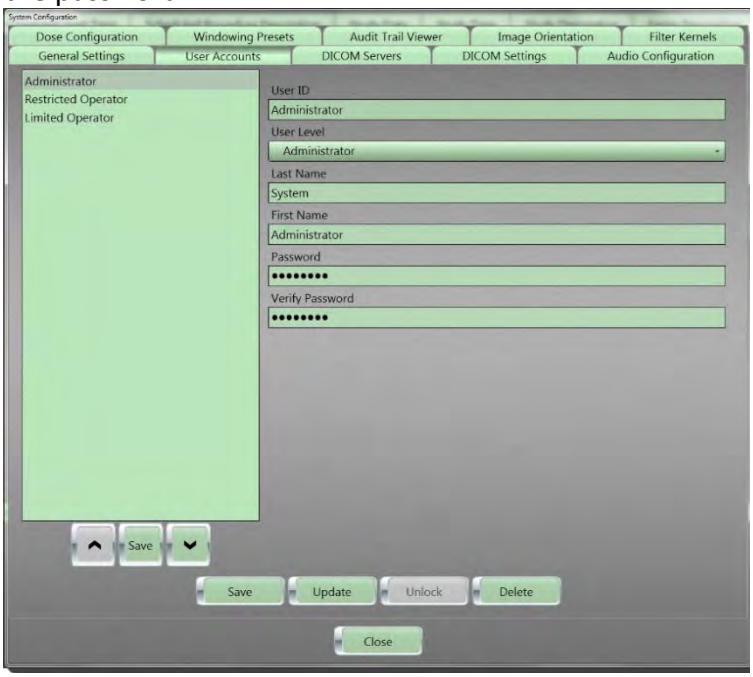


Figure 65: User account fields filled in

9. Click the **Save** button.
   The user is added to the list.

The **Save Aborted** popup appears if your password does not meet the rule for passwords. If this is the case, return to the step above, and fulfill the password rule.

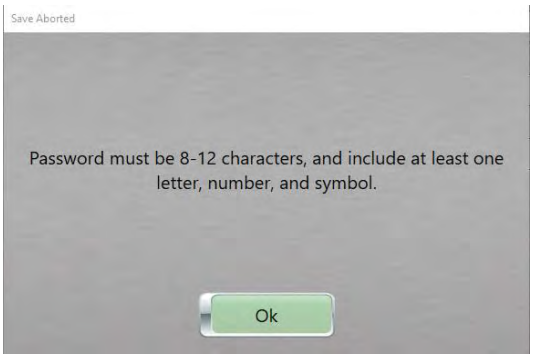


Figure 66: Save aborted popup message – Password requirements

10. Click the **Close** button to exit.

Setting or updating a user's information

1. Click **Customize > System**, from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **User Accounts** tab.

3. Select a user from the list of users.

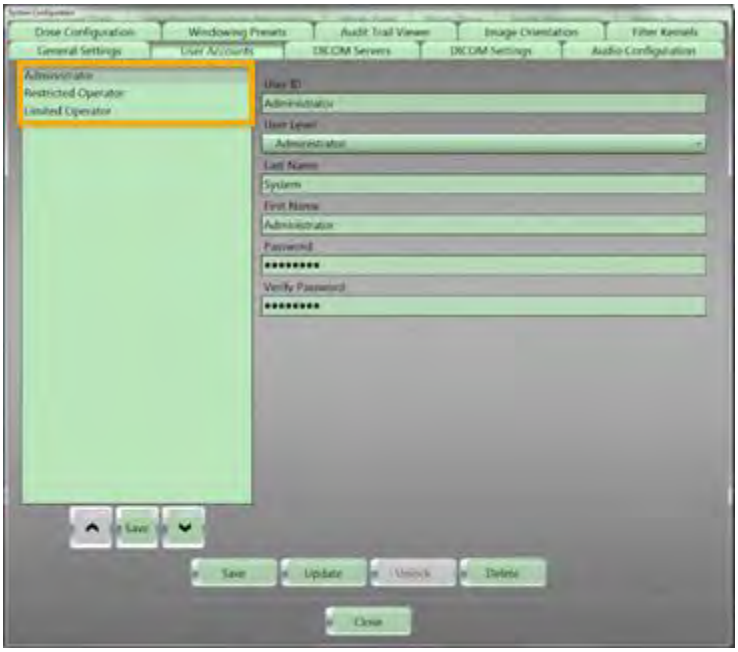


Figure 67: List of users

4. Modify the user's information; for example, password, or user's first and last name.

Note The password must be 8-12 characters and include at least a letter, number, and symbol.

The user's changes take effect after clicking the **Update** button. It is recommended that you log off and log back on and check that the password is working.

5. Click the **Update** button to keep the change(s).

The **Update Aborted** popup appears if your password does not meet the rule for passwords. If this is the case, return to the step above, and fulfill the password rule.

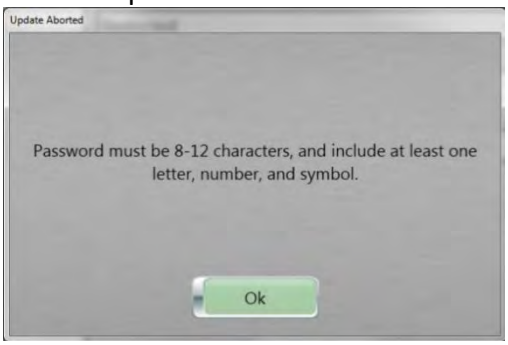


Figure 68: Update Aborted popup message – Password requirements

6. Click the **Close** button to exit.

Unlocking a user account

1. Click **Customize > System** from the main menu**.**
The **System Configuration** dialog box appears.

2. Click the **User Accounts** tab.

3. Select the user to unlock from the list of users in the panel.

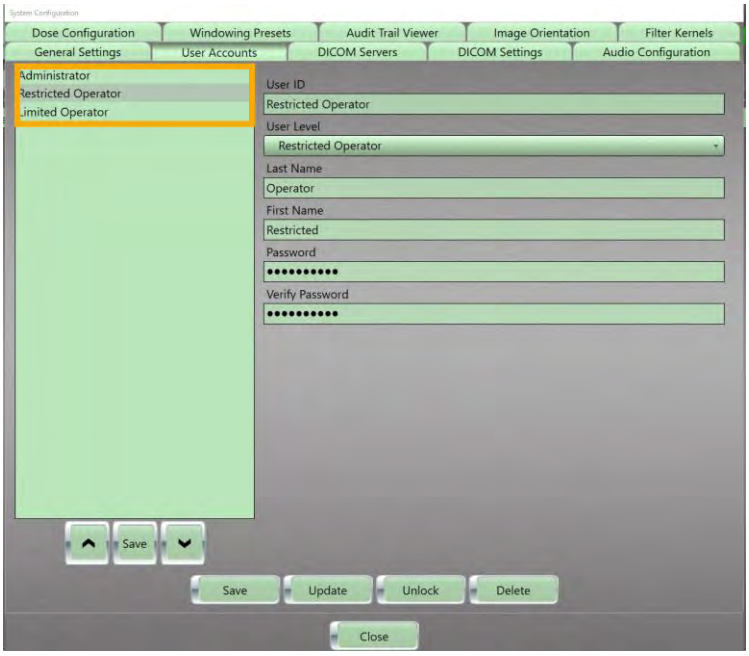


Figure 69: List of users not selected

4. Click the **Unlock** button.

   The user's changes take effect after clicking the **Update** button. It is recommended that you log off and log back on and check that the password is working.

Deleting a user

Note The administrator user cannot be deleted.

1. Click **Customize > System** from the main menu**.**
   The **System Configuration** dialog box appears.

2. Click the **User Accounts** tab.

3. Select the user to delete from the list of users.

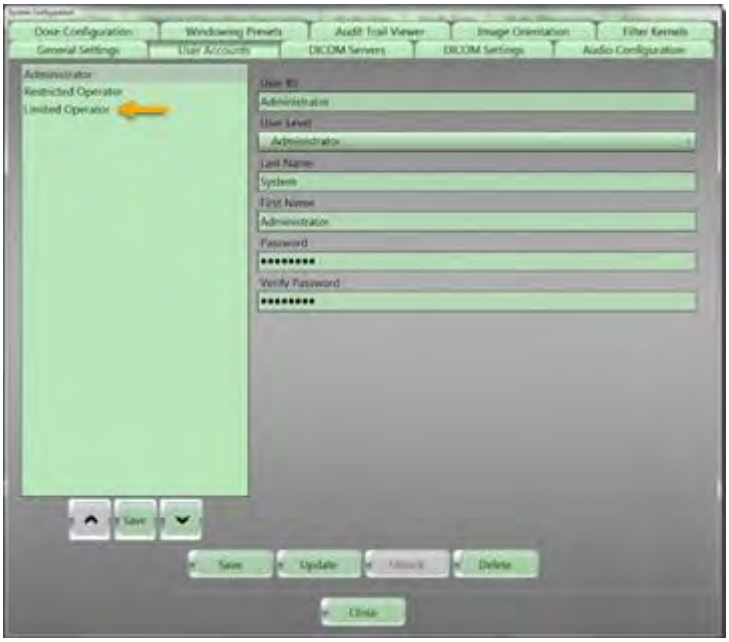


Figure 70: List of all available users

4. Click the **Delete** button.
   The **Action Succeeded** popup box appears.

5. Click the **Ok** button in the **Action Succeeded** popup.

6. Click the **Close** button to exit.

Modifying the order of the users in the accounts list

1. Click **Customize > System** from the main menu**.**
   The **System Configuration** dialog box appears.

2. Click the **User** Accounts tab.

3. Select the user order to modify from the list of users in the panel.

4. Click the **Down** arrow to move the user down the list.

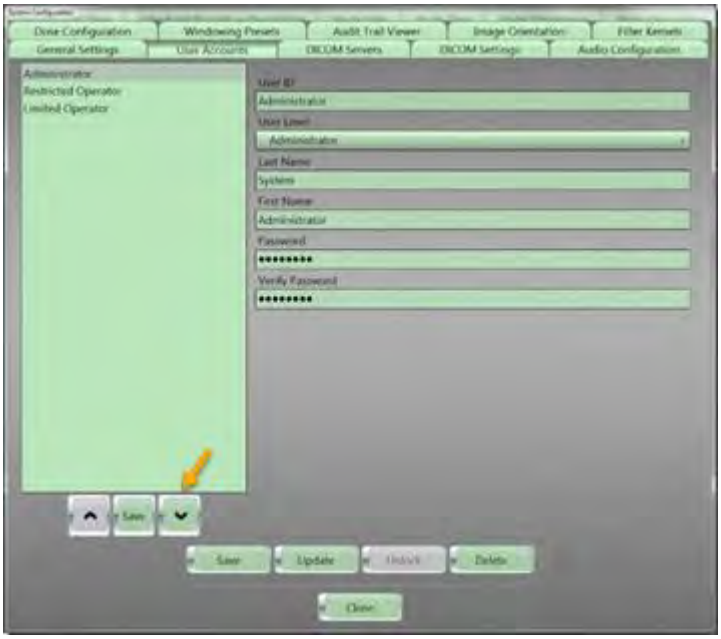


Figure 71: Down arrow

5. Click the **Up** arrow to move the user up the list.

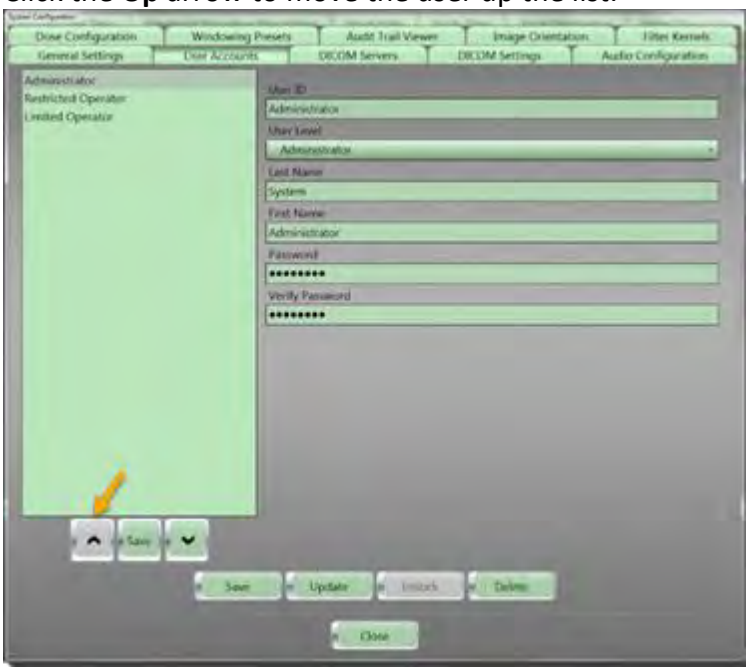


Figure 72: Up arrow

The **Up** arrow will not activate until you move down the list of users.

6. Click the **Save** button under the user list to keep the new user list order.

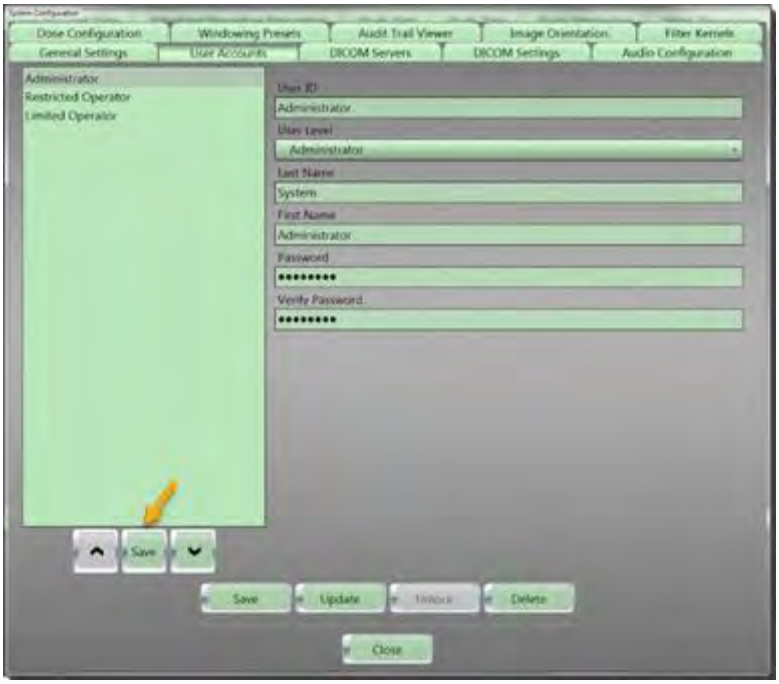


Figure 73: Save button for list order

7. Click the **Save** button next to the **Update** button to keep other changes.

8. Click the **Close** button to exit.

Assigning general settings

Perform the following to set how the hospital, workstation's application, scanner, and remote support are configured.

1. Click **Customize > System** from the main menu**.**
   The **System Configuration** dialog box appears.

2. Click the **General Settings** tab.

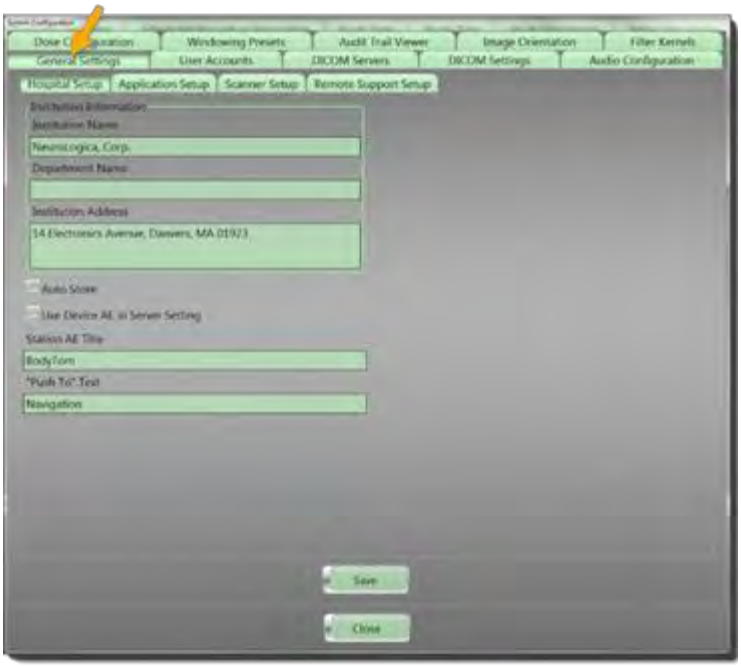


Figure 74: General Settings tab

3. The following tabs are only available to the administrator:

Hospital Setup	Sets up hospital information specific to the site.
Application Setup	Sets up application information the user will experience.
Scanner Setup	Sets up scanner IP address information.
Remote Support Setup	Sets up IP address information to allow NeuroLogica remote support.

The following sections provide detailed information related to the options available in the **General Settings** tabs.

Hospital Setup sub tab

1. Click **Customize > System** from the main menu**.**
   The **System Configuration** dialog box appears.

2. Click the **General Settings** tab.

3. Click the **Hospital Setup** sub tab.

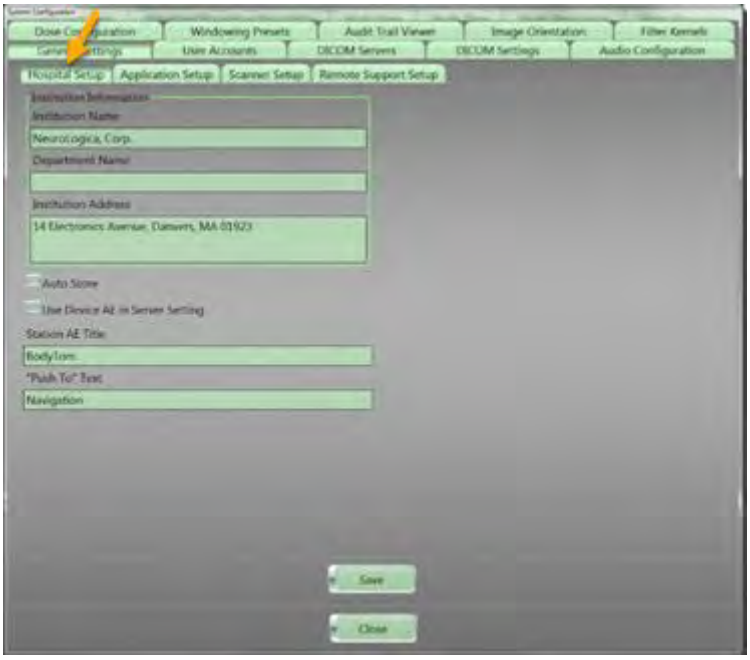


Figure 75: General Settings > Hospital Setup subtab

4. Enter the institution name in the **Institution Name** field.

Note The name appears on all images.

5. Enter the department name in the **Department Name** field.

6. Enter the institution address in the **Institution Address** field.

7. Click the following options that are applicable:
   - When **Auto Store** is selected and you Finalize a scan, the system will automatically send the images to the **Default PACS** server defined on the **DICOM Servers** tab. (see **System Configuration > DICOM Servers > Servers**). The status of your export will appear in the bottom right of the **Patient Browser** screen.
   - Click the **Use Device AE in Server Setting** option to apply the BodyTom 64 AE title tag to DICOM when the operator archives the image data to PACS.
     - If enabled when sending images to **PACS**, this option will include the BodyTom 64 AE setting as a **DICOM** tag.

8. Enter the system name (for example BodyTom 64) in the **Station AE Title** field.

9. Enter the name you want to call the archive option in the **"Push To" Text** box.

10. Click the **Save** button to keep your changes.
    The **Save Successful** popup appears.

11. Click the **Ok** button in the **Save Successful** popup.

12. Click the **Close** button to exit.

Application Setup subtab

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **General Settings** tab.

3. Click the **Application Setup** sub tab.

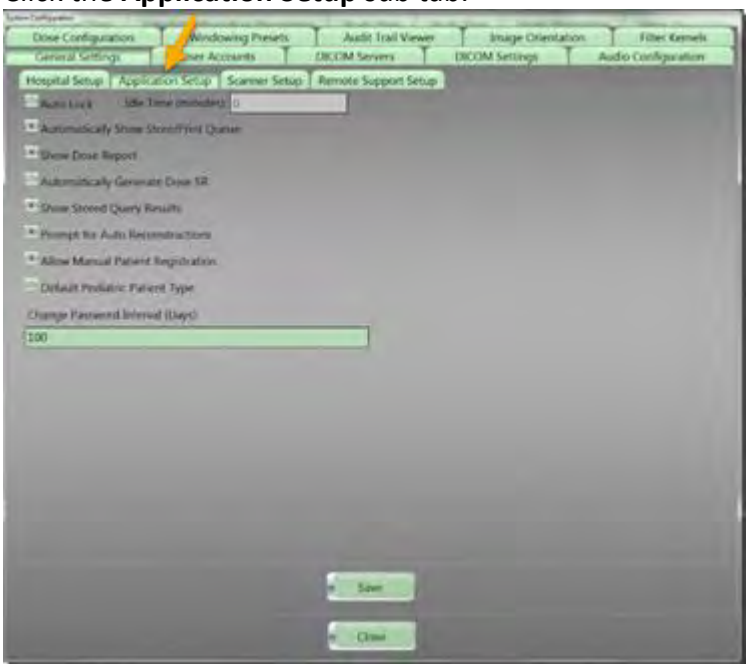


Figure 76: General Settings > Application Setup subtab

4. Click and/or enter information for the following options that apply:

Auto Lock	The **Auto Lock** feature can be used to automatically lock the workstation screen after a user defined **Idle Time** is reached.
Automatically Show Store/Print Queue	Allows the user to automatically display the **Store/Print Queue** status when images are set to archive to a network device.
Show Dose Report	Displays the **Dose Report** on the screen when the **Finalize** button is clicked.

	A dose report will not be generated until the operator clicks the **Finalize** button on the **Acquisition** tab.
Automatically Generate Dose SR	Generates a **Dose SR** (Structured Report) along with the dose report when the **Finalize** button is clicked.
Show Stored Query Results	Displays the **Stored Results** at the bottom of **Patient Registration**.
Prompt for Auto Reconstruction	Allows the user to automatically start any additional reconstructions added to a scan series after the exam is completed.
Allow Manual Patient Registration	Allows the user to manually register a patient.
Default Pediatric Patient Type	If selected, the **Protocol Manager** will default to the pediatric protocols.
Change Password Interval (Days)	Sets the number of days before a password change is required.

5. Click the **Save** button to keep your changes.

6. Click the **Close** button to exit.

Scanner Setup subtab

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **General Settings** tab.

3. Click the **Scanner Setup** sub tab.

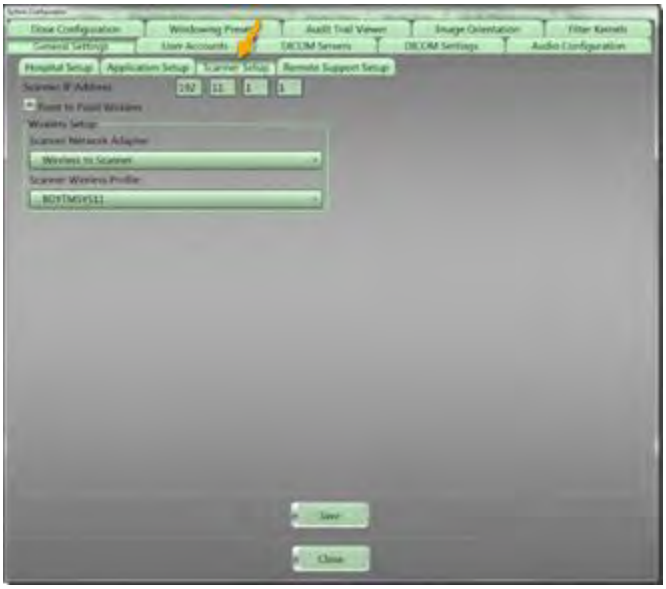


Figure 77: General Settings > Scanner Setup subtab

4. Click and/or enter information for the following options that apply:

Scanner IP address	Sets the scanner's IP address in the field(s).
Point to Point Wireless	Sets up wireless information regarding the connection from the workstation to the scanner. For **Scanner Network Adapter**, enter the adaptor, for example, Wireless to Scanner. For **Scanner Wireless Profile**, enter the wireless identifier in the field.

5. Click the **Save** button to keep your changes.

6. Click the **Close** button to exit.

Remote Support Setup subtab

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **General Settings** tab.

3. Click the **Remote Support Setup** subtab.

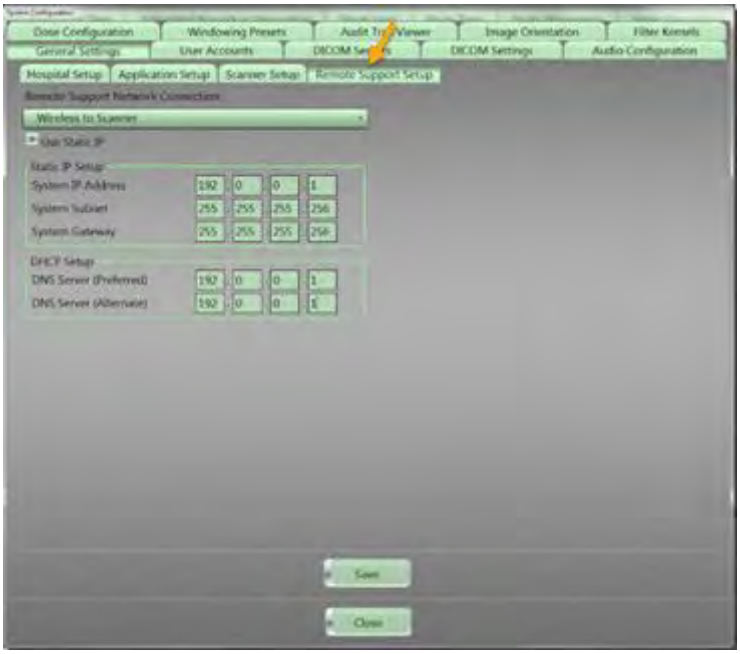


Figure 78: General Settings > Remote Support Setup subtab

4. Click the **Remote Support Network Connection** dropdown to select one of the following network connections**:**
   - Wireless to Scanner
   - Wired to Network

5. Click the **Use Static IP** option to enter the **Static IP Setup** data for the following:
   - System IP Address
   - System Subnet
   - System Gateway

6. Enter the **DHCP Setup** to enter IPs for the following:
   - DNS Server (Preferred)
   - DNS Server (Alternate)

7. Click the **Save** button to keep your changes.

8. Click the **Close** button to exit.

Managing DICOM servers

Digital Imaging Communication in Medicine is the definition of the acronym **DICOM**. **DICOM** servers are used to export images from the scanner. The **System Configuration > DICOM Servers** tab allows a user with administrative rights to access all the **DICOM** devices connected to the scanner.

See **DICOM** standards on the **NEMA.org** website for a full description of settings and actions that are available.

Note You must have administrative privileges and be logged in as an administrator to access and modify DICOM servers.

Incorrect changes to the DICOM servers may make the system inoperative.

DICOM servers are set up by the **field-service engineer** and the appropriate IT person at the hospital.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **DICOM Servers** tab.

Figure 79: DICOM Servers tab

The following tabs appear:

Servers	Lists existing servers based on type: **Store** and **Worklist** **Store**: Identifies a storage server. **Worklist**: Identifies servers in a database you can query from. Also displays server details and options, with controls for saving, updating, deleting, and echoing servers.
PACS List	Displays a list of **PACS** by **Server Name**, **Type**, and **In List** – to send to by default.
Options	Displays controls for **PACS Options** and **HIS/RIS Options**.

Figure 80: DICOM Servers tabs

3. Go to the following sections to assign specific actions to the **DICOM** server.

Assigning a server as a store or worklist server

1. Click **Customize > System** from the main menu**.**
   The **System Configuration** dialog box appears.
2. Click the **DICOM Servers** tab.
   The **Servers** tab is active.

Figure 81: DICOM Servers > Servers tabs

3. Click one of the following options:

Store	A storage server, typically a **PACS** server that archives images and patient information. The images and data can later be imported from the server to another system or the same system. It is partly a backup and partly a waypoint for transferring data from the system the scans were acquired on to another system for viewing.
Worklist	A database of patient information that can be queried to generate a list of patients based on name, modality, procedure date, and other variables. These patients are usually hosted on a server within the facility and the information can be imported from the server when trying to acquire all a patient's information before a procedure is run. This eliminates the need to manually enter patient information at the time of the procedure.

4. Under **Details**, enter the server's name in the **Server Name** text box.

5. For the **HIS/RIS** and **PACS Network Connection**, click the dropdown to identify the following:
   - Wireless to Scanner
   - Wired to Network

6. Click the **Point to Point Wireless** check box if it applies.

7. Click the **Wireless Profile** dropdown to select the appropriate profile.
8. In the **Server AE Title** text box, enter the server AE title.
9. In the **Device AE Title** text box, enter the BodyTom 64 AE title.
10. In the **Server IP Address** text boxes, enter the server IP address.
11. In the **Port** text box, enter the port identifier.
12. In the **Connection Timeout** text box, enter the number of seconds before the connection timeout is activated.
13. Click the **Use Static IP** option to identify the following:
    - System IP Address
    - System Subnet
    - System Gateway
14. To set the server as a default server, click the **Default Server** check box.
15. To set the server as the default surgical navigation server, click the **Default Navigation** check box.
16. To enable the storage commitment, click the **Enable Storage Commit** check box to send a message back to system that confirms the storage was successful; it is an extra confirmation from **PACS** that the images were received.
17. To gather responses, click the **Listen for Responses** check box.
    For every image that is sent, the system will wait for acknowledgement before sending the next image.
18. To gather 12-bit images, click the **12-bit Images** check box.
19. Click the **Save** button, to keep your work.

Figure 82: Action Succeeded popup message – Server saved

The new server should appear in the list box to the left.

20. Click the **Ok** button.

21. Click the **Close** button to exit.

Modifying a server

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **DICOM Servers** tab.

3. Click server type: **Store** or **Worklist**.

4. Select a server from the list.

5. Modify the parameters.
   See "Assigning a server as a store or worklist server" on page 133.

6. When all your changes are made, click the **Update** button.
   A message appears that explains the update was successful and includes the update(s).

Figure 83: Action Succeeded popup message – Server updated

7. Click the **Ok** button.

8. Click the **Close** button to exit.

Echoing a server

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **DICOM Servers** tab.

3. Click a server type: **Store** or **Worklist**.

4. Select the server to echo from the list.

5. Click the **Echo** button.
   The status of the server appears.

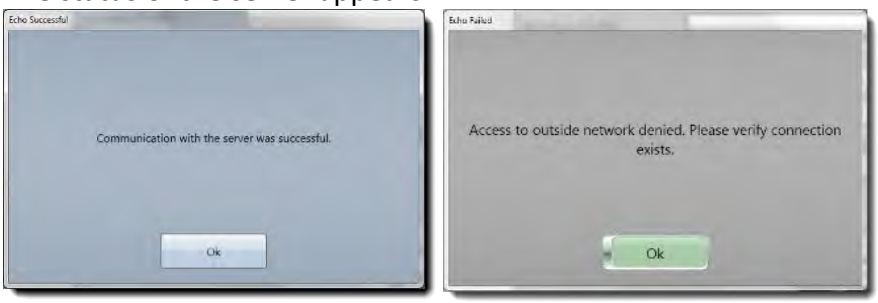


Figure 84: Echo Successful and Echo Failed popups

6. Click the **Ok** button.
   If the echo was unsuccessful, determine why and repeat step 5 until you are successful.

7. Click the **Close** button to exit.

Deleting a server

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **DICOM Servers** tab.

3. Click a server type: **Store** or **Worklist**.

4. When the server you want to remove is available, click the server from this list.

5. Click the **Delete** button.
   The server is removed from the list; the **Action Succeeded** popup appears.

6. Click the **Ok** button.

7. Click the **Close** button to exit.

Moving a server up and down the server list

1. Click **Customize > System** from the main menu.

The **System Configuration** dialog box appears.

2. Click the **DICOM Servers** tab.
3. Click a server type: **Store** or **Worklist**.
4. Select the server to move up or down the list.
5. Click the **Up** arrow to move the server up the list; click the **Down** arrow to move the server down the list.

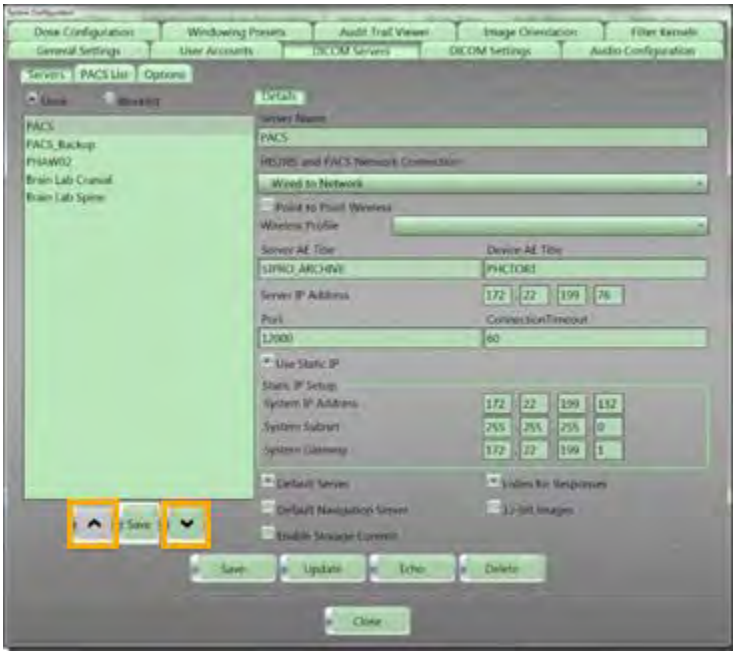


Figure 85: Up and Down arrows to move up and down server list

6. Click the **Save** button to save the server order.

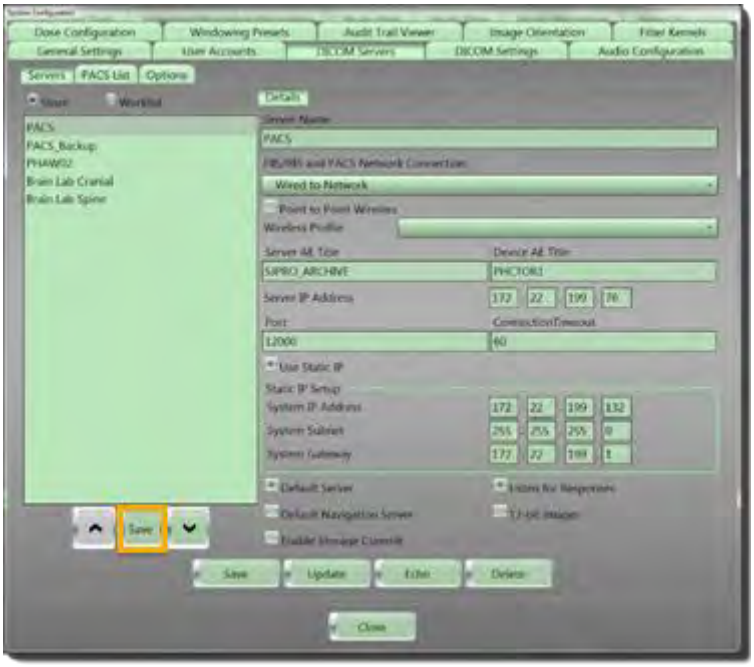


Figure 86: Save button

The **Action Succeeded** popup appears.

7. Click the **Ok** button.

8. Click the **Close** button to exit.

Saving DICOM servers to a PACS list

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **DICOM Servers** tab.

3. Click the **PACS List** tab to view available servers.

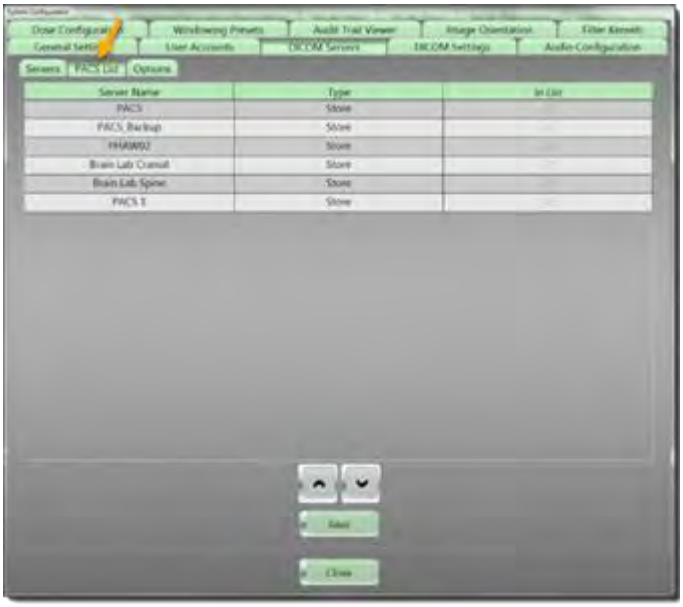


Figure 87: DICOM Servers > PACS List tab

4. Double-click the light-gray checkmark under **In List**.
   Each checkmark adds the server to the **PACS** listing. The checkmark turns green when active.

5. Click the **Save** button.
   The **PACS List Saved** popup appears.

Figure 88: PACS List Saved popup message – PACS saved

6. Click the **Ok** button.

7. Click the **Close** button to exit.

Selecting PACS options

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **DICOM Servers** tab.

3. Click the **Options** tab.

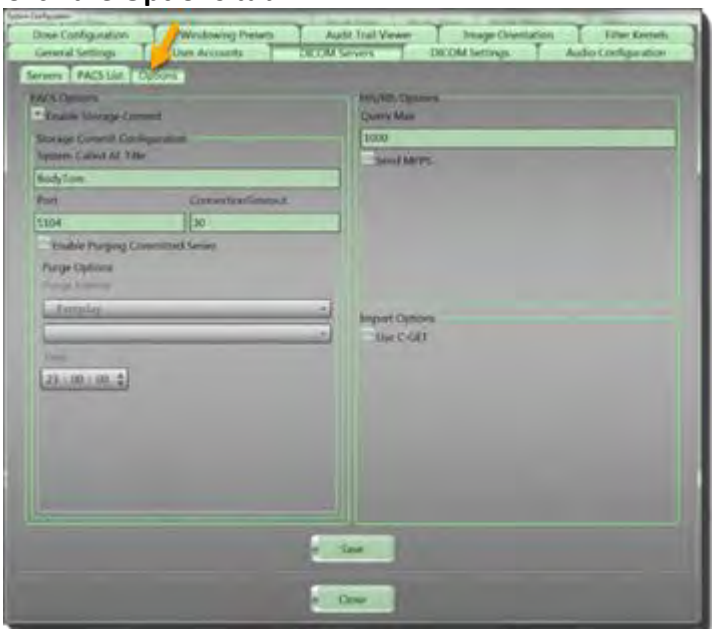


Figure 89: DICOM Servers > Options tab

4. Under **PACS Options**, click the **Enable Storage Commit** to verify that patient information and data archived to the **PACS** server was received.
   - If **Enable Storage Commit** is not selected, it is assumed and accepted that the data was received.
   - If **Enable Storage Commit** is selected, the workstation sends a request to the PACS server to verify that the data was received.

5. If the **Enable Storage Commit** check box is selected, perform the following:
   - Enter the appropriate title in the System Called AE Title text box.
   - Enter the port identifier in the Port text box.
   - Enter the number of seconds before a connection timeout in the Connection Timeout (secs) text box.
   - Enter 30 seconds or 60 seconds.

6. Under **Purge Options**, make selections based on the understanding that any studies archived to the **PACS** server are deleted from the workstation on a regular basis, depending on the selected interval; identify the following:

Purge Interval	Select one of the following from the dropdown: **Everyday**, **Weekly**, or **Monthly.** When you select the first **Purge Interval** dropdown and select **Weekly** or **Monthly**, the inactive dropdown is active to let you select the day of the week or the first of the month.
Time	Changes the hour, minute, and second interval; use the buttons to increase those time elements.  Figure 90: Time (increase and decrease time) arrows

7. Under the **HIS/RIS Options**, enter the maximum number of results sent back from a query worklist in the **Query Max** text box.
   There is no maximum limit.

8. Click the **Send MPPS** check box to apply a service that allows a modality to better coordinate with image storage servers by giving the server a list of objects to send before or while sending such objects.

9. Under **Import Options**, click the **Use C-GET** check box to pull information from a **PACS** server when importing ***from*** the server (as opposed to archiving to it).
   The administrator sets this to pull from **PACS** from anywhere, so the machine does not have to be set up as a reliable destination on the **PACS** machine. **PACS**, typically needs to equate a computer's IP address with an AE title; however, **C-GET** accepts that the calling IP is a legitimate device.

   The NeuroLogica BodyTom 64 scanner automatically uses **C-Move** when importing from **PACS**. If the operator wants to use **C-GET** instead, the user can select **C-Get**.

10. Click the **Save** button.
    The **PACS List Saved** popup appears.

Figure 91: PACS List Saved popup

11. Click the **Ok** button.

12. Click the **Close** button to exit.

Assigning DICOM settings

DICOM settings include many kinds of settings. The administrator can add or remove optional information to be displayed using actions described in this section.

See **DICOM** standards on the **NEMA.org** website for a full list and description of **DICOM** tags.

Note You must have administrative privileges and be logged in as an administrator to access and modify DICOM settings.

Incorrect changes to the DICOM settings may make the system inoperative.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **DICOM Settings** tab.

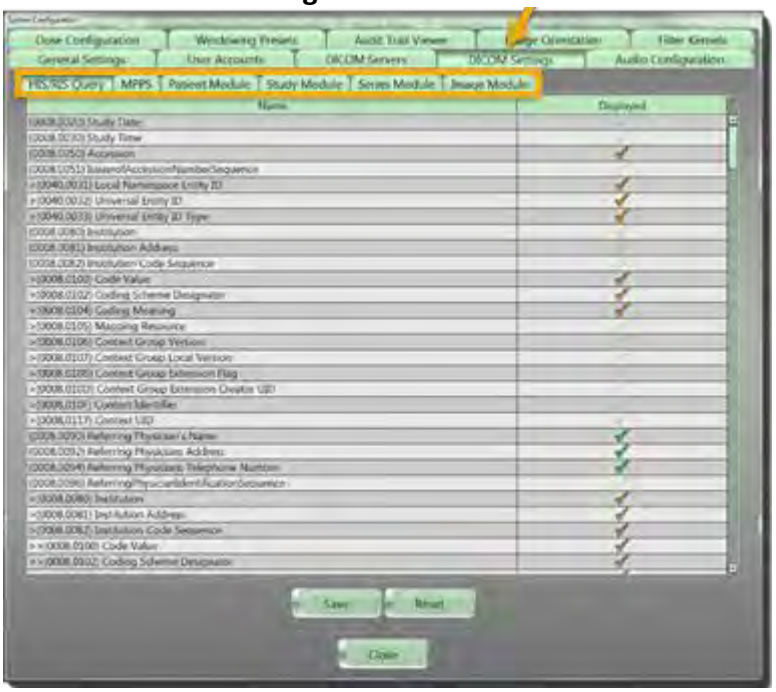


Figure 92: DICOM Settings tabs (six)

3. Click the **HIS/RIS Query** tab to select the types of **HIS/RIS** query results the user will see when performing a **HIS/RIS** query.
   See “Selecting PACS options” and go to step 6, for more information.

Note Even numbered **DICOM** tags are public **DICOM** tags as per the **DICOM** standard. Odd numbered **DICOM** tags are vendor specific.

Green checkmarks are optional **DICOM** tags and orange checkmarks are required per the **DICOM** standard and cannot be modified.

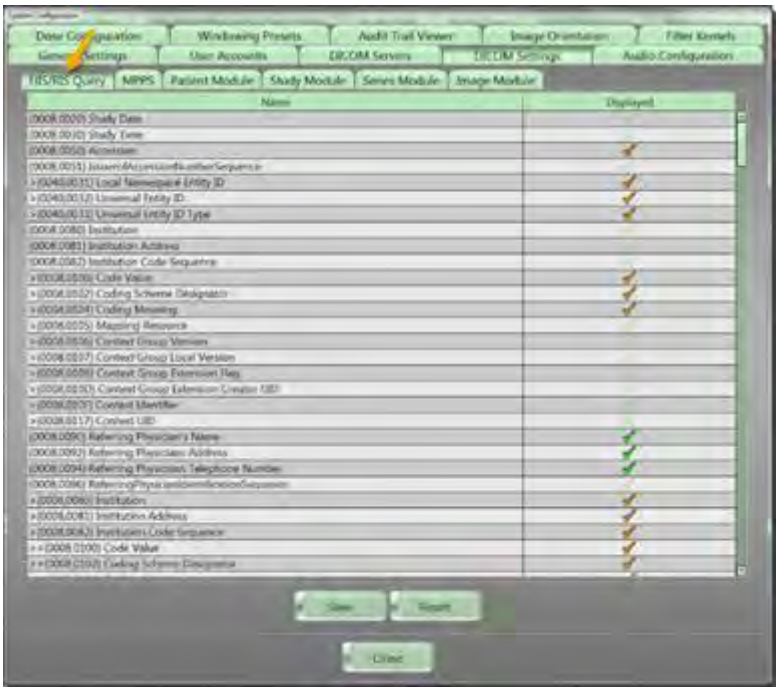


Figure 93: DICOM Settings > HIS/RIS Query

4. Click the **Modality Performed Procedure Step (MPPS)** tab to select the types of **MPPS** information the user will see.

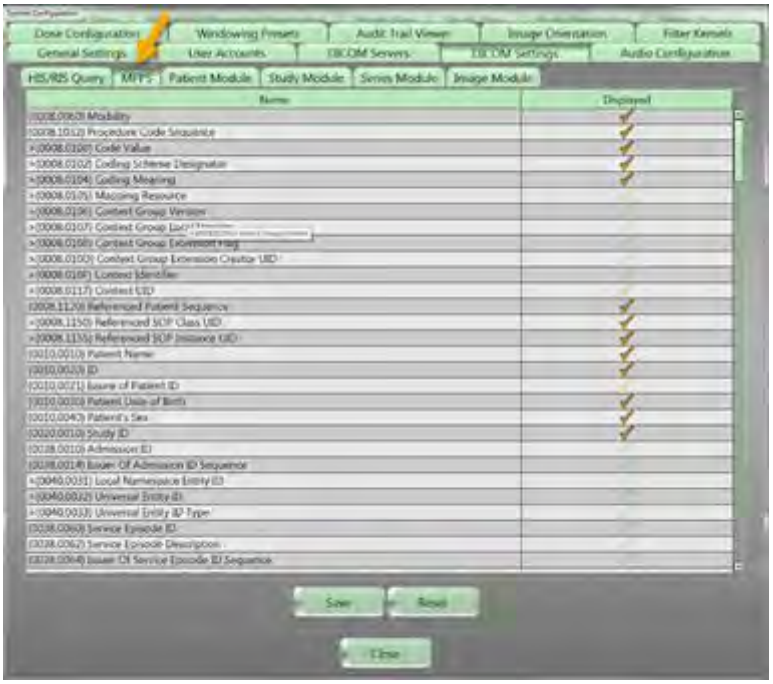


Figure 94: DICOM Settings > MPPS

5. Click the **Patient Module** tab to select the types of **Patient Module** information the user will see.

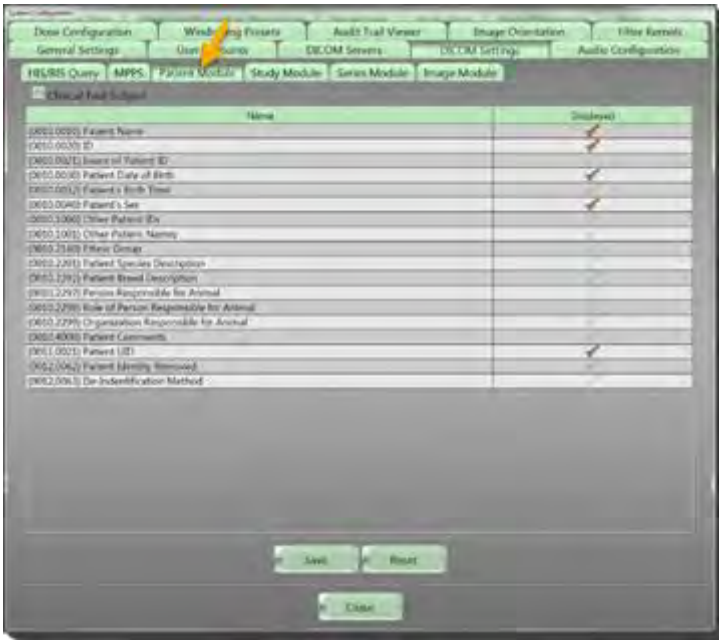


Figure 95: DICOM Settings > Patient Module

6. Click the **Study Module** tab to select the types of **Study Module** information the user will see.

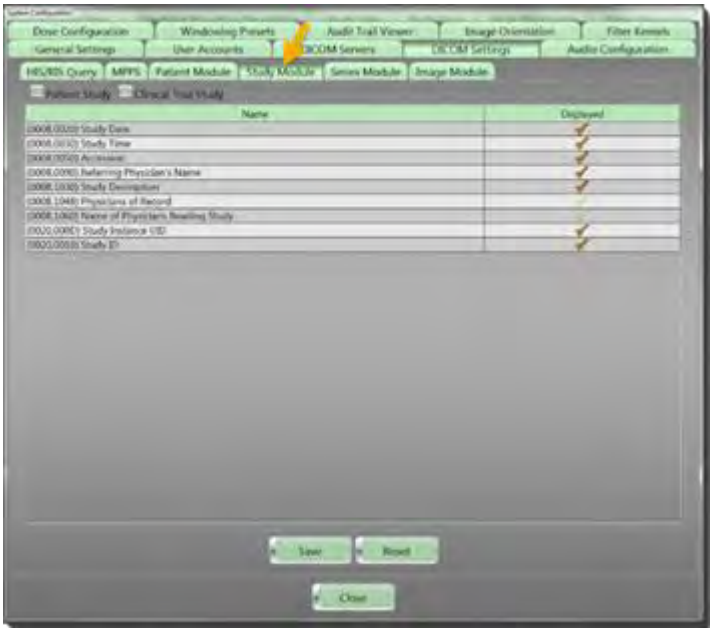


Figure 96: DICOM Settings > Study Module

7. Click the **Series Module** tab to select the types of **Series Module** information the user will see.

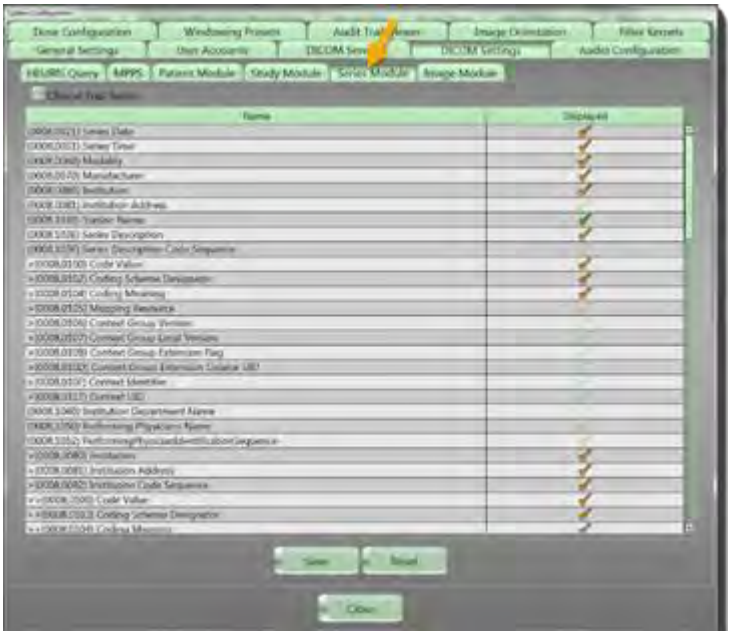


Figure 97: DICOM Settings > Series Module

8. Click the **Image Module** tab to select the types of **Image Module** information the user will see.

Figure 98: DICOM Settings > Image Module

9. Click the **Save** button to save your changes.

10. Click the **Close** button to exit.

Assigning audio configuration

Default audio files are installed on the workstation. Audio files can be attached to protocols and sent to the scanner. Each audio file has an indication if it has been sent to the scanner.

Note You must have administrative privileges and be logged in as an administrator to access and modify audio configurations.

Incorrect changes to the audio configurations may make the system inoperative.

Finding and listening to audio files

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.
2. Click the **Audio Configuration** tab.

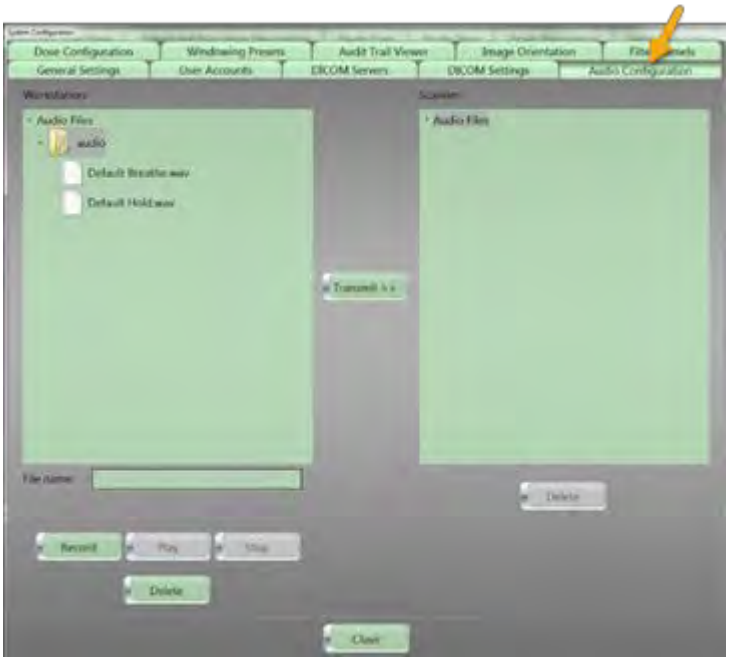


Figure 99: Audio Configuration tab

3. Review the audio files that exist on the **Workstation.**

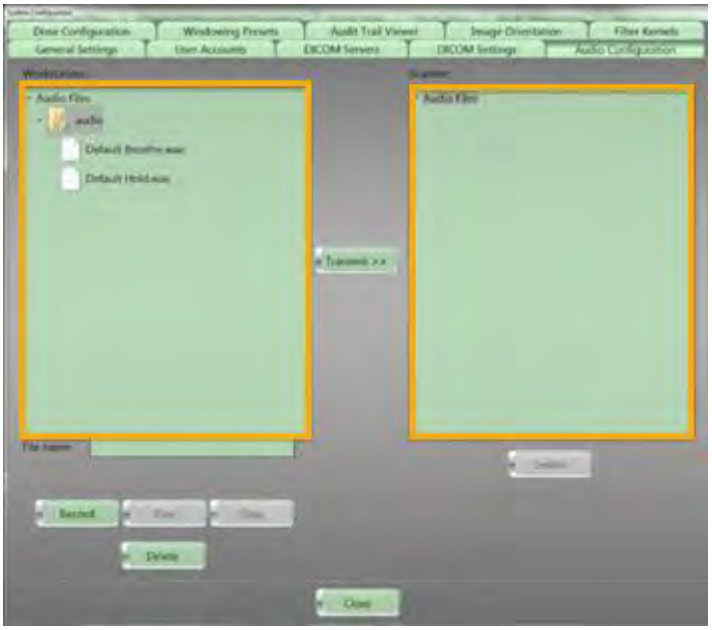


Figure 100: Audio files list

4. To listen to an audio file, select the name from the workstation list and click the Play button.

5. To exit the Audio Configuration, click the **Close** button.

Recording and saving an audio file

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Audio Configuration** tab.
   The available audio files appear under **Workstation**.

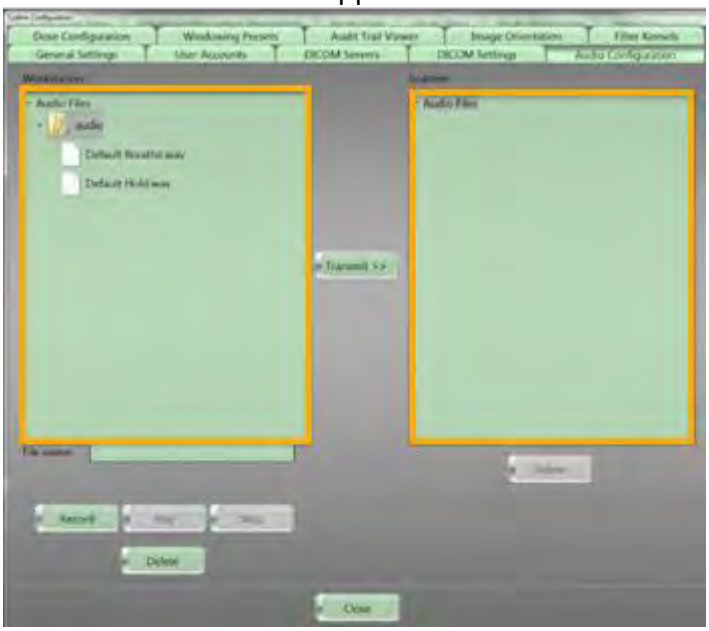


Figure 101: Audio files list

3. Enter the name of your new audio file in the File name text box.

4. Click the **Record** button.

5. Record your audio file.

6. Press the **Stop** button.

7. To review, highlight your new recording and press the **Play** button.

Figure 102: New audio file

8. When you like your recording, highlight the file, and press the **Transmit** button to copy the file into the audio folder for your scanner protocols.

9. Click the **Close** button to exit.

Transmitting an audio file

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the Audio Configuration tab.
   The available audio files appear under **Workstation**.

3. Select the audio files under **Workstation** audio files to transfer to the scanner.

4. Click the **Transmit** button.

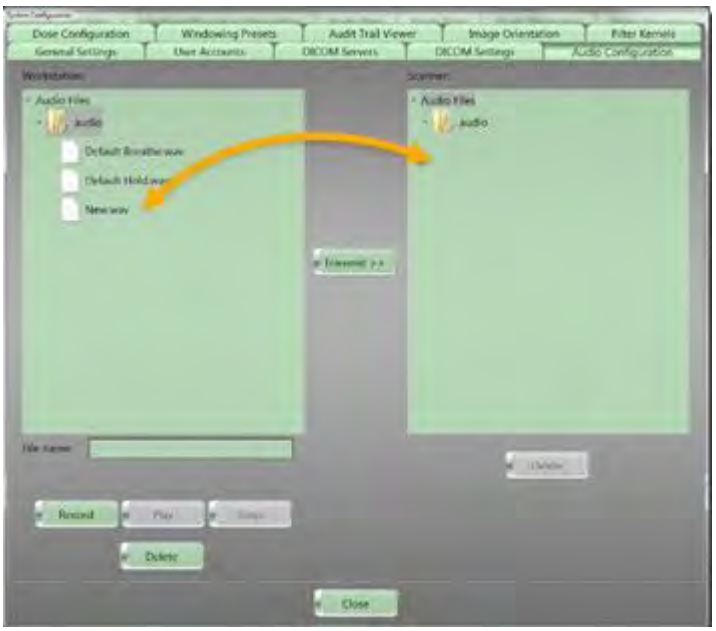


Figure 103: Audio files transmitted to save to the scanner

5. Click the **Close** button to exit.

Deleting an audio file

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.
2. Click the Audio Configuration tab.
   The available audio files appear under **Workstation**.
3. Select the audio file you want to delete from the list.
4. Click the **Delete** button.
5. Click the **Close** button to exit.

Assigning dose report

The **dose report** is created at the end of the scan and can be customized to include **DICOM** specific tags.

Note	You must have administrative privileges and be logged in as an administrator to access and modify dose report settings.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Dose Configuration** tab.

3. Click the **Dose Report** tab.

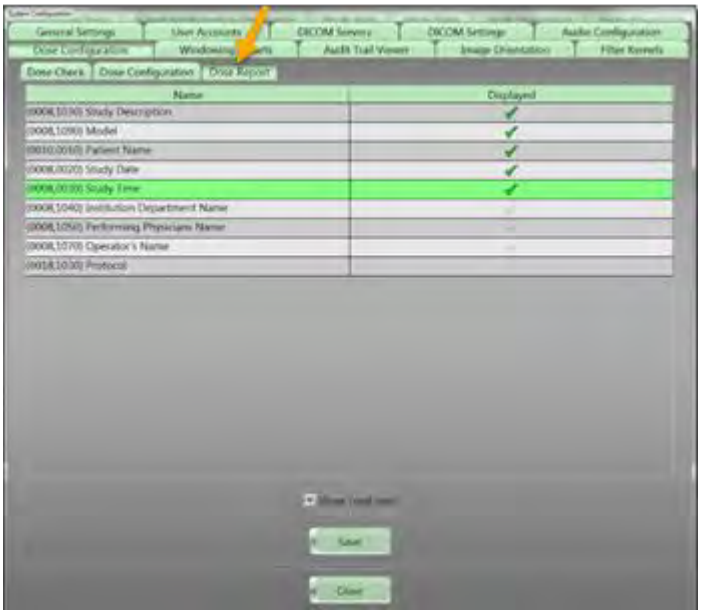


Figure 104: Dose Report tab

4. Select the **DICOM** tags you want to see in the **dose report.**
   A **dose report** is generated after the exam is finalized; the black area includes dose report information like the following.

Figure 105: Generated dose report

5. Click the **Save** button.

6. Click the **Close** button to exit.

Applying dose configuration

Note You must have administrative privileges and be logged in as an administrator to access and modify dose configurations.

Incorrect changes to dose configuration settings may make the system inoperative.

Note You can check the **Audit Trail** to review the audit log that details what dose limit was removed, by whom, and the date and time it took place.

Dose configuration consists of both **Dose Notifications** and **Dose Alerts**.

Dose Notification	Notifies the user when the planned $CTDI_{vol}$ and/or DLP value of a single series will exceed the defined value.
Dose Alert	Notifies the user when the planned $CTDI_{vol}$ and/or DLP value from the combination of all planned series will exceed the defined value set in **System Configuration.** Dose Alerts represent a value which would be well above an institution's established CTDI/DLP range to the given examination and warrant a more stringent review and consideration before proceeding.

Setting Dose Check

See Appendix A on page 380 for information on protocols, $CTDI_{vol}$, and DLP.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Dose Configuration** tab.

3. Click the **Dose Check** tab.

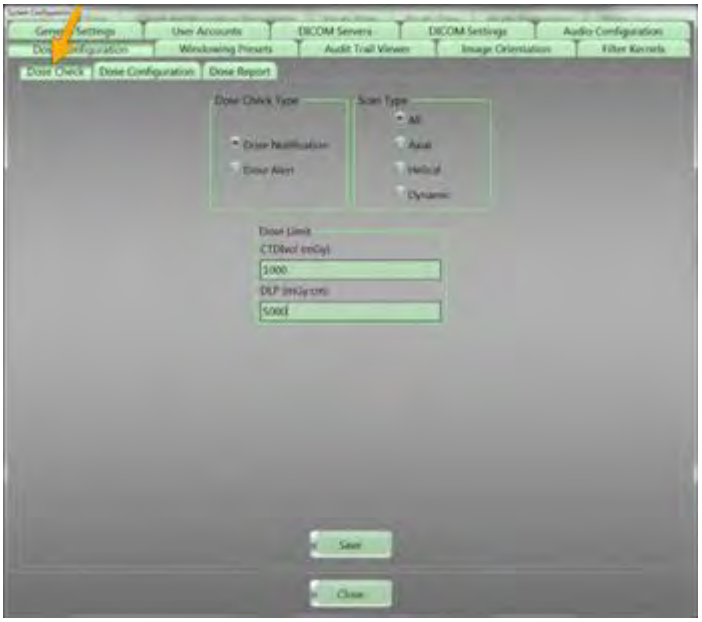


Figure 106: Dose Configuration > Dose Check

4. Click one of the following **Dose Check Type** options:

Dose Notification	Notifies the user when a pre-defined $CTDI_{vol}$ or DLP value will be exceeded on a series-by-series basis.
Dose Alert	Notifies the user when a pre-defined $CTDI_{vol}$ or DLP value will be exceeded from a combination of all planned series or scans.

Note The default **Dose Alerts** which are set at 1000mGy CTDI and 5000mGy*cm DLP are designed to prevent the patient from receiving any possible deterministic effects due to excess dose. However, the system allows these values to be modified by the user. Any modifications to the **Dose Alerts** should be done by qualified medical personnel.

5. Click one from the following **Scan Type** options.

All	Identifies ***all*** scan types.
Axial	Identifies only **Axial** scan types.
Helical	Identifies only **Helical** scan types.
Dynamic	Identifies only **Dynamic** scan types.

6. Define the **Dose Limit** by entering the following:
   - Enter the $CTDI_{vol}$ (mGy) value in the text box.
   - Enter the DLP (mGy.cm) value in the text box.

7. Click the **Save** button.
   The **Save Successful** popup appears.

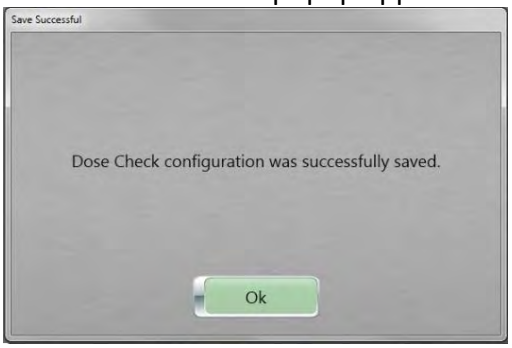


Figure 107: Save Successful popup – Dose Check successfully saved

8. Click the **Ok** button.

9. Click the **Close** button to exit.

Assigning Dose Configuration to a patient protocol

Dose Configuration limits are used to prevent users from selecting kV or mA values that are not appropriate for the given patient types, such as pediatrics etc.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Dose Configuration** tab.

3. Click the **Dose Configuration** subtab.

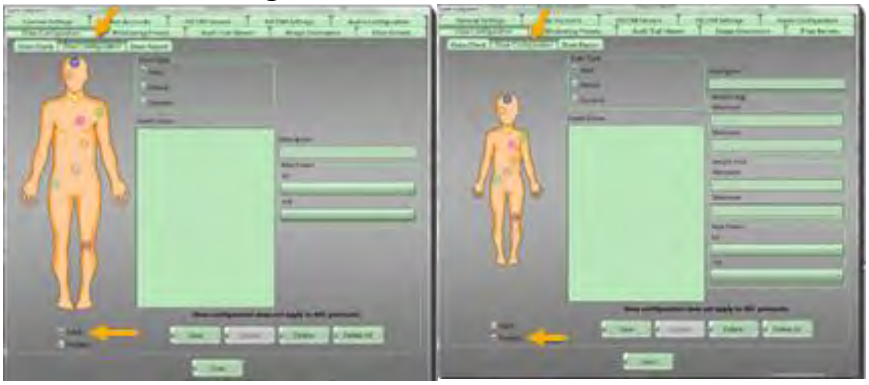


Figure 108: Dose Configuration > Dose Configuration for adult and pediatric

4. Click one of the following:

Adult	Selecting Adult shows the pre-defined adult protocols, stored by anatomical area.

Pediatric	Selecting Pediatric shows the pre-defined pediatric protocols, stored by anatomical area.
Trauma	The **Trauma** orb can be used to store protocols commonly used for emergency scans.

5. Click the colored orb that marks the anatomical region to apply the dose to.

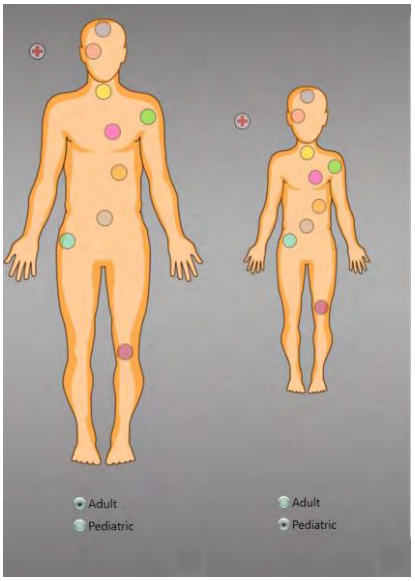


Figure 109: Anatomical orbs

6. Click a scan type from the following list:

Axial	Identifies only **Axial** scan types.
Helical	Identifies only **Helical** scan types.
Dynamic	Identifies only **Dynamic** scan types.

7. Enter a description for the **Dose Configuration** in the **Description** text box.

8. For **Pediatrics** enter the **Minimum** and **Maximum Weight** and **Length** information.

9. Under the **Max Power** settings, click the **kV** dropdown and select the maximum allowed kV.

10. Click the **mA** dropdown and select the maximum allowed mA.

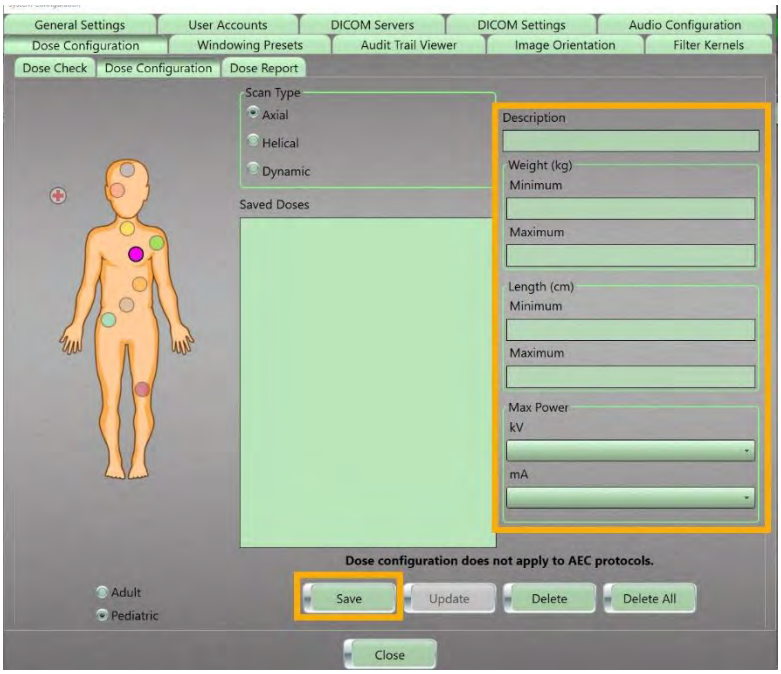


Figure 110: Pediatric Dose Configuration Parameters

11. Click the **Save** button to save your work.
    If the level overlaps an existing level, you are prompted to adjust.

Figure 111: Invalid Parameter popup message – Dose setting kV already exists

If the save is successful, the **Save Successful** popup appears.

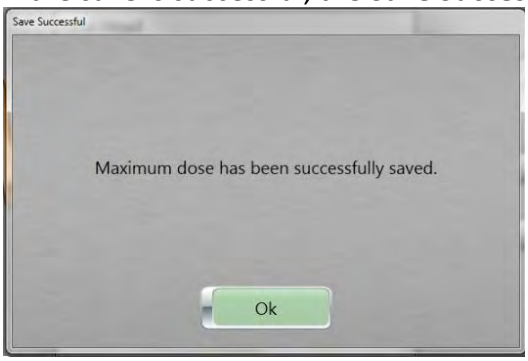


Figure 112: Save Successful popup message – Maximum dose saved

12. Click the **Ok** button.

13. Under the **Saved Doses** list box, check that your dose configuration appears, if so, go to the next step.

14. Click the **Close** button to exit.

Updating saved dose

To modify a saved **Dose Configuration.**
See "Setting Dose Check" page 153 and/or "Assigning Dose Configuration to a patient protocol" on page 155.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Dose Configuration** tab.

3. Select the desired **Saved Dose** from the **Saved Doses** list.

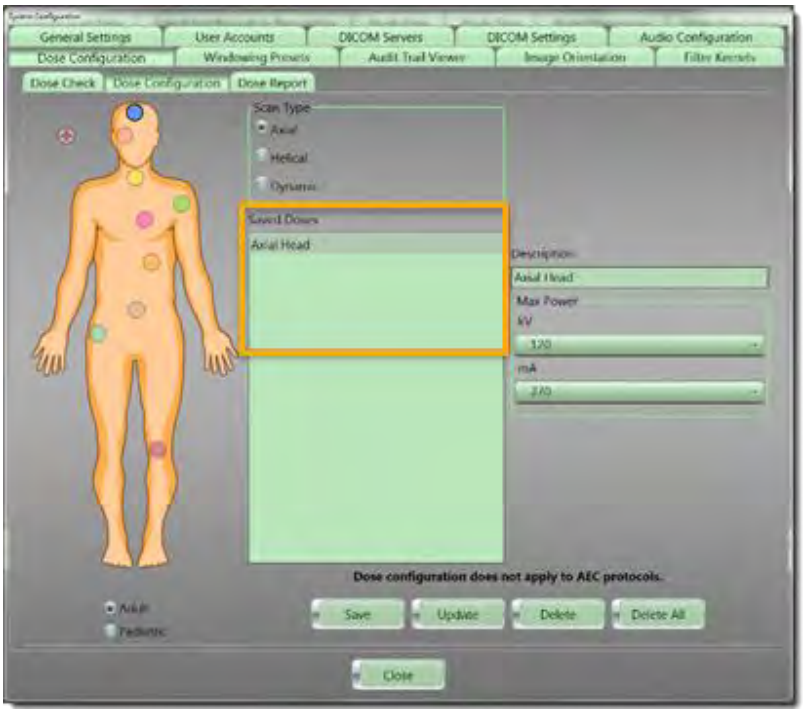


Figure 113: Saved Doses List

4. Modifying values causes the **Update** button to become active.

5. Click the **Update** button.

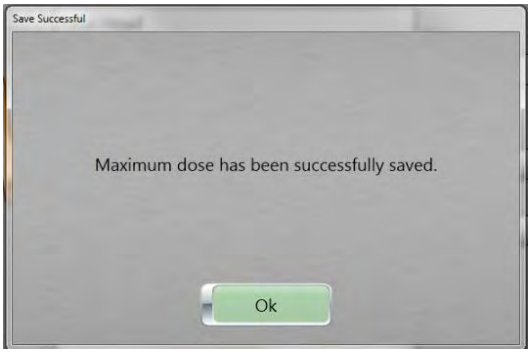


Figure 114: Save Successful popup message – Maximum dose saved

6. Click the **Ok** button.

7. Click the **Save** button to save your work.

> **Note** If the level overlaps an existing level, you are prompted to adjust.

8. Click the **Close** button to exit.

Deleting a saved dose limit

To remove a saved **Dose Configuration.**

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.
2. Click the **Dose Configuration tab.**

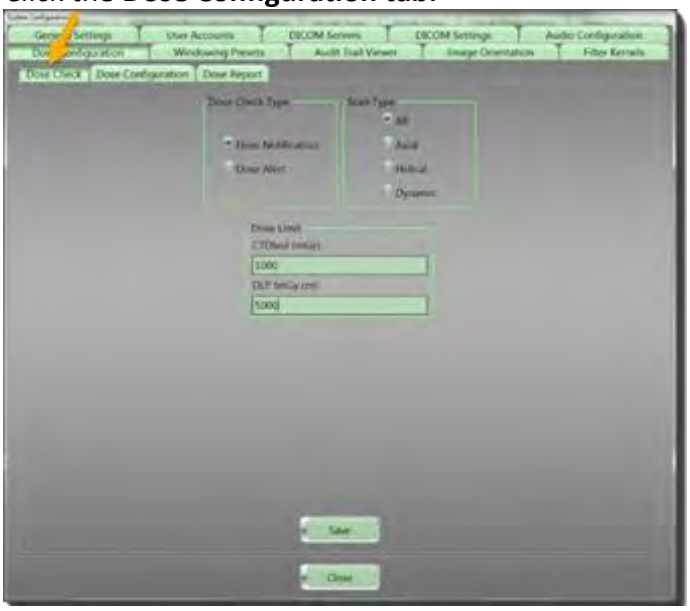


Figure 115: Dose Configuration > Dose Check tab

3. Click an already-saved dose, under the **Saved Doses** list.

4. Perform one of the following:
   - To delete a saved dose from the Saved Doses list and clear the restriction, select the dose, and click the Delete button.
   - To delete all the saved doses in the Saved Doses list and clear all restrictions saved, click the Delete All button, which returns all settings for that selection to the maximum scanner default.

Note If there are no saved doses or limits, the operator will be able to scan using the maximum 140kV and 300mA available on the scanner.

5. Click the **Save** button.
   The save success message appears and, because the **CTDIvol (mGy)** and **DLP (mGy.cm)** are empty, there is no longer a limit applied.

   The **Save Successful** popup appears.

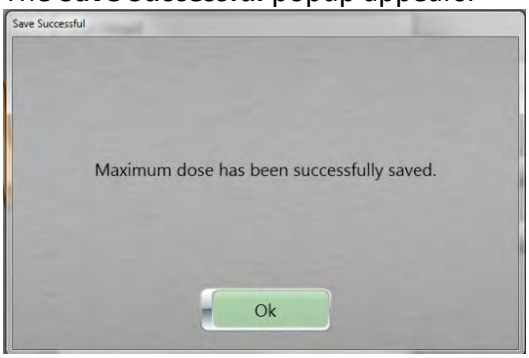


Figure 116: Save popup message – Maximum dose saved

6. Click the **Ok** button.

7. Click the **Close** button to exit.

Applying Windowing Presets

Windowing presets allow you to define window width and center presets for specific anatomical locations as well as specific reconstruction kernel presets. An Administrative User can delete or update the default Window Presets as well as create new Windowing Presets.

Note You must have administrative privileges and be logged in as an administrator to access and modify the windowing presets.

Editing kernel presets

Note Kernel presets are pre-installed in the system; kernel presets can be set and modified.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Windowing Presets** tab.

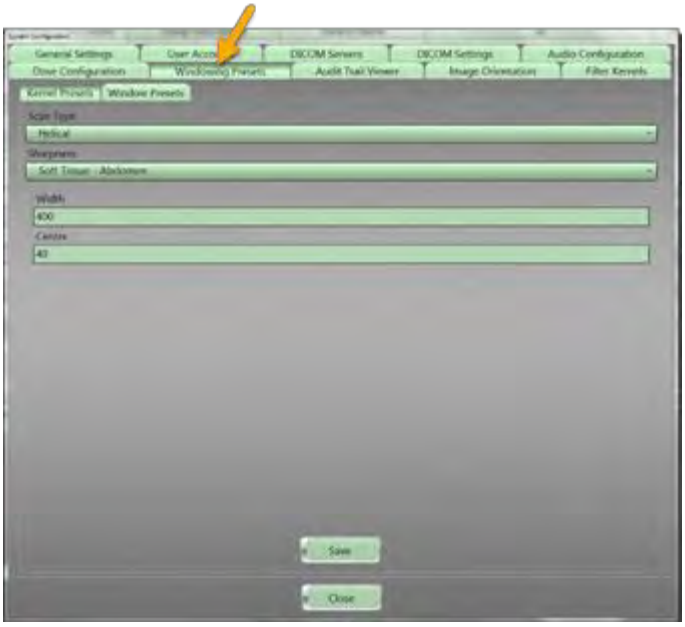


Figure 117: Windowing Preset tab

3. Click the **Kernel Presets** tab.

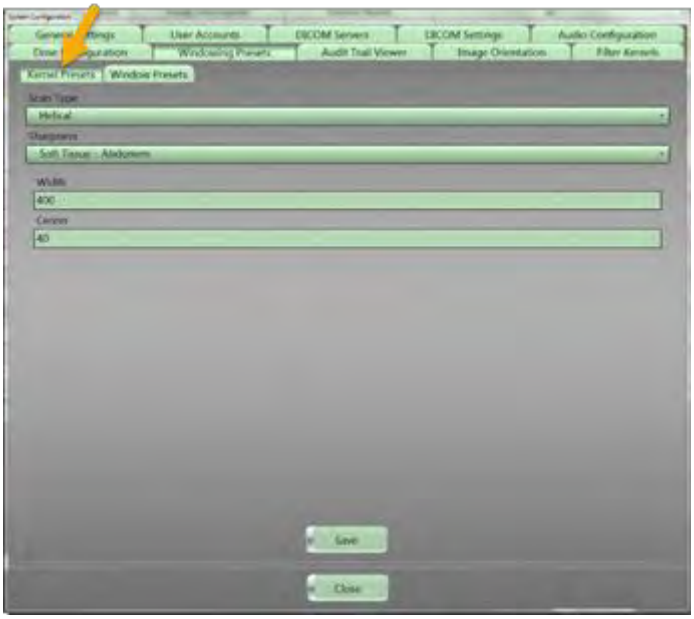


Figure 118: Windowing Presets > Kernel Presets tab

4. Click the **Scan Type** dropdown to select one of the following scan types:
   - Axial
   - Helical

5. Click the **Sharpness** dropdown to select a sharpness from the list. **Sharpness** is the reconstruction algorithm, and the available **Sharpness** values are based on the scan type.

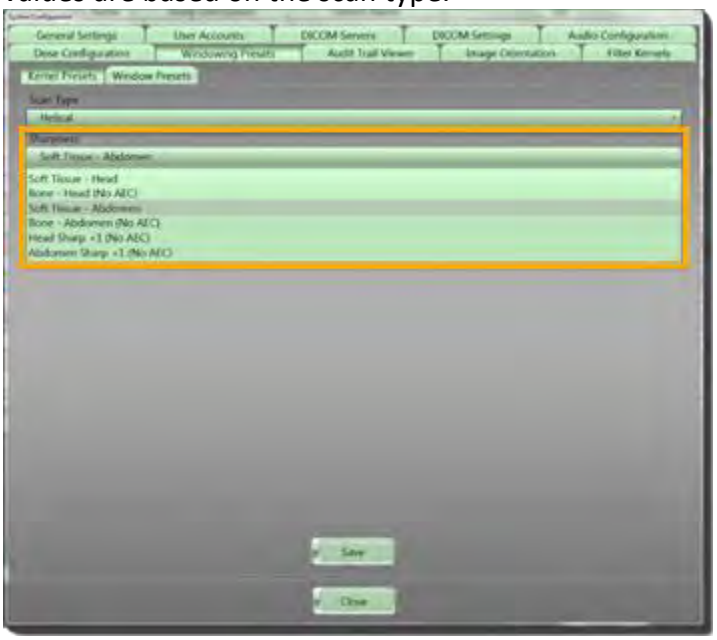


Figure 119: Sharpness dropdown

6. Enter the Window Width in the **Width** text box.

Window Width describes the range of Hounsfield units, or shades of gray, displayed across the image. The **Window Width** controls the contrast of the image. Low Hounsfield numbers below the range are displayed as black, while High Hounsfield numbers above the range are displayed as white.

7. Enter the Window Center in the **Center** text box.
   Window Center describes the Hounsfield number in the center of the Window Width. **Window Center** controls the brightness or density of the image.

8. Click the **Save** button to save your work.
   The **Action Succeeded** popup appears.

Figure 120: Action Succeeded popup message – Preset saved

9. Click the **Ok** button.

10. Click the **Close** button to exit.

Setting Window Presets

Window presets allow you to define **Window Width** and **Window Center** presets for specific anatomical locations, such as bone, brain, lung, and soft tissue.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Windowing Presets** tab.

3. Click the **Window Presets** subtab.

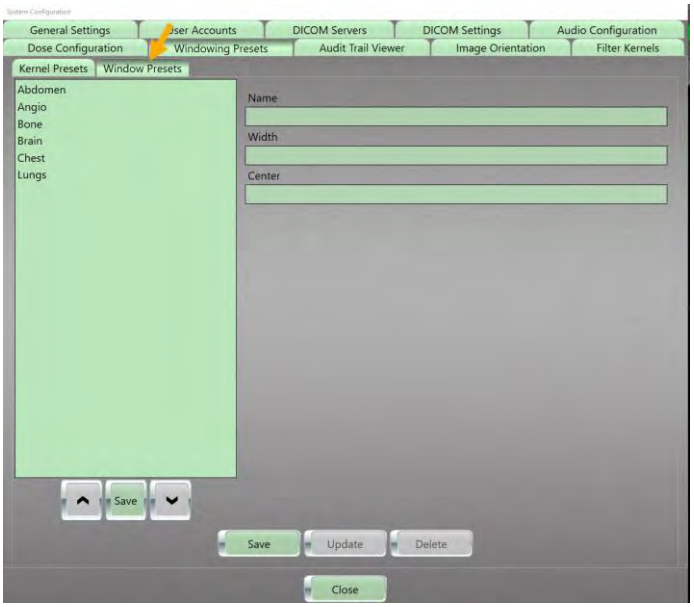


Figure 121: Window Presets tab

4. Enter the name of the window preset in the **Name** text box.

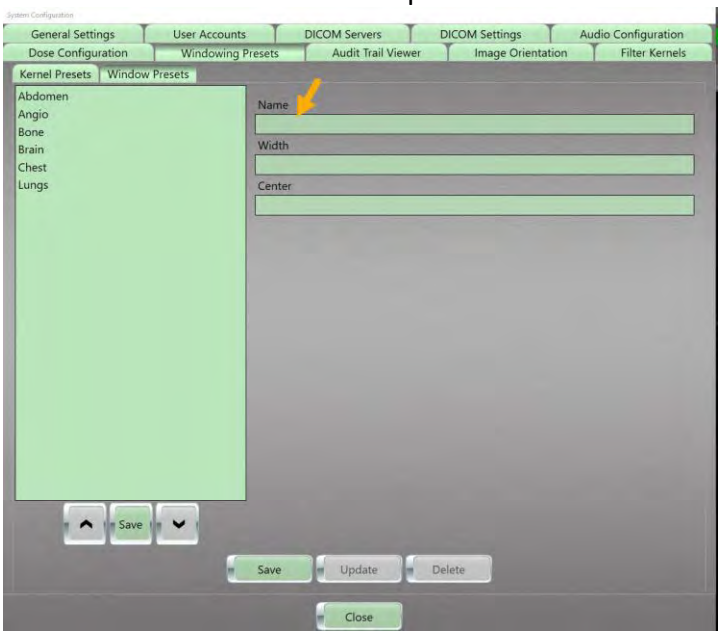


Figure 122: Window Presets > Name

5. Enter the width of the window preset in the **Width** text box.

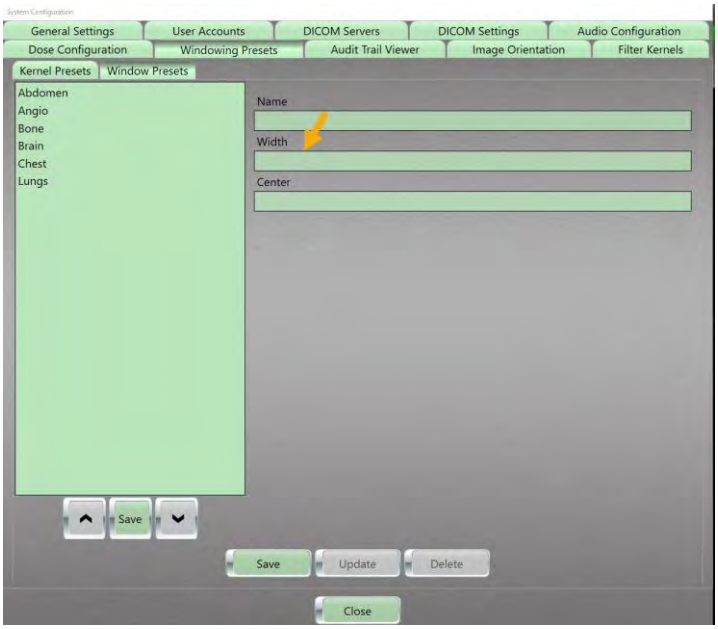


Figure 123: Window Presets > Width

6. Enter the center for the window preset in the **Center** text box.

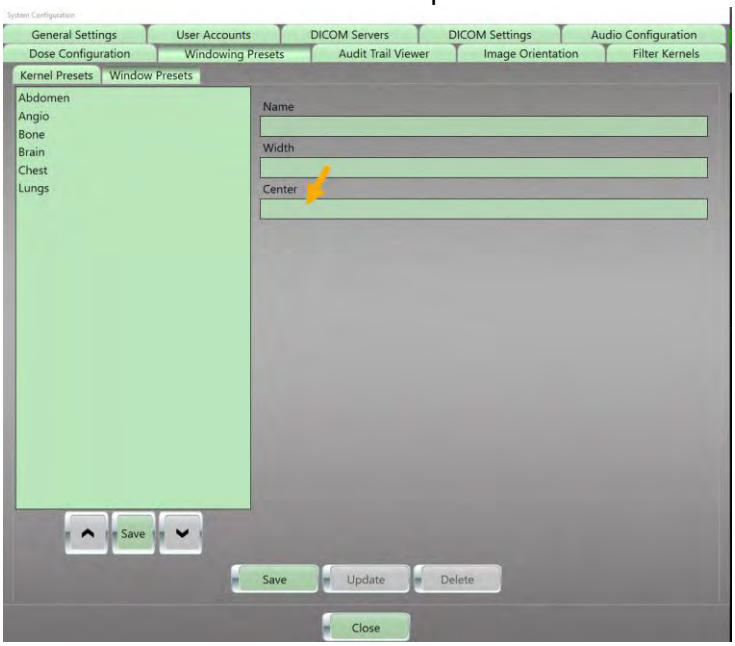


Figure 124: Window Presets > Center

7. Click the **Save** button to save your work.
   The **Action Succeeded** popup appears.

Figure 125: Action Succeeded popup message – Preset saved

8. Click the **Ok** button.

9. Click the **Close** button to exit.

Editing a window preset

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Windowing Presets** tab.

3. Click the **Window Presets** subtab.

4. Click a preset that exists in the **Window Presets** listing.

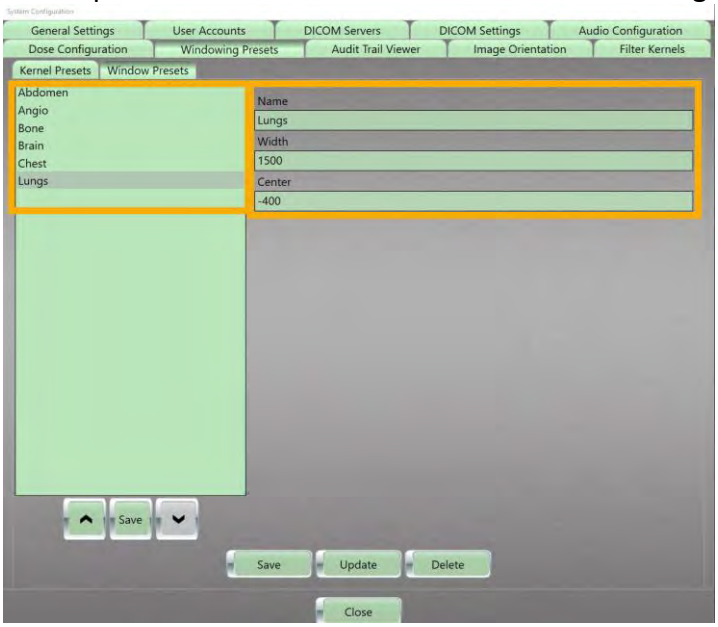


Figure 126: Listing update

5. To edit the preset, make your changes in the **Name**, **Width**, and/or **Center** text boxes.

6. Click the **Save** button to save your changes.
   The **Action Succeeded** popup appears.

Figure 127: Action Succeeded popup message – Preset saved

7. Click the **Ok** button.

8. Click the **Close** button to exit.

Deleting a preset

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Windowing Presets** tab.

3. Select the preset.

4. Click the **Delete** button.
   The **Action Succeeded** popup appears.

Figure 128: Action Succeeded popup message – Preset deleted

5. Click the **Ok** button.

6. Click the **Save** button to exit.

Setting up the Audit Trail Viewer

The **Audit Trail Viewer** gives a user with administrative access the ability to view all activities performed by anyone logged into the system. This includes changes to protocols, deletion of images, as well as acknowledgement of alerts etc.

Note You must have administrative privileges and be logged in as an administrator to access the Audit Trail Viewer.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Audit Trail Viewer** tab.

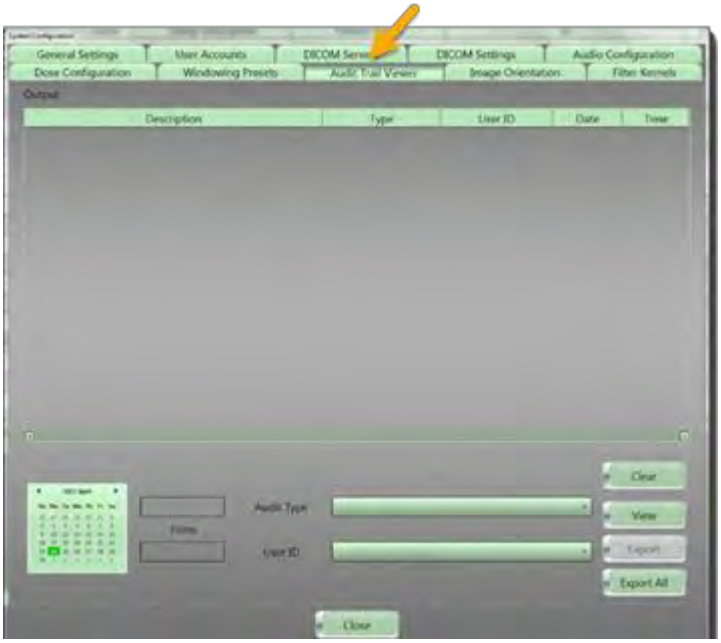


Figure 129: Audit Trail Viewer tab

3. From the **Audit Trail Viewer** tab, use the calendar to select a date range to view.
   - To select a single date, position the mouse pointer in the top box and click the date on the calendar to find audits for that date.
   - To select a date range, click the desired start date on the calendar. This will automatically populate the top box of the **From** range. Click the desired end date on the calendar, which automatically fills the bottom box of the **From** range.

Figure 130: Adding a date or a date span

4. Click the **Audit Type** dropdown to select the type of audit you are searching.

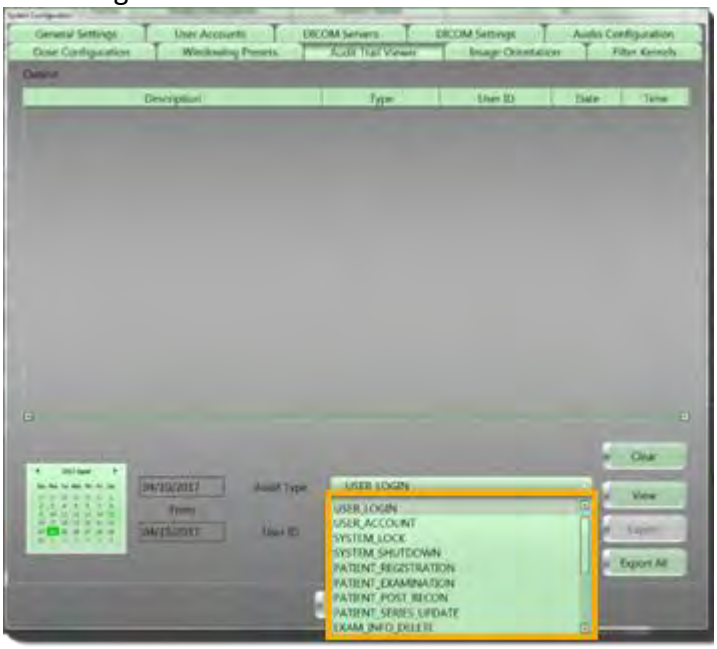


Figure 131: Audit Trail Viewer > Audit Type dropdown

5. From the **User ID** dropdown, click the type of user to track.

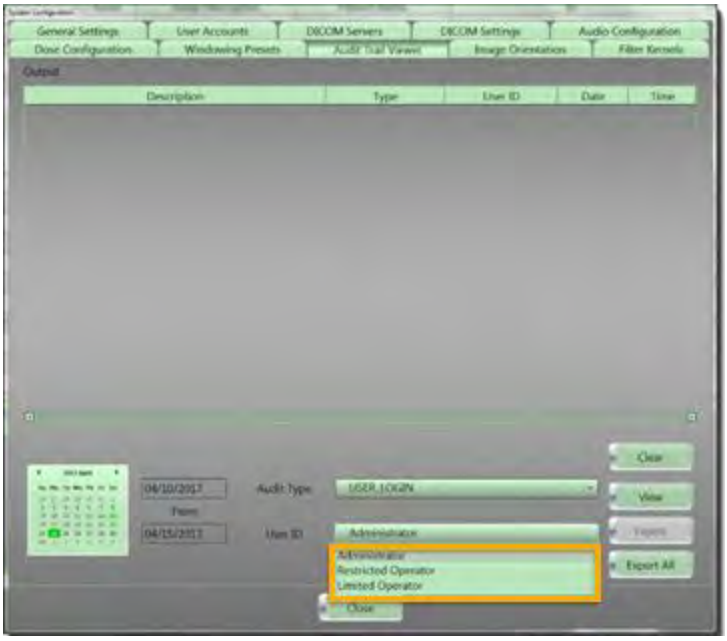


Figure 132: Audit Trail Viewer > User ID dropdown

6. Click the **View** button to see the result of audits that met your criteria.

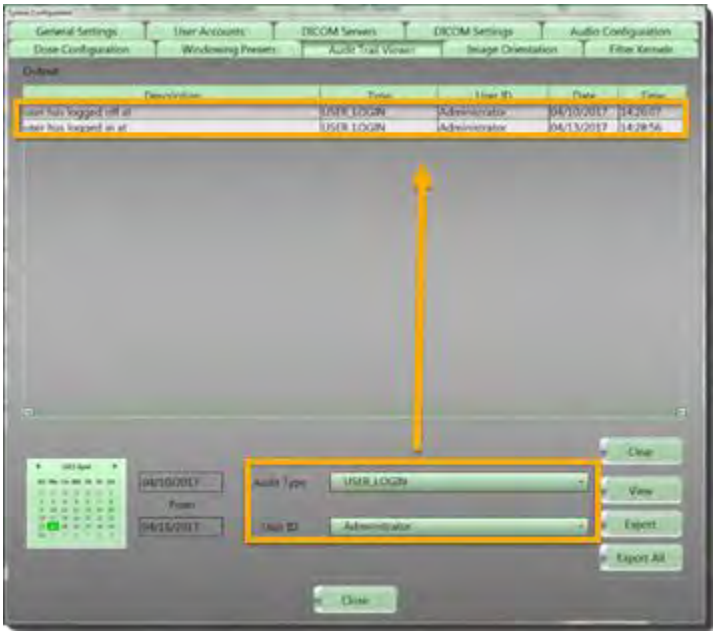


Figure 133: Audit results

7. Perform one of the following:
   - Click the **Clear** button to remove the audit results.
   - Click the **Export** button to export the audit result that you selected to the audit backup file on the system.
   - Click the **Export All** button to export the audit results to the audit backup file on the system.

8. Click the **Close** button to exit.

Setting image orientation

NeuroLogica describes patient orientation as if the viewer were looking towards the front of the gantry. In other words, if the patient is lying face up with their head in the gantry, the image orientation displays the patient's Right side on the Left side of the Viewer. If the patient's feet are going into the gantry, the image orientation displays the patient's Left side on the Left side of the Viewer.

Note You must have administrative privileges and be logged in as an administrator to modify image orientation settings.

Changes to image orientation settings will modify the displayed orientation markers on the images.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Image Orientation** tab.

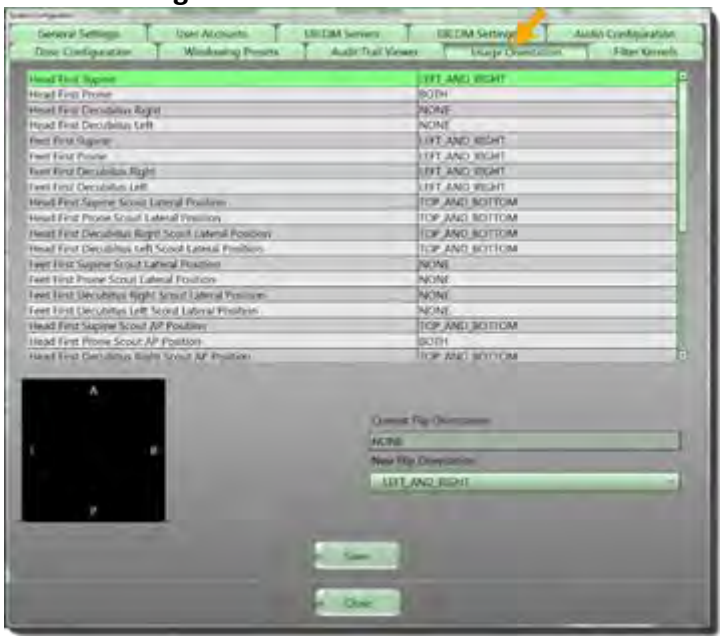


Figure 134: Image Orientation tab

The top half of the **Image Orientation** screen shows the available patient orientations. The black image orientation square represents the viewing area and shows four different orientation markers: A = anterior, L = left, P = posterior and R = right. If you do not see letters in the image orientation box, select an image orientation from the list.

3. Select the appropriate orientation from the list.
   For example, select, **Head First Supine**. In the figure below, the highlighted selection shows the current orientation in the **Current Flip Orientation** field, which is not changeable; however, the **New Flip Orientation** lets you change the orientation.

4. Click the **New Flip Orientation** dropdown to select one of the following new-flip orientations:
   - NONE
   - LEFT_AND_RIGHT
   - TOP_AND_BOTTOM
   - BOTH

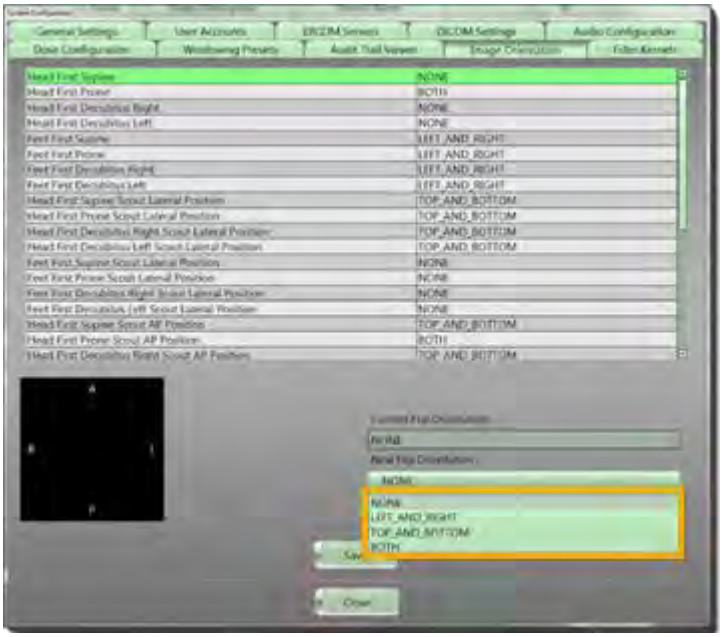


Figure 135: Image Orientation > New Flip Orientation dropdown

5. Click the **Save** button to save changes.

6. The **Settings Saved** popup appears.

Figure 136: Settings Saved popup message – Image orientation settings saved

7. Click the **Ok** button.
8. Click the **Close** button to exit.

Setting Filter Kernels

Filter kernels allow you to activate custom kernel options for both **Axial** and **Helical** scans to control the sharpness and smoothness of the images.

1. Click **Customize > System** from the main menu.
   The **System Configuration** dialog box appears.

2. Click the **Filter Kernels** tab.

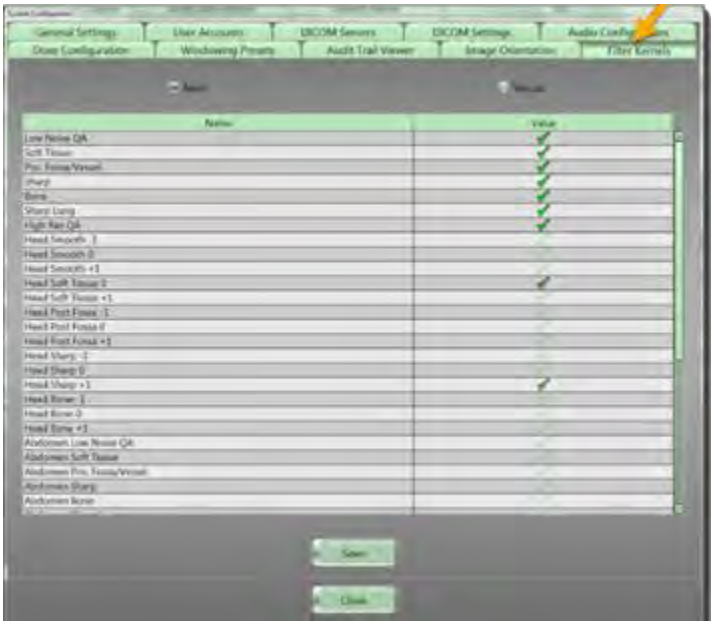


Figure 137: Filter Kernels tab

3. Perform one of the following:
   - To add new Axial kernels, select the **Axial** radio button, then double-click the **Value** cell next to the desired Axial kernel.

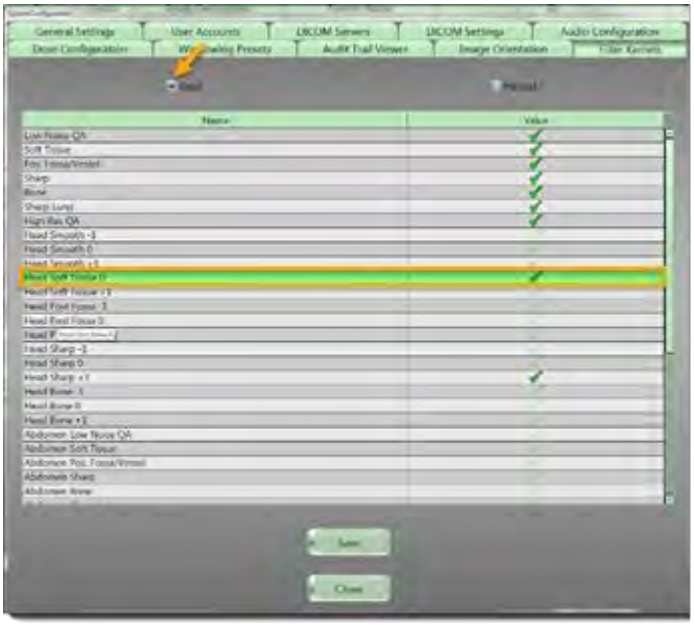


Figure 138: Selected Axial kernel

To add new Helical kernels, select the **Helical** radio button, then double-click the **Value** cell next to the desired Helical kernel.

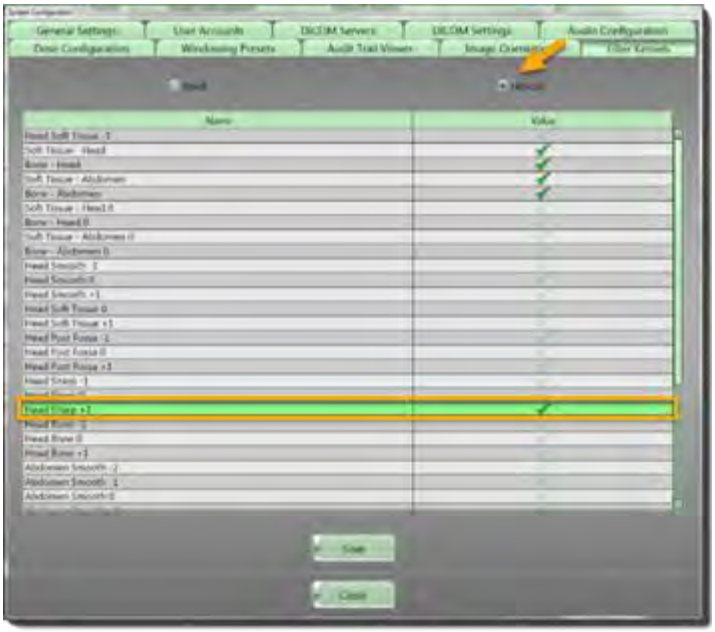


Figure 139: Selected Helical kernel

4. Click the **Save** button.
   The **Success** popup appears.

5. Click the **Ok** button.

6. Click the **Close** button to exit.

User configuration

User configuration allows users with either **Administrator** or **Limited Operator** access to change the password for their own account.

Updating your user account

1. Click **Customize > User** from the main menu.
   The **User Configuration** dialog box appears.

Note You must have administrative or limited operator privileges to access and modify user accounts.

Incorrect changes to user accounts may cause users to be unable to access the system.

The **Update Accounts** tab is the default selection.

2. Modify the following fields associated with your user account by entering relevant information:
   - Last Name
   - First Name
   - Password
   - Verify Password

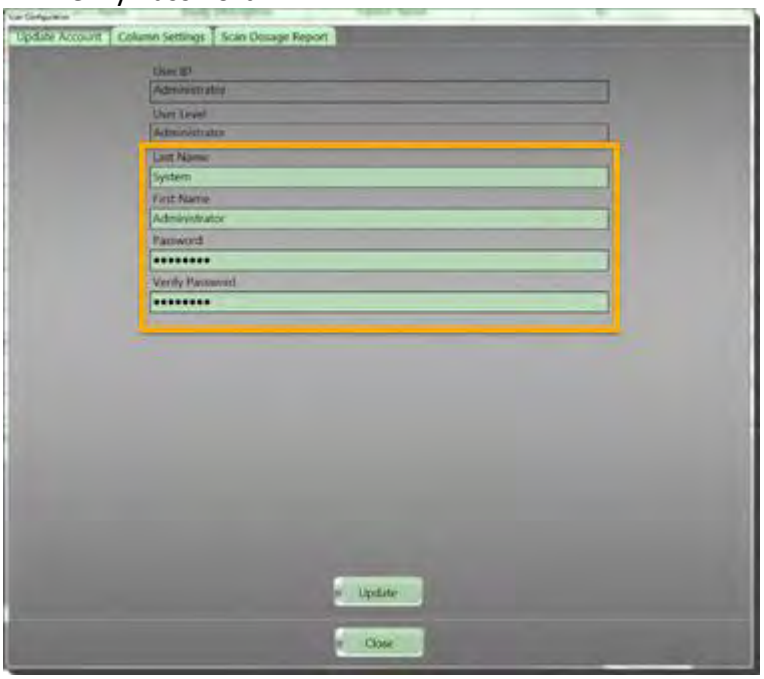


Figure 140: Last Name, First Name, Password, and Verify Password fields

3. Click the **Update** button.

4. The **Update Succeeded** popup appears.

Figure 141: Update Succeeded popup message – Account updated

5. Click the **Ok** button.

6. Click the **Close** button to exit.

Applying column settings to HIS/RIS Query

Allows you to customize the columns of information that appear when viewing the **Hospital Information System** (**HIS**) and/or **Radiology Information Systems** (**RIS**) information that is queried.

All users can access user configuration and make changes to the column settings; however limited and restricted operators cannot make their changes to the column headings the default. Only users with administrative access can make column settings a default, using the **Make Default** option.

1. Click **Customize > User** from the main menu.
   The **User Configuration** dialog box appears.

2. Click the **Column Settings** tab.

3. There may be no entries that appear, initially.

Note When an option is selected (for example **HIS/RIS Query** or **Patient Browser**), a table is created that lists the columns, along with a check box to indicate whether it will be displayed within the table. Required columns ***cannot*** be unchecked and are colored orange instead of the default green.

4. Click the **HIS/RIS Query** option.

Figure 142: Column Settings dialog box with HIS/RIS Query option

5. Double click the Checkmark under **Displayed** column for the row you want to display or remove if it is already selected.

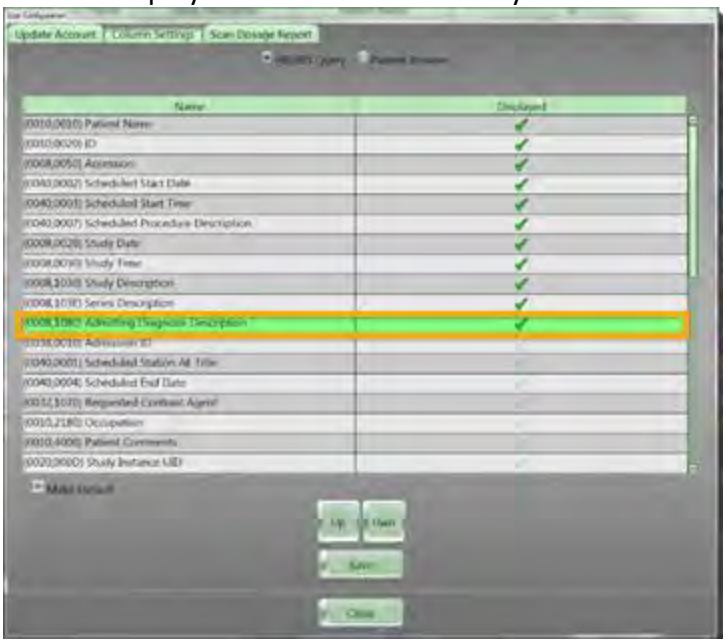


Figure 143: Column Settings with a selected query in HIS/RIS

6. Notice that the **Up** and **Dwn** buttons are active when a row is selected.

7. Click the **Up** or **Dwn** buttons to move the active selection up or down the list.

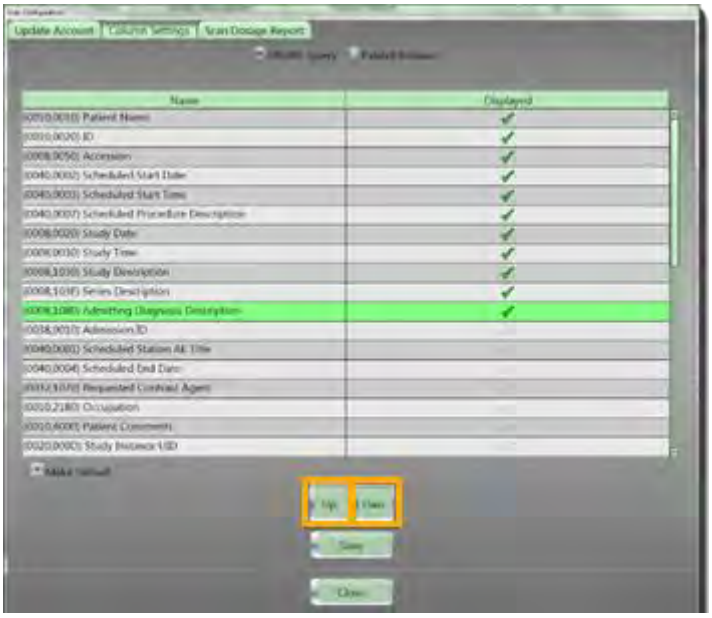


Figure 144: Column Settings with HIS/RIS Query option using Up and Dwn buttons

8. If you have administrative privileges, click the **Make Default** option to make the selected column display the default for all users.

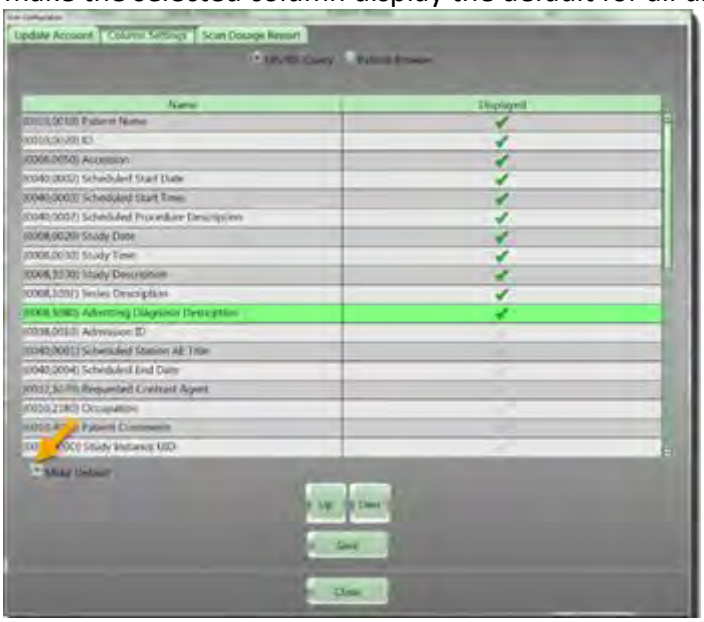


Figure 145: Make Default option

9. Click the **Save** button to keep changes.

10. Click the **Close** button to exit.

Applying column settings to Patient Browser

Allows you to configure the columns of information seen in the **Patient Browser.**

1. Click **Customize > User** from the main menu.
   The **User Configuration** dialog box appears.

2. Click the **Column Settings** tab.

3. Click the **Patient Browser** option.

Figure 146: Column Settings with Patient Browser option

4. Click one of the following options:

Patient/Study	Information that appears on the top portion of the **Patient Browser** that defines patient specific information.
Series	Information that appears on the lower portion of the **Patient Browser** that defines series specific information.

5. Double click the Checkmark under **Displayed** column for the row you want to display or remove if it is already selected.

6. Notice that the **Up** and **Dwn** buttons are active when a row is selected.

7. Click the **Up** or **DWN** buttons to move the active selection up or down the list.

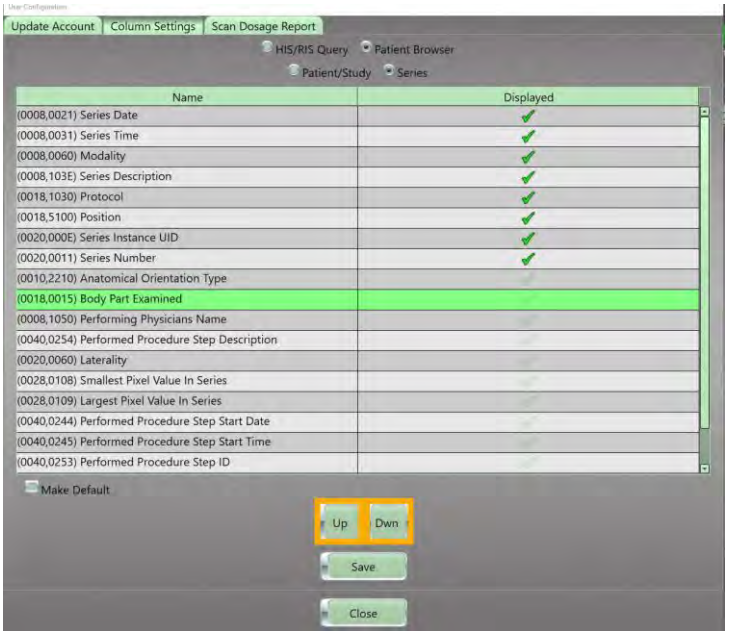


Figure 147: Column Settings with Patient Browser Series option – using Up and Dwn buttons

8. If you have administrative privileges, click the **Make Default** option to make the selected column display the default for all users.

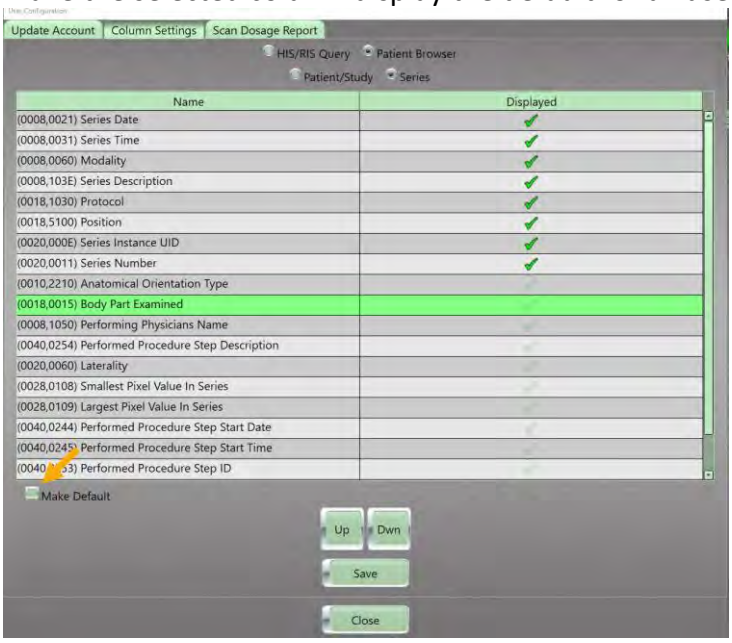


Figure 148: Make Default option

9. Click the **Save** button to keep changes.

10. Click the **Close** button to exit.

Viewing Scan Dosage Report

1. Click **Customize > User** from the main menu.
   The **User Configuration** dialog box appears.

2. Click the **Scan Dosage Report** tab.

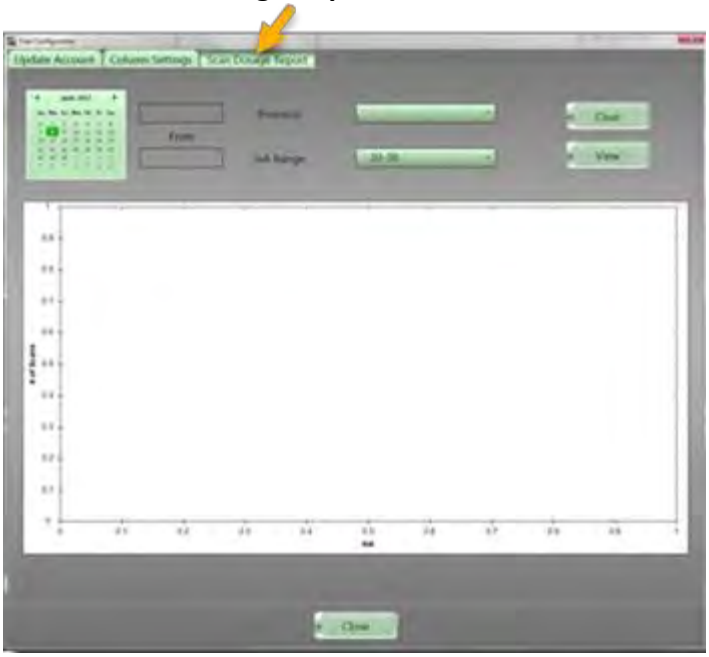


Figure 149: Scan Dosage Report tab

3. To view **Dosage Reports,** click the date or date range on the calendar.

Note	If the date is left blank – all doses for all dates are retrieved.

4. Click the **Protocol** dropdown to select a protocol.

Note	If the protocol is left blank – all doses for all protocols are retrieved.

5. Click the **mA Range** dropdown to select the mA range.
   The **mA Range** default is 20-30; it can be changed after data is retrieved.

Figure 150: Date, Protocol, and mA Range filled

6. Click the **View** button to display a graph showing dosages performed by the scanner using the selected filters.

Figure 151: Scan Dosage Report results

Note If you adjust the mA range, the graph displays those ranges within the retrieved data.

7. To clear the filters selected, click the **Clear** button.

Selecting a room for the BodyTom 64

Selecting a room ensures that the correct calibration is loaded or used when the scanner has been calibrated in more than one location.

1. Click **Customize > Select Room**.
2. A list of the rooms available appear in the cascading menu.

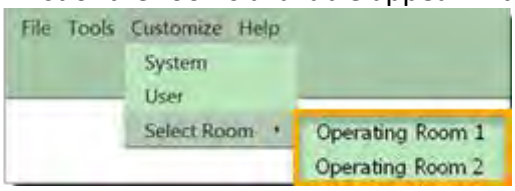


Figure 152: Available rooms before moving the scanner

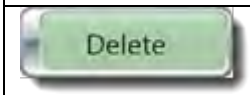
3. Click the room in which the scanner will be used.
4. Move scanner to the selected room.

Chapter 6 Protocol Manager

Note You must have administrative privileges and be logged in as an administrator, to access the Protocol Manager.

Protocol Manager allows a user with administrative privileges to create new protocols, modify existing protocols and delete protocols from the system. **Protocol Manager** provides three patient options: **Adult, Pediatric,** or **Trauma** patient**.**

Table 28: Protocol Manager command buttons

Button	Action
	Allows you to create a new protocol.
	Allows you to create a new protocol from an existing protocol.
	Allows you to modify protocols.
	Deletes a saved protocol.
	Imports previously exported protocols into the workstation.
	Exports protocols to a media device.
	Closes the **Protocol Manager** dialog box.
	Moves a protocol up or down the ordered list.
	Saves the order of the protocol list.

Note: Protocol parameters are customized to your requirements in conjunction with local and nationally recognized published guidelines. These protocols **must be** approved by your facility physicist **before** the system's acceptance.

WARNING Any modification to an existing protocol, or any new protocol created, should be reviewed, and approved by a radiologist and/or residing medical physicist. Failing to do so could cause a patient to receive an excessive and/or unnecessary dose of ionizing radiation.

Resources for radiation protection of pediatric patients appear below and are for referring physicians with a focus on radiation exposure:

- American Academy of Pediatrics (AAP), https://www.aap.org: Search for radiation risk to children from Computed Tomography
- Federal Drug Administration (FDA), https://www.fda.gov/search

  Search for guidelines for pediatricians regarding medical radiation safety
- American College of Radiology (ACR): https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria
- Image Gently® and CT scans

  https://www.imagegently.org/Procedures/Computed-Tomography
- Image Gently/FDA Digital Radiography Safety Checklist: https://www.imagegently.org/Portals/6/Procedures/Attachment%20D.CR.DR%20%20checklist.pdf

Creating a new protocol

1. Click **Tools >Protocol Manager** from the main menu.
   The **Protocol Manager** dialog appears.

Figure 153: Protocol Manager for adult and pediatric

2. Click one of the following:

Adult	To create and/or scan with adult scan protocols, which are stored by anatomical location.
Pediatric	To create and/or scan with pediatric scan protocols, which are stored by anatomical location.
Trauma	The **Trauma** orb can be used to store protocols commonly used for emergency scans.
	By selecting either an **Adult** or **Pediatric** patient, the corresponding list of saved protocols becomes available.

3. Click the colored orb corresponding to the appropriate body part.

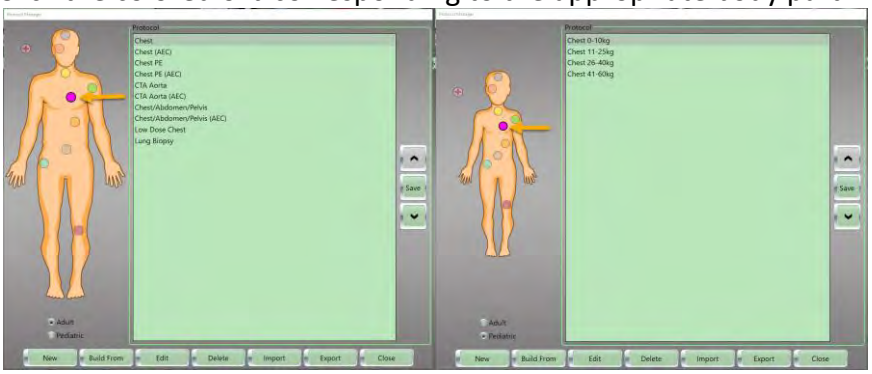


Figure 154: Adult and pediatric anatomical orbs, with Chest orb selected

Existing protocols in the selected Orb will appear in the **Protocol** list box as seen below. The **New** button will become active.

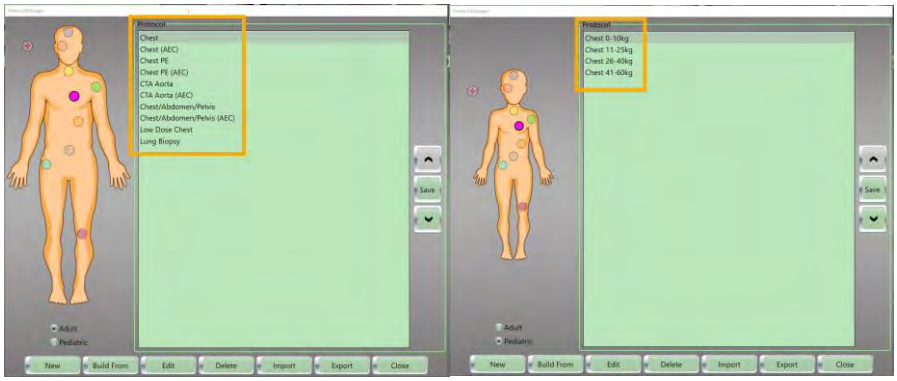


Figure 155: Adult and pediatric protocol lists

4. Click the **New** button to create a new protocol.
   The **New Protocol** dialog box appears.

Figure 156: New Protocol dialog box

Enter **Protocol Information** in the text boxes:

Protocol Description	The name of the protocol as it will be displayed in protocol manager. Reference Protocols begin with the letters NL and cannot be deleted from the system.
Anatomical Reference	References the anatomy that will be scanned.
Default Study Description	The **DICOM** image tag; if entered, this description will also appear in **PACS** as a **Study Description DICOM** tag (0008,1010).

5. Under **Patient Position**, select one of the following scanning positions from the dropdown:

HFS	Head First-Supine
HFP	Head First-Prone
HFDL	Head First-Decubitus Left
HFDR	Head First-Decubitus Right
FFS	Feet First-Supine
FFP	Feet First-Prone
FFDL	Feet First-Decubitus Left
FFDR	Feet First-Decubitus Right

You can also move the rotating positional handles by hovering the mouse pointer over the handle and clicking to select a position.

- The arrows at the feet rotate the patient orientation from **Head First** to **Feet First**.
- The arrow above the patient rotates the patient orientation from **Supine** to **Prone** to **Decubitus**.

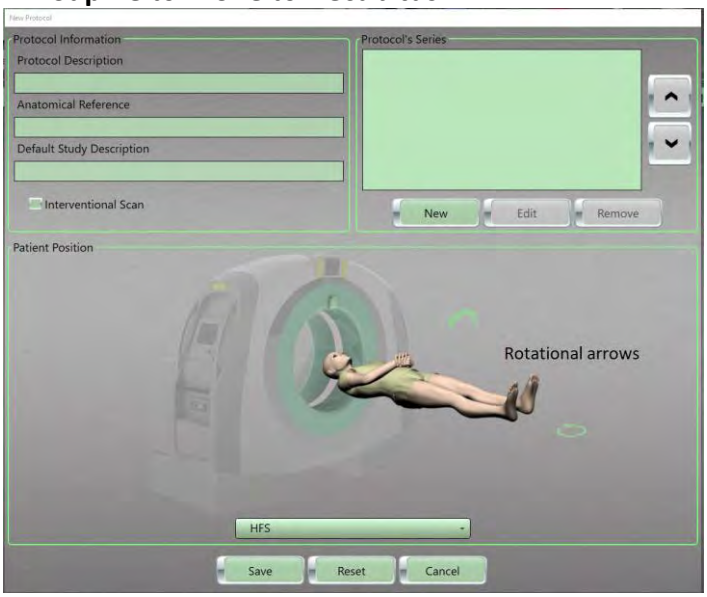


Figure 157: Patient position handles

6. Under **Protocol's Series**, click the **New** button.
The **New Series** dialog box appears.

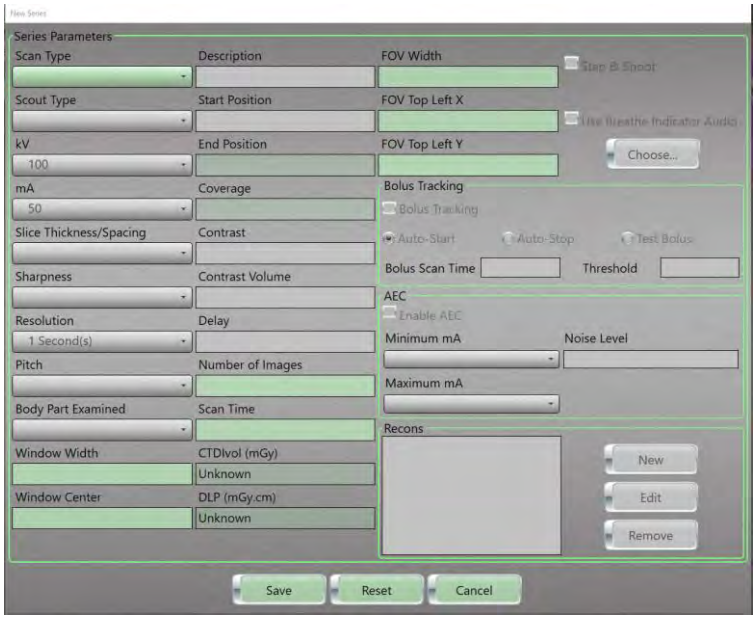


Figure 158: New Series dialog box

7. For **Scan Type**, select one of the following:
   - Axial
   - Helical
   - Dynamic
   - Reference
   - Scout

Note For **Helical** scanning, the exposed area is extended by at least ½ rotation to 1 full rotation at the start and end of the planned scan, based on the sharpness selected.

8. For **Scout Type**, select one of the following:
   - AP
   - PA
   - Lateral

   Scout Type is not available for **Axial**, **Helical**, **Dynamic**, and **Reference** scan modes.

9. For **kV** (scan voltage), select one of the following:
   - 80 To set the scan kV to 80.
   - 100 To set the scan kV to 100.
   - 120 To set the scan kV to 120.
   - 140 To set the scan kV to 140.

   kV is not selectable when using the **Dynamic** and **Reference** scan modes.
   See "Identifying load factors" on page 228.

10. For **mA** (scan current), select the desired value from the dropdown. The available **mA** range is 30 to 300 with an increment of 5mA. **mA** is not selectable when using the **Reference** scan mode.

11. For **Slice Thickness/Spacing**, select the desired value from the dropdown.
    Slice Thickness/Spacing is not available for **Scout** and **Reference** scan modes.

12. For **Sharpness**, select the image reconstruction kernel from the following list of kernels:
    - Low Noise QA – Not for Clinical Use
    - Soft Tissue – Available for Axial Scan Type only
    - Soft Tissue – Head – Available for Helical Scan Type only
    - Soft Tissue – Abdomen – Available for Helical Scan Type only
    - Pos. Fossa/Vessel – Available for Axial Scan Type only
    - Sharp – Available for Axial Scan Type only
    - Bone (No AEC) – Available for Axial Scan Type only
    - Bone – Head (No AEC) – Available for Helical Scan Type only
    - Bone – Abdomen (No AEC) – Available for Helical Scan Type only
    - Sharp Lung (No AEC) – Available for Axial Scan Type only
    - High-Res QA (No AEC) – Not for Clinical Use

    Sharpness is not selectable when using the **Reference** and **Scout** scan modes.

Note The **Low Noise QA** and **High-Res QA (No AEC)** options **should not** be used for clinical scanning.

13. For **Resolution**, which also refers to scan time, select one of the following options:
    - 1 Second(s)
    - 2 Second(s)

    Resolution in only available for **Axial Scan Types.**

14. For **Pitch**, which describes how fast the scanner is moving during one rotation of the x-ray tube, select one of the following options:
    - **0.4** where the scanner will move 15.36mm per second.
    - **0.8** where the scanner will move 30.72mm per second.

    Pitch is only available for **Helical Scan Types.**

15. For **Body Part Examined**, select the appropriate Body Part from the drop-down menu.

16. For **Window Width**, enter the range of CT numbers that are distributed over the viewable gray scale of the display device or film.

17. For **Window Center**, enter the CT number in the center of the viewable gray scale.

18. For **Description**, enter the desired study description.

19. For **Start Position**, enter the start scan position.

20. For **End Position**, enter the end scan position.

21. **Coverage** is a calculated value that automatically fills based on the **Start** and **End** position values.

22. For **Contrast**, enter the type of contrast given for example.

23. For **Contrast Volume**, enter the amount of the contrast given. **Contrast** is not available for **Reference** and **Scout** scan modes.

24. For **Delay**, enter the delay time that will occur after clicking the **START** button on the scanner control panel.

25. **Number of images** is a calculated value based on the Slice Thickness/Spacing and length of the scan.

26. **Scan Time** is a calculated value based on the protocol parameters selected. Scan time is affected by **Resolution, Pitch** and **Scan Length.**

27. For **$CTDI_{vol}$ (mGy)**, if applicable, the calculated number appears here, depending on other selections.
    CT Dose Index Volume ($CTDI_{vol}$) represents the dose for a specific scan protocol, which considers gaps and overlaps between the radiation-dose profiles from consecutive rotations of the x-ray source. The $CTDI_{vol}$ is calculated differently for both the **Axial** and the **Helical** scan modes:
    - For Axial scan mode: $CTDI_{vol} = [(N \times T)/I] \times CTDI_w$
    - For Helical scan mode: $CTDI_{vol} = 1/pitch \times CTDI_w$

28. **Dose Length Product (DLP (mGy.com))**, is the measure of ionizing radiation exposure during the entire acquisition of images. Therefore, DLP (mGy.cm) = $CTDI_{vol}$ (mGy) x irradiated length (cm).

29. Select the following options, if applicable. See Scanning with special features for more details.

Step & Shoot	Allows you to manually start the **Axial** scan acquisition from the workstation when scanning a patient who is unable to remain still.

Bolus Tracking	A CT angiography technique that allows you to monitor the administration of contrast to initiate the scan at peak contrast enhancement.
Enable AEC	Allows you to automatically adapt the tube current according to the patient's body habitus to achieve the specified image quality at the lowest possible dose.

30. To add a secondary reconstruction for the protocol, click the **New** button in the **Recons** section.

    The **New Reconstruction** popup appears.

Figure 159: New Reconstruction popup

31. Complete the following in the **New Reconstruction** popup:
    - Enter a description in the **Description** text box to identify the new reconstruction.
    - Click the **Slice Thickness/Spacing** to select a slice thickness and spacing.
    - Click the **Sharpness** dropdown to select a sharpness from the list.
    - Enter the window width in the **Window Width** text box.
    - Enter the window center in the **Window Center** text box.
    - If needed, enter the FOV width in the **FOV Width** text box.
    - If needed, enter the FOV top left x location in the **FOV Top Left X** text box.
    - If needed, enter the FOV top left y location in the **FOV Top Left Y** text box.

32. Perform one of the following:
    - Click the **Save** button to save the reconstruction protocol to the list.
        - The dialog box closes, and your changes are added to the **Recons** area.
    - Click the **Reset** button to reset the fields to their original data.
    - Click the **Cancel** button to remove your changes and return to the previous dialog box.

33. Click the **Save** button on the **New Series** dialog box.

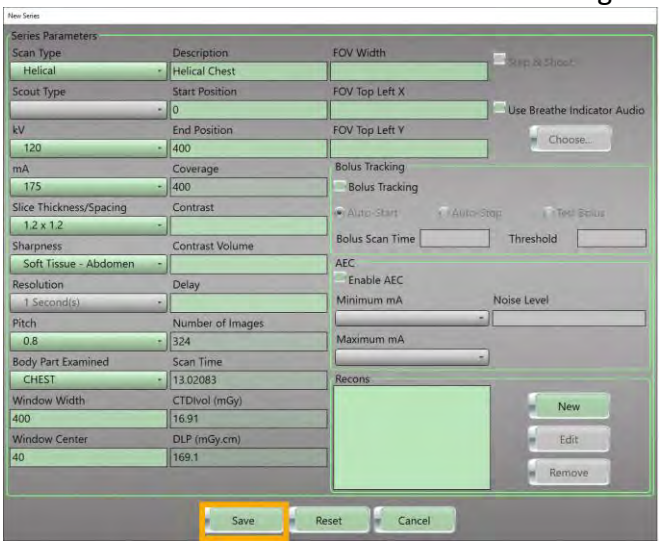


Figure 160: Edit Series dialog box

34. Repeat the steps 6 thru 33 to add additional scans to the protocol.

35. When all required series have been created click the **Save** button on the **New Protocol** dialog box.

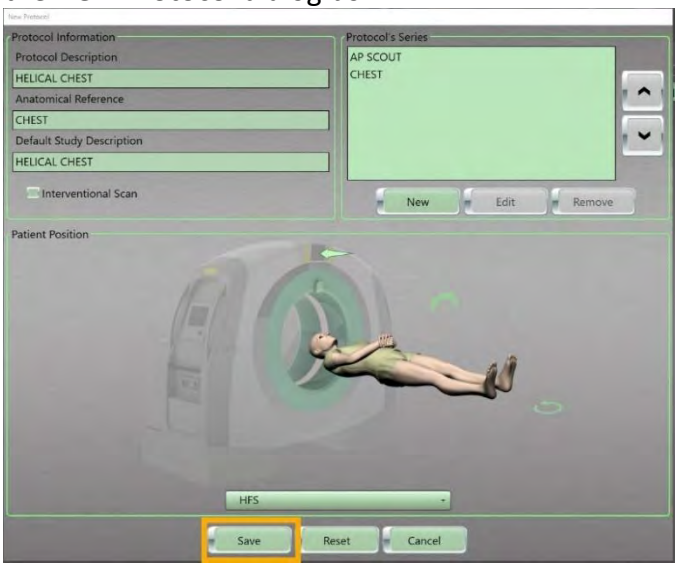


Figure 161: Save New Protocol

36. Click the **Close** button to exit.

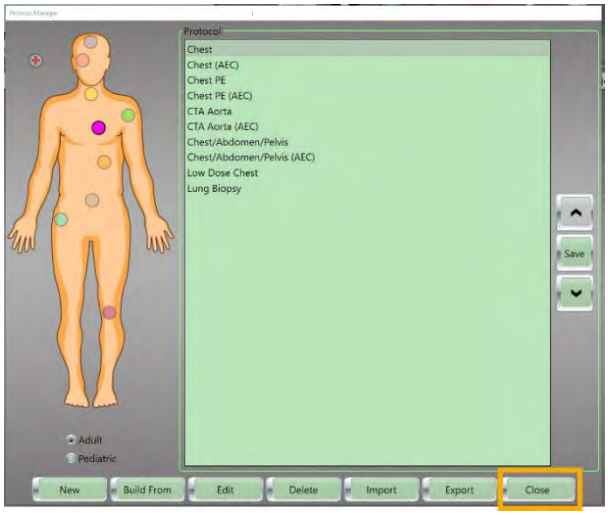


Figure 162: Close Button

Using Build From to create a new protocol

The **Build From** button is used in **Protocol Manager** when you want to create a new protocol from an existing protocol.

1. Click **Tools >Protocol Manager** from the main menu.
   The **Protocol Manager** dialog appears.

2. Click one of the following:

Adult	To create and/or scan with adult scan protocols, which are stored by anatomical location.
Pediatric	To create and/or scan with pediatric scan protocols, which are stored by anatomical location.
Trauma	The **Trauma** orb can be used to store protocols commonly used for emergency scans.
	By selecting either an **Adult** or **Pediatric** patient, the corresponding list of saved protocols becomes available.

Note Protocol parameters are customized to your requirements in conjunction with local and nationally recognized published guidelines. These protocols **must be** approved by your facility physicist **before** the system's acceptance.

WARNING Any modification to an existing protocol, or any new protocol created, should be reviewed, and approved by a radiologist and/or residing medical physicist. Failing to do so could cause a patient to receive an excessive and/or unnecessary dose of ionizing radiation.

Resources for radiation protection of pediatric patients appear below and are for referring physicians with a focus on radiation exposure:

- American Academy of Pediatrics (AAP), https://www.aap.org: Search for radiation risk to children from Computed Tomography
- Federal Drug Administration (FDA), https://www.fda.gov/search

  Search for guidelines for pediatricians regarding medical radiation safety
- American College of Radiology (ACR): https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria
- Image Gently® and CT scans

  https://www.imagegently.org/Procedures/Computed-Tomography
- Image Gently/FDA Digital Radiography Safety Checklist: https://www.imagegently.org/Portals/6/Procedures/Attachment%20D.CR.DR%20%20checklist.pdf

3. Click the colored orb corresponding to the appropriate body part.

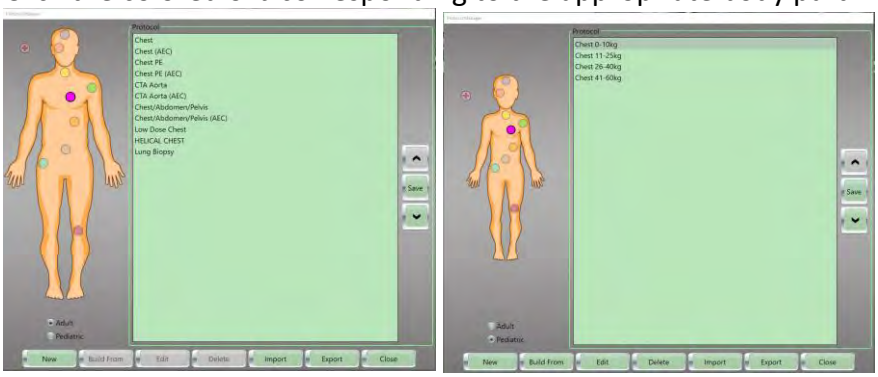


Figure 163: Anatomical orbs

4. Click the protocol you will **Build From** in the **Protocol** list. The **Build From** button will become active.

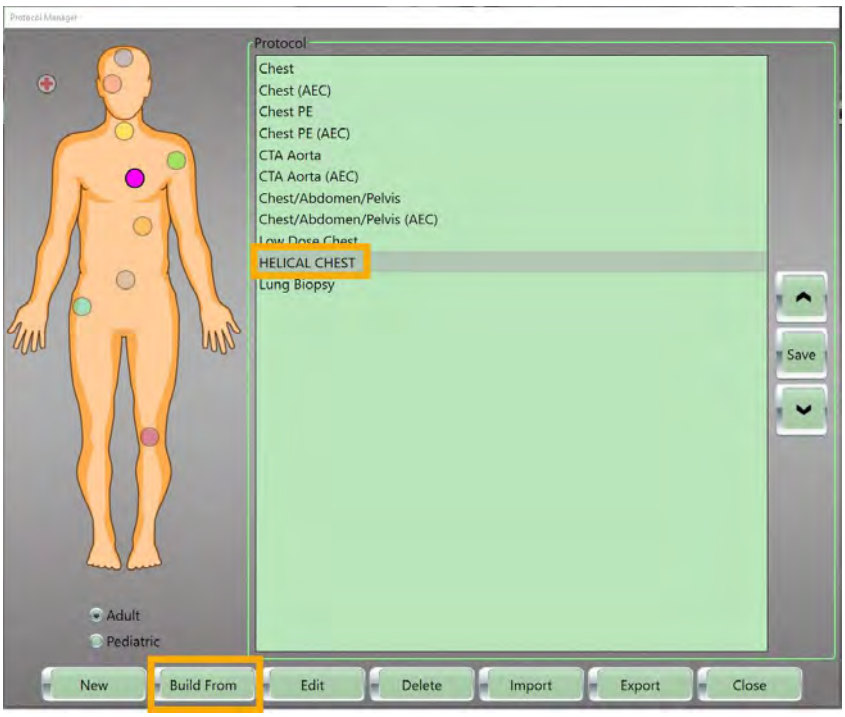


Figure 164: Build from protocol selected

5. Click the **Build From** button.

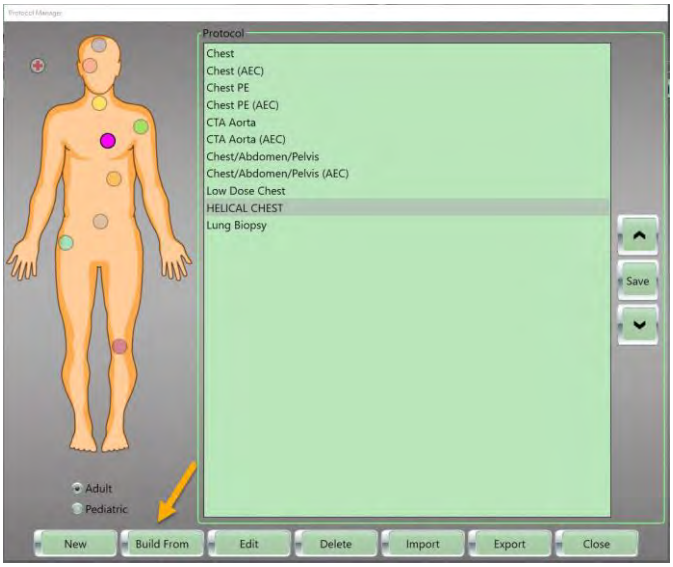


Figure 165: Build From button

6. The **New Protocol** dialog box appears.

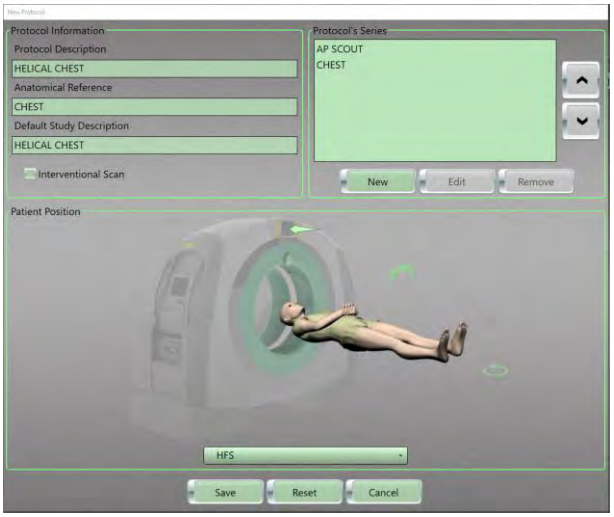


Figure 166: New Protocol dialog box

7. Modify the protocol parameters to meet your needs. Click the **Update** button on the **Edit Series** dialog box to save your changes.

   See “Creating a new protocol” on page 186 to learn how the fields and options perform to make informed choices on what to change.

Note Be sure to assign the **Build From** protocol a new **Protocol Description** before you make your additional changes.

8. When all required series have been modified click the **Save** button on the **New Protocol** dialog box.

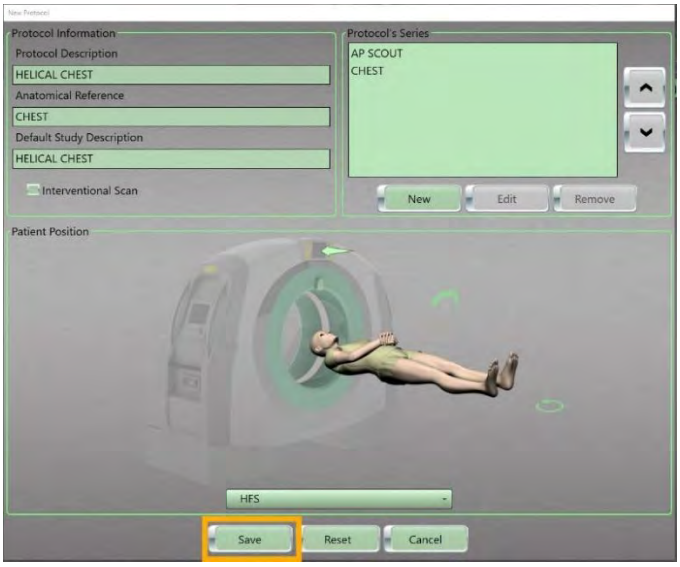


Figure 167: Build from save

9. Click the **Close** button to exit.

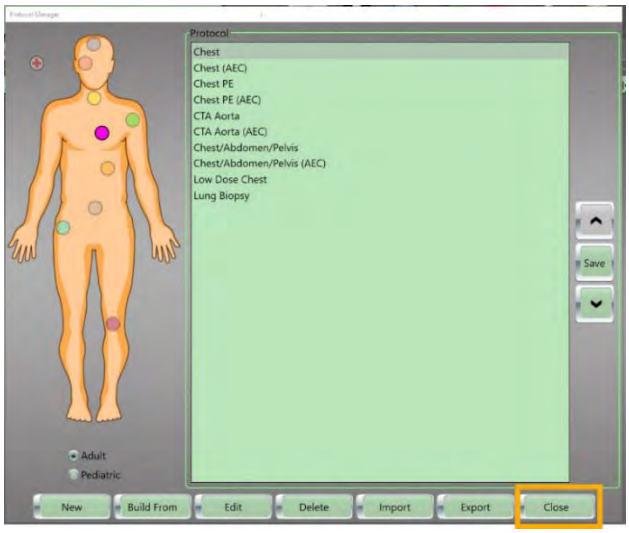


Figure 168: Build from close

Editing an Existing Protocol

The **Edit** button is used in **Protocol Manager** when you want to modify the parameters of an existing protocol.

1. Click **Tools >Protocol Manager** from the main menu.
   The **Protocol Manager** dialog appears.

2. Click one of the following:

Adult	To edit adult scan protocols, which are stored by anatomical location.
Pediatric	To edit pediatric scan protocols, which are stored by anatomical location.
Trauma	To edit protocols store in the **Trauma** orb.

3. Click the colored orb corresponding to the appropriate body part.

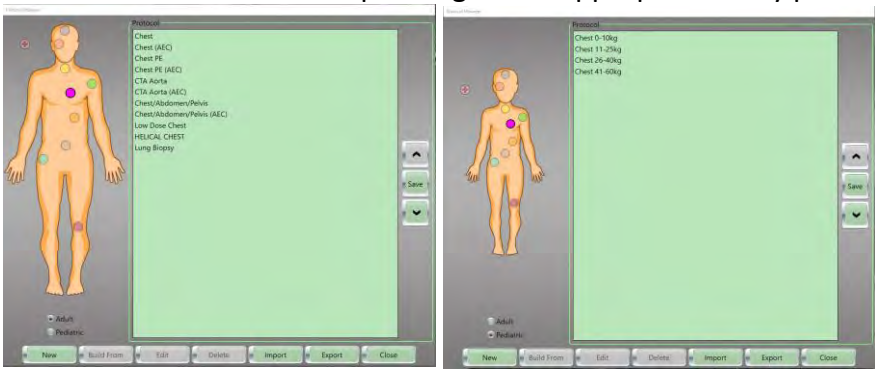


Figure 169: Edit protocol orbs

4. Click the protocol you wish to **Edit i**n the **Protocol** list. The **Edit** button will become active.

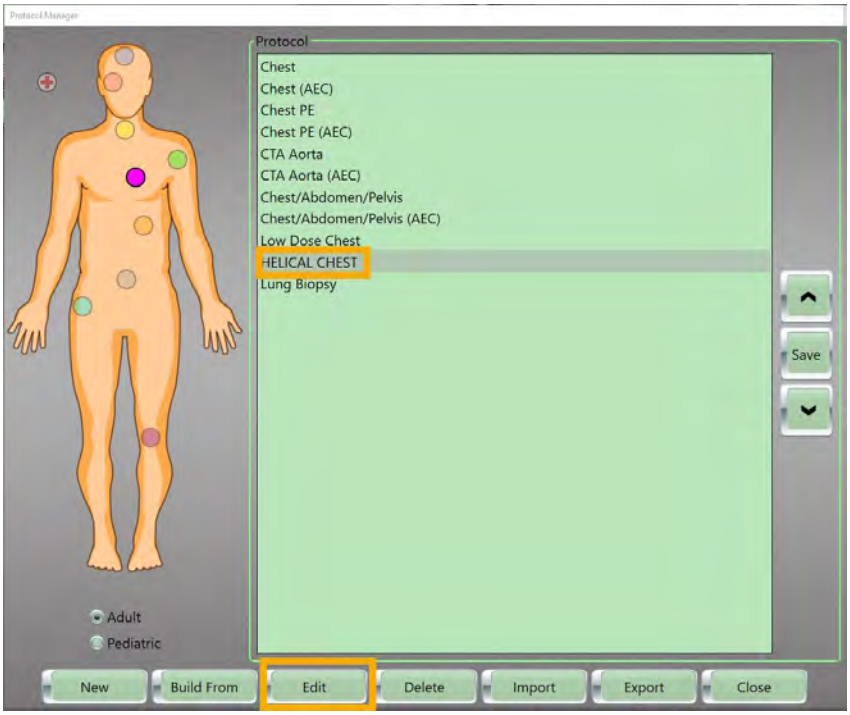


Figure 170: Edit protocol selected

5. Click the **Edit** button.

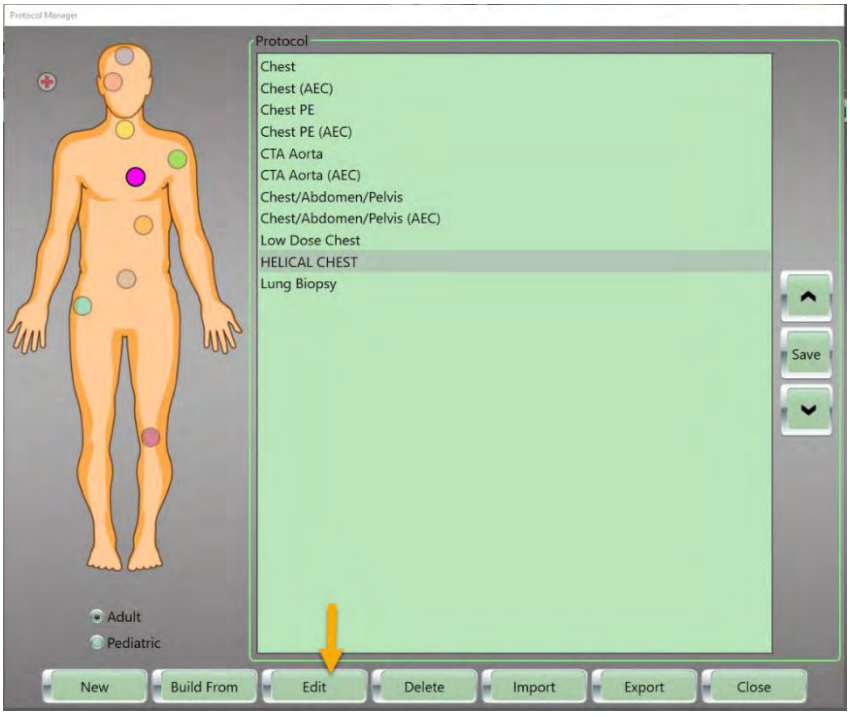


Figure 171: Edit button

6. The **Edit Protocol** dialog box appears.

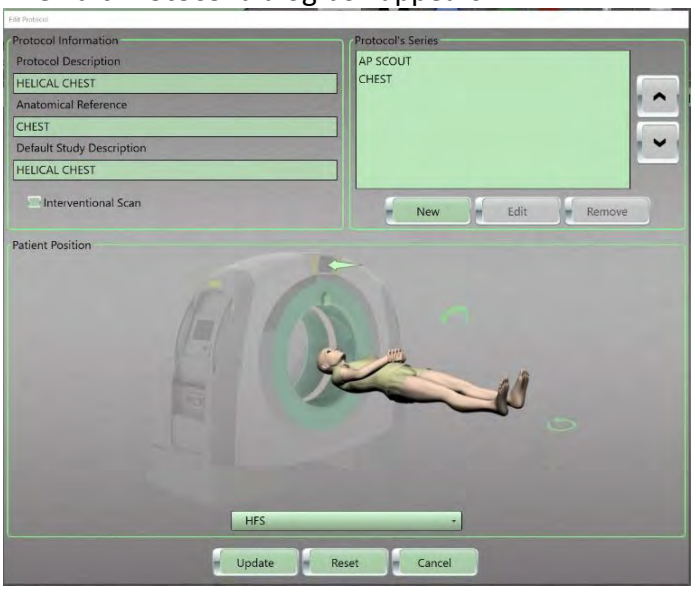


Figure 172: Edit Protocol dialog box

7. Modify the protocol parameters to meet your needs. Click the **Update** button on the **Edit Series** dialog box to save your changes.

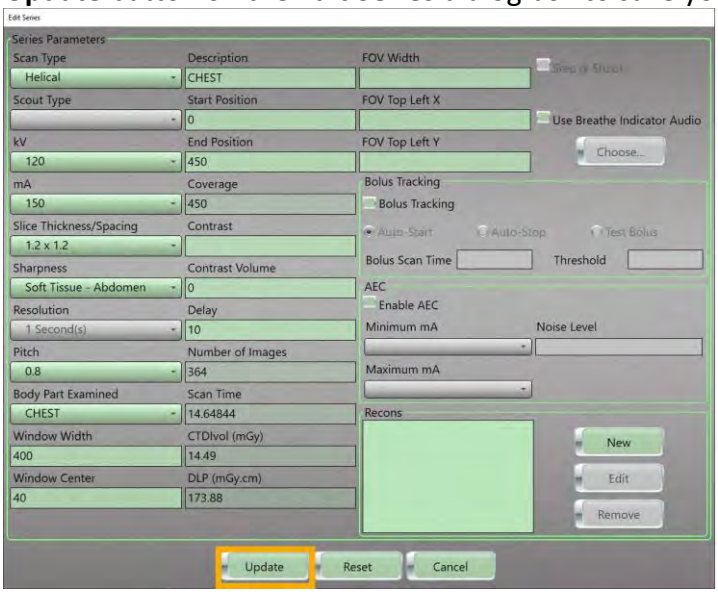


Figure 173: Edit series update button

See “Creating a new protocol” on page 186 to learn how the fields and options perform to make informed choices on what to change.

Note Be sure to assign the **Build From** protocol a new **Protocol Description** before you make your additional changes.

8. When all required series have been modified click the **Update** button on the **Edit Protocol** dialog box.

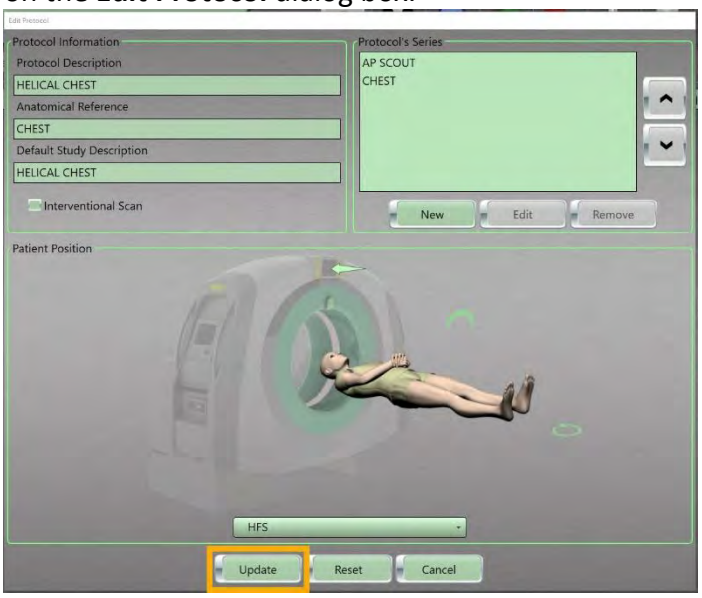


Figure 174: Edit protocol update button

9. Click the **Close** button to exit.

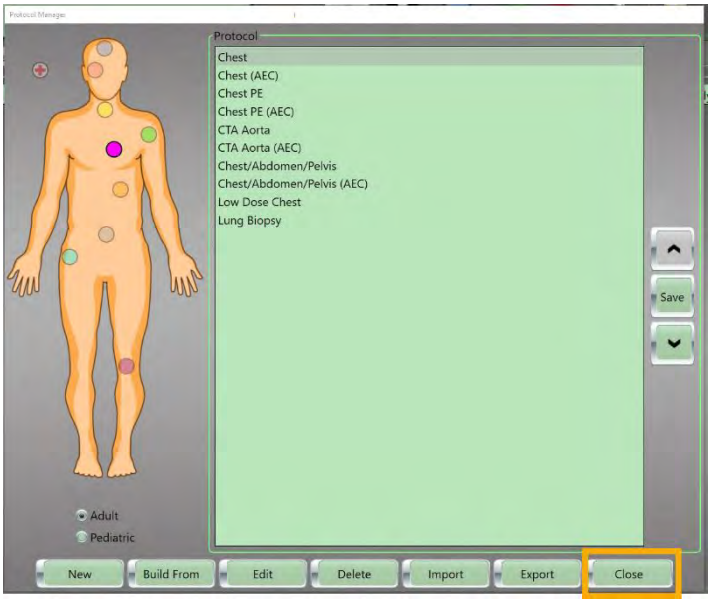


Figure 175: Edit protocol close button

Copying and pasting protocols

To copy and paste protocols from one body part orb to another, including the Trauma orb.

1. Click **Tools >Protocol Manager** from the main menu.
   The **Protocol Manager** dialog appears.

2. Click one of the following:

Adult	To copy and paste adult scan protocols, which are stored by anatomical location.
Pediatric	To copy and paste pediatric scan protocols, which are stored by anatomical location.
Trauma	To copy and paste protocols stored in the **Trauma** orb.

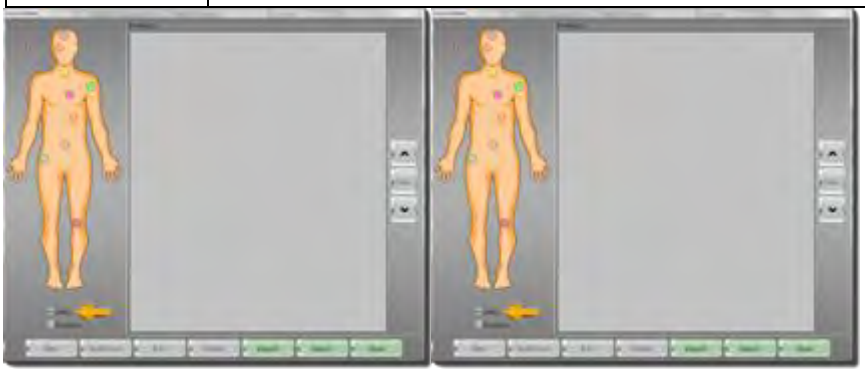


Figure 176: Protocol Manager for Adult and Pediatric

3. Click the colored orb corresponding to the appropriate body part.

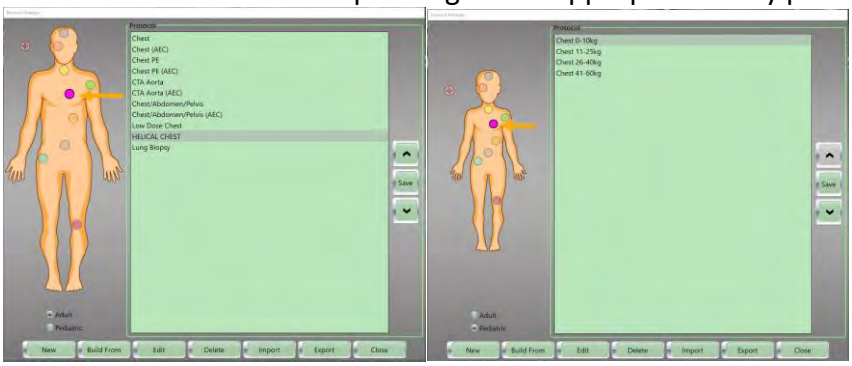


Figure 177: Anatomical orbs, in this case the chest orb

4. Review the protocol you would like to copy.

5. Highlight the protocol, right-click to see the floating menu, and click **Copy**.

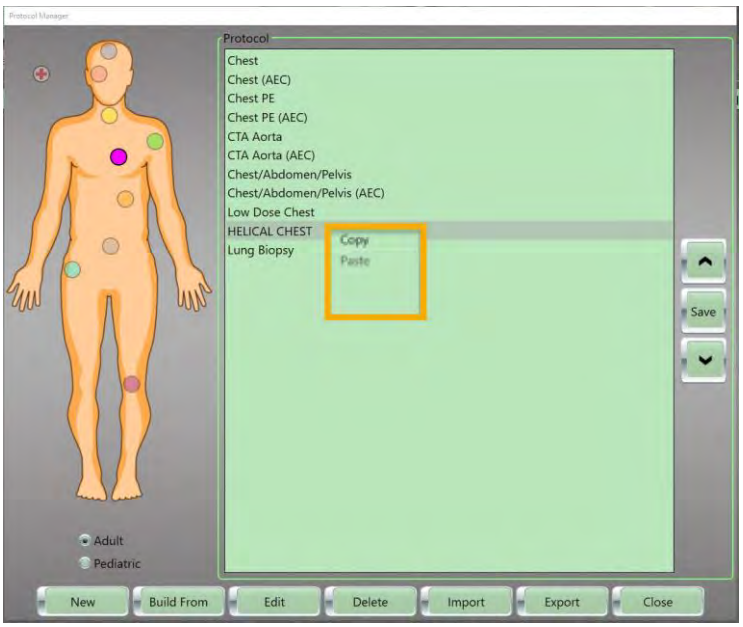


Figure 178: Copy right-click floating menu

6. Go to body part orb you want to paste the protocol to, which can include the Trauma orb.
7. Right-click to see the floating menu and click **Paste**.

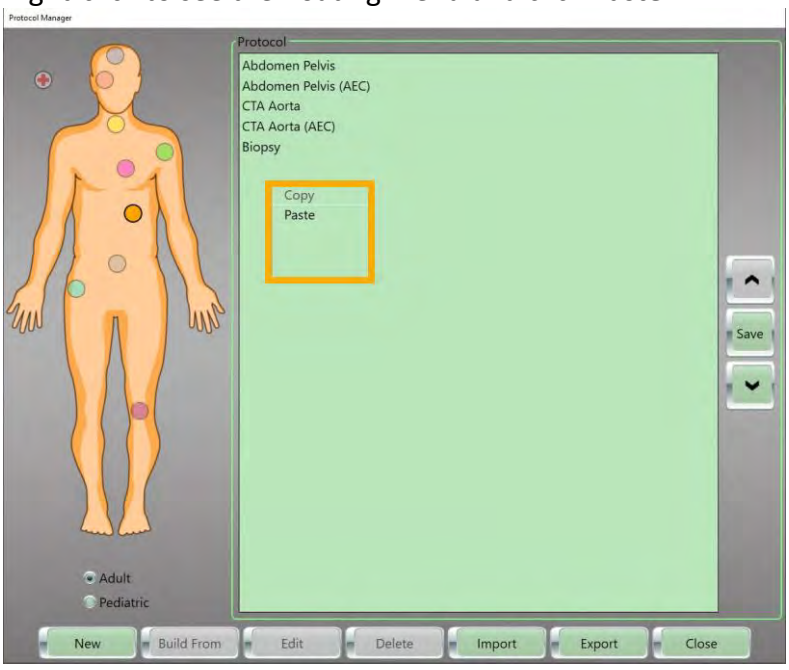


Figure 179: Paste right click floating menu

8. Click **Close** button to exit.

Deleting a protocol

1. Click **Tools >Protocol Manager** from the main menu.
   The **Protocol Manager** dialog box appears.

2. Click one of the following:

Adult	To delete adult scan protocols, which are stored by anatomical location.
Pediatric	To delete pediatric scan protocols, which are stored by anatomical location.
Trauma	To delete protocols that are stored in the **Trauma** orb.

3. Click the colored orb corresponding to the appropriate body part.
   Select the protocol from list to be deleted.

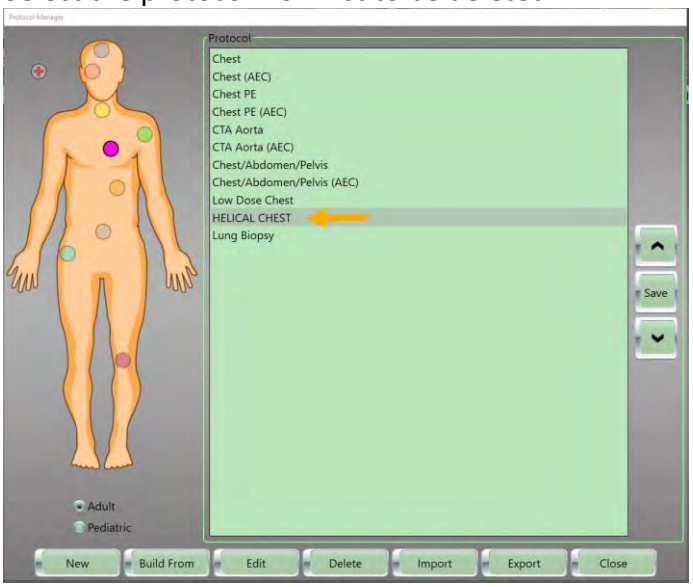


Figure 180: Protocol Manager with a protocol selected

4. Click the **Delete** button.
   The **Delete Confirmation** popup appears.

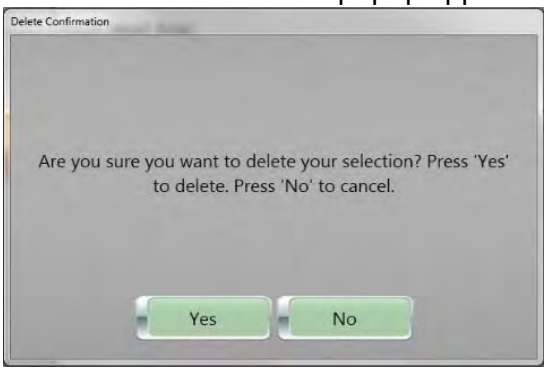


Figure 181: Delete Confirmation popup message – Yes or No to delete selection

5. Perform one of the following in the **Delete Confirmation** popup:
   - Click the **Yes** button to delete the selected protocol.
   - Click the **No** button to return to the Protocol Manager dialog box.

   The **Delete Confirmation** dialog box disappears, and the **Protocol Manager** dialog box appears.

6. Click the **Close** button to exit.

Adding breathing instructions to your protocol

Default audio files are installed on the workstation. Audio files can be attached to protocols and sent to the scanner. Each audio file has an indicator whether it was sent to the scanner.

1. Click **Tools >Protocol Manager** from the main menu.
   The **Protocol Manager** dialog box appears.

2. Click one of the following:

Adult	To add breathing instructions to adult scan protocols, which are stored by anatomical location.
Pediatric	To add breathing instructions to pediatric scan protocols, which are stored by anatomical location.
Trauma 	To add breathing instructions to protocols stored in the **Trauma** orb.

3. Click the colored orb corresponding to the appropriate body part.

4. Click the protocol you would like to add **Breathing Instructions** to.

5. Click the **Edit** button.

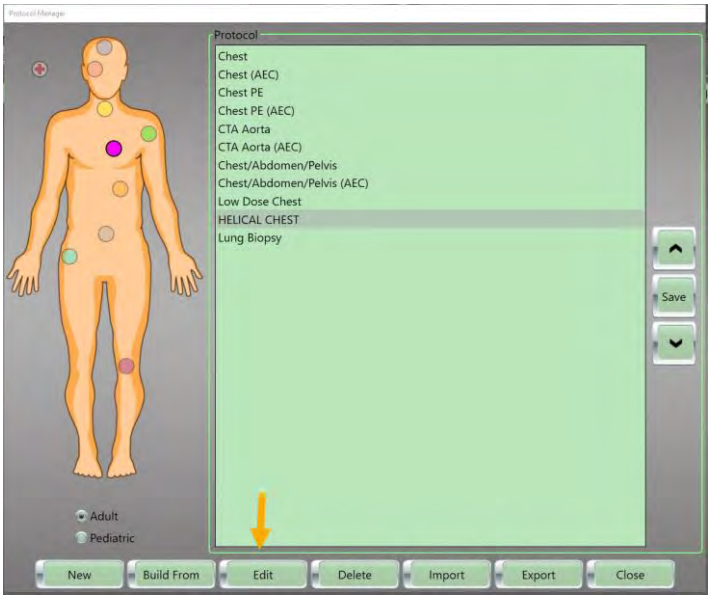


Figure 182: Edit button

The **Edit Protocol** dialog box appears.

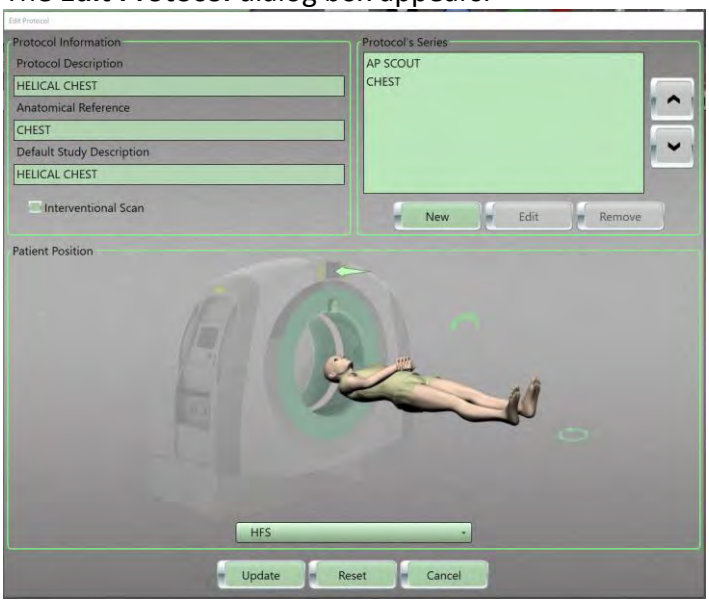


Figure 183: Edit Protocol dialog box

6. Select the **Protocol's Series** you want to add breathing instructions to.

The **Edit** button is enabled.

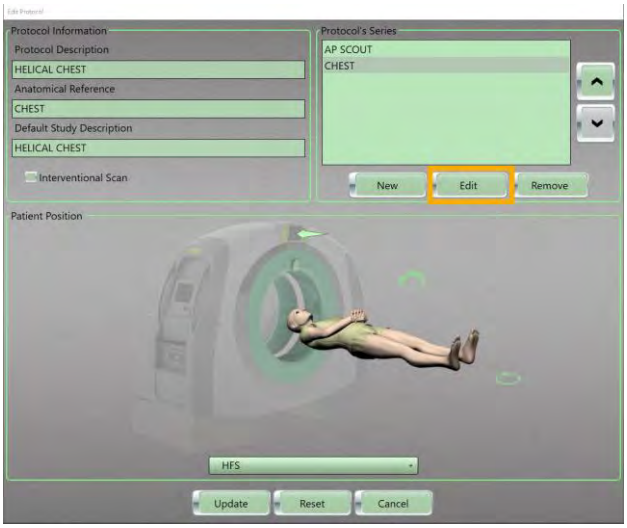


Figure 184: Add breathing edit button

7. Click the **Edit** button.
   The **Edit Series** dialog box appears.

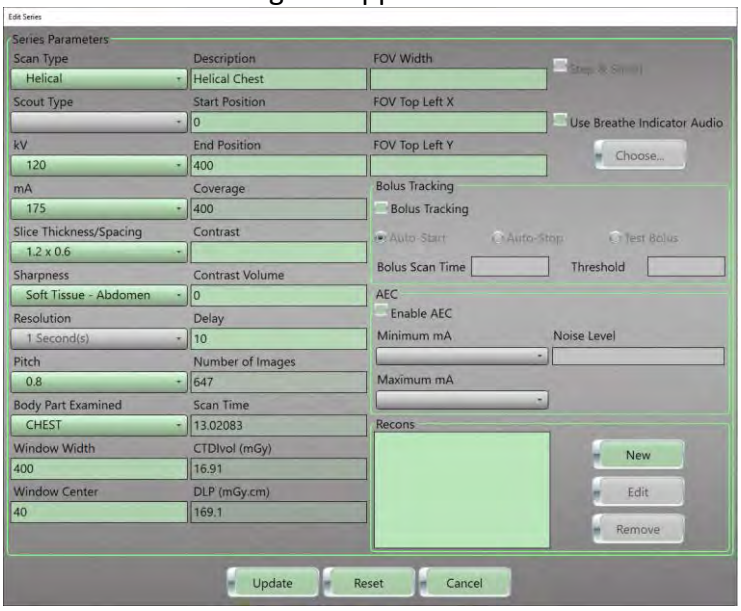


Figure 185: Edit Series dialog box

8. Click the **Use Breathe Indicator Audio** option and click the **Choose** button.

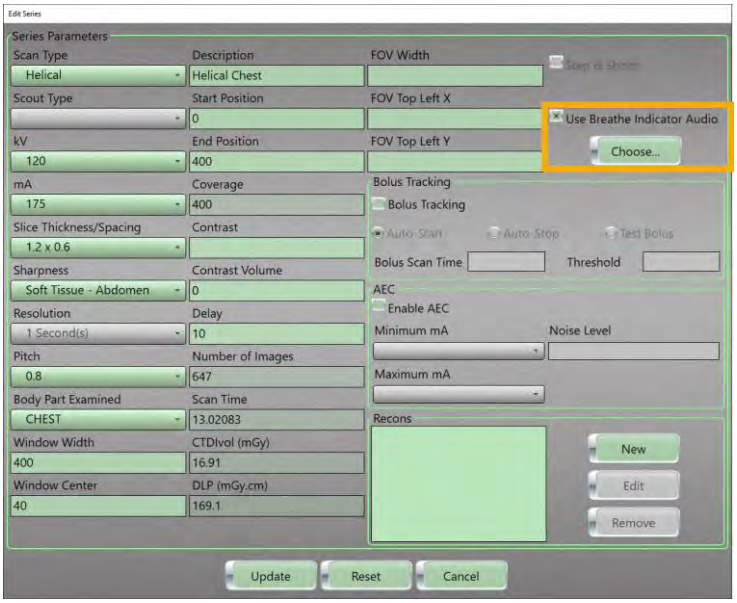


Figure 186: Use Breathe Indicator Audio option

The **Breathe Indicator Audio Files** popup appears.

Figure 187: Breathe Indicator Audio Files popup

9. Select an audio file to use for the **Breathe** instruction.
   The **Breathe** and **Hold** buttons are activated.

10. Click the **Breathe** button to place the file with **Breathe** files.

11. Select an audio file to use for the **Hold** instruction.

12. Click the **Hold** button to place the file with **Hold** files.

13. Click the **Apply** button to keep the files you selected to use with protocols.

14. Click the **Close** button to exit.

Importing protocols from a storage device

1. Click **Tools >Protocol Manager** from the main menu.
   The **Protocol Manager** dialog box appears.

2. Click the **Import button**

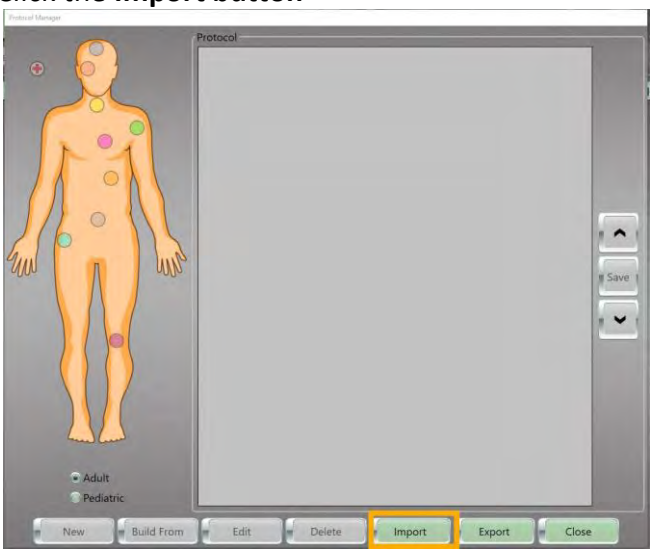


Figure 188: Import button

3. The **Select File** popup appears.

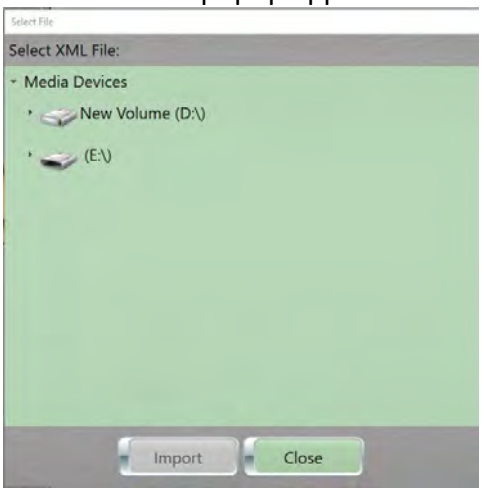


Figure 189: Select File popup

4. Double click the Drive Letter that contains the protocols you want to import.

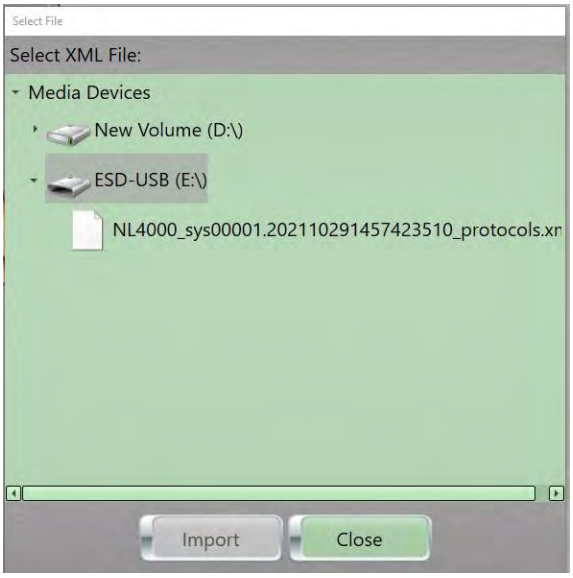


Figure 190: Select file

5. Click the file in the **Select File** popup.

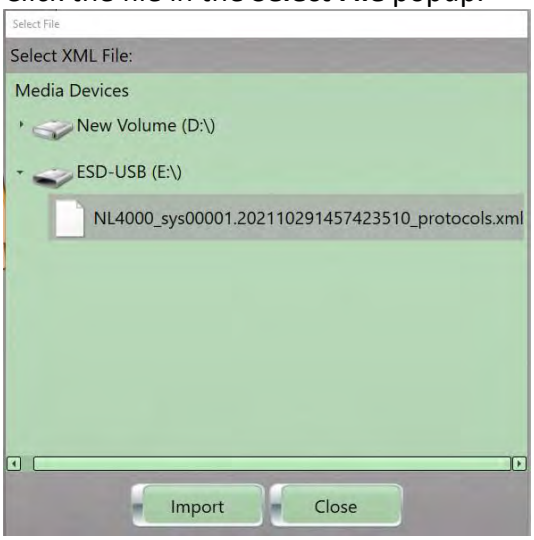


Figure 191: Import button active in Select File when file(s) selected

6. Click the **Import** button.

Figure 192: Protocols Imported popup message – Protocols imported

7. The **Protocols Imported** popup appears.
8. Click the **OK** button.
9. Check that the required files have been imported.
10. Click the **Close** button to exit.

Exporting protocols to a storage device

1. Click **Tools >Protocol Manager** from the main menu.
   The **Protocol Manager** dialog box appears.
2. Click the **Export** button.

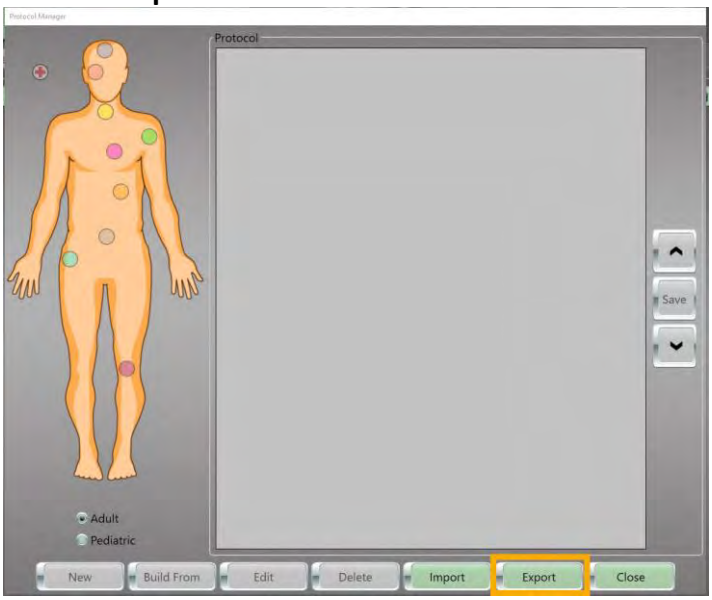


Figure 193: Export button

3. The **Select Directory** dialog box appears.

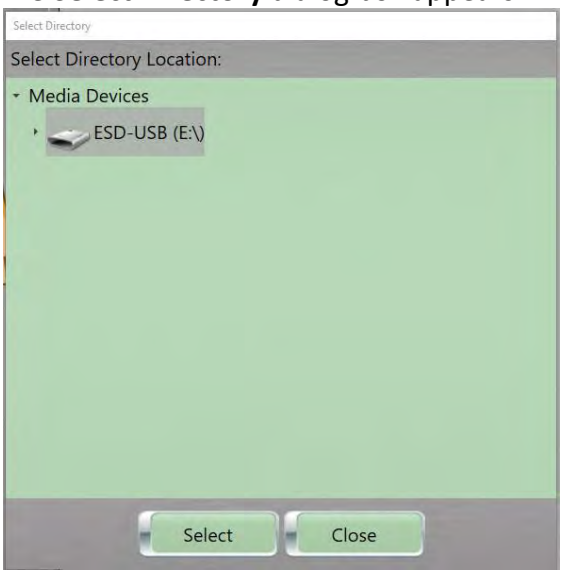


Figure 194: Select Directory popup

4. If more than one **Media Device** is available, select the device to use.
5. Click the **Select** button.
6. The **Protocols Exported** popup appears.

Figure 195: Protocols Exported popup message – Protocols exported

7. Click the **Ok** button.
8. Check that the exported files are exported.
9. Click the **Close** button to exit.

Changing the order of protocols in the list

1. Click **Tools >Protocol Manager** from the main menu.

The **Protocol Manager** dialog box appears.

2. Click one of the following:

Adult	To change the order of adult scan protocols, which are stored by anatomical location.
Pediatric	To change the order of pediatric scan protocols, which are stored by anatomical location.
Trauma 	To change the order of protocols stored in the **Trauma** orb.

3. Click the colored orb corresponding to the appropriate body part.

4. Click the protocol to move up or down the list.

5. Click the **Up** arrow to move the protocol up the list; click the **Down** arrow to move the protocol down the list.

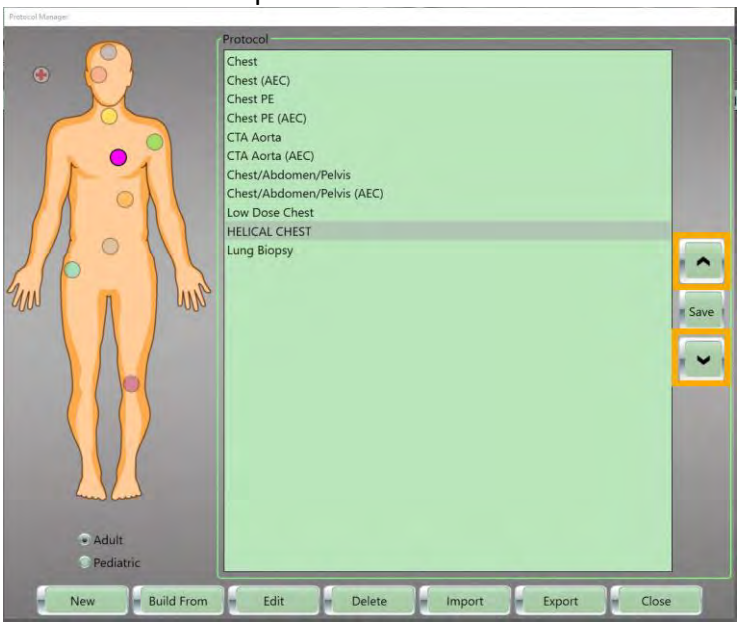


Figure 196: Changing protocol order with Up and Down (arrow) buttons

6. When you are finished ordering your protocols, click the **Save** button to save the new ordered list.

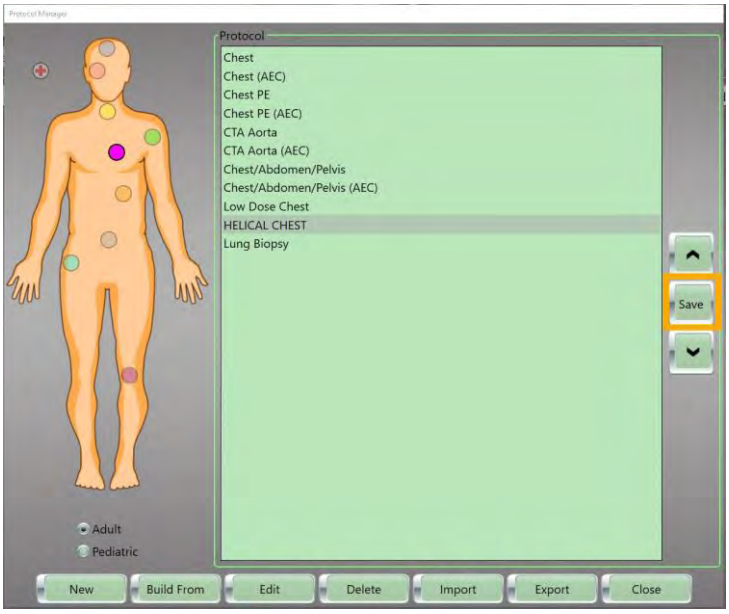


Figure 197: Protocol Save button

7. Click the **Close** button to exit.

Chapter 7 Daily Calibration and Quality Assurance

In this chapter, you will learn how to perform a daily air calibration and use the **Quality Assurance** (**QA**) tool that verifies the system is working as specified.

Keep in mind that **before** using the BodyTom 64 system, you ***must*** conduct a **Quality Assurance** (**QA**) test to verify the system is working as specified. Performing a daily (air) calibration

Note NeuroLogica recommends that an air calibration is performed every 6-8 hours. If the air freshness falls below 50%, or the scanner is moved to an area with a dramatic change in humidity or temperature, perform another air calibration to ensure optimum image quality during patient scanning.

If room-temperature fluctuations have occurred, you may need to perform more than one air calibration. In addition, scanners can drift out of alignment; make sure you perform a **QA Test** with the test phantom **before** scanning a patient.

Note It is recommended that the scanner is on for at least 60-90 minutes prior to performing the air calibration.

It is recommended practice that the scanner is plugged in and turned on even when it is not in use.

1. Make sure that nothing is in the bore before starting the daily air calibration.

2. Click **Tools > Perform Daily Cal** from the main menu.
   The **Perform Daily Cal** popup appears.

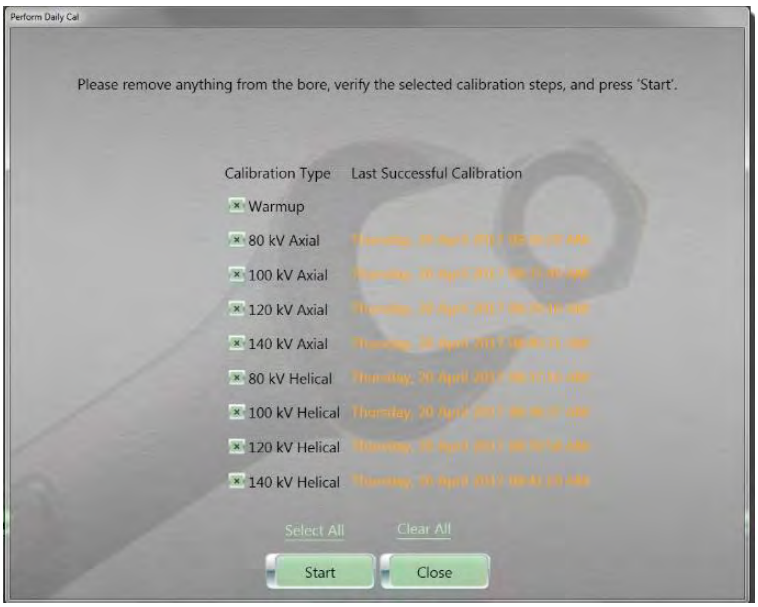


Figure 198: Perform Daily Cal popup

Colors identify previous air calibrations outcomes:

Green	Indicates the calibration was successful
Yellow	Indicates the calibration is soon to expire
Orange	Indicates the calibration has expired
Red	Indicates the calibration failed.

3. Select one of the following options:
   - Click **Select All** to perform all calibration steps.
   - Click **Clear All** and individually select the calibration step(s) to perform.

4. Click the **Start** button.
   The **Perform Daily Cal** popup appears, and the timer counts down.

Figure 199: Perform Daily Cal popup with count down

A warmup period begins, and the countdown begins; when completed the daily calibration will perform the calibration(s) you selected.

Note To stop the calibration, click the **Cancel** button to end the daily (air) calibration(s).

When the calibrations are completed the **Daily Calibration Summary** will display showing the status of the steps performed.

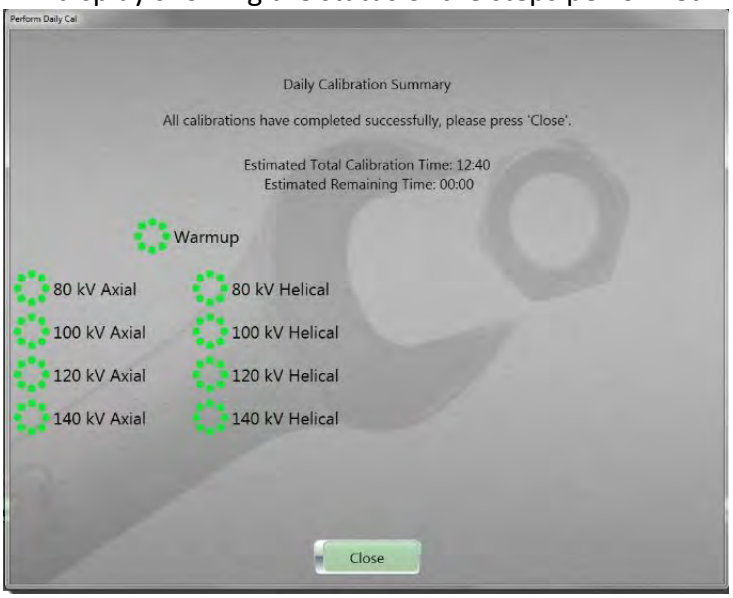


Figure 200: Perform Daily Cal summary popup

The following are the status indicators:

Green	Identifies the calibration completed successfully.
Yellow	Identifies the calibration is in progress.
Red	Identifies the air calibration failed.

5. Click the **Close** button to exit the **Perform Daily Cal** popup.
The **Daily Cal** icon will change to green when it reaches a 100% air freshness.

Figure 201: Air freshness icon changes as the air quality drops from green to yellow to red

The QA phantom overview

The **QA phantom** is a device that measures parameters that characterize image quality; these parameters are as follows:

- Uniformity
- Noise
- High-contrast resolution
- Slice width
- Low-contrast resolution
- Sensitometry (contrast scale)

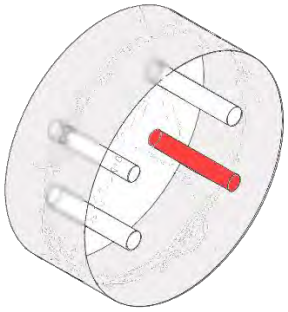


Figure 202: QA phantom

The **QA phantom** is a 20cm diameter disk consisting of a substrate made of **poly methyl methacrylate** (**PMMA**) containing specific inserts. The uniform area of the disk is used to measure uniformity and noise. Four other parameters are measured by the inserts in the substrate.

The QA phantom goes onto the phantom holder when performing a QA. See "Storing the QA phantom" on page 349.

Figure 203: Phantom holder

The **Axial** resolution wire, also called the **Modulation Transfer Function** (**MTF**) wire, is intended for measuring resolution in the **Axial** plane. Resolution is defined as the ability to distinguish small objects. It is expressed in line pairs per millimeter.

The **slice width wires** are the two inclined wires. They are intended to determine scanner resolution along the Z axis, that is, in the direction that is perpendicular to the **Axial** plane. Resolution along the Z axis is expressed in terms of slice width in millimeters. Although one wire is sufficient to measure the Z axis resolution if its position is accurately known, a second wire is included to confirm the alignment. If the alignment was incorrect, the results of the slice width test would not be accurate.

The low-contrast insert is a compound insert. It is made of two half cylinders of different materials with a known contrast difference between them. The low-contrast insert is intended to measure the contrast resolution of the scanner. The contrast resolution is the ability to measure slight differences in x-ray attenuation.

The sensitometry inserts are an air bore and cylinder made of different materials. They are intended to measure the contrast scaling of the scanner.

The QA scan protocols appear in the following table.

Table 29: Scan protocols used by the QA

Scan voltage	120 kV
Scan current	200 mA
mAs	400 mAs

Scan time	2 second
Kernel	Pos. Fossa/Vessel
Slice thickness	9.6mm

Starting Quality Assurance

To ensure the system is at its optimum, factory-specification level, the workstation provides **QA** tools to verify the system's state and to perform image-quality verification. To maintain consistent image quality over the system's lifetime, you should establish and maintain a regular **Quality Assurance** (**QA**) program. **QA** results are stored in the **Patient Browser**. Contact your local service representative to delete **QA** results.

The **QA protocol** is shipped with the system and appears when you click **Quality Assurance** from the main menu. You cannot customize or modify the **QA protocol**.

Note The **QA test** should be conducted per hospital requirements.

Before you begin this section, be sure to run a fresh **Daily Calibration** on the system. See "Performing a daily (air) calibration" on page 216.

Also, before you start the **QA protocol**, make sure the **QA phantom** is available and ready to install on the phantom holder. The phantom serial number label should be facing the front of the scanner and be positioned at the top – as shown in the figure below. The red insert should be on the bottom right when facing the scanner. The position of the phantom will greatly affect the **QA** results.

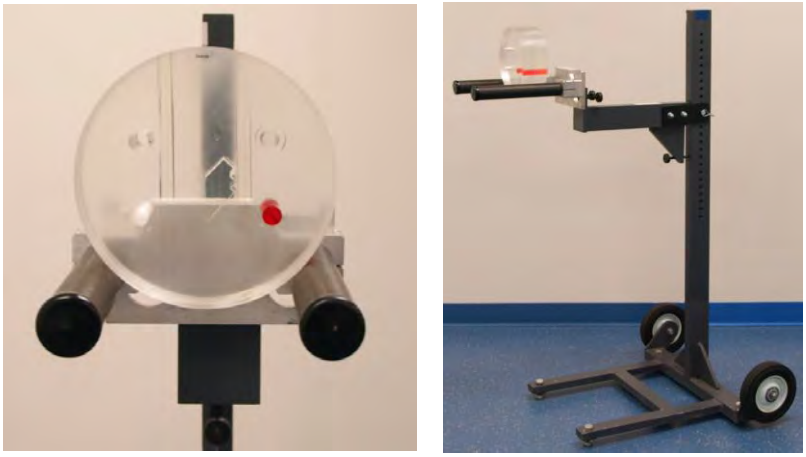


Figure 204: Phantom on the phantom holder

1. Move the QA stand to the front of the gantry, so the prongs point into the bore as shown.

Figure 205: Place QA phantom

2. Ensure the QA stand is centered in the bore using the sagittal laser as shown. If needed, adjust the prongs side to side.

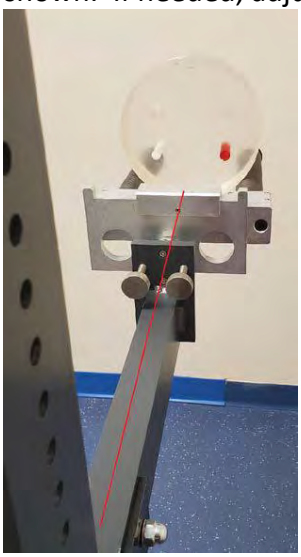


Figure 206: Proper QA stand positioning

3. Place the QA phantom on the prongs as shown.

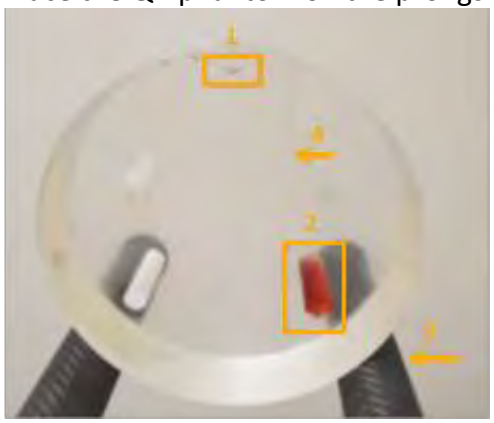


Figure 207: QA phantom positioning

1. The serial number label should be facing the front of the gantry and at the top.
2. The red insert should be on the bottom right.
3. The phantom should be in the middle of the carbon fiber post/prongs.
4. The two wires in the phantom should be vertically straight.

4. On the pendant, press the **Laser** button and align the internal laser to the etched line in the center of the phantom.

Figure 208: Laser button

See the laser precautions in "Laser safety" on page 56.

5. Click **Tools > Quality Assurance** from the workstation main menu.

6. The following **Quality Assurance** popup appears.

Figure 209: Quality Assurance popup

7. Click the **Prepare** button to begin the QA procedure.

8. The **System Ready to Scan** popup appears.

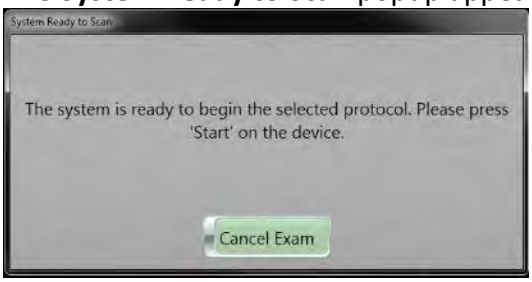


Figure 210: System Ready to Scan popup message – System is ready to begin

9. Go to the scanner and press the **START** button.
   The system will scan the phantom and display the **QA Results** image.

Figure 211: QA results of QA image

Note Items in green are passed results. Items in red are failed results. Often positional issues cause the failure; reposition your phantom and perform another scan. If you try multiple times and failures persist, call your service representative or **Technical Support**.

10. Click the **Close** button on the **QA Results** popup when finished reviewing. The image of the phantom appears.

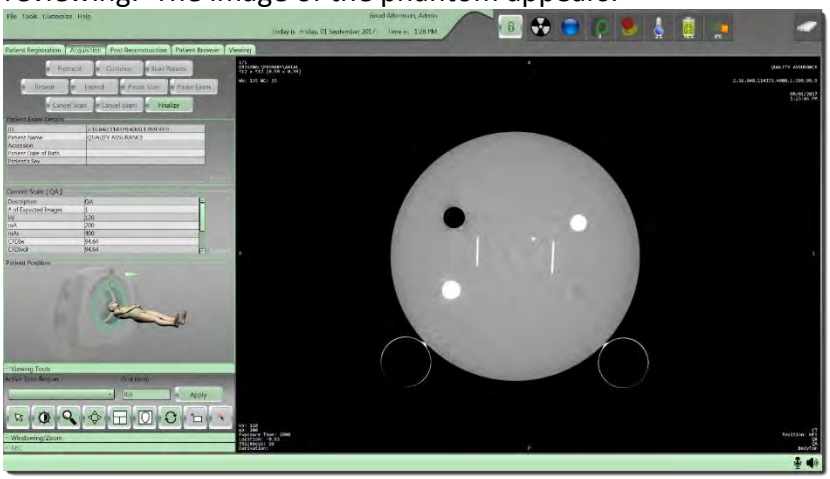


Figure 212: Phantom image

11. Click the **Finalize** button on the workstation to exit the protocol.

12. The **QA** appears in the **Patient Browser**; however, it is locked.

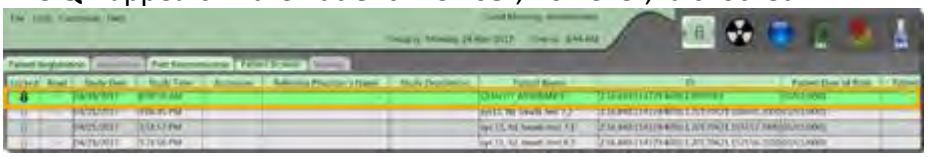


Figure 213: Locked QA results shown in Patient Browser

Note See your service representative to remove locked QA results.

Ensuring good image quality

To produce consistent image quality over the system's lifetime, you should establish and maintain a regular **Quality Assurance** (**QA**) program. **QA** results are stored in the Patient Browser. Contact your local service representative to delete **QA** results.

1. Compare the results to previous or optimum values and repeat these tests on a regular basis to detect changes in image quality values ***before*** any problem becomes visible.

Note If you notice degradation in image quality or a change in QA values, schedule a site visit and let your service representative or imaging physicist run more detailed tests.

Early intervention could prevent a major breakdown.

QA begins with baseline performance data that is acquired during system installation or after the repair or replacement of an x-ray generator-assembly, collimator, detector, Data Acquisition System (DAS) or main power circuitry.

2. Compare subsequent **QA** results against the baseline.
   Baseline images can be saved for a visual comparison with QA checks, but measurement values provide a more objective way to monitor quality.

Figure 214: Results of QA image after the QA test

Identifying filtration accuracy

Values of attenuation equivalent, half-value layer, and quality-equivalent filtration are expressed as a thickness of aluminum at the minimum of 99.9% purity. Attenuation of items in the x-ray beam should not be higher than 2mm of equivalent Aluminum (Al).

CAUTION Do not put anything in the x-ray beam that exceeds 2mm of equivalent AL as it may produce adverse effects to the image.

Using Axial plane to determine image resolution

The method to determine resolution in the **Axia**l plane is to measure the modulation-transfer function of the scanner. A planar section of the **MTF** wire provides a point, called an **impulse**. The impulse is blurred by the imaging system, and the measurement of the blur quantifies the resolution. The blur is quantified by the **MTF** amplitude, which provides a measure of gain for a given object size in line pairs per centimeter (lp/cm).

The **MTF** is measured in two directions, called **radial** and **tangential** directions. The **radial** direction is along the line that joins the wire to the scanner isocenter. The **tangential** direction is perpendicular to the radial direction. The **MTF** along each direction produces a curve. The points at which each curve's amplitude is 50% and 10% of its amplitude at zero lp/cm are reported.

The expected results are given below.

Table 30: Modulation Transfer Function (MTF) direction

Direction	50%	10%
Radial (lp/cm)	4.7	7.2
Tangential (lp/cm)	4.7	7.2

Table 31: QA results

	Low limit	High limit
Slice width (mm)	9	11
Noise (HU)	2.5	3.5
Low-contrast resolution (mm)	4	6
Uniformity (HU)	0	5
CT of air (HU)	-1030	-950
CT of Teflon (HU)	924	1004
CT of acrylic (HU)	75	155

Measuring slice width

The method for determining the slice width for the **Axial** mode QA is to take an image of the inclined wire. The scanned section of the inclined wire is a line segment. The scanner blurs a scanned object in the **Axial** plane as well as in the direction perpendicular to it. The image of the inclined wire includes both the **Axial** plane blurring (**MTF**) of the scanner as well as the blurring in the z-direction. The slice width is determined by removing the component of in-plane blurring, by measuring the length of the wire segment and by using the known angle of wire inclination. The range is noted in QA results; see Table 31 on page 227.

Measuring noise

Noise is measured as the standard deviation of pixel values in a 1cm **Region of Interest** (**ROI**) at the center of the phantom. The **ROI** selection is automatic. The $CTDI_{100}$ center dose in a standard CTDI head phantom is 145 mGy for this scanning technique. The BodyTom 64 noise measurement is performed on a 10mm slice.

Measuring low contrast

Low-contrast resolution is measured as the difference between the mean CT values in each half of the low-contrast insert. An **ROI** is automatically selected around the low-contrast phantom and is automatically segmented into halves. Within each **ROI**, the mean pixel value is computed. The two mean values are subtracted.

The expected difference in the mean values is given in the electronic report. The low contrast should be: 5.0 ±1.0 HU.

Finding uniformity

A **ROI** is automatically selected in each of five locations in the phantom. One **ROI** is at the center. Four outer **ROI**s are 60 to 70mm from the center of the phantom and spaced 90 degrees apart. A mean value is calculated in each **ROI**. The maximum difference between the means is calculated. The maximum allowable difference between the means is 3 HU.

Identifying CT contrast scale

Contrast scale represents the attenuation scaling of the scanner. The mean CT numbers of each of the sensitometry objects is calculated and reported.

Identifying load factors

Table 32: Load factors

Protocol description	kV	mA	Time (seconds)
Axial	80-140	30-300	1
Helical	80-140	30-300	1 per rotation

CAUTION When conducting multiple or repeat scans, ensure that the total exposure does not exceed 1Gy CTDI.

Note The highest x-ray tube current is 300mA and the highest x-ray tube voltage selection at this current is 140kV.

The nominal x-ray output power is 42kW when operating at an x-ray tube voltage of 140kV and x-ray current of 300mA for 4 seconds.

The x-ray tube voltage/current tolerance is ±10%.

The BodyTom 64 dose information (21 CFR 1020.33 c)

Dose is measured using standard CTDI head and body phantoms. Surface and center CTDIs were both measured. Weighted CTDI is computed using surface and center CTDIs:

$$CTDI_w = (\frac{2}{3}\, CTDI_{surf} + \frac{1}{3}\, CTDI_{cen})$$

Measured values are normalized to scan current, for example, CTDI values are in mGy/100 mAs. For any given scan protocol $CTDI_w$ can be estimated using following equation and data from Table 33 and Table 34 on page 230:

$$CTDI_w(kV, m, S) = \left(\frac{m}{100.0} \cdot \boldsymbol{S}\right) CTDI_w(kV, 100mAs)mGy$$

$CTDI_w$ can also be computed using data from Table 35 and Table 36 on page 230, and the following equation:

$$CTDI_w(kV, m, S) = \left(W(kV) \cdot \frac{m}{100.0} \cdot \boldsymbol{S}\right) CTDI_w(120_{kV})mGy$$

Where $\boldsymbol{W}$ is the $\boldsymbol{kV}$ relative dose ratio with respect to 120 kV. $\boldsymbol{m}$ is the x-ray tube current in mA and $\boldsymbol{S}$ is the scanning time in seconds. If scan kV matches measured scan voltage, then $\boldsymbol{W}$ is equal to ***1.0.*** For **Helical** scans, $CTDI_{vol}$ is calculated as follows:

$$CTDI_{vol} = \frac{CTDI_w}{Pitch}$$

For **Axial** scans, $CTDI_{vol}$ is calculated as follows:

$$CTDI_{vol} = \frac{CTDI_w}{Scan\ Increment}$$

Body $CTDI_w$ phantom

$CTDI_w$ using CTDI body phantom is listed in the following table. Data was measured using the 64 rows collimation with the phantom placed on the phantom holder. Dose measurements were taken using raw data acquisition in **Service** mode.

Note Performing scans in different **Acquisition** modes can cause slight variations in measured dose.

Table 33**:** Body $CTDI_w$ (mGy/100mAs)

	140 kV	120 kV	100 kV	80 kV
$CTDI_{100}$ Center (C)	8.23	5.51	3.25	1.53
$CTDI_{100}$ Surface (S)	16.29	11.58	7.48	4.10
$CTDI_w$	13.77	9.56	6.02	3.25

Head $CTDI_w$ phantom

Weighted average Computed Tomography Dose Index (**CTDIw**) using the CTDI head phantom is listed in the following table. Data was measured using the 16 rows collimation. Dose measurements were taken using raw data acquisition in **Service** mode using phantom holder.

Table 34: Head $CTDI_w$ (mGy/100mAs)

	140 kV	120 kV	100 kV	80 kV
$CTDI_{100}$ Center (C)	36.83	25.55	15.76	8.03
$CTDI_{100}$ Surface (S)	41.26	28.81	18.19	9.90
$CTDI_w$	39.68	27.50	17.38	9.28

Normalized CTDI tables are listed below. CTDI is normalized with respect to a typical 120kV scan protocol:

Table 35: Normalized CTDI of body phantom

	140 kV	120 kV	100 kV	80 kV
$CTDI_{100}$ Center (C)	1.494	1.000	0.589	0.277
$CTDI_{100}$ Surface (S)	1.406	1.000	0.645	0.354
$CTDI_w$	1.440	1.000	0.630	0.340

Table 36: Normalized head CTDI

	140 kV	120 kV	100 kV	80 kV
$CTDI_{100}$ Center (C)	1.442	1.000	0.617	0.314
$CTDI_{100}$ Surface (S)	1.432	1.000	0.631	0.344
$CTDI_w$	1.443	1.000	0.632	0.337

The BodyTom 64 dose in air

Dose measurements were taken using raw data acquisition in **Service** mode.

Table 37: CTDI air (mGy/100mAs)

	140 kV	120 kV	100 kV	80 kV
64 rows	35.4	25.8	17.3	10.2
16 rows	54.2	38.6	25.7	15

Dose is measured using a typical head protocol and a typical abdomen protocol. Dose in air was also measured for repeatability over 10 scans. Average value and standard deviation are noted below:

Table 38: Mean and standard deviation of CTDI air at 120kV

	16 rows	64 rows
Mean mGy	38.6	25.7
Standard deviation mGy	0.0232	0.00396

Additional QA measurements

The QA phantom is typically used to monitor the scanner on site; however, the ACR or AAPM phantoms can be used for measuring the imaging performance of the scanner.

Note Actual results on installed units can vary 20% due to machine and test tolerances.

ACR testing procedure

Most sites use the ACR phantom for evaluating the QA parameters of the scanner. Furthermore, each scanner is evaluated using the ACR phantom prior to shipping. Due to the special tube filtration some of the limits for CT values may be different from those set by the ACR committee. Table 39 lists the NL limits for the CT number and linearity of each insert in the ACR phantom. It also lists the limits set by ACR. The difference in CT number is mainly due to the difference of the x-ray beam quality due to the tube filtration and the ACR committee acknowledge this in published papers[2].

[2] The ACR committee will often change their limits, as such, the limits listed in Table 39 may have been changed.

Table 39: The CT number and linearity of the different inserts in the ACR phantoms

Insert Material	NL Limits	ACR Limits
Air	-1005 to -970	-1005 to -970
Polyethylene	-110 to -85	-110 to -85
Water	-7 to 7	-7 to 7
Acrylic	110 to 135	110 to 130
Bone	1010 to 1110	850 to 970

The scan protocols are typically selected by the site physicist or the CT manager. However, ACR recommends the use of standard head and abdomen protocols. NeuroLogica uses the protocols listed in Table 40.

Table 40: The NeuroLogica head and abdomen ACR scan protocols

Protocol	Head/Abdomen	Abdomen
kVp	120	120
mA	200	250
Time per rotation (seconds)	1	1
Dose (Weighted)	45 to 50 mGy	22 to 25 mGy
Scan FOV	59.5 cm	59.5 cm
Display FOV (minimum)	25.0 cm	25.0 cm
Reconstruction sharpness	Soft tissue	Soft Abdomen
Scan type	Axial	Helical
Z-axis collimation	9.6 mm	38.7 mm
Table increment (mm) or Table speed (mm/rot)	9.6 mm	30.7 mm/rot
Slice thickness	4.8 mm	4.8 mm
Scan time (seconds)	1	1
Slice separation	4.8 mm	4.8 x 4.8 mm
Number of images per scan	2	N/A

Measuring high-contrast resolution

The high-contrast resolution phantom is a wire placed at the center of a uniform disk. The wire provides an impulse function in the **Axial** plane when it is placed parallel to the scanner-gantry axis-of-rotation. The high-contrast resolution is measured from the **Modulation Transfer Function** (**MTF**). Typical **MTF** curves are shown in the following figures. Variations of 10% may occur in measurements due to phantom placement error and measurement inaccuracies.

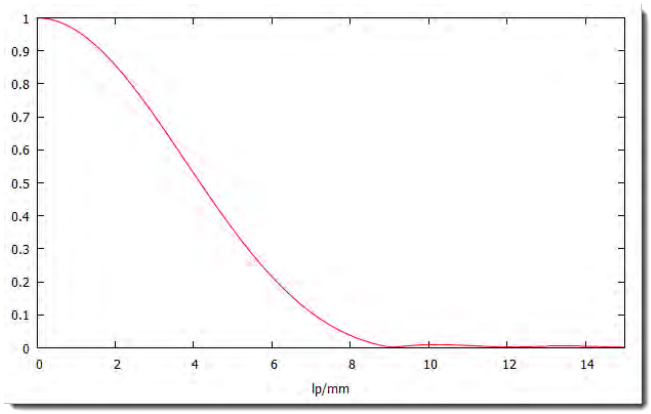


Figure 215: MTF

Table 41 lists the 50%, 20% and 10% cutoffs of the most commonly used kernels on the scanner. The cutoffs were measured using the MTF curve for each kernel like the one displayed in Figure 215.

Table 41: The cutoffs of some of the common reconstruction kernels

Scan Type	Kernel	MTF50%	MTF20%	MTF10%
Axial	Soft Tissue	3.4038	4.9538	5.7187
Axial	Pos. Fossa/Vessel	3.9930	5.7816	6.7455
Axial	Sharp	6.6819	8.2549	9.2587
Axial	Bone	7.7757	9.6942	10.9681
Axial	Sharp Lung	6.1620	8.9318	11.8802
Axial	High-Res QA	7.9286	10.5069	12.4050
Helical	Bone Head	5.2370	6.5734	7.1577
Helical	Soft Tissue-Abd	6.2422	7.2252	7.7846
Helical	Soft Tissue-Head	3.0327	4.4322	5.1328
Helical	Bone-Abdomen	5.5166	6.8081	7.4292

Noise, uniformity, and mean CT number of water

One of two phantoms may be used in these tests. These are Catphan® 412 or a cylindrical 20cm diameter water cylinder.

The variation in standard deviation may be ±10% due to variations between systems.

Noise is measured as the standard deviation at isocenter. The value is around 3.5 ±4 HU when the imaging protocol is 120 kV, 400 mAs and standard Post-Fossa kernel. This protocol gives a $CTDI_{100}$ center dose of 92 mGy.

Noise is measured as the standard deviation of pixel values in a large **ROI** at the center of the phantom. Using a slice thickness of 4.8mm the noise values are listed below.

Table 42: Uniformity and Mean CT Number using Water Phantom

Description	Noise (HU)
Body (cp300 mm Water phantom)	9.2285HU
Head (cp200mm Water Phantom)	3.42HU

Uniformity and mean CT number

The mean CT number of air is -1000 HU and that of water is 0 HU. The tolerance of the mean CT number will be ±3 HU. For mean CT numbers measured at different points of the water phantom, the maximum difference in the means will be less than 4 HU[3]. An **ROI** is automatically selected in each of five locations in the phantom. One **ROI** is at center. Four outer **ROI**s are 60 to 70mm from phantom center and spaced 90 degrees apart. A mean value is calculated in each **ROI**. The maximum difference between means is calculated.

Maximum difference between peripheral **ROI**s and the center **ROI** mean CT values in an image is less or equal to 4 HU. The maximum error in CT number of water is ±3 HU.

Table 43: Uniformity and Mean CT Numbers using Water Phantom

Description	Uniformity (HU)	Mean CT Number (HU)
Body (cp300 mm Water phantom)	1.91	0.32
Head (cp200mm Water Phantom)	1.45	-1.0

Low-contrast resolution

The phantom used for low-contrast resolution measurement is CTP 515 section of the Catphan 600.

The **low-contrast resolution** is 4mm rod at 0.3% contrast when the center $CTDI_w$ dose is 71 mGy. The imaging protocol is 120 kV, 300 mAs with 1 rotation, 4.8mm slice thickness, and using the soft tissue filter.

[3] For States that required the sites to perform water phantom testing, please contact customer service for assistance.

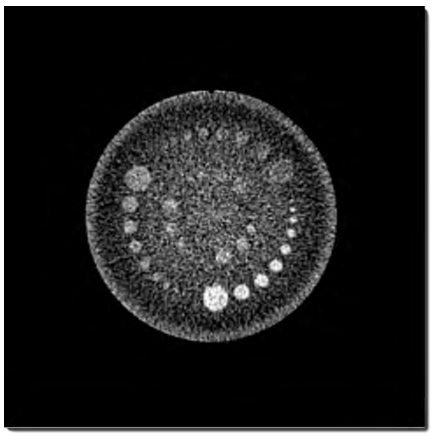


Figure 216: Catphan 515 using 120kV, 300mA, 1 rotation, and 5mm slice

Tube accuracy

Table 44: Tube accuracy

kV	Tolerance
140	± 5%
120	± 5%
100	± 5%
80	± 5%

Half-value layer

Table 45: Half-value layer

Scan voltage (kV)	100	120	140
Half value	6mm	7mm	8mm

Allowable variations

The following are allowable variations:

Dose	A ±5% variation in dose may occur due to variations between systems and measurement differences. The maximum variation is ±10%.
High Contrast Resolution	The variation in values on the **MTF** curve may be ±10%. These will occur mainly due to phantom placement errors, measurement inaccuracies and system variations.
Noise	The variation in standard deviation may be ±10% due to variations between systems.

Uniformity	The maximum difference between **ROI** means in an image is 4 HU. The maximum error in the CT number of water is ±3 HU.

Dose: Maximum variation is ±10%.

Variation in values on the **MTF** curve may be ±10%. These occur mainly due to phantom placement errors, measurement inaccuracies and system variations.

Scatter radiation

Reference the following radiation scatter plots identifying proper distances to protect from radiation exposure. The scatter plots provide scattered radiation dose in air-kerma, per current-time product in both standard and SI units for nominal technique of 120kV (µRad/100mAs and µGy/100mAs respectively). This information is given so the facility physicist and/or **Radiation Safety Officer** (**RSO**) can use these charts to calculate exposure with the following formula:

$$Stray\ radiation\ (scan\ current, scan\ voltage) = stray\ radiation\ (100, 120) \times \left(\frac{scan\ current}{100}\right) \times \left(\frac{scan\ voltage}{120}\right)^{2.3}$$

In addition, per IEC 60601-2-44, 3rd Edition, “Particular requirements for the basic safety and essential performance of x-ray equipment for computed tomography”, scatter plots are provided as shown in Figure 219 on page 238 and Figure 220 on page 239 for the maximum techniques settings of 140kV and 300mA (standard and SI units respectively).

This information is specifically intended for the facility Physicist and/or an **RSO** to perform a safety and shielding analysis such as described in NCRP 147, “Structural Shielding Design for Medical X-Ray Imaging Facilities.”

WARNING Exposure to secondary radiation can be harmful, and scanner usage should only be done under the direct supervision of the facility’s qualified **Radiation Safety Officer** (**RSO**) in compliance with site, local, mode, provincial, and national regulations. Only this **RSO** can perform the calculations necessary to determine what additional safety precautions are necessary, such as shielding, personal protections, and so on.

Note The BodyTom 64 scanners are compatible with IRR1999 and EU Directive 96/29/EURATOM.

Typical application environment and radiation safety

The BodyTom 64 is an advanced radiation protection mobile CT. There is an effective x-ray shielding that is equivalent of 0.75mm of lead within the gantry. The scanner can be used in a mobile environment and/or within an enclosed environment.

The scatter plot below shows the dose map during a normal scan:

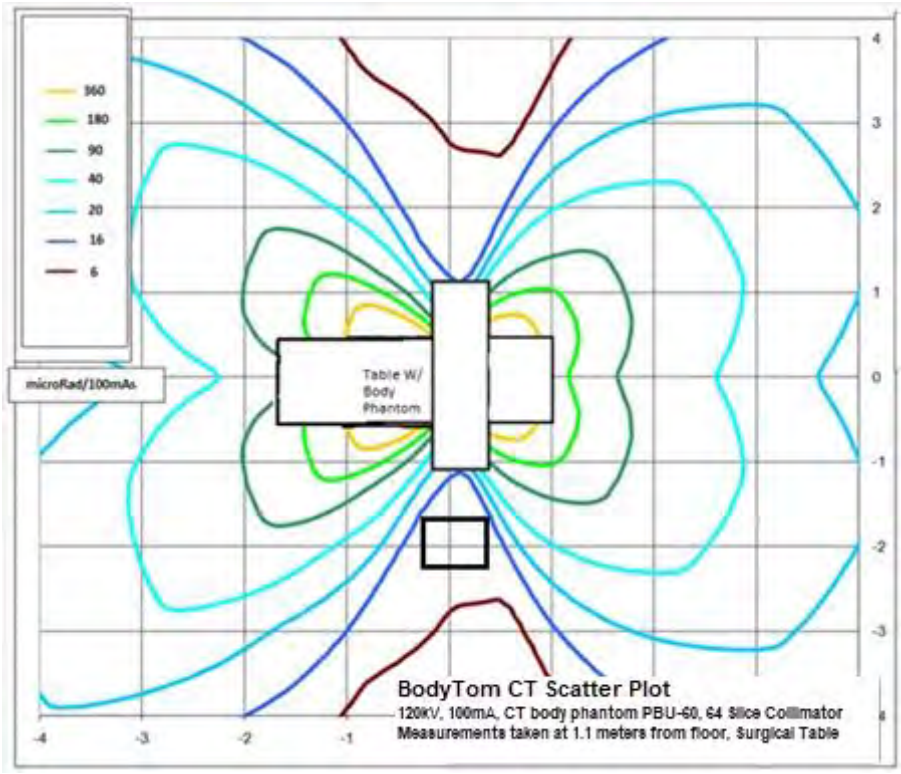


Figure 217: Scatter plot (120kV, 100mA in µRad)

Note In compliance with IEC 60601-2-44:2009, section 203.11, the above figure shows the scatter radiation measured at the edge of the gantry in the tomographic plane is ≈20% of the scatter radiation measure at the same distance along the axis of rotation in the horizontal plane.

The black box (located at 0 on the X axis and -2 on the Y axis) represents an approximate (24 x 24 x 79in. or 60 x 60 x 200cm) zone of occupancy. The system in **Scan** mode stands at 78.5in., which meets the 79in. (200cm) requirement.

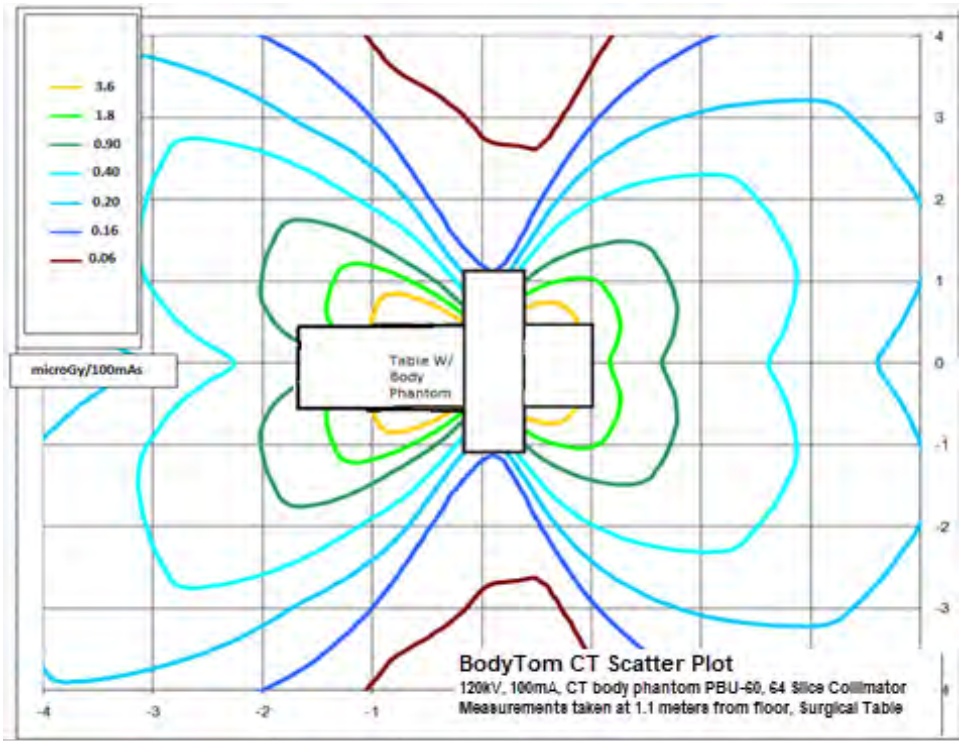


Figure 218: Scatter plot (120kV, 100mA in µGy)

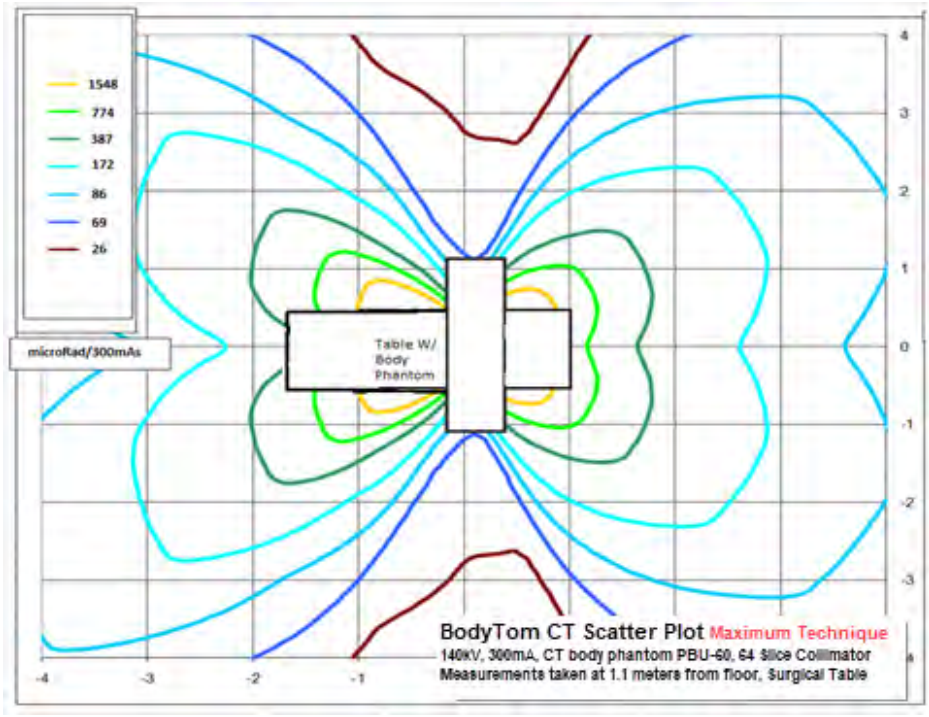


Figure 219: Scatter plot (140kV, 300mA in µRad)

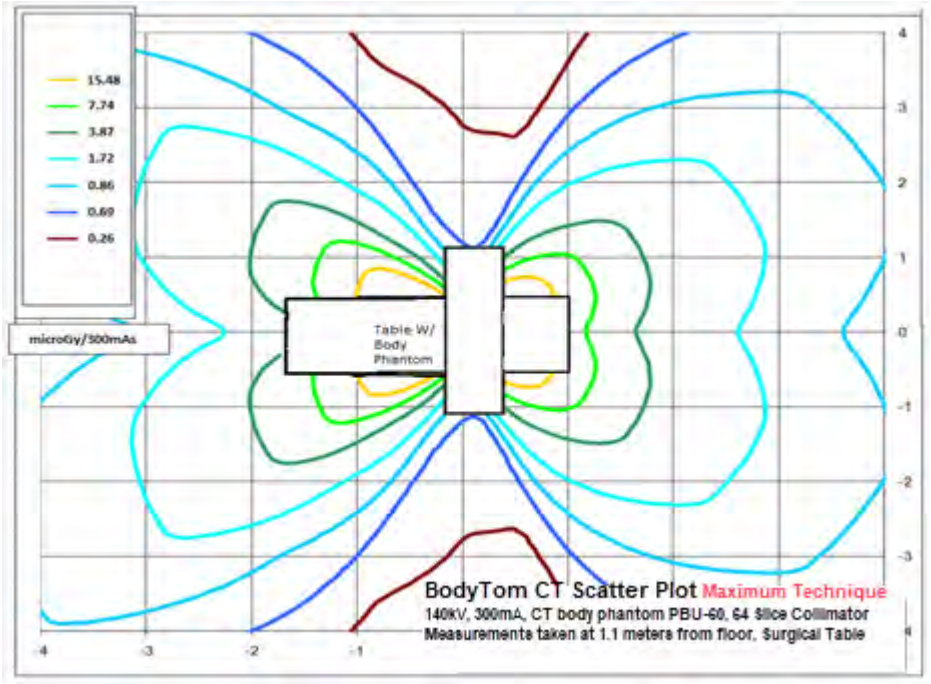


Figure 220: Scatter plot (140kV, 300mA in µGy)

Note The anatomical body phantom was placed on a scan table inside the gantry to consider scatter through patient. Measurements were made using the following scan protocol: 140kV, 200 mA, and 5 sec. The following figures show measurement points in vertical X—Y and perpendicular Y—Z planes, followed by corresponding tables detailing resulting data.

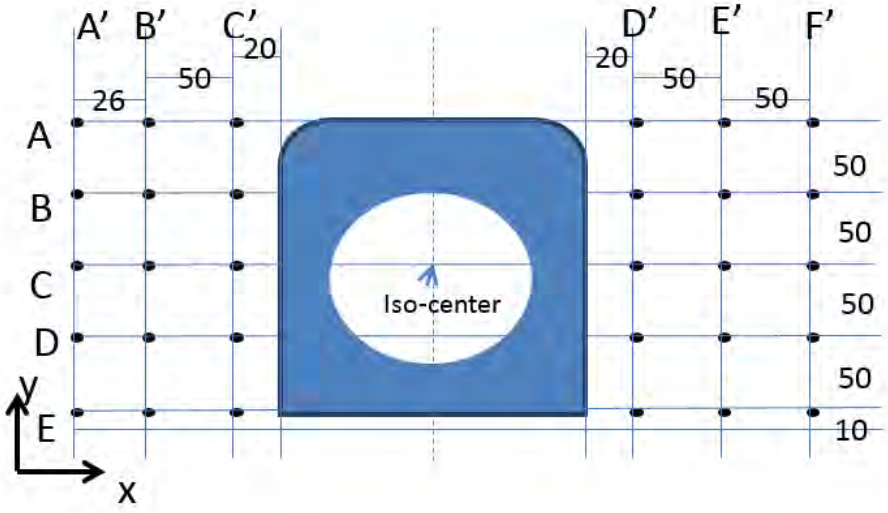


Figure 221: Scatter measurements (X—Y plane)

Table 46: Scatter measurements (X—Y plane) (µRad/100 mAs)

	A’	B’	C’	D’	E’	F’
A	12.2	15.3	17.7	18.3	15.7	12.7
B	11.9	14.8	16.4	16.7	16.0	12.6
C	11.4	13.6	11.1	12.9	15.2	12.5
D	9.40	10.4	8.87	9.57	12.4	10.4
E	6.09	6.26	4.09	4.26	7.66	7.66

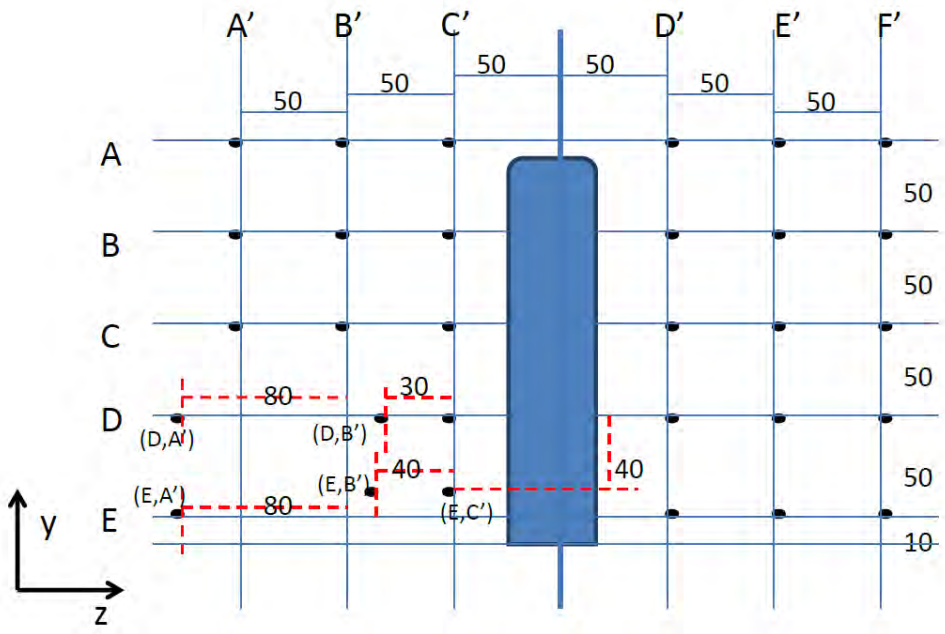


Figure 222: Scatter measurements (Y—Z plane)

Table 47: Scatter measurements (Y—Z plane) (µRad/100 mAs)

	A’	B’	C’	D’	E’	F’
A	300	676	852	591	870	437
B	218	539	2320	2940	1090	465
C	137	328	931	1120	461	233
D	27.8	1080	2790	2240	765	282
E	8.96	844	441	85.3	538	345

Dose profile/Geometric Efficiency

A graphical presentation of the **dose profile** along a line – Z perpendicular to the **tomographic plane** and centered at the **isocenter**, determined in free air for one **Axial** scan, in the center location of the head-dosimetry phantom, and the center location of the body-dosimetry phantom – is given in the accompanying documents for each selectable value of N × T. When more than three different values of N × T are available, the information is provided for at least the minimum, maximum and one mid-range value. The **dose profile** is presented on the same graph and to the same scale as the corresponding **sensitivity profile** required by 203.111.

Dose profile was measured for 64 rows by taking a stationary scan with the radio-chromic film, centered on top of the detector array. The scan protocol was as follows: 120 kV, 200 mA, 5 sec. After the scan was taken, the radio-chromic film was scanned, and the profile extracted. The following figure shows the dose profile and detector array.

Geometric efficiency was calculated as the ratio of the detector array to FWHM of dose profile using the following formula:

$$Geom_{Efficiency} = \frac{N_{rows} \cdot w_z \cdot M_f}{FWHM}$$

where N_{rows} is the number of detector rows; $w_z$is the width of the detector in the z-direction; M_f is the magnification factor; $FWHM$ is the full width at half maximum of the profile. Table 48 on page 242 lists the measured geometric efficiencies for the two existing collimations of the BodyTom 64.

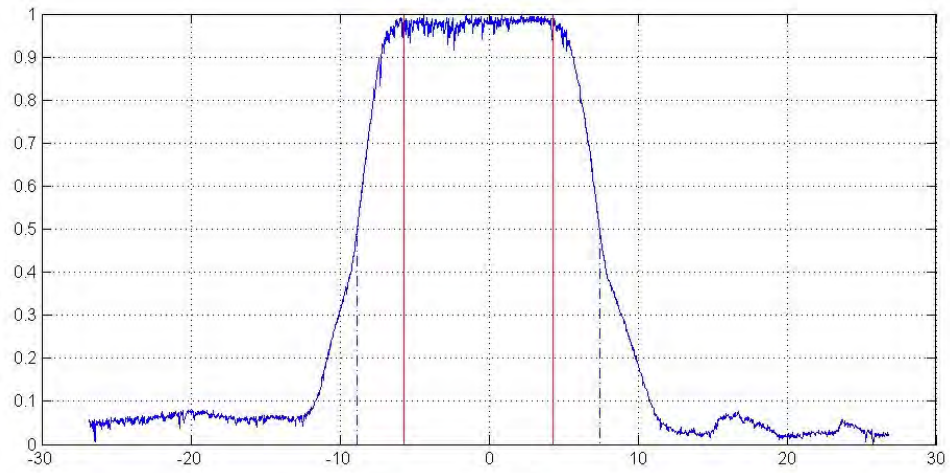


Figure 223: Dose profile for 16 rows

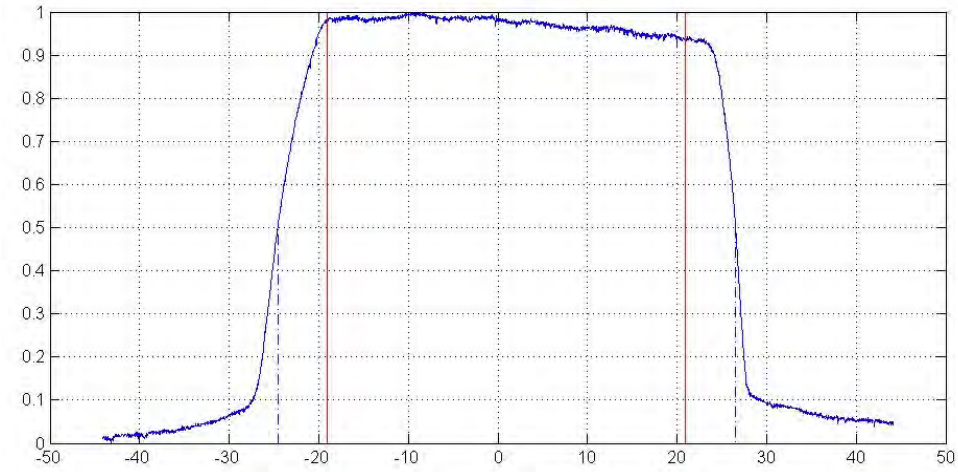


Figure 224: Dose profile for 64 rows

Table 48: The geometric efficiency of the two different collimations of the BodyTom 64

Collimation	Geometric Efficiency
64 rows collimation	83 ± 5%
16 rows collimation	60 ± 5%

Chapter 8 Patient Registration

Patient Registration is the first step in the patient scan process.
You can register a patient in the following ways:

- Manually register a patient from the **Patient Registration** tab.
- Perform a query to acquire already-entered patient data from the **Hospital Information System** (**HIS**) or **Radiology Information System** (**RIS**).

It is assumed that the workstation is connected to the site's **HIS/RIS** system. If you are not connected, you can always manually register a patient.

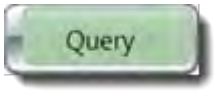
Figure 225: Activated Patient Registration tab

Navigating the Patient Registration screen

Make sure the **Patient Registration** tab is selected.

Notice the buttons at the bottom of the **Patient Registration** dialog box. Many of these buttons are active *only* if you are already connected to the site's **HIS/RIS** or if you clicked the **Query** button, and the list of patients populated in the **Query Results** list. When a patient is selected, the buttons are active.

Table 49: Patient Registration buttons

Patient Registration button	Action
	Searches the **HIS/RIS** server for scheduled patients. The population of patient information could take several minutes to appear, depending on the number of patient entries the query retrieves after clicking the **Query** button.
	Cancels the current query. Entries retrieved prior to cancellation appear in the **Query Results** list and Stored **Results** if they are moved there.
	Registers the selected patient and takes you to the **Acquisition** tab to select a protocol to be used for scanning.

Patient Registration button	Action
View	Shows selected patient details.
Search	Searches queried patient entries for specific information.
Store	Selects patient(s) from query results and moves them into the **Stored Results** list.
Delete	Removes patient(s) from the **Stored Results** list.
Manual	Manually enters a new patient and, when completed, takes you to the **Acquisition** tab to select a protocol to be used for scanning.

Registering the patient

The following procedures show you how to register or enter patient information into the system before scanning a patient. Patients are registered manually or queried from the **Hospital Information System/Radiology Information System** (**HIS/RIS**). The system can be configured to add or create specific patient information when the patient is registered.

Querying patient information

1. If necessary, click the **Patient Registration** tab on the main screen.

Figure 226: Patient Registration tab

2. Click the **Query** button at the bottom of the screen.
   The **Query Information** dialog box appears.

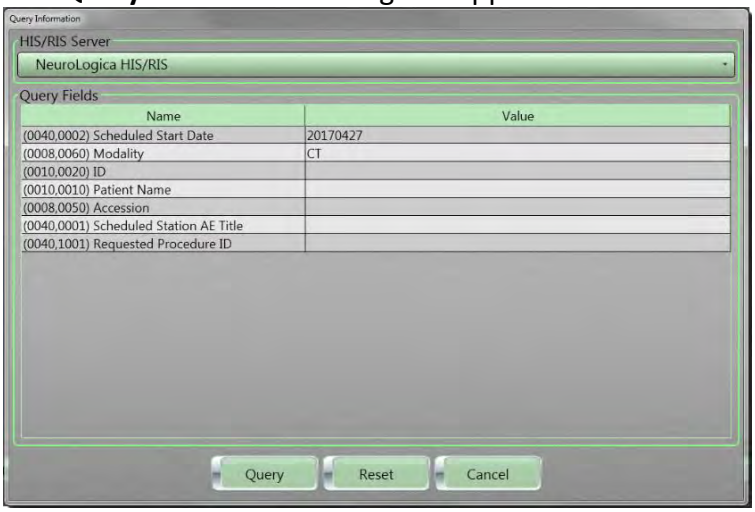


Figure 227: Query Information dialog box

3. Click the **HIS/RIS Server** dropdown and select the worksite to pull data from.
   The default worksite appears at the top. If there is no list, see your site administrator to set it up.

4. Double-click any of the named **Query Fields** you would like to use to query for patients by entering the value in the **Value** column.
   A popup associated with the **Query Field** you selected appears. For example, if you double-click the **Scheduled Start Date** row, the **Edit Value** popup appears. Enter the desired start date. Another example would be to click the **Patient Name** value row. Again, the **Edit Value** popup appears; however, this time **Patient Name** text boxes are provided so you can type the patient's name to query. You can click any of the **Value** rows to fill in data to help query for the patient you are looking for. You can enter as much or as little information as needed. If no information is available, leave the value blank.

Figure 228: Edit Value popup for name

5. When you are finished filling in query selections, perform one of the following:
   - Click the **Update** button to query based on the newly entered data to help narrow down your search.
   - Click the **Close** button to remove any changes and return to the previous **Query Information** popup.
6. A list of patients matching your selected criteria variables populates in the **Query Results** list on the **Patient Registration** tab.

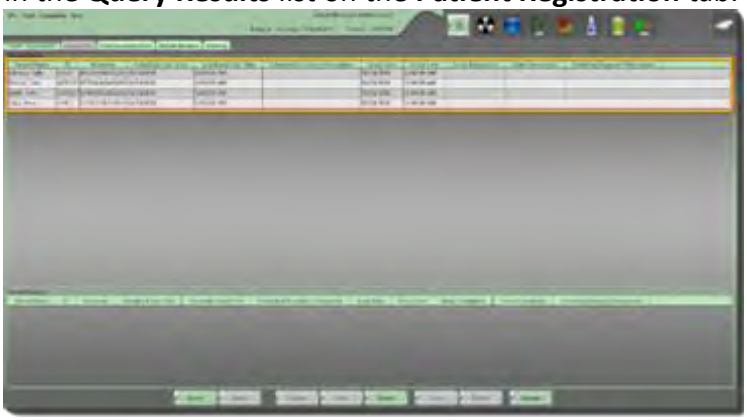


Figure 229: Patient Registration Query Results table

7. Select a patient and click the **Register** button to register the patient for the exam.
   The system enables and opens the **Acquisition** tab. To perform the acquisition steps, see "Performing a scan" on page 255.

Storing patients in the Stored Results list

This list is helpful when multiple patients need to be scanned and a connection to a worksite like **HIS/RIS** is unavailable at the exam location.

1. If necessary, go to the **Patient Registration** tab to query the patients(s).

2. Perform steps 2 through 5 in "Querying patient information" on page 244.

3. Click the **Query** button.
   Let the criteria you selected populate into the **Query Results** list area.

4. Select one or more patient entries from the **Query Results** list.
   Select patients in the following ways:
   - To select one patient, click anywhere in the patient's row.
   - To select more than one patient at a time, press and hold the **Ctrl** key and click patient entries until finished and release the **Ctrl** key.
   - To select all the patients, press and hold the **Shift** key, click the first patient in the list, then click the last patient to highlight all patients between the first patient selected and the last.

5. Click the **Store** button.
   The patient information you selected appear in the **Stored Results** list at the bottom of **Patient Registration**.

Figure 230: Patient Registration Stored Results table

6. Click the patient you want to select from the **Stored Results** table.

7. Click the **Register** button to register the patient for the exam.
   The system enables and opens the **Acquisition** tab. To perform the acquisition steps, see "Performing a scan" on page 255.

Manually registering a patient

You manually register a patient for examination when the **HIS/RIS** server is unavailable, the patient cannot be found, and/or was never entered into the system.

1. If necessary, go to the **Patient Registration** tab.

Figure 231: Patient Registration tab

2. Click the **Manual** button at the bottom of **Patient Registration**.
   The **Exam Information** dialog box appears with the **Patient** tab open.

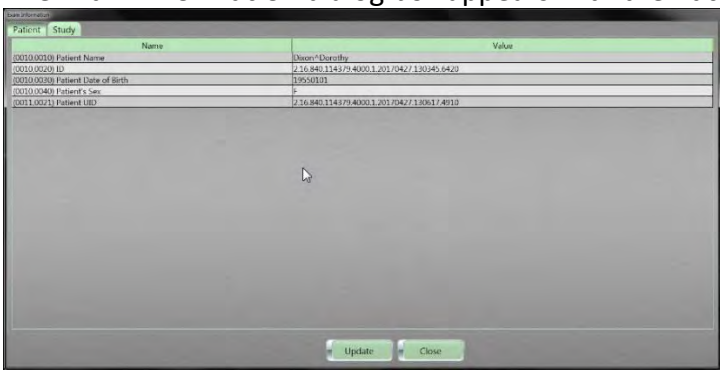


Figure 232: Exam Information dialog box

3. For **Patient Name**, double-click the **Patient Name** value.
   The **Edit Value** dialog box appears with patient name fields.

4. Enter patient name information in the fields provided and click one of the following buttons:
   - Click the **Update** button to save your entries and close the **Edit Value** dialog box.
   - Click the **Close** button to close the **Edit Value** dialog box ***without*** saving your work.

Notice that the value appears with the last name first, separated by ^, the first name next, separated by ^, the middle name (if you supplied that information), and any other information you entered.

Note The **Patient ID** is automatically generated by the system; you can replace this automated identifier with your patient's hospital ID number.

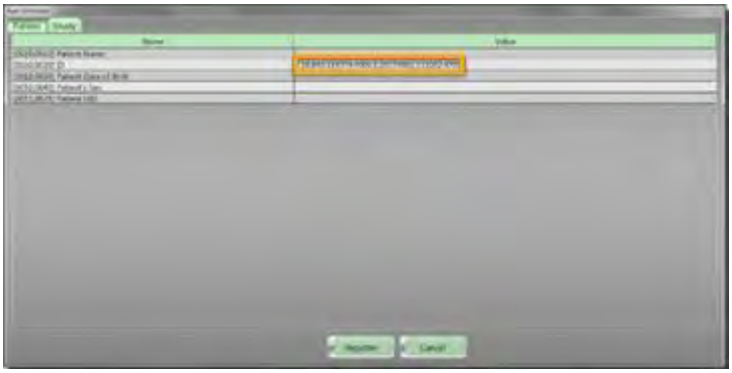


Figure 233: Patient ID field

5. For the **Patient Date of Birth**, perform the following:
   - Double-click the **Patient Date of Birth** field.
   - Enter the patient's birth date in the **Patient Date of Birth** field. Be sure to move the cursor to the far left to ensure two digits are included for the month and the day; four digits are required for the year.
   - Perform one of the following:
     - Click the **Update** button to save your work and close the **Edit Value** dialog box.
     - Click the **Close** button to close the **Edit Value** dialog box without saving your work.

6. For the **Patient's Sex**, perform the following:
   - Double-click the **Patient's Sex** field.
   - Enter the patient sex in the field by entering the appropriate letter:
     - **F** for Female
     - **M** for Male
     - **O** for Other
   - Perform one of the following:
     - Click the **Update** button to save your work and close the **Edit Value** dialog box.
     - Click the **Close** button to close the **Edit Value** dialog box without saving your work.

7. Perform one of the following:
   - Click the **Register** button to register your patient data.
   - Click the **Cancel** button to exit without entering your data.

   When you click the **Register** button, the system enables and opens the **Acquisition** tab.

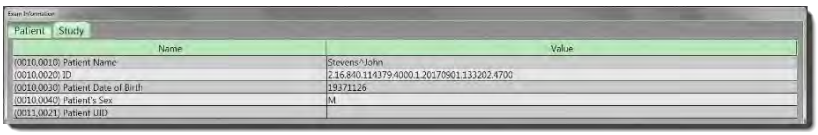


Figure 234: Patient data filled in

After your patient is registered, you can view the **Patient Exam Details** to ensure your data is correct.
If it is not correct, go to the next step to make the necessary changes.

8. Click the **Expand** link.
   The **Exam Information** popup appears.

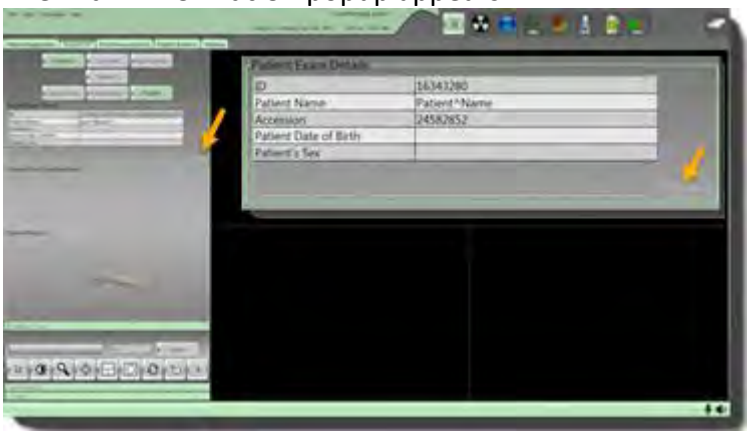


Figure 235: Expand link in context and close up

9. Make your changes in the **Exam Information** popup.

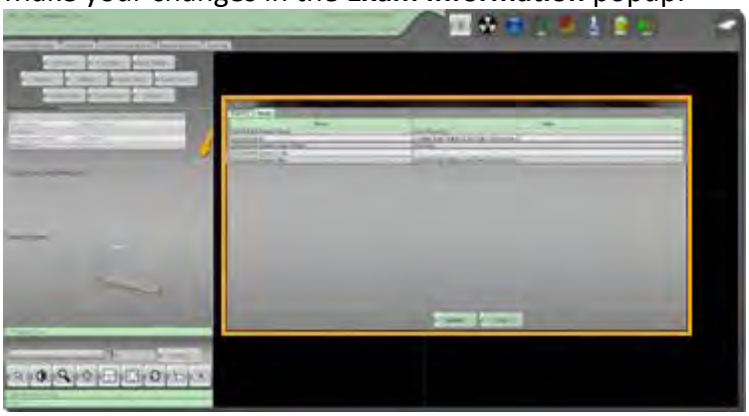


Figure 236: Exam Information popup

10. Click the **Update** button to save changes.

Viewing patient information

This procedure lets you view, but not change, the patient information.

1. If necessary, click the **Patient Registration** tab on the main screen.

Figure 237: Patient Registration tab

2. Select a patient from the **Query Results** list or the **Stored Results** list.
3. Click the **View** button.
4. Review the patient's information.
   This popup presents static information that you cannot change.
5. Click the **Close** button to exit the **View Entry Information** popup.

Deleting patients from the Stored Result list

Patient information can be manually deleted from the **Stored Results** list, you cannot delete patients from the **Query Results** list.

1. If necessary, go to the **Patient Registration** tab.

Figure 238: Patient Registration tab

2. Select one or more patients from the **Stored Results** list to delete.
   Select patients in the following ways:
   - To select one patient, click anywhere in the patient's row.

- To select more than one patient at a time, press and hold the **Ctrl** key and click patient entries until finished and release the **Ctrl** key.
- To select all the patients, press and hold the **Shift** key, click the first patient in the list, then click the last patient to highlight all patients between the first patient selected and the last.

3. Click the **Delete** button.
   The patients you selected are removed from **Stored Results** list.

Chapter 9 Patient Scanning

After you register the patient, the **Acquisition** tab automatically opens. The **Acquisition** tab lets you check that the selected patient information is accurate before you perform the scan. The **Acquisition** tab is also where you select protocols for the scan before you scan the patient. A protocol determines the parameters used to acquire patient images.

Figure 239: Active Acquisition tab

After the protocol is selected, you can scan the patient. See "Performing a scan" on page 255.

The following table provides information on the buttons on the **Acquisition** tab and what they are used for. Later you will learn how to set protocols for the scan.

CAUTION When conducting multiple or repeat scans, make sure the total exposure does not exceed maximum limit of 1Gy.

Table 50: Acquisition buttons

Acquisition button	Action
Protocol	Allows you to modify the protocol selected or choose a new protocol.
Continue	Authorizes the scanner to move to the next step if applicable.
Start Recons	Begins any post-reconstructions that were defined during the protocol setup.
Repeat	Allows you to repeat a portion or all the scan.
Pause Scan	Allows you to pause the scan acquisition.
Pause Exam	Allows you to pause the entire multi-step protocol acquisition.
Cancel Scan	Cancels the current scan within a protocol.
Cancel Exam	Cancels the entire exam.

Acquisition button	Action
Finalize	Completes the examination.

The following shows what appears in **Acquisition**:

Figure 240: What appears on Acquisition

Identifying Scan Types

Scan types identify how images are acquired during a scan. The following Scan types are available.

Axial

The **Axial** scan type lets you scan in the **Transverse** plane. Data is acquired as the x-ray tube rotates around the patient.

Helical

The **Helical** scan type acquires data continuously as the x-ray tube rotates around the patient and the scanner translates over the patient in the Z axis.

Dynamic

The **Dynamic** scan type acquires data at multiple time points over the same anatomic location while the scanner remains stationary; x-ray exposure can be continuous or intermittent.

Reference

The **Reference** scan type acquires a single 10mm slice to review anatomical position or place the **Region of Interest** (**ROI**) for **Bolus Tracking** scans. **Reference** scanning can only be used in conjunction with **Helical** and **Dynamic** scanning during a **CT Angiography** (**CTA**) or **Perfusion** protocol.

Scout

The **Scout** scan type acquires data continuously as the x-ray tube remains stationary at a designated angle and the scanner translates over the patient in the Z axis. The resulting **2D** projection is used during scan planning.

Performing a scan

You cannot complete this procedure without a registered patient.

Note If the scan needs to be stopped, perform the following:

For an immediate or hard stop, press the **E-STOP** button. This stops x-ray, centipede movement, and gantry rotation immediately.

For a controlled stop, press the **Cancel Scan** button.

Note Be sure the scanner is calibrated for the room you will scan in. See "Selecting a room for the BodyTom 64 " on page 184 and "Performing a daily (air) calibration" on page 216.

1. From the workstation, go to the **Patient Registration** tab to assign the patient to the scan in one of the following ways:
   - Query an already existing patient from the HIS/RIS.
   - Manually register the patient.
     See "Chapter 8 Patient Registration" on page 243.

   The **Acquisition** tab will be activated when the patient is registered.

2. From the **Acquisition** tab, click the **Protocol** button to open the **Exam Planner** dialog box.

3. Move scanner and align patient as needed.
   See "Positioning the scanner before a scan" on page 93.

4. On the pendant, press the **Laser** button to turn on the laser and use it to align the patient to the scanner.
See "Positioning the patient using the laser lights" on page 94.

5. On the workstation screen, click the appropriate option:

Adult	To scan with adult scan protocols, which are stored by anatomical location.
Pediatric	To scan with pediatric scan protocols, which are stored by anatomical location.
Trauma	To scan with protocols stored in the **Trauma** orb.

Note Protocol parameters are customized to meet your requirements in conjunction with local and nationally recognized published guidelines. These protocols **must be** approved by your facility physicist **before** the system's acceptance.

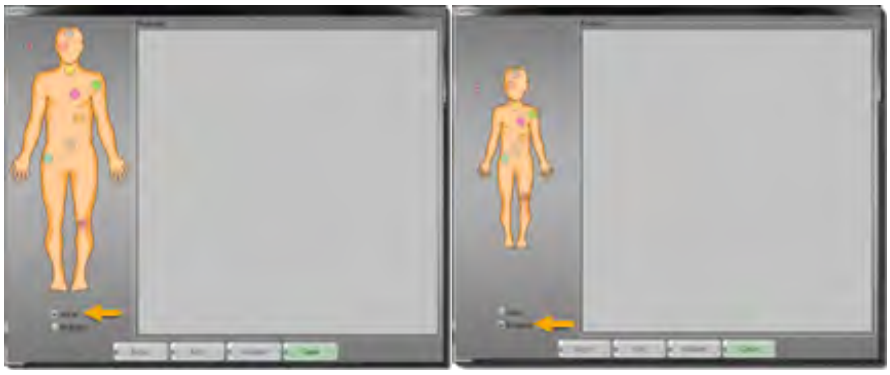


Figure 241: Exam Planner for Adult and Pediatric

6. Click the colored orb corresponding to the appropriate body part you will scan.

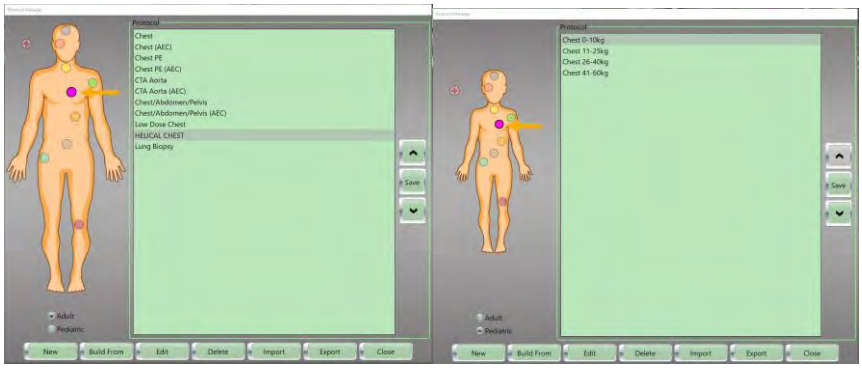


Figure 242: Anatomical orbs, with the Chest orb selected

7. Click the appropriate protocol from the list.

8. Click the **Edit** button to review the selected protocol.

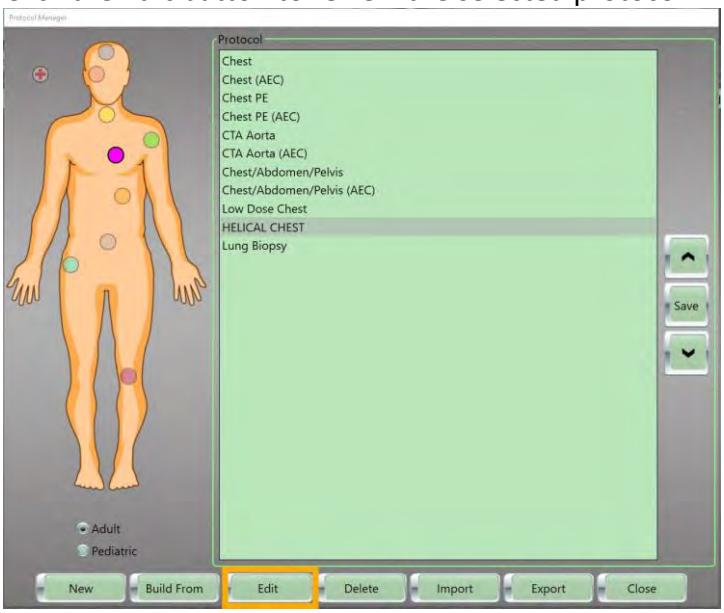


Figure 243: Protocol selected and Edit button active

The **Edit Protocol** dialog box appears.

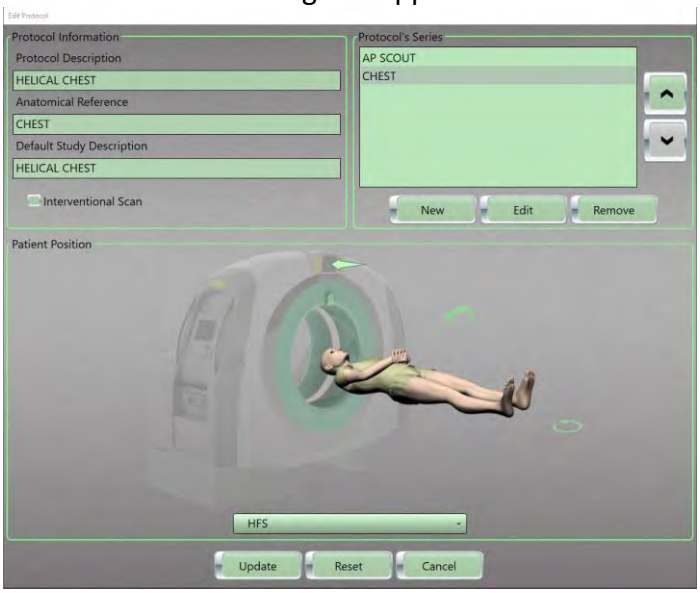


Figure 244: Edit Protocol dialog box

The **Protocol Information** tab displayed on the left and the Protocol's **Series** boxes displayed on the right show the series that are already created. The **Patient Position** appears identical whether it is for an adult, pediatric, or trauma patient.

Note You can modify a protocol; however, changes you make from **Acquisition** will not be saved permanently. Permanent changes to protocols can only be made by in **Protocol Manager**.

Assuming you have the proper user privileges, you can modify protocol parameters such as, kV, mA, and coverage at the time of the scan, but the modifications will not be saved for future use.

9. To edit an existing protocol, perform the following:
   - In the **Edit Protocol** dialog box, go to the **Protocol's Series** list and select the series to modify.
   - Click the **Edit** button.
     The **Edit Series** dialog box appears.

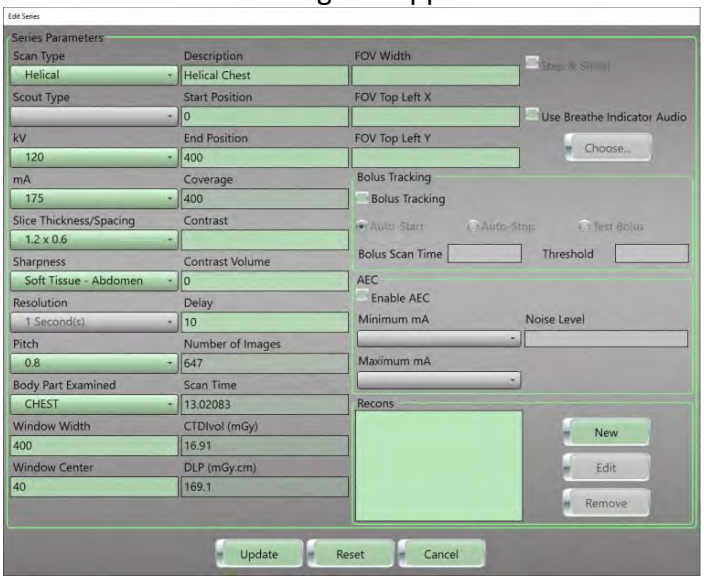


Figure 245: Edit Series dialog box

   - Make desired changes. Select the **Update** button in the **Edit Series** dialog box.
   - Alternatively, click the **Reset** button to remove any changes and return to the previous settings or click the **Cancel** button to return to the previous dialog box.

10. Click the **Update** button on the **Edit Protocol** dialog box.

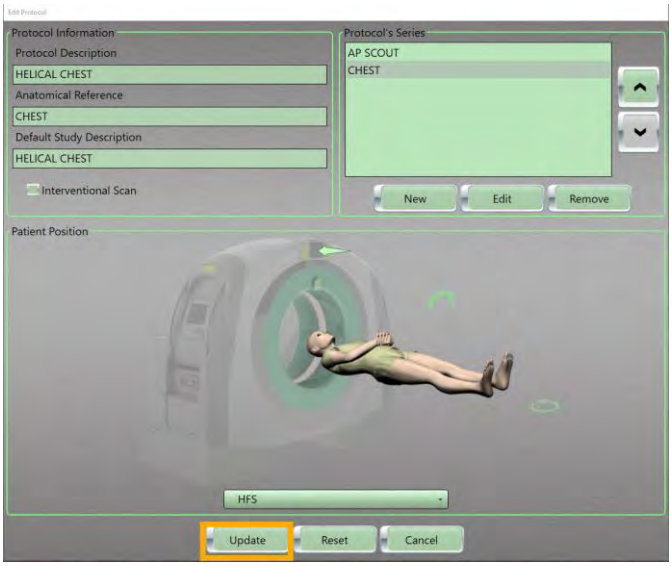


Figure 246: Update button

11. Click the **Begin** button from the **Exam Planner** dialog box.

12. When the **Is Scanner Properly Positioned?** popup appears, click the **Continue** button.

Figure 247: Is Scanner Properly Positioned? popup

Note If zero reference is not selected when starting your scan, the scanner considers the last known zero reference point to be the origin and start-point for the next scan. **Always** make sure to zero reference the scanner, when you set up a scan.

The system state orb will change color from yellow to green. The **System Ready to Scan** popup appears.

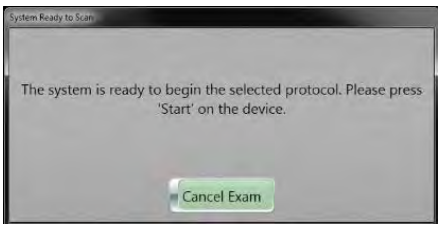


Figure 248: System Ready to Scan

WARNING ***Do not*** stand in either the forward or reverse paths of the scanner during the scan.

Note The scanner's side panels permit a low radiation exposure rate of <0.01mR/sec/100mAs – when x-ray is emitted.

The **START** button on the scanner control panel turns green when it is enabled.

Figure 249: Scanner control panel – START button

13. Press the **START** button on the scanner control panel to acquire your scan.
    The pre-set scan delay countdown begins. The green light turns off when the **START** button is pressed.

Figure 250: Countdown popup

You can press **CANCEL** on the scanner to end the current scan operation. If pressed when lit, the system cancels the current scanning operation. If pressed during scanning, 1 current scan rotation, or 1 second, completes and then the scan is terminated. Alternatively, you can press the **Cancel Scan** button on the screen to cancel the entire scan or **Cancel Exam** button to cancel the entire exam.

Figure 251: Scanner control panel – CANCEL button

Note During the scan, observe the following:

Yellow lights on top of the scanner, and an audible beep identify that radiation is being emitted.

The patient's scan results appear; approximately one image per second.

When scanning begins, the **Continue**, **Repeat**, **Extend**, **Pause Scan**, **Pause Exam**, and **Cancel** buttons are enabled.

When you click the **CANCEL** button, the message "Scan is terminated" appears on both scanner and workstation.

14. If applicable, set your parameters and **Field Of View** (**FOV**) on your scouts.

Note **FOV** can only be adjusted when two scouts are acquired.

Figure 252: Scouts and FOV button

Scan coverage can be modified by selecting the drag boxes and adjusting the lines and can be centered by clicking on the small green circle and dragging the plan box.

15. Click **Continue** to proceed with your planned scan.

Figure 253: Continue button

The **Pending Scanning Movement** popup appears.

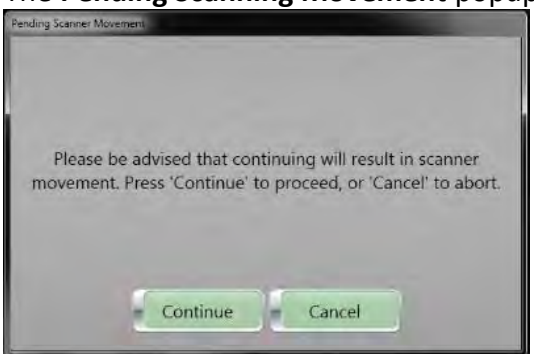


Figure 254: Pending Scanner Movement popup message

16. Click the **Continue** button to scan.
    Click the **Cancel** button to cancel the scan.

17. The **System Ready to Scan** popup appears.

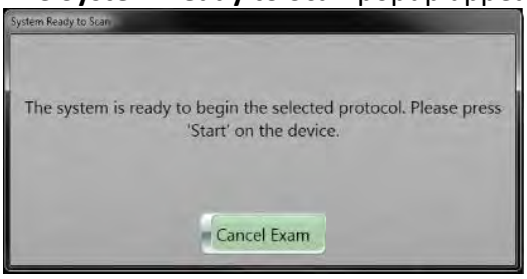


Figure 255: System Ready to Scan popup message – System is ready to begin scan

18. The **START** button on the scanner control panel turns green when it is enabled.

Figure 256: Scanner control panel – START button

19. Press the **START** button on the scanner control panel to acquire your scan.
    The pre-set scan delay countdown begins. The green light turns off when the **START** button is pressed.

20. If the **Perform Reconstructions** popup appears, do one of the following:
    - Click the **Yes** button to perform post reconstructions now.
    - Click the **No** button to pause the reconstructions until a later time. When ready, click the Start Recons button.

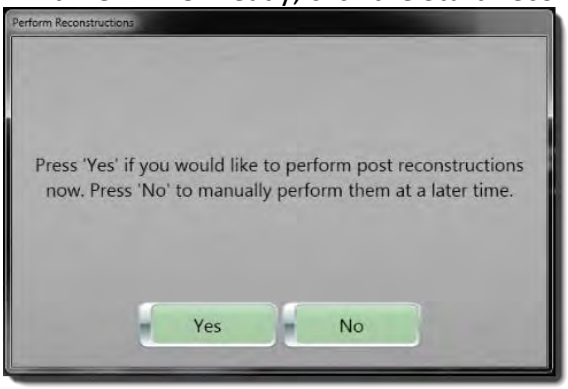


Figure 257: Perform Reconstructions popup message – To perform post reconstructions

21. Use the **Viewing** tools to review the scan.
    See "Examining the scanned image with tools" on page 291.

22. Click the **Finalize** button when finished.
    The dose report if **Show Dose Report** in **System Configuration** is enabled appears. In addition, the examination details are saved.

Note You must press the **Finalize** button before you can send the patient's data to **PACS**.

Figure 258: Dose report

Repeating an image

The **Repeat** function can be used to repeat a scan if necessary. The entire scan be repeated, or after reviewing the images, a new start position and coverage can be selected if only a portion of the scan needs to be repeated.

1. While the **Acquisition** tab remains active, click the **Repeat** button.
   The **Protocol Viewer** dialog box appears.

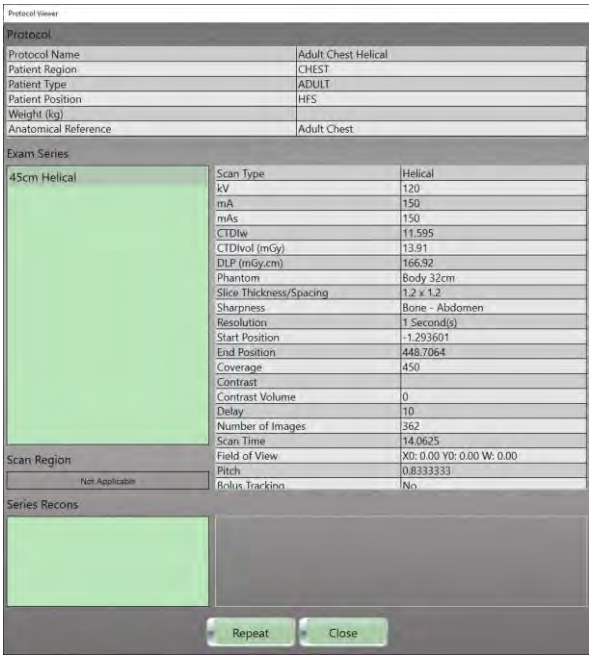


Figure 259: Protocol Viewer dialog box

2. Review the protocol parameters.

3. Click the **Repeat** button from the **Protocol Viewer** dialog box.

4. The **Repeat Protocol** popup appears.

Figure 260: Repeat Protocol popup

Note You can change the start and end position or use what appears.

5. Click the **Repeat** button on the **Repeat Protocol** popup.
   Scout lines appear in blue, which indicates the second scan and modifications of the start and end points – if made.
   The scanner will move to the start position.

6. Press the **START** button on the scanner's control panel to begin the repeat scan.

Scanning with special features

The following features are available for use in protocols.

Using the step-and-shoot option

The **Step & Shoot** option in the protocol lets the user control the start of the scan acquisition. This is helpful in the case of an uncooperative or ill patient where motion is an issue.

1. If necessary, change the **Scan Type** to **Axial**.
2. Click the **Step & Shoot** option in the **Edit Series** dialog box.

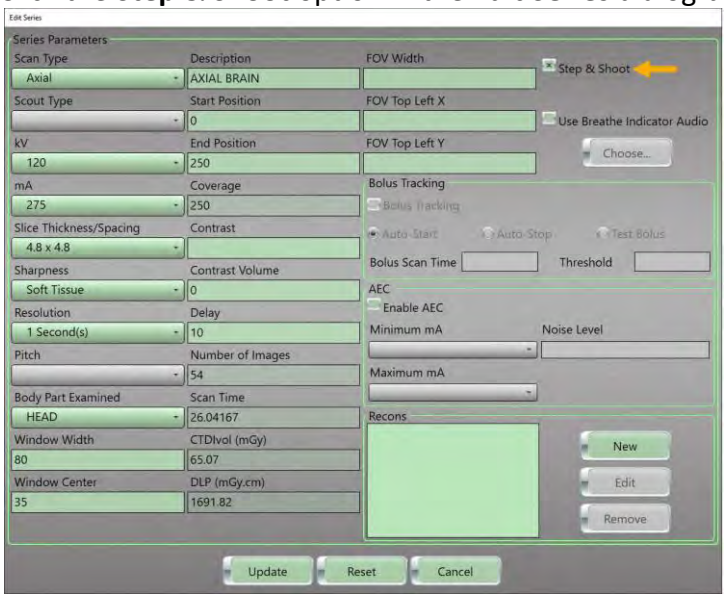


Figure 261: Step & Shoot option in the Edit Series dialog box

3. Click the **Update** button in the **Edit Series** dialog box.
4. Click the **Update** button in the **Edit Protocol** dialog box.
5. Click the **Begin** button in the **Exam Planner** dialog box to begin the scan.
   The system state orb will change color from yellow to green. The **System Ready to Scan** popup appears.

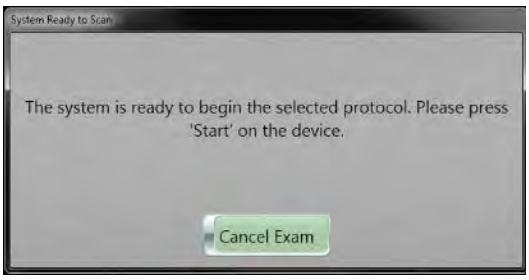


Figure 262: System Ready to Scan popup

6. To continue the scan, go to the scanner and press the **Scan** button on the screen.
   The first set of images are acquired at this position.
   The **Step & Shoot** popup appears for you to control the next acquisition.

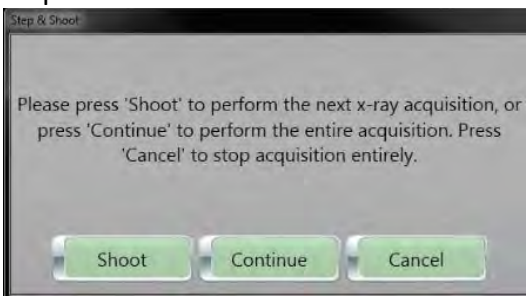


Figure 263: Step & Shoot popup

7. Click the **Shoot** button to start the scan.
   To cancel the scan, click the **Cancel** button.

8. Continue for the length of the scan.

9. Click the **Finalize** button when finished.

Performing a scan with Automatic Exposure Control

Note Depending on system's configuration, not all functions may be available to perform this procedure.

Computed Tomography (**CT**) is responsible for the largest contribution to the collective effective dose to patients in radiology. The challenge to radiologists and medical physicists is to establish adequate image quality with the lowest radiation exposure to the patient.

Tube current (mA) is one of the key technical scanning parameters for adjusting radiation dose in CT. To optimize radiation dose in CT, users can adjust mA either with manually selected values or with the application of Automatic Exposure Control (AEC). **AEC** refers to the automatic adaption of mA based on user specified image quality and attenuation characteristics of the scanned body region.

Scout scans provide a graph of mA values based on object density and desired noise level. Axial or Helical scans in the protocol can utilize AEC, limiting the mA value of each slice to the minimum necessary to achieve the desired image quality. This ability to modulate the mA throughout the scan to achieve the desired noise level can reduce patient dose.

When using AEC, it is vitally important that the patient is well-centered in the gantry. AEC aims to deliver the specified image quality across a range of patient sizes. The use of AEC may change the planned $CTDI_{vol}$ and DLP values. It tends to increase $CTDI_{vol}$ for large patients and decrease it for small patients relative to a reference patient size.

Note: Ensure patient is accurately centered in the gantry.

Do not use AEC when any type of metal is going to be scanned.

Do ***not*** use **AEC** with a small **FOV**, that is, tiny neonatal patients.

An automatic adjustment of the tube's current cannot occur when the tube potential is changed.

AEC can only be used with the following Sharpness options:

- Helical Soft Tissue – Head
- Helical Soft Tissue – Abdomen
- Axial Soft Tissue
- Axial Pos. Fossa/Vessel
- Axial Sharp

1. Under **AEC,** click the **Enable AEC** option.

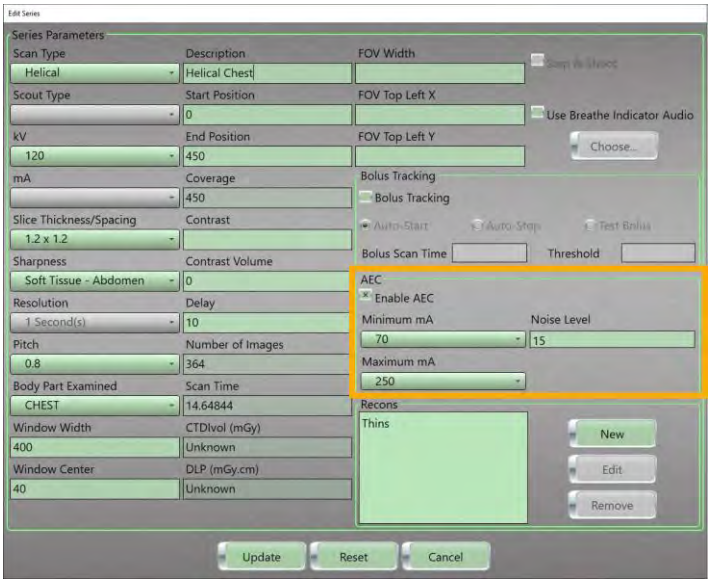


Figure 264: Edit Series dialog box with AEC options selected

2. Select the **Minimum mA** dropdown to set the minimum allowed mA value to be used for scanning.

3. Select the **Maximum mA** dropdown to set the maximum allowed mA value to be used for scanning. The available range is 30 to 300.

4. Select the **Noise Level** to set the standard deviation of noise value for the acquired images. The noise range is 1-200.

Note Consult with the site's physicist for guidance specific to the department.

5. Click the **Update** button in the **Edit Series** dialog box.

6. Click the **Update** button in the **Edit Protocol** dialog box.

7. Make sure your patient and scanner are properly positioned.

8. Click the **Begin** button to begin the scan.

9. Press the **START** button on the scanner control panel.

10. After the scouts are acquired and the scan region is set, click the **AEC** tab.

11. Click the **Toggle Graph** button to view the graph on the scout.

Figure 265: Toggle Graph button

The graphs will now appear on the scout(s). Review the mA modulation to ensure it meets your clinical needs.

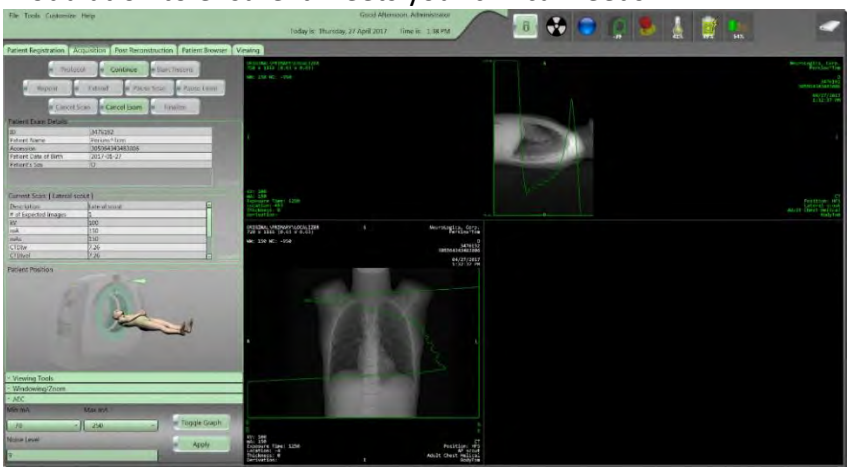


Figure 266: Graphs on the scout(s)

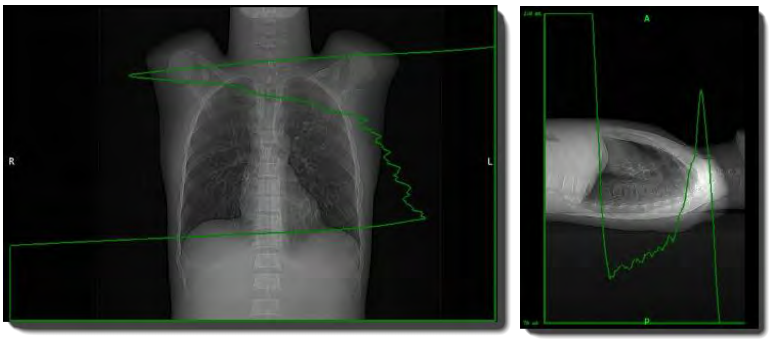


Figure 267: AEC modulation graph

12. To return to the scout parameter view, click the **Toggle Graph** button, again.

13. If changes to the mA or Noise levels are required, you can modify the Minimum, and Maximum mA and noise as needed on the image.

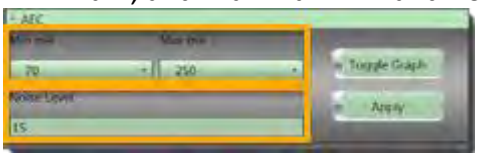


Figure 268: Minimum mA and maximum mA; noise level

14. When the desired level is achieved according to your department policy, click the **Continue** button to start the scan.

15. Press the **START** button from the scanner.

Note While reviewing the scan you will see mA modulation as per your graphs.

16. Click the **Finalize** button.

Performing a CT angiography scan with Bolus Tracking

CT angiography is a technique that uses contrast to visualize arterial and venous vessels throughout the body. This ranges from arteries serving the brain to those bringing blood to the lungs, kidneys, arms, and legs.

Table 51: Bolus tracking parameters and tools

Option	Description
Bolus Scan Time	The amount of time allowed to monitor the bolus.
Auto-Start	Begins the scan after the specified bolus scan time if no bolus is detected.
Auto-Stop	Stops the scan after the specified bolus scan time if no contrast is detected.
Test Bolus	A small amount of contrast is injected, and a timing graph is displayed after specified bolus scan time.
Threshold	Hounsfield Unit detection at the area being monitored – ROI.
Use Calculated	When performing the test bolus, click the **Use Calculated** option to use the bolus timing calculated from the test bolus scan.
Use Manual	Allows you to select a manual timing of bolus after the test bolus has calculated a timing.

1. Perform steps 1 through 8 in "Performing a scan" on page 255.

2. Click the **Bolus Tracking** option and set parameters, such as **Auto-Start**, **Auto-Stop**, **Bolus Scan Time**, and **Threshold**.

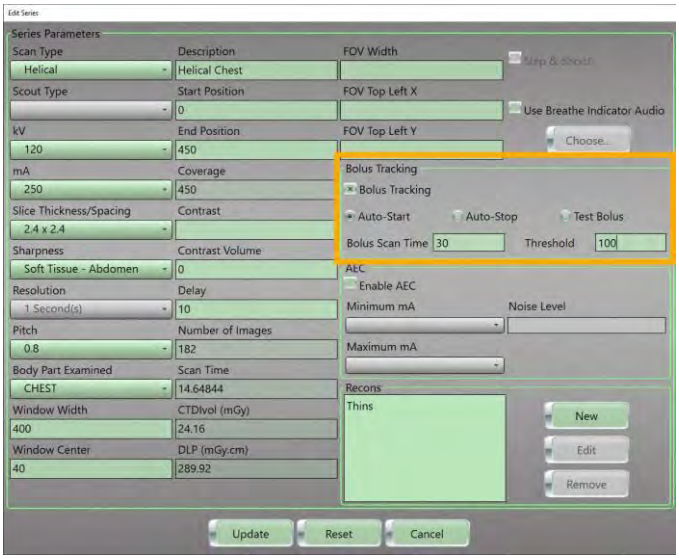


Figure 269: Bolus Tracking option

3. Click the **Update** button in the **Edit Series** dialog box.
4. Click the **Update** button in the **Edit Protocol** dialog box.
5. Click the **Begin** button to acquire the scout(s).
6. Acquire the scout(s).
7. To move the scout or reference line go to the **Viewing** tools and select **Active Scan Region**.

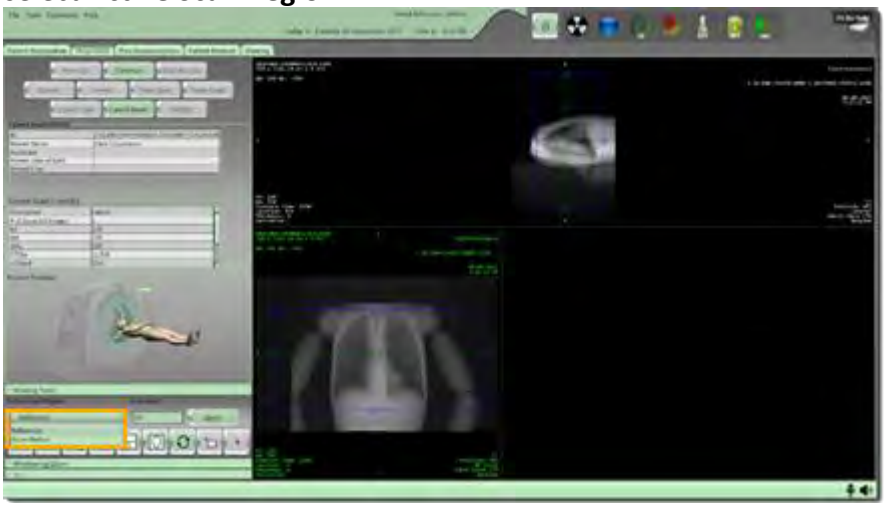


Figure 270: Active Scan Region – Bolus Reference or Helical CTA

Note If the protocol contains one or more scouts, the system places the scan region for each series on the scout based on start and end positions that were entered for each series in the protocol. The **Active Scan Region** dropdown populates the data with the ID that corresponds to each region. You can adjust the scan region prior to continuing the exam, as described below.

8. On the scout, use the Blue lines to plan the helical scan.

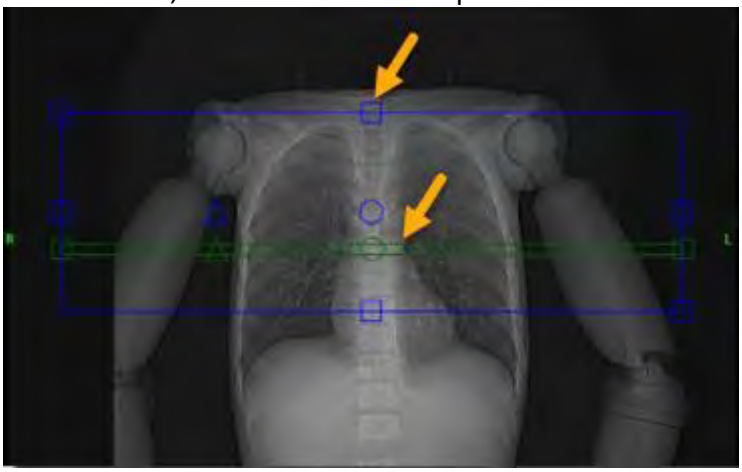


Figure 271: Scout line (blue) and Reference line (green)

Note The distance between the **Reference** and **Bolus Tracking** scans cannot exceed 100mm.

9. Position the green **Reference** line at the desired anatomical location.

10. Click the **Continue** button.
    The scanner will move to the reference line noted on the scout.

11. Go to the scanner and press the **START** button on the scanner control panel.

12. Click the **ROI** tool and draw the **ROI** on the **Reference** image.

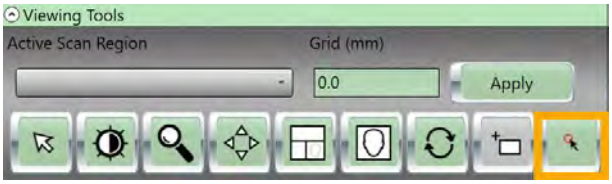


Figure 272: Bolus ROI tool

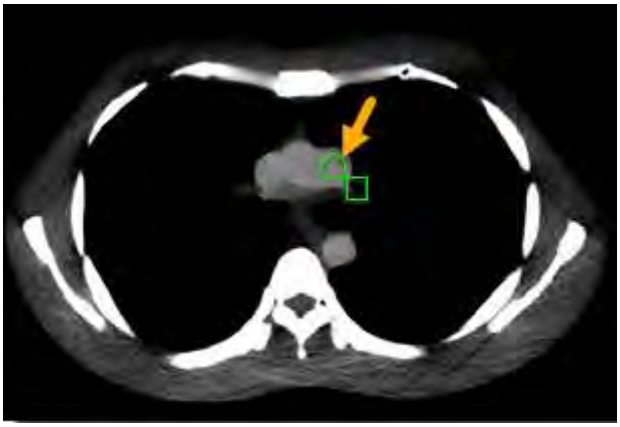


Figure 273: ROI on the Reference scan

13. Click **Continue**.

14. Load the injector and set your desired flow and rate and arm the injector.

15. When the scanner is ready, press **START** on the scanner and manually start the injector at the same time.

16. The Helical scan will trigger when the threshold value set for the ROI is exceeded.

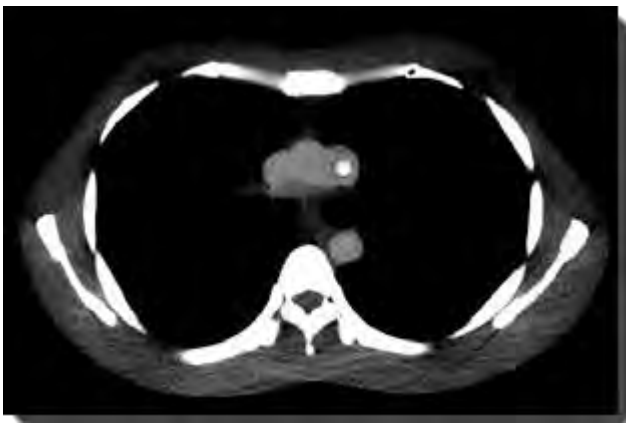


Figure 274: Scan triggers when bolus enters reference point/ROI

17. Review the completed scan.

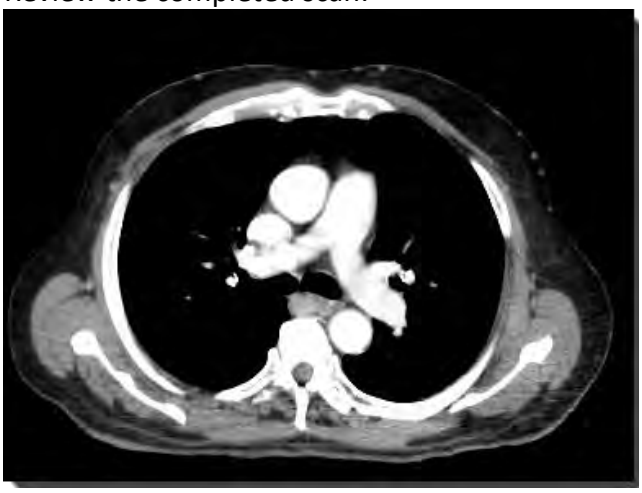


Figure 275: Scan at peak enhancement

18. Press the **Finalize** button when complete.

Performing Test Bolus

Test Bolus evaluates the timing of the injected contrast.
A small amount of contrast is injected, and a timing graph is displayed after the specified bolus scan time. When the contrast is detected, the system stops scanning and a report on the recommended delay-time for CTA protocols appear.

1. Perform steps 1 through 8 in "Performing a scan" on page 255.

2. Click the **Bolus Tracking** option, click the **Test Bolus** option and set parameters.

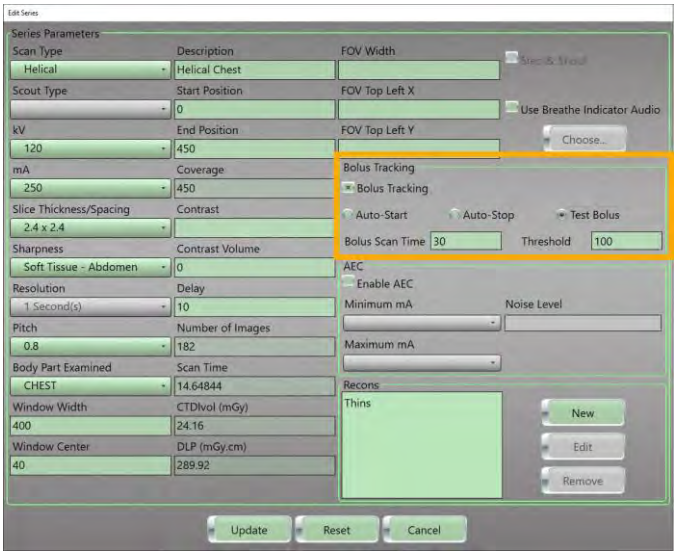


Figure 276: Test Bolus option

3. Click the **Update** button in the **Edit Series** dialog box.
4. Click the **Update** button in the **Edit Protocol** dialog box.
5. Click the **Begin** button to acquire the scout(s).
6. Acquire the scouts(s).
7. To move the scout or reference line go to the **Viewing** tools and select **Active Scan Region.**

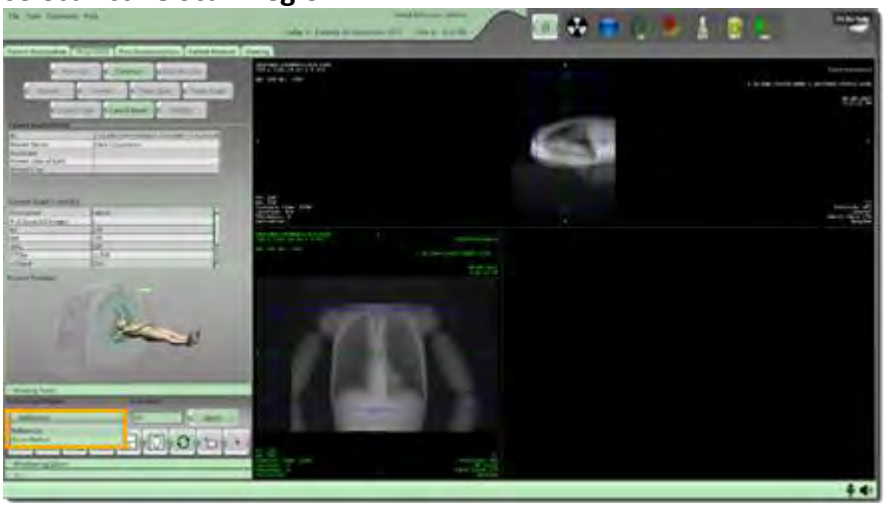


Figure 277: Active scan region

8. On the scout, use the blue lines to plan the helical scan.

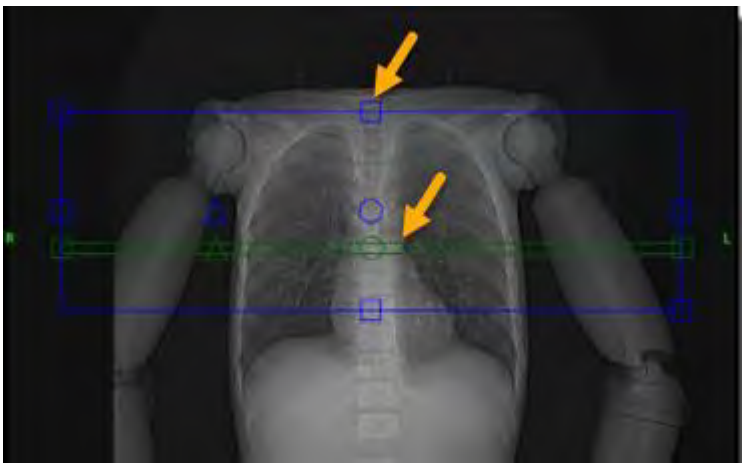


Figure 278: Scan planning lines

9. Position the green **Reference** line at the desired anatomical location.

10. Click the **Continue** button.
    The scanner will move to the reference line noted on the scout.

11. Go to the scanner and press the **START** button on the scanner control panel.
    The reference image will be scanned and displayed.

12. Click the **ROI** tool and draw the **ROI** on the **Reference** image.

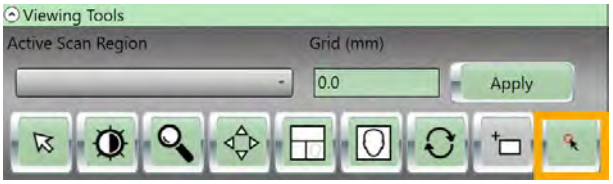


Figure 279: Bolus ROI

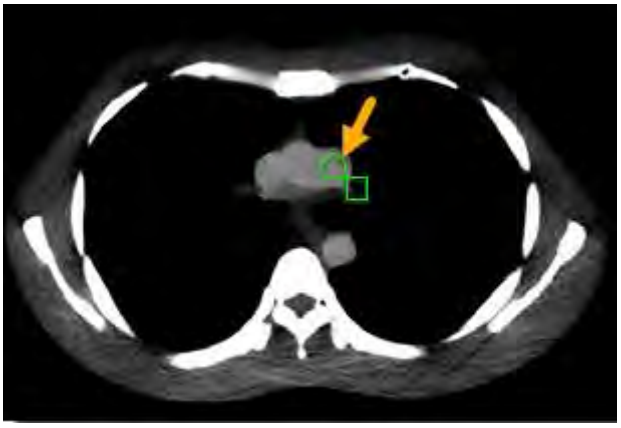


Figure 280: ROI on the Reference scan

13. Click **Continue** button.

14. Load the injector and set your desired flow and rate and arm the injector.

15. When the scanner is ready, press **START** on the scanner and manually start the injector simultaneously.

16. The **Bolus Timing graph** appears and shows the calculated, bolus-tracking time.

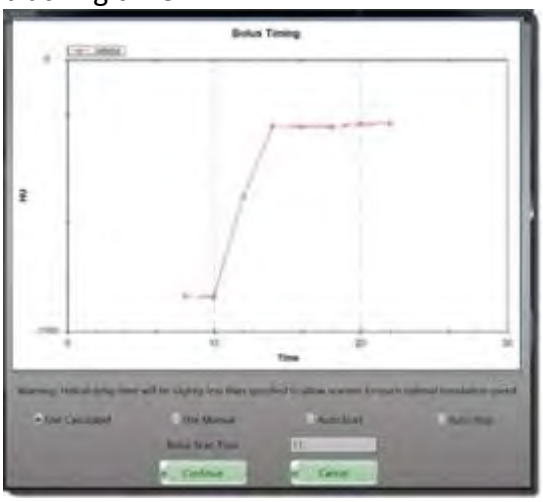


Figure 281: Bolus timing graph

17. Select from one of the following:

Use Calculated	Uses the bolus timing calculated from the **Test Bolus** scan.
Use Manual	Allows you to manually set the delay time prior to the start of the helical scan.
Auto Start	Begins the scan after the specified bolus scan time if no bolus is detected.
Auto Stop	Stops the scan after the specified bolus scan time if no contrast is detected.

18. Click the **Continue** button.
    Review completed scan.

19. Press the **Finalize** button when complete.

Performing a CT Perfusion Scan

CT perfusion (CTP) is a technique used to evaluate cerebral perfusion of the level of blood flow in the brain, by monitoring the initial phase of iodinated contrast media through the vasculature of the brain.

1. Perform steps 1 through 8 in "Performing a scan" on page 255.

2. After selecting CTP protocol, review the Dynamic CTP options including Scan Time and make your selections.

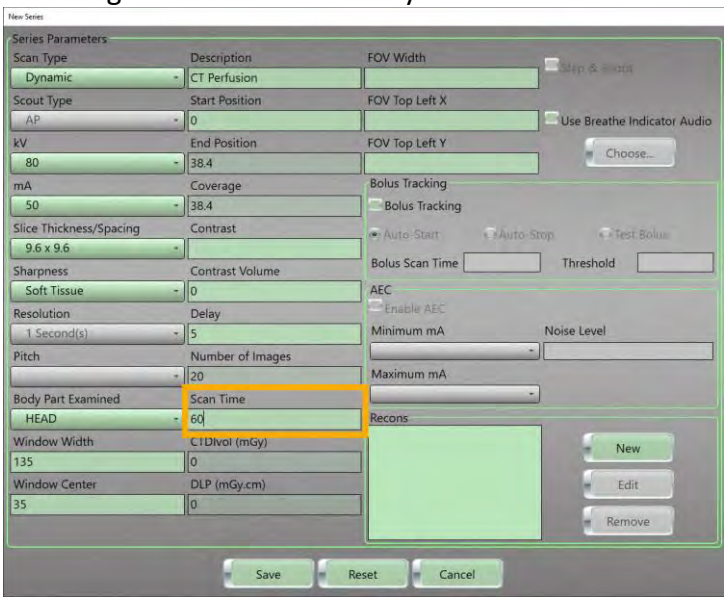


Figure 282: Edit Series CTP Scan Time

3. Click the **Update** button in the **Edit Series** dialog box.

4. Click the **Update** button in the **Edit Protocol** dialog box.

5. Click the **Begin** button to acquire the scout(s).

6. Perform scout and set Dynamic CTP scan location.

7. To move the Dynamic CTP location use the green circle inside the reference line.

8. Click the **Continue** button.
   The scanner will move to the reference line noted on the scout.

9. Load the injector and set your desired flow rate. When the scanner is ready, press **Start** on the scanner and manually start the injector at the same time.

10. Review completed scan.

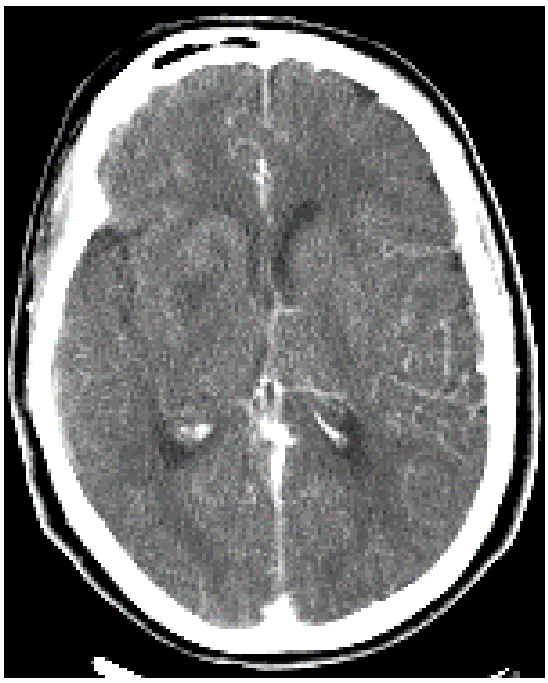


Figure 283: Brain Perfusion Image

11. Select **Finalize.**

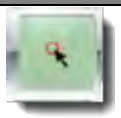
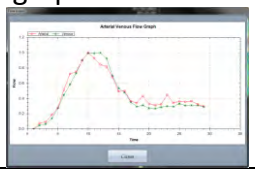
Calculating and creating perfusion maps

1. Select a perfusion patient from **Patient Browser** and select the series to view.

2. To open the image, click the **View Images** button or double-click the series.
   The **Viewing** tab is enabled, and the **CTP** tab automatically opens.

Figure 284: CTP tools

Table 52: CTP Tools

CTP Viewer tools		
	**Perfusion Artery/Vein Selection**	Select to place the arterial and venous ROIs on the images.
	**Calculate CBF, CBV, MTT Map**	Select to calculate the CT Perfusion maps.
	**Clear Perfusion Map**	Cancels the calculations and returns to **Calculation** mode.
	**Show Artery/Vein Flow Graph**	Displays the Arterial Venous Flow graph. 
	**Peak Image**	Displays the image that has the highest HU value based on the arterial ROI placement.

3. Click the **Perfusion Artery/Vein Selection** tool.
4. Place an **Arterial ROI.**
5. Place a **Venous ROI.**
6. Click the **Calculate CBF, CBV, MTT Map** tool.
7. The Perfusion Maps are calculated and displayed:

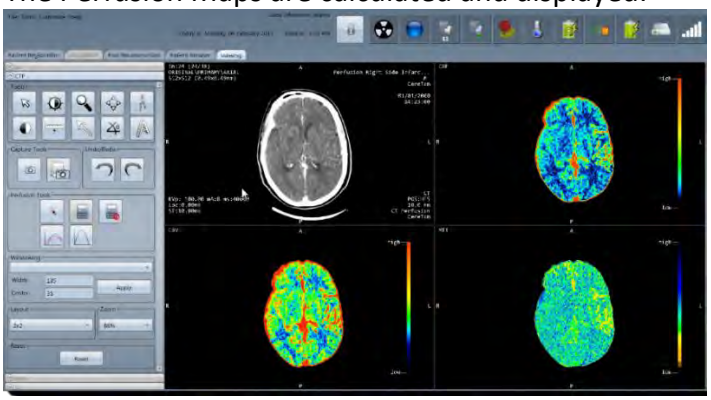


Figure 285: Perfusion maps

The calculations produce three maps and the perfusion image:

Perfusion Images	Top, left corner
Cerebral Blood Flow (CBF)	Top, right corner
Cerebral Blood Volume (CBV)	Bottom, left corner
Mean Transit Time (MTT)	Bottom, right corner

8. Clicking the **Artery/Vein Flow Graph** displays the following:

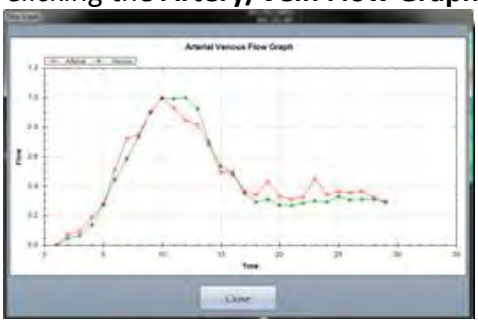


Figure 286: Arterial Venous Flow

This graph displays arterial and venous flow rates with respect to time.

9. Click the **Peak Image** tool to display the **peak image.**
   The peak image displays the image that has the highest HU value based on the arterial ROI placement.

10. Click the **Clear Perfusion Maps** tool to cancel calculations and return to **Calculation** mode.

11. Click the **Reset** button to reset images back to the original setting(s). You cannot undo this action.

Using the Interventional Package

The Interventional Package is designed to make Interventional procedures quick and easy for the technologist and physician. When activated the gantry will spin continuously to make the transition to a scan as fast as possible.

When enabled, the **Interventional Tab** will be displayed as seen below.

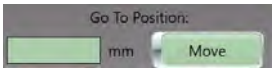
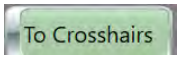
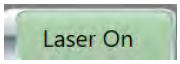
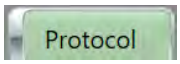
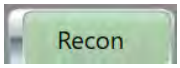
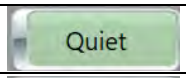
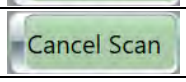
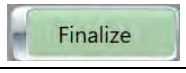
Figure 287: Interventional Tab

When activated, the **Interventional Tab** provides a streamlined workflow specifically for interventional cases.

Figure 288: Interventional Tab - Patient exam details

The Interventional Tab includes the following options:

Table 53: Interventional Tab options

Option	Description
	Allows a typed in value, when Move is clicked the scanner goes to that location
	Moves the scanner to the Laser location
	Toggles the laser lights on or off
	Allows protocol parameters for the Interventional procedure to be modified
	Initiates X-Ray when the user is ready
	Repeats the last scanned protocol
	Allows a selected raw data set to be Post Reconstructed without leaving the Interventional workflow
	Stops the gantry rotation
	Cancels the currently planned scan
	Ends the current examination
	Allows you to archive the series selected in the Scan Tree to any archive device
	Performs a 38.4mm axial scan at the current scanner location
	Moves the scanner to the last scanned position and performs a 38.4mm axial scan

	Exits the system from the Instant Repeat Feature

The tab also includes a **Scan Tree, Current Scan,** and an updated **Dose Gauge.**

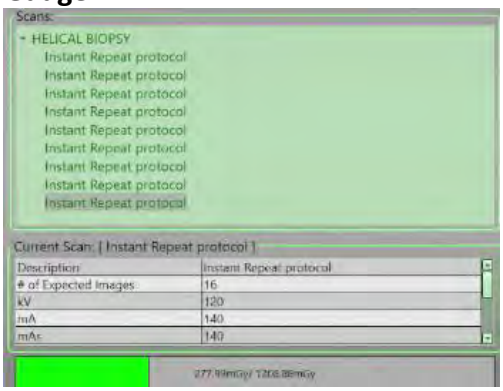


Figure 289: Scan Tree, Current Scan, and Updated Dose Gauge

The **Scan Tree** allows access to acquired scans for quick image loading or repeat scanning using those parameters.

- When a series in the **Scan Tree** is selected, the images associated with it will be displayed, allowing them to be reviewed to ensure the proper start and end locations as well as the thickness and spacing are selected for repeat scans.
- Clicking any of the scans in the **Scan Tree**, then clicking 'Repeat', moves the scanner to the Start location from the selected series and automatically initiates scanning.

The **Current Scan** box shows the protocol parameters used for the most recent active scan.

The **Dose Gauge** displays the accumulated CTDI and DLP in mGy for the current procedure and is updated each time a new scan is initiated.

Viewing Tools, Windowing, and Zoom options are available by clicking the appropriate line below the Dose Gauge.

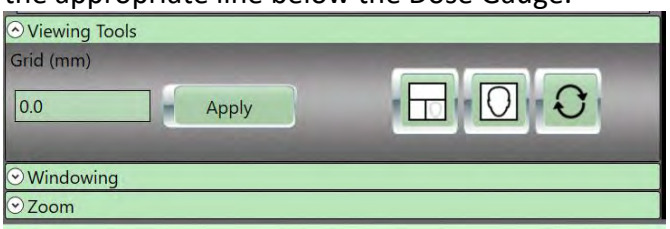


Figure 290: Viewing Tools, Windowing, and Zoom options

A right click menu on the active image, also allows access to a full array of viewing and measuring tools.

Figure 291: Interventional Workflow

Interventional Workflow

Any protocol can be used as an Interventional protocol.

1. Register a patient
2. Click **'Protocol'**
3. Select the desired protocol
4. Ensure the **'Interventional Scan'** box is selected.

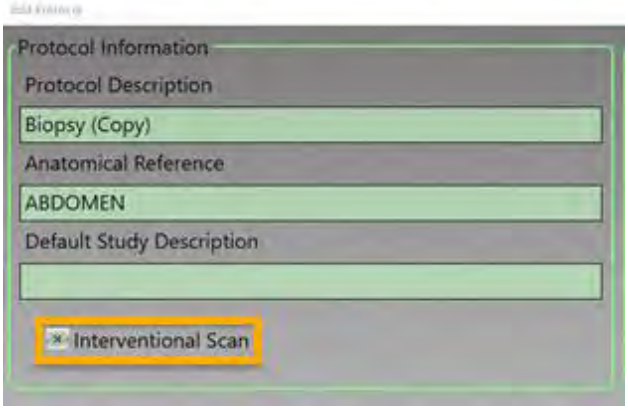


Figure 292: Interventional Workflow - Protocol Information dialogue box

5. Click **'Begin'** to accept the protocol and perform the scout scan(s).
6. Plan your scan over the region of the procedure and acquire that scan.

Note NeuroLogica suggests the use of a Grid positioned on the patient in the area of the procedure to be performed.

7. Once the scan has been acquired the system will automatically move to the Interventional tab and show the following:

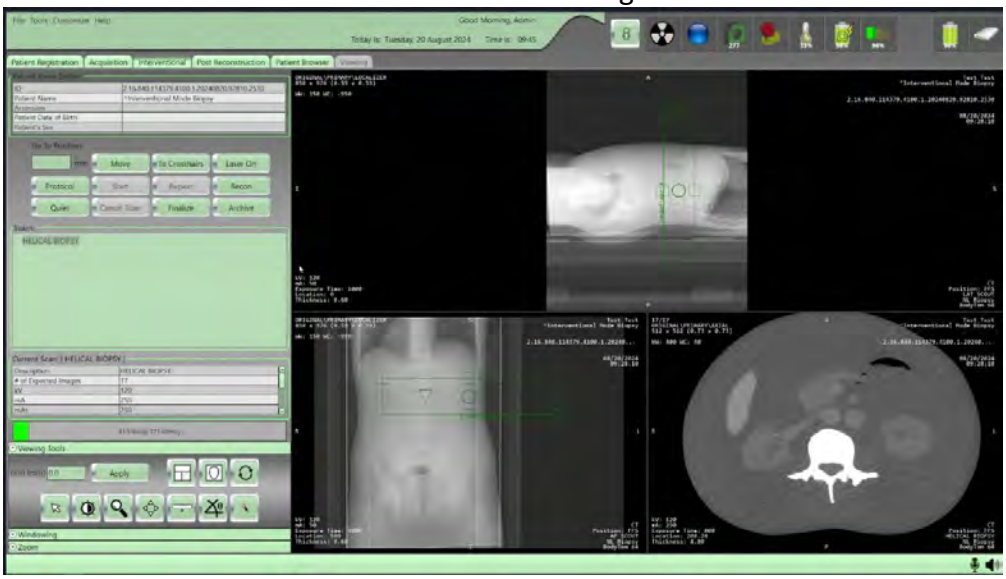


Figure 293: Interventional Workflow - Scan acquired

8. Review the acquired images from the previous scan to determine the location of the procedure to be performed.

Note To make viewing of the axial images easier, you can select the **'Toggle Scouts'** button, which will display only the axial image on screen.

Figure 294: Toggle Scouts Button

9. Enter the procedure location in the **'Go To Position'** box, and click **'Move'**.
   - This will move the scanner to the selected location and allow the physician to mark the patient. Make a note of this location as you will use it to center the scanner over this area for future scans.
   - You can use the **'Laser On/Off**' toggle button to enable the laser light if it is not already on to allow the physician to mark the patient.

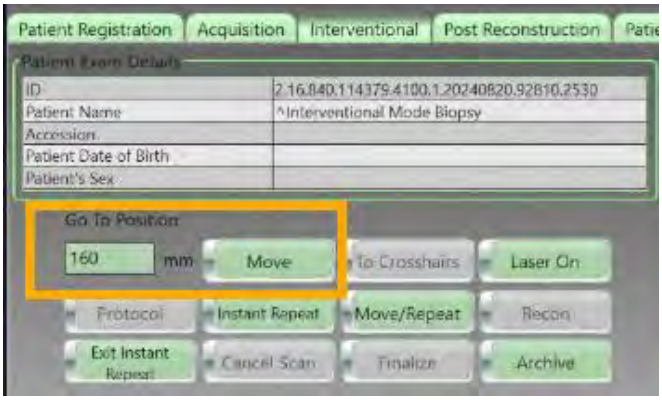


Figure 295: Go To Position

10. After the physician has marked the procedure location on the patient, enter a value in the **'Go To Position'** box and click **'Move'** to move the scanner out of the procedure field and allow the physician to prep the skin and administer local anesthetic. In the example below we are using a scanner location of 500.

Figure 296: Go To Position for Patient Prep

11. When the physician has completed prepping the patient and is ready to image the procedure area, enter the location noted in Step 9 above into the **'Go To Position'** box and click **'Move'**.

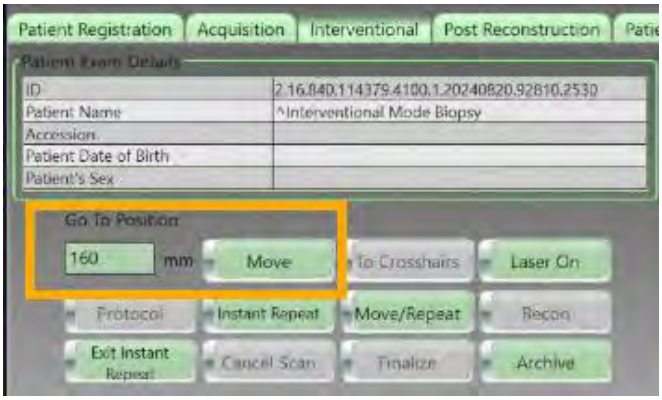


Figure 297: Move to procedure location

12. Wait for scanner to stop at the correct location, then Click **'Protocol'**

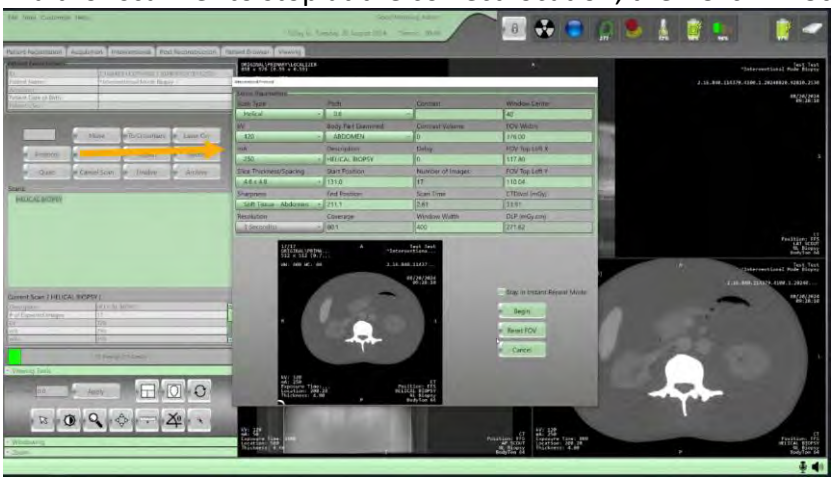


Figure 298: Interventional Protocol Parameters

13. Place a check in the **'Stay in Instant Repeat Mode'**
    - This will automatically modify the protocol to an Axial scan with a set 38.4mm coverage.
    - You can modify any of the available parameters, like kV, mA, Sharpness etc., on screen to meet your needs.

Figure 299: Stay in Instant Repeat Mode

14. Once parameters are selected click **'Begin'**

15. Click the **'Instant Repeat'** button to initiate the scan set in the protocol.

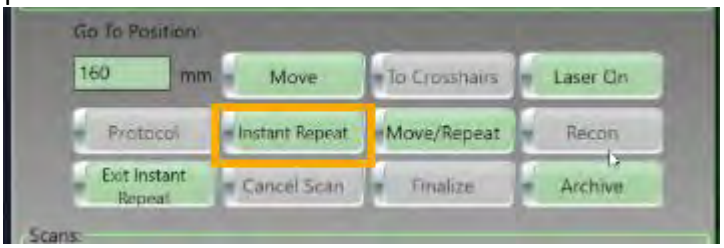


Figure 300: Initiate Scans - Interventional protocol

16. When satisfied the anatomy of interest is included in the images, you can enter a location in the '**Go To Position'** box and click **'Move'.**
    - This moves the scanner out of the way to allow the physician access to the patient.

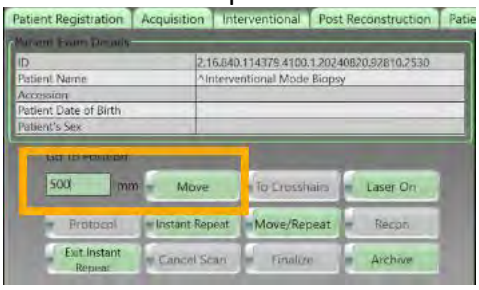


Figure 301: Move the Scanner

17. When ready to perform another scan in the original position, click **'Move/Repeat'**
    - The scanner will move back to the previously defined start location and perform additional scans as defined in the protocol.

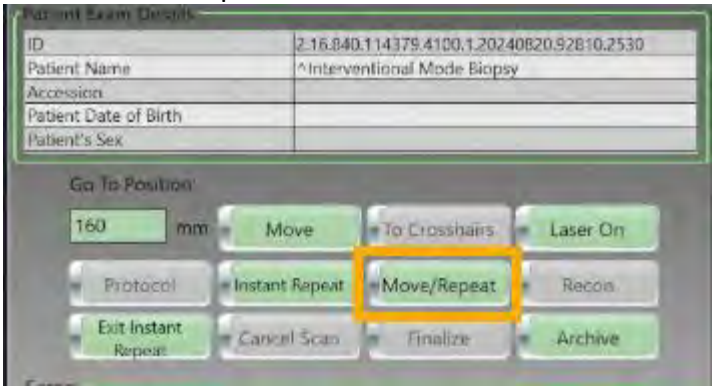


Figure 302: Repeat Scans - Interventional protocol

18. You can now use the '**Move**' and **'Move/Repeat'** options to move the scanner back and forth to allow the physician access to the patient and perform repeat imaging to confirm needle position in the patient.

Note If the physician needs to modify the needle location, you can move the scanner to that new location and click the **'Instant Repeat'** button. This will acquire one axial rotation of 38.4mm using the parameters previously set in the protocol at this new location. This will also be saved as the new **'Move/Repeat'** location.

19. If changes to the protocol are necessary, click **'Exit Instant Repeat'.**

20. Click **'Protocol'**

21. Modify the parameters to the desired values, ensure the **'Stay in Instant Repeat Mode'** is selected and click **'Begin'.**

22. You must then click **'Instant Repeat'** to initiate the new scan.

23. When the procedure is completed, click the **'Exit Instant Repeat'**

Figure 303: Exit Instant Repeat

24. Click **'Finalize'**

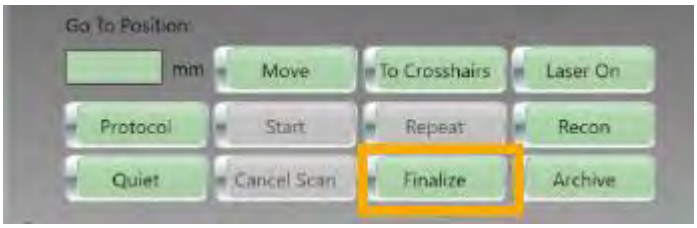


Figure 304: Finalize

Note If the scanner has been idle in the **'Instant Repeat'** mode for five minutes a message will be presented on the screen stating that **'Instant Repeat'** will be disabled in two minutes. Clicking the **'OK'** button will prevent the system from disabling **'Instant Repeat'** for an additional five minutes, at which time the message would be presented again.

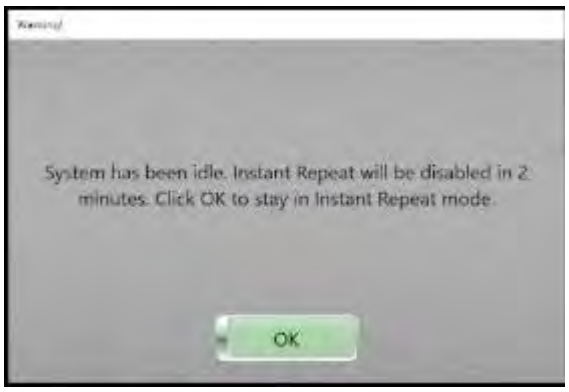


Figure 305: Instant Repeat will be disabled

Examining the scanned image with tools

The image tools can only be used when the **Acquisition** tab is enabled and an image is displayed, or when images are loaded to the viewer from the Patient Browser tab.

From the **Acquisition tab**, you can zoom, pan, modify window width, and center, and change layout; see the table below to understand the basics of what each tool looks like and how it performs.

Using tools on the Acquisition tab

The following table describes some of the tools available to you when the **Acquisition** tab is active. For a comprehensive list, see Table 57: 2D, MPR, 3D, and CTP image tools.

Table 54: Image tools

Image tool	Tool name	Action
	**Clear Tool**	Resets the tool to the default pointer.
	**Window Width/Center**	Adjusts window width and center of image.
	**Zoom**	Magnifies the image.
	**Pan**	Adjusts image on X or Y axis

Image tool	Tool name	Action
	**Toggle Scouts**	Display's or removes scouts from Acquisition.
	**Toggle Layout**	Changes the layout to 2x2. Repeat process to return to 1x1.
	**Scan Region Re-Draw**	If scout lines and the scan region is deactivated, allows you to reactivate.

Chapter 10 Patient Browser

The **Patient Browser** lets you view patient information and images associated with the patient information after the patient's scan.

Figure 306: Active Patient Browser tab

The following table identifies the buttons found on the **Patient Browser**.

Table 55: Command buttons

Button	Action
Archive	Selects the archive destination for selected information.
Import	Imports exam information from **PACS** or **Media**.
Delete	Deletes the selected exam information from the **Patient Browser** tab.
Register	Reregisters a patient who is already in the system.
Build Dose	Generates a Dose Report and Dose SR for the selected patient.
Show Info	Shows patient, study, series, and image information.
View Images	Displays selected patient images in **Viewing.**
Compare	Allows you to compare two series.

Navigating the Patient Browser

The **Patient Browser** lets you perform tasks on existing series, for example archiving and previewing the series. This section will introduce you to **Patient Browser** and identify the symbols, areas, and buttons you can use.

The **Patient Browser** can be broken down into the following sections:

- Exam table

- Series table
- Selected protocol table
- Patient Browser's active buttons
- Preview window

Figure 307: Patient Browser sections

Identifying symbols on Patient Browser

Symbols may appear next to series in the exam and/or series tables. These symbols are more vivid when active; they are identified below as active symbols.

Locked 	Indicates the series is locked and cannot be deleted.
Read/Mark 	Indicates the series is marked to be read or read by the physician.
PACS 	Indicates the series has been sent to **PACS.**
Stored 	Indicates the series has been sent to **PACS**; the archived series appear below the initial table
Media 	Indicates the series has been sent to a media device, for example USB.

Figure 308: Patient Browser locked, read, PACS and Stored (archived), and media symbols

Using the vertical and horizontal scroll bars on Patient Browser

Navigation scroll bars let you move the lists in the Patient Browser sections up, down, and horizontally to view all available exam information.

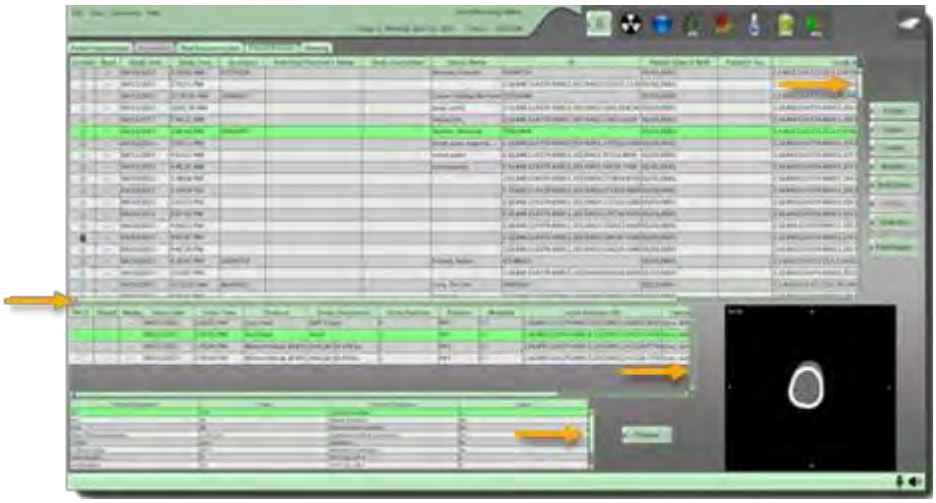


Figure 309: Patient Browser horizontal and vertical scroll bars

Locking a study

1. Click the **Patient Browser** tab.
2. Select the study to lock.

3. Right-click the mouse button.

4. Click **Lock** on the floating menu.

Figure 310: Floating menu - Lock

The **Lock** symbol appears for any selected series.

Figure 311: A locked series

A series cannot be deleted while in the **Lock** mode.

5. To unlock right-click and click **Unlock**.

Note All **QA** series are locked to prevent deletion. The **QA** series can only be unlocked by your field service representative.

Marking a series to read

1. Click the **Patient Browser** tab.

2. Select the study to mark.

3. Right-click the mouse button.

4. Click **Mark** on the floating menu.

Figure 312: Floating menu - Mark

The **Mark** symbol appears for any selected series.

5. To unmark any series, right-click **Unmark**.

Using the preview window

1. Click a patient in the exam table.
2. Click a series in the series table.
3. Click the **Preview** button to the right of the **Series Protocol Table.**

Figure 313: Preview Button

4. The selected series will appear in the **Preview** window.

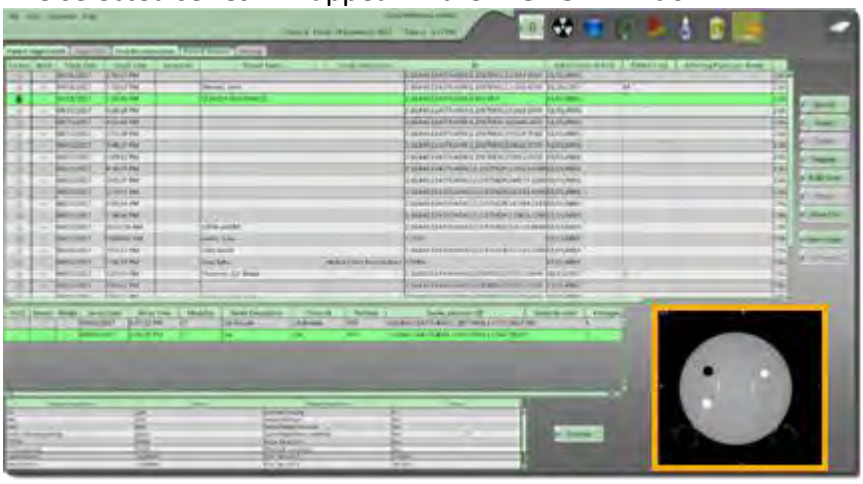


Figure 314: The series appears in the preview window

Archiving patient series

You can archive patients and studies (or series) to **PACS**, media (USB or CD), or surgical navigation devices.

Archiving to PACS

1. Click the **Patient Browser** tab.

2. Select the patient study for **PACS** in the following way:
   - To select one patient and all associated series, click the patient, and click the **Archive** button.
   - To select specific series for a patient, press and hold the **Ctrl** key, then click each individual series from the **Series** table, and click the **Archive** button.

   The **Archive Destination** popup appears.

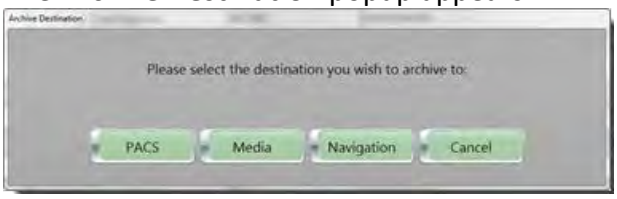


Figure 315: Archive Destination popup

3. Click the **PACS** button.
   The **Archive to Server** popup appears.

4. Click the **Select Archive Location** dropdown and select a site.

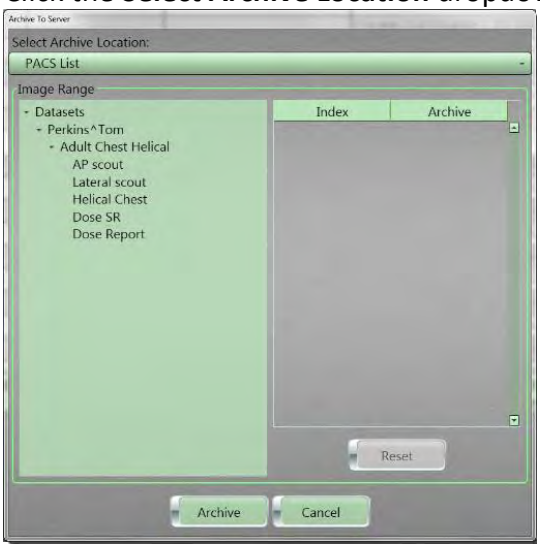


Figure 316: Archive To Server popup

5. Review the **Image Range** items to make sure all those items you selected in step 2 are captured.

6. Click the **Archive** button to begin the archive process.

   If enabled the **Store/Print Queue** dialog box will appear to show the status of your image transfer. You can also activate the **Store/Print Queue** dialog box by clicking **Tools > Store/Print Queue** from the main menu.

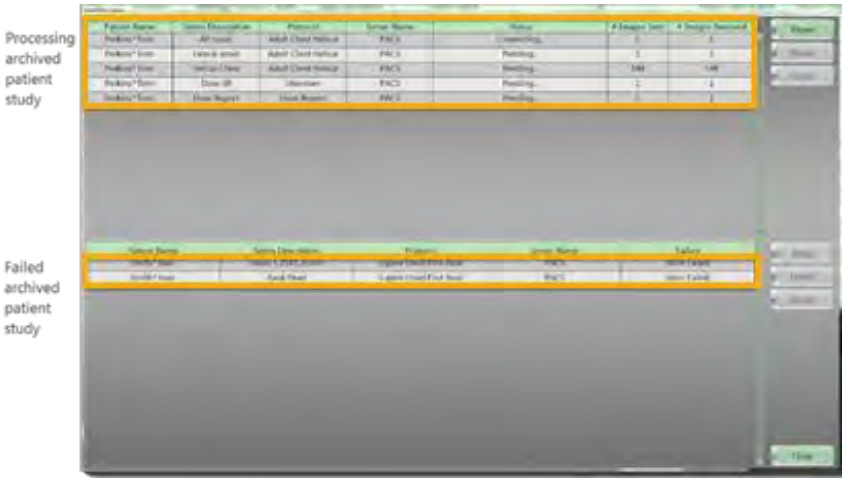
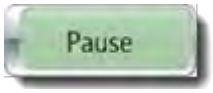


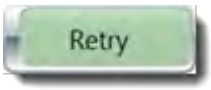
Figure 317: Store/Print Queue dialog box

7. Watch the status of each series:
   - **Pending** informs you that the series is paused because you clicked the **Pause** button.
   - **Connecting** informs you that the series is in process of archiving to its targeted location.
   - Each series will move from the top portion of the popup to the bottom portion of the **Store/Print Queue** popup when it has been processed.

8. While the archiving is in process, you can perform one of the following from the buttons in the **Store Print Queue** dialog box.

Table 56: Store and Print Queue buttons

Store and Print Queue button	Action
	When you select one or more series, temporarily stops the series from being stored. This is a toggle button with the **Resume** button.
	When you select one or more series, deletes either a series to be stored, or a series that failed to store.

Store and Print Queue button	Action
	Stops the archive to USB or a drive.
	When you select one of more series, tries to archive the selections.
	When you select one of more series, displays an explanation of why a series failed to store.
	Closes the **Store/Print Queue** popup.

9. If the series is not successfully stored to its targeted destination, the "Store Failed" message appears in the **Failure** column. This means the series was not successfully archived.

10. If there are failed archived series; click the **Retry** button to attempt to archive the series you selected.

Note Any **Storing Failure** status appears in the bottom of the popup to inform you why the failure occurred. If an archive job fails, it will be sent to the **Failed Store/Print Jobs** list.

11. When the archiving is complete, click the **Close** button to exit the **Store/Print Queue**.

    You can also click the **Close** button, and the archiving process will continue as you do other tasks.

Archiving to Media

1. Click the **Patient Browser** tab.

2. Select the patient study to archive following way:
   - To select one patient and all associated series, click the patient and click the **Archive** button.
   - To select specific series for a patient, press and hold the **Ctrl** key, then click each individual series from the **Series** table, and click the **Archive** button.

     The **Archive Destination** popup appears.

Figure 318: Archive Destination popup

3. If you are archiving a USB device, insert the USB drive into the USB port.

4. Click the **Media** button.
   The **Archive to Media** popup appears.

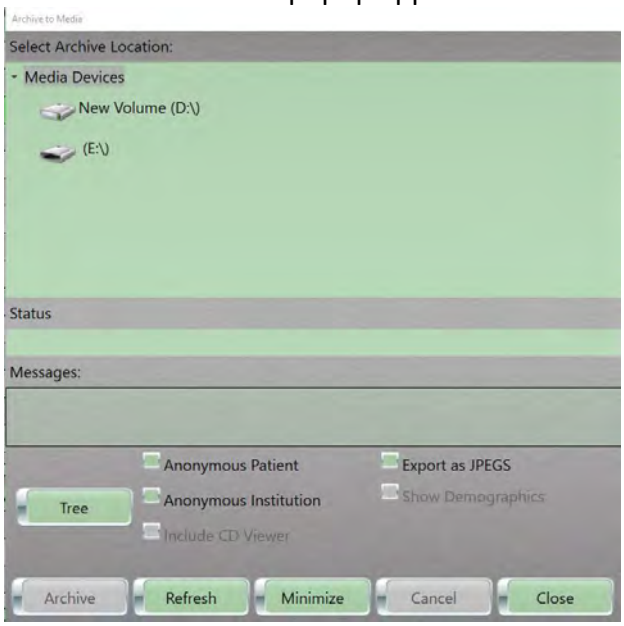


Figure 319: Archive to Media popup

5. Click the targeted drive and path destination.

6. The **Archive** button is active.

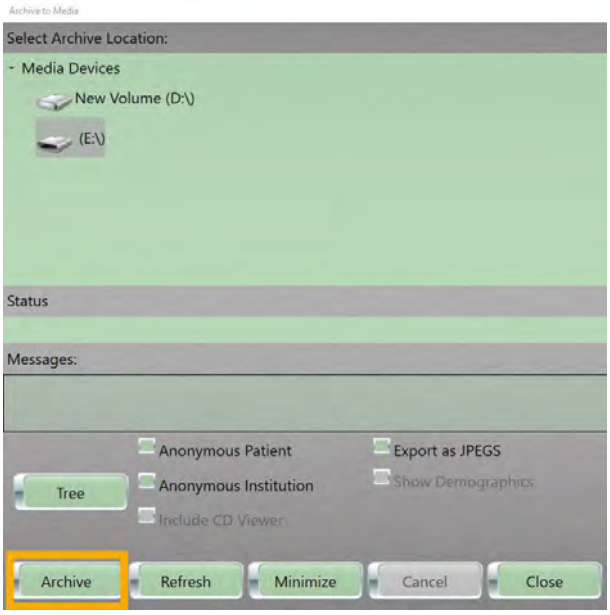


Figure 320: Archive Button active

7. Click the appropriate check boxes for your archive process:

Anonymous Patient	Makes the patient's information anonymous for HIPAA standards.
Anonymous Institution	Makes institutional information anonymous for HIPAA standards.
Include CD Viewer (requires CD viewer software installed)	Includes a CD viewer application to view images from the media.
Export as JPEGS	Exports image files in .JPG format.
Show Demographics	Includes the demographic information in archive if you clicked the Export as JPEGS check box.

8. Click the **Archive** button to begin the archive process.
   - The **Cancel** button is active after clicking the Archive button; click the **Cancel** button to stop the archive.

9. The **Archive to Media** dialog will update the status when archiving is complete.

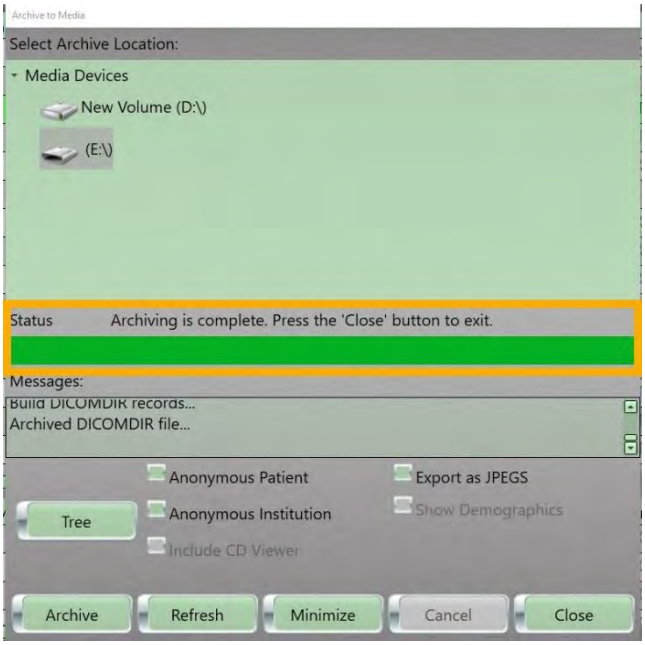


Figure 321: Archiving complete

- Click the **Refresh** button to remove any messages that appear in the **Message** box.
- Click the **Minimize** button to continue working in other areas while the archiving process runs.
  - A disk appears at the bottom; click it to maximize the **Archive to Media** popup.
- Click the **Close** button to exit the **Archive to Media** popup after the archive process is complete.

Archiving to Navigation

1. Click the **Patient Browser** tab.
2. Select the patient study or series.
3. Click the **Archive** button.
4. Click the **Navigation** button.
5. Click the **Select Archive Location** dropdown and select the location.

Figure 322: Archive to Server popup

6. Under **Image Range**, select the image(s) you want to send to navigation.
   To return to the default selections, click the **Reset** button.

7. Perform one of the following:
   - Click the **Archive** button to send the image to **Navigation**.
   - Click the **Cancel** button to return to **Patient Browser**.

Import

Import allows you to add patient images to the Patient Browser.

Importing from PACS

1. Click the **Patient Browser** tab.

2. Click the **Import** button to import data.
   The **Import Location** popup appears.

Figure 323: Import Location popup

3. Click the **PACS** button.
   The **Import from PACS** dialog box appears.

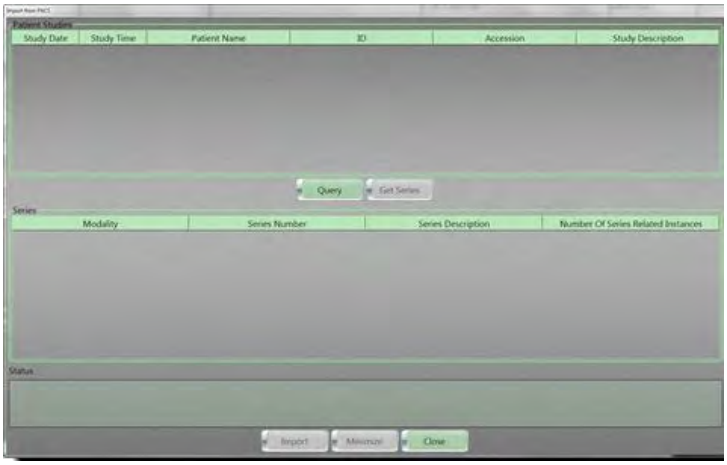


Figure 324: Import from PACS dialog box

4. Click the **Query** button.
   The **Query Information** dialog box appears.

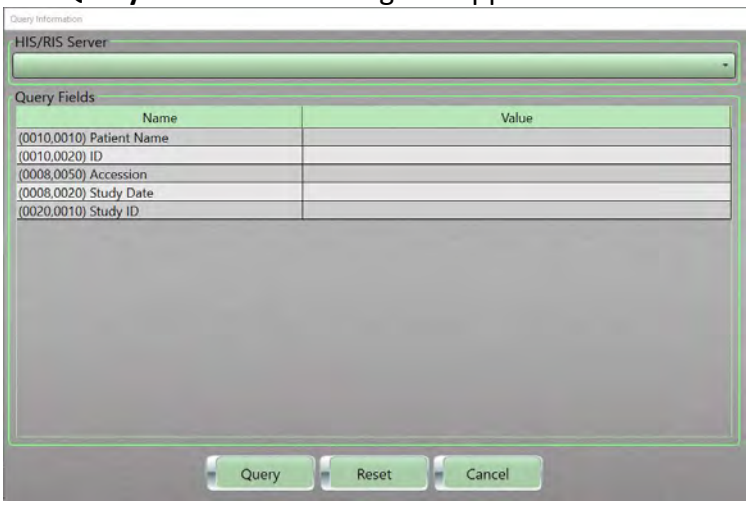


Figure 325: PACS Query Information dialog box

5. Perform the following:
   - Select a **HIS/RIS** server from the dropdown.
   - Set the values to search in your query.
   - Click one of the following buttons:
     - Click **Query** to save the search results.
     - Click **Reset** to clear the query information.
     - Click **Cancel** to exit the **Query Information** popup.

6. From the **Queried** results, select a patient and click the **Get Series** button.

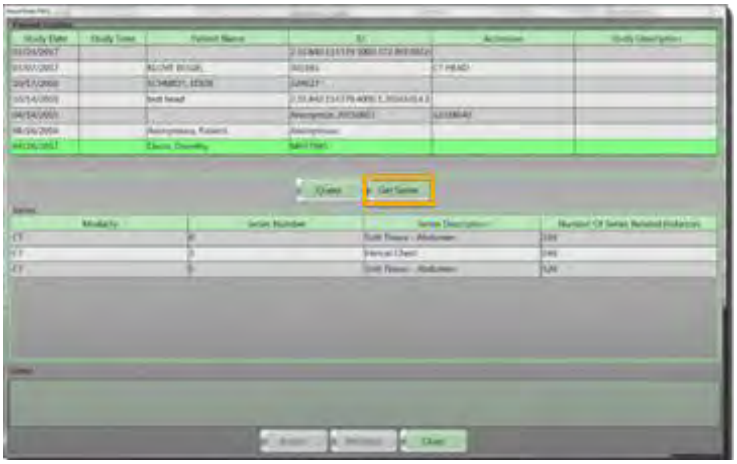


Figure 326: Import PACS dialog box with active Get Series button

7. Click the **Import** button.

8. Click the **Close** button to exit the **Import from PACS** dialog box.

Importing from media

1. Click the **Patient Browser** tab.

2. Click the **Import** button on **Patient Browser**.
   The **Import Location** popup appears.

Figure 327: Import Location popup

3. Click the **Media** button.
   The **Import from Media** popup appears.

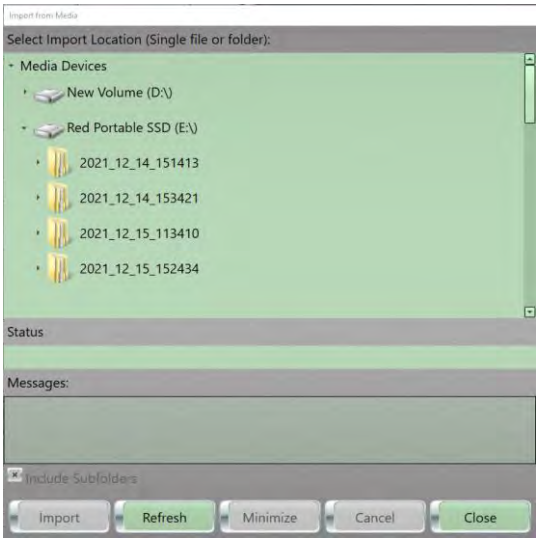


Figure 328: Import from Media popup

4. Click the drive and path where images were previously stored.
   The **Import** button is active.

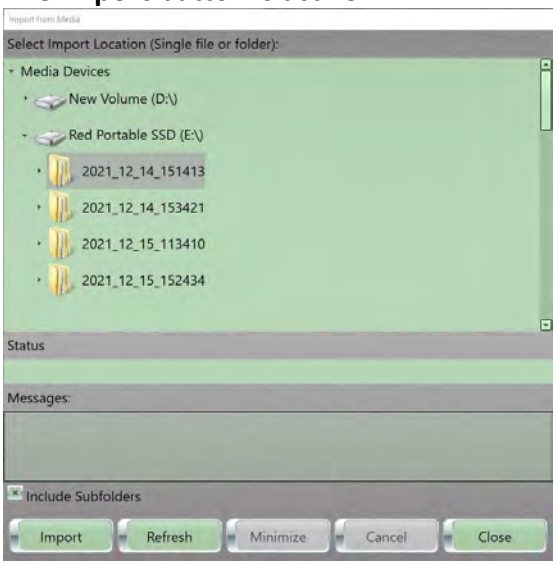


Figure 329: Active Import button

   - If necessary, click **Subfolders** to see the entire path.

5. Click the **Import** button.
   The imported images appear in **Patient Browser**.

Delete

1. Click the **Patient Browser** tab.

2. Select the study or the series to delete.

3. Click the **Delete** button.
   The **Confirm Deletion** popup appears.

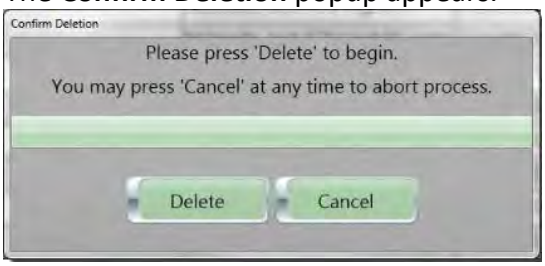


Figure 330: Confirm Deletion popup

4. Click the **Delete** button on the **Confirm Deletion** popup.
   The patient data will be deleted from the **Patient Browser.**

Registering a patient from Patient Browser

If additional scans must be performed on a patient that is listed in the **Patient Browser,** you can register them by performing the following:

1. Click the **Patient Browser** tab.

2. Select the patient to register.

3. Click the **Register** button.

Figure 331: Patient browser register button

4. The **Create New Study** popup appears.

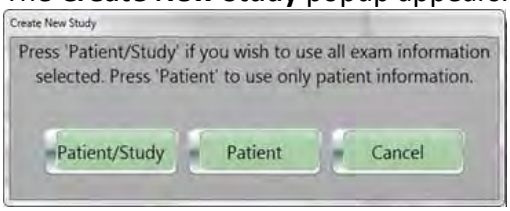


Figure 332: Create New Study popup

5. Perform one of the following:
   - Click the **Patient/Study** button to use all exam information selected, including the accession number.
   - Click the **Patient** button to use only patient information.

- Click the **Cancel** button to exit the **Create New Study** popup.

Building dose from Patient Browser

The **Build Dose** button in the Patient Browser, allows you to manually create a Dose Report and Dose SR image which will appear in the Series table when completed.

1. Click the **Patient Browser** tab.
2. Select the patient to use for the **Build Dose.**
3. Click the **Build Dose** button.

Figure 333: Build dose button

4. The **Build Dose Please Wait** popup appears.

Figure 334: Please Wait popup

5. The Dose Report and Dose SR image will be saved to the Series Table.
6. If the **Dose Build Failed** popup appears, click the OK button, make the necessary changes, and try again.

Figure 335: Dose Build Failed popup

Note **Dose Structured Reports (Dose SR)** cannot be viewed in the BodyTom 64 system; **Dose SR** can be viewed in **PACS** with the appropriate viewer.

Using Show Info to view, update, and move a series

1. Click the **Patient Browser** tab.
2. Select the patient.
3. Select the series.
   The **Show Info** button becomes active.
4. Click the **Show Info** button.
   The **View/Update Information** dialog box appears.

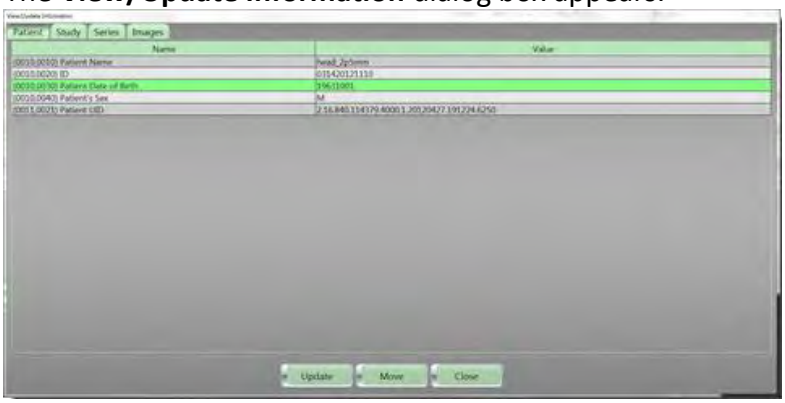


Figure 336: View/Update Information dialog box

The following tabs appear:

Patient	Data about the patient, such as patient name, date of birth, and sex of patient.
Study	Data about the study, such as date, time, and referring physician.

Series	Data about the series, such as the position reference indicator, model, pixel-padding value, and series date and time.
Images	Data about the image, such as the instance number (sequential), exposure time.

5. Click the tab(s) to review and update the necessary information.

6. Double-click any editable field and make your change(s).

7. Click one of the following buttons
   - Click the **Update** button to save your changes.

Note If information is invalid, you are prompted to correct the information and click **Update** again.

If the field cannot be edited, a prompt appears tell you the selected field is not editable.

   - Click the **Move** button to show the **Move Series** popup.

Note The **Move Series** function is used when a scan has been acquired under the wrong patient file or to move a patient that was registered manually to the **Patient Registration** tab. Moving the patient to the **Patient Registration** tab will capture all the patient's information.

   - Click the **Registration** button to move the patient into an existing patient or by manually creating a new patient using the **Patient Registration** process.
   - Click the **Cancel** button to exit the **Move Series** popup.
   - Click **Browser** to go to the **Patient Browser** tab and move the series.
   - Click the **Move** button to confirm moving the series.
   - Click the **Cancel** button to exit the **Patient Browser** tab and return to the **View/Update Information** popup.

8. Click the **Close** button to exit the **View/Update Information** popup.

Note An audit log of both old and new patient series, including the date and time of change and who performed it, is generated.

Modifying a series scanned under the wrong patient

If a patient has been scanned under the wrong identification, the series can be corrected.

1. Click the **Patient Browser** tab.

2. Select the series that was scanned with incorrect patient identification to modify the data.

3. Click the **Show Info** button.
   The **View/Update Information** dialog box appears.

Figure 337: View/Update Information dialog box

4. Click the **Move** button.
   The **Move Series** popup appears, denoting where to retrieve patient information from.

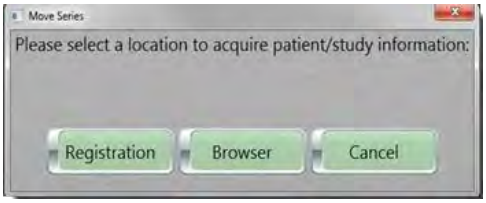


Figure 338: Move Series popup

The following defines what each button performs:

Registration	If patient information is stored within hospital's **HIS/RIS** server, click the **Registration** button, which will open the **Register Patient** tab to let you choose patient/study information.
Browser	If patient information is stored within system's browser, click **Browser** button, which show the **Patient Browser** tab information to let you select a series with correct patient information.
Cancel	Returns you to the previous dialog box.

5. Perform one of the following:
   - If you clicked the **Registration** button in the previous step, go to the next step.
   - If you clicked the **Browser** button in the previous step, go to step 11.

6. Click the **Manual** button.
   The **Exam Information** dialog box appears.

7. Enter the corrected data in any of the fields.
   See "Registering the patient" on page 244.

8. Click the **Update** button to save the change(s).

9. Click the **Move** button.
   A prompt appears to review changes made to the patient and/or series information for changes to take effect.

10. Click the **Ok** button and then the **Update** button.
    The corrected patient and moved data will appear in the **Patient Browser**.

11. If you selected the **Browser** button, the **Patient Browser** tab is showing; select the correct patient and series.

12. Click the **Move** button.
    A prompt appears to review changes made to the patient and/or series information for changes to take effect.

13. Click the **Ok** button.

14. Review the patient to ensure it is the proper one.

15. Click the **Update** button.

16. Click the **Cancel** button to return to the **Patient Browser**.

Loading a series into view

1. Click the **Patient Browser** tab.

2. Select the patient.

3. Select the series.

4. Click the **View Images** button or double-click the selected series.

The **Viewing** tab opens, and the series appears for viewing and manipulating.

Appending a series

Note Regardless of how many series are appended, the series are listed chronologically. This tool can be used to put all images from a patient together on a CD or to **PACS**.

1. Click the **Patient Browser** tab.
2. Select the study to append.
3. Select the first series.
4. Right-click the mouse to select the second series.
   The **Append Images** appears on the floating menu.

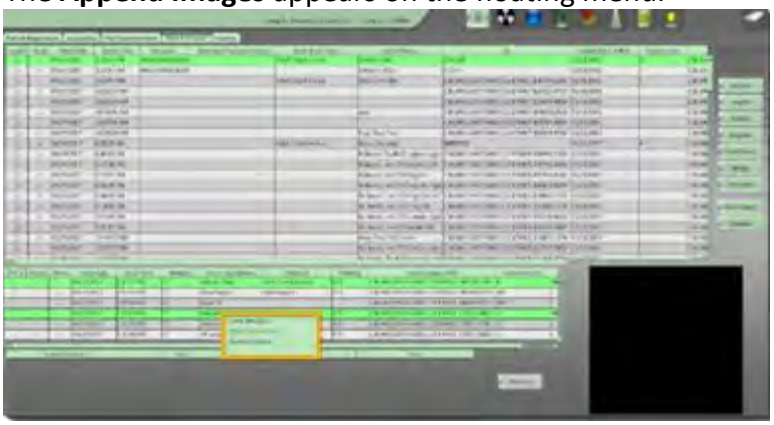
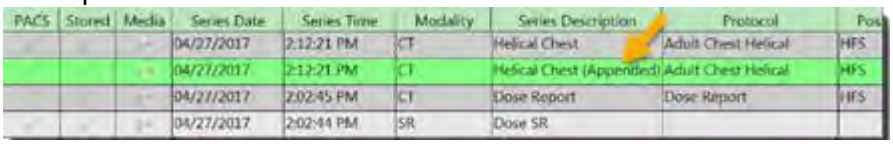


Figure 339: Floating menu - Append Images

5. Click Append Images.
   The **Please Wait** popup appears.

Figure 340: Please Wait popup

A new series is created with (Appended) at the end of the description.



PACS	Stored	Media	Series Date	Series Time	Modality	Series Description	Protocol	Pos
			04/27/2017	2:12:21 PM	CT	Helical Chest	Adult Chest Helical	HFS
			04/27/2017	2:12:21 PM	CT	Helical Chest (Appended)	Adult Chest Helical	HFS
			04/27/2017	2:02:45 PM	CT	Dose Report	Dose Report	HFS
			04/27/2017	2:02:44 PM	SR	Dose SR		

Figure 341: (Appended) series created

Chapter 11 Viewing Images

Viewing lets you see already-scanned images from previous examinations. To view images, select the patient in **Patient Browser** and then select the series to view. To open the image, click the **View Images** button or double-click the series.

Figure 342: Active Viewing tab

The following tables identify the tools in the **Viewing** tabs that let you manipulate images. Some image tools appear on specific viewing tabs, only. The view tabs are **2D**, **MPR**, **3D**, and **CTP** (if enabled).

Table 57: 2D, MPR, 3D, and CTP image tools

Image tools	Tool name	Action
Common tools		
	**Clear Tool**	Resets the tool to the default pointer device.
	**Window Width/Center**	Adjusts window width and center of image.
	**Zoom**	Magnifies the image.
	**Pan**	Adjusts image on X or Y axis.
	**Invert**	Inverts black to white and white to black.
	**Capture**	Saves a screen capture of a selected viewport.
	**Capture All**	Saves screen captures of all visible viewports.
	**Reset**	Reverts all images back to their original mode.

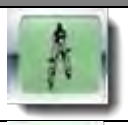
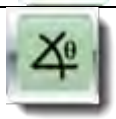
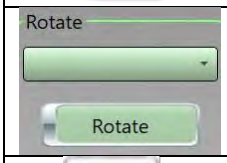
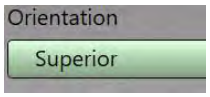
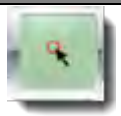
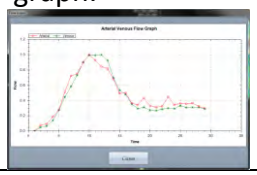
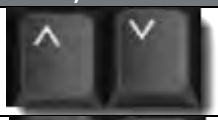
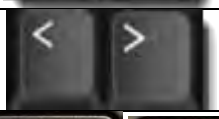
Image tools	Tool name	Action
2D and CTP tools		
	**Region of Interest (ROI)**	Defines a circular **ROI** and displays the **ROI** information.
	**Arrow**	Draws an arrow on the image.
2D, CTP, and MPR tools		
	**Line**	Draws a line on the image and is used for measurement.
	**Angle**	Draws an angle on the image and displays the angle information.
2D only tools		
	**Add Annotation**	Create text box for annotation.
	**Rotate**	Rotates images.
	**Reverse Image Stack**	Reverses the order in which images display.
	**Flip Vertically**	Flips images up or down.
	**Flip Horizontally**	Flips images right or left.
	**Cine Reverse**	Cines backward through the images.
	**Cine Forward**	Cines forward through the images.
	**Stop**	Stops the cine loop.
MPR only tools		
	**Tilt**	When selected a White ‘steering’ wheel allows you to correct a rotated image.

Image tools	Tool name	Action
3D only tool		
	**Color Preset**	Dropdown menu allows you to select from multiple color options.
	**Render Mode**	Dropdown menu allows you to display images in Color, MIP, or Grayscale.
	**Orientation**	Dropdown menu that allows you to select from multiple orientation options.
	**Rotate**	Rotates the 3D image.
	**Undo**	Reverses the most recent action taken.
	**Redo**	Restores the most recent Undo action taken.
CTP only tools		
	**Perfusion Artery/Vein Selection**	Select to place the arterial and venous ROIs on the images.
	**Calculate CBF, CBV, MTT Map**	Select to calculate the CT Perfusion maps.
	**Clear Perfusion Map**	Cancels the calculations and returns to **Calculation** mode.
	**Show Artery/Vein Flow Graph**	Displays the Arterial Venous Flow graph. 
	**Peak Image**	Displays the image that has the highest HU value based on the arterial ROI placement.

Using keyboard shortcuts

Keys are a quick way to navigate around. The table below provides keyboard shortcuts you can use to manipulate images in the **Viewing** tab.

Table 58: Arrow key navigation

Arrow keys	Action
	To scroll through images.
	To adjust the window center.
	To quickly scroll through images.

Setting window width and center

Note Any modifications you make are not saved to the image.

1. Select a patient from **Patient Browser**, select the series to view.

2. To open the image, click the **View Images** button or double-click the series.
   The **Viewing** tab is enabled and the **2D** viewer opens.

3. The following options allow you to adjust the window width and center of the image:
   - Click the Window Width/Center icon in the Tools menu, then while holding the left mouse button down drag up/down to modify Window Center and right/left to modify Window Width.
   - To adjust with a preset, click the **Windowing** dropdown and select a preset.

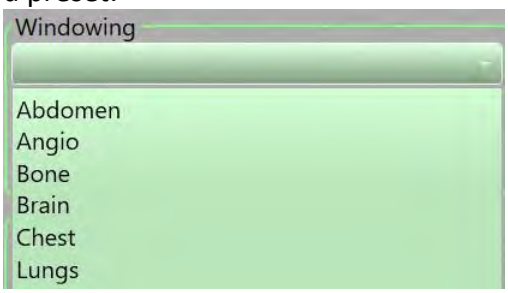


Figure 343: Windowing preset dropdown list

- Type values in the **Width** and **Center** text boxes and click the **Apply** button.

Figure 344: Windowing Width and Center text boxes, and the Apply button

- Right click over an image and use the **Activate Window Tool** option then while holding the left mouse button down drag up/down to modify Window Center and right/left to modify Window Width.

Figure 345: Right click menu

Viewing images in 2D

2D lets you view scanned images in a **2-Dimensional** space. Standard **2D** mode is used when *only* one dataset is loaded. The default layout is a 2 x 2 grid.

The **Viewing** tab and **2D** viewer opens when you select a dataset from the **Patient Browser.**

1. Select a patient from **Patient Browser** and select the series to view.
2. To open the image, click the **View Images** button or double-click the series.

The **Viewing** tab is enabled and the **2D** tab is opened.

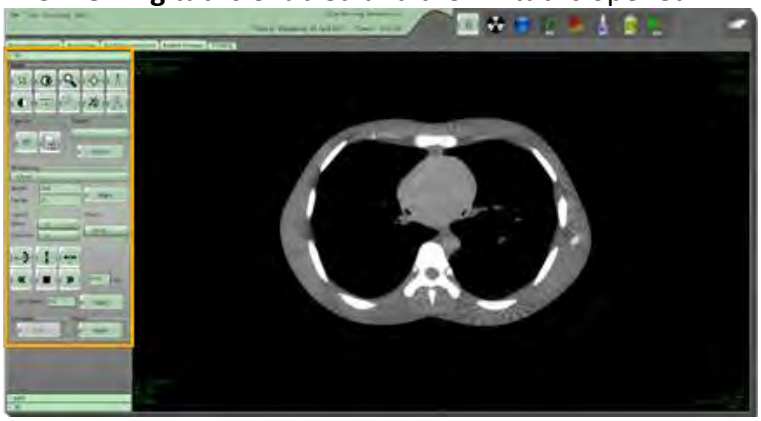


Figure 346: 2D tools

3. Use any of the image tools to manipulate your images.

4. Click the **Reset** button to reset images back to the original setting(s). You cannot undo this action.

Comparing images

You can compare images in two different ways:

Note You can compare two series from the same patient or two series from different patients.

Using the floating menu to compare images

1. Select the patient in **Patient Browser**.

2. Select the first series from the series window.

3. Right-click and click **Mark for Compare** from the menu.

Figure 347: Floating menu - Mark For Compare

4. Select the second series or a series from a different patient.

5. Right-click and then click **Compare With Selected Series** from the floating menu.

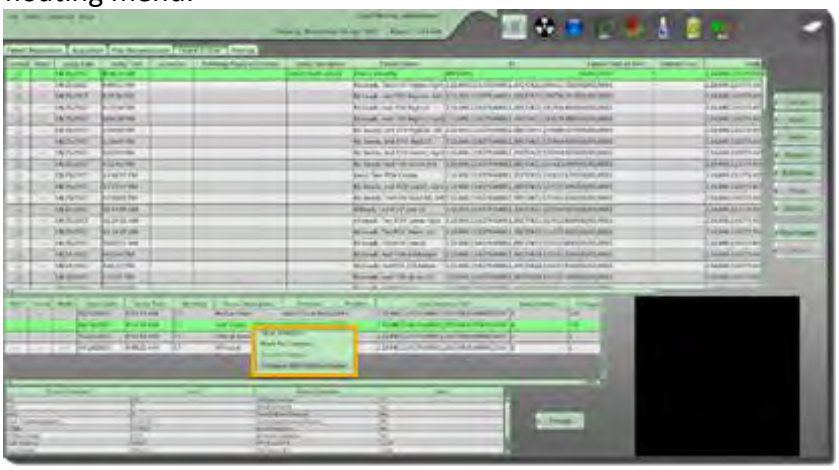


Figure 348: Floating menu - Compare with Selected Series

Both series are loaded into **Viewing** to compare.

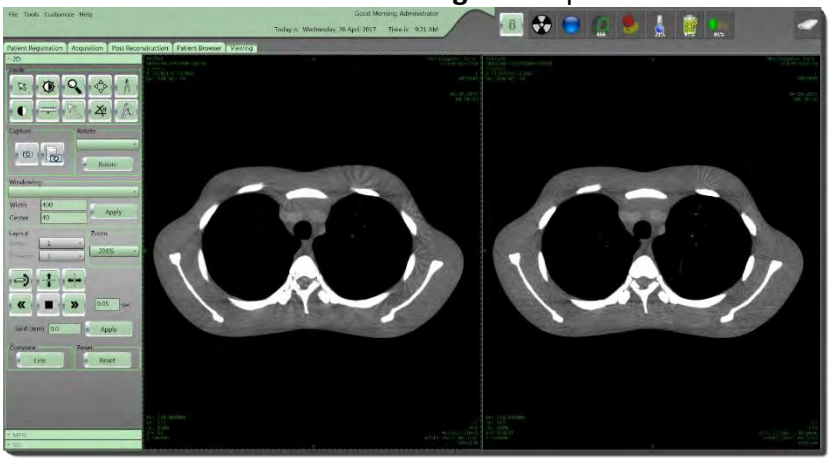


Figure 349: Compared series

6. Click the **Link** button to link both images together to view.

Figure 350: Link button

The **Unlink** button replaces the **Link** button.

7. Click the **Reset** button to reset images back to the original settings.

Using the Compare button to compare two images

1. Select the patient in **Patient Browser**.

2. Select the first series.

3. Press and hold the **Ctrl** key.

4. Select the second series.
   Both series are highlighted.

5. Click the **Compare** button.

Figure 351: Using the Compare button

Comparing a scout and a scan

1. Select a patient from **Patient Browser**.

2. Select a scout from the series window.

3. Press and hold the **Ctrl** key on the keyboard.

Figure 352: Scout and scan selected to compare

4. Select the scan from the series window.
   Both images are highlighted.

5. Click the **Compare** button.
   The scout and the scan will appear on screen at the same time. A green localizer line appears on the scout.

6. Compare the scout to the scan.

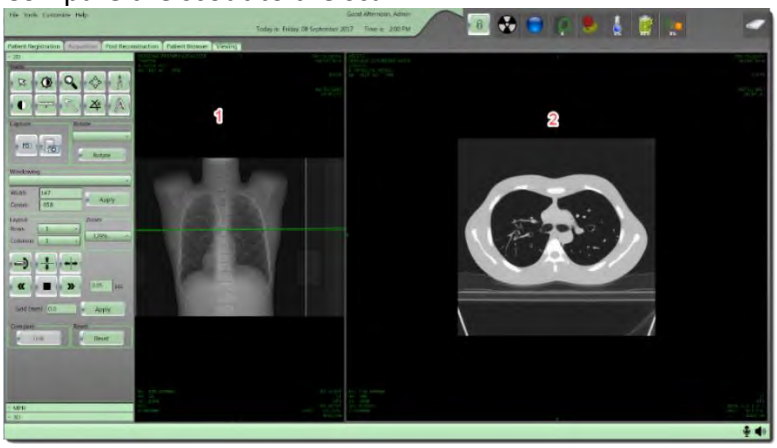


Figure 353: Comparing a scout (1) and a scan (2)

7. To remove the scout, right-click on the scout and click **Hide Scout Viewpoint**.
   To return the scout to view, right-click in the viewing window and click **Show Scout Viewport**.

Using the ROI

1. Select a patient from **Patient Browser** and select the series to view.

2. To open the image, click the **View Images** button or double-click the series.
   The **Viewing** tab is enabled and the **2D** tab is opened.

3. Click the **ROI** tool.

4. Move the mouse pointer to the image where you want the **ROI** located.

5. Click the left-mouse button and drag the **ROI** diameter to the required size. To lock the **ROI** in place, click the left-mouse a second time.
   - To change the location of the ROI or the details of the ROI, click the **ROI** or measurements you wish to move. The ROI and its measurements will turn yellow, and the pointer becomes a hand. Click and hold the mouse button on either the ROI or it's measurements and drag to a new location. Click anywhere outside the ROI to freeze it in the new location.
     - When you move the **ROI** to a different location the measurements of the ROI are automatically updated based on the new location.

6. To remove the **ROI,** left click anywhere on the **ROI,** right click to see the floating menu, and click **Delete Annotation,** or click on the **ROI** and when it turns yellow, press **Delete** on the keyboard.

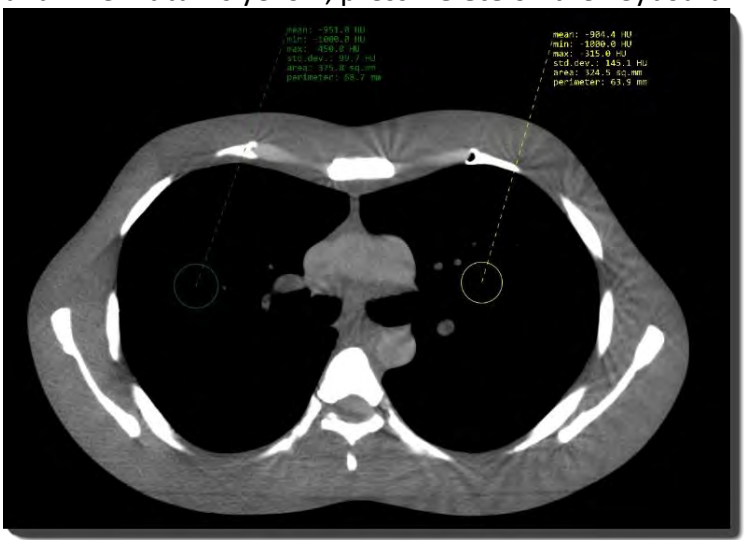


Figure 354: ROI

Using Layout and Rotate in 2D view

Layout lets you alter the number of images presented on the **Viewing** tab. **Rotate** lets you turn the images. Select a patient from **Patient Browser**, select the series to view.

1. Select a patient from **Patient Browser** and select the series to view.

2. To open the image, click the **View Images** button or double-click the series.
   The **Viewing** tab is enabled and the **2D** tab is opened.

3. To adjust the layout of the viewing area, click the **Rows** and/or **Columns** dropdowns to select the number of rows or columns you want to show.

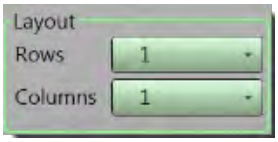


Figure 355: Layout (viewing tools)

4. To rotate the image, click the **Rotate** dropdown and select the number of degrees to rotate the images.

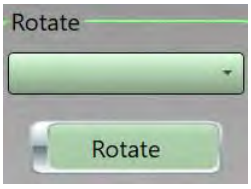


Figure 356: Rotate dropdown

5. Click the **Rotate** button to see the images turn to the new angle.

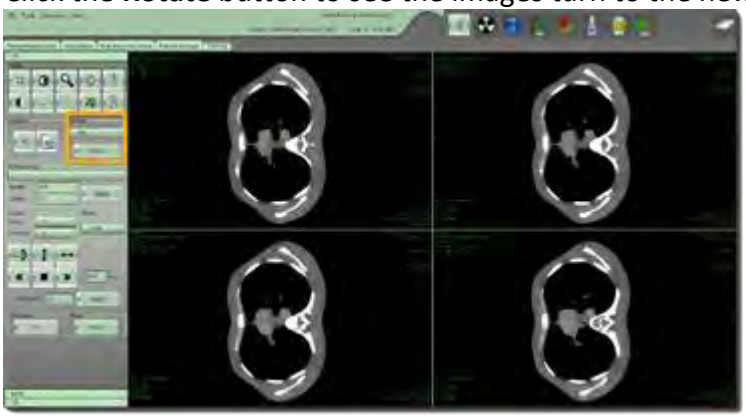


Figure 357: Rotate (viewing tools)

Applying a grid to your images in 2D

1. Select a patient from **Patient Browser** and select the series to view.
2. To open the images, click the **View Images** button or double-click the series.
   The **Viewing** tab is enabled and the **2D** tab is opened.
3. Change the size of the grid in the **Grid (mm)** text box.

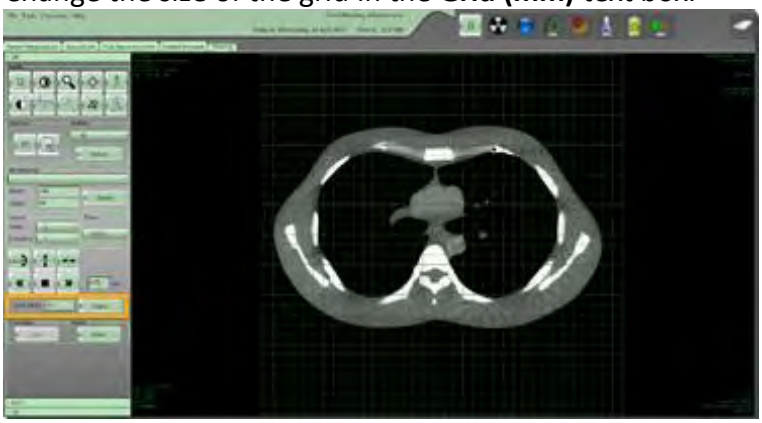


Figure 358: Grid (mm)

4. Click the **Apply** button to apply a grid over the image.
5. Perform one of the following to remove the grid:
   - Click the **Reset** button.

- Enter 0 in the **Grid (mm)** text box and click the **Apply** button.

Viewing images in MPR

Multi-Planar Reformation (**MPR**) allows images to be created from the original **Axial** plane into **Coronal, Sagittal** or **Transverse (Axial)** planes. **MPR** is fast, uses all the attenuation values in the dataset, and can be easily performed on the workstation. **MPR** however, provides on a **two-dimensional (2D)** display of the image data.

Viewer layout is 2 x 2 as seen below.

1. Select a patient from **Patient Browser** and select the series to view.

2. To open the images, click the **View Images** button or double-click on the series.
   The **Viewing** tab is enabled and the **2D** tab is opened.

3. Click the **MPR** tab.
   The **MPR** screen appears.

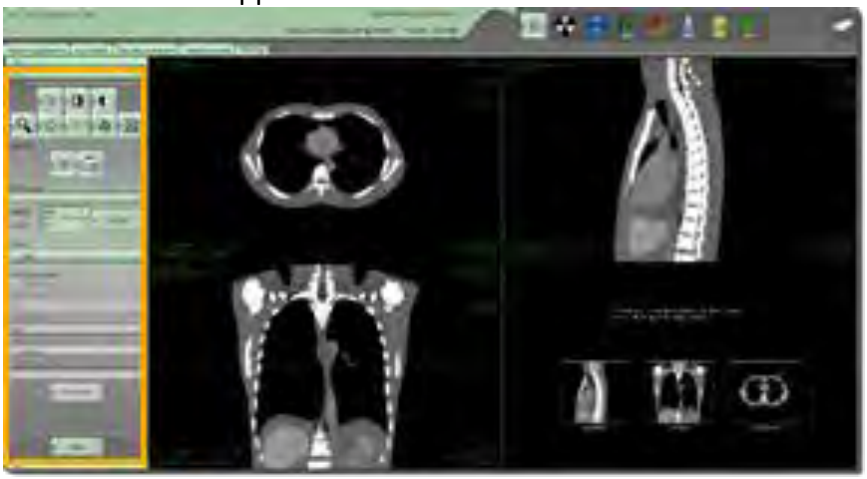


Figure 359: MPR tools

4. Select the image reformat at the bottom of the screen.

Figure 360: Image reformat selections

5. Use any of the image tools to manipulate the images.

6. The tilt tool can be used to modify the rotation of the images.

7. Adjust the image angle by moving the circle.

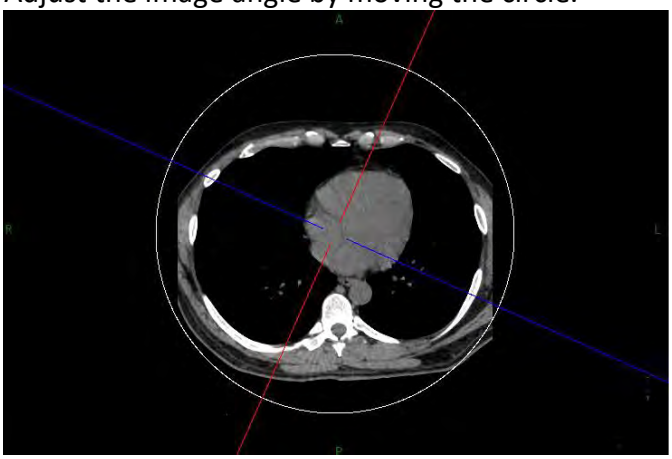


Figure 361: Tilt tool

8. Click the reset button to reset the images back to the original settings.
   You cannot undo this action.

Understanding and using slab

Through the reformation process, axial images are stacked creating a volume, or slab, which can be assessed in different planes. The thickness and spacing of each slab can be varied to meet the needs of the viewer. The reformations can be displayed in an average, maximum or minimum projection.

MPR's should be created using 1.2mm slices with a spacing of 0.6mm whenever possible.

Creating the slab

1. Select a patient from **Patient Browser** and select the series to view.

2. To open the images, click the **View Images** button or double-click the series.
   The **Viewing** tab is enabled and the 2D tab is opened.

3. Click the **MPR** tab.
   The **MPR** screen appears.

4. Click the **Sagittal**, **Coronal**, or **Transverse** plane to create your slab.

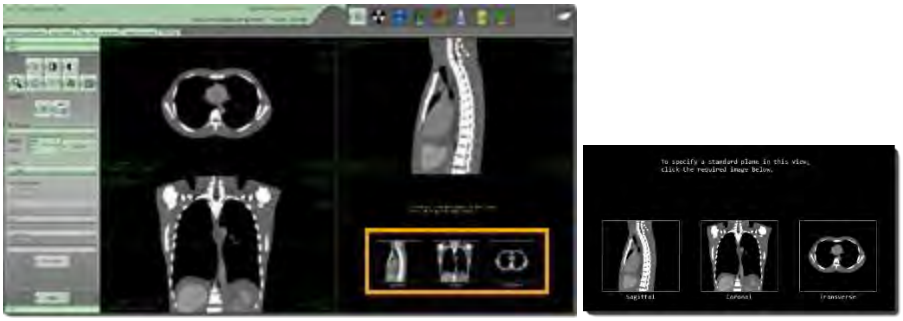


Figure 362: Image formats

5. The **Secondary Series** option is enabled.

6. Select **Enable Slab**.

Figure 363: Enable Slab option

The **Enable Slab** option is inactive if no **MPR** view is selected.

Figure 364: Enable Slab option under Secondary Series

7. Set the **Cyan** lines to determine the beginning and end of the slab.

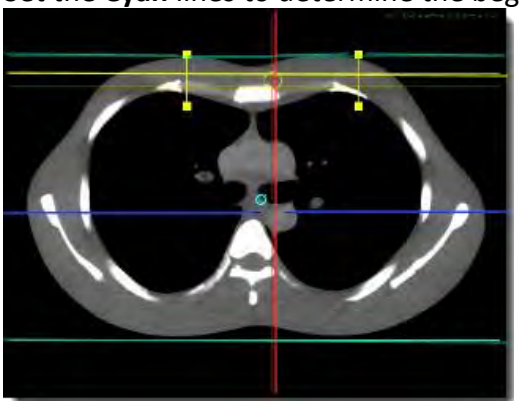


Figure 365: Cyan Line and cyan circle to drag for FOV

8. Use the **Cyan** circle to drag the planned slab if required.

9. Define the **Slab Thickness** and **Slab Spacing** in the text boxes.

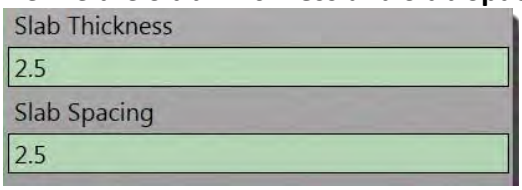


Figure 366: Slab Thickness and Slab Spacing text boxes

You can also use the **yellow** squares found on the slab thickness display to modify the **Slab Thickness.**

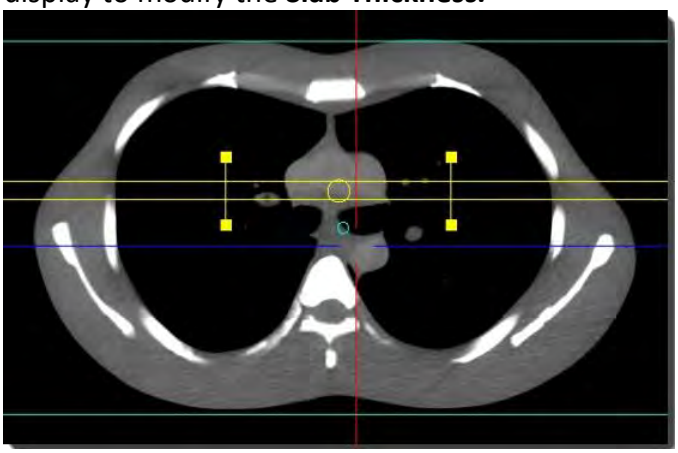


Figure 367: Small yellow boxes to manually drag for desired slab thickness

10. Click the **Slab Rendering Options** dropdown to select the appropriate option.

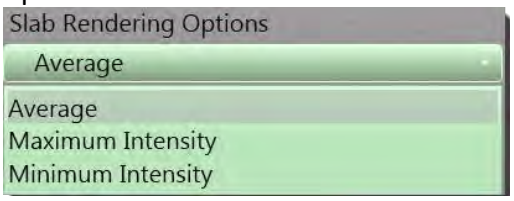


Figure 368: Slab Rendering Options dropdown

The following options are available in MPR Slab mode:

Slab Thickness	The thickness of the MPR slab.
Slab Spacing	The space between the start of one slab and the next.
Slab Rendering Options	Where you define the pixel values that will be displayed in each slab: options include, Average, Maximum Intensity and Minimum Intensity.
Maximum Intensity	The highest pixel values for all slices within the slab is displayed.
Minimum Intensity	The lowest pixel values for all slices within the slab is displayed.

Average	The pixel values of all slices within the slab are combined and the average value for each pixel is displayed.
Series Description	Text field for naming the series of images created when clicking the **Generate** button.
Yellow lines	Define the slab thickness. The boxes on the lines allow you to adjust the thickness using the mouse.
Cyan lines	Define the slab **FOV** and dictate the range of the new series to be generated. The cyan lines are adjustable by clicking and dragging on the lines themselves; both lines are moved by clicking and dragging the central circle marker.
Red, blue, and green lines	Define the cross sections of the anatomy being viewed.
Generate	Generates a new series with the name given in the **Series Description** field, based on the selected **MPR** view pane.

11. Select the **Tilt Tool** to correct any rotation on the image.

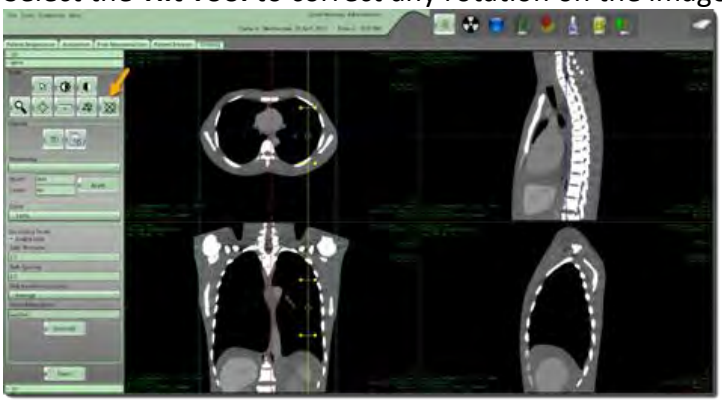


Figure 369: Tilt tool

12. Use the mouse pointer to move the white **Tilt** circle.

Note The circle does not represent the Field of View

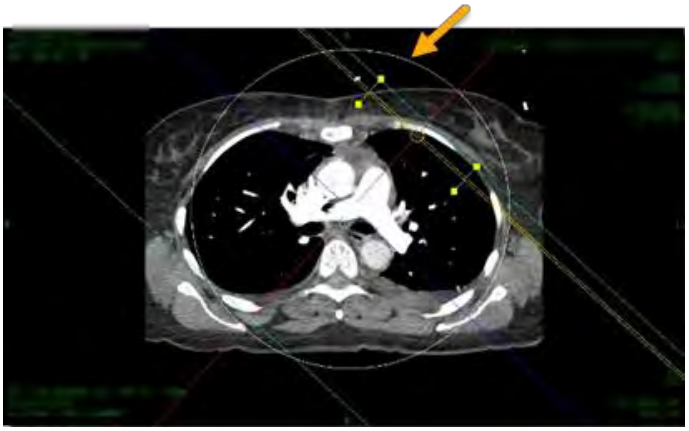


Figure 370: Tilt white circle

13. Enter the slab name in the **Series Description** text box.

14. The slab can be previewed in the bottom right viewport.

Note Make sure **Zoom** is at 100% or below.

Ensure all expected anatomy is included when previewing the created MPR.

15. When you are ready to save, click the **Generate** button.
    A **Saving Series** popup appears.

    When the series is complete, the **Capture Complete** pop-up appears.

Figure 371: Capture Complete popup message – Series saved

16. Click **OK** to close the **Capture Complete** popup message.

17. The new **MPR** images appear in the Patient Browser with the description in the Series Description text box.

CT	50cm Helical	Adult Abdomen Helical
CT	Coronal Abdomen	Adult Abdomen Helical
CT	Lateral Scout	Adult Abdomen Helical

Figure 372: MPR images in Patient Browser

18. To create additional MPR's. select the Reset button in MPR mode, select the MPR view you want to create and perform the steps above to create the new view.

Viewing images in 3D

In **3D** viewing, a 3-Dimensional image is created by stacking all the images of a scan on top of one another to create a 3D-volume. The initial display shows the **3D** volume and a box appears around it. **MPR** planes also appear.

1. Select a patient from **Patient Browser** and select the series to view.

2. To open the images, click the **View Images** button or double-click the series.
   The **Viewing** tab is enabled and the 2D tab is opened.

3. Click the **3D** tab.

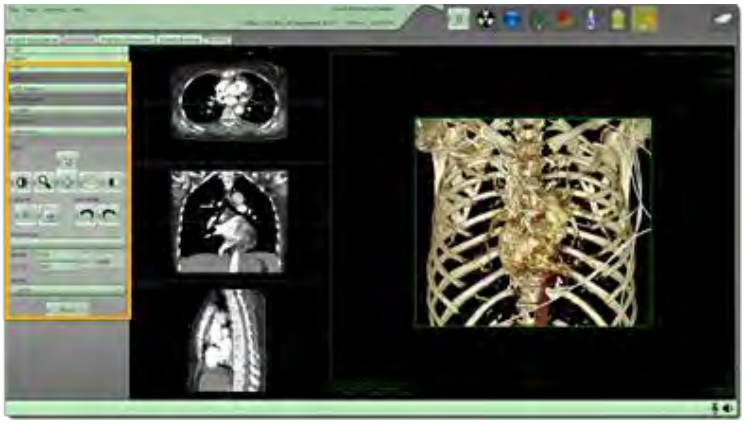


Figure 373: 3D tools

4. To rotate the image up to 360°, click **Rotate** and move the image with the mouse pointer to the rotation of choice.

5. You can change the **Color Presets** from the dropdown menu:

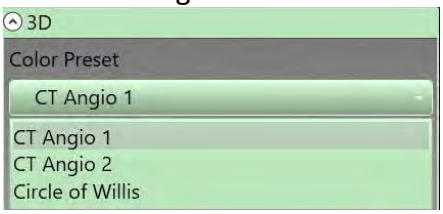


Figure 374: 3D Color Presets

6. You can change the **Render Mode** from the dropdown menu:

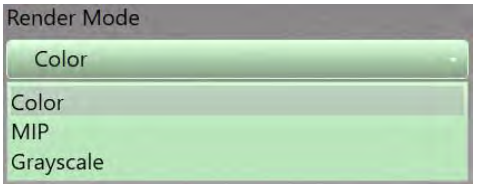


Figure 375: 3D Render modes

7. Click the **Orientation** drop-down box to assign an orientation:

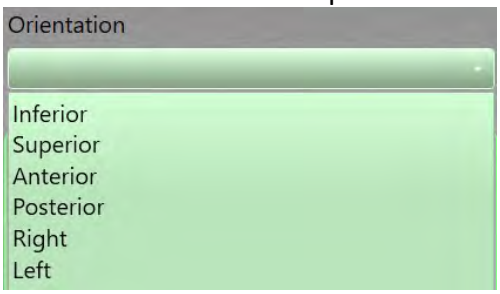


Figure 376: 3D Orientation options

8. Click the **Reset** button to reset images back to the original settings. You cannot undo this action.

Chapter 12 Post Reconstruction

The system stores multiple patient series of raw data to allow post reconstruction of images. **Post Reconstruction** allows reconstructing of the acquired data using different algorithms, slice thicknesses, or use of image enhancement algorithms, such as **Metal Artifact Reduction, Noise Reduction** and **Windmill Correction.**

Reconstruction Overview

Metal artifact reduction

Streak artifacts are often seen around metal leads, prostheses, applicators, bone, or metal screws. Numerous factors can contribute to these streaks including under-sampling, photon starvation, patient motion, beam hardening, and scatter. You can use **Metal Artifact Reduction** (**MAR**) to reduce these streaks. **MAR** removes the metal from the image to reconstruct the soft tissue only; then it adds it back, to reduce the artifacts. This is currently used only on **Axial** scans.

Noise reduction

Noise appears as grain on the image and is caused by a low signal to noise ratio. This occurs more commonly when a thin-slice thickness is used. It can also occur when the radiation dose is insufficient to penetrate the anatomy being scanned.

Note Noise reduction applies to post-processing filters that reduce the amount of noise in the images. In clinical practice, using noise reduction may allow for a reduction in CT patient-dose depending on the clinical task, patient size, anatomical location, and clinical practice. Consult with the site's radiologist and physicist to determine the appropriate dose to obtain diagnostic image quality for a particular clinical task.

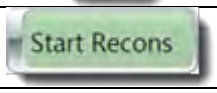
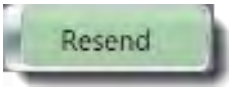
Windmill Correction

The Windmill Correction reduces artifacts that are common in **Helical** scans due to the nature of the cone-beam reconstruction.

Figure 377: Active Post Reconstruction tab

The tools available to **Post Reconstruction** are identified in the table below.

Table 59: Reconstruction tools

Image tools	Tool name	Action
	**Load Images**	Loads images from selected series into viewing.
	**Stop**	Cancels the current, post-reconstruction request. All images are generated until you click the **Stop** button.
	**FOV**	Adjusts the **FOV** prior to reconstruction.
	**Clear Tool**	Resets tool to default pointer device.
	**Window Width/Center**	Adjusts the width and center of selected image.
	**Zoom**	Magnifies the image.
	**Pan**	Adjusts the image on X or Y axis.
	**Reset**	Resets the display to default viewer settings.
	**Start**	Begins your **Post Reconstruction**.
	**Resend**	Sends the last acquired scan from the recon workstation to the **Patient Browser**.

Performing Post Reconstruction

The following figure identifies parts of **Post Reconstruction**:

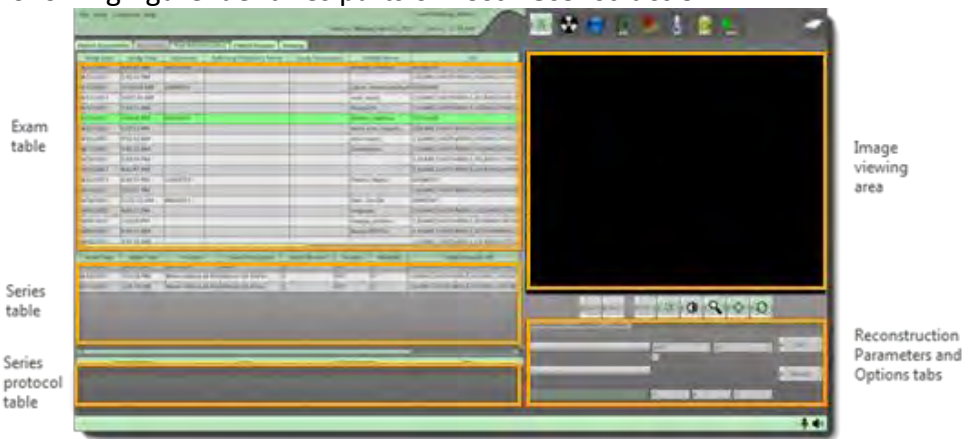


Figure 378: Post Reconstruction areas

1. Click the **Post Reconstruction** tab.

2. Select a study in the **Exam Table.**
   When you select a study, all the scanned series for that study appear in the **Series Table.**

3. Select the series to reconstruct.

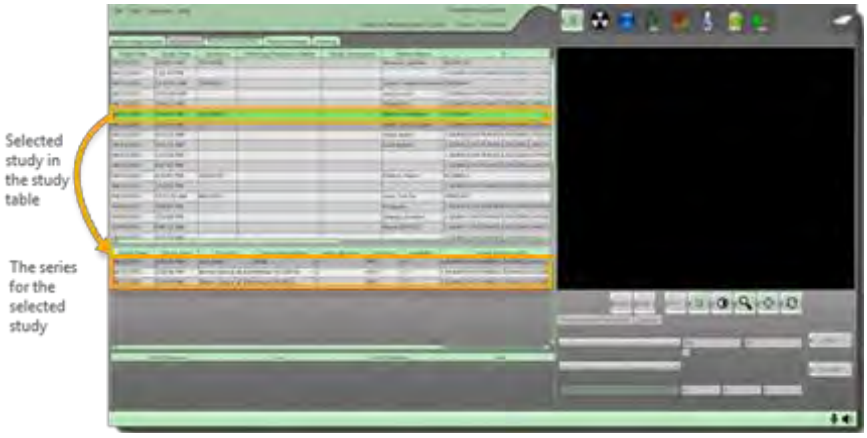


Figure 379: Post Reconstruction study and series tables

4. Click the **Load** button.
   The scan or series will load into the viewer. The series protocol table and the **Reconstruction Parameters** and **Options** tabs are active. The scan will appear in the **Image Viewing Area**.

5. View the study in the Image Viewing Area.

Figure 380: Post Reconstruction viewing image area

6. To modify the **FOV**, perform the following:
   - Click the **FOV** tool, click and drag the mouse to form a square on the image in the **Image Viewing Area**.
     - The size of the square appears in the Width box in the **Reconstruction Parameters and Options** tab.
   - Click the circle in the middle of the FOV square and drag to move the **FOV**.
   - Click one of the two drag boxes on the corners to adjust the size of box.
     - The **Width** dimension, and **X/Y** coordinates are adjusted as the size changes.
     - The **FOV** size cannot exceed the range of 50 - 600mm square.

Figure 381: FOV resizing boxes

Note You can also enter a number in the **Width** or X and Y box to define a specific **FOV**.
Alternatively, click the **Use FOV Max** option to use the maximum **FOV**.

7. Click the **Sharpness** dropdown to select a reconstruction algorithm from the **Reconstruction Parameters** tab.

Figure 382: Sharpness on the Reconstruction Parameters tab

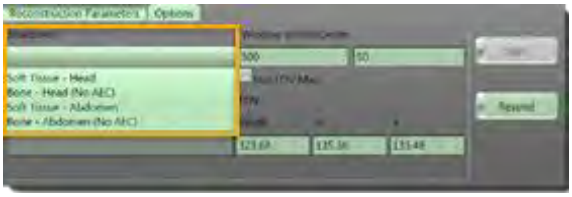


Figure 383: Reconstruction Parameters Sharpness dropdown

8. Click the **Slice Thickness/Spacing** dropdown to select.

Figure 384: Reconstruction Parameters Slice Thickness/Spacing dropdown

The slice thickness and spacing options available are determined by the type of scan that was acquired (Axial vs. Helical).

9. The **# of Expected Images** text box shows the calculated number of images that will be reconstructed based on the parameters used for the reconstruction.

Figure 385: # of Expected Images

10. Click the **Options** tab. The following are only available during **Post Reconstruction.**

11. Perform the appropriate action:
    - If desired, select **Noise Reduction** for an **Axial** or **Helical** scan.

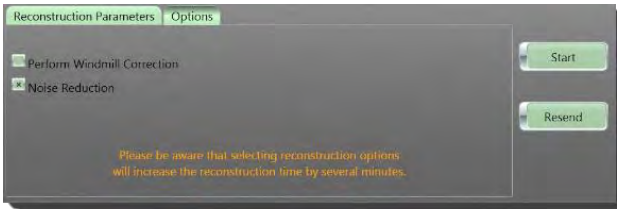


Figure 386: Noise Reduction on the Options tab for a Helical scan

    - If desired, select **Perform Windmill Correction** for a **Helical** scan.

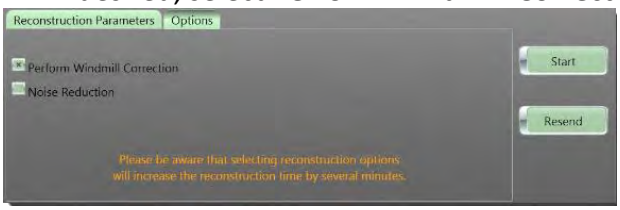


Figure 387: Perform Windmill Correction and/or Noise Reduction on the Options tab for a Helical scan

    - If desired, select **Metal Artifact Removal f**or an **Axial** scan.

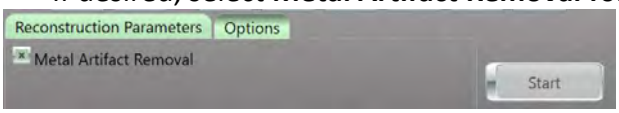


Figure 388: Metal artifact removal

12. Click the **Start** button to generate a new dataset.
    When you click the **Start** button, the reconstructed images appear in the viewing pane.

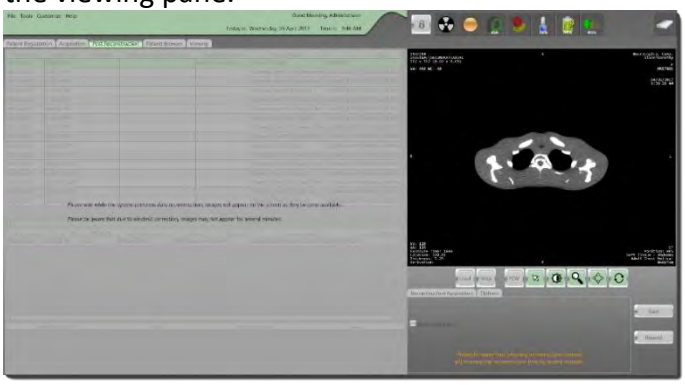


Figure 389: Please wait while the system performs data reconstruction message

13. When the reconstruction is complete, the images appear in **Patient Browser.**

Resending images from the scanner to the workstation

Pressing the Resend button lets you send the last acquired scan from the recon computer to the **Patient Browser**. This may be necessary when you have wireless interruptions and/or workstation shuts down unexpectedly.

Figure 390: Resend button

Chapter 13 Accessories and Options

In this chapter you will learn how to convert a bed, stretcher, or any type of adjustable surface into a scanning platform using the Universal Transfer Board.

To request the catalog(s) to reference product descriptions/details and part numbers for the available accessories/options that are used with the BodyTom 64, see "Contact information" on page 24:

When using a fixed scanner, the table moves from one portion of anatomy to another while the gantry remains stationary. With the BodyTom 64, an in-place scanning platform remains stationary while the gantry or scanner translates from one point to the other to cover the anatomy.

The universal transfer board can be used for most beds or stretchers. It is placed under the patient and secured to the bed or stretcher with straps.

WARNING NeuroLogica Corp. recommends that the weight of the patient being positioned on the scan board does not exceed the bed manufacturer's safe, recommended, operating patient load. Realizing patient safety is of the utmost importance, it is recommended that safe judgment be exercised at all times when it comes to the clinical care of patients. There are a number of varying factors, such as the condition of the bed being used, unique patient anatomy, as well as the proper scan board and positioning of the patient, per NeuroLogica Corp.'s clinical training guidelines and product labeling. If any excessive wear or damage is noticed to any scan board, do not use it for a patient scan; contact a qualified service technician to assess, repair, and/or replace the device.

Using the Universal Transfer Board

The universal transfer board is a carbon-fiber, radiolucent board that is designed to work with any ICU bed or stretcher. The carbon-fiber board comes with a 0.5-inch-thick headboard and 2-inch x 5-foot straps to strap the board to the ICU bed or stretcher.

You can use the universal transfer board on any bed, table, or stretcher. Because you can attach the universal transfer board to almost any type of surface, it is used anywhere throughout the hospital including the ICU, OR, and ER. The universal transfer board is placed on the mattress and secured with a strap or placed directly on a surgical table under the cushions. The patient lies on the board with the patient's head in the head holder. The BodyTom 64 is moved into position and the scan is performed.

The universal transfer board is always used with mattress stiffeners.

The mattress stiffeners provide a solid surface at the head of the bed to prevent the mattress from sagging when a scan is performed. There are usually four mattress stiffeners stored with the BodyTom 64 for easy transport.

The universal transfer board is used for adults.

Note The universal transfer board is an optional accessory that does not come with the system.

Table 60: Universal Transfer Board weight-bearing restrictions

The weight limit of the Universal Transfer board is equal to the weight limit of the patient bed. The weight limit on the portion of the Universal Transfer board that supports the patients head is 7.5 kg / 17lbs. The universal transfer board is used to support and scan the patients head, *only*.

See also "Parts that potentially come into contact with the patient" on page 86.

WARNING The weight limit for the superior portion of the Universal Transfer Board is 7.5kg or 17lbs.

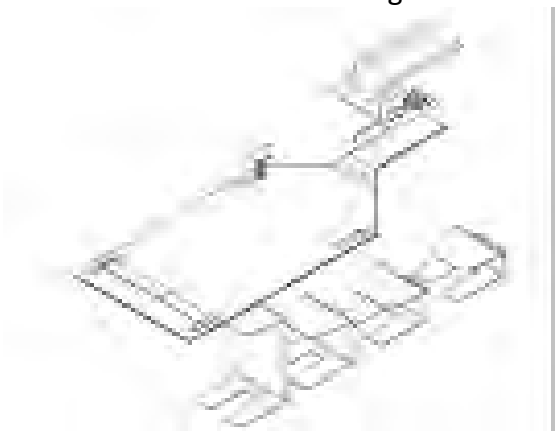


Figure 391: Universal transfer board and stiffeners

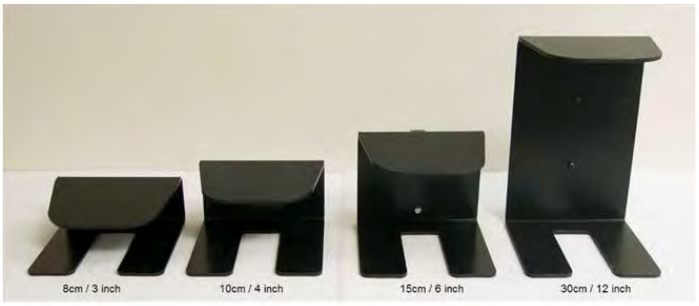


Figure 392: Four types of mattress stiffeners

Note: Tipping of the board is a major concern. The universal transfer board **MUST** be securely fastened to the surface prior to placing the patient on the board.

1. Obey all warning labels when using the scan board.

2. Select the appropriate mattress stiffener for the mattress size and insert.

Figure 393: Mattress stiffener in place

3. The universal transfer board requires mattress stiffeners that provide a solid surface at the head of the bed to prevent the mattress from sagging with the weight of the patient when a scan is performed.

4. With the proper mattress stiffener properly inserted, apply the universal transfer board on top.

5. Position the board in accordance with the yellow, safety-warning stickers to avoid a tipping hazard. Do not extend the board beyond the mattress for proper placement.

Figure 394: Universal transfer board properly positioned on the bed on a mattress stiffener

6. When the board is properly positioned on the bed, secure it by using the safety strap.

7. The safety strap must be attached to the board, passed completely under the bed, and secured on the other side.

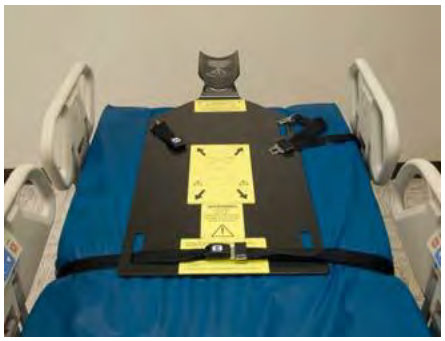


Figure 395: Universal transfer board with safety strap installed

8. When the universal transfer board is securely fastened to the bed, transfer the patient to the board and secure the upper strap to the patient and the scan board.

9. When the patient is positioned and securely strapped in, position the scanner over the patient.

10. Initiate the scan.

Chapter 14 Cleaning and Storing the System and Workstation Specifications

Be familiar with this section before using the cleaning or storing the system.

Cleaning the scanner and workstation

When the system is between uses, NeuroLogica recommends keeping it clean as described below. This will help remove body fluids to prevent a health risk and damage to internal parts.

Note NeuroLogica recommends a solution of ≥99% pure Isopropyl Alcohol (IPA) to sufficiently clean the equipment.

WARNING Do not use flammable or potentially explosive disinfecting sprays, since resultant vapor could ignite, causing personal injury and/or damage to the equipment.

WARNING To prevent short-circuiting or possible electrical shock, do not spray cleaning agents or spill liquid cleaning agents directly onto the machine.

WARNING Always electrically isolate this equipment from the main electrical supply before cleaning and disinfecting it to prevent short-circuiting or possible electrical shock.

CAUTION The unit surfaces may be cleaned with a soft cloth and the recommended solution or a similar mild non-abrasive cleaning solution. General purpose liquid disinfectant may also be used as necessary. Apply the cleaning solution to the cloth, not directly to the unit.

WARNING Before cleaning the workstation (drive system), be sure to disconnect the workstation from the wall outlet (power source). Failure to do so could result in electrical shock and cause severe injury to you and/or damage to electrical components.

CAUTION Do not allow electrical components to become wet. For eye and hand protection, it is important to wear safety glasses and rubber gloves, respectively.

CAUTION Do not spray cleaning agents directly on the system. Spray a clean cloth with the solution and then wipe down the scanner and workstation.

Cleaning the outside of the scanner and workstation

1. Prepare detergent/disinfectant (regulated by EPA as hospital disinfectant) solution according to instructions on label for correct usage.
   - Use a basin or spray bottle (with product label).
   - Use a pump (usually on detergent/disinfectant containers) to dispense the concentrate in the basin or spray bottle, then fill with correct amount of tap water.
   - If using a spray bottle, empty and rinse out after use.

Note The stability of the solution is unknown after 24 hours; therefore, a fresh preparation of cleaning solution ***must*** be prepared for each day of cleaning.

2. Use general purpose germicidal cleaner on the external covers and rails. Do not use cleaners on the screens.

3. Use swabs moistened with cleaning solution, clean and remove any dust, soil, dried contrast media, or foreign matter; allow all components to air dry.

4. Wipe down and clean the frame of device and allow to air dry; return to its storage area.

Note Wash (at 25°C) with neutral detergents, *only*; softening agents ***are not allowed***.

The following recommended products are registered by the EPA as hospital disinfectant; these solutions are quaternary ammonium compounds and are used in environmental sanitation of non-critical surfaces:

- TB Quat™ is a cleaning solution manufactured by ABC Compounding Co.
- Wex-cide™ is a disinfectant manufactured by Wexford Labs, Inc., product number Wexcide128.

Maintenance of the workstation

WARNING Maintenance checks and all service must be performed by service personnel trained by NeuroLogica Corp. See "Contact information" on page 24.

Storing the system

Storing the scanner and workstation

Store the scanner in a dry, well ventilated, climate-controlled area. You can use the key to lock the scanner when not in use. See "Identifying operator control panel buttons" on page 78 to locate the lock.

CAUTION When the scanner is not in use and stored, it must be plugged in a 120V or 250V outlet to charge the batteries.

CAUTION When the workstation is not in use and stored, it must be plugged in a 120V (or other compatible) outlet to charge the batteries.

Store the scanner on its centipedes or castor wheels (feet).

Note If the floor surface is soft (spongy) store the system on its centipedes to disperse the weight of the system evenly.

1. After transporting the scanner to an acceptable storage location, you can either store the system in **Transport** mode (on its caster wheels) or **Scan** mode (on its centipedes).

Figure 396: BodyTom 64 castor wheels

2. Turn off the scanner and workstation.
   The system is now ready to be stored.

See "Powering the workstation" on page 101.

Note It is recommended practice that the scanner is plugged in and turned on even when it is not in use.

Storing the QA phantom

Store the phantom in a secure location with easy access for the daily QA procedure.

Workstation specifications

Table 61: Workstation specifications

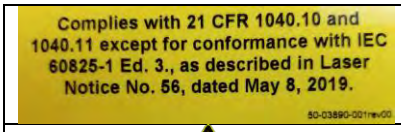
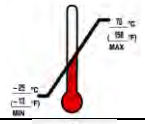
Phase	Single	
Voltage Range	100-240VAC ± 10%	
Factory Outlet Recommendations	NEMA 5-20R	NEMA 6-30R
Frequency	50 or 60Hz	
Battery Capacity	Fully Charged/ 12 hrs. (Typical)	
Typical Usage	110-120 VAC 60 Hz	230-240VAC 50 Hz
Wiring	125V, 2 Pole, 3 Wire Grounding	250V, 2 Pole, 3 Wire Grounding
Battery Operating Voltage	51.8VDC	
Overall width	41in. (104cm)	
Overall height	79in. (199cm)	
Overall length	101in. (256.5cm)	
Weight EST	3510 lbs. (1592kg)	
Battery power (2) 12 VDC (lithium polymer)	800W	
Max programmed speed fwd.	1.6 MPH	
Max recharge time	~ 8hrs.	
Max continuous operation	8hrs.	
Locking and unlocking cycles	20	
Hrs transport over floors	2hrs.	
Hrs system locked no external power	2hrs.	
Max slope holding angle with scanner	7º C (44.6º F)	
Max doorway threshold	1in. (2.54cm)	

Max elevator threshold	¾in. (1.905cm)
Height to locking adapter	8.59in. - 8.69in.
Min/Max storage temperature	-25º C to 70º C (-13º F to 158º F)
Min/Max operating relative humidity	20% to 80% (non-condensing)
Min/Max storage relative humidity	20% to 85% (non-condensing)
Min/Max ambient operating temperature	15º C to 35º C (59º F/95º F)

Understanding the symbols and product-marking plate

Table 62: Symbols

	Alternating current.
	Protective earth (ground).
	Functional Earth
	Caution: consult accompanying documents.
	Caution: risk of electrical shock.
	Electrostatic sensitive devices.
	Type B equipment
	X-ray warning
	X-ray source assembly emitting
	Non-ionizing radiation
	Warning: laser in use
	Warning: Laser Radiation Do Not Stare into Beam Class 2 Laser Product
	Laser Output and Standards Information Label

	Warning: FDA Laser Information
	Warning: high temperature
	Emergency switch
	Crush warning
	Foot/toe crush warning when lowering machine
	System up
	System down
	Indicates temperature limits.
	Indicates mechanical deactivation device.
	Indicates a radiation precaution; may be affected by radiation from other sources; may produce interference that affects other equipment.
	Indicates a coil power cord.
	Indicates a chain hazard could cause severe personal injury.
	Keep away from rain for packaging.
	Humidity limit for packaging.
	Warning: battery charging.
	Fuse usage.
	Refer to instruction in user manual/booklet
	Medical Device Symbol
	Legal Manufacturer Symbol

	Intertek ETL (Edison Testing Laboratories) Mark
	European Authorized Representative Symbol
	CE Mark or Conformité Européenne ; number below CE represent Notified Body number

Note Disregarding information on safety is considered ***abnormal use***.

Locating the product-marking plate on the workstation

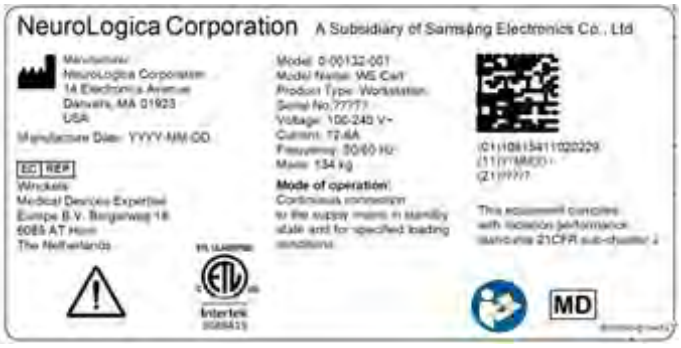


Figure 397: Product-marking plate on side of the workstation

Listing of replacement parts for workstation

To ensure proper compliance requirements of replacement parts, (for example, cables and accessories), parts must be purchased through NeuroLogica Corp.

WARNING Using other manufacturer cables and accessories may affect EMC performance. Unauthorized use of these items will void warranty and may cause harm to patient, others and/or equipment.

Product Safety and Electromagnetic Comparability

Tested by: Intertek Testing Services NA, Inc., 70 Codman Hill Road, Boxborough, MA 01719

Appendix A Glossary

A

Algorithm	Mathematical filter applied to raw data during CT image reconstruction to remove blurring artifact inherent to back-projection. Also referred to as a kernel.
Annotation	User comments or text added to an image.
Anterior	Front of the patient's body
Application Entity (AE)	An end point of a DICOM information exchange, including the DICOM network or media interface software; that is, the software that sends or receives DICOM information objects or messages. A single device can have multiple AEs.
Attenuation	The reduction in intensity of a radiation beam as it passes through a substance.
Automatic Exposure Control (AEC)	Software used to adjust or modulate the mA throughout an acquisition to reduce patient radiation dose to a minimum.
Axial scan mode	Data acquisition while the scanner remains stationary. The scanner position may be incremented between exposures to collect data over a longer Z axis range. Also referred to as step and shoot.

B

Bolus Tracking	Monitors flow of contrast media in vessel and triggers scan at optimal timing. This is a scanner feature to automatically initiate a prescribed Axial, Helical or Dynamic scan when a threshold level of contrast enhancement is reached at a specified region of interest.

C

Collimation	Restricts x-ray to only the selected anatomy, minimizing dose to patient and reducing scatter.

Computed Tomography Angiography (CTA)	A test that uses x-rays to provide detailed pictures of the heart and the blood vessels that go to the heart, lung, brain, kidneys, head, neck, legs, and arms. A CT angiogram can show narrowed or blocked areas of a blood vessel.
Computed Tomography Dose Index (CTDI)	An approximate measure of the radiation dose received in a single CT section or slice.
Computed Tomography Dose Index Volume ($CTDI_{vol}$)	Represents the dose for a specific scan protocol, which considers gaps and overlaps between the radiation-dose profiles from consecutive rotations of the x-ray source. It is not patient dose. The CT dose index volume is noted as $CTDI_{vol}$. It is reported in units of mGy. The $CTDI_{vol}$ is based on measurements made by the manufacturer in a factory setting. The $CTDI_{vol}$ is calculated differently for both the Axial and the Helical mode: For Axial scan mode: $CTDI_{vol} = [(N \times T)/I] \times CTDI_w$. For Helical scan mode: $CTDI_{vol} = 1/pitch \times CTDI_w$. See also dose and patient dose.
Computed Tomography Dose Index ($CTDI_w$) weighted average	The measure of ionizing radiation exposure per slice of data acquisition. CTDI represents the integrated dose along the Z axis from one axial CT scan (one rotation of the x-ray tube). The CT Dose Index is noted as $CTDI_w$.
Computed Tomography (CT) number	Relative value assigned to each pixel to quantify the attenuation occurring in each voxel in comparison with the attenuation of water. The calculated CT number for a given pixel is given in Hounsfield units (HU).
Computed Tomography Perfusion (CTP)	Evaluates cerebral perfusion or level of blood flow in the brain by monitoring the initial passing of iodinated contrast media through the vasculature of the brain.
Contrast media	Used to improve sensitivity and specificity of clinical diagnoses.

Contrast resolution	The ability of a CT system to detect an object with a small difference in linear attenuation coefficient from the surrounding tissue. Also referred to as low-contrast detectability or sensitivity.

D

Digital Imaging Communication in Medicine (DICOM)	Digital Imaging and Communications in Medicine, or DICOM, is a standard that helps people doing work in the field of radiology. The DICOM standard is designed to promote communication and integration between a variety of radiology imaging systems and equipment used in filmless radiology.
Digital tilt	The ability to correct the image post-acquisition and correct positional inaccuracies prior to sending to PACS.
Dose	The generic term that refers to the $CTDI_{vol}$, the standardized parameter to measure scanner radiation output – or the amount of amount of ionizing radiation absorbed by patient per unit mass.
Dose Length Product (DLP)	The measurement of dose for an entire series of CT images. DLP is equal to the calculated dose per section multiplied by the length of a CT acquisition along the Z axis.
Dynamic Host Control Protocol (DHCP)	A standardized network protocol used on Internet Protocol (IP) networks. The DHCP is controlled by a DHCP server that dynamically distributes network configuration parameters, such as IP addresses, for interfaces and services.
Dynamic scan mode (multiple detector widths)	Data acquisition at multiple time points over the same anatomic location(s).

E

Electromagnetic Compatibility (EMC)	The branch of electrical sciences that studies the unintentional generation, propagation, and reception of electromagnetic energy with reference to the unwanted effects (Electromagnetic interference (EMI)) that such energy may induce.
Electromagnetic Interference (EMI)	A disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction. The disturbance may degrade the performance of the circuit or even stop it from functioning.

F

Field of View (FOV)	The diameter of the acquired attenuation data displayed across the image matrix.

H

Helical scan mode	A CT acquisition whereby an x-ray acquisition whereby the x-ray tube and scanner move continuously during scanning, yielding a data set in the form of a helix. Also referred to as spiral.
Hospital Information System/Radiology Information Systems **(**HIS/RIS)	A Radiology Information System (RIS) is the core system for the electronic management of imaging departments. The major functions of the RIS can include patient scheduling, resource management, examination performance tracking, examination interpretation, results distribution, and procedure billing. RIS complements Hospital information systems (HIS) and Picture Archiving and Communication System (PACS) and is critical to efficient workflow to radiology practices.
Hounsfield Unit (HU)	The unit of the CT number scale assigned to each pixel to quantify relative attenuation.

I

Interscan delay time	Minimum amount of time that must transpire between end of one scan and initiation of next scan. Interscan delay times include idle time between scans to allow tube cooling.
Iterative Bone Correction (IBC)	A feature build into the reconstruction software, which performs a correction on every single Axial image the scanner produces, including both primary series from a scan as well as secondary reconstruction images. Current IBC settings were chosen to provide optimal correction for standard medical imaging; however, the setting can be customized as needed.

K

Kernel	A mathematical filter applied to raw data during CT image reconstruction to remove blurring artifact inherent to back-projection. Also referred to as an algorithm.

M

mAs	Tube current-time product: The product of tube current and exposure time per rotation, expressed in units of milliampere seconds (mAs).
Matrix	Two-dimensional (2D) grid numbers arranged in rows and columns.
Maximum Intensity Projection (MIP)	The multiplanar reformation technique that displays only the maximum pixel value along a ray traced through the object to the viewers assumed perspective in front of the scanner display screen.
Mean Transit Time (MTT)	A common measurement during CTP studies of the brain. Refers to the average transit time, in seconds, needed for blood to pass through a given region of brain tissue.

milli amperage (mA)	Tube current: the number of electrons accelerated across an x-ray tube per unit time, expressed in units of milliampere (mA).
Modality Performed Procedure Step (MPPS)	A mechanism for modalities to pass information about the imaging performed back to the HIS/RIS or PACS.
Modality worklist manager	Scheduled (but not yet scanned) patient list.
motion artifact	Voluntary and involuntary patient motion during CT scan, appearing as a streak artifact on image; ghosting or blurring of image.
Multi-Planar Reformation (MPR)	The process of displaying CT images in a different orientation from the one used in the original reconstruction. Allows for reformation of images in planes that would otherwise be difficult or impossible to acquire with CT. Requires only image data. Raw data is not utilized.

N

Noise	Random statistical variations in the signal. Can be quantum noise, electronic noise due to lost signal, or artifact noise. Manifests itself as overall graininess of the reconstructed image.

P

Partial volume artifact	Occurs when an object is only partly positioned within a voxel or is much smaller than the overall voxel volume. The object's attenuation is not accurately represented by the pixel value. Overlapping reconstructions further reduce partial volume artifacts.
Patient Browser, local database	Where the already-scanned patient list is stored.
Patient coordinates	References are as follows: • X left to right. • Y anterior to posterior. • Z head to feet.

Patient dose	The absorbed dose to a patient. See also $CTDI_{vol}$.
Peak kiloVoltage (kV)	The penetrating power of the photons coming from the x-ray tube.
Picture Archive and Communications Systems (PACS)	Stores medical information, including 2D images, and 3D medical images. All modern PACS setups will work with DICOM.
Pitch	In Helical mode, refers to the speed of the scanner movement over the table as the scanner rotates.
Pixel	A single, picture element of image matrix.
Post reconstruction	Prescribing the reconstruction parameters after scan acquisition.
Projection	View of anatomical cross-section from a particular vantage point.
Prone	Patient lying on stomach.
Protocol	Prescribes the acquisition and reconstruction parameters to be used for a scan.

Q

Quality Assurance (QA)	Procedure of performing periodic specified tests or measurements to assure that a set quality level, as specified by system manufacturer, has not been compromised.

R

Radiation Safety Officer (RSO)	The person within an organization responsible for the safe use of radiation and radioactive materials as well as regulatory compliance.
Radio Frequency Interference (RFI)	Also called Electromagnetic Interference (EMI), is an unwanted disturbance that affects an electrical circuit due to electromagnetic radiation emitted from an external source.
Raw data	A transmission measurement obtained by the detectors used to mathematically reconstruct the CT image.
Reconstruction filter	Used to ensure accurate anatomical reconstruction. Also allows for either spatial resolution or low-contrast-resolution enhancement.

Region Of Interest (ROI)	Provides a quantitative analysis of the Hounsfield values of a specific anatomic area. A graphic outline in the shape of a circle is placed over an area on the image. Software calculates the average CT number in HU within the ROI.
Resolution	A scan time, per slice, in Axial mode, only.
Retrospective reconstruction	Reconstruction performed after the initial prospective reconstruction. Multiple retrospective reconstructions of raw data are possible, with changes to display FOV, kernel, slice thickness etc.

S

Scan delay	The time between the initiation of contrast agent administration and CT data acquisition. The chosen scan delay determines the phase of contrast enhancement for a given CT acquisition.
Scan protocol	A list of scanner-load parameters used to perform an x-ray exposure.
Scan types	Axial, Helical, Dynamic, Reference, and Scout.
Scout	Digital survey radiograph acquired by the CT system for the purpose of prescribing the cross-sectional acquisition. Like a conventional radiograph, the scout is produced by translating the scanner over the patient without tube or detector rotation. Also referred to as topogram or scanogram.
Series	A set of images acquired in a scan.
Size Specific Dose Estimate (SSDE)	Not dose to any specific organ but rather the mean dose in the center of the scanned volume. That is, SSDE is not the exact patient dose, as factors such as scan length and patient composition can differ from the assumptions used to calculate SSDE, for example conversion factors based on patient size provided to estimated patient dose for a patient of a particular size.
Slice spacing (Spacing)	The distance between the center of one CT slice and the center of the next slice.

Slice thickness	The dimension of a constructed CT slice along the longitudinal direction of acquisition (Z axis).
Spatial resolution	The ability of a CT imaging system to display fine details, separately. Given in units of line pairs per centimeter (lp/cm).
Supine	Lying on back.

T

Temporal resolution	The ability of a CT system to freeze motion and provide an image – free of blurring.
Test Bolus	Scan mode used to measure the contrast transit time using a small injection of contrast media.
Threshold	The CT number (Hounsfield Unit (HU)) where Bolus Tracking tool will trigger the system to begin the scan.
Time Attenuation Curve (TAC)	A graph of the contrast enhancement versus time. TAC is used to determine blood flow rate in seconds for contrast timing.
Time delay	Monitoring delay: Time from injection to the start of monitoring scans.
Transverse plane	Perpendicular to direction of Z axis.

V

Volume Rendering (VR) image or object	A 3D modeling technique that utilizes the entire acquired dataset but adjusts the opacity of the voxels included in the 3D image according to their tissue characteristics.
Voxel	Abbreviation of volume element. Refers to the volume of tissue represented by a pixel in the matrix used to display the CT image.

W

Window Center (WC)	The pixel value given in Hounsfield Units (HU) at the center of the window width. Window Center controls the brightness (density) of the CT image.

Window Width (WW)	The range of pixel values assigned a shade of gray in the displayed CT image. Window width controls the contrast of the CT image.

Appendix B Listing of All Buttons, Tools, and Icons

Status bar icons

Table 63: Status bar icons

Status bar icon	Status bar icon name	Status description
	**X-ray status**	Identifies x-ray as on or off. The icon changes from a gray/black icon when x-ray is off to a rotating yellow/black icon when x-ray is on.
	**System state**	Identifies the system's current state. The orb changes color depending on the state the system is in. See Table 26 on page 114 for a list of the different orb colors and system states they identify.
	**Scanner position**	Identifies the system's current position relative to its zero reference.
	**System E-STOP status**	Identifies when **E-STOP** is engaged. The icon will flash when **E-STOP** is pressed.

Status bar icon	Status bar icon name	Status description
	**System tube heat status**	Indicates the current X-Ray tube heat status. The values are color coded as follows: Blue 0% - 19% Yellow 20% - 50% Orange 51% - 75% Red 76% - 100% **NOTE:** The scanners tube heat must be below 20% before the scanner powers down. If the tube is too hot, a message will display on the LCD scanner control panel instructing you to wait until the tube heat is low enough to safely power off the scanner.
	**Scanner battery capacity status**	Indicates the remaining scanner battery percentage available. The capacity values are color coded as follows: Green 100% - 51% Yellow 50% - 25% Red 24% - 0%
	**System air freshness status**	Indicates the air freshness status; it is recommended that an air calibration be performed: • Every eight (8) hours. • When the air freshness status falls below 50%. • If the scanner is moved to an area with a dramatic change in humidity and/or temperature. The calibration status values are color coded as follows: Green 100% - 51% Yellow 50% - 25% Orange 24% - 0% After calibration it returns to 100%.

Status bar icon	Status bar icon name	Status description
	**Workstation battery capacity status**	Indicates the remaining workstation battery capacity available. The capacity values are color coded as follows: Green 100% - 21% Yellow 20% - 11% Red 10% - 0% You will be prompted to plug the workstation into an outlet to charge if the battery capacity is low; a scan cannot complete when the battery capacity is 10% or lower. When the workstation reaches the red capacity range, the system will shut down. A message informs you that the system will shut down due to low battery. The lightning bolt icon signifies that the workstation is currently charging and goes away when unplugged.
	**Image storage space status**	Indicates the available disk space for image storage. The available space values are color coded as follows: Green 100% - 51% Yellow 50% - 20% Red 19% - 0%

System state orbs

Table 64: System state orbs

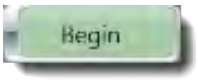
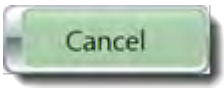
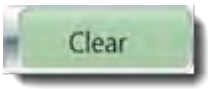
Orb	Color	State
	Dark gray	The system is in an unknown state.

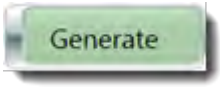
Orb	Color	State
	Light gray	The system is powering up or down.
	Dark purple	The system is busy.
	Purple	The system is completing air calibration.
	Light purple	The system is archiving.
	Blue	The system is idle.
	Green	The system is ready to perform a scan.
	Light yellow	The system is planning.
	Dark yellow	The system is preparing.
	Light orange	The system is reconstructing.
	Dark orange	The system is scanning.
	Pink	The system is not ready.
	Red	The system is in fault.

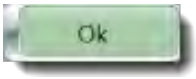
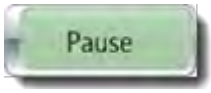
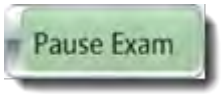
Workstation buttons

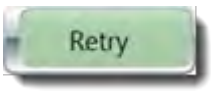
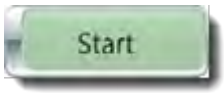
Table 65: BodyTom 64 workstation buttons

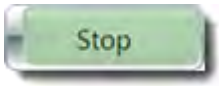
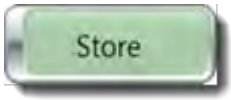
Workstation button	Action
	In **Protocol Manager** – adds a new protocol from the list.
	In **Patient Browser** – selects the archive destination for selected information.

Workstation button	Action
	In **Patient Browser** – used to begin a protocol.
	In **Protocol Manager** – used to create a new protocol from a previously saved protocol.
	In **Patient Browser** – generates the dose for the selected patient.
	In **Patient Registration** – cancels the current query. In **Patient Browser** – cancels any series being imported.
	In **Acquisition** – cancels the entire exam being performed.
	In **Acquisition** – cancels the current scan within a protocol.
	In **System Configuration** – clears information in fields.
	In **Protocol Manager** – closes popup. In **Store/Print Queue** – closes the **Store/Print Queue** popup. In **System Configuration** – closes **System** or **User Configuration** dialog boxes.
	In **Patient Browser** – allows you to select multiple series of patient images to compare in **Viewing.**
	In **Acquisition** – authorizes the scanner to move to the next step.
	In **Patient Registration** – deletes patient(s) from the **Stored Results** list. In **Patient Browser** – deletes selected exam information from **Patient Browser**. In **Store/Print Queue** – deletes a series to be stored or a series that failed to store. In **Protocol Manager** – deletes a saved protocol. In **System Configuration** – clears a saved dose setting to remove the restriction.

Workstation button	Action
	In **System Configuration** – deletes saved dose settings to remove all restrictions.
	In **Store/Print Queue** – when you select one or more series, displays an explanation of why a series failed to store.
	Move selected item down the list.
	In **Patient Registration** – used to modify protocols.
	In **System Configuration** under **DICOM Servers** – echoes the selected server to test the connection.
	While in Interventional Mode, exist the system from the Instant Repeat Feature.
	In **Protocol Manager** – exports protocols to a media device.
	In **Acquisition** – completes the examination. Completes all protocols, builds Dose SR and images, and directs user to **Patient Browser**.
	In **Viewing** - generates a new series with the **Series Description** field information – based on the selected **MPR**.
	In **Patient Browser** – imports the exam information from **PACS** or **Media**. In **Protocol Manager** – imports previously exported protocols to the workstation.
	Performs a 38.4mm axial scan at the current scanner location while in the Interventional Mode
	In **Patient Registration** – manually enters a new patient and, when completed, takes you to the **Acquisition** tab to acquire the data for a scan.
	In **Patient Browser** – used to select the destination for patient data to media.

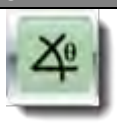
Workstation button	Action
	In **Patient Browser** – minimizes the **Import for Media** popup.
	While in Interventional Mode, move the scanner to the last scanned position and performs a 38.4mmm axial scan.
	In **Protocol Manager** – used to create a new protocol.
	To accept the selections you make.
	In **Patient Browser** – used to select the destination for patient data to **PACS**.
	In **Patient Browser** – used to select only patient information for a patient when using **Register** feature.
	In **Patient Browser** – used to select all exam information for a patient when using **Register** feature.
	In **Store/Print Queue** – when you select one or more series, temporarily stops the series from being stored. This is a toggle button with the **Resume** button.
	In **Acquisition** – pauses entire protocol.
	In **Acquisition** – pauses current scan within a protocol.
	In **System Configuration** under **Audio Configuration** – used to play audio files.
	For **Quality Assurance** – used to prepare workstation to run a **Quality Assurance** test.
	In **Acquisition** – selects an existing protocol for the current study.

Workstation button	Action
	In **Patient Registration** – searches the **HIS/RIS** server for scheduled patients.
	In **Patient Registration** – registers the selected patient and then takes you to the **Acquisition** tab to acquire the data for an examination (scan). In **Patient Browser** – opens the **Create New Study** dialog box and moves selected patient to **Acquisition**.
	In **Patient Registration** – used to take patient information stored in **HIS/RIS** server to **Patient Registration** to choose the patient and study.
	In **Acquisition** – repeats the last scan that was performed.
	In **Post Reconstruction**, sends the last acquired scan from the recon workstation to the Patient Browser.
	In **Viewing** – reverts all images back to original state. In **System Configuration** – resets information back to default or clears information in fields.
	In **Store/Print Queue** – when you select one or more series, continues to store previously paused series. This is a toggle button with the **Pause** button.
	In **Store/Print Queue** – when you select one of more series, tries to archive the selections.
	In **System Configuration** – saves updated information.
	In **Patient Registration** – searches queried patient entries for specific information.
	In **Patient Browser** – shows patient, study, series, and image information; used to modify series scanned under a wrong patient.
	For **Daily Calibration** – begins the daily (air) calibration.

Workstation button	Action
	In **Acquisition** – begins any post-reconstructions that were defined during the protocol setup. In **Post Recons** – begins a manual reconstruction
	In **System Configuration** under **Audio Configuration** – stops audio files from playing.
	In **Patient Registration** – selects patient(s) from query results and moves them into the **Stored Results** list.
	In **System Configuration** under **User Accounts** – used by administrators to unlock a user's account.
	Move selected item up the list.
	In **Protocol Manager** – updates information on an existing protocol. In **System Configuration** – updates information.
	In **Acquisition** – prompts the application to send the selected protocol to the scanner and verify that the scanner has tube and battery capacity to perform the protocol.
	In **Patient Registration** – shows selected patient details. In **System Configuration** – shows information.
	In **Viewing** – to load and views images.

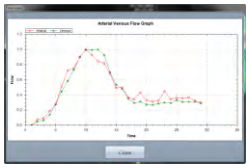
Viewing tools

Table 66: Viewing tools

Tool	Tool name	Action
	**Angle**	**2D, CTP, and Viewing tool** – draws an angle on the image and displays the angle information.
	**Arrow**	**2D, CTP, and Viewing tool** – draws an arrow on the image, which can be repositioned.

Tool	Tool name	Action
	**Calculate CBF, CBV, MTT Map**	**CTP only tool** – calculates the Cerebral Blood Flow (CBF), Cerebral Blood Volume (CBV) and Mean Transit Time (MTT) maps.
	**Clear Perfusion Map**	**CTP only tool** – cancels the calculations and returns to **Calculation** mode.
	**Capture**	**Common tool** - saves a screen capture of selected viewport.
	**Capture all Viewports**	**Common tool** - saves screen captures of all visible viewports.
	**Cine Reverse**	**2D only tool** – cines backward through the images.
	**Cine Forward**	**2D only tool** – cines forward through the images.
	**Clear Active**	**Common tool** (**Acquisition**, **Post Reconstruction**, **Viewing**) - resets the tool to the default pointer device.
	**Field Of View**	**Post Reconstruction tool** – adjusts the **Field Of View** (**FOV**) prior to reconstruction.
	**Flip Horizontal**	**2D only and Viewing tool** – flips images right or left.
	**Flip Vertical**	**2D only and Viewing tool** – flips images up or down.
	**Invert**	**Common tool** (**Viewing**) - inverts black to white and white to black.
	**Load**	**Viewing tool** – loads images from selected series into viewing.
	**Measure (Line)**	**2D, CTP, and Viewing tool** – draws a line on the image and displays length information.

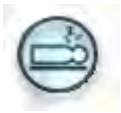
Tool	Tool name	Action
	**Pan**	**Common tool** (**Acquisition**, **Post Reconstruction**, **Viewing**) - click and move pointer over image. Left click and hold down the mouse button and drag the image in the chosen direction. Release mouse button to position image in new location.
	**Peak Image**	**CTP only tool** – displays the image that has the most visible contrast (based on arterial **ROI** placement).
	**Perfusion Artery/Vein Selection**	**CTP only tool** – selects the artery and vein to be used for performing perfusion calculations.
	**Redo**	**Axial and Helical Viewing tool** – restores the last text editing or resizing and positioning of controls – if no other action occurred since last time the **Undo** button was clicked.
	**Redo**	**Viewing tool** – performs the most recent action, again. The button is disabled if the application cannot redo the application.
	**Region of Interest (ROI)**	**2D, CTP, and Viewing tool** – defines a circular **ROI** and displays the **ROI** information (5mm diameter by default).
	**Reset**	**Post Reconstruction and Acquisition tool** – resets the display to default viewer settings.
	**Reverse Image Stack**	**2D only and Viewing tool** – reverses the order in which images display.
	**Rotate**	**MPR only and Viewing tool –** rotates the image.
	**Scan Region Re-Draw**	**Acquisition tool** – if scout lines and the scan region is deactivated, allows you to reactivate.

Tool	Tool name	Action
	**Show Artery/Vein Flow Graph**	**CTP only tool** – displays the Arterial Venous Flow graph. 
	**Stop**	**Post Reconstruction tool** – cancels the current, post-reconstruction request. All images are generated until you click the **Stop** button.
	**Stop Cine**	**2D only tool** – stops the cine loop.
	**Text (Annotation)**	**2D only and Viewing tool** – creates text box for annotation.
	**Tilt**	**MPR only tool –** corrects a rotated image.
	**Toggle Layout**	**Acquisition tool** – changes the layout to 2x2. Repeat process to return to 1x1.
	**Toggle Scouts**	**Acquisition tool** – removes scouts from **Acquisition**.
	**Undo**	**Axial and Helical Viewing tool** – reverses the most recent action taken (a successful copy, cut, delete, undo or paste action).
	**Undo**	**Viewing tool –** removes the most recent action performed on image. The workstation remembers the last five adjustments made. The tool is disabled if the workstation cannot redo the adjustment.

Tool	Tool name	Action
	**Window Width/Center**	**Common tool** (**Acquisition**, **Post Reconstruction**, **Viewing**) – click and move pointer over image. Left click and hold the mouse button and drag in chosen direction to adjust Window Width and Window Center. Width and center values appear in the **Width/Center** status display. A pre-defined width/center setting can also be selected. Select the preset from the dropdown list below the **Windowing Preset** button. Width and center presets can also be saved or deleted.
	**Zoom**	**Common tool** (**Acquisition**, **Post Reconstruction**, **Viewing**) - click and move the pointer over the image. Left-click the mouse and hold down the left-mouse button and move in upward direction to zoom in (enlarge) and downward to zoom out (shrink).

Table 67: Pendant buttons

Pendant	Button	Description	Action
		**POWER**	Illuminates when power is supplied to pendant.
		**LASER**	Turns on all three positional lasers. While the lasers are on, the scanner spins for the internal laser to be seen within the scanner opening.
		**GO TO SCAN PLANE**	Moves the scanner forward approximately 30cm. This is the distance between the internal and external lasers.
		**ZERO REFERENCE**	Sets the scanner to zero before starting a scout or a scan.
		**MOVE BACKWARD (slow)**	Pressing and holding moves the scanner backward 10mm per second.
		**MOVE FORWARD (slow)**	Pressing and holding moves the scanner forward 10mm per second.
		**MOVE BACKWARD (fast)**	Pressing and holding moves the scanner backward 60mm per second.
		**MOVE FORWARD (fast)**	Pressing and holding moves the scanner forward 60mm per second.
		**SET MEMORY**	Allows the user to program **Scan** and **Rest** positions for the scanner.

		**SCAN POSITION**	Moves the scanner to the **Scan Position** saved using the Set Memory feature.
		**REST POSITION**	Moves the scanner to the **Rest Position** saved using the Set Memory feature.

Appendix C Sample of Reference Protocols Provided

Table 68: Sample of BodyTom 64 adult protocols and important estimates

Protocol Name	Type	kV	mA	Slice Thickness /Spacing	Sharpness	Resolution	Coverage	$CTDI_{vol}$ (mGy)	DLP[4] (mGy.cm)
Adult Head Axial	Axial	120	200	4.8 x 4.8	Soft Tissue	1 Sec.	250	47.32	1183
C-Spine Helical	Helical	120	250	1.2 x 1.2	Soft Tissue - Abdomen	Pitch = 0.8	400	24.16	966.4
Adult Chest Helical	Helical	120	150	1.2 x 1.2	Bone	Pitch =0.8	450	14.49	652.05
Adult Abdomen Helical	Helical	120	250	2.4 x 2.4	Soft Tissue - Abdomen	Pitch = 0.8	500	24.16	1208

Table 69: Sample of BodyTom 64 pediatric protocols and important estimates

Protocol Name	Type	kV	mA	Slice Thickness /Spacing	Sharpness	Resolution	Coverage	$CTDI_{vol}$ (mGy)	DLP[5] (mGy.cm)
Pediatric Head Axial	Axial	100	175	4.8 x 4.8	Soft Tissue	1 Sec.	200	32.02	640.4

[4] DLP is based on length from coverage column

[5] DLP is based on length from coverage column

Appendix D Automatic Exposure Control

1 Introduction:

Automatic Exposure Control (AEC) is a feature which allows the exposure to automatically be modified based on the attenuation of the scanned object. The main objective of AEC is to optimize the x-ray current based on prior knowledge of the scanned objects profile. AEC is used to optimize patient exposure while attempting to maintain acceptable diagnostic quality of the reconstructed images.

AEC uses image noise to optimize the scan current. The image noise on CT scanners can be traced to two sources: **Electronic Noise** and **Quantum Noise.** Electronic Noise is generated by the electronic components of the Data Acquisition System (DAS). **Quantum Noise** is related to x-ray generation. Currently **Quantum Noise** is the major component of noise on CT images, the contribution of **Electronic Noise** has become less significant since the early days of CT scanners.

2 Image Noise:

2.1 Electronic Noise:

The DAS is composed of the crystals, the photodiodes, the Analog to Digital Convertors (ADC) and other electronic components known as “converter cards” since they convert x-rays into a quantifiable current. Thermal Noise is the most common source of electronic noise in the CT system. As the scanners internal temperature increases thermal noise becomes the dominant component of the DAS’s electronic noise. Imperfections in the semiconductor chips used in the DAS also contribute to the Electronic Noise. However, with the advance in semiconductor crystals this has become less relevant. Currently Electronic Noise has no significant impact on image quality when using proper scan parameters, i.e., scan voltage, current and exposure.

2.2 Quantum Noise:

The generation of x-ray photons can be described by a Poisson random process. Poisson random processes are used to describe event generation over a fixed time interval. A Poisson random process is used to describe Queues in general. In a queue the number of new arrivals to the queue over a fixed time interval follow a Poisson distribution.

The **Quantum Noise** is related to the standard deviation of the Poisson distribution which inversely proportional to the square roots of the number of events:

$$\sigma_I \propto \frac{1}{\sqrt{N}}$$

Where **σ** is the image noise and ***N*** is the number of detected photons. The above equation can help relate the image noise to the scan current, ***I***, the scan time, ***t***, and the slice thickness, ***Sw***, since the number of photons is proportional to either one:

$$N \propto It \ \ and \ N \ \propto Sw$$

The image noise of a given scanner can be written as a function of the scan parameters:

$$\sigma = \frac{K}{\sqrt{I \cdot t \cdot Sw}}$$

To reduce the image noise, we can either increase the scan current, the scan time or the slice width, or any combination thereof. ***K*** is constant that is dependent on the image reconstruction process. It follows, for two different scan currents I_1 and I_2 over the scan times t_1 and t_2 and using the same slice thickness, the image noises for the two scans can be related using the following equation:

$$\frac{\sigma_2}{\sigma_1} = \sqrt{\frac{I_1 \cdot t_1}{I_2 \cdot t_2}} \ or \ \sigma_2 = \sqrt{\frac{I_1 \cdot t_1}{I_2 \cdot t_2}}\ \sigma_1$$

The same relation exists between the image noise and the slice thickness

$$\frac{\sigma_2}{\sigma_1} = \sqrt{\frac{Sw_1}{Sw_2}} \ or \ \sigma_2 = \sqrt{\frac{Sw_1}{Sw_2}}\ \sigma_1$$

As a result, doubling the slice thickness can reduce the image noise by almost 40%. Figure 1 shows the Noise as a function of the scan current (left) and the inverse of the scan current (right). The scan done for the same slice thickness of 2.5 mm and same scan time of 1 second.

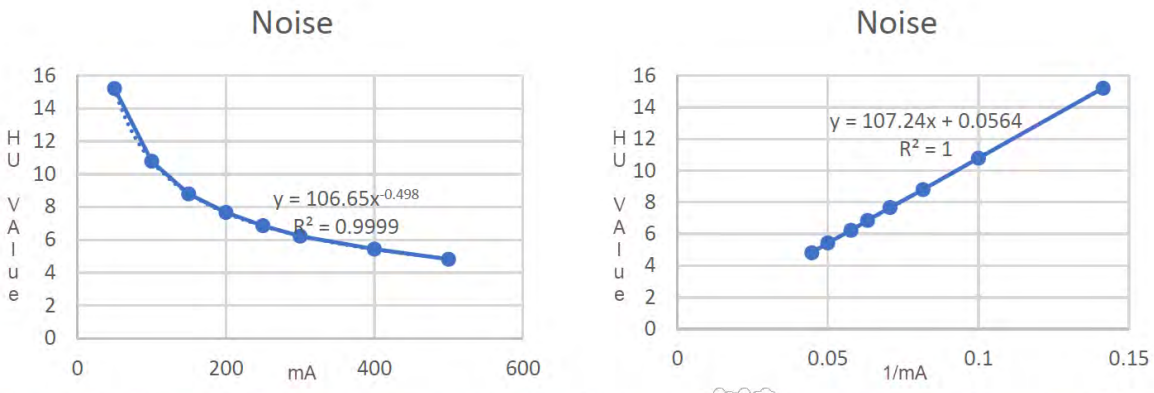


Figure 1: The Noise in a 20 cm water phantom as a function of the scan current I (left) and the inverse of square root of the current $1.0/\sqrt{I}$.

3 AEC working instructions:

3.1 AEC input parameters:

AEC requires three different input parameters: Minimum mA, Maximum mA, and the Noise Level.

Minimum mA: The Minimum mA is set to prevent an unacceptable amount of noise in the reconstructed images.

Maximum mA: The Maximum mA value is used to prevent over-exposure of the patient being scanned. This is typically set to reduce the chances of over exposure which may lead to radiation sickness. However, in the case of the BodyTom 64, the maximum scan current is set to protect the x-ray tube.

The noise level: The first step of AEC is to build an equivalent stack of cylindrical water phantoms or Water Equivalent Diameter (WED). The WED is created based on the measured attenuation from the scout. The noise level represents the noise in each section of the stack of water equivalent phantoms. The selected noise level should be within an acceptable range, and it should be dictated by the scan protocol.

One of the key features of the scanners AEC is the ability the user has to re-adjust the noise level based on the estimated mA until the desired mA profile is attained. The feature works as follows:

1. A protocol is created with the AEC feature enabled, and a Minimum mA, Maximum mA, and Noise Level are defined.

2. The above-mentioned protocol is used to create a Scout image.

3. The user can toggle the AEC graph to view the scan current profile. The profile will be overlayed on top of the scout.

4. If the scan current profile is acceptable, then the user will initiate the diagnostic scan as desired.

5. If the scan profile is not acceptable, the user can **adjust** the noise level and **recalculate** the scan current.

6. The process can be repeated as many times as needed until the user is satisfied with the current profile. The AEC tool will allow the user to view the scan current before initiating the actual scan.

3.2 The scan parameters:

The scan protocol parameters are not needed for AEC however they do affect the current estimation:

1. **kV**: the scan kV is used to select the appropriate noise table used for estimating the scan mA.

2. **Slice Thickness:** The noise is measured at a slice thickness of 5.0 mm; however, the scan protocol slice thickness can be any of the allowable thickness values. The selected slice thickness is then used to adjust the noise table using the equation in section 2.2. The entire noise table will be multiplied by the square root of the slice thickness ratio. The multiplication factor is:

$$\alpha = \sqrt{\frac{5.0}{Selected\ Sw\ in\ mm}}$$

3. **The reconstruction kernel:** The noise image depends on the reconstruction kernel. AEC is limited to SoftTissue and PostFossa Kernels. AEC will be disabled if the user selects a different reconstruction kernel.

3.3 Notes

When AEC is selected the user should be aware of:

1. **Patient Positioning:** The patient should be properly positioned as close as possible to the scanner iso-center. Failure to do so can lead to an over-estimate of the scan current leading to an increase in patient dose.

2. **Presence of metal implants:** AEC should not be used if the patient has metal implants in the region to be scanned.

3. **The measured noise:** the final noise in the image depends on the size of the scanned patient. AEC assumes that the patient is cylindrical, as such the measured noise level could be different then the selected noise level.

4. **Anatomical features:** AEC should be used when the region to be scanned includes significant differences in attenuation, such as the chest and abdomen. Anatomical regions with slight differences in attenuation like the head, will not benefit from AEC use.

3.4 Sample protocols:

Below are some suggested protocols. The noise levels depend on the size and weight of the patient. The noise levels in the table below are for illustration purposes. The site physicist and CT manager should dictate the final noise levels.

	Noise Level	Minimum mA	Maximum MA	Slice thickness
Chest scanning	15	50	250	1.2
Chest/Abdomen	13	50	280	2.4

4 AEC algorithm description:

AEC uses the measured attenuation of the scanned object and the selected noise level to estimate the scan current at each planned scan location during the scan. The mA is typically estimated using different water phantom diameters.

The BodyTom 64 uses Z-modulated AEC where each planned scan location is modeled using a cylindrical water phantom, or WED. The WED is calculated using the scout profile. Once the WED is estimated a specific mA value is assigned to each planned scan location. The Flowchart (Figure 2) below describes the basic steps for using AEC:

1. Select the appropriate AEC parameters to be used, those values are:
   a. Minimum mA
   b. Maximum mA
   c. Noise Level

2. Acquire a Scout using the same kV that will be used for the Axial or Helical acquisition.

a. An AP or Lateral Scout can be used; however, AP scouts are preferred.

3. For each planned slice, the system calculates the WED and assigns a specific mA value to that location. Figure 3 shows the WED of the equivalent water phantoms as calculated based on the scout image (left). The estimated diameters (right) shows that the water portion of the phantom match the true diameter of the phantom.

4. Using the measured noise in different diameters water phantoms at different mA levels, find the mA that generates the selected noise level.

5. Adjust the mA based on the scan mode. Figure 4 shows the estimated mA as well as the adjusted mA for the axial scan mode.

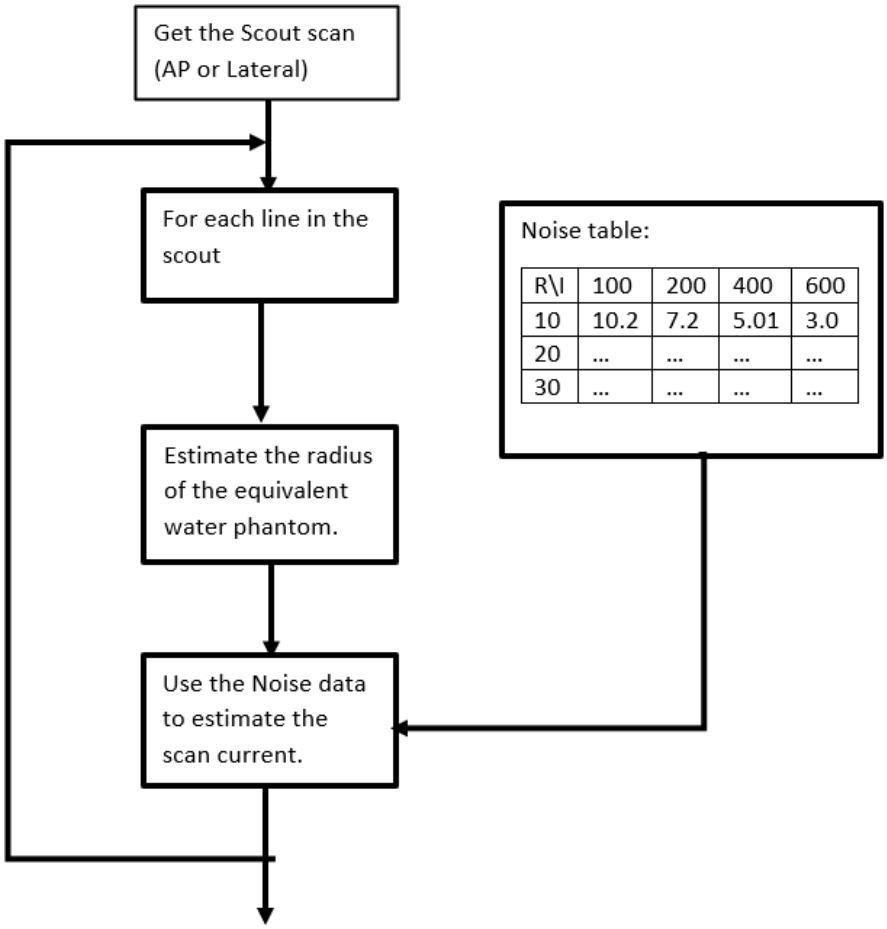


Figure 2: The AEC flowchart

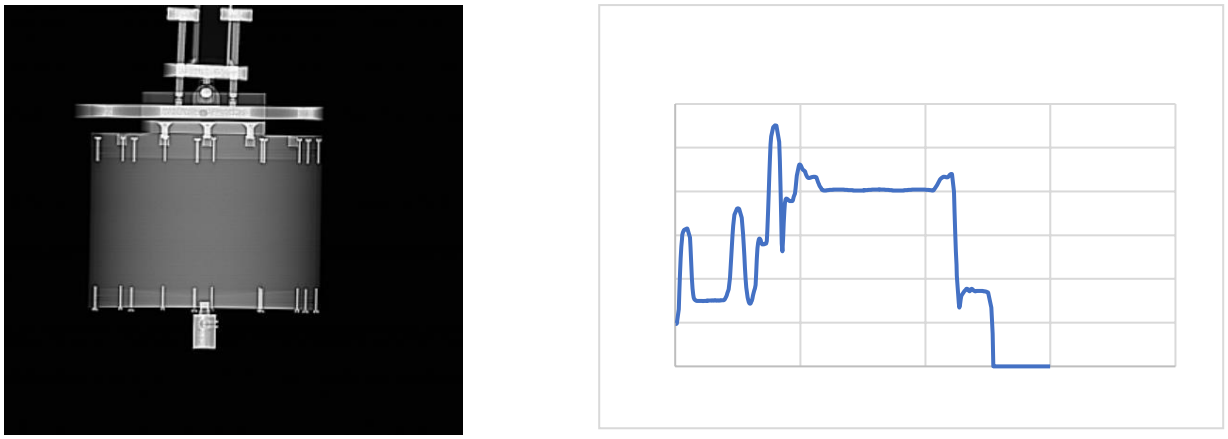


Figure 3: the AP scout of a 20 cm water phantom and the estimated radius based on the scout.

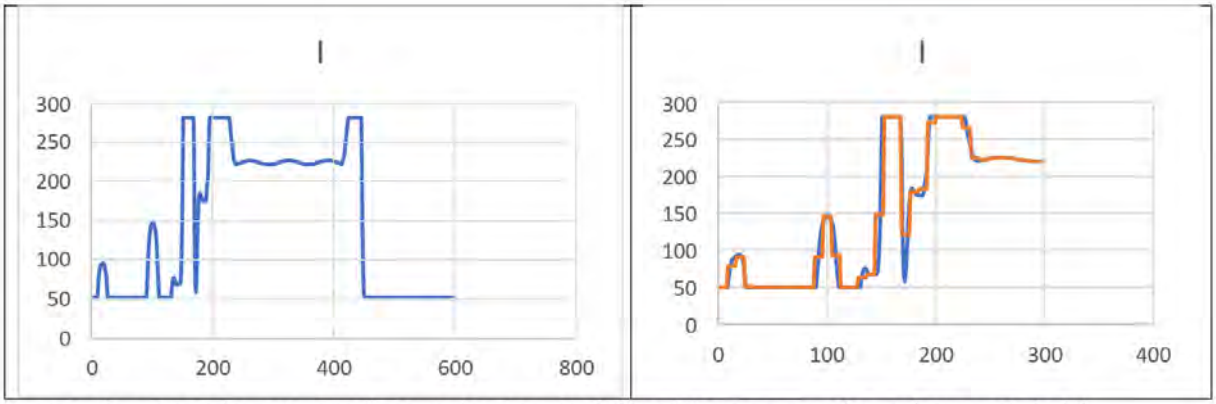


Figure 4: The estimated current using the equivalent diameter (left) and the scan current for axial scan mode (right).

5 The Noise measurements:

The noise tables used for predicting the scan current is measured for each scan voltage. For each scan voltage the noise is measured using a set of predefined scan currents of 50, 100, 150, 200, 250 and 300 mA. The noise is measured using different water phantoms. In our case we have used 150, 200 and 300-mm water phantoms. Table 70 shows a sample of the noise table at 120 kV.

Table 70: The measured noise at 120 kV

Phantom Diameter (mm)	Scan Currents (mA)					
	50	100	150	200	250	300
100	7.5868	5.4078	4.4009	3.8519	3.4769	3.1679
150	10.76	7.6690	6.2493	5.4768	4.8741	4.4806
200	17.41	12.3721	10.1349	8.8315	7.8699	7.1964
250	28.400	20.2000	16.4000	14.3000	12.7000	11.6000
300	49.952	35.6299	28.7523	24.9660	22.3726	20.2553

For example, if we desired to determine scan current in a 175mm water phantom that has 10 HU noise at 120 kV using the above table. The Noise is modeled using a 2-dimensional function of the current and the scan current. The scan current is then extracted from the 2D model. The noise is measured using a nominal slice width, typically 5.0 mm. The noise table will then be normalized based on the selected slice thickness of the scan protocol.

Appendix E Rotating Anode X-Ray Tube

VAREX IMAGING

GS-3073

Rotating Anode X-Ray Tube Tubes
Radiogénes à Anode Tournante
Drehanoden - Röntgenröhre
Tubos de Rayos-X con Ánodo Giratorio

Note: Document originally drafted in the English language.
Note : Document à l'origine rédigé dans l'anglais.
Anmerkung: Dokument ursprünglich gezeichnet in der englischen Sprache.
Nota: Documento elaborado originalmente en la lengua Inglesa.

Product Description

The GS-3073 is a 5.5" (140 mm) 150 kV, 2.5 MJ (3.5 MHU) maximum anode heat content, rotating anode insert. This insert is specifically designed for CT Scanners. The insert features a 7° tungsten-rhenium facing on molybdenum with a graphite backed target and is available with the following nominal focal spot:

0.7 x 0.8
1.2 x 1.4
IEC 60336

Loading Factor for slit focal:
Small - 120 kV, 100 mA
Large - 120 kV, 200 mA

Maximum Anode Cooling Rate:
8,750 W (12,250 HU/sec)

Maximum continuous anode heat dissipation:
3,400 W (4,760 HU/sec)

Nominal Anode Input Power:
Small - 23 kW IEC 60613
Large - 42 kW IEC 60613

Reference Axis:
Perpendicular to port face.

This insert is intended for use in a Varex Imaging B-240H housing.

Description du Produit

Le tube GS-3073, est une tube à anode tournante de plateau 140 mm, (5,5 pouces), 150 kV, d'une capacité therimque de 2,5 MJ (3,5 MUC). Il est à spécialement concu pour une utilisation avec les scanners CT. Le pente de l'anode en molybdéne traitée, tungsténe, rhènium, recourte de graphite, est de 7°. La dimension des foyers est de:

0,7 x 0,8
1,2 x 1,4
CEI 60336

Facteur de charge pour foyer à fente:
Petit - 120 kV, 100 mA
Grand - 120 kV, 200 mA

Toux maximum de refroidissement de l'anode:
8,750 W (12,250 UC/sec)

Description calorifique maximim de l'anode (en continu):
3,400 W (4,760 UC/sec)

Puissance Nominale de l'anode:
Petit - 23 kW CEI 60613
Grand - 42 kW CEI 60613

Référence axe:
Perpendiculaire à la face de sortie.

Ce tube est essentiellement destiné à être employé dans les gaines Varex Imaging des séries B-240H.

Produktbeschreibung

Die GS-3073 ist eine 140 mm (5.5") Doppelfokus Drehanoden-Röntgenröhre, mit einer Anoden Wärmespeicherkapazität von 2.5 MJ (3.5 MHU) und einer max. Spannungsfestigkeit von 150 kV. Die Röntgenröhre wurde für den Einsatz an CT Scanners entwickelt. Der rückseitig graphitbeschichtete Wolfram Rhenium-Molybdän Anodenteller besitzt einen Winkel von 7°. Folgende Brennfleckkombination ist lieferbar:

0.7 x 0.8
1.2 x 1.4
IEC 60336

Ladefaktor:
Klein - 120 kV, 100 mA
Gross - 120 kV, 200 mA

Nennleistung der Anode:
8,750 W (12,250 HU/sek)

Maximale kontinuierliche Wärmeableitung des Anodentellers:
3,400 W (4,760 HU/sek)

Nominale Anoden Eingangsleistung:
Klein - 23 kW IEC 60613
Gross - 42 kW IEC 60613

Referenz Achsen:
Senkrecht zum Strahlenaustrittsfenster.

Die Röntgenröhre ist für den Einbau in die Varex Imaging Strahlerhaube B-240H vorgesehen.

Descripcion del Producto

El GS-3073 es un tubo de ánodo giratorio de 140 mm (5.5"), 150 kV, 2.5 MJ (3.5 kUC), la cual es el maximo almacenaje termal del anodo, es diseñado especificamente para uso en CT scannners. El blanco emisor es una combinación de tungsteno, renio y molibdeno con grafito en la parte posterior con un rayo central de 7 grados. Disponible con las siguientes combinaciones de marcas focales:

0.7 x 0.8
1.2 x 1.4
IEC 60336

Carga Electrica Para la Abertura Focal:
Pequeño - 120 kV, 100 mA
Grande - 120 kV, 200 mA

Medida Maxima del Enfriamiento del Anodo:
8,750 W (12,250 HU/seg)

Maxima disipación termal continuo del Anodo:
3,400 W (4,760 HU/seg)

El Poder de Penetración para el Anodo Nominal:
Pequeño - 23 kW IEC 60613
Grande - 42 kW IEC 60613

Referencia de axes:
Perpendicular a la abertura facial.

Este tubo es diseñado, para uso en los encajes Varex Imaging de la serie B-240H.

133595-000 Rev A 01/17

VAREX IMAGING

GS-3073

Volumetric / Helical Scan Ratings IEC 60613
Tableaux des Caractéristiques Nominales de Balayage Volumétrique/Hélicoïdal CEI 60613
Volumen-/Spiralbelichtungs-Leistungdiagramme IEC 60613
Volumétrico/Clasificación Grafica del Escán/Helicoideo IEC 60613

3Ø 60 Hz ■

0.7 x 0.8 Focal Spot 7 Degrees
0,7 x 0,8 Dimension Focale 7 Degrés
0.7 x 0.8 Brennfleck 7 Grad
0.7 x 0.8 De Marcas Focales 7 Grados

Volume Scan Time (Seconds)	MAXIMUM ALLOWED TUBE CRRENT (ma) AS A FUNCTION OF THE FOLLOWING STARTING HEAT STORAGE AND TUBE VOLTAGES								
	Starting H.S. = 16%			Starting H.S. = 33%			Starting H.S. = 50%		
	120 kV	130 kV	140 kV	120 kV	130 kV	140 kV	120 kV	130 kV	140 kV
1	125	100	100	125	100	100	125	100	100
2	125	100	100	125	100	100	125	100	100
4	125	100	100	125	100	100	125	100	100
10	125	100	100	125	100	100	125	100	100
20	125	100	100	125	100	100	125	100	100
30	125	100	100	125	100	100	125	100	100
40	125	100	100	125	100	100	125	100	100
50	125	100	100	125	100	100	125	100	100
60	125	100	100	125	100	100	125	100	100
70	125	100	100	125	100	100	100 (a)	100 (a)	100 (a)

3Ø 180 Hz ■

0.7 x 0.8 Focal Spot 7 Degrees
0,7 x 0,8 Dimension Focale 7 Degrés
0.7 x 0.8 Brennfleck 7 Grad
0.7 x 0.8 De Marcas Focales 7 Grados

Volume Scan Time (Seconds)	MAXIMUM ALLOWED TUBE CRRENT (ma) AS A FUNCTION OF THE FOLLOWING STARTING HEAT STORAGE AND TUBE VOLTAGES								
	Starting H.S. = 16%			Starting H.S. = 33%			Starting H.S. = 50%		
	120 kV	130 kV	140 kV	120 kV	130 kV	140 kV	120 kV	130 kV	140 kV
1	175	175	150	175	175	150	175	175	150
2	175	175	150	175	175	150	175	175	150
4	175	175	150	175	175	150	175	175	150
10	175	175	150	175	175	150	175	175	150
20	175	175	150	175	175	150	175	175	150
30	175	175	150	175	175	150	175	175	150
40	175	175	150	175	175	150	175	150	150
50	175	175	150	175	175	150	150 (a)	150 (a)	125 (a)
60	175	175	150	175	175	150	125 (a)	125 (a)	100 (a)
70	175	150	150	150 (a)	150 (a)	125 (a)	100 (a)	100 (a)	100 (a)

3Ø 60 Hz ■

1.2 x 1.4 Focal Spot 7 Degrees
1,2 x 1,4 Dimension Focale 7 Degrés
1.2 x 1.4 Brennfleck 7 Grad
1.2 x 1.4 De Marcas Focales 7 Grados

Volume Scan Time (Seconds)	MAXIMUM ALLOWED TUBE CRRENT (ma) AS A FUNCTION OF THE FOLLOWING STARTING HEAT STORAGE AND TUBE VOLTAGES								
	Starting H.S. = 16%			Starting H.S. = 33%			Starting H.S. = 50%		
	120 kV	130 kV	140 kV	120 kV	130 kV	140 kV	120 kV	130 kV	140 kV
1	250	250	225	250	250	225	250	250	225
2	250	250	225	250	250	225	250	250	225
4	250	250	225	250	250	225	250	250	225
10	250	250	225	250	250	225	250	250	225
20	250	250	225	250	250	225	250	225	225
30	250	250	225	250	250	225	225	225	200
40	250 (b)	225 (b)	200 (b)	250 (b)	225 (b)	200 (b)	175 (a)	175 (a)	150 (a)
50	225	225	200	225 (a)	200 (a)	175 (a)	150 (a)	150 (a)	125 (a)
60	225	200	200	175 (a)	175 (a)	150 (a)	125 (a)	125 (a)	100 (a)
70	200 (a)	200 (a)	175 (a)	150 (a)	150 (a)	125 (a)	100 (a)	100 (a)	100 (a)

3Ø 180 Hz ■

1.2 x 1.4 Focal Spot 7 Degrees
1,2 x 1,4 Dimension Focale 7 Degrés
1.2 x 1.4 Brennfleck 7 Grad
1.2 x 1.4 De Marcas Focales 7 Grados

Volume Scan Time (Seconds)	MAXIMUM ALLOWED TUBE CRRENT (ma) AS A FUNCTION OF THE FOLLOWING STARTING HEAT STORAGE AND TUBE VOLTAGES								
	Starting H.S. = 16%			Starting H.S. = 33%			Starting H.S. = 50%		
	120 kV	130 kV	140 kV	120 kV	130 kV	140 kV	120 kV	130 kV	140 kV
1	375	350	325	375	350	325	375	350	325
2	375	350	325	375	350	325	375	350	325
4	375	350	325	375	350	325	375	350	325
10	350 (b)	300 (b)	300 (b)	350 (b)	300 (b)	300 (b)	350 (b)	300 (b)	300 (b)
20	350 (b)	300 (b)	300 (b)	350 (b)	300 (b)	300 (b)	325	300	275
30	300 (b)	275 (b)	250 (b)	300 (b)	275 (b)	250 (b)	250 (a)	225 (a)	200 (a)
40	250 (b)	225 (b)	200 (b)	250 (b)	225 (b)	200 (b)	175 (a)	175 (a)	150 (a)
50	250 (b)	225 (b)	200 (b)	225 (a)	200 (a)	175 (a)	150 (a)	150 (a)	125 (a)
60	250 (b)	225 (b)	200 (b)	175 (a)	175 (a)	150 (a)	125 (a)	125 (a)	100 (a)
70	200 (a)	200 (a)	175 (a)	150 (a)	150 (a)	125 (a)	100 (a)	100 (a)	100 (a)

Note:
1. Limits are based on maximum track rating except for the following codes:
a - Limited by available heat storage.
b - Limited by window heating.
c - Limited by filament emission.
2. H.S. = Heat Storage
kV = Tube Voltage

Remarque:
1. Les limites sont fonction de l'indice maximal de surface de l'anode, sauf pour les codes suivants:
a - Limité par le stockage thermique disponible.
b - Limité par le chauffage de la fenêtre.
c - Limité par le rayonnement des filaments.
2. H.S. = Stockage Thermique
kV = Tube Voltage

Anmerkungen:
1. Grenwerte basieren auf der maximalen Anodenoberflächenleistung mit Ausnahme der folgenden Codes:
a - Durch verfügbare Wärmekapazität begrenzt.
b - Durch Öffnungserwärmung begrenzt.
c - Durch Glühfadenemission begrenzt.
2. H.S. = Wärmekapazität
kV = Röhre Spannung

Nota:
1. La clasificación de la marca maxima son limitadas, excepto por los siguientes codigos:
a - Limitado por el almacenaje de calor disponible.
b - Limitado por el calor de conducción de la ventanilla.
c - Limitado por la emisión del filamento.
2. H.S. = Almacenaje de calor
kV = Tubo Voltaje

Note:
Rating charts reflect maximim tube performance. Tube operation is ultimately limited by system software.

Remarque:
Abaques de caractéristiques représentent des valeurs maximales. L'utilisation du tube est finalement limitée par le logiciel du système.

Anmerkungen:
Die leistungsdiagramme reflektieren die maximale Röhrenleistung. Der Röhrenbetrieb ist ultimativ zu begrenzen durch die Systemkontrollsoftware.

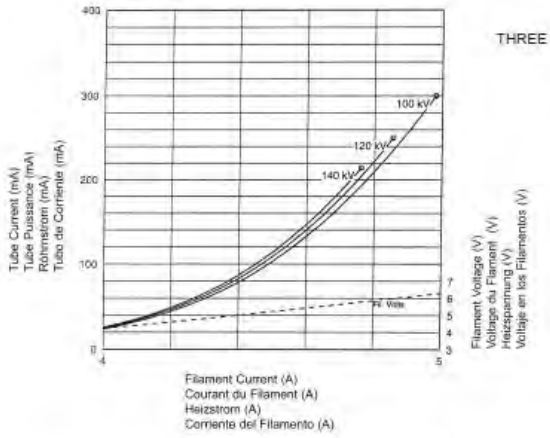
Nota:
El maximo poder del tubo es reflectada en el clasificación diagrama. La operación del tubo es ultimamente limitada por el control del sistema programado.

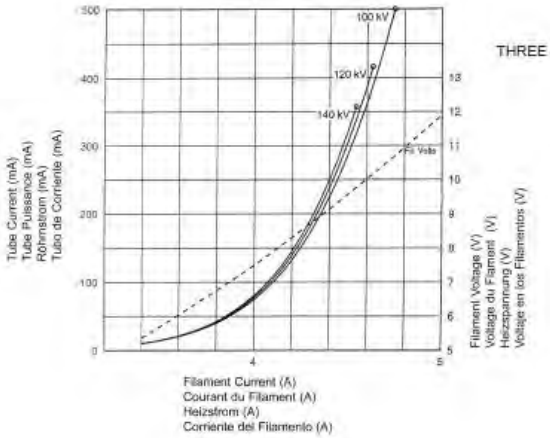
VAREX IMAGING

GS-3073

3 Ø ⎓

Cathode Emission Characteristics Charts IEC 60613
Caractéristiques d'Émission du Filament CEI 60613
Kathoden - Emissionskennlinien IEC 60613
Características de Emisión del Cátodo IEC 60613

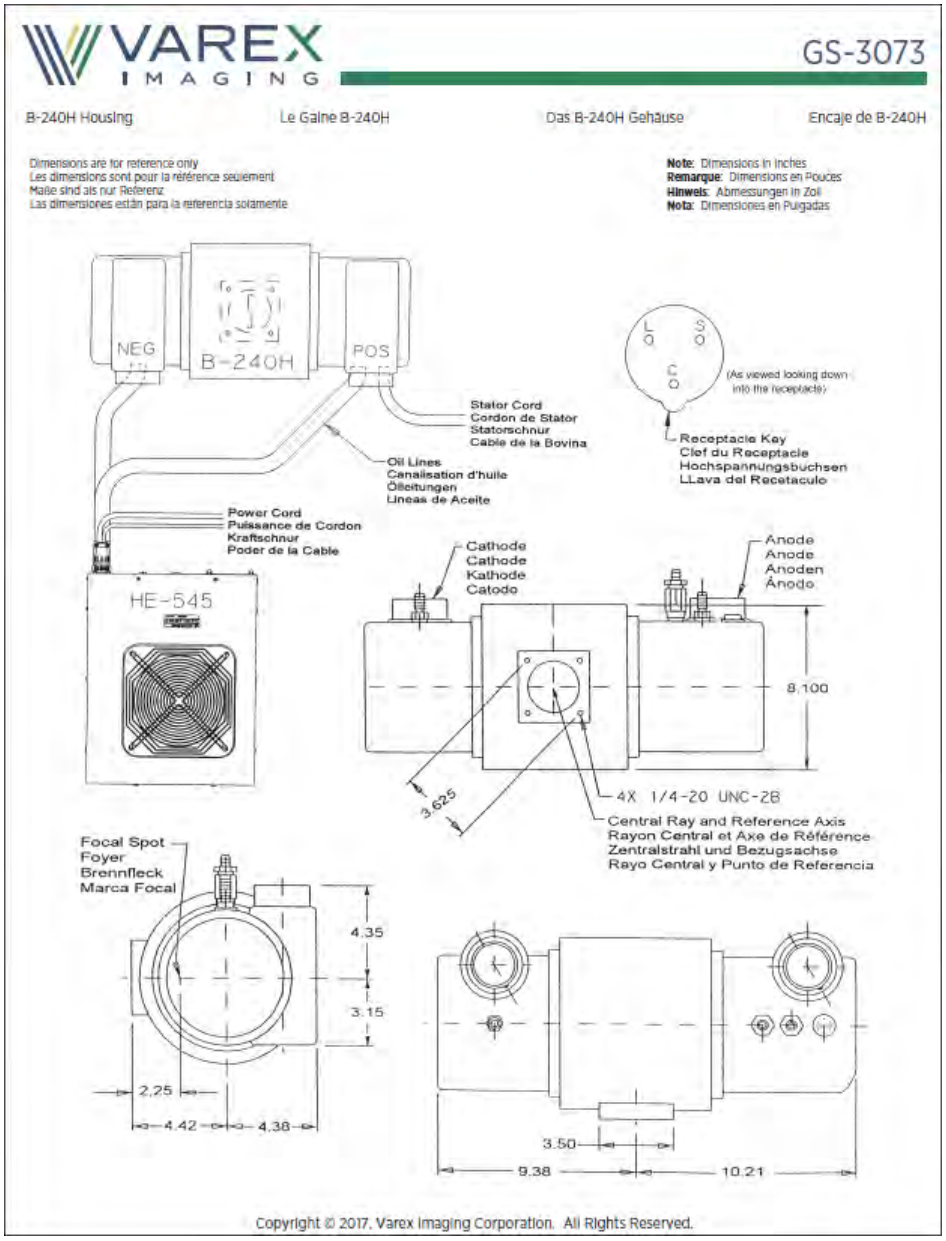




VAREX IMAGING

GS-3073

B-240H Housing	Le Gaine B-240H	Das B-240H Gehäuse	Encaje de B-240H
Maximum Peak Voltage ..... 150 kV Anode to Ground ..... 75 kV Cathode to Ground ..... 75 kV		Voltage Maximum ..... 150 kV Tension Anode - Terre ..... 75 kV Tension Cathode - Terre ..... 75 kV	
Maximum X-ray Tube Assembly Heat Content ..... 1.5 MJ (2.0 MHU)		Capacité Thermique Maximale de L'Ensemble Tube/Gaine .. 1,5 MJ (2,0 MUC)	
Maximum Continuous Heat Dissipation (Includes stator heat) ..... 3.7 kW (5.18 kHU/sec)		Dissipation thermique continue de la gaine (Inclut la chaleur statorique) ..... 3,7 kW (5,18 kUC/sec)	
Maximum Heat Exchanger Dissipation ..... 5.0 kW (7.0 kHU/sec)		Dissipation Maximale de l'échangeur de chaleur ..... 5,0 kW (7,0 kUC/sec)	
Focal Point Position (Central Ray) Within 1mm (X, Y Direction from the center of radiation port.)		Position du foyer (rayon central) à 1mm près (Coordonnées X, Y par rapport au centre du port de rayonnement.)	
X-Ray Tube Assembly Permanent filtration ..... 1.0 mm Al IEC 60522		Ensemble Radiogène Filtre non amovible ..... 1,0 mm Al CEI 60522	
Loading Factors for Leakage Radiation ..... 150 kV, 23 mA		Facteur de Charge Poru Rayonement de fuite ..... 150 kV, 23 mA	
Federal Standard High Voltage Cable 72		Embouts de Cables au Standard Federal 72	
Ambient Air Temperature Limits for Operation ..... 5°C to 40°C		Température Ambiante Pendant L'usage ..... 5°C à 40°C	
Temperature Limits for Storage and Transport ..... -20°C to +75°C		Limites de Température Pour le Transport et Pour L'Emmasinage ..... -20°C à +75°C	
Humidity ..... +10% to +90%		Humidité ..... +10% à +90%	
Atmospheric Pressure Range ..... 70 kPa to 106 kPa		Limites de pression atmosphérique ..... 70 kPa à 106 kPa	
Weight: Housing ..... 33.1 kg (73 lbs) Heat Exchanger ..... 15.4 kg (34 lbs)		Poids: Gaine ..... 33,1 kg (73 lbs) Échangeur de Chaleur ..... 15,4 kg (34 lbs)	
IEC Classification ..... Class 1		Classification CEI ..... Classe 1	
Safety Devices: (Internal) Thermal Switch Normally Closed Contact ..... Opening at 85°C ±4°C Closes at 74°C ±3°C		Dispositifs de Sécurité: Switch Thermique Normalement Fermé ..... Ouverture à 85°C ±4°C Se ferme à 74°C ±3°C	
Flow Switch - Normally Open contact Contacts close with adequate oil flow.		Contacteur de débit - Contact Normalement Ouverture Contacts fermés en présence d'un débit d'huil adéfquat.	
Heat Exchanger Control (Internal) Thermal Switch Normally closed contact ..... Opening at 70°C ±4°C Closes at 59°C ±3°C		Contrôle d'échangeur de chaleur (Interne) Switch Thermique Normalement Fermé ..... Ouverture à 70°C ±4°C Se ferme à 59°C ±3°C	
Filament Frequency Limits ..... 50 HZ - 25 kHZ		Limites de Fréquence des Filaments ..... 50 HZ - 25 kHZ	
Power Supply ..... DC		Alimentation Demandée ..... Courant Continu	
Maximale Spannungsfestigkeit ..... 150 kV Anode gegen Erde ..... 75 kV Kathode gegen Erde ..... 75 kV		Voltage Maximo Elevado ..... 150 kV Anodo a Tierra ..... 75 kV Catodo a Tierra ..... 75 kV	
Maximale Wärmespeicherkapazität des Strahlergehäuse ... 1.5 MJ (2.0 MHU)		Maximo Calor Contenido Ensamblaje del Tubo de Rayos X ... 1.5 MJ (2.0 MHU)	
Maximale kontinuierliche Wärmeableitung des Strahlergehäuse (einschließlich Statorwärmung) ..... 3.7 kW (5.18 kHU/sek)		Difusion del calor continuo del encaje (Incluye el calor de la bovina) ..... 3.7 kW (5.18 kHU/seg)	
Maximale Wärmeaustauscher - Verlustleistung ..... 5.0 kW (7.0 kHU/sek)		Disipación maxima del radiador ..... 5.0 kW (7.0 kHU/seg)	
Brennfleckposition (Zentralstrahl) Innerhalb 1mm. (X-, Y-Achse von der Mitte des Strahlenaustrittsfensters)		Posición de la marca focal (Rayo Central) Dentro de 1mm. (La Dirección axial X, Y se refiere del centro de la Radiación Portal.)	
Röntgenstrahlers Eigenfilterwert ..... 1.0 mm Al IEC 60522		Ensamblaje de Tubo de Rayos X Filtración Permanente ..... 1.0 mm Al IEC 60522	
Ladefaktoren für Leckstrahlmessung ..... 150 kV, 23 mA		Especificaciones de Encaje para la fuga de Radiacion ..... 150 kV, 23 mA	
Federal Standard Hochspannungsbuchsen 72		Cable de Receptaculos Comun Federal 72	
Umgebungstemperaturgrenzen für den Betrieb ..... 5°C zu 40°C		Temperatura Limitada de Operación ..... 5°C a 40°C	
Temperaturgrenzen für Aufbewahrung und Transport ..... -20°C zu +75°C		Temperatura Limitada de Almacen y Transporte ..... -20°C a +75°C	
Feuchtigkeit ..... +10% zu +90%		Humedad ..... +10% a +90%	
Luftdruck ..... 70 kPa zu 106 kPa		Limites de la presión atmosférica ..... 70 kPa a 106 kPa	
Gewicht: Gehäuse ..... 33.1 kg (73 lbs) Wärmetauscher ..... 15.4 kg (34 lbs)		Peso: Encaje ..... 33.1 kg (73 lbs) Radiador ..... 15.4 kg (34 lbs)	
IEC Klassifizierung ..... Klasse 1		IEC Clasificación ..... Clase 1	
Sicherheitseinrichtungen: Thermoschalter normalerweise geschlossen Verbindung ..... Offen bei 85°C ±4°C Schließt an 74°C ±3°C		Aparatos de Seguridad: Interruptor Termal Normalmente Cerrado ..... Apertura en 85°C ±4°C Se cierra en 74°C ±3°C	
Strömungsschalter - Kontakte normalerweise offen Kontakte schließen sich bei ausreichendem Ölfluß.		Interruptor de Flujo - Normalmente los contactos setan abiertos Contactos cerrado con a decuado flujo de aceite.	
Wärmetauscher-Steuerung(Intern) Thermoschalter normalerweise geschlossen Verbindung ..... Offeng bei 70°C ±4°C Schließt an 59°C ±3°C		Control del Radiador (Interno) Interruptor Termal Normalmente Cerrado ..... Apertura en 70°C ±4°C Se cierra en 59°C ±3°C	
Heizfaden Frequenzgrenze ..... 50 HZ - 25 kHZ		Limites de la frecuencia del filamento ..... 50 HZ - 25 kHZ	
Netzanschluß ..... DC		Suministrador-de-Poder ..... Corriente Directa	


VAREX IMAGING
GS-3073
B-240H Housing
Le Gaine B-240H
Das B-240H Gehäuse
Encaje de B-240H
Dimensions are for reference only
Les dimensions sont pour la référence seulement
Maße sind als nur Referenz
Las dimensiones están para la referencia solamente
Note: Dimensions in inches
Remarque: Dimensions en Pouces
Hinweis: Abmessungen in Zoll
Nota: Dimensiones en Pulgadas
NEG
B-240H
POS
Stator Cord
Cordon de Stator
Statorschnur
Cable de la Bovina
Oil Lines
Canalisation d'huile
Öleitungen
Lineas de Aceite
Power Cord
Puissance de Cordon
Kraftschnur
Poder de la Cable
HE-545
(As viewed looking down into the receptacle)
Receptacle Key
Clef du Receptacle
Hochspannungsbuchsen
Llava del Recetaculo
Cathode
Cathode
Kathode
Catodo
Anode
Anode
Anoden
Ánodo
8.100
3.625
4X 1/4-20 UNC-2B
Central Ray and Reference Axis
Rayon Central et Axe de Référence
Zentralstrahl und Bezugsachse
Rayo Central y Punto de Referencia
Focal Spot
Foyer
Brennfleck
Marca Focal
4.35
3.15
2.25
4.42
4.38
3.50
9.38
10.21
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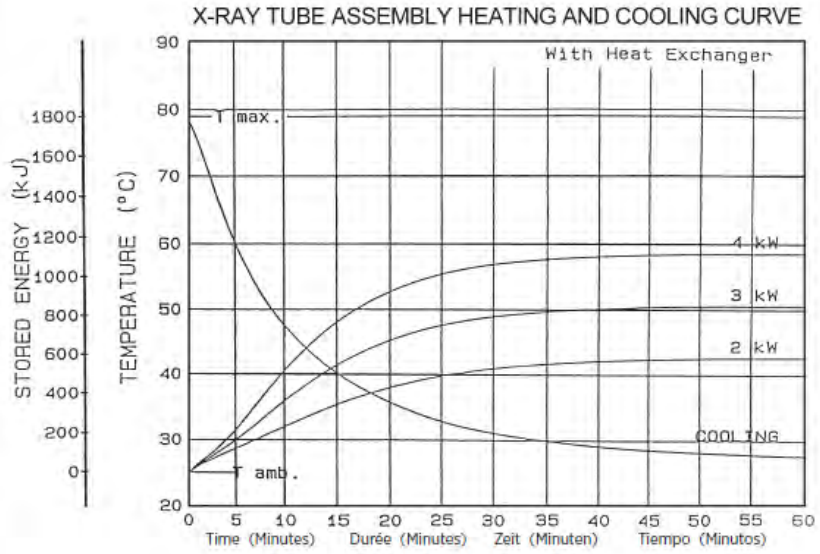
VAREX IMAGING

GS-3073

Tube Housing Assembly Heating and Cooling IEC 60613
Échauffement et Refroidissement de l'Ensemble CEI 60613
Röhrengehäusebaugruppe Aufheizung und Abkühlung IEC 60613
Enfriamiento y Calentamiento del Encaje Asamblado IEC 60613



Note:
1. Heat inputs into housing include tube power, filament power, and stator power.

2. Heating curves based on no restrictions of natural convection around tube housing assembly.

3. Heating and cooling curves reflect maximum tube performance. Tube operation is ultimately limited by system software control.

Remarque:
1. L'apport calorifique dans la gaine inclut la puissance du tube, du filament et du stator.

2. Courbes d'échauffement basées sur une circulation d'air naturelle sans entrave autour de l'ensemble gaine-tube.

3. Les abaques d'échauffement et de refroidissement représentent des valeurs maximales. L'utilisation du tube est finalement limitée par le logiciel du système.

Anmerkungen:
1. Der Erwärmungskurven berücksichtigen die Verlustleistung aus der Anode, der Kathode und des Stators.

2. Die Heizkurven basieren auf keinerlei Einschränkung der natürlichen Konvektion in der Umgebung der Strahlerhaube.

3. Die Angaben stellen die höchstzulässigen Betriebswerte dar. Der technische Betrieb muß im Rahmen der Belastungs- und Abkühlkennlinien erfolgen.

Nota:
1. La energía del encaje incluye el poder del tubo, el poder del filamento y el poder de la bovina.

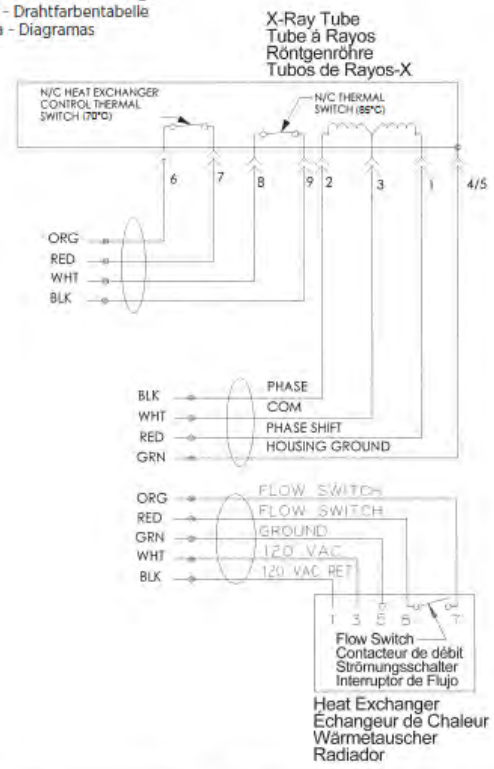
2. Las curvas de calentamiento no son afectadas por el calor natural creado en la parte exterior del encaje.

3. El máximo poder del tubo es reflectada en el diagrama de enfriamiento y calentamiento del tubo es ultimamente limitada por el control del sistema programado.

VAREX IMAGING

GS-3073

Stator - Wiring Diagram
Stator - Schéma de Câblage
Stator - Drahtfarbentabelle
Bovina - Diagramas



Stator Ratings and Characteristics
Spécificités et Caractéristiques du Stator
Statornennleistungen und Merkmale
Caracteristicas y Clarificacion de la Bovina

	Wire Color Couleurs des Branchements Kabelfarben Cable de Color	Description Description Beschreibung Descripcion
1	Red Rouge Rot Rojo	Phase Shift Stator de Changement de Phase Veränderliche Statorphase Cambio de Fase del Estator
2	Black Noir Schwarz Negro	Phase Phase Phase Fase
3	White Blanc Weiss Blanco	Common Neutre Neutral Común
4/5	Green Vert Grün Verde	Housing Ground Masse de la Gaine Masse des Gehäuses Encaje a Tierra
6	Orange Orange Orange Anaranjado	Thermal Switch Switch Thermique Thermoschalter Interruptor Termal
7	Red Rouge Rot Rojo	Thermal Switch Switch Thermique Thermoschalter Interruptor Termal
8	White Blanc Weiss Blanco	Thermal Switch Switch Thermique Thermoschalter Interruptor Termal
9	Black Noir Schwarz Negro	Thermal Switch Switch Thermique Thermoschalter Interruptor Termal

Stator Drive Frequency Frequence d'entrainement du stator Statorantrieb Frequenz Frecuencia de la impulsión del estator	RPM
50 Hz	2800 - 3000
60 Hz	3400 - 3600
150 Hz	8500 - 9000
180 Hz	9500 - 10,800

Stator Type: "R"

Stator Coil Resistance:
Black to White 14.0 Ohms ±15%
Green to White 46.0 Ohms ±15%

Starter Voltage:	**Start**	**Run**
50/60 Hz	200 VAC	80 VAC
150/180 Hz	470 VAC	140 VAC

Time to Full Speed:
50/60 Hz 0 - 3000 RPM 9.6 Sec.
150/180 Hz 0 - 8000 RPM 9.6 Sec.

X-Ray Tube Assembly:
GS-3073/B-240H IEC 60601-2-28

Genre Stator: "R"

Résistance de la bobine du stator:
(résistance ohmique)
Noir - Blanc 14,0 Ohms ±15%
Vert - Blanc 46,0 Ohms ±15%

Tension de démarrage:
50/60 Hz 200 alternatif au démarrage
80 alternatif en maintien
150/180 Hz 470 alternatif au démarrage
140 alternatif en maintien

Temps our atteindre la vitesse maximum:
50/60 Hz de 0 à 3000 trs./mn 9,6 Sec.
150/180 Hzde 0 à 8000 trs./mn 9,6 Sec.

Ensemble radiogène:
GS-3073/B-240H CEI 60601-2-28

Statortyp: "R"

Stator - Spulenwiderstand
Schwarz - Weiss 14.0 Ohms ±15%
Grün - Weiss 46.0 Ohms ±15%

Spannungen:	**Anlauf**	**Weiterlauf**
50/60 Hz	200 VAC	80 VAC
150/180 Hz	470 VAC	140 VAC

Hochlaufzeit:
50/60 Hz 0 - 3000 U/min 9.6 Sek.
150/180 Hz 0 - 8000 U/min 9.6 Sek.

Röntgenstrahler:
GS-3073/B-240H IEC 60601-2-28

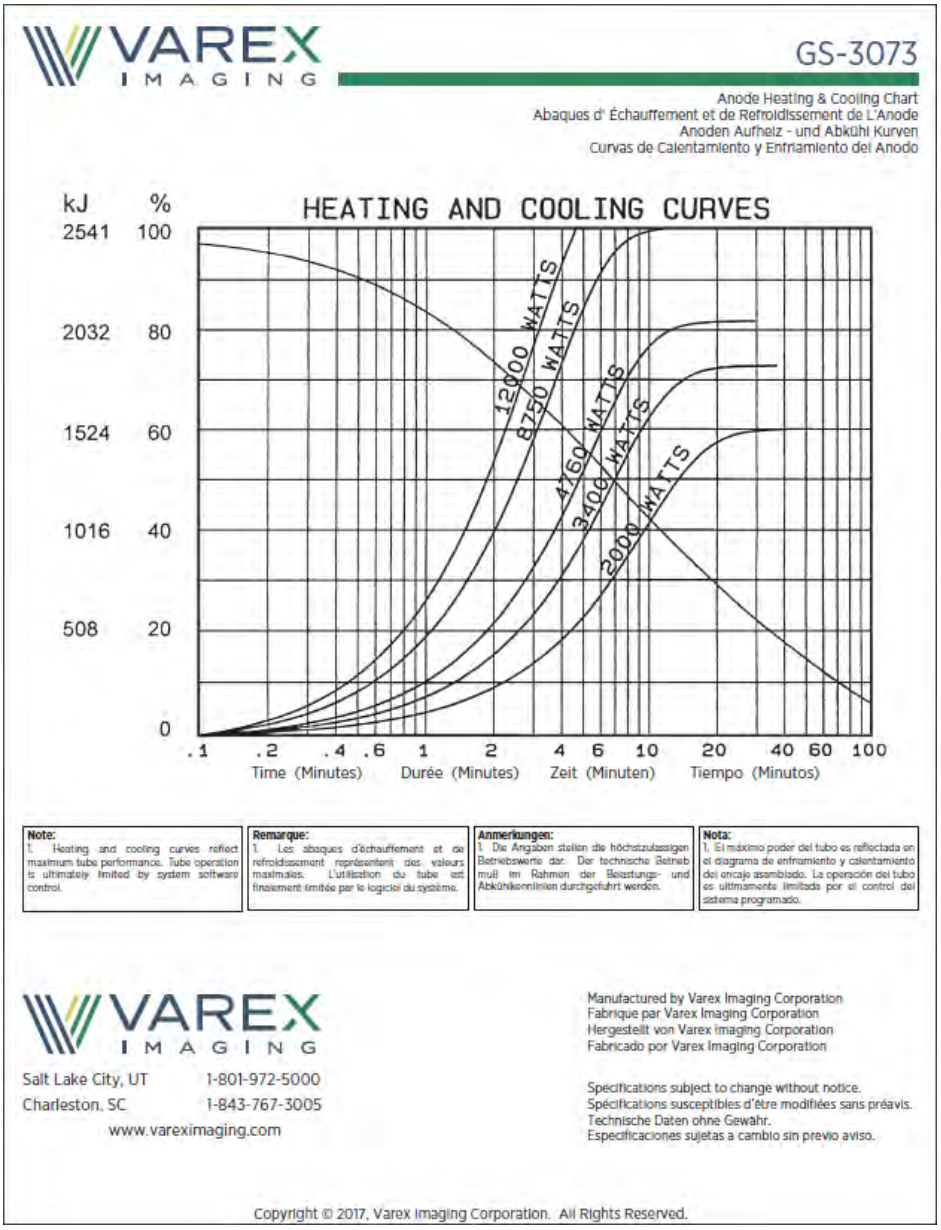
Tipo de la Bovina: "R"

Resistencia del Rollo de la Bovina:
Negro a Blanco 14.0 Ohms ±15%
Verde a Blanco 46.0 Ohms ±15%

Voltage de la Obtenida:	**Empezar**	**Funcionar**
50/60 Hz	200 VAC	80 VAC
150/180 Hz	470 VAC	140 VAC

Tiempo Para la Velocidad Maxima:
50/60 Hz 0 - 3000 RPM 9.6 Segundo
150/180 Hz 0 - 8000 RPM 9.6 Segundo

Ensamblaje de Tubos de Rayos X:
GS-3073/B-240H IEC 60601-2-28


VAREX IMAGING
GS-3073
Anode Heating & Cooling Chart
Abaques d' Échauffement et de Refroidissement de L'Anode
Anoden Aufheiz - und Abkühl Kurven
Curvas de Calentamiento y Enfriamiento del Anodo
HEATING AND COOLING CURVES
kJ
%
2541
100
2032
80
1524
60
1016
40
508
20
0
12000 WATTS
8750 WATTS
4160 WATTS
3400 WATTS
2000 WATTS
.1
.2
.4
.6
1
2
4
6
10
20
40
60
100
Time (Minutes)
Durée (Minutes)
Zeit (Minuten)
Tiempo (Minutos)
Note:
1. Heating and cooling curves reflect maximum tube performance. Tube operation is ultimately limited by system software control.
Remarque:
1. Les abaques d'échauffement et de refroidissement représentent des valeurs maximales. L'utilisation du tube est finalement limitée par le logiciel du système.
Anmerkungen:
1. Die Angaben stellen die höchstzulassigen Betriebswerte dar. Der technische Betrieb muß im Rahmen der Belastungs- und Abkühlkennlinien durchgefuhrt werden.
Nota:
1. El máximo poder del tubo es reflectada en el diagrama de enfriamiento y calentamiento del encaje asambiado. La operación del tubo es ultimamente limitada por el control del sistema programado.
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Charleston, SC 1-843-767-3005
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Appendix F Error Code

Table 71: Error code list

Error code	Error code description	Popup description	Cause
0	ABORT_EXAM	Exam has been aborted. Please try again. If problem persists, contact customer service with code:	Generic message whenever a scan/exam has been terminated abnormally. User would not typically see this because a more specific error should be posted.
1	CAN_DEVICE_DISCONNECT_CENT1	Communications fault. Please contact customer service with code:	Cannot communicate with centipede 1 device.
2	CAN_DEVICE_DISCONNECT_CENT2	Communications fault. Please contact customer service with code:	Cannot communicate with centipede 2 device.
3	CAN_DEVICE_DISCONNECT_ROTATE	Communications fault. Please contact customer service with code:	Cannot communicate with rotate device.
4	CAN_DEVICE_DISCONNECT_BIB	Communications fault. Please contact customer service with code:	Cannot communicate with BIB device.
5	CAN_DEVICE_DISCONNECT_OIB1	Communications fault. Please contact customer service with code:	Cannot communicate with OIB1 device. Note that this alone will not cause a Fault state but Start and Cancel buttons on one side of scanner will not operate.
6	CAN_DEVICE_DISCONNECT_OIB2	Communications fault. Please contact customer service with code:	Cannot communicate with OIB2 device. Note that this alone will not cause a Fault state but Start and Cancel buttons on one side of scanner will not operate.
7	CAN_DEVICE_DISCONNECT_POWER	Communications fault. Please contact customer service with code:	Cannot communicate with CCB device.
8	CAN_DEVICE_DISCONNECT_TRANS	Communications fault. Please contact customer service with code:	Cannot communicate with Transport device.
9	CAN_DEVICE_DISCONNECT_DCB	Communications fault. Please contact customer service with code:	Cannot communicate with DCB device.

Error code	Error code description	Popup description	Cause
10	CAN_DEVICE_DISCONNECT_HVG	Communications fault. Please contact customer service with code:	Cannot communicate with HVG device.
11	HVG_LATCH_ERROR_ENABLE	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	There was a problem with x-ray Enable signal.
12	HVG_LATCH_ERROR_INTERLOCK	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	An interlock condition was asserted.
13	HVG_LATCH_ERROR_110_TIMER	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	The 110% timer has expired and forced x-rays off.
14	HVG_LATCH_ERROR_XRT_THERM_SW	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	X-ray tube thermal switch asserted.
15	HVG_LATCH_ERROR_HE_FLOW_SW	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Heat exchanger flow switch asserted.
16	HVG_LATCH_ERROR_WDT	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	The watchdog timer has timed out and forced x-rays off (WD timer is controlled by the DCB firmware), this error would be unusual.
17	HVG_LATCH_ERROR_ARC_FAULT	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Arcs occurred.
18	HVG_LATCH_ERROR_HVG_FAULT	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	A generic HVG fault condition occurred (look at HVG_ERROR_ code).
19	HVG_LATCH_ERROR_STARTER	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Anode (starter) device reported and error.
20	HVG_LATCH_ERROR_DAS_OVER_RANGE	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	DAS (detector) data values are out of range.

Error code	Error code description	Popup description	Cause
21	HVG_ERROR_MA_REGULATION	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	There was a problem with mA regulation.
22	HVG_ERROR_KV_REGULATION	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	There was a problem with kV regulation.
23	HVG_ERROR_ANODE_STARTER	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Anode (starter) device reported and error.
24	HVG_ERROR_INV_OVER_TEMP	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Inverter over temp condition.
25	HVG_ERROR_UNCOMMANDED_EXP	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	An exposure happened without being commanded.
26	HVG_ERROR_ANODE_OVER_VOLTAGE	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Anode over voltage condition.
27	HVG_ERROR_CATHODE_OVER_VOLTAGE	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Cathode over voltage condition.
28	HVG_ERROR_ANODE_OVER_CURRENT	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Anode over current condition.
29	HVG_ERROR_CATHODE_OVER_CURRENT	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Cathode over current condition.
30	HVG_ERROR_FILAMENT_OVER_CURRENT	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Filament over current condition.
31	HVG_ERROR_ARC_DETECTED	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Arcs occurred.

Error code	Error code description	Popup description	Cause
32	HVG_ERROR_CURRENT_RET_WIRE_DISCON	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	Current return wire disconnect.
33	HVG_ERROR_MA_OVER_PROG	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	The actual mA was higher than programmed.
34	HVG_ERROR_KV_OVER_PROG	High voltage fault. Please retry task. If problem persists, please contact customer service with code:	The actual kV was higher than programmed.
35	HVG_ERROR_FILAMENT_REGULATION	High voltage failure, retry protocol, if problem persists contact customer service with code	There was a problem with filament regulation.
36	DCB_ERROR_BAD_DETECTORS	Data acquisition fault. Please contact customer service with code:	DCB reported a bad detector condition.
40	RECON_PROTOCOL_REJECTED_INVALID_PROTOCOL_TYPE_OR_USAGE_PARAMETER	Recon Protocol Rejected due to invalid Type or Usage parameter	Recon rejected protocol because of invalid parameters.
41	RECON_PROTOCOL_REJECTED_INVALID_PROTOCOL	Recon Protocol Rejected due to invalid Protocol	Recon rejected protocol because of invalid parameters.
42	RECON_PROTOCOL_REJECTED_INVALID_PROTOCOL_IMAGE_COODINATES	Recon Protocol Rejected due to invalid Image Coordinates	Recon rejected protocol because of invalid parameters.
43	RECON_PROTOCOL_REJECTED_INVALID_PROTOCOL_ROI_COODINATES	Recon Protocol Rejected due to invalid ROI Coordinates	Recon rejected protocol because of invalid parameters.
44	RECON_PROTOCOL_REJECTED_HELICAL_QA_FAILED	Recon Protocol Rejected due to Helical QA Failure	Recon rejected protocol because of invalid parameters.
45	RECON_PROTOCOL_REJECTED_RECON_BUSY	Recon Protocol Rejected due to Recon Busy	Recon is in an invalid state to perform a protocol.
46	RECON_PROTOCOL_REJECTED_SERIAL_LINK_DISCONNECT_OCCURRED	Recon Protocol Rejected due to Serial Link Disconnect	Recon rejected protocol because the serial link is not connected.

Error code	Error code description	Popup description	Cause
47	RECON_PROTOCOL_REJECTED_INSUFFICIENT_MEMORY	Recon Protocol Rejected due to Insufficient Memory	Recon rejected protocol because of insufficient memory necessary to perform requested protocol.
48	RECON_PROTOCOL_REJECTED_INVALID_PROTOCOL_SLICE_COODINATES	Recon Protocol Rejected due to invalid Slice Coordinates	Recon rejected protocol because of invalid parameters.
50	RECON_DATA_CORRUPTED	System has encountered an unexpected error. Please contact customer service with code:	The Recon app reported data corruption (view headers not correct).
51	RECON_OFFSET_CAL_FAILED	System failed to properly perform protocol calibration. Please try again. If problem persists, please contact customer service with code:	The Recon app reported Offset Cal failure.
52	RECON_AIR_CAL_FAILED	System failed to properly calibration system. Please try calibration again. If problem persists, please contact customer service with code:	The Recon app reported Air Cal failure.
53	RECON_OFFSET_CAL_TIMEOUT	System failed to properly perform protocol calibration. Please try again. If problem persists, please contact customer service with code:	Scanner control app timed out waiting for an offset cal to complete.
54	RECON_OFFSET_PROTOCOL_TIMEOUT	System failed to properly perform protocol calibration. Please try again. If problem persists, please contact customer service with code:	Scanner control app timed out waiting for Recon app to acknowledge a protocol request (offset or image).
55	RECON_PROTOCOL_TIMEOUT	System is unable to perform protocol. Please try again. If problem persists, please contact customer service with code:	Scanner control app timed out waiting for a scan to complete.
56	RECON_PROTOCOL_REJECTED	System is unable to perform protocol. Please try again. If problem persists, please	The Recon app rejected a scan protocol request.

Error code	Error code description	Popup description	Cause
		contact customer service with code:	
57	RECON_POST_NO_SCAN_INFO	System is unable to perform post reconstruction. Please try again. If problem persists, please contact customer service with code:	The image data was not found for a Post Recon or Resend Images command (where image data could be scan info file, .dcm files, .cor files, or entire directory).
58	RECON_POST_RECON_FAILED	System is unable to perform post reconstruction. Please try again. If problem persists, please contact customer service with code:	A Post Recon or Resend Images command could not be run due to scanner state.
60	PREPARE_FAILED	The scanner encountered a fault preparing for scan. Please contact customer service with code:	A generic Prepare error occurred. This should be accompanied by a more specific error. See scanner log for detail.
61	DISK_PREPARE_ERROR	Communications fault. Please contact customer service with code:	Disk subsystem reported an error during prepare.
62	CENTIPEDE_MOVE_TIMEOUT	The scanner failed to move to the correct location. Please check for obstructions or debris on the floor that could impede the movement and try again. If problem persists, please contact customer service with code:	Scanner Control app timed out waiting for scanner to reach requested position; OR scanner did not reach required velocity for a scout or helical scan.
63	ANODE_STARTUP_TIMEOUT	X-ray power sequence fault. Please contact customer service with code:	Scanner Control app timed out waiting for anode device to report anode rotation is at speed.
64	DISK_NOT_IN_TICK_MODE	Rotational speed fault. Please contact customer service with code:	Scanner Control app timed out waiting for disk to get to tick mode (during prepare for scans that specify disk rotation).
65	COLLIMATOR_POSITION_TIMEOUT	Failure to position collimator. Please contact customer service with code:	Scanner Control app timed out waiting for collimator to get to requested position.

Error code	Error code description	Popup description	Cause
66	DCB_READY_TIMEOUT	DCB communication fault. Please contact customer service with code:	Scanner Control app timed out waiting for DCB to report "ready" state.
67	HEAT_EXCHANGER_ERROR	X-ray cooling fault. Please contact customer service with code:	Heat exchanger did not come on during prepare.
68	FILAMENT_ERROR	X-ray filament fault. Please contact customer service with code:	Scanner Control app timed out waiting for DCB to report "filament on"; OR for filament monitor to report > 10.
69	SERIAL_LINK_NOT_UP	Communications fault. Please contact customer service with code:	Scanner Control app timed out waiting for serial link to come up; OR serial link was lost before start Acq.
70	ROTATE_COMMAND_FAILED	Rotation communication error. Please contact customer service with code:	Unused error code.
71	TRANSLATE_COMMAND_FAILED	Translate fault. Please contact customer service with code:	Move command to centipede device failed.
72	COULD_NOT_START_SSP	Software initialization fault. Please contact customer service with code:	SSP software (Scanner State and Position GUI, the GUIs that are on the scanner displays) did not start up.
73	ROTATE_TO_ANGLE_FAILED	Rotational fault. Please contact customer service with code:	Scanner Control app timed out waiting for "Rotate to Angle" operation.
74	COULD_NOT_CLEAR_ROTATE_FAULT	Rotation fault. Please contact customer service with code:	The rotate device has reported a fault, and the fault cannot be cleared.
75	ENCODER_CONSISTENCY_FAULT	Encoder consistency fault. Please contact customer service with code:	Unused error code.
76	INTERLOCK_TEST_FAILED	Interlock Test Failed. Please ensure that e-stop is not engaged. If e-stop is not engaged, please contact customer service with code:	The interlock circuit either remained continuous after a Software Interlock was applied; OR the interlock circuit was broken when it was expected to be continuous.
77	DCB_TRIPPED_WDT_FAULT	DCB has reported a Watchdog Timeout event. Please restart the scanner and if the problem	DCB is in a bad state and needs to power cycle to reset the watchdog timer.

Error code	Error code description	Popup description	Cause
		persists, contact customer service with code:	
78	DCB_MIB_LINK_FAULT	MIB has reported a fault and can't acquire DAS data. Please contact customer service with code:	MIB software not loaded or MIB not powered, or data cable connection issue.
80	DISK_SPACE_LOW	System disk space low, please contact customer service with code:	Unused error code.
81	DISK_SPACE_QUERY_FAILED	System disk space low, please contact customer service with code:	Unused error code.
82	NOT_ALL_BASE_DEVICES_PRESENT	Base communications fault. Please contact customer service with code:	Not all devices were found on Base CAN bus (or a device has become disconnected). This should be accompanied by another error code describing which device(s) disconnected. You can look at Scanner Control GUI for a status of which devices are present.
83	NOT_ALL_DISK_DEVICES_PRESENT	Disk communications fault. Please contact customer service with code:	Not all devices were found on Disk CAN bus (or a device has become disconnected). This should be accompanied by another error code describing which device(s) disconnected. You can look at Scanner Control GUI for a status of which devices are present.
90	CCB_BATTERY_OPERATIONAL	Battery system fault. Please contact customer service with code:	CCB device reported a (not) Operational Alarm (scanning not possible).
91	CCB_BATTERY_INTERLOCK	Battery system communication error. Please contact customer service with code:	CCB device reported an Interlock Alarm (scanning not possible).
92	CCB_BATTERY_MAIN_BREAKER	Circuit breaker has been tripped. Please reset and contact customer service with code:	Battery main breaker turned off. Scanner is running on wall power only. (Scanning not possible.)

Error code	Error code description	Popup description	Cause
93	CCB_LOW_BATTERY_ALARM	Low battery condition. Please charge system as soon as possible.	CCB device reported a Low Battery Alarm (scanning not possible).
94	CCB_DEAD_BATTERY_ALARM	Dead battery condition. The system is shutting down. Please charge system and report condition to customer service with code:	CCB device reported a Dead Battery Alarm (auto-shutdown of scanner is imminent) (scanning DEFINITELY not possible).
95	CCB_HIGH_BATTERY_ALARM	High battery condition has occurred. Battery charging has been disabled.	CCB device reported a High Battery Alarm
96	CCB_OVERCGARGED_BATTERY_ALARM	Please power down and unplug system and contact customer service immediately with code:	CCB device reported an Overcharged Battery Alarm. This is beyond a High Battery warning and is serious. The system should be turned off and unplugged immediately.
97	CCB_BATTERY_HIGH_TEMP_ALARM	Battery system fault. Please contact customer service with code:	CCB device reported a High Temp Alarm (scanning not possible).
98	CCB_BATTERY_OVER_TEMP_ALARM	Over temperature battery condition. Please power down and unplug system and contact customer service immediately with code:	CCB device reported an Over Temp Alarm. This is beyond a High Temp warning and is serious. The system should be turned off and unplugged immediately.
99	CCB_BATTERY_MEASUREMENT_ERROR	Battery system fault. Please contact customer service with code:	CCB device reported a Measurement Error Alarm (scanning not possible)
100	CCB_BATTERY_IMBALANCE_WARNING	Battery system fault. Please contact customer service with code:	One or more battery voltage levels are not the same as the others. No action required. System will try to correct itself.
110	RECON_PROTOCOL_REJECTED_INVALID_PROTOCOL_USAGE_PARAMETER	Reconstruction fault. Please contact customer service with code:	Recon received invalid usage parameter in protocol.
111	RECON_PROTOCOL_REJECTED_INVALID_NUMBER_OF_VIEWS_PARAMETER	Reconstruction fault. Please contact customer service with code:	Recon received invalid number of views in protocol.

Error code	Error code description	Popup description	Cause
112	RECON_PROTOCOL_REJECTED_RUN_DMA_SETUP	Reconstruction fault. Please contact customer service with code:	Recon failed to initialize DMA in preparation for scan.
113	RECON_PROTOCOL_REJECTED_UNDEFINED_USAGE	Reconstruction fault. Please contact customer service with code:	Recon received undefined usage parameter in protocol.
114	RECON_PROTOCOL_REJECTED_INVALID_RAW_DATA_REPLAY	Reconstruction fault. Please contact customer service with code:	Unused error code.
115	RECON_PROTOCOL_REJECTED_FILES_RETRIEVE_FAILED	Reconstruction fault. Please contact customer service with code:	Unused error code.
116	RECON_PROTOCOL_REJECTED_INVALID_PARAMETER_STRUCTURE_SIZE	Reconstruction fault. Please contact customer service with code:	Recon received incorrect structure size.
117	RECON_PROTOCOL_REJECTED_INVALID_PROTOCOL_FLASH_IO_CMD	Reconstruction fault. Please contact customer service with code:	Unused error code.
118	RECON_PROTOCOL_REJECTED_PREPARE_AND_PRIME_POST_RECON_USAGE	Reconstruction fault. Please contact customer service with code:	Unused error code.
119	RECON_PROTOCOL_REJECTED_INVALID_POST_RECON_STATE	Reconstruction fault. Please contact customer service with code:	Recon received a protocol while still processing previous protocol/post recon.
120	RECON_PROTOCOL_REJECTED_INVALID_MESSAGE_BODY_LENGTH	Reconstruction fault. Please contact customer service with code:	Recon received incorrect structure size.
121	RECON_PROTOCOL_REJECTED_INVALID_RELOAD_PARAMETER_FILES	Reconstruction fault. Please contact customer service with code:	Unused error code.
122	RECON_PROTOCOL_REJECTED_INVALID_UNSUPPORTED_COMMAND	Reconstruction fault. Please contact customer service with code:	Recon was sent an unsupported command from scanner control.
123	RECON_PROTOCOL_REJECTED_INVALID_HELICAL_FILTER_KERNEL_TYPE	Reconstruction fault. Please contact customer service with code:	Recon was sent an invalid helical filter kernel from workstation/scanner control.

Error code	Error code description	Popup description	Cause
124	RECON_PROTOCOL_REJECTED_INVALID_NUMBER_OF_HELICAL_IMAGES_FOR_WINDMILL	Reconstruction fault. Please contact customer service with code:	Recon received an invalid number of images for windmill.
125	RECON_PROTOCOL_REJECTED_GPU_FAILED_TO_START	Reconstruction fault. Please contact customer service with code:	Recon failed to initialize GPU during preparation for scan.
126	RECON_PROTOCOL_REJECTED_RECON_BUSY	Reconstruction fault. Please contact customer service with code:	Recon received a protocol while still processing previous protocol/post recon.
130	RECON_AIR_CAL_FAILED_NON_AIR_IMAGE	Reconstruction fault. Please contact customer service with code:	Air image above threshold for air calibration.
131	RECON_AIR_CAL_FAILED_SEND_EVENT	Reconstruction fault. Please contact customer service with code:	Air calibration failed to be performed.
132	RECON_AIR_CAL_IMAGE_EXCEEDS_THRESHOLD	Reconstruction fault. Please contact customer service with code:	Air image above threshold for air calibration.
133	RECON_AIR_CAL_FAILED_NO_VIEW_DATA	Reconstruction fault. Please contact customer service with code:	No view data received during an air calibration.
134	RECON_AIR_CAL_FAILED_CORRUPTED_VIEW_DATA	Reconstruction fault. Please contact customer service with code:	Corrupted views received during air calibration.
135	RECON_OFFSET_CAL_FAILED_SEND_EVENT	Reconstruction fault. Please contact customer service with code:	Offset calibration failed to be performed.
136	RECON_OFFSET_CAL_FAILED_NO_VIEW_DATA	Reconstruction fault. Please contact customer service with code:	No view data received during an offset calibration.
137	RECON_OFFSET_CAL_FAILED_CORRUPTED_VIEW_DATA	Reconstruction fault. Please contact customer service with code:	Corrupted views received during offset calibration.
138	RECON_OFFSET_CAL_FAILED_BAD_REFERENCE	Reconstruction fault. Please contact customer service with code:	Offset calibration failed due to bad reference.
139	RECON_OFFSET_CAL_80_PERCENT_BAD_REFERENCE	Please contact Customer Service immediately and run a Quality Assurance (QA) Phantom test to verify image quality. Error code:	80% of reference detector values are above the acceptable threshold during an offset cal.

Error code	Error code description	Popup description	Cause
140	UPS_LOW_BATTERY_ALARM	Workstation low battery condition. Please charge system as soon as possible.	UPS device reported a Low Battery Alarm.
141	UPS_DEAD_BATTERY_ALARM	Workstation dead battery condition. The Workstation is shutting down. Please charge cart and report condition to customer service with code:	UPS device reported a Dead Battery Alarm.
142	UPS_HIGH_BATTERY_ALARM	Workstation high battery condition has occurred. Cart battery charging has been disabled.	UPS device reported a High Battery Alarm.
143	UPS_OVERCHARGED_BATTERY_ALARM	Please power down and unplug workstation cart and contact customer service immediately with code:	UPS device reported an Overcharged Battery Alarm. This is beyond a High Battery warning and is serious. The cart should be turned off and unplugged immediately.
144	UPS_BATTERY_HIGH_TEMP_ALARM	Workstation battery system fault. Please contact customer service with code:	UPS device reported a High Temp Alarm.
145	UPS_BATTERY_OVER_TEMP_ALARM	Workstation over temperature battery condition. Please power down workstation, unplug cart and contact customer service immediately with code:	UPS device reported an Over Temp Alarm. This is beyond a High Temp warning and is serious. The cart should be turned off and unplugged immediately.
146	UPS_BATTERY_MEASUREMENT_ERROR	Workstation battery system fault. Please contact customer service with code:	UPS device reported a Measurement Error Alarm.
147	UPS_BATTERY_IMBALANCE_WARNING	Workstation battery system fault. Please contact customer service with code:	One or more battery voltage levels are not the same as the others. No action required. UPS will try to correct itself.
148	UPS_CHARGER_FAULT	Workstation battery system fault. Please contact customer service with code:	UPS device reported a Charger fault.
149	RECON_GENERAL_FAILURE	Reconstruction fault. Please contact customer service with code:	Recon software experienced an unknown failure.

Error code	Error code description	Popup description	Cause
150	RECON_LIVE_SCAN_STATE_ERROR	Reconstruction fault. Please contact customer service with code:	Recon got a Live Scan request while a Live Scan is already in progress.
151	RECON_QA_PHANTOM_NOT_FOUND	Reconstruction fault. Please contact customer service with code:	The QA Phantom was not found in the reconstructed image.
152	RECON_TIMED_OUT_WAITING_FOR_EOE	Reconstruction fault. Please contact customer service with code:	The scanner did not get End of Exam event from recon. Possible that recon did not get all its views, indicating a DRB/DMA issue.
153	RECON_DRB_CONNECTION_FAILED	Reconstruction fault. Please contact customer service with code:	Recon software was not able to connect to DRB device. Possible DRB device or DMA driver error.

Appendix G Revision History

Table 72: Revision History

Revision	ECO number	Effective date	Author	Changes
00	ECO-005397	2021/04/28	Stephen Lombadozzi	New Release
01	ECO-006571	2023/01/30	Keith A. Kaser	Revised BodyTom Elite manual 1-NL4000-060rev19 to include updates required for new BodyTom 64 systems. Added error code 78 and updated error codes 140-153.
02	ECO-006643	2023/03/29	Keith A. Kaser	Updated Laser Safety Section, page 58 (Bug# 5763) Removed unnecessary sentence from Administrative privileges section, page 73 (Bug# 5765) Modified Window Center/Level inconsistencies to all say Window Center (Bug# 5767) Modified use of the term Cine Backward to Cine Reverse for consistency with UI (Bug# 5769) Corrected typographical error on page 239 (Bug# 5774) Added detailed Scanner Start-up Shutdown directions as well as note that scanner shutdown will not occur if Tube Heat higher than 19% (Bug# 5781) Added unit values to graph on page 383 (Bug# 5772) Updated CTDI Values in Tables 32, 33, 34, 35, 36 and 37.
03	ECO-006933	2023/12/05	Keith A. Kaser	Update to Table 15 per Intertek review to match testing report. Replace I-Book symbol with Blue Man symbol per Intertek feedback. Updated Window Width/Center information in table 64: Viewing Tools to be more in line with UI. Updated Error codes to re-number Recon error codes and added Error code 77 which was missing from the document.

Revision	ECO number	Effective date	Author	Changes
				Made minor grammar and spelling corrections throughout the document.
04	ECO-007472	2025/03/24	Keith A. Kaser	Added Warning in Safety Information section related to decommissioning system to remove health software. Updated trade name and device name for clarity. Updated missing cross reference on page 70. Updated Product Marking plate in Figure 1. Reformatted and updated Contact Information table to include CE mark for European distributer as well as updated address for Brazilian Distributer. Added CE mark to Table of Symbols. Updated Table 62: Symbols. Updated Tables 33, 34, 35, 36 and 38 to resolve Bug# 6339. Updated the “Using the Interventional Package” section to include the new Instant Repeat functionality. Update Workstation Product Marking Plate to include proper “Refer to instruction in user manual/booklet” icon.