LightSpeed[16]
With Xtream
CT Scanner System

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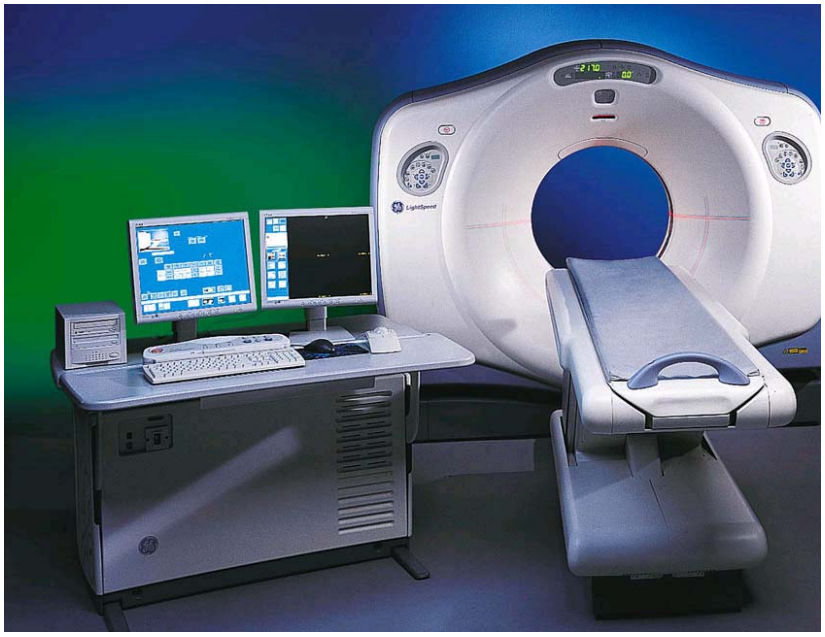

Introduction

The LightSpeed[16] CT Scanner with **Xtream™** technology is the next step in GE's CT Continuum™ and its award-winning LightSpeed CT platform. The LightSpeed[16] CT Scanner routinely acquires 16 sub-millimeter slices in one rotation, at a scan speed of 0.5 seconds. As with the very first LightSpeed product introduction, the LightSpeed[16] utilizes Designed for Six Sigma (DFSS™) methodology in all aspects of manufacturing and engineering.

LightSpeed[16] is available both as a new system or as a cost-effective upgrade to an existing LightSpeed system.

Primary Benefits

- Routine use of **sub-millimeter slices** without image noise or coverage compromise.
- **Small lesion and small vessels assessments** – pancreas, liver or circle of willis, renal arteries, coronary arteries and peripheral vascular arteries.
- The 6.3 MHU **Performix X-Ray Tube** demonstrates the highest reliability and delivers the power you need for image quality. The Performix Tube now comes standard with a one-year, non pro-rated warranty.
- **microVoxel™ imaging** improves 3D and reformatted 2D resolution through the optimum choice of sub-millimeter slice thickness and reconstructed voxel size.
- Unmatched **Volume Image Quality** specification in all planes (sagittal, coronal and axial): 15.4 lp/cm @ 0% MTF @ 0.5 sec. Rotation
- **HiLight™ Matrix II Detector** is designed to deliver consistent image quality with its 21,888 individual elements: 16 rows of 0.625mm thickness and 8 rows of 1.25mm thickness
- **Xtream™ technology**, a revolutionary new workflow design, breaks through existing limits on speed, image quality and flexibility to provide an optimized workflow solution from acquisition to final report.
- Lowest dose acquisition using **SmartmA,™** an automatic modulation technique and DLP display that tells the operator the dose before the scan starts.
- **HyperPlane™** reconstruction algorithm tackles the inherent issues with fast, high pitch helical scanning by reducing helical artifacts and dose, and optimizing the slice profile.
- **CrossBeam™** reconstruction algorithm solves the technical challenge of cone beam artifacts.
- Large breadth of **Advanced Software Applications**: Advanced Lung Analysis, CT Colonography, Advanced Vessel Analysis, Brain and Body Perfusion, Cardiac Analysis, Cardiac Function, SmartScore Pro and Advantage Sim.
- **Compact system design** of the LightSpeed[16] allows for installation in only 28m² (302 square feet).
- **Productivity features** designed for the CT Technologist: In-Room Start, Remote Gantry Tilt, Breathing Lights with countdown timer, Gantry Controls mounted on all four corners of the gantry and an Integrated IV Pole at the foot of the table.
- **1700 mm scannable range** for full body scans.
- **254 GB Disk** (system, image, scan disks) stores up to 250,000 512^2 images and 2881 scan data files.
- **Cardiac acquisition with Segment, Burst and Burst Plus** enable you to scan patients with heart rates from 40 to 110 BPM, and provide for **temporal resolution up to 65 ms.**
- **Color Coding for Kids,** winner of a National Heroes Award from the Emergency Medical Services for Children, provides pediatric scan protocols based on the Broselow-Luten™ Pediatric System. This Color Coding system is incorporated into the protocol selection on the operator's console and is designed to facilitate pediatric emergency care and reduce medical errors.
- **VariViewer™**: provides an interactive axial review mode that can change the slice thickness reconstruction instantaneously, resulting in the ability to "scan thin and view thick."

Clinical Performance

Chest / Abdomen / Pelvis

Coverage	600 mm
Rotation	0.5 sec.
Mode	16 x 0.625 mm
Pitch	1.75:1
mA	420
mAs	210
Speed	35 mm/s
Scan Time	17.1 seconds

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Peripheral Run-Off

Coverage	1,400 mm
Rotation	0.5 sec.
Mode	16 x 1.25 mm
Pitch	1.75:1
mA	380
mAs	190
Speed	70 mm/s
Scan Time	20 seconds

High Resolution Chest

Coverage	200 mm
Rotation	0.5 sec.
Mode	16 x 0.625 mm
Pitch	1.75:1
mA	440
mAs	220
Speed	35 mm/s
Scan Time	5.7 seconds

The net result is that in many cases, helical scans on the Lightspeed[16] are up to 12 times faster than 4-slice CT systems. With the Lightspeed[16], users can routinely use a 0.5 second scan speed and 0.5625:1, 0.9375:1, 1.375:1, and 1.75:1 helical pitches. This added performance, at the same image quality, may allow you to: reduce contrast media, perform better thin-slice CT angiography exams, use thinner slices for most exams, and perform longer helical exams without tube cooling delays.

The LightSpeed[16] delivers this level of performance through a balanced design that focuses on image quality, coverage, and exam speed.

Main Features

- Full 360° rotation speed of 0.5 sec. provides for improved temporal resolution and image quality in areas such as cardiac imaging;
- Faster scan times enable shorter breath holds and more comfortable exams for patients;
- Faster scan times reduce the occurrence of re-scans by lowering the possibility of patient motion during the exam;
- Routine scanning with a slice thickness of 0.625mm - optimizes lesion detection and facilitates the use of thinner images for volume presentations.
- **Reduced partial volume artifacts**:
  - Prospective or retrospective image reconstruction of 0.625 mm, 1.25 mm, 2.5 mm, 3.75 mm, 5 mm, 7.5 mm or 10 mm images from inherently thinner acquisition data sets;
  - For both helical and axial acquisitions.
- **Image decomposition to:**
  - Retrospective reconstruction of thin images from data sets where thicker images were initially reconstructed;
  - Facilitates more detailed image analysis without need for re-scans;
  - Improves 3D visualization;
  - For both helical and axial acquisitions
- Up to 2,881 multi-slice 1-sec scan rotations stored on disk. Facilitates retrospective image decomposition during off hours.
- **Eight fundamental scan modes** to simplify the inherently complex nature of multi-slice helical scanning.
- **Standard set of clinically- proven protocols** derived from leading luminary sites around the world. Up to 8,460 protocols can be edited, modified and stored on the system.
- **Remote Gantry Tilt** from the Operator's Console to increase exam speed, including built-in safety features to prevent accidental contact of the gantry with the patient.
- Built-**in patient breathing lights** and digital counter provides a goal-oriented approach to coach the patients in holding their breath during an exam.
- **SmartStart™** gantry-mounted start scan button and countdown display, facilitates single-technologist operation by allowing start of scan at the gantry, with a visual reminder of time until X-ray initiation.
- **SmartHelical™** GE proprietary, non-linear interpolation algorithms, balance slice profile, helical pitch, image noise and required technique.
- **SmartTrack™** advanced hardware and software for X-ray beam tracking minimizes patient dose.
- **SmartTools™** software automates every exam task in order to increase throughput.
- **SmartBeam™** hardware and software optimizes X-ray beam filtration independently for body and head applications.
- **HiRes Chest™** software provides a single-slice, high-resolution scan mode that minimizes dose for this critical application.
- **SmartPrep™,** standard on LightSpeed[16], provides software for real-time monitoring of contrast enhancement.
- * **Direct3D™,** makes 3D routine and instant by building the 3D model during axial image reconstruction, reducing the need for user interaction.
- *** SmartScorePro™,** provides EKG-gated hardware and software on the Advantage Workstation for coronary artery calcium scoring.
- *** CardiacSnapShot**, provides software and hardware to perform EKG-gated reconstructions of the heart in SnapShot Segment mode.

  - SnapShot Segment is a single sector protocol using information from one heart cycle to generate an image with temporal resolution of 250ms.

  - SnapShot Burst is a multi-sector protocol using up to two sectors from two different heart cycles to produce an image with temporal resolution of 125ms.

  - SnapShot Burst Plus is a multi-sector protocol using up to four sectors of data from four different heart cycles to produce images with temporal resolution to 65ms.
- **CTDI$_w$, DLP** (Dose Length Product), **and Dose Efficiency** display during scan prescription provides patient dose informatbon to the operator.

Interactive CT Technology

The LightSpeed[16] CT Scanner supplies exceptional computer and image processing power that significantly enhances clinical productivity, building upon the strength of the LightSpeed family - true interactive CT technology.

Interactive CT embodies a variety of design choices all striving to enhance operator and department productivity. A truly interactive CT system will:

- Provide a user interface beyond "**intuitive**" to become purely "natural" - from the screens to the console hardware itself;
- Allow two users to **review cases side-by-side**, with minimal interference;
- Supply a **truly multi-tasking** environment where even advanced image processing can take place quickly and simultaneously with other processes underway;
- Operate with a very high degree of **automation**, yet allow patient-specific

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changes to be easily made, with virtually no restrictions;

- Be as self-teaching as possible, and have **on-line access to tutorials** as needed.

One key element of this design is to combine some of the best features from several product families into one state-of-the art CT system. For example, the LightSpeed[16] CT Scanner combines:

- **SmartTools** productivity software to automate every step of the examination, critical for ensuring the highest productivity and throughput possible with the LightSpeed[16] CT Scanner;
- **Large screen interface** for controlling scan acquisition easily, with virtually everything at a single glance;
- Excellent simultaneity and **multi-tasking** performance;
- Completely **protocol-driven** scan control with a dramatic reduction in number of screens;
- Highly flexible editing tools that allow easy tailoring of the exam to the patient;
- Large, 1024 color display;
- Leading edge, **real-time image processing** (MPR, MPVR, Volume Viewer*).

In summary**, primary benefits** of Interactive CT on the LightSpeed[16] Scanner:

- A **natural scan control** user interface
  - Dramatic reduction in the number of screens; only 2 screens to set up first scan and 1 screen for real-time monitoring while scanning;
  - Easier and more **flexible** protocols
  - Much more flexible and **intuitive graphic prescriptio**n process with a 1024 Localizer;
  - **View/Edit Wizard™** intuitively adjusts dependent parameters automatically in response to operator-initiated changes and highlights them for quick review; also alerts the operator to incompatible dependencies requiring operator intervention;
  - **DynaPlan Plus™** full screen display illustrates scan status pictorially, with real-time feedback.
- Large color screen
  - Extensive use of picture icons and color cues enhance ease of use;
  - Large on-screen controls and attractive color palette provide comfortable viewing over extended periods.
- Enhanced **multi-tasking** allows operators to review more than one exam simultaneously, independently - even with AutoView and AutoFilm on/
  - **BrightBox™** dedicated controls for image next, prior, manual paging and trackball W/L helps make two person image review practical;
  - Up to four 512x512 images from four different exams can be viewed on a large 1024 color display.
- **SmartmA™** User Interface - automatically optimizes mA to maintain constant image noise when collimation/detector configuration, scan mode, scan rotation speed, table speed, or image thickness changes. It takes the guesswork out of setting scan technique when changing parameters (note: user must select initial Noise Index as well as maximum mA setting). Noise index enable 100% Image Quality reproducibity from one patient to another and from one user to another.
- **Protocol Pro™** protocol manager - provides operator control of automated features (like AutoFilm, AutoStore, and AutoTransfer) on per patient basis.
- Patient demographics and exam protocols can be preprogrammed in advance of patient arrival through the Schedule Patient feature.
- A preprogrammed selection of AutoView and Image Review Layouts allow simple customization of the image presentation to match the anatomical area of interest - without the complexity of free-form “windows”.
- **ImageWorks™** provides instant access to advanced image processing features such as MIP, MPR, MPVR, Volume Viewer*, Advanced Vessel Analysis*, CT Perfusion 2* and DentaScan*.
- No waiting for network transfer or image retrieval from archive media.
- Background filming allows use of the full screen for AutoView and image review/processing without interruption when auto or batch filming. Special “one touch” controls provide on-screen viewing of camera progress during **AutoFilm** without disrupting other image processes in progress.
- **ProView™** visualization algorithms available to enhance anatomical structures without additional image reconstruction time.
- Operator console convenient to locate in suite.
  - Computer, image processor and image reconstruction hardware completely integrated in base of console - no separate computer cabinet to site;
  - Split table top allows unrestricted patient viewing while still supporting 2 large color monitors;
  - Front and back work surfaces can be set during installation within a range of vertical heights that help accommodate a variety of siting requirements - especially surrounding the height of the console relative to the window into the scanning suite.
- Work surface accommodates a large variety of working conditions and individual operator preferences.
  - **Wide work surface** has room for papers, patient charts, logbooks or other peripheral devices;
  - Wide area also helps make two person operation more comfortable and practical;
  - All console components (monitors, keyboard, mouse and BrightBox) are free-standing and can be easily moved on the front work surface;
  - All surfaces made of high-impact resin that hides marks and are easy to clean.
- **Direct network connection** means a multi-suite Ethernet card is not required for a gateway out of the suite - saving costs and simplifying installation.
- **Learning Solutions** provides an on-line Operator manual detailing system operation via a multi-media CD-ROM player integrated into the front of the operator console. Learning Solutions can also be accessed on a stand alone PC providing flexibility and productivity for on demand learning of system operation

Advanced Tube & Generator Technology

- The Performix X-ray tube, with 6.3 MHU of storage and 53.2 kW operation, provides increased helical performance with greater patient throughput and virtually no tube cooling. Advanced technology in the Performix tube includes a metal-ceramic frame for long life, a high-speed bearing for sub-second scanning, a high-efficiency motor to accelerate the large anode and

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efficient cooling for high throughput and superior helical performance.

- Wide range of technique factors (10 to 440 mA, in 5 mA increments) gives the operator and physician flexibility to tailor technique to specific needs, optimizing patient dose, and providing the power needed to perform a broad spectrum of axial and helical examinations.

System Specifications

Scan Modes:

The LightSpeed[16] CT system can perform virtually any clinical application due to its wide variety of scan modes. With the LightSpeed[16], body CT studies are easier to perform and more productive than ever before.

Helical:

- Continuous 360° scanning with table incrementation and no interscan delay.
- Scans can be acquired in a wide variety of speeds.

Axial:

- Up to 16 contiguous axial slices acquired simultaneously with each 360° rotation, with the time between scans set by the user-selected interscan delay (ISD) or intergroup delay (IGD).
- Scans may be easily clustered in groups to allow multiple scans in a single breath hold.
- Minimum scan-to-scan cycle time of only 1.5 sec with table moves of ≤ 10 mm (any scan time).

Scout™:

- Single radiographic plane for scan localization and graphical prescription of prospective reconstruction;
- Extended range matches helical scannable range.

Helical Scans

Slip ring technology has advanced axial scanning by enabling scans with zero interscan delay and simultaneous table movement.

Helical Multi-slice Modes:

Simplified scan prescriptions and easy-to-use default protocols make the LightSpeed[16] fast and efficient in patient set up.

Multi-slice acquisitions and short intergroup delays significantly reduce potential mis-registration between scans by increasing the number of scans possible in a patient breath hold. Contrast agents may be better utilized as well due to significantly faster scan acquisition.

Helical protocols are almost identical to "classical" axial scan protocols. At the beginning of a study, the operator selects the type of exam with the anatomical programmer, and indicates the desired scan range - either manually, or from a Scout.

After completing the prescribed exam, the system remains ready to continue with additional helical scans or a set of axial scans.

The operator may reconstruct helical scans prospectively with up to 90% overlap, and retrospectively, at any arbitrary table location in 0.1 mm increments.

Helical Multi-slice Modes

The complex nature of helical multi-slice scanning has been simplified by grouping all critical acquisition parameters within 8 basic scan modes, all optimized for image quality and speed. For eight-slice acquisition: 0.625: 1; 0.875: 1; 1.35: 1 and 1.675: 1. For sixteenslice acquisition: 0.5625: 1; 0.9375: 1; 1.375: 1 and 1.75: 1. These clinically derived multi-slice scan modes offer a wide range of selections that carefully balance acquisition speed, image thickness, artifact level and retrospective image reconstruction flexibility.

This simplified user interface guides the user in the choice of scan parameters. The user selects a pitch mode, a desired image slice thickness and table travel per rotation. The user interface also displays the resulting choice of retrospective image thicknesses available for each choice of acquisition parameters.

The 16 slice helical acquisition modes provide table speeds from 5.625 mm/rotation up to 35 mm per rotation, enabling scan speeds that are up to 12 times faster than 4-slice helical scanners.

Prospective Multiple-Thickness Reconstruction:

For all helical scan modes, the operator can choose to reconstruct images prospectively in any of the defined nominal slice thicknesses.

In addition to the initial reconstructed slice thickness, the operator has the option to prospectively specify additional images to be reconstructed from a single raw data set. These images can be reconstructed at any of the defined nominal slice thicknesses available for a given table speed and scan mode.

This effectively facilitates later, more detailed image analysis without additional patient scans and subsequent dose and image registration concerns.

8-SLICE HELICAL MODES

	Table Speed (mm/rotation)			
Slice Thick-ness (mm)	**Pitch 0.625:1**	**0.875:1**	**1.35:1**	**1.675:1**
1.25	6.25	8.75	13.5	16.75
2.5	6.25 12.5	8.75 17.5	13.5 27.0	16.75 33.5
3.75	6.25 12.5	8.75 17.5	13.5 27.0	16.75 33.5
5	6.25 12.5	8.75 17.5	13.5 27.0	16.75 33.5
7.5	6.25 12.5	8.75 17.5	13.5 27.0	16.75 33.5
10	6.25 12.5	8.75 17.5	13.5 27.0	16.75 33.5

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16-SLICE HELICAL MODES Table Speed (mm/rotation)				
Slice Thick-ness (mm)	**Pitch 0.5625 :1**	**0.9375 :1**	**1.375 :1**	**1. 75:1**
0.625	5.625	9.375	13.75	17.5
1.25	5.625	9.375	13.75	17.5
	11.25	18.75	27.5	35
2.5	5.625	9.375	13.75	17.5
	11.25	18.75	27.5	35
3.75	5.625	9.375	13.75	17.5
	11.25	18.75	27.5	35
5	5.625	9.375	13.75	17.5
	11.25	18.75	27.5	35
7.5	11.25	18.75	27.5	35
10	11.25	18.75	27.5	35

Helical Scan Parameters

Scan Speeds: Full 360° rotational scans in 0.5, 0.6, 0.7, 0.8, 0.9, 1.0 seconds.

Scan Technique:

— kVp: 80, 100, 120, 140

— mA: 10 to 440 in 5 mA increments

— Power: 0.8 to 53.2 kW

— Focal Spot Selection:

Small spot for up to 24 kW

Large spot for greater than 24 kW

Single Acquisition: 120 second scan maximum.

Helical Tilt: helical acquisition is possible with the gantry tilted to a maximum of 30 degree, in half degree increments.

Multiple Acquisition Maximum Scan Time: Multiple scans may be acquired in one series to produce up to 3,000 contiguous helical images. Up to 2,881 seconds helical coverage is possible in multiple series.

Minimum Inter-Group Delay (IGD): 5 seconds between adjacent helical scans

* Option

Scan Fields of View:

— 25 cm for adult head

— 25, 50 cm for body

— 25 cm for pediatric head

Helical Scan Enhancements

Full simultaneity allows complete image display, processing and analysis, as well as image archival and filming, concurrent with scanning and reconstruction -- even when acquiring helical images in a multi-slice mode.

Confirm Rx to X-Rays on: < 15 sec. for any state of tube and gantry; < 10 sec. with the gantry rotating

Anatomical Programmer: a ten-region anatomical selector allows quick and easy access to 90 user-programmable protocols per region. Separate selector for adult and pediatric exams. There are four selection tabs to select: GE, User, Service and Most Recent Patient. Copy/Paste is supported for easy modification and copying of protocols.

Ten user-defined regions. Each region has one default protocol displayed with the anatomical selector for very fast access to most commonly used protocols

Protocols include preset scan time, kVp, mA, scan mode, slice thickness and spacing, table speed, scan FOV, display FOV and center, recon algorithm and special image acquisition and processing options

Any scan parameters may be edited for each scan or all scans - either before or during an exam. The number of scans may also be easily changed.

AutoScan™: Fully automates longitudinal table movement and start of each scan.

AutoVoice™: 3 preset (English) and 17 user-defined messages automatically deliver patient breathing instructions; especially useful for multiple helical scanning.

Trauma Patient: Allows patient scans and image display/analysis without entering patient data before scanning.

Biopsy: Simplified prescription for single or multiple scans around an arbitrary table position aids biopsy studies.

Advanced Artifact Reduction (AAR) Filter significantly reduces streaking artifacts when highly absorbent objects are in the field of view – ie: large shoulders, screws.

Helical Image Reconstruction

Reconstruction Algorithms: Soft Tissue, Standard, Detail, Bone, Bone Plus, Lung and Edge

Reconstruction Matrix: 512

Display Matrix: 1024.

Display FOV: Freely variable center/off-center, prospective/retrospective target selection.

CT Number Scale: -1024 to 3071 HU

Helical Reconstruction Times:

— Reconstruction time as fast 6 images per second

— Typical 0.167 sec. image-to-image recon in normal 16 slice recon mode.

— Maximum image-to-image cycle time is ± 10% for prospective and retrospective image-to-image display. This applies for 512 matrix; any display FOV; in AutoView (all layouts); with concurrent filming and image archival for all scan modes.

— Iterative bone processing increases time by 250 milliseconds. Iterative bone processing, which is always enabled for adult head scanning, reduces image artifacts in head scans stemming from X-ray beam hardening effects.

Minimum DFOV: 9.6 cm

Minimum Pixel Size: 0.19 mm

Queued Recon: Requests will be processed continuously and simultaneously with other processes on the system including scanning. Prospective recon will be prioritized over retrospective recon.

Priority Recon Queuing: One touch selection marks most recent rotation for

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next available recon. Available during or after scanning.

Images annotated to indicate continuous scan acquisition with table incrementation:

HE (helical) + Pitch

Table speed

Prospective Multiple Reconstruction (PMR): Up to 3 sets of reconstructions can be pre-programmed as part of the scan protocol prior to acquisition. The operator can select different start/end location, slice thickness, interval, reconstruction algorithms and display fields of view for each reconstruction. This frees the operator from sitting at the console and directly contributes to increased productivity.

Prospective Recon: Operator may initiate full recons at any table location in increments of 1/10 the image thickness; image thickness remains constant.

Retrospective Recon: Operator may initiate full recons at any table location in 0.1 mm increments; image thickness remains constant.

Retrospective Image Decomposition: The operator has the option to retrospectively decompose the original raw data set and reconstruct additional images at any of the defined nominal image thickness available for a given table speed and scan mode.

Helical Scan Protocols

All protocols assume 120 kVp scans under typical clinical conditions.

Single Helical Scans:

Scan Time	Maximum mA
10 sec.	440
20	390-440
30	330-380
40	290-350
50	260-320
60	230-310
70	210-300
80	180-280
90	170-270
100	160-260
110	150-250
120	140-230

Multiple Helical Scans

(contiguous helical coverage with 5-second IGD):

Scan Time	IGD	No. Scans	Max mA
10 sec.	5 sec.	3	340-420
		4	300-400
		5	270-390
		6	240-360
20 sec.	5 sec.	2	300-360
		3	240-330
		4	180-310
30 sec.	5 sec.	2	230-310
		3	180-280
		4	140-240
40 sec.	5 sec.	2	190-290
		3	140-230
		4	110-190
50 sec.	5 sec.	2	170-270
		3	120-200
		4	90-160
60 sec.	5 sec.	2	140-240
		3	100-170

Contiguous Helical Coverage

Multiple helical scans can be performed in succession with only 5-second delays between helical scans, providing up to 2,881 contiguous rotations (with up to 1,500 images in one series).

(The following chart assumes 120-second helical with 5-sec IGD)

Total Scan Time (sec.)	Total Elapsed Time (sec.)	Max mA
150	155	100-200
200	205	80-150
450	465	50-70

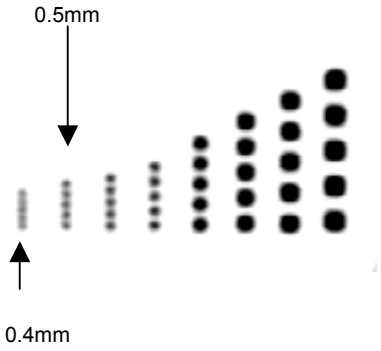
Helical Scan Image Quality

Volumetric Helical Scan Image Quality

With LightSpeed[16] being a sub-millimeter isotropic CT scanner, it is now possible to specify coronal and sagittal image quality:

1. Visual Measurement:

Reformatted resolution is demonstrated on the Nuclear Associates AAPM High Contrast Resolution Insert #76-413.



An Effective 0.5 mm voxel size is clearly seen in coronal and sagittal views.

2. Statistic Measurement:

Volumetric MTF is computed from the X,Y and Z axis of a 0.2mm bead using sagittal and coronal images of the 8" Catphan, MTF module with bead source #CTP445.

Detail Algorithm

MTF (z-axis) is 12.4 lp/cm @ 10%, 15 lp/cm @ 0% which is a 0.333 mm limiting resolution

In Plane Helical Scan Image Quality

For details of scan technique please refer to the technical reference manual.

High-Contrast Spatial Resolution

On GE Performance phantom:

Standard Algorithm

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- 0.584 mm limiting resolution
- 4.0 lp/cm @ 50% MTF
- 6.5 lp/cm @ 10% MTF
- 8.5 lp/cm @ 0% MTF

Hi-Res Algorithm (Edge).

- 0.324 mm limiting resolution
- 8.5 lp/cm @ 50% MTF
- 13.0 lp/cm @ 10% MTF
- 15.4 lp/cm @ 0% MTF

Line pair values decrease with larger focal spot (by 5% with Standard and by 7% with Hi-Res); limiting resolution is unaffected.

Low-Contrast Detectability

On 8 inch (20 cm) CATPHAN phantom:
5 mm @ .3% at 13.3 mGy
3 mm @ .3% at 37.2 mGy

Noise:

On either an AAPM water phantom or GE Quality Assurance phantom:

0.32% +/- 0.03% at 28.5 mGy (2.85 Rad)

CTDI:

On CTDI Head and Body Dose Reference Phantoms:

$CTDI_{vol}$ expressed in mGy/100 mAs for IEC pitch 1: (normalized to a pitch of 1).

Head	20.9 mGy/100 mAs
Body	10.6 mGy/100 mAs

Axial Scans

Multi-slice acquisitions and short interscan delays significantly reduce potential missed registration between scans by increasing the number of scans possible in a patient breath hold. Contrast agents may be better utilized as well due to significantly faster scans.

Axial Multi-slice Prescription

Simplified scan prescriptions and easy-to-use default protocols make the Lightspeed[16] CT Scanner fast and efficient in patient set-up. Axial protocols are nearly identical to helical scan protocols.

Axial Multi-slice Modes

The LightSpeed[16] acquires axial scans in sets of 8 or 16 contiguous images in one 360° rotation.

For each rotation of the gantry, the LightSpeed[16] collects 16 rows of scan data. There are five reconstruction modes available for creating images from the multi-slice scan data (1i, 2i, 4i, 8i, and 16i). By using 1i, 2i, 4i, and 8i reconstruction modes, scan data can be combined prior to image reconstruction to create slices with reduced partial-volume artifacts. This is particularly useful for posterior-fossa imaging.

1i Mode:

- Produces 1 image per rotation
- Nominal Thickness: 1.25, 5, 10 mm

2i Mode:

- Produces 2 images per rotation
- Nominal Thickness: 0.625, 2.5, 5, 7.5, 10 mm

4i Mode:

- Produces 4 images per rotation
- Nominal Thickness: 2.5, 3.75, 5 mm

8i Mode:

- Produces 8 images per rotation
- Nominal Thickness: 1.25, 2.5 mm

16i Mode:

- Produces 16 images per rotation
- Nominal Thickness: 0.625, 1.25 mm

Axial Scan Parameters

Scan Time:

- 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 2.0, 3.0 and 4.0 second full scans (360° acquisition)

Scan Technique:

- kVp: 80, 100, 120, 140
- mA: 10 to 440, in 5 mA increments
- Power: 0.8 to 53.2 kW
- Focal Spot Selection:
  - Small spot for up to 24 kW
  - Large spot for greater than 24 kW

Scan Plane Geometry:

- +/- 30° gantry tilt, in 0.5° increments
- Longitudinal positioning in 0.01 mm per slice increment. Gantry display in 0.5 mm increments.

Interscan Delay (ISD):

- Minimum ISD with table movements of 0 - 10 mm: 1.0 sec.
- Minimum ISD with table movements of more than 10 mm and up to 20 mm: 1.3 sec
- User-selectable.

Inter Group Delay (IGD):

- Minimum IGD is the same as minimum ISD; also user-selectable.

Scan-to-Scan Cycle:

- Minimum scan-to-scan cycle of 1.5 seconds possible for 0.5 sec. scan speed with minimum ISD's.

Scan Fields of View:

- 25 cm for adult head
- 25, 50 cm for body
- 25 cm for pediatric head

Scan with no table incrementation, contiguous image location, or skipped image location are possible. Overlapped axial scans are not possible.

Axial Image Reconstruction

Reconstruction Algorithms: Soft Tissue, Standard, Detail, Bone, Bone Plus, Lung and Edge.

* Option

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Reconstruction Matrix: 512

Display Matrix: 1024.

Display FOV: Freely variable center/off-center, prospective/retrospective target selection.

CT Number Scale: -1024 to 3071 HU

Axial Image Reconstruction:

- Reconstruction time as fast as 6 images per second.
- Typical 0.167 sec. image-to-image recon in 16 slice recon mode.
- Maximum image-to-image cycle time is ± 10% for prospective and retrospective image-to-image display. This applies for 512 matrix; any display FOV; in AutoView (all layouts); with concurrent filming and image archival for all scan modes.
- Iterative bone processing increases time by 250 milliseconds.

Prospective Multiple Reconstruction (PMR): Up to 3 sets of reconstructions can be pre-programmed as part of the scan protocol prior to acquisition. The operator can select different reconstruction algorithms and display fields of view for each reconstruction. This frees the operator from sitting at the console and directly contributes to increased productivity.

The operator has the option to reconstruct the original raw data set at any of the defined nominal slice thicknesses.

Reconstructions can be prescribed down to 1/16 the original acquisition image thickness for images acquired in the 1i scan mode, down to 1/8 the original thickness for 2i mode, and down to 1/4 the original thickness for 4i mode.

Similarly, additional reconstruction supports partial-volume artifact reduction by reconstructing images with 4, 8, or 16 times the acquisition image thickness.

These reconstruction features effectively facilitate later, more detailed image analysis without additional patient scans and subsequent dose and image registration concerns.

The following table illustrates the retrospective reconstruction image thicknesses available for each acquisition thickness and mode:

Prospective Perscription		
Scan Mode	Slice Thickness	Recon Slice Thicknesses
16 row	0.625	16i - 0.625mm 8i - 1.25mm 4i - 2.5mm 2i - 5.0mm
16row	1.25	16i - 1.25mm 8i - 2.5mm 4i - 5.0mm 2i - 10mm
8 row	1.25	8i - 1.25mm 4i - 2.5mm 2i - 5.0mm 1i - 10mm
8row	2.5	8i - 2.5mm 4i - 5.0mm 2i - 10mm

Axial Scan Protocols

All protocols assume 120 kVp scans under typical clinical conditions.

Standard Scans:

Scan Time	ISD	mA	Scans	Acquisition Time
1 sec.	1 sec.	440	18-45	0:35-1:27
1	1	400	24-55	0:47-1:49
1	1	360	32-68	1:03-2:15
1	1	340	37-76	1:13-2:31
1	1	320	43-86	1:25-2:49
1	1	300	50-97	1:37-3:11
1	1	280	58-110	1:45-3:37
1	1	260	66-122	1:55-3:59
1	1	240	74-135	2:07-4:21
1	1	220	84-152	2:21-4:49
1	1	200	94-168	2:37-5:21
2	1	200	37-77	1:13-2:33
2	1	180	42-86	1:23-2:51

- Cluster Scans (All cluster protocols assume 9-second clusters of five slices, 1-second scans with 1-second interscan delays and 7 seconds between clusters).

mA	# Scans (Clusters)	Acquisition Time
440	15-45 (3-11)	0:41-2:49
400	25-55 (5-13)	1:13-3:21
340	35-75 (7-18)	1:45-4:41
320	45-85 (9-20)	2:17-5:13
300	50-95 (10-22)	2:33-5:45
280	60-110 (12-25)	3:05-6:33
260	75-125 (13-28)	3:21-7:21
240	85-145 (14-31)	3:37-8:09
220	100-170 (16-34)	4:09-8:57
200	115-185 (18-38)	4:41-10:01
180	135-250 (22-43)	5:45-11:21

Axial Scan Image Quality

For details of scan technique parameters, please refer to the technical reference manual.

High Contrast Spatial Resolution:

On GE Performance phantom:

Standard Algorithm

- 0.584 mm limiting resolution
- 4.0 lp/cm @ 50% MTF
- 6.5 lp/cm @ 10% MTF
- 8.5 lp/cm @ 0% MTF

Hi-Res Algorithm

- 0.324 mm limiting resolution
- 8.5 lp/cm @ 50% MTF
- 13.0 lp/cm @ 10% MTF
- 15.4 lp/cm @ 0% MTF

Line pair values decrease with larger focal spot (by 5% with Standard and by 7% with Hi-Res); limiting resolution is unaffected.

Low-Contrast Detectability

On 8 inch (20 cm) CATPHAN phantom:

5mm @ .3% at 13.3 mGy
3mm @ .3% at 37.2 mGy

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Noise:

On either an AAPM water phantom or GE Quality Assurance phantom:

0.32% +/- 0.03% at 29.3 mGy (2.93 Rad)

CTDI:

On CTDI Head and Body Dose Reference Phantoms:

CTDI expressed in mGy/100 mAs:

Head	16.8 mGy/100 mAs	center
	17.0 mGy/100 mAs	surface
Body	5.50 mGy/100 mAs	center
	10.0 mGy/100 mAs	surface

$CTDI_{100}$ expressed in mGy/100 mAs:

Head	18.7 mGy/100 mAs	center
	17.9 mGy/100 mAs	surface
Body	5.4 mGy/100 mAs	center
	11.2 mGy/100 mAs	surface

$CTDI_{vol}$ expressed in mGy/100 mAs:

Head	18.4 mGy/100 mAs
Body	9.3 mGy/100 mAs

Scout Scans

ScoutView™ scans provide excellent detail for anatomical localization in conjunction with scan prescription.

Scan locations may be prescribed at the operator console either graphically (via mouse), or explicitly (keyboard entry) from a Scout scan.

Prescription of scans with multiple gantry angles are also available on a single Scout.

Scout Scan Parameters

Aperture: 1.25 mm effective aperture

Table speed: 100 mm/sec.

Scan Technique:

- kVp: 80, 100, 120, 140
- mA: 10 to 440 in 5 mA increments
- Power: 0.8 to 53.2 kW

Orientation: AP, RLAT, PA, LLAT (preset); or any angle from 0° - 359° (manually selected).

Axial scan prescription lines indicate scan location to nearest 1 mm table position.

Scouts longer than 1,000 mm are auto minified to fit the display.

User Interface

The Lightspeed[16] Operator Console utilizes a computer workstation with the following user interface features:

- Two 20-inch monitors
  - Scan/recon monitor for scan and recon control with no image display
  - Image monitor for image display, analysis, processing, and management
  - Each monitor provides a 1280 x 1024 high resolution, flicker-free display
  - Optional 18" LCD Monitors.
- Scan control keyboard assembly with intercom speaker, microphone and volume controls
- Three button mouse with mouse pad
- BrightBox (trackball assembly)
- Two wide work surfaces

All these devices are free-standing and can be easily moved to accommodate a large variety of working conditions and individual operator preferences.

Split table top allows unrestricted patient viewing while still supporting 2 monitors. Each work surface can be adjusted at installation to help accommodate a variety of siting requirements.

Desktop Overview

The user interface utilizes the paradigm of managed work environments for a more intuitive clinical workflow.

Virtually all clinical operations are managed through three "virtual desktops" or applications managers: Exam Rx, ImageWorks and Learning Solutions. Operators can effortlessly move back and forth between these environments simply by clicking on an icon. **Xtream™ technology** enhances multi-tasking architecture and maintains simultaneously all processes so no work is lost or disrupted as desktops are switched.

Exam Rx:

The Exam Rx desktop environment provides the clinical tools necessary for comfortable, efficient control of patient studies.

These tools include patient scheduling and data entry, exam protocol selection, protocol viewing and editing, scan data acquisition, image reconstruction, image display and routine analysis, AutoFilm or manual filming, AutoStore and AutoTransfer.

ImageWorks:

ImageWorks is a desktop environment designed to take advantage of the Lightspeed[16] CT Scanner System computer and image processor.

Standard features include archive, network and manual film control, as well as some advanced image processing such as multi-planar reformatting (MPR), multi-projection volume rendering (MPVR), and MR image display. It also has optional add-on packages for Volume Viewer*, CT Perfusion2* and DentaScan*.

The ImageWorks desktop also provides a gateway for DICOM 3.0 image transactions, either through a local area network, or via DICOM-formatted MOD media.

Learning Solutions:

The LightSpeed[16] provides an on-screen, on-line operator manual via a multi-media CD-ROM player integrated into the front of the operator's console. Learning Solutions is also viewable on a stand-alone PC providing flexibility and productivity for on-demand learning of system operation.

Exam Rx

Patient Scheduling

Patient demographics and exam protocols can be pre-programmed in advance of patient arrival by selecting Schedule Patient from the scan/recon monitor. This productivity enhancement allows entry of all or some of a patient's demographic data, as well as pre-selection of the exam protocol.

* Option

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This feature is available any time a patient exam is not currently underway.

This feature uses the same interface as New Patient selection for simplified, consistent programming.

Patient information can be easily recalled to set up an immediate exam via List/Select Scheduled Patient on the scan/recon monitor. Pre-programmed patient exams can also be recalled from the New Patient screen automatically by entering the patient ID number.

Patient Data Entry:

Patient data can be entered as part of New Patient set-up, or can be recalled from the list of pre-scheduled patients.

Trauma Patient ID allows patient scans and image display/analysis without entering patient data before scanning.

Exam Protocol Selection:

One of the main contributions of the LightSpeed[16] CT Scanner System to department productivity is its simplified exam set-up.

- Exam parameter set-up has been greatly simplified through the exclusive use of protocols
- Protocols can be easily selected in one of three convenient ways:
  - A large, graphical Anatomical Programmer located on the New Patient screen
  - A default list of the "top 10" most commonly used protocols located near the anatomical programmer
  - A numerical entry
- Two Anatomical Programmers - one for adults and one for pediatrics - provide quick and easy access to 8,460 user-programmable protocols (total). Each programmer has ten anatomical regions with 90 protocols for each region
- Default protocols have been expanded through Protocol Pro - a "behind the scenes" protocol manager - that allows preselection of automated features like AutoVoice, AutoFilm, AutoStore and AutoTransfer on a per-exam basis.
- Protocol Pro also provides preselection of two different window/level settings per image for AutoFilm and can automatically display the 1024 Localizer each time a new series is requested.
- Default protocols also include preset scan time, kVp, mA, slice thickness, scan mode, table speed, image interval, gantry tilt, scan field-of-view, display field-of-view and center, recon types, and breath timing parameters.
- Any scan parameter can be edited for each scan or all scans either before or during an exam. Scans can be easily added or removed from the prescription.
- Scan/recon control uses only 2 screens to set up first scan - New Patient and Protocol View/Edit.

Protocol View/Edit:

- A single, full screen View/Edit table allows fast and easy examination and modification of exam parameters before scanning begins
- Exam parameters can be changed for just one scan, or for all scans in a series
- When used in conjunction with the 1024 Localizer, changes made in the View/Edit table that affect the number of scans, image interval, starting/ending locations, tilt, or display FOV are automatically shown on the 1024 Localizer
- Any changes made directly on the 1024 Localizer display using the mouse and the on-screen cursor controls are also reflected automatically in the View/Edit table
- View/Edit Wizard intuitively adjusts dependent parameters automatically in response to operator-initiated changes and highlights them for quick review. It also alerts the operator to incompatible dependencies requiring operator intervention.
- Tab card groupings for Timing, Recon and Filming help organize the large number of parameters available within each protocol.
- As many as 8,460 protocols can be stored on the Operator Console.

Scan Data Acquisition:

- Full-screen DynaPlan Plus illustrates scan status graphically, with real-time feedback while the exam is underway. Scans, programmed delays (prep, breathing, inter-group), and even AutoVoice announcements are clearly shown before and during scanning.
- AutoScan: Fully automates longitudinal table movement and the start of each scan
- AutoVoice: Preset (English) and user-recorded messages automatically deliver patient breathing instructions, especially useful for multiple or multi-pass helical scans
- Full Simultaneity allows scan and recon to work concurrently with image display, processing and analysis (including computationally intensive features such as MPR, MPVR and 3D*/MIP) while still running image archival, filming and networking processes.

Dose Computation & Display

$CTDI_{vol}$ (CTDI volume), DLP (Dose Length Product), and Dose Efficiency computation and display during scan prescription provides patient dose information to the operator.

$CTDI_{vol}$ is a dose index defined by IEC 601-2-44. This index is computed automatically by the Lightspeed[16] CT System and reported on the Exam Rx screen. $CTDI_{vol}$ is a single number consisting of 2/3 of the $CTDI_{100}$ peripheral dose plus 1/3 of the $CTDI_{100}$ central dose that is divided by the helical or axial pitch factor.

$CTDI_{100}$ is a dose index based upon CTDI dose measurements over a 100 mm volume, as defined in IEC 601-2-44.

Dose Length Product (DLP) is given in mGy*cm and is computed and displayed for each group prior to the scan. Additionally, an accumulated DLP is displayed for the entire exam, as the exam prescription progresses. The final exam accumulated DLP provides a convenient measure for maintaining patient or procedure dose management statistics.

Dose Efficiency is automatically computed and displayed on the Exam Rx screen. The dose efficiency is a measure of how much of the Z-axis X-ray beam is used by the system, as defined in IEC 601-2-44.

AutoView Layouts:

- Eight powerful AutoView layouts provide exceptional flexibility in tailoring the 1,024 image display to the user or the application at hand - without the complexity of free-form "windows."
- AutoView Layouts include:
  - 1024 AutoView image
  - 768 AutoView image (matches the image size shown on the HiSpeed Advantage 2.X Series OC monitor)

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- 512 AutoView image + 512 Localizer Scout with cut lines automatically showing the location of the AutoView image on the Scout
- Two 512 AutoView images (same image but at different window/level settings) + 512 Localizer Scout with cut lines automatically showing the location of the AutoView images on the Scout
- 512 AutoView image + 512 AutoFilm image
- Last two 512 AutoView images
- Last four 512 AutoView images
- AutoLink which links the current series to a view port

- Basic image review features such as window/level, magnification and flip/rotate are available for AutoView images.
- Any window not used for AutoView is available to independent, simultaneous review of other exams.
- Special BrightBox, a three-button trackball device, provides independent control of image next, prior, manual paging and trackball window/level for any review images in focus. This helps make two person operation practical.
- Regardless of the AutoView Layout used, AutoFilm viewing is available anytime via an on-image selection - without disrupting other image processes in progress. Background filming allows full use of the image display monitor for AutoView and image review/processing without interruption during AutoFilm.

Image Review Layouts:

- Five flexible Image Review Layouts are provided for those applications where greater than 512 image display may be desired and AutoView is not required.
- Image Review Layouts include:

Note: uses short notation for screen options

- 1024 single image display
- 768 single image display
- Two 512 image display, horizontal format
- Two 512 image display, vertical format
- Four 512 image display

- Each image display window can be further subdivided into four more images, increasing the total number of images that can be displayed at once to 16.
- BrightBox image control is also available for Image Review Layouts.

Image Access:

- Point and click interface along with a pictorial directory (browser) allows for easy selection by exam, series or image

Routine Image Display:

- Image display features provided within Exam Rx:
  - Zoom/Roam
  - Explicit Magnify
  - Flip/Rotate
  - ProView
  - Display Normal
  - List/Select
  - Ellipse ROI
  - Measure Distance
  - Grid On/Off
  - Cross Reference
  - User Annotation
  - Exam/Series Page
  - Hide Graphics
  - Erase
  - Screen Save
  - Gray Scale Enhancement
- ProView visualization algorithms are available to enhance anatomical structures without additional reconstruction time:
  - Four Selections for enhancement of high contrast objects where fine detail is required without aliasing (such as lungs)
  - Three Selections for modifying perceived levels of noise and low contrast discrimination
- Three ways are provided to adjust window/level of images in focus in order to meet a variety of clinical work environments and user preferences:
  - Six user-programmable keys on the scan control keyboard (F6 - F11), plus one key for returning to prior setting (F5)
  - On-image through middle mouse button
  - BrightBox trackball

Routine Measurements:

- Image measurement features provided within Exam Rx:
  - Box ROI
  - Ellipse ROI
  - Trace ROI
  - Measure Distance
  - Measure Angle
  - Grid On/Off
  - Hide Graphics
  - Erase
  - Screen Save
  - MIROI (Multiple Image ROI)
  - Report Pixels

Display Preferences:

- Display settings available to tailor the overall display (settings apply to all images in all exams):
  - Annotation Levels
  - Inverse Video
  - Next/Prior Each View Port
  - Next/Prior Series Binding
  - Continuous Report Cursor

Auto Image Management:

The Exam Rx work environment conveniently provides for selection of AutoFilm, AutoStore (to local or remote MOD), and AutoTransfer (across a network).

An AutoFilm Composer provides a simple programming interface for automated filming set-up.

Batch Filming is accomplished through a single keystroke which automatically prints an entire series at a time.

Manual Image Filming:

- On-screen filming is available for any analog or digital camera using a 3M-952 protocol.
- Images may be individually filmed manually via “drag and drop” to the on-screen Film Composer.
- Print Series permits automatic printing of an entire series with one keystroke.
- Page filming permits creation of an entire film with one keystroke.
- Multiple image formatting allows filming of multiple images in a single film frame.
- Film formats supported are 1:1, 2:1, 4:1, 6:1, 8:1, 9:1, 12:1, 15:1, 16:1, 20:1, 24:1 and 35-mm slide

Important note: The Lightspeed[16] CT Scanner comes standard with a DICOM Print Interface configurable for multiple DICOM Print destinations. Connections with cameras that

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do not support DICOM Print may require a filming interface (purchased separately).

To save further filming cost, the Operator Console can directly print to a postscript printer such as the GE Color Printer available as an option.

ImageWorks

ImageWorks software is designed to take advantage of the Lightspeed[16] CT Scanner's computer and image processor. This desktop environment includes image management and networking.

Because some of the image analysis and display features of ImageWorks replicate those in Exam Rx, the next section describes only features that are incremental or significantly different.

Image Analysis

• **Multi-Projection Volume Reconstruction** (MPVR): Quick and easy way to generate volumetric images for CT angiography without thresholding data or removing unwanted anatomy. An entire volume is used to generate images in any plane, creating real-time frames of reference at the same time;

• Clinical utility is extended via two additional modes:

− MIPS - enhances contrast and improves visualization of calcifications

− Average - generates 2D radiographic images;

• **Multi-planar Reformation** (MPR): Provides real-time assessment of anatomy in offaxis planes. Sagittal, coronal, oblique and curved planar reformations available;

• **Batch reformatting** can also be defined and executed for later viewing if desired;

• Image Addition and Subtraction: Includes image addition of more than two images at a time;

***Volume Viewer**

Volume Viewer is an innovative and powerfull suite of productivity enhanvers (Volume Rendering, Volume Analysis and Navigator) that includes :

- Dynamic Volume Review™ for Fast Screening
- Curved Volume Of Interest
- Protocol Management and Loading
- Review Layout Presets
- Multiple VR Objects Merge
- Pseudo Surface Shading Mode
- Predefined Cut Planes
- Volume Rendered Navigator views
- VR Preset save/recall
- 3D Rendered Lumen View
- Automatic Path Tracking
- Path Bridging (in case of occlusions)
- SmartCursor™ for Easy Navigation
- Synchronized Reformatted Views
- Cut visualization mode

***Advanced Vessel Analysis**

Advanced Vessel Analysis is the ultimate tool to assess and quantify vascular structures, including stenosis analysis, stent planning procedures, post stenting or vascular surgery follow-up.

- protocol driven tools to perform quick, flexible and accurate quantitative analysis of vascular anatomy
- provides maximum, minimum and mean intraluminal diameter measurements
- provides cross-sectional areas of true orthogonal sections of the aortoiliac systems at selected anatomical points
- clinical benefits include: stenosis sizing, pre- and post- surgical assessment, stent planning
- Measurements in % stenosis or mm of stenosis, and measurement of length and dimension of stenosis.

Image Display

- Magnifying Glass allows quick 2X mag window that can be moved over an image.
- Image Scroll moves an image within its' own window.
- Groupings allow application of window/level values, magnification/minification, image scroll or flip and rotate to a user-defined image set.
- Save State stores user-selected image orientation and window/level with each data set.
- Window/Level values may be:
  - Preset to provide six on-screen instant window/level settings
  - Set independently for up to 16 images on the screen
  - User-modified in discrete or variable steps
  - Adjusted real-time on-image by holding down the middle mouse button and moving the mouse
- Cine mode provides paging in up to 4 view ports of up to 128 previously-stored CT or MR images at full selected display frame rate. For more than 128 images, display frame rate may be reduced.
- Cine mode also provides temporal, spatial or manual playback loops.
- Text Page

Image Annotation

- Image annotation and cursor are shadowed to permit ease in reading.

Image Management

- Images may be stored and retrieved via Magnetic Optical Drive (MOD) media using DICOM 3.0 format. This allows interchange with other imaging systems supporting DICOM 3.0 MOD media. Not all vendors implementation of DICOM 3.0 are identical, so please check with the manufacturer for compatibility.
- Off-line retrieval of all image files. Images may be viewed as soon as they are restored from MOD.
- Image retrieval time is approximately 30 images 512 per second.

VariViewer™:

- VariViewer is an interactive axial review mode that can change the slice thickness reconstruction instantaneously.
- The user selects the volume to be specifically analyzed and chooses the slice thickness to be displayed as axial images. The user can then save a number of recon images sets, viewing a large number of slices for pure axial review and filming.

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- Batch film can typically enable you to reduce filming images by 50%, thickening the slab from 1.25 to 2.5mm with no information loss.

Image Networking:

Exams can be selected and moved from MR Signa Advantage, CT HiSpeed Advantage, Advantage Independent Console, Advantage Windows Workstation to the Lightspeed[16] CT Scanner's Operator Console. This is performed via the AdvantageNet (GenesisNet) point-to-point protocol. This protocol supports send, receive and pull/query (no broadcast). NOTE: Because the Lightspeed[16] creates images in pure DICOM format, exams *can not* be moved from the Lightspeed[16] CT Scanner System to MR Signa Advantage, CT HiSpeed Advantage or the Advantage Independent Console systems.

Exams can also be selected and moved between the Lightspeed[16] CT Scanner System and any imaging system supporting the DICOM 3.0 protocol for network send, receive and pull/query. GE systems that support this interoperability include CT HiSpeed CT/i, X/i, NX/i, QX/i, MR Signa LX, and Advantage Windows 1.2/2.x/3.x/4.x.

Image transfer time using either AdvantageNet or DICOM 3.0 protocols is approximately 0.1 second per 512 image on a 100baseT Network.

Computer Based Training

This innovative feature provides on-screen, on-line support of Exam Rx and ImageWorks functions via a multi-media CDROM player, integrated into a tower on operator console for easy access. Use of rich graphics and text to provide truly useful system help.

A well-indexed table of contents helps speed access to information. The CD can be viewed on the scanner or on a PC.

Industry Standards

- The LightSpeed[16] CT Scanner System complies with a wide variety of industry standards to facilitate more rapid adoption of features and performance improvements as the computing and medical imaging industry evolves.

DICOM Conformance Standards:

- DICOM 3.0 Storage Service Class
  - Service Class User (SCU) for image send
  - Service Class Provider (SCP) for image receive
- DICOM 3.0 Query/Retrieve Service Class
- DICOM 3.0 MOD Media Service Class on 1.2- and 2.3-GB MOD media
- DICOM 3.0 Storage Commitment Class Push
- DICOM 3.0 Modality Worklist*
- DICOM 3.0 Modality Performed Procedure Step*
- DICOM 3.0 Print

Filming Protocol:

- 3M-952 Standard

System Components

Gantry:

Advanced slip ring design continuously rotates generator, tube, detector and data acquisition system around the patient.

- Aperture: 70 cm
- Tilt: ± 30°
- Tilt Speed: 1°/sec.
- Focus to Detector: 95 cm
- Focus to Isocenter: 54 cm
- Maximum SFOV: 50 cm
- Rotational Speeds: 360° in 0.5, 0.6, 0.7 0.8, 0.9, 1.0, 2.0, 3.0 and 4.0 sec.
- Remote Tilt from Operator's Console.
- Integrated breathing lights and countdown timer.
- Integrated start scan button with countdown to X-ray on.

Scan plane toward front of gantry for improved positioning access.

Biopsy and interventional studies have been facilitated through a more streamlined gantry shroud, and bilateral table/gantry controls and gantry display that maximize maneuverability while working next to the gantry.

Laser Alignment Lights:

- Define both internal and external scan planes to ± 1 mm accuracy.
- Operate over full range of gantry tilt; activated any time during exam (with tube stationary).
- Coronal light remains perpendicular to axial light as gantry tilts.

Visual readout is easy to read from the table side or from the operator console.

Gantry tilt controls are located on the side of the gantry.

Table

- Single table, cantilever design with wide height range
- Vertical Range: 51.6 cm to 99.1 cm
- Vertical Scannable Range: 80.6 cm to 99.1 cm
- Elevation Speeds: 5 mm/sec and 40 mm/sec
- Horizontal Range: 170 cm
- Horizontal Scannable Range: 170 cm metal-free (axial) and 160 cm metal-free (helical & Scout)
- Horizontal Speed: Up to 100 mm/sec
- Table automatically recenters on scan plane with changes in vertical position (after setting internal landmark with alignment lights on)
- Table Load Capacity:
  - 180 kg (400 lb) with +/- 0.25 mm positional accuracy
  - 205 kg (450 lb) maximum allowed with normal operation and +/- 1 mm positional accuracy
- Controls on gantry for elevation and cradle incrementation. Foot pedals on both sides of table for fast elevation. Cradle position controlled from OC for prescribed scans.
- IV Pole integrated at the foot-end of the table prevents IV lines from becoming crossed and tangled, and ensures that the lines stay securely in place on the patient.

X-Ray Tube

Performix ADV Metal-Ceramic Tube Unit. Design optimized for exams requiring a large number of scans without tube cooling.

* Option

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- Heat Storage Capacity: 6.3 MHU
- Heat Dissipation:
  - Anode (max) 840 KHU/min
  - Casing (cont) 300 KHU/min
  - Tube Unit: 6.9 kW continuous for 10 minutes
- Dual Focal Spots:
  - Small Focal Spot:
    0.7 mm (W) x 0.6 mm (L) nominal value
    (IEC 336/93)

    0.9 mm (W) x 0.7 mm (L) traditional methodology
  - Large Focal Spot:
    0.9 mm (W) x 0.9 mm (L) nominal value
    (IEC 336/93)

    1.2 mm (W) x 1.2 mm (L) traditional methodology
- Maximum Power: 53.2 kW
- Beam collimated to 55° fan angle.

Average time to replace tube: ≤ 10 hours

High Voltage Generation

- High-frequency on-board generator. Continuous operation during scan.
- 53.2 kW output power.
- kVp: 80, 100, 120, 140
- mA: 10 to 440 mA, 5 mA increments

Maximum mA for each kVp selection:

KVp	Max mA
80	400
100	420
120	440
140	380

HiLight Matrix II Detector:

21,888 individual elements composed by: 8 rows of 1.25 mm thickness and 16 rows of 0.625 mm thickness, each containing 888 active patient elements; 24 reference elements.

4 typical modes of data output:
- 8 x 1.25 mm (uses center 16 rows)
- 8 x 2.5 mm (uses all 24 rows)
- 16 x 1.25 mm (uses all 24 rows)
- 16 x 0.625 mm (uses center 16 rows)

70% geometric efficiency; 98% absorption efficiency.

Data Acquisition System

12,288 available input channels.

1,640 Hz maximum sample rate.

Effective analog to digital conversion range greater than two million to one.

Scan/Control Unit

Located in base of Operator Console.

Host Computer

- Dual SMP 2.66.GHz Intel Xeon processors with 512KB L2 cache.
- Intel Hyper-threading technology.
- 2GB DDR266 Dual Channel Memory with a throughput of 4.2GB/sec

Image Processor:

- Nvidia Quadro4 980XGL AGP 8X graphics with 128MB Memory
- Graphics Processor Unit (GPU) Clock 300Mhz
- Graphics Memory Clock 325Mhz

Image Reconstruction Engine (GRE)

- Custom-designed special purpose CT Image Generator
- Custom CT back projection hardware accelerates 2D & 3D back projection.
- Intel Hyper-threading Technology.
- 32-bit floating point data format
- 2GB DDR226 ECC Dual Channel Memory Standard (4.2 GB/sec).

Software Architecture:

- Software architecture based on industry standards and client-server design

Peripherals:

Total of 254 GB system:

- Main system (host) disk drive:
  - High Performance Drive
  - 36 GB, 3.5 inch form factor
  - 15,000 RPM
  - Ultra320 SCSI interface
  - Assigned to applications software and image files
- 2 system disk drives (Image Disk)
  - High Performance Drive
  - 73 GB, 3.5 inch form factor each.
  - 15,000 RPM
  - Ultra320 SCSI interface
  - Assigned to image files only

  - 250,000 uncompressed 512 images
- Scan data disk drive:
  - High Performance Drive
  - 36 GB, 3.5 inch form factor
  - UltraSCSI interface
- Scan data disk drive:
  - High Performance Drive
  - 36 GB, 3.5 inch form factor
  - UltraSCSI interface

- Standard **MOD** drive:
  - Magnetic Optical Disk Drive
  - Erasable, rewritable media
  - 2.3 GB, 3.5 inch form factor
  - Assigned to DICOM 3.0 format image file.
  - Stores 4,700 lossless JPEG compressed 512 image files per side
  - Off-line retrieval of image. Images may be viewed as soon as they are restored from MOD

- **DVD Ram**:
  - 4.7 GB per side, 5.25" half height form factor
  - Transfer rate 2.7MB/sec
  - Assigned to scan data file and protocol file storage/retrieval.

- **Color monitors**:
  - 21 inch diagonal width
  - 1280 x 1024 dot resolution
  - Non-interlaced, flicker-free presentation
  - 76 kHz Horizontal deflection frequency

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- 72 Hz Vertical deflection frequency
- Sync on green

- LCD Color Monitor*: 18" diagonal width
- Scan control **keyboard** (English language) assembly with intercom speaker, microphone and volume controls.
- Global **modem** to allow InSite connectivity
- 3-Button **Mouse**
- 3-Button **Trackball**

Image Networking:

- Standard auto-configuring 100BaseT/10BaseT Ethernet (UTP connection)
- Direct network connection; multi-suite ethernet card not required for gateway out of suite
- Protocols supported:
  - DICOM 3.0 network send (one IP address at a time) and receive, pull/query, and storage commitment push;
  - AdvantageNet (GenesisNet) point-to-point send, receive and pull/query (no broadcast);
  - InSite point-to-point;
  - TCP/IP (for system administration)

Compatible Options

- A DICOM Print Interface is standard on the system.
- English Keyboard (B7800KE)
- French UIF & Keyboard (Z62401F)
- German UIF & Keyboard (Z62401G)
- Italian UIF & Keyboard (Z62401H)
- Spanish UIF & Keyboard (Z62401S)
- Portuguese UIF & Keyboard (Z62401P)
- ConnectPro HIS/RIS Interface with Performed Procedure Step (PPS) M4 compatibility (B7500LN)
- Bar Code Reader (B7540RB)
- Volume Viewer (B7540LD)
- DentaScan (B7540LS)
- SmartScorePro (B7850PL) – Gating SW
  - Prospective or retrospective EKG-gated cardiac imaging in a single breath-hold
  - 250-300 msec temporal resolution
  - Easy-to-use calcium scoring software with integrated patient report generation
- Snapshot Option (B7710LS)
- CT Perfusion 2(B7700PL)
- Smart Step (B7868WL) – SW
  - Smart Step HW (B7868SM & B7868SN)
- Advanced Vessel Analysis (B7868LA)
- CT Colonoscopy (B7868LC)
- CardIQ2 (B7710LR)
- Remote 21 inch Color Monitor (B7530RC)
- Exide UPS (B7999PS)
- Metal Free Table Interface for 3rd Party Attachments (B7999PM)
- LCD Monitor (B7858LC)
- GE Color Printer (E7014LA)
- Table Tray

Siting Requirements

Minimum Suite Size:

Overall Suite:

15.5 feet (4.74 m) wide x 19.5 feet (5.96 m) deep x 9 feet (2.75 m) high.

Recommended Suite Size:

Overall Suite:

19.5 feet (5.96 m) wide x 24.5 feet (7.49 m) deep x 9 feet (2.75 m) high.

Exam Room: 13 feet (3.97 m) wide x 19.5 feet (5.96 m) deep.

Control Room: 11 feet (3.36 m) wide x 12.5 feet (3.82 m) deep.

Equipment Room: Not required. Power Distribution Unit heat and noise output under all operating conditions with all available options is low enough to allow inclusion in the patient scanning suite with the table and gantry.

Temperature and Humidity:

Exam and Control Rooms: 60°-75°F (15°-26°C) at 30%-60% relative humidity (non-condensing).

Equipment Room: If a separate equipment room is used to house the PDU, the allowable temperature range is 60°-84°F (15°-29°C) at 30%-60% relative humidity (non-condensing).

Temperature Rate of Change: 3°C/hour max.

Relative Humidity Rate of Change: 5% RH/hour max.

Power Requirements:

The only facility input to the system is a 380 to 480 V nominal, 3 phase Delta or Wye, 50/60 Hz, 90 kVA service, 20 kVA average power; main disconnect to be located within 5 feet (1.5 m) of the PDU. The facility must also provide a protective disconnect device with low voltage, low energy local and multi-point remote capability, in the line feeders to the PDU.

Complete, detailed specifications of all power requirements are available upon request. For most installations, the Lightspeed[16] CT Scanner System does not require any power conditioning equipment to be used in conjunction with the PDU. Regulators are not recommended for use with this system. For those sites with known large power line transients, a suppresser filter for the system computer and peripherals may be useful. In general, suppresser filters are not recommended.

Compatible UPS options are available if desired.

Cooling Requirements:

The cooling requirements do not include cooling for the room lighting, personnel or non-CT equipment present. Cooling requirements are listed by subsystem to allow planning for each room of the CT suite.

Cooling requirements are given for minimum, recommended and growth allowance scenarios.

- The minimum cooling figures assume patient throughput of 3 patients per hour and 75 scan rotations per patient.
- The recommended cooling requirements assume patient throughput limited by the tube cooling algorithm.
- The suite cooling can be sized for future developments by using the growth allowance figures. This cooling will accommodate more patients per hour and/or potential future system enhancements.

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	Minimum Allowance	
Subsystem	**Watts**	**BTU/hr**
Gantry	5,440	18,600**
Table	200	700
PDU	1,000	3,400
Operator Console	2,165	7,400
Optional Laser Camera	800	2,730

Recommended cooling values should not be used for calculating system input power requirements.

** Recommended Allowance: 7,150/24,400
Growth Allowance: 9,200/31,400

System Components Dimensions			
		mm	**inches**
Gantry:			
	Width:	2,230	87.6
	Depth:	1,007	39.6
	Height:	1,887	74.1
Table:			
	Width:	610	24
	Length:	5,050	199
	Height:	1,120	44
Power Distribution Unit:			
	Width:	762	30
	Depth:	585	23
	Height:	1,270	50
Operator Console:			
	Width:	1,238	48.7
	Depth:	1,288	50.7
	Height:	1,257	49.5

Warranty

The published Company warranty in effect on the date of shipment shall apply. The Company reserves the right to make changes.

All specifications are subject to change.

Regulatory Compliance

This product is designed to comply with applicable standards under the Radiation Control for Health and Safety Act of 1968.

Laser alignment devices contained within this product are appropriately labeled according to the requirements of the Center for Devices and Radiological Health.

This product is a CE-compliant device which satisfies regulations regarding Electro-Magnetic Compatibility (EMC) and Electro-Magnetic Interference (EMI), pursuant to IEC-601.

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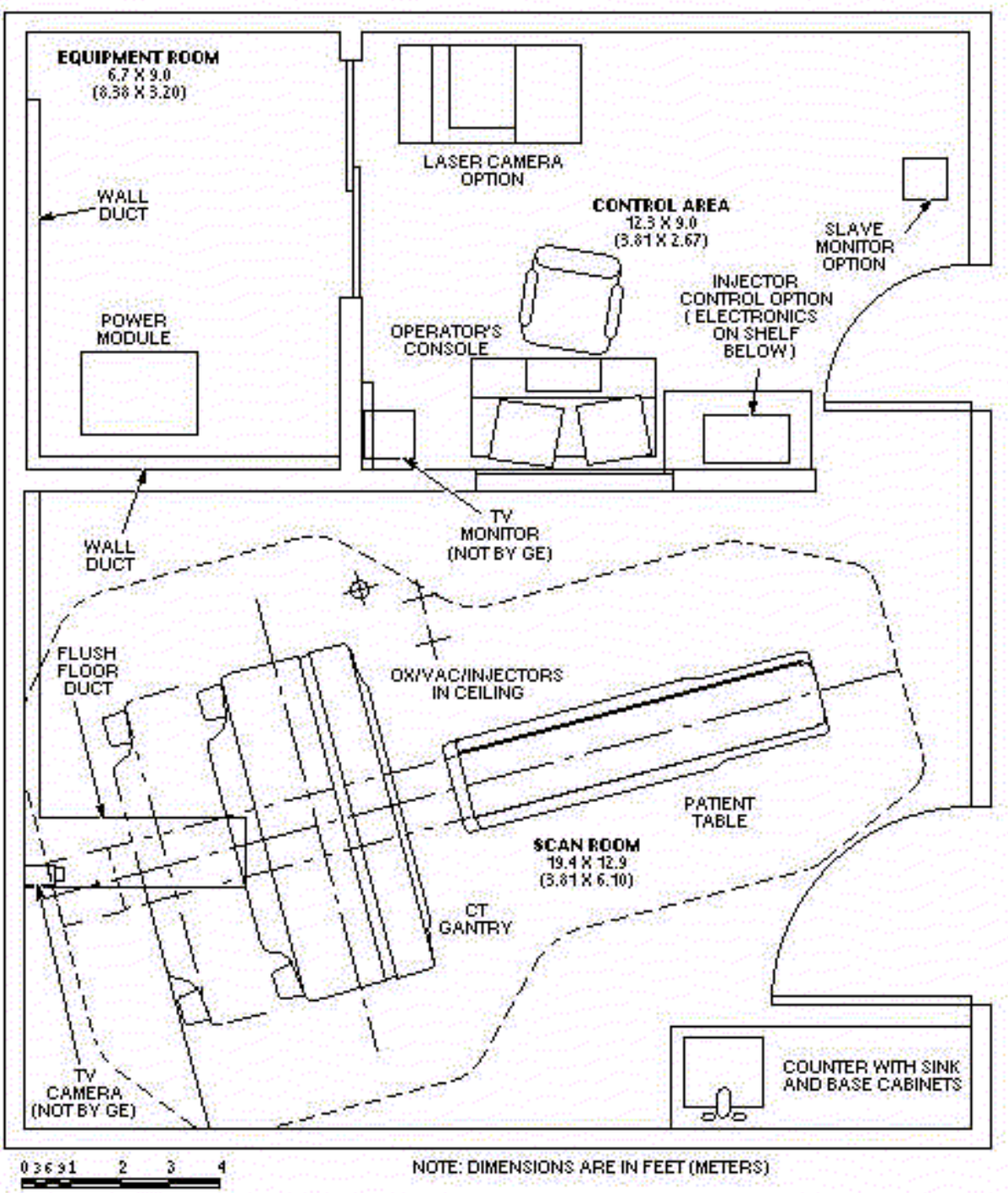

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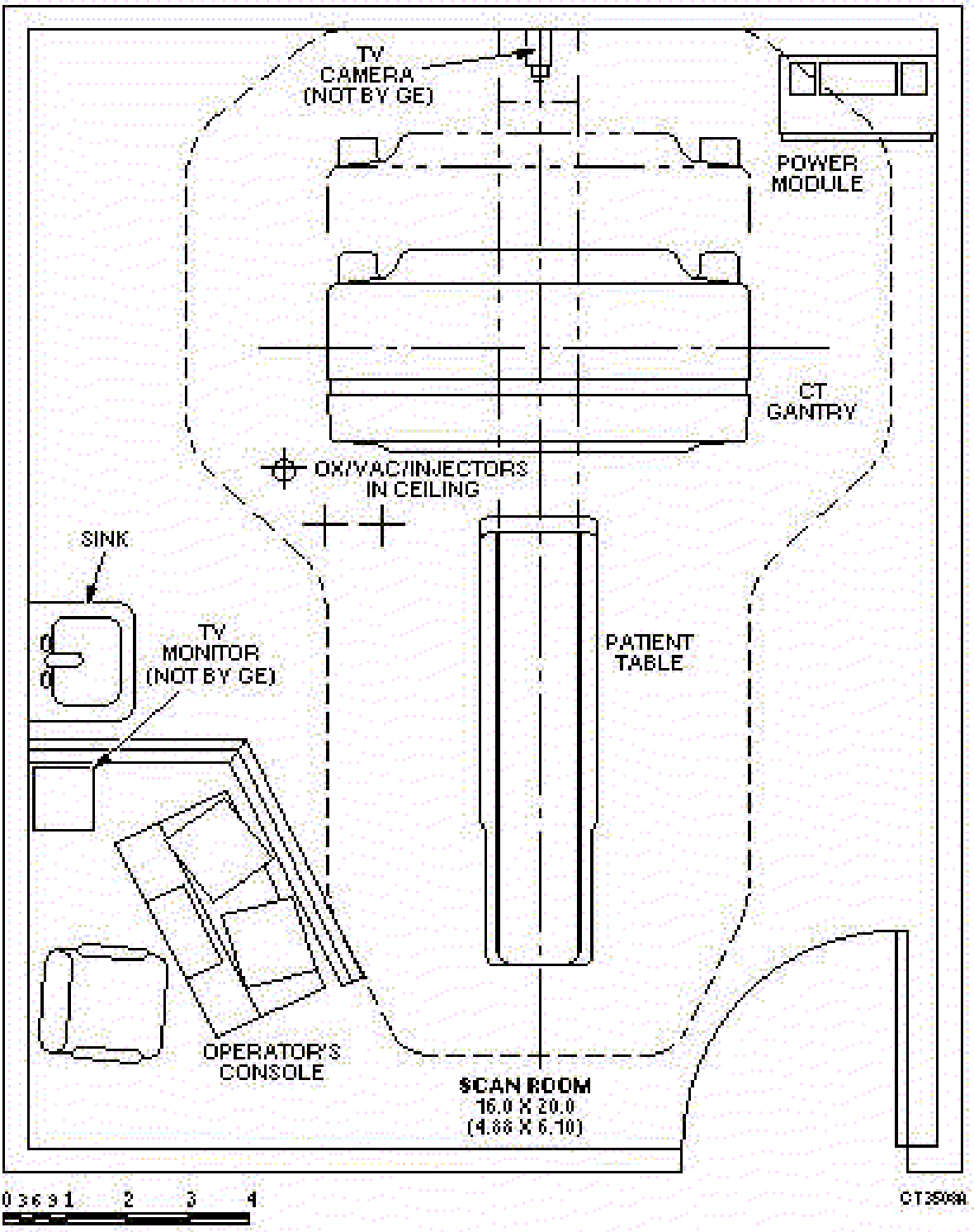
Minimum Room Layout

Typical Room Layout



* Option