Discovery CT590 RT PDS March 2012

Administración de empresas (Universidad Libre de Costa Rica)

Discovery CT590 RT

Radiation Oncology CT Simulator

Introduction

The GE Discovery CT590 RT delivers a new standard in radiation therapy CT simulation, with dramatic breakthroughs in CT image quality and advanced 4D workflow. The system enables significant improvements in image noise and low contrast detectability with the GE CT technological exclusive ASiR (Adaptive Statistical Iterative Reconstruction). And combined with the new TG66 compliant table to deliver accurate patient positioning, the Discovery CT590 RT is an ideal CT simulator for precision radiotherapy applications such as SRS and SBRT.

The Discovery CT590 RT advances the state-of-the-art in 4D respiratory gating -- with both prospective and retrospective respiratory gating -- by automating the 4D workflow on the CT console. And GE's Discovery systems always deliver the advanced capabilities for routine clinical applications such as IMRT, and capabilities for advanced research such as 4D IGRT.

Primary benefits

- The system can acquire CT anatomical images that are clinically useful in the simulation and planning of radiation therapy for the treatment of cancer.
- This product was designed to meet the demanding needs of Radiotherapy departments. While facilitating routine plans, the scanner's distinctively designed 80 cm wide bore simplifies planning even for very difficult cases or large patients.

The Power to Perform:

- The powerful **8 MHU, 100 kW, Performix® Pro VCT 100 X-ray Tube** demonstrates high reliability and delivers the high power you need for image quality with 800mA.
- **Variable Speed**. Discovery CT590 RT not only offers fast acquisition speed, but also builds on GE's exclusive VariSpeed™ technology 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 second scans – so you have the power to customize rotation speed for your application.
- This product provides **routine 16-slice acquisition** without image noise or coverage compromise.
- **Routine Sub-millimeter 16-slice** image acquisition with 16 x 0.625 detector capability.
  - **microVoxel™ imaging** improves 3D and reformatted 2D resolution through the optimum choice of sub-millimeter slice thickness and reconstructed voxel size.
- **ASiR™** (Adaptive Statistical Iterative Reconstruction) dose reduction technology
  - A reconstruction technology that may enable reduction in pixel noise standard deviation. The ASiR reconstruction algorithm may allow for reduced mA in the acquisition of diagnostic images, thereby reducing the dose required.[1]
  - A reconstruction technology that may enable improvement in low contrast detectability.[1]
  - Acquire a scan using Dose Reduction Guidance (**Auto ASiR** guidance). Use this procedure to have the system automatically select the ASiR level by selecting a dose reduction percentage. Facilitates user to perform CT scanning with ASiR technic.
- Outstanding **Volume Image Quality** specification in Z 18.1 lp/cm & X,Y 15.4 lp/cm 0% MTF @ 0.5 second rotation.
- **HiLight™ Matrix II Detector** is designed to deliver consistent image quality with its 21,888 individual

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[1] In clinical practice, the use of ASiR may reduce CT patient dose depending on the clinical task, patient size, anatomical location and clinical practice. A consultation with a radiologist and a physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task.

elements: 16 rows of 0.625mm thickness and 8 rows of 1.25mm thickness.

- The new console builds on the **Xtream™ FX technology**, a major advance in workflow design, has greatly improved speed, image quality and flexibility to provide an optimized workflow solution from acquisition to final report.
  - **Direct MPR** enables automated protocol-driven axial, sagittal, and coronal reformats. Reformatted images may be routed to multiple network destinations, eliminating the need to transfer and store all thin-slice data.
  - **Exam Split** allows multi-anatomical exams to be read in separate anatomic sections. This allows specialists to review only those images needed for a given requisition.
  - **Data Export** is a stand-alone tool to convert clinical images into PC-friendly formats like .jpeg, .mpeg, and .avi from the image browser, creating more flexible report creation for both referring physicians and patients. Images can then be saved using Data Export tool to CD, USB flash or transferred (FTP) to an IP destination.
  - **Xtream/Enhanced Xtream Injector Interface***, with validated OEM injectors, utilizes the CAN CiA425 communication protocol to provide synchronized start of the scan and injection from the CT Operator console or from the scan room. The Enhanced Xtream Injector Interface adds the ability to set the contrast injection parameters as part of the CT scan protocol from the console interface providing consistency of user entered parameters and reduction in the opportunity for error.
  - The **new operator's console** delivers sixteen frames per second reconstruction at full resolution for any slice thickness, even with GE's **CrossBeam™** cone beam reconstruction algorithm turned on. Plus it delivers up to 8 frames per second transfer rate and a 250,000-image storage capacity. It is an inherently scalable platform designed with the future in mind.
- **1,200GB Disk**: stores up to 250,000 uncompressed 512×512 images, stores up to 9,600 scan rotations at 16 slice mode or up to 1,500 scan data files.
- **Generator Design capable of 100kW**: A powerful generator backs the tube with capability to deliver current up to 800mA. This intelligent generator enables GE's prospective dose modulation capability, delivering fast power transitions synchronized with density changes in your patient's anatomy – resulting in optimized performance with minimized dose.
- **Volara™ Digital Data Acquisition System**: with Zero Data Loss (ZDL) improvement for better utilization of photons in low-signal imaging. The effective analog to digital conversion range is greater than two million to one.
- **65 cm Display Field–of-View** (wide view) is a patented algorithm that generates an approximate CT image reconstruction outside of the CT measurement field of view. The investigated result of attenuation coefficient accumulation accuracy deviation is less than 2% in the study.[2].
- **Trauma Patient**: Allows patient scans and image display/ analysis without entering patient data before scanning.
- **3D Dose Modulation**: Lower dose acquisition using **SmartmA™**, an automatic modulation technique and DLP display that tells the operator the dose before the scan starts.
  - Having this kind of volumetric knowledge before you scan allows you to easily personalize dose protocols and minimize dose for virtually every patient – large and small.
  - During the scan, real-time, 3D dose modulation helps deliver consistent image quality because it automatically accounts for the changing dimensions of your patient's anatomy. With minimal off-focal radiation from the **Performix® Pro VCT 100 X-ray tube**, the Discovery CT590 RT reduces dose and enhances clarity.
- **Color Coding for Kids**, is designed to facilitate pediatric care while adhering to the ALARA principle. Winner of a National Heroes Award from the Emergency Medical Services for Children, the Color Coding system, incorporated into the protocol selection on the operator's

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[2] The wide view image performance measurement metrics is evaluated via comparing the attenuation coefficient accumulation accuracy of wide view images between the scanned images where the scan object located completely within 50cm FOV and where partially out of 50cm FOV.

console, provides pediatric scan protocols based on the Broselow-Luten™ Pediatric System

- **HyperPlane**™ reconstruction algorithm tackles the inherent issues with fast, high pitch helical scanning by reducing helical artifacts and optimizing both the dose performance and slice profile.
- **CrossBeam**™ reconstruction algorithm solves the technical challenge of cone beam artifacts
- **Compact system design** of the Discovery CT590 RT allows for installation in only 22.6 m^2 (243 square feet) minimum scan room size with the standard VT1700 patient table.
- **VT1700*** is a selectable table with load capacity up to 500lb (227kg) and 1700mm scan range. VT1700 table meets the table requirement of TG66 per GE TG66 test procedure.
- **High capacity table** is a selectable table with load capacity up to 650lb (295kg) and 1600mm scan range. High capacity table meets the table requirement of TG66 per GE TG66 test procedure.
- **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 plus table tray.
- **SmartView™ Fluoro*** offers real-time 12 frames per second CT fluoroscopy with image latency of less than 170 ms. Detailed targeting is supported by multiple acquisition modes, up to and including high-resolution acquisition at 1.25 mm (16x0.625 mode only). Optimized dose efficiency is made available with continuous and quick check scan modes. A simple and efficient user interface provides six user-selectable display layouts, in-room image review and WW and WL control. Flip, rotate, roam and zoom capabilities maintained during acquisition. Features ceiling-mounted in-room LCD monitor and full-featured handheld, cradle-mounted controller.
- **Speed**

  The net result is that in some cases, helical scans on the Discovery CT590 RT are up to 14 times faster than conventional 4-slice CT systems. With the Discovery CT590 RT, 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, with equivalent image quality may allow you to: perform better thin-slice CT angiography exams, use thinner slices for most exams, and perform longer helical exams without tube cooling delays.

  The Discovery CT590 RT delivers this level of performance through a balanced design that focuses on image quality, coverage, and exam speed.

Radiation Oncology Applications Suite

- **Advantage™ 4D** captures the full range of motion of critical internal structures and lesions during respiration. This application, which is available **both on** the CT console and Advantage™ Workstation (AW), aids users in selecting the proper phase(s) of the respiratory cycle in order to plan for a more targeted standard or gated radiation treatment, eliminating the need to apply general- or guessing margins. Advantage™ 4D on console is 48% faster compared to the workflow with Advantage™4D on AW. It provides the ability to perform respiratory motion assessment on the console prior releasing the patient from the CT simulator.
  - **Auto4D** is the mode of Advantage™ 4D on the console, which offers a faster, even more efficient automated 4D process workflow including binning and intensity image creation.
    - Auto 4D reduces the 4D binning time by 45%.
    - Auto 4D enables 4D images to be automatically binned, networked and available in AdvantageSim™ MD or Treatment Planning System within 1.5 minute or less.
  - **Prospective Respiratory Gating** allows for a CT acquisition synchronized with an amplitude or phase defined trigger upon the respiratory curve in modes of either free breathing or deep inspiration breath hold. The derived information aids user in planning for targeted radiation.
- **Accessing applications via the AW Server client on the CT console *.** It is a software that allows accessing to applications hosted on an AW Server, from the CT console. It offers customers the freedom to use oncology and

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other care area applications on the CT console when productivity and workflow demands. Some of the benefits for radiation therapy are the capability to perform isocenter marking or respiratory motion assessment on the console without having to place a dedicated planning workstation in the console room or walk over to the planning room. Basic planning can be executed on the console before plans are transferred to the next step in the treatment planning process.

- Large breadth of Advanced Software Applications*: Lung VCAR™, Advantage CTC™, Advanced Vessel Analysis, CT Perfusion™, Advantage™ 4D, SmartScore, Integrated Registration, and AdvantageSim™ MD.
- **AdvantageSim™ MD*** available on **Advantage™ Workstation (AW)** offers a robust package of virtual simulation and planning tools. Powerful macros increase productivity for geometric planning and generate high resolution DRRs and exquisite low-contrast resolution for visualizing tumors and critical structures. AdvantageSim MD takes respiratory motion management to the next level by seamlessly integrating 4D data into the planning process, and providing multi-modality/multi-phase simulation for the optimal use of state-of-the-art treatment methods, like IMRT and IGRT. Auto segmentation algorithms provide accurate contours for 15 anatomical structures in less than 4 minutes.
  - With **Integrated Registration*** available on the Advantage™ Workstation (AW), CT, MR, PET and SPECT datasets can be automatically registered helping clinicians to target critical structures with confidence.
  - Accuracy

    For exceptional accuracy, rigid and deformable algorithms are optimized to anatomical regions and imaging modalities.
  - Speed

    For the sake of speed, automatic fusion takes otherwise time-consuming image registration down to seconds, while auto-propagation of results makes multiple registration steps unnecessary. This is particularly valuable in 4D multi-phase and multi-sequence MR studies.
  - Ease of Use

    Results can be seamlessly exported to GE AdvantageSim or any Treatment Planning System.

Main features

- Full 360° rotation speed of 0.5 sec provides for improved temporal resolution and image quality for demanding temporal applications such as 4DCT.
- Faster scan times enable shorter breath holds and more comfortable scans for patients.
- Faster scan times reduce the possibility of patient motion during the exam.
- Routine scanning with a slice thickness of 0.625 mm optimizes delineation of anatomy and detection of pathology 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 multiple acquisitions.
  - Improves 3D visualization
  - For both helical and axial acquisitions
- Stores up to 9,600 scan rotations at 16 slice mode or up to 1,500 scan data files. Facilitates retrospective image decomposition during off hours.
- **Eight fundamental scan modes** to simplify the inherently complex nature of multi-slice helical scanning
- **Reference protocols** delivered. Up to 8,460 protocols can be edited, modified and stored on the system.
- **Large head SFOV (LargeIBO)**. Used for the adults with positioning accessories around head and neck that are outside of a 25cm DFOV, such as stereotactic head holder. Large Head SFOV is 50 cm and the maximum DFOV is 50cm. The Large bow tie filter is used for the

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scan acquisition and IBO (Iterative Bone Option) is applied during image reconstruction.

- **Remote Gantry Tilt** from the Operator's Console to increase exam productivity, including built-in safety features to help avoid injury from 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 a scan.
- **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 optimizes dose for this critical application.
- **SmartPrep**™, provides software for real-time monitoring of contrast enhancement, and automatically play the prerecorded messages after the operator triggered the scan phase. With Auto Minimum Delay function enabled, the diagnostic delay time is set automatically to the minimum time.
- **Direct3D**™ makes 3D routine and instant by building the 3D model during axial image reconstruction, reducing the need for user interaction.
- **IQ Enhance** (IQE) is special algorithm to reduce helical artifact in thin slice helical scanning. IQ Enhance (IQE) allows faster pitch scanning covering more anatomy at the same image quality.
- **Chest Kernel** enables the reconstruction of lung detail and mediastinum structure in single kernel selection. It provides soft tissue resolution when viewing images in soft tissue WW/WL and high resolution when viewing images in Lung WW/WL. It doubles your productivity by using a single combined image and reduces the disk storage requirements by 50% for Chest exams.
- **Graphic Retro** allows users to prescribe retro recon graphically on appropriate prospective image by mouse. Visual adjustment parameters such as DFOV, AP/RL center improves retro recon productivity.
- **Flip/Rotation** provides image orientation flips and rotates prospectively for auto-filmed images and retrospectively through Exam Rx Display and the Image Works viewer. These image orientation operations do not produce images installed in the image database but rather create modified image films or screen saves.
- **Copy PMR & Series** Series Copy forward and Copy Patient. Orientation and Position. The following parameters are selectable to copy forward, Start Location, End Location, Interval, DFOV, A-P Center, and R-L Center.
- **Preset Exam Description:** Preset Exam Description allows user to select Exam Description from the drop down menu, which makes patient information input easier.
- **WW/WL Preset for Scout**: Window width/window level (WW/WL) Preset for Scout supports presetting WW/WL values in protocol management tool or during scan prescription. User does not need to modify WW/WL in show localizer.
- **Series number for Retro Recon:** The system will automatically specify the series number for Retro Recon series. The number assigned is 100 plus the series number. A new series number can be specified by selecting New Series. The system will specify a series number of the 301 to 399.
- **$CTDI_{vol}$, DLP** (Dose Length Product), and Dose Efficiency display during scan prescription provides patient dose information to the operator.
- **Dose Check** provides checking against a Notification Value if the estimated dose for the scan is above the typical dose value. Checking against an Alert Value where the user needs specific authority to continue the scan at the current estimated dose without changing the scan parameters. Defining Alert Values for Adult and Pediatric with age threshold.
- **DICOM Structured Dose Report** creates a machine-readable record to be saved with each CT exam. This allows a hospital's radiation tracking system/RIS/HIS to retrieve the Dose information for a given CT study.

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Interactive CT technology

The Discovery CT590 RT Scanner supplies exceptional computer and image processing power that enhances clinical productivity, building upon the strength of the previous multi-slice CT 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 changes to be easily made, with virtually no restrictions
- Be as user friendly as possible, and have **online 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 Discovery CT590 RT scanner combines:

- **SmartTools** productivity software to streamline every step of the examination, a critical tool to facilitate the highest productivity and throughput possible with the Discovery CT590 RT 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 scan to the patient
- Leading-edge, **real-time image processing** (MPR, MPVR, Volume Viewer*)

In summary, **primary benefits** of Interactive CT on the Discovery CT590 RT 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
  - Much more flexible and **intuitive graphic prescription** 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
  - 1024 color display
  - 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. Adjusts scan techniques when changing parameters (Note: user must select initial Noise Index, as well as maximum mA setting). Noise Index enables 100% image quality reproducibility 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.

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- 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*, Advantage CTC* and DentaScan*.
  - –No waiting for network transfer
- 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
- Application Auto-Launch for **Neuro 3D Filters*** provides the ability to prescribe the automatic application of the prescribed filter prior to the scan acquisition.
- Operator console conveniently located 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 sitting 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 persons operation more comfortable and practical.
  - – All console components (monitors, keyboard, mouse and BrightBox*) are freestanding 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 technology

- Performix™ Pro VCT 100 X-ray tube with **8** MHU of storage and capability of **100** kW operation provides increased helical performance with greater patient throughput and virtually no tube cooling delays. Advanced technology in the Performix Pro VCT 100 X-ray tube includes an anode grounded tube configuration with electron collector, which reduces heat load on the anode for longer axial and helical scan protocols and removes off-focal electrons from the X-ray generating path, resulting in lower patient dose and higher image contrast; efficient anode heat transfer to eliminate interpatient delays for demanding helicals; a center-loaded high-speed bearing for 0.5s scanning and highly stable focal spots for high resolution; and a metal-ceramic frame for long life.
- Wide range of technique factors (**10** mA to **800** mA, in 5 mA increments) gives 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 Discovery CT590 RT system can perform virtually any clinical application due to its wide variety of scan modes.

Helical:

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

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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 seconds 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
- WW/WL preset for Scout

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 reference protocols make the Discovery CT590 RT fast and efficient in patient set up.

Multi-slice acquisitions and short intergroup delays significantly reduce potential misregistration between scans by increasing the number of scans possible in a patient breath hold.

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 16-slice 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 14 times faster than conventional 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.

16-slice helical modes

Table speed (mm/rotation)

Slice thickness (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 11.25	9.375 18.75	13.75 27.5	17.5 35
2.5	5.625 11.25	9.375 18.75	13.75 27.5	17.5 35
3.75	5.625 11.25	9.375 18.75	13.75 27.5	17.5 35
5	5.625 11.25	9.375 18.75	13.75 27.5	17.5 35
7.5	11.25	18.75	27.5	35
10	11.25	18.75	27.5	35

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Helical scan parameters

Scan speeds: Full 360° rotational scans in 0.5, 0.6, 0.7, 0.8, 0.9, and 1.0 second.

Scan technique:

- kVp: 80, 100, 120, 140
- mA: 10 to 800 in 5 mA increments
- Power: 0.8 to 100 kW
- Focal Spot Selection @140 kVp:
  - Small spot for up to 46.9 kW
  - Larger spot for greater than 46.9 kW

Single acquisition: 120-second scan maximum.

Scan range:
1600 mm for VT1700

1500 mm for High Capacity Table

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

Scan fields of view:

- 25 cm for adult head
- 25, 50 cm for body
- 25 cm for pediatric head
- 65 cm extrapolated for large patient

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 seconds for any state of tube and gantry; < 10 seconds 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 reference 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 and SmartPrep.

Preset messages are supported in 9 different languages: Chinese, English (Male/Female), French, German, Italian, Japanese, Korean, Spanish, and Mexican Spanish.

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 – i.e., large shoulders, screws.

Helical image reconstruction

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

Reconstruction matrix: 512

Display matrix: 1024.

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

CT number scale: -1024 to 3071 HU; -31743 to 31743 Expanded HU range.

Helical Reconstruction Times:

- Reconstruction time as fast as 16 images per second
- Typical 0.167 second image-to-image recon in normal 16-slice recon mode

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- 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.

Maximum DFOV: 65 cm effective with wide field of view.

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 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 10 sets of reconstructions can be preprogrammed 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
5 sec	745-800
10	675-795
20	600-670
30	555-595
40	525-540
50	465-500
60	425-470
80	360-430
100	280-400
120	270-380

Multiple helical scans:

Scan time	IGD	No. scans	Max mA
5 sec	5 sec	2	685-800
		3	645-775
		4	620-755
		5	600-735
		6	580-705
10 sec	5 sec	2	605-690
		3	565-625
		4	540-575
		5	515-540
		6	490-515
20 sec	5 sec	2	530-550
		3	450-485
		4	390-450
30 sec	5 sec	2	435-480
		3	355-425

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		4	270-395
40 sec	5 sec	2	370-435
		3	270-390
		4	260-370
50 sec	5 sec	2	280-405
		3	260-370
		4	230-350
60 sec	5 sec	2	270-385
		3	245-355
		4	200-275

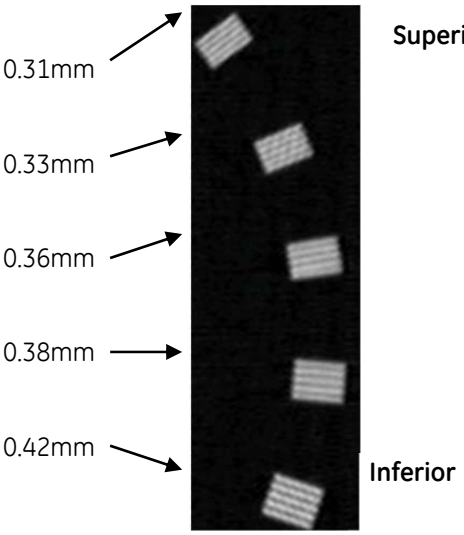
Helical scan image quality

3D High-Contrast Spatial Resolution
With Discovery CT590 RT being a sub-millimeter option, it is possible to specify coronal and sagittal image quality.

An optimized X-ray source (focal spot shape & dynamics, as well as reduced off focal radiation) allows for improved measurement methods to fully characterize the limiting resolution of the Discovery CT590 RT system design. The additional power of Discovery CT590 RT provides images with fine vascular and anatomical detail.

For details of scan techniques and tolerances, please refer to the Technical Reference Manual.

1. Visual Measurement:
Reformatted resolution is demonstrated on the Catphan High Contrast Resolution Insert Module CTP528.



0.35 +/- 0.05mm voxel size is clearly seen in the reformatted plane.

2. 3D MTF:
In-plane MTF is demonstrated on a 0.05mm tungsten wire.

Z-plane MTF is demonstrated on a 0.1mm aluminum disc.

Standard algorithm – typical

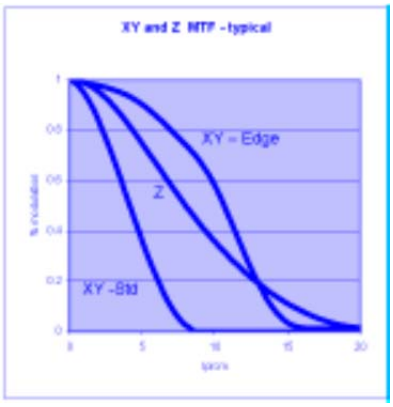
	X/Y – lp/cm
50%	4.2
10%	6.8
0%	8.5

Hi-Res algorithm (edge) – typical

	X/Y – lp/cm
50%	10.5
10%	13.9
0%	15.4

Detail algorithm-typical

	Z lp/cm
50%	7.3
10%	12.2
4%	14.2
0%	18.1



Low-contrast detectability
On 8 inch (20 cm) CATPHAN phantom

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Reconstruction mode	Object Size	% Contrast	Dose Level (mGy CTDI vol)
Standard Algorithm	5mm	0.30%	13.3
	3mm	0.30%	37.2
Standard Algorithm with ASiR	5mm	0.30%	9.98
	3mm	0.30%	27.9

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

0.32% +/- 0.03% at 28.5 mGy (2.85 Rad) CTDIvol with Standard Reconstruction Algorithm

0.32% +/- 0.03% at 17.1mGy (1.71Rad) CTDIvol with Standard and ASiR Reconstruction Algorithm

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 14.87 mGy/100 mAs

Body 7.82 mGy/100 mAs

Large Head 14.68mGy/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.

Axial multi-slice prescription

Simplified scan prescriptions and easy-to-use reference protocols make the Discovery CT590 RT scanner fast and efficient in patient set-up. Axial protocols are nearly identical to helical scan protocols.

Axial multi-slice modes

The Discovery CT590 RT acquires axial scans in sets of 8 or 16 contiguous images in one 360° rotation. For each rotation of the gantry, the Discovery CT590 RT 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 800, in 5 mA increments
- Power: 0.8 to 100 kW
- Focal Spot Selection @140 kVp:
  - Small spot for up to 46.9 kW
  - Large spot for greater than 46.9 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 second
- Minimum ISD with table movements of more than 10 mm and up to 20 mm: 1.3 second
- User-selectable

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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 second scan speed with minimum ISDs

Scan fields-of-view:

- 25 cm for adult head
- 25, 50 cm for body
- 65 cm, effective, for large body, wide view
- 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, Chest 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; -31743 to 31743 expanded HU range.

Axial reconstruction times:

- Reconstruction time as fast as 16 images per second
- Typical 0.167 second 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.

Prospective Multiple Reconstruction (PMR): Up to 10 sets of reconstructions can be preprogrammed 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 Prescription		
Scan mode	Slice thickness	Recon slice thickness
16 row	0.625	16i – 0.625 mm 8i – 1.25 mm 4i – 2.5 mm 2i – 5.0 mm
16 row	1.25	16i – 1.25 mm 8i – 2.5 mm 4i – 5.0 mm 2i – 10 mm
8 row	1.25	8i – 1.25 mm 4i – 2.5 mm 2i – 5.0 mm 1i – 10 mm
8 row	2.5	8i – 2.5 mm 4i – 5.0 mm 2i – 10 mm

Axial scan protocols

All protocols assume 120 kVp scans under typical clinical conditions.

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Standard scan

Scan time	ISD	mA	Scans	Acquisition time
1 s	1 s	800	4-17	7-33s
1	1	750	7-30	13-59s
1	1	700	12-46	23-91s
1	1	650	21-66	41-131s
1	1	600	35-91	69-181s
1	1	550	58-127	115-253s
1	1	500	85-167	169-333s
1	1	450	106-199	211-397s
1	1	400	128-245	255-489s
1	1	300	126-257	251-513s
1	1	250	246-442	491-883
1	1	200	366-592	731-1183

- 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
800	0-15 (0-3)	0-41s
750	5-30 (1-6)	9-89s
700	10-45 (2-9)	25-137s
650	20-70 (4-14)	57-217s
600	40-100 (8-20)	121-313s
550	70-145 (14-29)	217-457s
500	110-220 (22-44)	345-697s
450	130-240 (26-48)	409-761s
400	155-275 (31-55)	489-873s
350	190-325 (38-65)	601-1033s
335	65-170 (13-34)	201-537s
300	220-355 (44-71)	697-1129s
250	580-1975 (116-395)	1044-3555s
200	>1000 scans	>2000s

Axial scan image quality

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

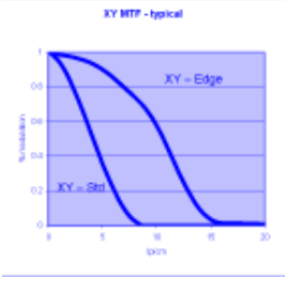
High contrast spatial resolution:
In-plane MTF is demonstrated on a 0.05 mm tungsten wire.

Standard algorithm – typical

	X/Y – lp/cm
50%	4.2
10%	6.8
0%	8.5

Hi-res algorithm (edge) – typical

	X/Y – lp/cm
50%	10.5
10%	13.9
0%	15.4



Low-contrast detectability
On 8 inch (20 cm) CATPHAN phantom:

Reconstruction mode	Object Size	% Contrast	Dose Level (mGy CTDI vol)
Standard Algorithm	5mm	0.30%	26.6
	3mm	0.45%	37.2
Standard Algorithm with ASiR	5mm	0.30%	19.95
	3mm	0.45%	27.90

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

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0.32% +/- 0.03% at 29.3 mGy (2.93 Rad) $CTDI_{100}$ with Standard Reconstruction Algorithm

0.32% +/- 0.03% at 17.6 mGy (1.76Rad) $CTDI_{100}$ with Standard and ASiR Reconstruction Algorithm

CTDI:
On CTDI Head and Body Dose Reference Phantoms:

CTDI expressed in mGy/100 mAs:

Head 12.67 mGy/100 mAs center

13.37 mGy/100 mAs surface

Body 4.05 mGy/100 mAs center

8.43 mGy/100 mAs surface

Large Head 11.86 mGy/100 mAs center

13.89 mGy/100 mAs surface

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

Head 12.88 mGy/100 mAs center

14.47 mGy/100 mAs surface

Body 3.86 mGy/100 mAs center

9.07 mGy/100 mAs surface

Large Head 11.74 mGy/100 mAs center

14.77 mGy/100 mAs surface

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

Head 13.94 mGy/100 mAs

Body 7.33 mGy/100 mAs

Large Head 13.76mGy/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 is also available on a single Scout.

Scout scan parameters

Aperture: 1.25 mm effective aperture.

Table speed: 100 mm/second.

Scan Technique:

- kVp: 80, 100, 120, 140
- mA: 10 to 800 in 5 mA increments
- Power: 0.8 to 100 kW

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

WW/WL preset f for scout

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 Discovery CT590 RT Operator Console utilizes a computer workstation with the following user interface features:

- Two 19-inch LCD 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
- 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 freestanding and can be easily moved to accommodate a large variety of working conditions and operator preferences.

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

Desktop overview

* Option

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. The new console 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 Discovery CT590 RT CT Simulator computer and image processor.

Standard features include Interchange, 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*, Advanced Vessel Analysis*, CT Perfusion*, Advantage CTC*, and DentaScan*. The ImageWorks desktop also supports USB flash and provides a gateway for DICOM 3.0 image transfers, either through a local area network, or via DICOM formatted CD/DVD media.

Learning Solutions:
The Discovery CT590 RT provides an on-screen, online 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 preselection of the exam protocol.

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. Preprogrammed 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 Discovery CT590 RT CT simulator to facilitate 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.
- Reference 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.

- Reference 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 scan parameters before scanning begins.
- Scan 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 onscreen 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, intergroup), and even AutoVoice announcements are clearly shown before and during scanning.
- AutoScan: Fully automates longitudinal table movement and the start of each scan.
- AutoVoice: 3 preset in 17 user-defined messages automatically deliver patient breathing instructions with a programmable delay; especially useful for multiple helical scanning and SmartPrep. Preset messages are supported in 9 different languages: Chinese, English (Male/Female), French, German, Italian, Japanese, Korean, Spanish, and Mexican Spanish.
- 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 60601-2-44. This index is computed automatically by the Discovery CT590 RT 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 CTD_{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 60601-2-44.

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 60601-2-44.

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:

* Option

- 1024 AutoView image
- 768 AutoView image (matches the image size shown on the HiSpeed Advantage 2.X Series OC monitor)
- 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:

* Option

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- 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 methods of adjusting window/level of images in focus are provided 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, 25:1 , 30:1, 35:1, 42:1 and 35-mm slide (depends on capability on imager side).

Important Note: The Discovery CT590 RT Scanner comes standard with a DICOM Print Interface configurable for multiple DICOM Print destinations. Connections with cameras that 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 Discovery CT590 RT 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

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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 off axis planes. Sagittal, coronal, oblique and curved planar reformations available
- **Batch reformatting** can also be defined and executed for later viewing if desired.
- **Direct MPR** allows customer to move from routine 2D review to prospective 3D image review of axial, sagittal, coronal, and oblique planes while enabling automated protocol-driven batch reformats to be created and networked to their desired reading location, reducing total exam time and increasing technologist and radiologist productivity.
- **Exam Split** provides customers with the capability to "split" a series of patient images into separate groups. These new smaller image groups can then be networked to desired reading stations for multiple "reads" and multiple billings on select patient exams. Virtual mode provides ability to send window level values, flip & rotate images, and compatibility with MPPS.
- **Data Export** provides CT scanner customers with a stand-alone tool to convert clinical images into PC-friendly formats like .jpeg, .mpeg, and .avi, creating more flexible report creation for both referring physicians and patients. Images can then be saved to USB flash or using Data Export tool to CD or transferred (FTP) to an IP destination.
- Image Addition and Subtraction: Includes image addition of more than two images at a time.

Volume Viewer*
Volume Viewer is an innovative and powerful suite of productivity enhancers (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 an excellent 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.

* Option

- 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 saved and retrieved via CD-R or DVD-R with DICOM Interchange 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.

Direct MPR

- Direct MPR enables automated protocol-driven axial, sagittal, and coronal reformats. Reformatted images may be routed to multiple network destinations, eliminating the need to transfer and store all thin-slice data.
- Direct MPR provides 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, sagittal, coronal and oblique images. The user can then save a number of recon images sets, viewing a large number of slices for pure axial or multi-planar review and filming.
- Batch film typically can enable you to reduce filming images by 50%, thickening the slab from 0.625 to 1.25mm or 1.25 to 2.5mm with no information loss.

Image networking:

Exams can be selected and moved between the Discovery CT590 RT and any imaging system supporting the DICOM protocol for network send, receive and pull/query. NOTE: Because the Discovery CT590 RT creates images in pure DICOM format, exams cannot be moved from the Discovery CT590 RT to MR Signa Advantage, CT HiSpeed Advantage or the Advantage Independent Console systems.

Image transfer time using DICOM 3.0 protocols is approximately 8fps on a 1000baseT Network.

DICOM Interchange allows the saving of any image from the database, along with PC viewer to a CD-R or DVD-R without marking the exam/series or image as archived for exam transfer between stations that are not networked or pass along to referring physicians or patients.

Learning solutions

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

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 Discovery CT590 RT CT Simulator complies with 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 Storage Commitment Class Push

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- DICOM 3.0 Modality Worklist*
- DICOM 3.0 Modality Performed Procedure Step*
- DICOM 3.0 Print
- DICOM Structured Dose Report allows a hospital's Radiation tracking system to retrieve the Dose information for a given CT Study.

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: 80 cm
- Tilt: ± 30°
- Tilt Speed: 1°/second
- Focus to Detector: 1062.5 mm
- Focus to Isocenter: 606 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 second
- 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.
- Table automatically re-centers on scan plane with changes in vertical position (after setting internal landmark with alignment lights on)
- Vertical movement
  - 43-99.1cm for VT1700
  - 52.5-99.1 cm for High Capacity table
- Vertical Scannable Range: 73.5-99.1cm
- Elevation Speeds: 15mm/s and 30mm/s
- Horizontal Range:
  - -163cm for High Capacity Table
  - -173cm for VT1700.
- Horizontal scannable range (metal free) varies with table configurations:

Table	Axial	Helical	Scout
VT1700	170cm	160cm	160cm
High Capacity Table	160cm	150cm	150cm

- Horizontal Speed : 125mm/s
- Table Load Capacity:

  -VT1700mm

  227 kg (500 lb) maximum load allowed with normal operation and +/- 0.25 mm table longitudinal repeatability.

  -High Capacity Table

  295kg (650 lb) maximum load allowed with normal operation and +/- 0.25 mm table longitudinal repeatability.

* Option

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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 Pro VCT 100 Anode Grounded Metal-Ceramic Tube Unit. Design optimized for exams requiring a large number of scans without tube cooling delays. [4]*

- Heat Storage Capacity: 8 MHU
- Heat Dissipation:
  - Anode (max) 2100 KHU/min
  - Casing (cont) 648 KHU/min
  - Tube Unit: 8 kW continuous
- Dual Focal Spots:

- Small Focal Spot:

  0.7 x 0.6 per IEC60336/1993, Loading factors: 120kV, 125mA
  0.9 x 0.7 per IEC60336/2005, Loading factors: 120kV, 168mA

- Large Focal Spot:

  0.9 x 0.9 per IEC60336/1993, Loading factors: 120kV, 250mA
  1.2 x 1.1 per IEC60336/2005, Loading factors: 120kV, 400mA

- Maximum Power: 100 kW @140 kVp
- Beam collimated to 56° fan angle.

Average time to replace tube: < 10 hour

Maximum mA for each kVp selection:

KVp	Small spot max mA	Large spot max mA
80	300	675
100	310	770
120	335	800
140	335	715

[4] ASiR is licensed for use with a GE x-ray tube. Use of a third party tube will require the purchase of an additional license for this feature

High voltage generation

- High-frequency on-board generator. Continuous operation during scan
- 100 kW output power
- kVp: 80, 100, 120, 140 kVp
- mA: 10 to 800 mA, 5 mA increments

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.

2 typical modes of data output:

- 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

Volara™ Digital DAS with Zero data loss (ZDL) improvement.

14,592 available input channels.

1,968 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

- CPU: Dual Intel Xeon E5504 2.00GHz QC 12 MB L2 Cache
- NVidia Quadro FX1800 PCI-Express x16 768MB 3D graphics card with 768MB GDDR3 GPU Memory with Ultra-Fast Memory Bandwidth
- RAM: 12GB FBD DDR3-1333 REG ECC DIMM (6x 2GB quad channel)
- 300GB SAS 15K RPM HDD *4

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Image Processor

- NVidia Quadro FX1800 PCI-Express x16 768MB 3D graphics card
- 768MB GDDR3 GPU Memory with Ultra-Fast Menory Bandwidth
- 30-Bit Color Fidelity
- 128-bit color precision
- NVIDIA Unified GPU Architecture
- NVIDIA CUDA Architecture
- PCI Express 2.0 Complait
- Dual DisplayPort support—ultra-high resolution panels (up to 2560 x 1600 @60Hz)
- Single dual-link DVI-I output drives digital displays at resolutions up to 2560 x 1600 @ 60Hz
- Internal 400 MHz DACs—One analog display up to 2048 x 1536 @ 85Hz

Image Reconstruction Engine

- Custom-designed, scalable, special purpose CT Image Generator
- Pipelined parallel processing allows 12 views to be
- back-projected simultaneously
- Image Generator consisting of:
  - NVidia Quadro FX4800c PCI-Express x16 1.5GB Computing processor card
  - Dual 400Mhz RAMDAC (analog only)
  - Integrated TMDS transmitters
  - 128-bit IEEE floating point precision graphics per color component
  - 12-bit sub-pixel precision
  - 1.5GB memory with 384 bit interface
  - Supports dual DisplayPort outputs at up to 2560 x 1600
  - Supports dual analog outputs at up to 2048 x 1536 at 85Hz
  - Supports dual digital outputs at up to 2560 x 1600 at 60Hz
  - Fully programmable Graphics processing Unit (GPU) per OpenGL 3.0
  - Active fan heatsink
  - Support Scalable Link Interface (SLI)

Total of 4*300GB hard disk drivers system:

- System disk drives
  - High Performance Drive
  - 300 GB, 3.5 inch hard disk driver
  - 15,000 RPM
  - SAS interface
  - Assigned to system and application software only
- Scan data 2*300GB hard disk drivers
  - Disk RAID, consist of 2*300 GB, 3.5 inch hard disk drivers
  - High Performance Drive
  - 15,000 RPM
  - SAS interface
  - Assigned to scan raw data only
  - Store scan raw data up to 9,600 scan rotations at 16 slice mode or up to 1,500 scan data files.
- Imaging data disk drive:
  - High Performance Drive
  - 300GB, 3.5 inch hard disk driver
  - 15,000 RPM
  - SAS interface
  - Assign to image file only
  - 250,000 uncompressed 512x512 images.

Software architecture:

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

Peripherals:

- USB external DVD-RW/CD-RW Driver Kit:
  - 4.7 GB capacity (DVD)

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- Up to 7,168 image storage (DVD)
- 20x DVD, 48x CD Max
- Supports CD-R, DVD-R

- **Color monitors:**
  - –19 inch diagonal width
  - –1280 x 1024 dot resolution
  - –Non-interlaced, flicker-free presentation
  - –76 kHz Horizontal deflection frequency
  - –72 Hz Vertical deflection frequency
  - –Sync on green
- Scan control **keyboard** (English language) assembly with intercom speaker, microphone and volume controls
- 3-Button **Mouse**
- 3-Button **Trackball** *

Image networking:

- Exam transfer 10 frames per second on dedicated 1 GB connection
- Standard auto-configuring 100BaseT/10BaseT Ethernet (UTP connection)
- Supports gigabit ethernet capability
- 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

Options on CT Console

- A DICOM Print Interface is standard on the system
- English UIF & USB Keyboard
- Asian USB Keyboard
- Chinese UIF & USB Keyboard
- French UIF & USB Keyboard
- German UIF& USB Keyboard
- Scandinavian UIF & USB Keyboard
- Danish UIF & USB Keyboard
- Dutch UIF & USB Keyboard
- Italian UIF & USB Keyboard
- Norwegian UIF & USB Keyboard
- Spanish UIF & USB Keyboard
- Swedish UIF & USB Keyboard
- Portuguese, Braz UIF & USB Keyboard
- Euro Misc USB Keyboard
- Finnish UIF
- Japanese UIF
- ConnectPro HIS/RIS Interface with Performed Procedure Step (PPS) M4 compatibility
- USB Bar Code Reader
- USB Trackball
- Exam Split
- Xtream™ injector/Enhanced Xtream Injector
- SmartStep
- SmartView™
- Prospective Respiratory Gating
- Neuro 3D Filter
- LCD Monitor
- GE Color Printer
- Table Tray

Options both on CT Console and on Advantage™ Workstation (AW)

- Advantage 4D™
- Volume Viewer

* Option

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- CT Perfusion 4 – Neuro
- CT Perfusion 4 – Multi-organ
- Advanced Vessel Analysis
- Advantage CTC
- DentaScan
- AutoBone™

Options on Advantage™ Workstation (AW)

- Integrated Registration*
- AdvantageSim™ MD*
- SmartScore™

Sitting requirements

Recommended room size:

Exam Room:

14.6 feet (4.42m) wide x 22 feet (6.71m) deep for VT1700

14.6 feet (4.42m) wide x22.8 feet (6.92m) deep for High Capacity Table

Minimum exam room size:

12.2 feet (3.71m) wide x 20 feet (6.10m) deep for VT1700

12.2 feet (3.71m) wide x 22 feet (6.71m) deep for High Capacity Table

Control Room:

5.7 feet (1.7m) wide x 14.6 feet (4.2m) 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, 150 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 Discovery CT590 RT CT simulator 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 allowance scenarios.

- The recommended cooling requirements assume patient throughput limited by the tube cooling algorithm.

	Minimum allowance	
Subsystem	**Watts**	**BTU/hr**
Gantry	12600	43000
Table	300	700
PDU	1000	3400
Operator console	2100	7165
Optional laser camera	800	2730

Cooling values should not be used for calculation system input power requirement.

System components dimensions

* Option

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		mm	inches
Gantry:			
	Width:	2,439	96
	Depth:	1,006	39.6
	Height:	1,992	78.4
Table: alternate sizes for optional table			
	Width:	650	25.6
High Capacity Table	Length	5430	213.8
Mid	Length:	4980	196.1
	Height:	1002	39.4
Power distribution unit:			
	Width:	700	27.6
	Depth:	550	21.7
	Height:	1062	41.8
Operator console:			
	Width:	470	18.5
	Depth:	740	29.1
	Height:	656	25.8

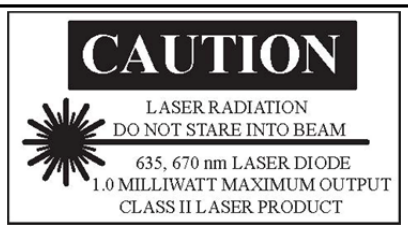
Warranty

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 that satisfies IEC 60601-1 and applicable collateral and particular standards, including regulations regarding Electro-Magnetic Compatibility (EMC) and Electro-Magnetic Interference (EMI).

This product complies with radiation performance standards 21 CFR subchapter J.

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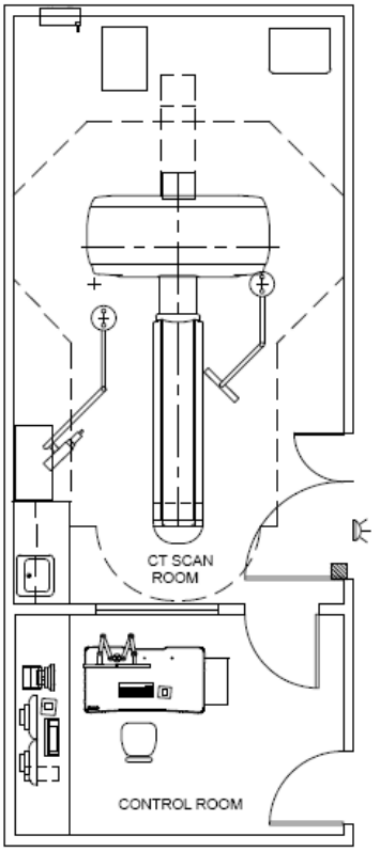
Typical room layout



GE imagination at work

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