

Toshiba Aquilion Quad CT Scanner

Aquilion Multi is a whole-body Computed Tomography (CT) Scanner which utilizes low voltage slip-ring technology for the continuous rotation of the X-ray tube and multi-row detectors. The combination of a high-speed scanner and an extremely powerful, high-voltage generator meets every diagnostic requirement. Solid-state multi-row detectors and optimal reconstruction techniques ensure high quality images. The Aspire CI technology, with an excellent performance record, is included in the standard composition, and meets the requirements of advanced diagnostic techniques. A high-performance CPU, large-size color monitor, hybrid keyboard and refined Graphic User Interface (GUI) are employed to make the operation environment highly efficient.

Highlights Include:

- Large Aperture, Slip Ring Gantry and Extra-wide Couch
- Ergonomic Operators console
- High Frequency X-ray Generator
- High Heat Capacity X-ray Tube
- Volume Image Processor
- On-line Help
- High Capacity Hard Disk Drive
- Magneto-Optical Disk (MOD) Storage
- Image Data Transfer Link
- Patient Positioning Accessories
- Operator Manuals and QA Phantoms

Key Features

High-Speed Scanning: Using slip-ring technology, Aquilion Multi is able to perform 0.3 second partial scans and 0.5 second routine scans to meet the demands of dynamic and helical examinations.

High Image Quality: The Aquilion Multi features 896 channels of 34 rows of solid state detectors, specialized user-selectable image reconstruction algorithms, and a wide selection of slice thicknesses. The system provides outstanding low-contrast resolution of 2.5 mm at 0.25% and high-contrast resolution of 0.35 mm.

High-Power Generator: Robust high voltage circuits capable of generating 60 kw of power and 500 mA provide the foundation for supporting the 7.5 MHU X-ray tube. Helical Scans up to 100 seconds and 1,390 mm maximum are possible.

High Patient Throughput: The scan cycle time, including the time needed for scanning, image reconstruction and image display is 1.5 seconds.

Aspire CI: Real-time helical display and SureStart are included in the standard composition.

Easy Operation: Operations are easily performed using the 21-inch color monitor, mouse and hybrid keyboard. The eXam Plan makes it possible to scan automatically by programming the scanning procedures, including VoiceLink which can record the vocal instructions of the Operator.

EQUIPMENT DESCRIPTION

Aquilion Multi Gantry

The Aquilion Multi gantry uses rotate-rotate (third generation) design to provide accurate alignment between beam and detector for more precise image data.

A low-voltage slip-ring assures reliable, continuous power and signal transfer. Digital signal transmission from the gantry is accomplished using innovative optical coupling technology. The generator is located inside the gantry to conserve space.

A 72 cm patient aperture with deeply contoured front and back openings provides maximum patient access, valuable for trauma patients and interventional procedures.

The system is calibrated for five scan fields of view (18, 24, 32, 40, 50 cm) for accurate Hounsfield number reconstruction when scanning a wide range of patient sizes.

Controls on each side of the gantry allow ready access to all gantry and table controls for easy and accurate patient positioning. Gantry and table positioning can also be controlled from the scanner console.

Three laser alignment lights, built into the front of the gantry, make accurate patient positioning fast and reproducible.

A wide range of scan times (0.3 partial rotation; 0.5, 0.75, 1, 1.5, 2, and 3 seconds full rotation) provides great flexibility for optimizing image quality. Lung and cardiac examinations may benefit from reduced motion artifact with 0.3 and 0.5 second scan times. A 3 second scan time assures high mAs for scans of exceptionally large patients.

A gantry tilt range of ± 30 degrees provides the flexibility to align difficult anatomical structures to the acquisition scan plane for improved image quality and patient comfort and cooperation.

Slice Thickness selections of 4x0.5 mm, 4x1 mm, 4x2 mm, 4x3 mm, 4x4 mm, 4x5 mm, 4x8 mm, and 2x10 mm provide a wide range of flexibility to optimize imaging results.

A series of patient guide lights on the top of the gantry indicate when X-rays are on and how far the scan has progressed. A green light confirms when the patient may resume breathing.

Couch

A 47 cm wide metal-free ClearVue Couchtop provides ample room to position patient and any life support equipment. The couch top can be lowered to 30 cm (12 inches) from the floor for conveniently transferring patients, especially the elderly and young children.

A horizontal stroke of 1,820 mm and a scanning range of 1,430 mm facilitates scanning, even of tall patients.

Table incrementation can be manually controlled by the operator from both the gantry and console, or automatically programmed by an eXam Plan protocol.

The couch top can support up to a 450 lb load while maintaining accuracy of ± 0.25 mm.

Aquilion Multi Console

The console consists of hybrid keyboards, mouse, monitors and Navibox. The console controls the entire system including power on/off operations and is used for image display. Functions included in the console are:

- Selection of scan parameters
- Scanscope control
- Remote control of Couchtop movement
- Gantry tilt
- Window level and window width adjustment
- Other various mouse-operated image processing functions

High line rate 21-inch color monitors display images in a 512 x 512 or 1024 x 1024 matrix. CT number display ranges from -1,024 to +8,191.

The system supports up to 32 VoiceLink commands which are recorded in any desired language and digitally stored on site. Voice commands can be included in all eXam plan protocols for automatic playback during the exam.

Window width and level are continuously variable. Three preset windows can be stored in the eXam Plans.

X-ray Generator

A powerful and robust 60 kw generator supplies up to 500 mA for low-noise images even in high attenuation situations. The generator is located inside the gantry to conserve space. Available tube current ranges from 10 to 500mA with 10 mA increments for fine tuning X-ray output to clinical needs.

Multiple kV selections including 80, 100, 120, and 135 kV for optimally scanning a wide range of anatomy.

X-ray Tube

The Aquilion Multi is equipped with the MegaCool X-ray tube. This compact, high-performance tube was designed specifically to minimize tube cooling delays in heavy patient-load conditions using the half second scan time.

The MegaCool X-ray tube has dual focal spots and an anode capacity of 7.5 million Heat units. It can dissipate heat at 1.386 MHU per minute (maximum).

The MegaCool DF achieves this by employing proprietary G-Shaft, anode grounding PureFocus and Dual Fluid cooling technologies.

The G-Shaft supports the anode on both sides to provide stability at half second rotation speeds and provides two pathways for heat dissipation.

PureFocus is a unique collimator that absorbs scattered electrons that represent up to 30% of the heat load in a conventional tube.

Cooling is enhanced by pumping fluid through the tube to an air heat exchanger mounted in the gantry. A second proprietary fluid is circulated adjacent to the most heavily heat loaded area on the tube. This "Dual Fluid" technology requires no external cooling device.

Detectors

A highly stable solid-state detector array is responsible for the excellent low contrast resolution of 2.5 mm at 0.25% contrast at 250 mAs. This ensures that clinical images present the maximum amount of diagnostic information available.

A total of 896 detector channels in the XY plane (18.3 detectors per degree) and 34 rows of detector elements along the Z axis provide 14.5 lp/cm spatial resolution at 2% MTF for visualizing fine detail. A reference detector is located near the beam source.

A rate of up to 1,800 views/second produce finely detailed high resolution images.

Computer

Ten microprocessors to support system functions for user convenience and scanner speed. The main controlling CPU is an SGI workstation. Simultaneous tasks include scanning, reconstruction, display, archiving and filming. Images for a new case can be acquired while reviewing another case while yet another is being filmed.

The main computer platform consists of two Silicon Graphics workstations employing sophisticated central processors. Additional microprocessors are located within the workstation, and throughout the scanner to handle ancillary functions and facilitate multi-tasking. The computer uses a 64 bit bus. Reconstruction, simultaneous scanning, reconstruction, display, archiving, and filming. Ultra-fast hard disk capacity of 45 GB allows rapid access to 16,000 images and up to 4,000 gantry rotations of raw data.

An erasable magnetic disk drive (2.6 GB) rapidly and cost effectively archives up to 9,600 (512 x 512) images per disk. Images are transferred at a rate of 2-4 seconds per image. Magnetic disks are able to store 600 rotations raw data files.

ACR-NEMA DICOM 3.0 Storage SCU

The ACR-NEMA DICOM 3.0 storage SCU (PACS) interface allows the CT scanner to export images out onto a network. This feature consists of software only and utilizes pre-existing Ethernet ports on the CT scanner to connect to a coax-Ethernet-based network running TCP-IP communication protocols.

Image format and transfer commands conform to DICOM 3.0 standards. Image studies can be sent out in batch. The system can be set to automatically transfer images out to the network after an exam is completed.

ACR-NEMA DICOM 3.0 Print SCU

The DICOM3 Print SCU system allows the CT system to send image data that has been acquired and reconstructed to a film imager via Ethernet in conformance with the DICOM3 (Digital Imaging and Communications in Medicine v3.0) standard.

ASPIRE CI: Continuous Imaging

Continuous Imaging provides the ability to view a helical scan at 8 frames per second (512 x 512 matrix). This immediate image feedback allows the operator to more rapidly assess if a scan is proceeding as planned and covering the area of interest. This can reduce unnecessary radiation dose to the patient while increasing CT scanner throughput and productivity.

ASPIRE CI: SureStart Contrast Monitoring

SureStart provides the ability to monitor contrast media at a selected target and to automatically delay the start of a Helical scan until a pre-set concentration threshold is achieved. Alternatively, the operator may manually begin the helical run after the contrast is seen to have arrived at the target. This capability allows the operator to optimize vessel and organ opacification, and potentially to reduce the volume of contrast material used without compromising image quality. During Continuous Imaging, SureStart updates the image display at a rate of 8 frames per second.

Patient Management

Individual patient information can be entered at the time of examination, or in advance into an on-line Patient Appointment file to make actual patient scanning proceed as quickly as possible.

Scanogram

The Aquilion Multi performs a Scanogram, a digital projection radiograph, for planning the axial and helical scans in the shortest time possible. The Scanogram can be up to 139 cm in continuous coverage which is useful for planning multiple helical exams and for trauma patients. Scanograms can be acquired with the X-ray tube at default positions of 0, 90, 180, or 270 degrees or at any arbitrary angle in 5 degree increments for optimum scanning flexibility. Scan planning is carried out with on-screen graphic overlays of the Scanogram which are used interactively to select and adjust scan slice helical coverage area(s), voice command insertion time(s), gantry tilt, reference position, plan number, Image number, and fields-of-view.

Image Management

Images can be stored on hard disk, magnetic optical disks or transferred via an Ethernet connection to other storage devices or image networks. Image order can be sorted by a number of options, including image number, table position, gantry tilt, scan time, for the most useful presentation of stored information.

Image Display

Images can be displayed in multiple formats ranging from 1 to 16 frames per screen. An inset Scanogram can be overlaid for quick reference marking. Images can also be added, subtracted, rotated and filtered. Window width and level can be adjusted non-linearly, accommodating up to six built-in curves and six user-defined curves.

Image Quality Enhancement

Automatic 2-pass Beam Hardening Correction (BHC): Compensates for the non-uniform beam hardening effect of bone for more accurate reconstruction. Although useful throughout the body, the most significant image quality improvement is seen in the brain, with reduction of streak artifacts in the posterior fossa and elimination of cupping artifact in the mid-brain.

Raster Artifact Suppression Protocol (RASP): Dramatically reduces artifacts caused by non-uniform attenuation, such as in the shoulders and pelvis. RASP may be applied in post-processing.

A New Automatic Patient Motion Correction (APMC): Reduces streak artifacts caused by movement of high-contrast interfaces, such as air, contrast or metal, during scanning. APMC is especially useful for scanning trauma or sedated patients who cannot co-operate.

Over 20 reconstruction algorithms, grouped by anatomical application, are provided for customized image reconstruction according to the diagnostic information needed or physician preference.

Helical Scan

Provides continuous data collection while moving the couch top to obtain a seamless volume of raw data from which slices can be reconstructed at any point along the patient axis.

- Completely integrated into the system's eXam Plan protocols.
- Includes the following helical scan modes for maximum utilization:
 - Single phase (one single acquisition).
 - Multiple Phase. Two or more helical acquisitions in the same or opposite directions. Interscan delay can be set as short as 5 seconds. A complete sequence, including up to 10 Helical scans with pre-set delays, can be programmed as a single eXam Plan. Any Scanning parameter, such as slice thickness, table speed or mA can be changed between runs. Useful for observing multiple contrast phases following a single injection. Helical and conventional scans can be combined into one eXam Plan protocol.
- Helical data reconstruction employs the MUSCOT algorithm, which markedly reduces artifacts while providing unparalleled flexibility in operator selected parameters. Seven helical pitches, ranging from 2.5 to 6 are available. Images may be reconstructed at any point within the scanned volume, and with image thicknesses ranging from nominal up to 5 times that value. Image raw data may also be stacked, to further reduce partial volume artifacts or to decrease the number of images to be archived. Helical images also may be zoom reconstructed from raw data to increase in-plane spatial resolution.
- Scanning region can be prescribed graphically from the Scanogram image.
- Helical rotation speeds of 0.5, 0.75, 1.0 or 1.5 seconds/360° can be selected.
- Allows helical pitches of 2.5, 3.0, 3.5, 4.5, 5.0, 5.5, and 6.0
- Table movement is variable from 0.5 to 100 mm/sec. In 0.1 mm/sec. Increments for full helical scanning flexibility.
- Slice thicknesses include: 4x0.5 mm, 4x1 mm, 4x2 mm, 4x3 mm, 4x4 mm, 4x5 mm, 4x8 mm, and 2x10 mm.
- Maximum continuous X-ray-on time is 100 seconds.
- Maximum Continuous coverage is 139 cm.
- Maximum program duration is one hour.

MultiView

MultiView uses fast multiplanar reconstruction and batch mode specifically for multislice data sets. Planar images are reconstructed at different angles for better anatomical visualization. All three orthogonal images (coronal, sagittal, and axial) are displayed in real-time for immediate viewing. Positioning the cursor on any image automatically generates the corresponding orthogonal images.

3-D Imaging

The system provides excellent quality shaded volume rendering three dimensional images. Zooming and panning over the 3-D surface is provided, and distance measurements may be performed. Features include:

3-D Surface Display

3-D Shaded Volume Display

Maximum Intensity Projection (MIP) Minimum Intensity Projection
Intensity Volume Rendering

Quantitative Analysis

- Profile display of CT numbers along a selected line in the axial plane.
- Distance measurement and display.
- CT number display.
- Histogram display – graphically plots CT number distribution for a region of interest (ROI). Quickly provides measure of image noise.
- Circulatory Function Analysis fits a curve to CT number changes over time for a selected RIO.
- Functional images can be based on peak height, peak time, appearance time, area under curve, mean transit time, 2nd moment, and transit time.
- ROI's can be rectangular, circular or irregular shape.

Image Manipulation

- “Vari-area” allows for the pre-selection of a region of interest for zooming, using raw data for immediate post-scan display.
- Zooming of raw data for greater sharpness of detail.
- User defined post-processing filters for edge enhancement and smoothing.

Annotation

- Four lines of comments and arrow display.
- 36 exam information fields are available and can be selectively masked or shown, depending on specific site requirements.

Exam Plan Protocols

360 individual eXam Plan protocols can be custom programmed to allow for automatic execution of exams based on anatomy or individual physician preference. Virtually all system parameters can be programmed into the protocols, including: mA, kV, scan time, field-of-view, patient position and posture, vari-area, slice thickness, table top speed/incrementation, scan mode(s) (Helical, Scanoscopy, Scan&Scan, Scan&View, Dynamic), reconstruction modes (s), convolution filters(s), image filters, window/level presets, auto filming, voice command(s), scan start delay, interscan delay(s), auto archive, auto enlargement, reference position, multiple reconstruction.

- The names of the eXam Plans are displayed on the screen and can be directly accessed by clicking on the display.
- EXam Plans can be temporarily modified on-the-fly to adjust to varying needs as they arise.
- Exam Plan sets can be stored on MOD disks and copied to other Toshiba scanners.

Archiving

- Image data and raw data can be protected to prevent accidental erasure.
- Raw data can also be stored on, and retrieved from MOD providing the capability or reconstructing images using different parameters, such as slice position or reconstruction algorithm.

Filming

- Filming can be executed at any time.

- Individual image display filming calls up each image for window/level adjustment before filming.
- Autofilming allows a complete exam to be filmed with the push of one button. It can be included as a part of an eXam Plan protocol.
- Film format can be controlled using the console.
- Images are displayed in a 512 x 512 or 1024 x 1024 matrix and transmitted to the camera as digital data for speed and simplicity.