PICKER

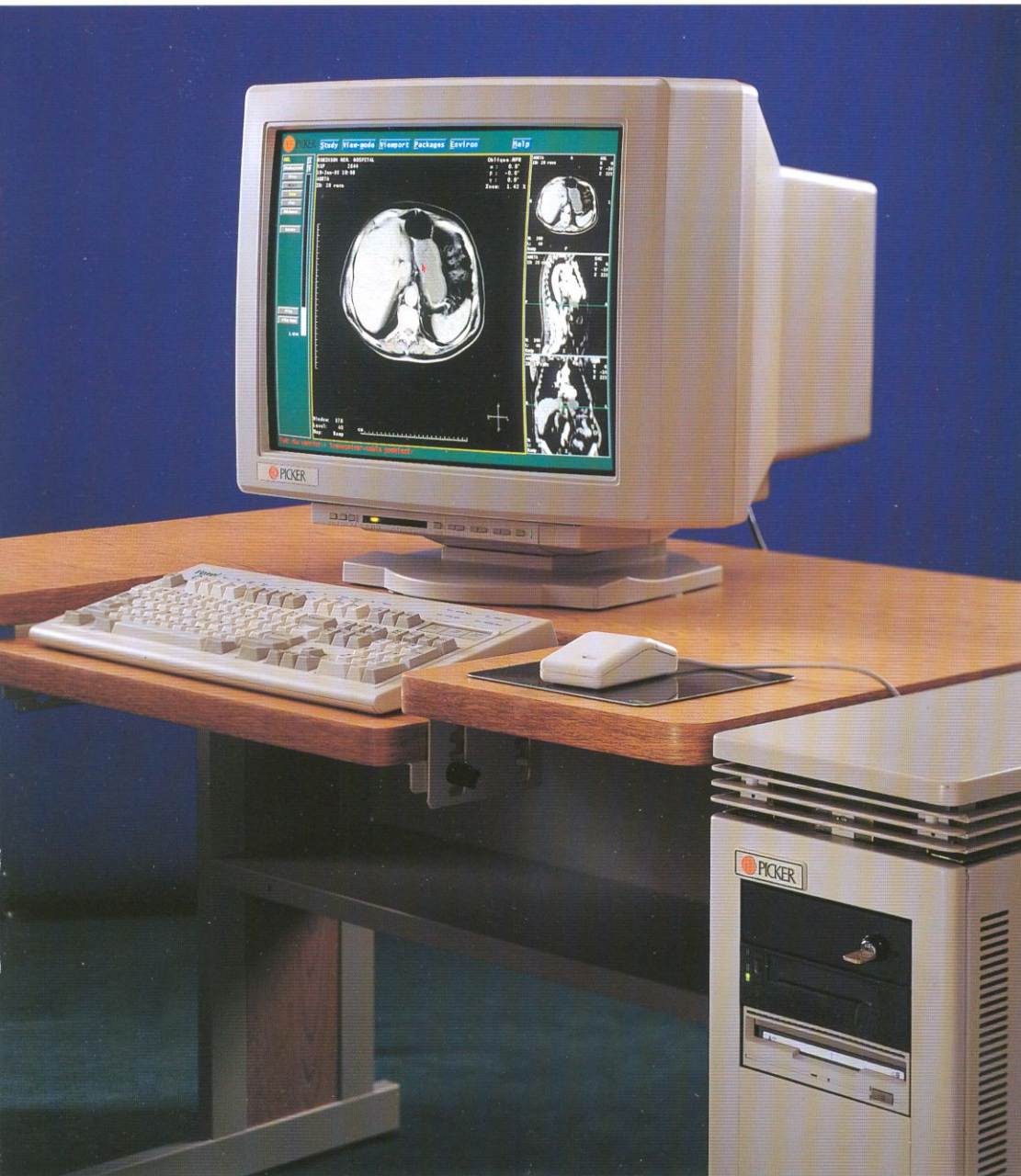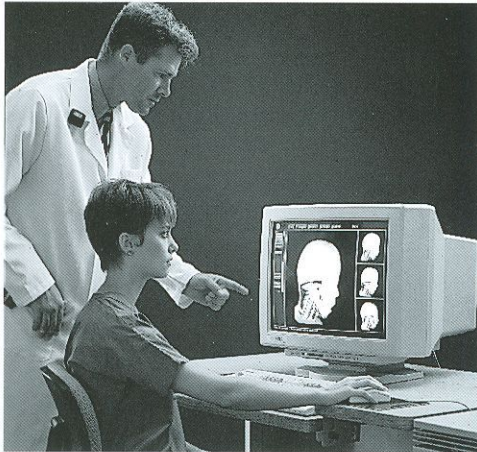# Voxel Q™
Real-Time Visualization and Analysis System

Provides the critical tools necessary for advanced or specialty visualization requirements.

Description

Voxel Q™ is the medical imaging system of choice for computed tomography (CT) and multimodality image review providing unsurpassed image reformatting, rendering and output clarity. Voxel Q is the only visualization system which delivers 10 million trilinear interpolations per second (TRIPS) to speed superior visualization of vascular soft tissue and bony structures.

Voxel Q supports many capabilities for viewing critical structures. Its features include: 2-D cine review, real-time multiplanar reformation (MPR), high-speed 3-D, quick maximum intensity projection (MIP), unique 4-D Angio, volume sculpting capabilities, CT angiography analysis and quantitative analysis.

Being ACR/NEMA DICOM conformant, the Voxel Q incorporates superior connectivity capabilities by displaying datasets from multiple modalities and multiple vendors for comparative viewing and diagnosis. Patient studies from other modalities including magnetic resonance (MR), X-ray, nuclear medicine and multiple vendors supporting the DICOM 3.0 industry standard can easily be transferred to the Voxel Q for visualization as well as filming. Voxel Q enables convenient image data transfer, automatically or manually, for technologists or physicians to "push or pull" patient studies to and from the scanner to the Voxel Q as required. (Note that full visualization capabilities are offered for third party data.)

Voxel Q provides the critical tools necessary for advanced or specialty visualization requirements. Voxel Q's speed, image quality and simplicity provide the basis for significant efficiency increases in radiology departments.

Features

Multi-Image Display

The Voxel Q monitor screen is divided into viewports which display independent or related images simultaneously. This allows from four to 48 images from CT, MR and nuclear studies to be examined together on the same screen. In the standard screen layout, the monitor is divided into one main viewport and three sub-viewports which are most often used for displaying reference views. Images in each of the viewports may be transferred from one viewport to another. Basic display features include:

- Screen Markers & Study Information
- Viewing Multiple Studies
- Screen Annotation
- Viewport Transfer

Interactive Visualization

Highlights of major features and capabilities provided in all rendering modes by Voxel Q's real-time interactive visualization software include:

- Window/Level Adjustment
- Volume of Interest (VOI) Adjustment
- Scan Information Display
- Movie Creation and Playback
- Filming/Hardcopy
- Split Screen Presentation
- On-Line Help Documentation
- Zoom
- Color Presentation
- Measurement
- Screen Saves
- Archive
- Disk Management

Features
(continued)

Cine Visualization

Allows you to rapidly move the images in the patient's z-axis direction to quickly review a large dataset of spiral images.

Volumetric Reconstruction

Volumetric rendering algorithms are used in all modes to yield superior image quality. All images are reconstructed at full spatial resolution.

Multiplanar Reformatting (MPR)

MPR mode instantly displays multiplanar reformatted images in axial, sagittal and coronal planes as well as arbitrary oblique and curved planes. Throughout MPR analysis, annotations in the reference viewports show the exact position of the image in the active viewport on the orthogonal planes.

Major MPR mode capabilities include:

- Batch MPR Package with automatic filming
- Curved MPR
- Slice Plane Thickness Adjustment
- Oblique MPR

3-D Reconstruction (3-D Shaded Surface Display)

This mode provides the capability for real-time, interactive generation and manipulation of 3-D shaded surface images. Three-dimensional images are generated instantly on command without requiring lengthy background construction of contour files.

Special 3-D capabilities include:

- Volumetric Rendering
- Slicing
- Cube Cuts
- Adjustable Shading
- Rotation
- Slice Plane Mapping
- Transparency

Maximum Intensity Projection (MIP)

MIP aids the visualization of vascular structures, emphasizing areas of calcification along major vessel walls. MIP is the most commonly used method for reformatting CT (CTA) studies such as carotid and renal evaluation.

4-D Angio

Picker's exclusive 4-D Angio™ mode provides unique, simultaneous visualization of vasculature, soft tissue and bone. The optional 4-D Angio visualization package provides the ability to see through and beyond surrounding structures. Conventional 3-D or MIP type reformations cannot accomplish optimum visualization of such structures. Four-D Angio accumulates the composite CT density along every ray trace. As a result, 4-D Angio provides excellent visualization of tortuous vessels in relation to bony structures in three-dimensional perspective.

Measurement

Advanced measurement capabilities are provided in every rendering mode, including measurements of:

- Density value (in Hounsfield units if CT) of a point.
- Distances along straight and curved lines.
- Angles between lines and radius of curvature for curves.
- Area, minimum and maximum voxel values, mean and standard deviation, and a density histogram for a specified region of interest.
- Volume of 3-D objects.

Features
(continued)

Segmentation/Disarticulation

Voxel Q provides basic segmentation capabilities through interactive thresholding and window/level adjustment. In addition, Voxel Q's advanced segmentation package provides the ability to identify up to 15 organs/structures on an image and manipulate them individually, or make them invisible for easier visualization of the surrounding area. For example, a femur can be identified, and then "removed" from an image so that the acetabular articulate surface may be examined.

Voxel Q provides two segmentation packages (region-based and contour-based) offering a range of tools for segmentation of the anatomy.

Contour Creation Tools:
- Isodensity
- Freehand
- Rubberband
- Edit
- Copy-to-slice range stretch

Region Creation Tools:
- Full region
- Manual paint
- Place seed & grow region
- Grow volume
- Previous slice load
- Next slice load
- Grow slice
- Place barrier

Multimodality Image Fusion

This option enables any combination of CT, magnetic resonance (MR), single photon emission computed tomography (SPECT) or positron emission photography (PET) data studies to be registered and interactively viewed, either in linked viewports or as fused colorwash images. This mode also provides linked measurements.

Virtual Endoscopy

This advanced visualization capability is an innovative approach to screening patients for diseases, such as obstructed airway or polyps. Voxel Q generates the virtual reformations in a cine fashion to display the area of interest as if traveling through the anatomy. The anatomy is displayed with variable levels of translucency allowing surrounding structures to be visible and used as landmarks essential for the physician or surgeon.

Specifications

Base System Components

Voxel Q CPU

Technology Platform
• Sun SPARC™ host

Operating System
• Sun OS™ (Unix™)

Data Exchange
• Ethernet (TCP/IP); AUI connector

CPU Memory
• 16 MBytes

Service and Applications Modem
• For remote diagnostics and software upgrades
• Internal Hayes compatible - 14,400 baud

Data Storage Devices

1.0 GByte Disk

8mm Tape Drive System
• Cartridge output capacity up to 2.5 GBytes
• Software to read Picker Q-series scanner 8mm archive tapes

Voxel Q Image Processor

Performance
• Custom bit-slice parallel/pipeline architecture
• 1,000 MIPS equivalent performing for rendering
• 10 million trilinear interpolations per second (TRIPS)

Dataset Memory

• 64 MBytes standard (upgrade to 128 MBytes)
• High-speed eight-way interleaved object memory

Voxel Q Operator Console

Keyboard
• Full alphanumeric keyboard
• Template overlay
• 12 function keys
• Six hot keys including automated study archive, deletion, screen layout changes, disk space display and magnetic tape reading
• Mouse and mouse pad

20" Color Display Monitor
• Full-color 24-bit RGB image display plus 16-bit overlay
• 1408 x 1024 pixels displayed
• Up to 48 user-selectable independent or related viewports
• 60 Hz, non-interlaced refresh

Putty/Walnut Computer Desk
Includes matching adjustable chair

Operator Console

The Voxel Q software capabilities are easily accessible through an intuitive, menu-driven interface. Features and easy touch functions can be selected quickly using the mouse or keyboard (with a single function key). User prompts and operation status updates are also incorporated into the display interface. When a menu item is selected, a brief description of the corresponding feature appears at the bottom of the screen. In addition, an extensive on-line HELP facility provides more detailed explanations as required.
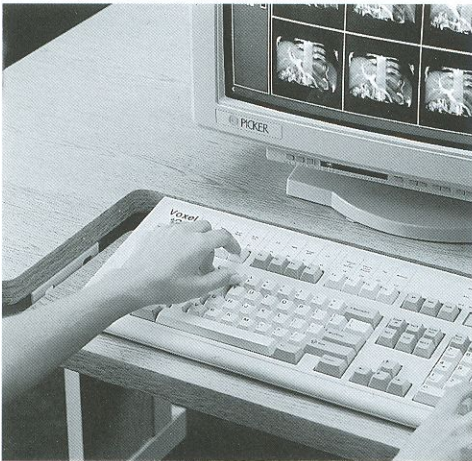
Easy Touch Functions:
- Study selection and display
- Display of clinical parameters (scan and patient)
- 2-D, MPR, oblique MPR or 3-D image review
- Region and volume of interest selection
- Window and level preset values
- Segmented pathology or structure display and removal
- Measurement tool selection
- Generation of axial, sagittal or coronal views
- Image magnification
- Image rotation
- Image viewport selection
- Archive images
- Filming
- Cine
- Control window/level, cine speed and slice selection
- HELP instructions and information
- Remote network image access

Remote Digital Filming Module*:
- Software for transparent filming with HYPERLAN II Q-series scanner link
- Separate multimodality input not required
- Additional digital input for scanner not required

* Purchase of HYPERLAN II is required for use of this module
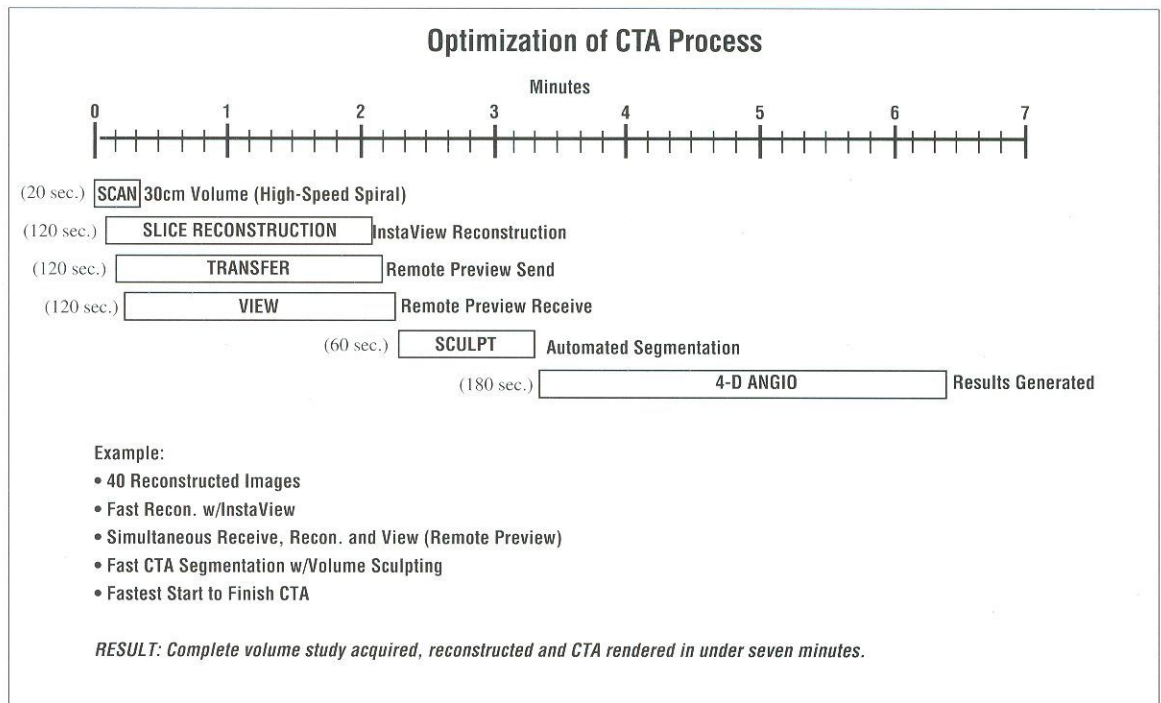
Computer & Image Processing

Voxel Q achieves real-time, interactive capabilities through the patented Voxel Processor™. The Voxel Processor's large, on-line memory holds a complete spiral patient study accessible for the rapid creation of any image on command.

The high-speed hardware, optimized for visualization and analysis, achieves a level of performance far beyond that of a general purpose workstation. For example with the Voxel Q, a typical CT angiography case can be completed from start to finish in less than seven minutes.

Voxel Q offers superior image quality, performing all reconstructions using volumetric rather than conventional surface rendering techniques. All images are created using the full spatial and density resolution of the original data, displaying the most intricate details of anatomy.

Voxel Q's software design permits many multitasking functions (such as scanning, network transfer of images, image processing, formatting, display and filming) to occur simultaneously. An example of this is the CTA process depicted below.

In this example, images are reconstructed and displayed every three seconds on the scanner and simultaneously transferred and displayed on the Voxel Q. Note the images can be monitored on the Voxel Q while reconstruction occurs. Therefore, visualization work can be started immediately after the last image is received.

Optimization of CTA Process

Minutes
0   1   2   3   4   5   6   7

(20 sec.) | SCAN | 30cm Volume (High-Speed Spiral)

(120 sec.) | SLICE RECONSTRUCTION | InstaView Reconstruction

(120 sec.) | TRANSFER | Remote Preview Send

(120 sec.) | VIEW | Remote Preview Receive

(60 sec.) | SCULPT | Automated Segmentation

(180 sec.) | 4-D ANGIO | Results Generated

Example:
- 40 Reconstructed Images
- Fast Recon. w/InstaView
- Simultaneous Receive, Recon. and View (Remote Preview)
- Fast CTA Segmentation w/Volume Sculpting
- Fastest Start to Finish CTA

RESULT: Complete volume study acquired, reconstructed and CTA rendered in under seven minutes.

Storage Capabilities

IMAGE STORAGE*

Standard Image Disk	Voxel Q
Capacity	1.0 GByte
Storage: Uncompressed Images (256^2)	4,200
Storage: Uncompressed Images (512^2)	1,080
Optional Image Disk*	
Additional Capacity 2.0 GByte	3.0 GByteTotal
Total Storage: Uncompressed Images (256^2)	18,200
Total Storage: Uncompressed Images (512^2)	4,680
Additional Capacity 4.0 GByte	5.0 GByteTotal
Total Storage: Uncompressed Images (256^2)	32,200
Total Storage: Uncompressed Images (512^2)	8,280
Standard 8mm Tape	
Capacity	2.2 GByte
Storage: Uncompressed Images (512^2)	4,000
Optional Optical Disk	
Storage:	250/Side
Uncompressed Images (512^2)	500/Platter

* Image disk space can be user-customized to include image archiving, scan data archiving and other features.

Connectivity

Picker has taken a leadership role in implementing connectivity standards. Picker's HYPERLAN II™ is a medical imaging data communications network that offers performance, capacity and expandability for today's demanding high-volume, multiple-CT department. In addition, Picker's Q-systems support ACR/NEMA DICOM V3.0 which provides multivendor image transfers utilizing Ethernet standards.

HYPERLAN II

HYPERLAN II was designed for data transfer between Voxel Q and Picker's Q-series scanners. This advanced connectivity tool is the first to allow transparent image review and manipulation of medical images by a remotely located viewing station. For optimal scanner to Voxel Q throughput, images are transferred via the Picker HYPERLAN II network as fast as three seconds per 512 X 512 image.

HYPERLAN II, using the Ethernet and TCP/IP protocols, runs over fiber optic and copper (coaxial and twisted pair) media. This provides full compatibility with existing Ethernet installations and provides compliance with evolving future network standards such as FDDI and ATM.

Remote Preview
Voxel Q and HYPERLAN II give clinicians the ability to view images within seconds of acquisition. Using Voxel Q's remote preview capability, images from spiral or other modes of CT scanning can be displayed within six seconds of their availability on the CT console. It saves time and adds efficiency in trauma CT or stat patient image review. Remote preview is ideal in any diagnostic situation where near real-time review of patient CT data is required. Images can be displayed while a patient is still on the scanner couch and the radiologist is remotely located. Remote preview provides optimum throughput when advanced visualization is required.

Connectivity
(continued)

Network Filming

Voxel Q remote filming is a unique feature of Picker's Q-series scanners. Remote filming allows images to be pushed over the HYPERLAN II network to be filmed by any laser camera digitally connected to a Q-series scanner. Remote filming does not require a multimodality laser camera input nor does it require any user interaction on the scanner. Images are automatically forwarded. Remote filming provides true laser camera filming redundancy in multiple camera and/or scanner installations.

ACQSIM Connectivity

The range of ACQSIM™ system interoperability is based on the Voxel Q visualization system. For optimal oncodiagnostic throughput, Voxel Q is connected to any Q-scanner system via HYPERLAN II. Voxel Q links to planning devices via the industry standard Ethernet connections, via DICOM or other protocols.

ACR/NEMA DICOM V3.0

The ACR/NEMA DICOM interface is a detailed specification that describes a means of formatting and exchanging images and associated information. This standard is endorsed by the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) and specifies the physical connection and a set of protocols to allow the data to be transferred reliably and efficiently.

Voxel Q DICOM V3.0 capabilities include:
- Receive
- Send
- Query/Retrieve

Multimodality Connectivity

DICOM incorporates superior connectivity capabilities by supporting and displaying large datasets from multiple modalities and multiple vendors for comparative viewing and diagnosis, including MR, X-ray, nuclear PET and SPECT data.
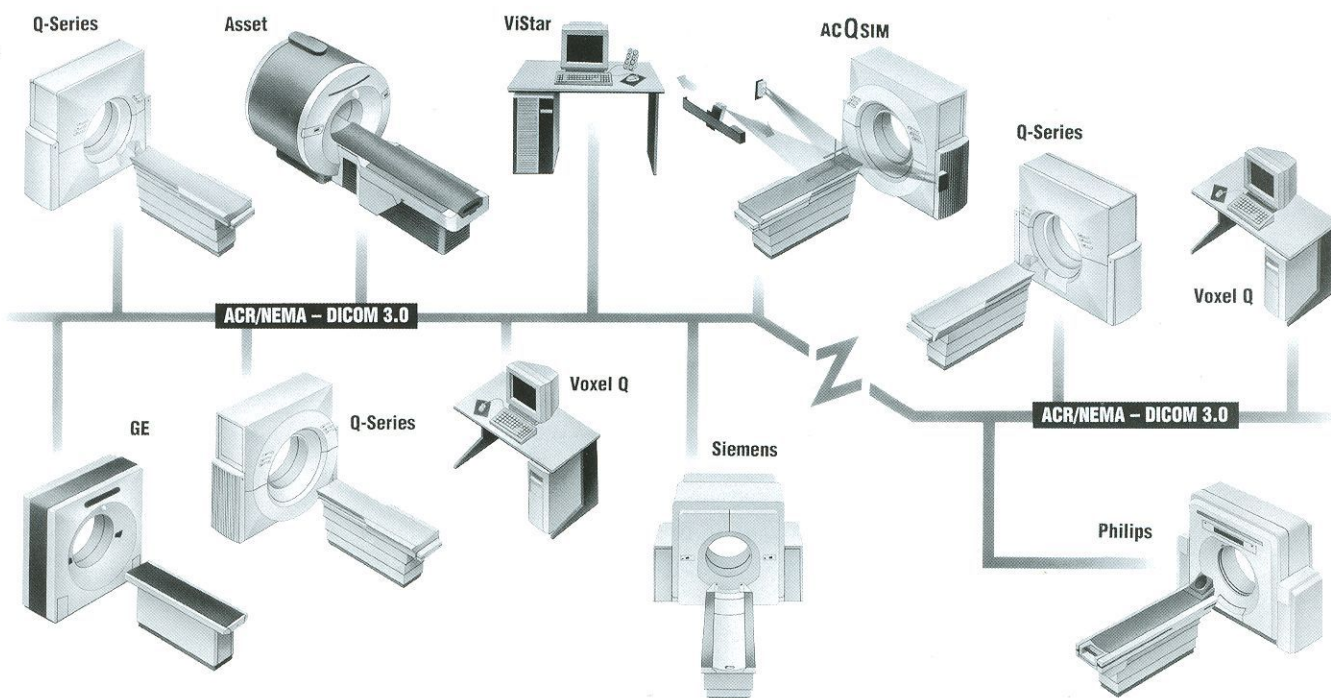
**System Options
& Software Upgrades**

Software Options

Dental Planning
CT/MR Angiography
Maximum Intensity Projection
4-D Angiography
Multimodality Image Fusion
Virtual Endoscopy
German Language Interface

Memory and Disk Upgrades

Memory Options
- Upgrade to 128 MBytes

Data Storage Options
- Upgrade to 3.0 GByte Disk System (total capacity)
- Upgrade to 5.0 GByte Disk System (total capacity)

Interface Options

Networking
- HYPERLAN II
- Entry/MTE Ethernet converter
- Nuclear Interfile Data Link
- ACR/NEMA DICOM 3.0
- MTE 1200 Ethernet converter
- TIFF Output Package

Remote Slave Monitor Option
- Full image viewing capabilities
- 20-inch full color 24-bit RGB monitor
- Maximum distance from Voxel Q to control center: 50 feet (15.24m), without amplifiers

Laser Camera Interface Option

Color Printer and Interface Option
- Color dye sublimation printer
- Near-photographic quality color hardcopy
  8-1/2 inches x 11 inches (21.6cm x 27.9cm)
  or 8-1/2 inches x 14 inches (21.6cm x 35.6cm)
- Continuous-tone printing with up to 256 levels of gray scale
- Up to 16.7 million colors

Scitex Printer
- Uncompromised image quality with 3060 x 5280 pixels and 100 bit addressable gray scale
- Dry prints with no chemical processing
- Large 12 inches x 18 inches paper size
- Connectivity options to suit every environment
- Printed pages archivable for file or file storage

System Options & Software Upgrades
(continued)

5-1/4 Optical Disk Archiver
- 5-1/4 inch optical disk drive
- Interface cables
- One media platter
- Housed in CPU tower enclosure
- 350 MByte capacity per media side

Nine-track Magnetic Tape System
- Autoloading of all standard tape sizes
- Reads densities of 800/1600/3200/6250 bytes per inch (bpi)
- Tape drive dimensions:
  - Width: 19 inches (48.3cm)
  - Depth: 26 inches (66cm)
  - Height: 11 inches (27.9cm)
- Includes table:
  - Width: 24 inches (61cm)
  - Depth: 29 inches (73.7cm)
  - Height: 30 inches (76.2cm)
- Software to read archive tapes from Picker 1200™ CT scanners (SS04 and Level II software) and Picker MR devices

Third Party Tape Reader Option
- Reads 9-track tapes from major CT and MR scanner systems from vendors including GE, Elscint, Hitachi, Imatron, Phillips, Siemens, Technicare Deltascan and Toshiba
- Scanner software and model must be specified at the time of order

One year warranty on the Voxel Q system and associated optional hardware.

Site Requirements

General
- Dedicated/private telephone line (direct-in-dial, analog type) prior to installation
- All Ethernet and/or filming cables required are run to the Voxel Q system tower enclosure at the time of installation
- The coordination of fiber optic cable installation (if necessary) with Picker-recommended fiber optic contractor
- Placement of the Voxel Q outside of the range of one gauss magnetic field which may affect image quality

Equipment Dimensions
Tower Enclosure Dimensions
- Width: 13 inches (33.0cm)
- Depth: 30 inches (76.2cm)
- Height: 29 inches (73.7cm)

Computer Desk Dimensions
- Width: 48 inches (121.9cm)
- Depth: 30 inches (76.2cm)
- Height: 29 inches (73.7cm)
- Total Height (monitor to floor): 52 inches (132.1cm)

Weight
- Workstation: 150 lbs. (67.5kg)
- Computer Module: 200 lbs. (90.0kg)

Site Requirements
(continued)

Electrical

- Standard 120 VAC (U.S.A., Canada and Puerto Rico or other in-coming international local power)* 15-amp dedicated circuit (standard three-prong plug) power is recommended
- 50 or 60 Hz

* Isolation transformer and cable package available for international power conversion requirements.

Environment

Ambient Temperature
- 50 to 80 degrees Fahrenheit (10 to 26.7 degrees Celsius)

Humidity
- 20 to 80%

Altitude
- 0 to 10,000 feet (3,048m)

Power Dissipation

The btu/hr. ratings listed below are estimations based on an average hourly duty cycle and standby modes of equipment operation:

EQUIPMENT	btu/hr	KW	hp
Host Graphic Processor	4,000	.8	1
Monitor, Keyboard, Mouse	1,473	.2	.3
TOTAL	5,473	1	1.3

Note: Contact the Picker Site Planning Department for specific requirements pertaining to imaging/viewing equipment floor space and electrical, mechanical, structural and environmental specifications.

PICKER