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PRODUCT
DATA
9281-PE

Senographe 2000 D

Applications

Senographe 2000 D is the new Digital Mammography System from GE Medical Systems. It has been designed to perform screening exams as well as diagnostic views (spot compression, magnified and/or coned views).
It is a complete, modular system that eliminates the need for film cassettes and takes full advantage of the digital technology from on-screen image display (non-diagnostic softcopy reading) to networking, filming and archiving.

- Senographe 2000 D's digital technology offers the capability to acquire images in near-real time and to process them (variation of brightness and contast levels, auto-windowing, and image manipulation, …).
- It also offers high exam productivity, and potential dose reduction as compared to film/screen.
- Senographe 2000 D's Gantry leverages the best from the Senographe DMR Plus unit.
  The tube's Rhodium spectrum is optimized in digital imaging.
- The Senographe 2000 D's Gantry unit is equipped with a 19.20 x 23.04 cm, large flat panel digital detector, which is the result of 10 years of GE's research efforts. It allows excellent contrast sensitivity and very low noise level.
- Senographe 2000 D comes with an Acquisition Workstation that will display the acquired images in the room, to control breast positioning and possible motion blurring or to adjust brightness and contrast.
- Archiving, networking and filming for diagnostic is possible from the Acquisition Workstation which can print high quality film copies as needed.
- Senographe 2000 D also has an optional, non-diagnostic Review Workstation linked to the Acquisition Workstation by a high speed link. This powerful computer is equipped with two dedicated, very high resolution B&W monitors and the OneTouch dedicated keypad, all designed to optimize efficiency. Through DICOM, networking is possible from this workstation. Printing can also be done from the non-diagnostic Review Workstation on a DICOM compliant high resolution printer.

Senographe 2000 D's Gantry

- The unique dual anode Senographe DMR tube is featured on Senographe 2000 D allowing optimal use of Rhodium with digital imaging.
- All acquisition related user interface (choice of technique, exposure controls, …) are located on the Gantry's control panel.
- The non-removable detector is located in the image receptor at a fixed source to image for optimal imaging performance.
- Since there is no increase in the image receptor thickness, all patient positioning, choice of angulation, choice of magnification factors, etc. are performed in the exact same fashion as on a conventional unit.
- The grid is contained in a very thin easily removable bucky which slides on top of the image receptor.
- The bucky with grid can be removed for magnification purposes and replaced with a protective non-grid bucky.
- The Automatic Optimization of Parameters (AOP) and Manual

exposure modes are avaible on Senographe 2000 D. Taking advantage of the fast readout capability of the panel, a unique algorithm automatically optimizes the location of the measurement point under the breast for exposure control and thus eliminates cell positioning.

The Large Flat panel Digital Detector

- The detector benefits from GE Corporate R&D's latest technology to ensure digital image quality. It is installed on the Senographe 2000 D's gantry with no increase of image receptor thickness.
- The Detector relies on CsI scintillator and amorphous Silicon technology. It is composed of a single detector of a size of 19.20 x 23.04 cm.
- The detector's native pixel size is 100 microns.
- The detector is maintained at constant temperature (30 °C) to insure performance stability and reliability.
- Since unique advanced electronics are used in the detector, the noise level is extremely low, providing the opportunity to lower the dose while conserving equivalent signal-to-noise ratio in the image.
- The detector's high contrast sensitivity and dynamic range allow optimized viewing even of low contrast structures in low contrast areas of the breast.

The Acquisition Workstation

Once the image is acquired on the large flat panel detector, it is displayed on the Acquisition Workstation allowing positioning, motion blurring and contrast check. At the end of the exam the images can be automatically sent to the non-diagnostic Review Workstation, a mass archiver and/or printed on film, using a laser camera.

- This workstation is based on GE's Advantage Windows platform to insure software quality and robustness.
- It is placed in the acquisition room on a dedicated and ergonomically designed cart.
- The station is equipped with a dedicated, high quality, B&W, 1Kx 1.2 K monitor.
- The images displayed on the Acquisition Workstation are digitally processed and sub-sampled to allow full display of the preview image on the station's monitor.
- Images are automatically stored on the local hard disk and organized in a user-friendly database. The images are stored in Mammography DICOM format.
- Once the breast (left or right) is indicated, the system automatically determines all other viewing parameters, minimizing steps on system. This enables the technologist to focus on the patient rather than the system.
- Capitalizing on GE's experience in digital Mammography systems like Senovision, all user interface has been designed around ease of use and speed of operation.
- Image processing features:
  - "Thickness Equalization" algorithm to display all breast information on one image.
  - Automatic Contrast setting at image display.
  - Manual brightness/contrast adjustement.
  - Zoom & Roam, Magnifying Glass.
  - Flip, Rotate
  - Inversion
- From the Acquisition Workstation, it is possible to address the following connectivity features :
- "DICOM Push" feature to send images to any network, to a review workstation or to a networked mass-archiving system.
- "DICOM Print" to send images to be filmed on a high resolution DICOM laser camera.
- Record images on a DICOM-compliant interchange media (CD-R) for communication purposes.
- Archive images on a mass archiving system for permanent long term storage.
- Compatible with any HIS/RIS DICOM compliant system for patient data entry (manual entries are also possible).

The Non-Diagnostic Review Workstation (Option)

Once the image or the exam has been deemed acceptable on the Acquisition Workstation (in terms of positioning, etc.) it can be sent to the optional non-diagnostic Review Workstation for advanced image manipulation including : educational studies, annotation, and report preparation. It is possible that several Acquisition Workstations share one non-diagnostic Review Workstation.

- Like the Acquisition Workstation, this workstation is also based on GE's Advantage Windows platform.
- This is a powerful workstation, placed in the review room and equipped with two very high resolution (2Kx2.5K) B&W monitors and with the OneTouch dedicated Keypad for fast, user-friendly interface.

- The images are displayed in full resolution. The station offers different user selectable scenarios to provide efficient image manipulation.
- After transfer from the Acquisition Workstation, images are automatically stored onto the local hard disk and organized in the database to allow easy access at a later stage.
- Both on-screen user-interface and OneTouch dedicated keypad have been specially designed for user-friendliness and to save time.
- Image processing features :
  - Different "Auto-contrast" modes provide automatic contrast designed for visualization of different breast structures, at the touch of a button.
  - Manual brightness/contrast adjustement.
  - "Quadrant Zoom" cycles through zoomed images of the four quadrants of the breast at the touch of a button.
  - Magnifying Glass, Zoom, Roam.
  - Flip, Rotate, Inversion.
  - User annotations, graphics.
  - Measurements, distances and areas.
  - Choice of view format.
  - Patient and exam information on screen.
- Non-diagnostic Review Workstation connectivity :
  - "DICOM receive" for images coming from the Acquisition Workstation, from a mass-archiving system or from another station.
  - "DICOM Push" to send images.
  - "DICOM Print" to produce film hard-copies.
  - It is possible to connect a CD-R Interchange device for image communication purposes.

Digital Connectivity, Archiving & Printing

- The Senographe 2000 D Images are stored under the DICOM format.
- Senographe 2000 D features optional laser printing capabilities with high-resolution printers like the Agfa LR5200, Kodak Dryview 8600, or any other equivalent cameras.
- 750 digital images can be stored on the Senographe 2000 D's Acquisition Workstation hard disk, plus the raw data for each image. Up to 1500 images can be stored on the non-diagnostic Review Workstation's hard disk, plus an additional capacity of 6,000 images with the 54GB external hard disk tower option.
- At the completion of a patient exam, images are sent immediately to the printer, optional archive device, or optional non-diagnostic Review Workstation.
- A mass archive system can be connected with the Acquisition Workstation and the Review Workstation.
- Images are 'pushed' to the mass archive system exclusively from the Acquisition Workstation, but both the Acquisition and the non-diagnostic Review Workstations can receive archived images.
- A cost effective CD-R Interchange device (recordable) is available as an option, for image communication purposes. Up to 70 digital images can be archived on one CD-R.

Productivity - Typical Timing of Operations

- Senographe 2000 D provides productivity gains since :
- Film/screen cassettes are eliminated.
- Cheminal costs may be reduced.
- Labor costs are reduced due to elimination of cassette handling.
- Retakes can be reduced and exams are faster, so patient throughput is higher.
- The table above illustrates the typical characteristics of the system.

Operation	Timing (typical)
System boot up - Temperature stabilization (once a day)	5 min
Quality Control Tests (once a day)	2 min
Import DICOM Worklist from HIS/RIS (once a day)	30 sec
Image on Acq. Station screen, after end of XR exposure	10 sec
Time Between 2 exposures	10 sec
Transfert between Acquisition and Review workstations	15 sec per image
Go to next Image on Review workstation	1 sec
Go to next exam on Review workstation	5 sec

Ergonomics

- The user interfaces on both the Acquisition and the non-diagnostic Review Workstations have been designed for minimal learning time and intuitive, user-friendly interactions with the system.
- All the electronics, core components of the Senographe 2000 D system, as well as options are stored in the Acquisition console.
- Unique ergonomic features are available on the Acquisition cart :
  - Integrated view box for easy film to digital reference.
  - Lateral flipping tables for easy storage.
  - Flipping keyboard table for easy access to storage area.
  - An accessory storage drawer.
- On the non-diagnostic Review Workstation, the OneTouch dedicated keypad has been specially designed for a fast simple system use.

Reliability/Serviceability

- The Senographe 2000 D is InSite remote diagnostic compatible.
- Senographe 2000 D includes many self-diagnosis and calibration features to facilitate periodic system calibrations.

Regulations and Standards

- Senographe 2000 D complies with the following regulations :
- IEC 601.1.1: Safety requirements for medical electrical systems.
- UL 2601: Medical electrical systems.
- CSA 22.2 n°114 Radiation Emitting Equipment.
- 93/42/EEC: Medical device directive (CE Marking).
- JIS T1001: General requirements for safety of medical electrical equipment.
- 21 CFR Part 1020: Performance standards for ionizing radiation emitting products.

Technical Specs

Revolution® Large Flat Panel Digital Detector :

- Panel active area: 19.2 x 23 cm.
- Pixel (Pitch) size: 100 microns.
- Image size :
  - In basic mode, 1920 x 2300 pixels, 14 bits depth. 9Mb per image, image size of 19.2 x 23 cm.
- Typical Pre-sampled Modulation Transfer Function (MTF) :
  - 90% at 1 lp/mm.
  - 75% at 2 lp/mm.
  - 30% at 5 lp/mm.
  - 8% at 8 lp/mm.
- Detective Quantum Efficiency (DQE): DQE (at 2 lp/mm) = 0.6 for Rh/Rh 30kV 14mAs
- Acquisition bit depth = 14 bits.

Advantage Windows Based workstations :

- Senographe 2000 D's Acquisition and non-diagnostic Review Workstations have been uniquely designed for Mammography on GE's computer platform, Advantage Windows. They therefore benefit from the latest GE developments in terms of processing, connectivity & networking.
- Advantage Windows is the proven GE multi-modality computer platform, already available in CT, MR, X-Ray.
- Senographe 2000 D shares many Advantages Windows features such as DICOM storage and image networking, printing connectivity, …
- Mammography-specific user interfaces and applications have been developed on this Advantage Windows base.

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