

**CONQUEST**  
IMAGING

**TRAINING**



# **GE Voluson E10**

*Ultrasound Training Manual*



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## Module 1 Introduction

This manual is specific to the GE Voluson E10 systems field service training presented by the Conquest Imaging training department. After completing the training, you will:

- Understand overall system operation.
- Identify the parts, boards and modules.
- Understand the role of each component in the system.
- Be able to perform standard maintenance procedures.
- Have the knowledge to troubleshoot common problems.
- Be able to safely access and replace boards and modules.
- Understand of some of the differences in configuration for different system versions.

## Other Course Offerings

This course is one of many ultrasound training courses offered by Conquest Imaging.



The following are some of our current course offerings:

- Basic Ultrasound
- DICOM Standards and Networks

- Preventive Maintenance
- Probe Care and Handling
- NFPA 99 Electrical Safety
- Crash Course
- OEM Platforms

*You can use this margin for taking notes.*

To see the full descriptions and the scheduling of these courses, please visit our training department website:

<http://conquestimaging.com/education/>

### **Voluson E10**

*The Voluson E10 is most often used for womens health-OB/GYN applications.*



## Module 2 System Hardware and Theory

The goal of the System Hardware and Theory Module is to provide you with a solid grounding on the purpose of the GE Voluson E10 system's different components and how they function together within the system.

The three major functional blocks in all ultrasound systems are:

- Front End – Includes transducer analog signal processing functions.
- Back End – Includes user interface and system communication with DICOM systems.
- Power Systems – Generates, regulates and supplies the required voltages to the various parts of the system.

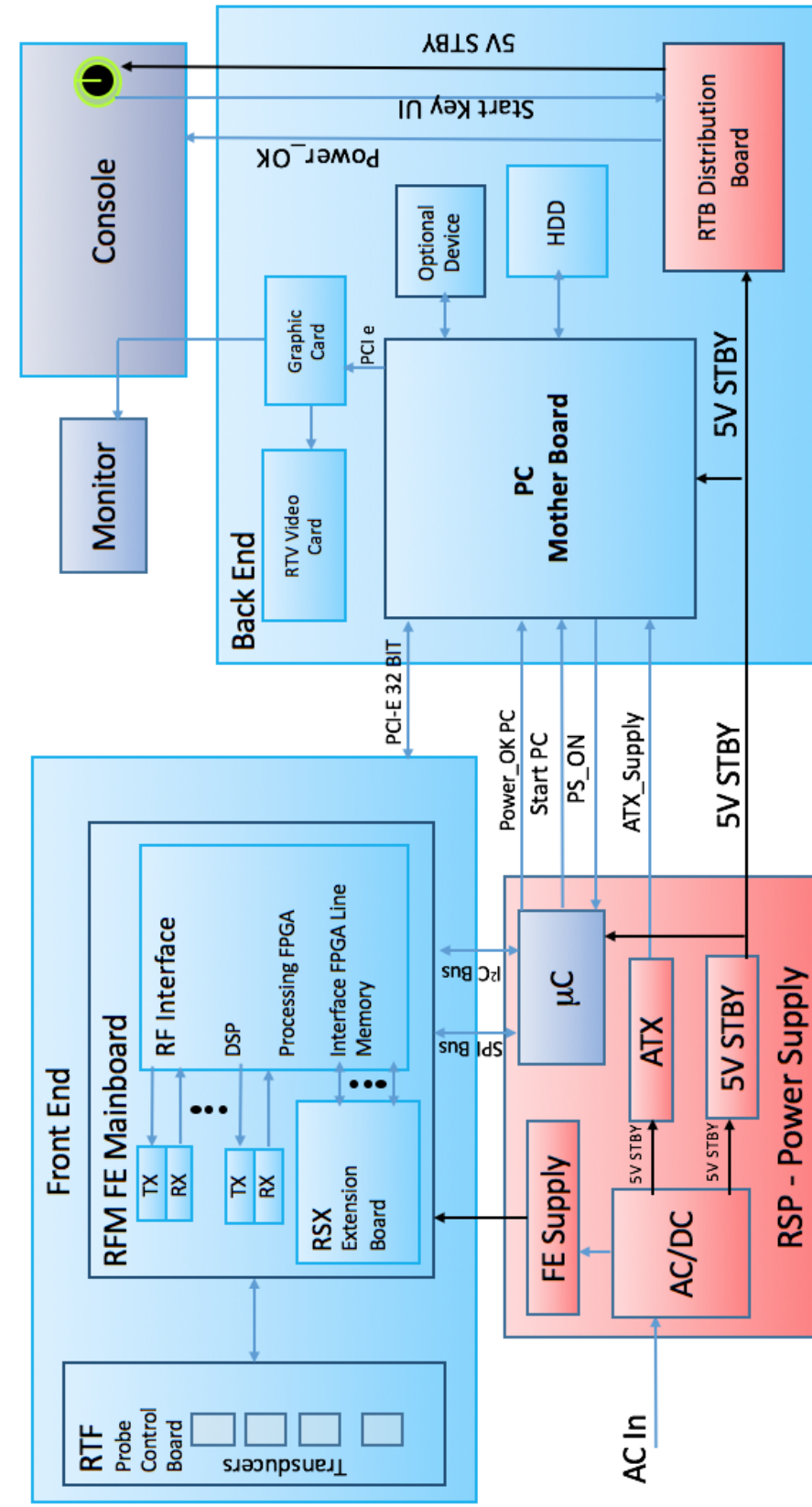
### *Signal Flow*

System configurations (GE dataflows) are stored on a hard drive inside the BEP, and all the necessary software is loaded from the hard drive on power up of the system.

The transmit bursts are routed from the RF interface to the relays where the ultrasound probes are connected. The signals are transmitted by the probes as ultrasound into the body. The input signals travel from the probe connector panel to the Front End Processor (FEP), then to the Back End Processor (BEP) for digital signal processing (DSP) and finally, the results are displayed on the monitor.



System Block Diagram



## System Front End Components

This section covers system frontend topics for the GE Voluson E10. Front End is a general term for the parts of the ultrasound system that receive the reflections from acoustic energy that have been transmitted into the body and perform the various signal processing functions on them needed to produce an ultrasound image. The following are some of the components and functions that are found in a typical ultrasound system front end:

- Transducers – Transmit focused acoustic energy and receive the resultant reflections.
- High voltage switches – Used for multiplexing (connects a particular transducer element to a particular transmitter/receiver pair)
- High voltage transmitters – Transmit analog data from the transducers.
- Time Gain Control Amp (TGC) – A variable gain amplifier (VGA) is used to compensate for image variations due to tissue depth.
- Analog to Digital converter and noise filtering.
- Digital Beamformers – Upconverts signals which increases sample rates. The signals are stored in memory, apodized and summed.
- Beamformed Digital Signal Processing – The digital beamformed signals received are processed into visual and audio outputs the process of which depends on if the transducer is B-mode (2D), Doppler, PWD or CWD.

The front end manages the input from the transducers, performs Analog to Digital conversion, Digital to Analog conversion along with many other signal processing functions.

## Voluson E10 Front End Processor (FEP)

In the Voluson E10 systems the front end beamforming electronics are comprised of the following boards:

### ***RTF - Probe Control Board***

The probe control board (RTF) recognizes different probe types and switches between the Probe Connectors (3 DLP-Connectors, 1 CW-Connector) as required. The board contains:

- One optional CW-Probe Connector
- Three 408 pin Probe-Connectors
- One 408pin Dummy-Probe Connector
- Probe Select Relays
- Probe Recognition

### ***RSE - Pencil Probe Board (optional)***

CW scanning is optional on the Voluson E10. This adapter board is for the connection of CW pencil probes is required for CW-Option.

### ***RFM - (RF-Interface & Beamformer) FE Mainboard***

The FrontEnd Mainboard supports Tx/Rx for 128 channels only.

#### ***RFM Board - Interface FPGA***

The interface FPGA on the RFM board provides the following functions:

- DMA logic
- Beamformer Interface
- RTF Control Interface
- RTF FPGA Control Interface

#### ***RFM Board - Processing FPGA***

The processing FPGA on the RFM board provides the following functions:

- Ultrasound Data Pre-Processing
- System Control
- Motor Control

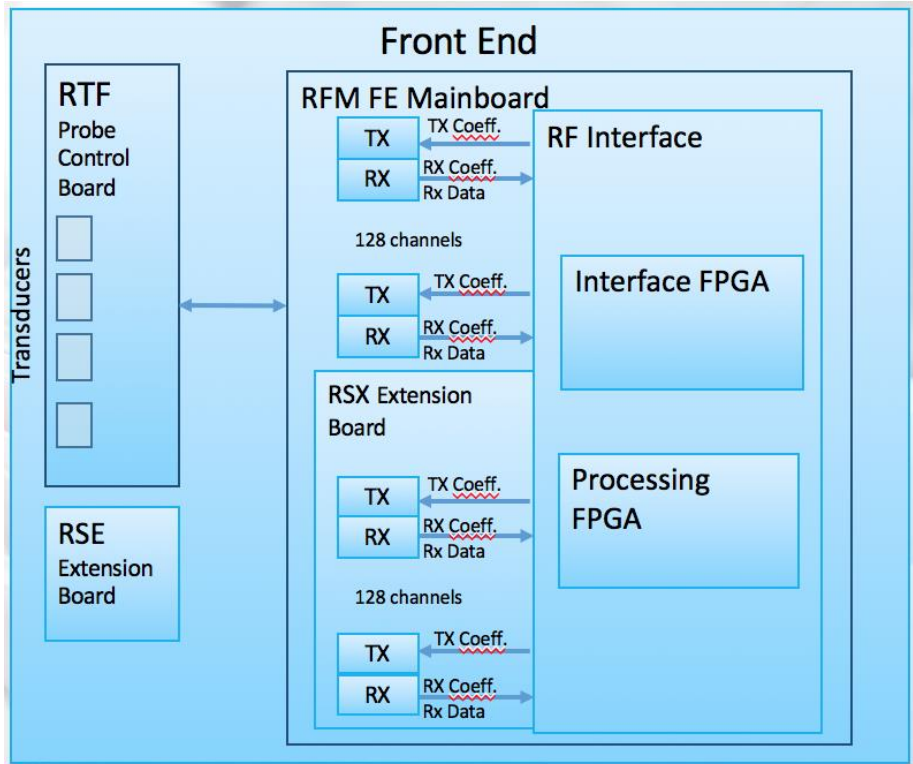
### ***RSX - (Beamformer Receiver/Transmitter) Extension Board***

Subset (for RFM) that is required to extend to 192 or 256 channels. All

*To extend to 192 or 256 channels, the RSX-(Beamformer Receiver/Transmitter) Extension board is required.*

components of RSX board are also present on RFM - (RF-Interface & Beamformer) FE Mainboard.

**Front End Block Diagram**



**System Backend Components**

This section describes the System Back End topics for the GE Voluson E10. The back end includes system blocks/components on the user interface side that perform functions such as master controller, signal processing, image memory, video layout, peripherals and user interface.

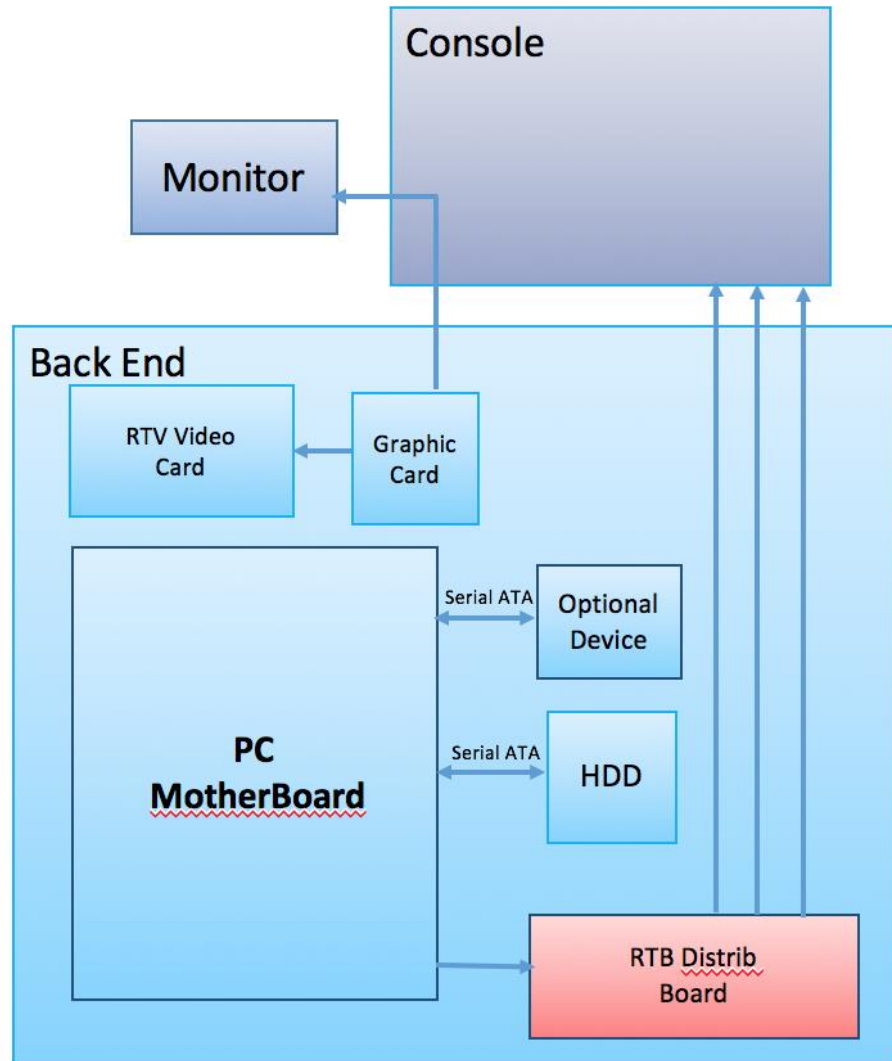
**Back End Processor (BEP)**



The Back End Processor (BEP) unit receives the data from the FEP electronics, stores it in memory, performs scan conversion to the pixel domain, and drives the system’s monitors.

Contains the HDD that holds the Base Image (Windows 7) and Application Software (System Specific). The BEP software also processes the Color Flow, Doppler, M-Mode data and the 3D/4D data.

## Back End Block Diagram



### PC-Motherboard

The major tasks of the motherboard are system control and image processing/rendering for 2D/3D/4D. It also provides control for the DVD drive and User Interface (UI) via USB connections. There are four motherboard configurations for the Voluson E10:

- ADVANTECH Micro-ATX + RTT/RTH6x
- ADVANTECH Micro-ATX + RTH50
- KONTRON Flex-ATX + RTT/RTH6x
- KONTRON Flex-ATX + RTH50

**Built in or external Components:**

- On Board VGA and Graphic Card
- LAN
- USB 2.0
- USB 3.0
- Sound
- CPU: 3.1 GHz at 4 cores

### Hard Disk Drive (HDD)



The 500GB Hard Disk is the main storage device of the Voluson E-Series ultrasound system. The Voluson E-Series Hard disk drive (HDD) is divided into four different partitions:

#### C: System partition:

- Operating System (Windows 7) including all Windows settings (IP-address, Network Name, etc.)
- US-Application Software (UISAPP)
- Global Service Platform Software
- Software Options

#### D: User partition:

- User Presets (Backup) database
- Images (Archive), Patient-ID's and Reports database
- Service and System settings databases

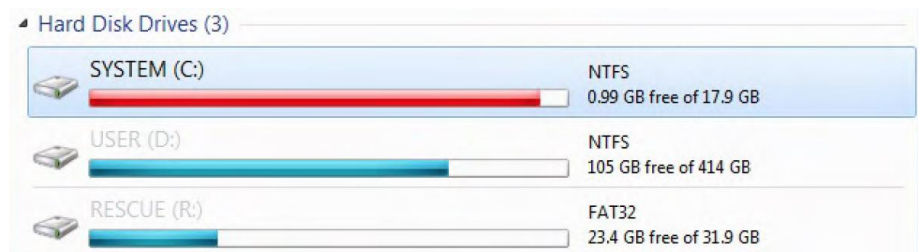
#### R: Rescue partition:

- Factory Images of the C: Partition for System recovery after HDD (Windows) crash.
- Printer Drivers

#### LINUX partition: (not visible in Windows)

- Linux operating system for rescue functionality.

### Distribution of partitions at 500 Gbyte HDD



### Graphic Card

The graphic Card supplies the RTV (Video manager) board with DVI Video. It offers dynamic contrast enhancement and color stretch video processing.

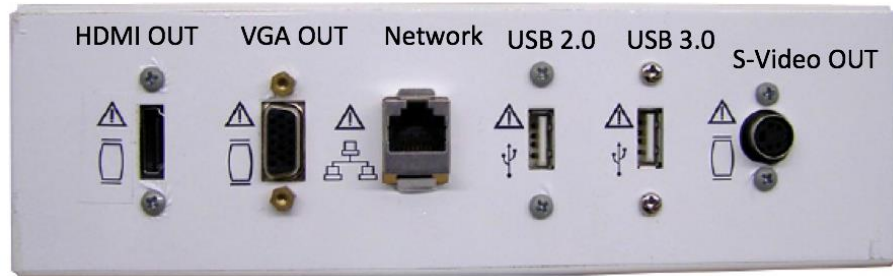
### RTV - Video Management Board

Distributes DVI-D-information coming from the Graphic Card to the DVI-D (digital) and DVI-I (integrated) connectors. It also converts DVI-D-inputs to S-Video output(s). Displays external playback video and adds overlay graphics to it.

- DVI-D output for the System Main Monitor
- DVI-I output for external device (only RGB signals used)
- S-Video output (2 channels)
- S-Video input for external devices
- USB connector for board configuration

### External I/O Connection Panel

The GES30 external I/O connection Panel is found at the rear of the system and includes VGA, USB, Network and S-Video cables to the Voluson E-Series system.



<b>HDMI OUT</b>	Connector for external monitor
<b>VGA OUT</b>	Connector for external monitor
<b>USB 3.0 port</b>	
<b>USB 2.0 port</b>	
<b>S-Video OUT</b>	S-Video OUT connector
<b>Network</b>	DICOM input/output, twisted pair RJ-45 10/100 megabit/s

### **Patient I/O Module**

*Inputs for the patient I/O are not meant for patient monitoring they are meant for correlation with patient scans only.*

The Patient I/O module allows ECG inputs to be used in conjunction with **patient studies**. **The scanned image that is displayed is synchronized with the ECG and PCG traces. In Doppler or M-Mode, the traces are synchronized** to that particular mode's sweep. The AUX input is capable of handling external ECG signals from other diagnostic ECG devices.

### **User Console**

The Voluson E-Series control console or User Interface(UI) consists of the following electronic sub-assemblies and/or functional components:

#### **Display/Touch screen module:**

- WXGA display - 1280 x 800 pixels
- Integrated USB to converter with USB2.0 High Speed Interface
- Projected capacitive touch screen
- Console module

#### **Seven port USB 2.0 Hub controller:**

- Contols (Encoder/Joycoder) with integrated rotary/push/flip function
- USB Trackball (2") with dedicated buttons to emulate standard three button mouse
- USB standard alphanumeric keyboard
- USB extended keyboard with controller
- LED Indicators with wide range dimming
- LED to illuminate probe port connectors

#### **DC/DC Converter:**

Converts 12VDC input voltage to 5VDC and 3.3VDC output voltages for UI components.

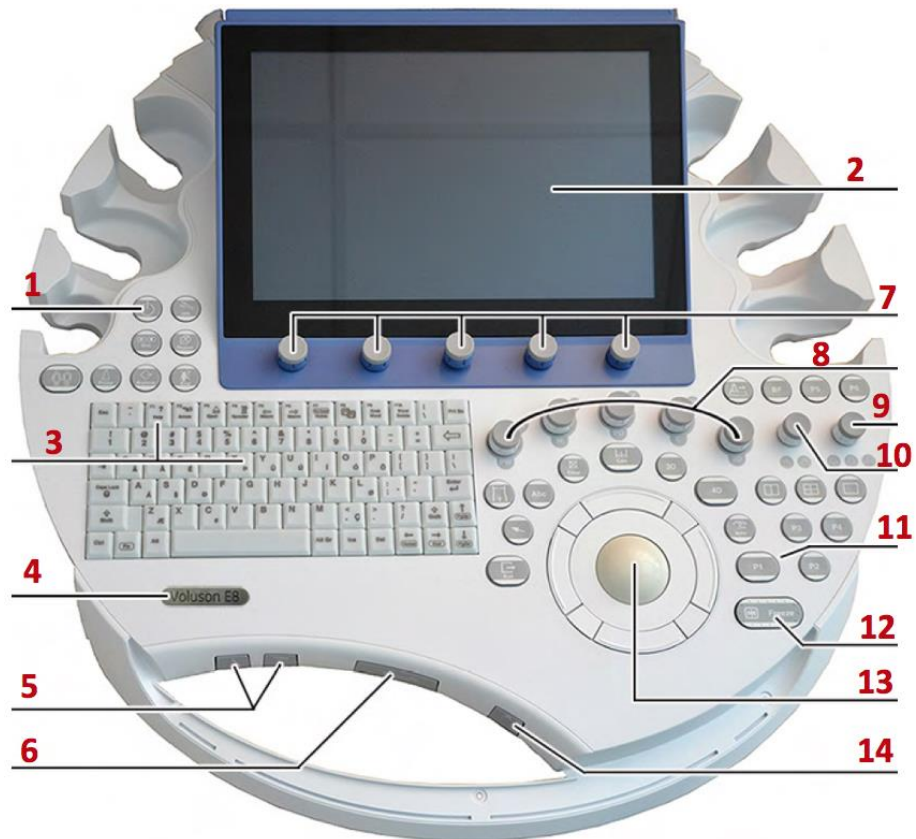


## Control Panel

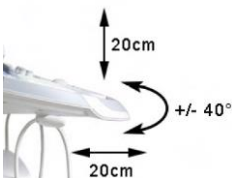
The control panel is the main user interface, receives user inputs, communicates with the system host CPU via Universal Serial Bus (USB) ports and displays various outputs via the touch panel.

It includes the On/Off switch, controls used to manipulate picture quality, and controls used to measure and analyze, an alphanumeric keyboard and ergonomic controls.

1. Power button ON/OFF/Standby
2. Touch Panel screen
3. Alphanumeric keyboard and F1 key (to invoke EUM)
4. Logo
5. Height adjustment control.
6. Console rotation button
7. Touch Panel rotary/push/flip controls
8. Five mode keys on/off (push), Gain (rotate) X,Y,Z rotary controls in 3D/4D Volume Mode
9. Focus Depth (flip), B-Image Angle (rotate), Focus Zones (push)
10. Zoom Box on/off (push), Zoom Size (rotate), B-Image Depth (flip)
11. P-keys
12. Freeze / Run key
13. Trackball and Trackball keys
14. Lamp on/off



## Control Console Positioning



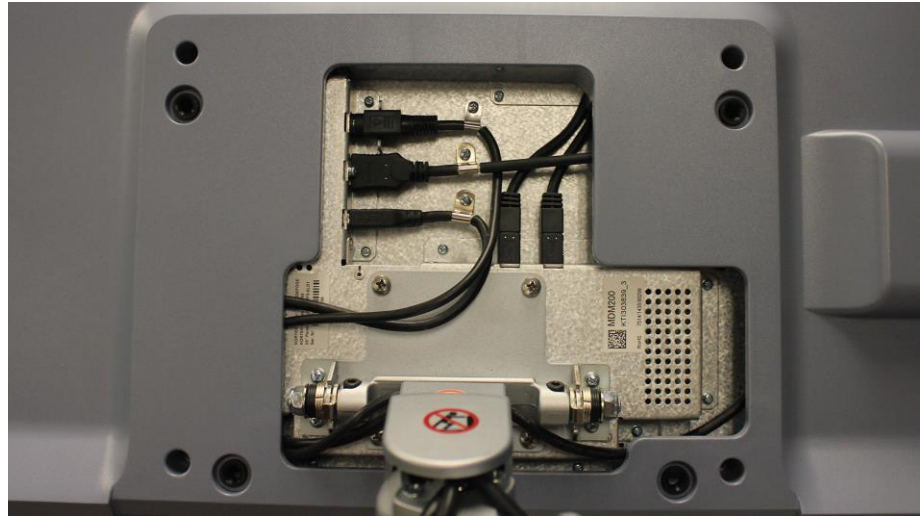
For ergonomic considerations the control console can be rotated, translated and adjusted in height. See [Control Console Positioning](#) in the Adjustments module of this manual.

- Height adjustment: 20 cm (7.9 inch)
- Translation adjustment: 20 cm (7.9 inch)
- Rotation adjustment: +/- 40°

### Video Monitor

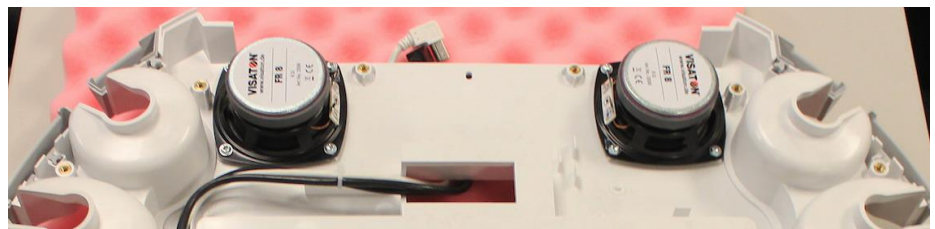
The monitor and it's housing are sold as separate FRUs.

The Voluson E-Series system video monitor displays the ultrasound images on a 23" color LCD.



### Audio

Audio is provided by two 8 Ohm speakers located in the user console on either side of the touch panel.

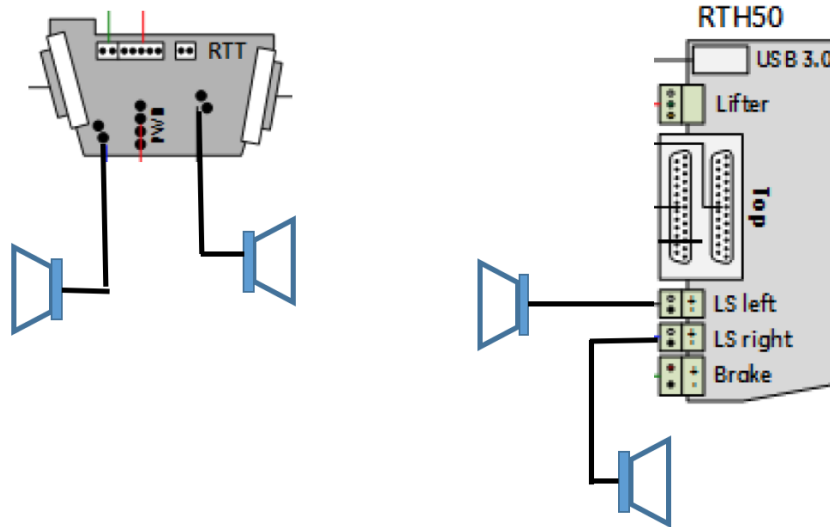




The audio system is used for:

- Audio Doppler operation
- Audio playback of recorded scan sessions
- Audio error notification.

The audio signal is passed to the speakers from either the RTH50 board or the RTT board depending on the version of the system.



## Power Distribution Components

The power distribution components in Voluson E10 systems are described in this section.

### *Main Power Supply (RSP)*

The AC Power's main tasks are to supply the various internal subsystems with AC power and to galvanically isolate the system from the on site Mains Power System. To reduce inrush current, an inrush current limiter is implemented. From the input voltage from the Power Supply (RSP) the AC/DC converter generates all system supply voltages, which include the:

- Front End voltages
- Standby voltages
- ATX motherboard supply
- Tx voltages

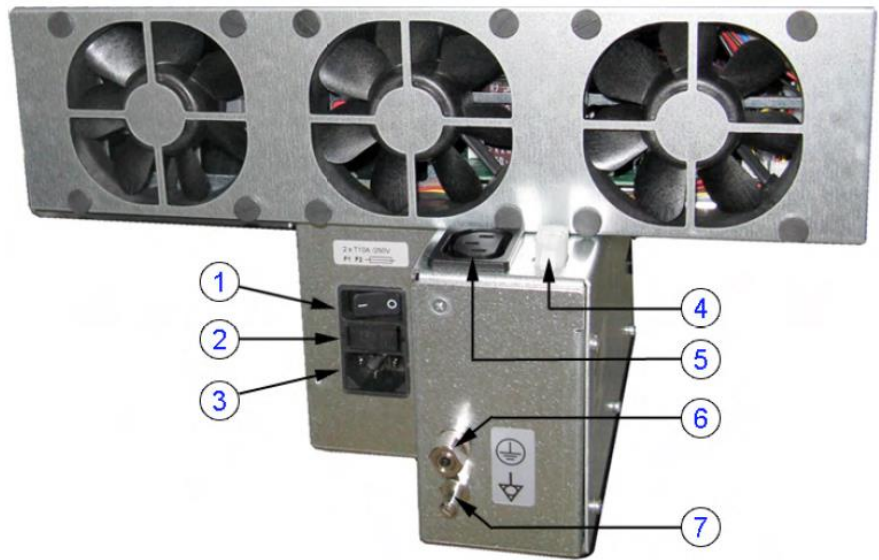
In addition, the AC/DC device contains the digital motor amplifier.

**Input Voltage Range:** 100 - 240VAC; 50/60Hz

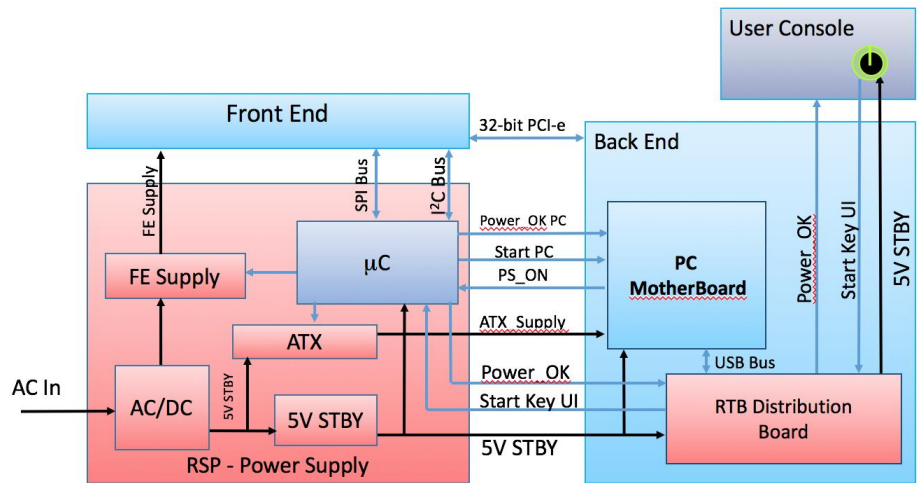
**Auxiliary Output Voltage** nominal 115VAC

All DC-supply voltages for built-in peripherals are also generated in the RSP- Power Supply Module.

- 1 Circuit Breaker
- 2 Fuses (2x T10A H/250V)
- 3 connector for Main Power Cable
- 4 Lift system (12VDC)
- 5 Auxiliary Output
- 6 Protective Earth connection
- 7 Equipotential connection



**Power Supply Block Diagram**



### RTB - Distribution Board Bottom



The following are the functions of the Distribution Board Bottom (RTB):

- USB2.0 Interface, Board is connected to PC via a USB cable.
- 5 port USB2.0 Hub for connecting peripherals (e.g., optional ECG)
- Feed through DC-Power and Signals for the console (12V\_ATX, 5V\_ATX, 5VSB, PWR\_On, Start\_Key, Loud speaker)
- Multiplexer and Amplifier for PC-Sound, Doppler Audio and VCR/DVD-Recorder)

### Normal Power ON / Shut Down Sequence

#### Power On / Boot Up:

*Note After turning off a system, wait at least 10 seconds before turning it on again. The system may not be able to boot if power is recycled too quickly.*

1. Connect the main power cable to the back of the system.
2. If not already done, screw on the pull-out protection of the mains power cable with the two screws.
3. Connect the main power cable to a hospital grade power outlet with the proper rated voltage. Never use an adapter that would defeat the safety ground.
4. Switch ON the circuit breaker at the rear of the system.

1. Circuit Breaker
2. Fuses
3. Outlet Plug



When AC power is applied to the system, the ON/OFF standby button on the control console is amber, indicating that the system is in standby mode.

5. Hold down the ON/OFF standby button (see: Figure 3-3 below) on the control console for ~3 seconds. The system automatically performs an initialization sequence which takes about two minutes and includes the following:

- Loading the operating system.
- Running a quick diagnostic check of the system.
- Detecting connected probes.

**Note** The mains outlet for the system peripheral auxiliary equipment are commonly switched with the ON/OFF standby button. The power switch of any attached printer(s) must be in ON position before starting the system. Some auxiliary equipment may switch itself to standby mode and must therefore be switched on separately.

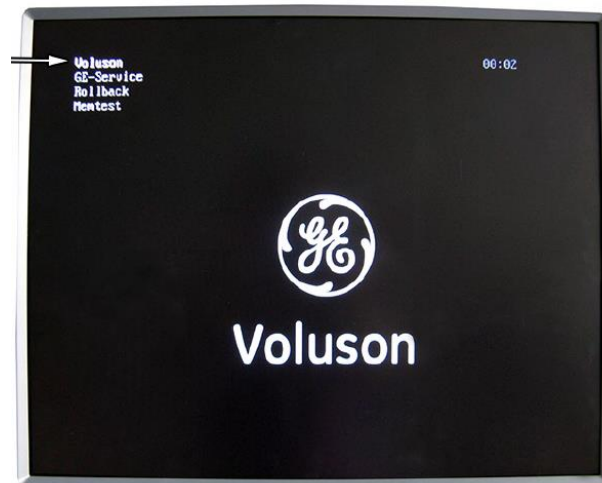
When the ON/OFF standby button on the control console is pressed, the system starts and the operating system is loaded which then leads to activate the application software.

As soon as the software has been loaded, the system enters 2D-Mode with the probe and application that was used before the system shutdown.

### Normal Boot-up Process

1. Power is distributed to peripherals, control console, monitor, FrontEnd and BackEnd processor.
2. The BackEnd processor and rest of the system starts with the sequence listed in following steps:
  - First the BIOS version is shown on the monitor.
  - Afterward the “Boot Screen” is displayed. (Voluson is highlighted).

### Boot screen



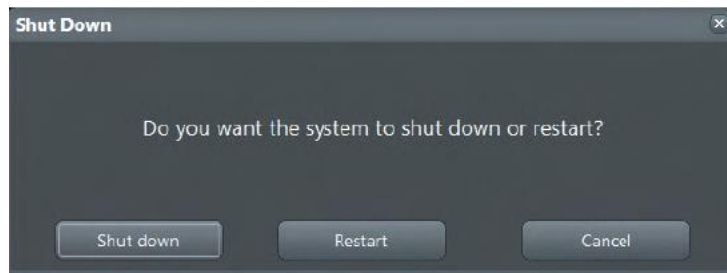
3. Back End processor is turned ON and starts to load the software.
4. The start screen is displayed on the monitor.
5. Start-up progress bars indicating software loading procedures, are displayed on the monitor.
6. The software initiates and sets up the FrontEnd electronics and the rest of the system (incl. clicking sound of relays on RTF board).
7. The keyboard backlight is lit.
8. As soon as the software has been loaded, the 2D screen is displayed on the monitor.

### *Normal Power Off / Shutdown*

To shutdown the system:

*Note After turning off a system, wait at least 10 seconds before turning it on again. The system may not be able to boot if power is recycled too quickly.*

1. If not already in read mode, freeze the image.
2. Press the ON/OFF Standby button on the control console. Following dialog appears:



*A full shutdown is also performed when pressing the ON/OFF standby button on the control console twice.*

3. Select Shutdown. The system performs an automatic full shutdown sequence.
4. Switch OFF the circuit breaker at the rear of the system.

### *Temperature Control*

#### **BTU Info**

The main air inlet is through a single filter at the rear of the Voluson E-Series system:

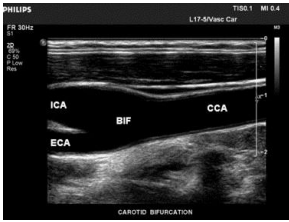
- Air holes in the RSP power supply allow the air to pass through; the three fans inside the RSP pull in the air and circulate it through the beamformer.
- The two backend fans blow air through the GEB-box (along its internal components and the PC- Motherboard). The warm air exits the system through holes in **the left side** panel (Main Air Outlet).
-



## Module 3 Operating Modes

The following general operating modes are available on Voluson E10 systems:

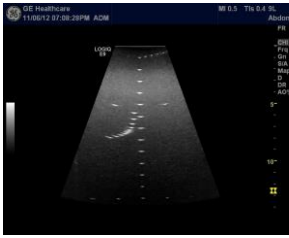
### B-Mode



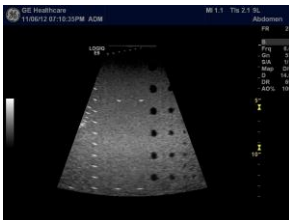
B-Mode is a two-dimensional image of the amplitude of the echo signal. It is used for location and measurement of anatomical structures and for spatial orientation during operation of other modes. In B mode, a two-dimensional cross-section of a three-dimensional soft tissue structure such as the heart is displayed in real time.

Ultrasound echoes of different intensities are mapped to different gray scale or color values in the display. The outline of the 2D (B-Mode) cross-section is a sector, depending on the particular transducer used. B-mode can be used in combination with any other mode.

### Harmonic Imaging

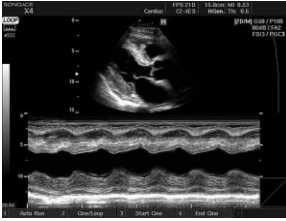


Tissue Harmonic Imaging, acoustic aberrations due to tissue, are minimized by receiving and processing the second harmonic signal that is generated within the insonified tissue. Coded Harmonics enhances near field resolution for improved small parts imaging as well as far field penetration. It diminishes low frequency amplitude noise and improves imaging technically difficult patients.



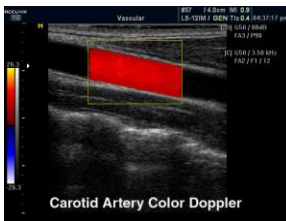
It may be especially beneficial when imaging isoechoic lesions in shallow-depth anatomy in the breast, liver and hard-to-visualize fetal anatomy. Coded Harmonics may improve the B-Mode (2D (B-Mode)) image quality without introducing a contrast agent.

## M-Mode



In M-mode, soft tissue structure is shown as a scrolling display, with depth on the Y-axis and time on the X-axis. It is mostly used for cardiac measurements. M-mode is also known as T-M mode or Time-Motion mode. Ultrasound echoes of different intensities are mapped to different gray scale values in the display. M-mode displays time motion information derived from a stationary beam. M-mode is normally used in conjunction with a 2D (B-Mode) (B-Mode) image for spatial reference.

## Color Flow Doppler Mode



Color Doppler is used to detect motion presented as a two-dimensional display. There are three applications of this technique:

- **Color Flow Mode** - used to visualize blood flow velocity and direction.
- **Power Doppler (Angio)** - used to visualize the spatial distribution of blood.
- **Tissue Velocity Imaging** - The Tissue Color Doppler Imaging is used for color encoded evaluation of heart movements. Tissue Velocity Imaging images provide information about tissue motion direction and velocity.

Blood flow is displayed as a real-time two-dimensional cross-sectional image. The 2D (B-Mode) (B-Mode) cross-section is presented as a full color display, with various colors being used to represent blood flow (velocity, variance, power and/or direction).

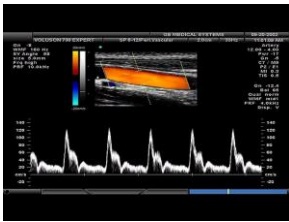
To provide spatial orientation, the full color blood flow crosssection is overlaid on top of the gray scale cross-section of soft tissue structure (2D (B-Mode) (B-Mode) echo). Blood velocity is the primary parameter used to determine the display colors, but power and variance may also be used.

A high pass filter is used to remove the signals from stationary or slowly moving structures. Tissue motion is discriminated from blood flow by assuming that blood is moving faster than the surrounding tissue. Color flow can be used with 2D (B-Mode) (B-Mode) and Spectral Doppler modes.

## Power Doppler

Power Doppler is the same as Color Doppler except that it uses the amplitude of the signal to detect movement. The power in the remaining signal after wall filtering is then averaged over time to present a steady state image of blood flow distribution. It is independent of velocity and direction of flow, so there is no signal aliasing. It is independent of angle allowing the detection of smaller velocities than Color Doppler, making it easier to detect indistinct ischemic areas as well as evaluate tiny low-flow vessels. Power Doppler can be used in combination with 2D (B-Mode) (B-Mode) and Spectral Doppler modes as well as with 4D mode.

## Pulsed (PW) Doppler



PW Doppler processing is one of two spectral Doppler modes, the other being CW Doppler. In spectral Doppler, blood flow is presented as a scrolling display, with flow velocity on the Y-axis and time on the X-axis. The presence of spectral broadening indicates turbulent flow, while the absence of spectral broadening indicates laminar flow. PW Doppler provides real time spectral analysis of pulsed Doppler signals.

PW Doppler can be used alone but is normally used in conjunction with a 2D (B-Mode) (B-Mode) image with an M-line and sample volume marker superimposed on the 2-D image indicating the position of the Doppler sample volume. The sample volume size and location are specified by the operator. Sample volume can be overlaid by a flow direction cursor which is aligned, by the operator, with the direction of flow in the vessel, thus determining the Doppler angle. This allows the spectral display to be calibrated in flow velocity (m/sec.) as well as frequency (Hz). PW PW Doppler can be used in combination with 2D (B-Mode) (B-Mode) and Color Flow modes.

## Continuous Wave (CW) Doppler

*CW Doppler is optional on the Voluson E10 systems.*

Continuous Wave Doppler systems use two crystals, one to send and one to receive the echoes. The transmitter inputs a continuous sinusoidal wave. The receiver detects the shift. An audible sound is created and recorded by either an analog recorder or spectral analyzer. Spectral analysis separates the signal into individual components and assigns a relative importance.

The benefits of CW Doppler include high sensitivity to low velocities and detection of high velocities without aliasing. CW Doppler cannot distinguish between the sending and receiving signals or extraneous echoes, nor does CW Doppler produce a precise image like Pulsed Wave Doppler.

## Other Modes

4D: The E9 Ultrasound System can be used to acquire multiple, sequential 2D (B-Mode) (BMode) images which can be combined to reconstruct a three dimensional image. 4D images are useful in visualizing three-dimensional structures, and in understanding the spatial or temporal relationships between the images in the 2D (B-Mode) (B-Mode) sequence. The 4D image is presented using standard techniques, such as surface or volume rendering.

## Module 4 Network Configuration

The following sections provide some basic biomedical networking background information along with information and procedures specific to the GE Voluson E10 ultrasound systems.

### DICOM

The Digital Imaging and Communications in Medicine (DICOM) is a standard that specifies a consistent file structure for biomedical images and important associated information that must remain associated with the images such as patient name time, date, institution etc. The DICOM specification identifies the elements required to achieve interoperability between medical imaging computer systems.

DICOM addresses these five general application areas:

- Network image management
- Network image interpretation management
- Network print management
- Imaging procedure management
- Off-line storage media management

### Prepare for Network Configuration

You will need to get the facilities network information from the system administrator. You can print out the information needed to configure the system using the [Network Configuration Worksheet](#) appended to the end of this manual.

### GE Dataflows

GE refers to communication between its ultrasound systems and other information providers on the network as “dataflows”. A dataflow is a set of configured settings.

Communication between the Voluson E-Series ultrasound system and other information providers on the network takes the form of data

flows. Each dataflow defines the transfer of patient information from either an input source to the system, or from the system to an output source. The following are the most common examples:

- The local database is used for patient archiving. Images are stored to internal hard drive.
- The local database is used for patient archiving. Afterwards images are stored to a DVD/CD or external USB device, etc.
- A remote database is used for patient archiving. Images are also stored to a remote archive.
- Search in the DICOM Modality Worklist, the patient found is copied into local database. The patient information and the examination results are stored to the local database. Images are stored to a DICOM server and to an image network volume on the local hard drive.

Patient information can include demographic data and images, as well as reports and Measurement and Analysis (M&A) data. A dataflow is a set of pre-configured services. Selecting a dataflow automatically customizes the ultrasound system to work according to the services associated with this dataflow.

By utilizing data flows, the Voluson E-Series ultrasound system is automatically configured to optimally meet the needs of the facility, while keeping the user interface unchanged. Once a dataflow is selected, the actual location of the database is entirely transparent to the user.

## TCP/IP Configuration

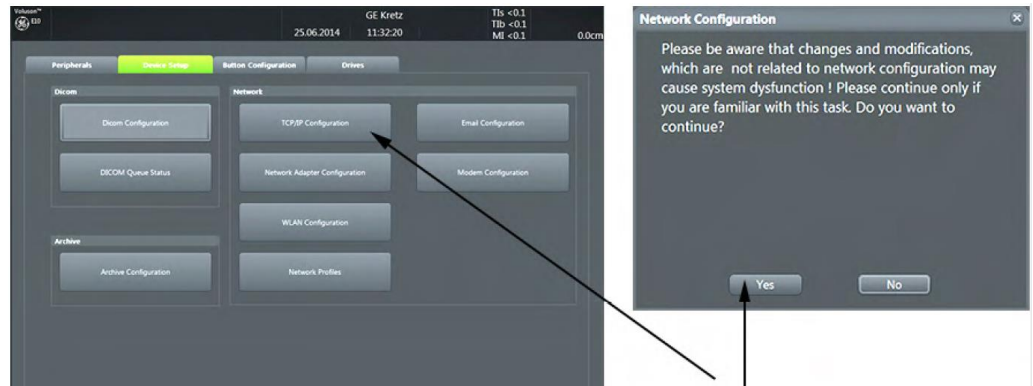
This section describes how to set up TCP/IP Configuration.

**Note** The following information for the Voluson E-Series must be obtained before you can start:

- Station name
- AE Title
- IP address
- Port Number.

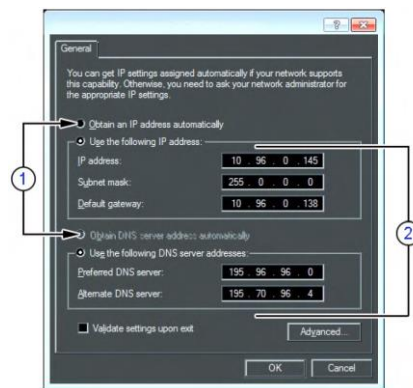
The IP addresses for the default gateway and other routers at the site for ROUTING INFORMATION. Only if necessary (e.g. for Internet access).

1. Press the **Utilities** key on the control console.
2. In the “**Utilities**” menu touch the Setup button to invoke the setup desktop on the screen.
3. On the right side of the screen select Connectivity and then click the **Device Setup** tab.
4. Click the **TCP/IP Configuration** button, read the message and confirm with **Yes**.



5. The “**Internet Protocol (TCP/IP) Properties**” dialog appears:

**Note** This example shows fictional numbers!



The IP and DNS settings can be assigned automatically, if your network supports this capability.

If fixed IP address is required, ask your network administrator for the appropriate settings.

Type in:

- IP address
- Subnet mask
- Default gateway
- DNS server

## WLAN Setup

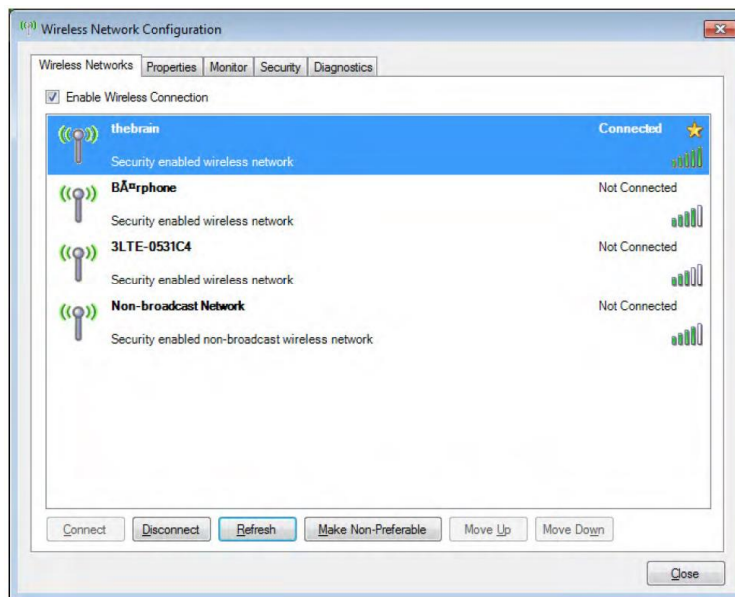
The following sections describe WLAN connectivity and setup.

### Connecting to the WLAN

To connect and set up the WLAN:

**Note** All software drivers are pre-installed for the designated Wireless Network adapter only.

1. Connect the Wireless Network adapter to any accessible USB port.
2. Press the **Utilities** key on the control console.
3. In the “**Utilities**” menu touch the **Setup** button to invoke the setup desktop on the screen.
4. On the right side of the screen select **Connectivity** and then click the **Device Setup** tab.
5. Click the **WLAN Configuration** button.
6. The **Wireless Network Configuration** tool with available **Wireless Networks** appears:



7. Check box "**Enable Wireless Connection**".



Note If the WLAN fails to connect, review and/or recreate the Wireless connection in the Security tab.

8. Highlight the wireless network you want to use and then click **Connect**.

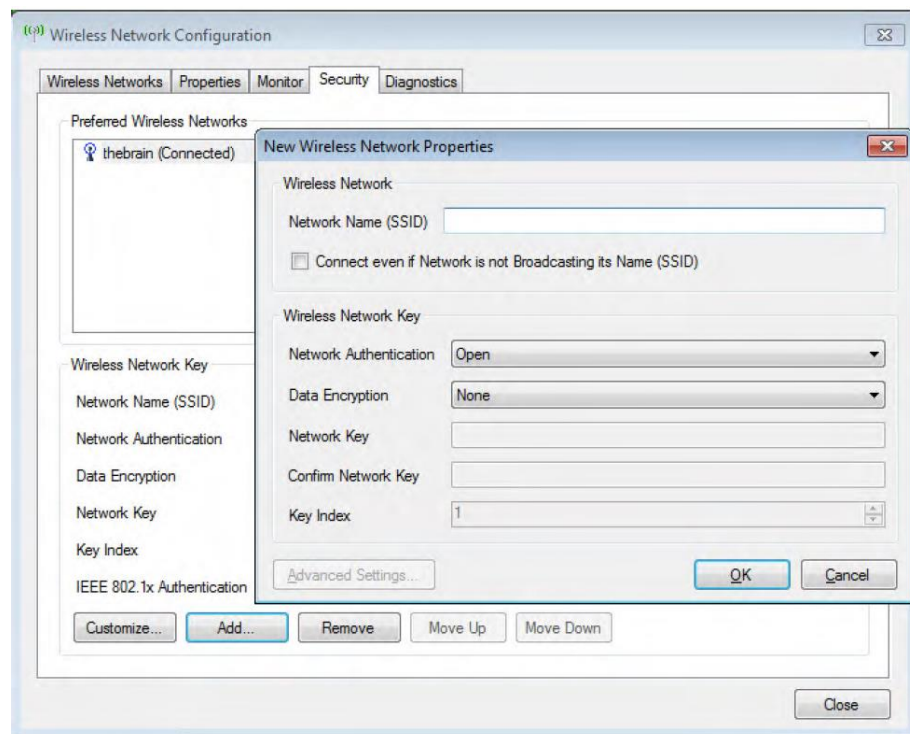
### Disconnecting from the WLAN

1. Press the **Utilities** key on the control console.
2. On the right side of the screen select **Connectivity** and then click the **Device Setup** tab.
3. Click the **WLAN Configuration** button. The **Wireless Network Configuration** tool with available **Wireless Networks** appears.
4. Select the WLAN you are connected to and then click **Disconnect**.

### Adding a WLAN Profile

1. Open the **Wireless Network Configuration** tool.
2. Select the **Security** tab and then click Add.

### Add WLAN Profile:



3. Add the following information to the **Wireless Network Properties** page:

- Network Name (SSID)
- Check box "Connect even if Network is not Broadcasting its Name (SSID)"
- Network Authentication (Open, Shared Key, WPA PSK or WPA2 PSK)
- Data Encryption
- Network Key
- Key Index

4. After you have filled in all the required information, click **OK**.

### ***Refreshing a WLAN Network***

1. Open the **Wireless Network Configuration** tool.
2. Click **Refresh**.

### ***Setting a WLAN Network as Non-Preferable***

When you make a WLAN non-preferable, you disconnect the network from the system and delete all connection settings from the system. Afterwards the system WILL NOT try to reconnect to this WLAN automatically. And if you want to reconnect, you will need to re-add this WLAN.

1. Press the Utilities key on the control console.
2. On the right side of the screen select Connectivity and then click the Device Setup tab.
3. Click the WLAN Configuration button; see Figure 3-52 on page 3-59 .
4. The Wireless Network Configuration tool with available Wireless Networks appear.
5. Highlight the wireless network you want to set as non-preferred.
6. Click Make Non-Preferable and confirm the message box.

### ***Removing a WLAN Profile***

1. Press the Utilities key on the control console.

2. On the right side of the screen select Connectivity and then click the Device Setup tab.
3. Click the WLAN Configuration button; see Figure 3-52 on page 3-59 .
4. The Wireless Network Configuration tool with available Wireless Networks appear.
5. Select the Security tab and then click Remove.

### ***Customizing an existing WLAN Profile***

1. Press the Utilities key on the control console.
2. On the right side of the screen select Connectivity and then click the Device Setup tab.
3. Click the WLAN Configuration button; see Figure 3-52 on page 3-59 .
4. The Wireless Network Configuration tool with available Wireless Networks appear.
5. Select the Security tab and then click Customize.

Figure 3-56 Security - Customize

6. Customize the following information:
  - Network Name (SSID)
  - Check box "Connect even if Network is not Broadcasting its Name (SSID)"
  - Network Authentication (Open, Shared Key, WPA PSK or WPA2 PSK)
  - Data Encryption
  - Network Key
  - Key Index
7. After you have filled in all the required information, click OK.

## Setup Instructions

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### **Available WLAN Channels**

The available WLAN channels show availability of wireless connect point that the system can talk to. Each channel supports a finite number of users and has limited signal strength. This may effect the ability to connect, the throughput and the connection dropping out.

1. Press the Utilities key on the control console.
2. On the right side of the screen select Connectivity and then click the Device Setup tab.
3. Click the WLAN Configuration button; see Figure 3-52 on page 3-59 .
4. The Wireless Network Configuration tool with available Wireless Networks appear.
5. Select the Properties tab.

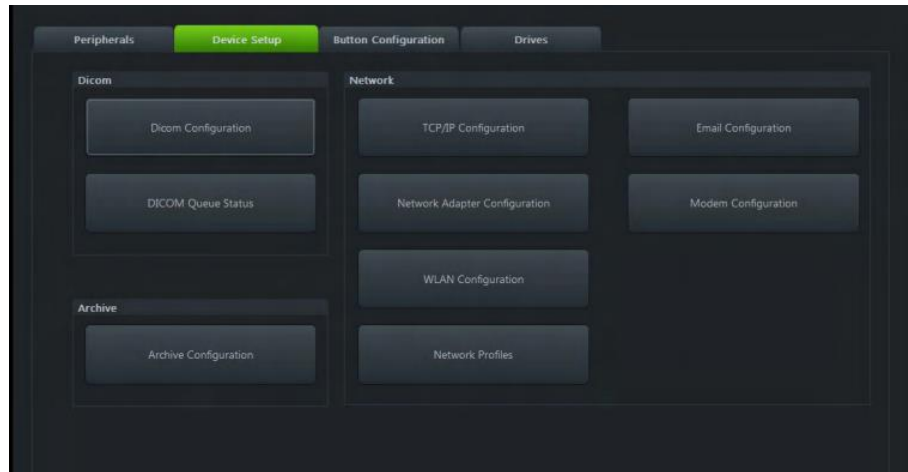
Figure 3-57 Properties

6. Click Available Channels.

### **DICOM Device Setup**

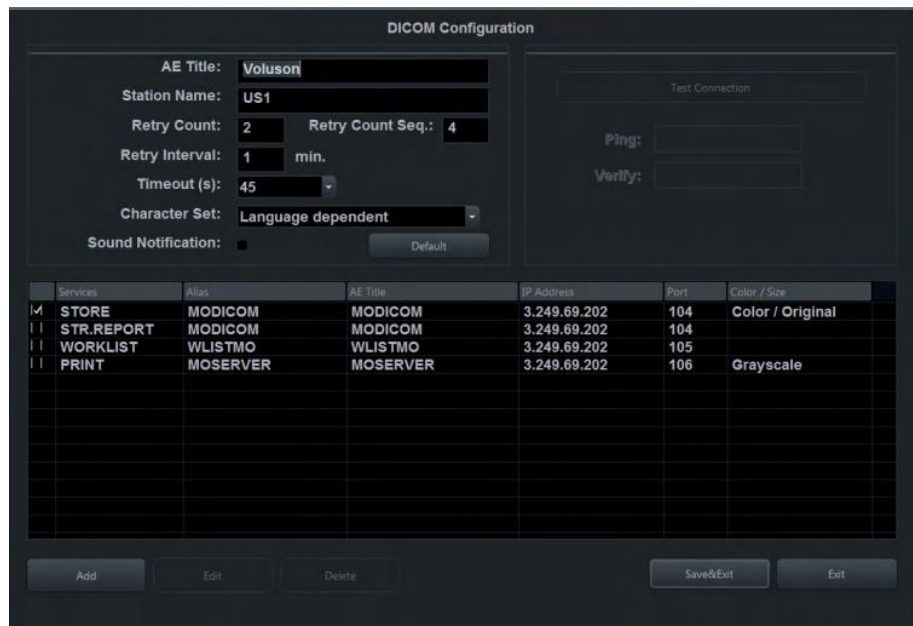
From the Device Setup screen it is possible to configure:

- DICOM
- Archive
- Network



## DICOM Configuration

The dialog section is where you set up details of all of your DICOM target nodes (image servers).



## Controls

**AE Title** - Enter the AE (Application Entity) Title under which your DICOM application is known to other DICOM applications (required). Obtain the correct AE Title from contact your DICOM network administrator.

**Station Name** - Enter the name of the hospital or institute.

**Retry Count** - Number of retries to establish a successful DICOM

connection.

**Retry Count Seq.** - Retry count for sequential mode (only valid if **Send sequ.** is checked). If the end number of Retry Count Seq. is reached and sending was not successful then the “problem” data set is marked as “failed” in the spooler and the system continues sending the next image data

**Retry Interval** - Retry interval minutes.

**Timeout (s)** - Define a timeout interval.

Default - Default values of **Retry Count, Retry Count Seq., Retry Interval, Timeout (s)** are set.

**Test Connection** - If a destination from the **Destination** List is selected and the **Test Connection** button is pressed, the connection to the selected destination is tested. If no destination is selected the button is disabled.

**Ping:** Ping the selected destination and check the response. The result can be OK or Failed

**Verify:** Send DICOM commands and check the response. The result can be **OK** or **Failed**.

If a serial report destination is selected, the **Test Connection** button changes to **Send Test Report** and the **Ping** and **Verify** fields disappear. A test report is sent to the serial port instead of testing the network connection.

**Sound Notification** - Acoustic signal for a successful or unsuccessful transfer (sending Images, Structured Report Transfer and Report).

**Destination List** - Contains all available destinations and displays:

- **Services**
- **Alias**
- **AE Title**
- **IP Address**
- **Port**
- **Color / Size**

In the checkboxes next to the destination, mark the currently

activated server. If more than one Service is added, then a selection of one Service can be done with the checkbox.

To check the same Services is not possible for:

- **Print**
- **MPPS**
- **STR. Report**
- **Query Retrieve**
- **Worklist**

When more than one **STORE**, **STORE3D** or **STORAGE COMMIT** service is activated, images are sent to all selected **STORE** or **STORE3D** destinations and committed with the corresponding **STORAGE COMMIT** destinations.

**Add** - Pressing the **Add** button opens the **Device Setup** dialog, where it is possible to add DICOM destinations. For more information see ['Adding a Service'](#).

*The **Edit** button is disabled if no destination is selected.*

**Edit** - Selecting a destination from the **Destination List** and pressing the **Edit** button opens the **Device Setup** dialog, with the information on the selected destination.

*The **Delete** button is disabled if no destination is selected.*

**Delete** - Selecting a destination from the **Destination List** and pressing **Delete** removes the selected destination. The **Delete** button is disabled if no destination is selected.

**Save&Exit** - When the **Save&Exit** button is pressed, the **DICOM Configuration** dialog is closed and all changes are saved.

**Exit** - When the **Exit** button is pressed, the **DICOM Configuration** dialog is closed and all changes are discarded.

***Note:** In Edit mode it is not possible to change the selected Service.*

### *Adding a Service*

Select a Service and enter the destination settings (**Alias**, **AE Title**, **IP Address** and **Port**).

### **Services**

The following services are available:

Further information regarding each service is provided in the following sections.

- **STORE:** Send screen images, 2D cine sequences and 3D/4D data to a DICOM server (e.g., Viewpoint).
- **STORE3D:** Send 3D/4D data only (volumes and cine sequences) to a different store server (e.g., PC with Software 4D View® installed) than screen images and 2D cine sequences.
- **PRINT:** Send images stored in printer clipboard to a DICOM printer.
- **MPPS:** Send images to a DICOM server with transfer information.
- **ST.COMMIT:** Send image with an additional layer of security.
- **STR.REPORT:** Send a structured report.
- **QUERY RETRIEVE:** Query images or other DICOM objects and Retrieve them from a PACS or other DICOM Modality.
- **WORKLIST:** Retrieve Patient Information (Name, ID, Birth,...) from an external Worklist server (e.g., HIS - Hospital Information System / RIS, Viewpoint).
- **REPORT:** Send the Patient report data to a PC via network or serial port.

**Alias** - Enter a name for the DICOM node to make it easier to handle various nodes. Use any name, but do not insert space characters.

**AE Title** - Enter the AE (Application Entity) Title under which your DICOM application is known to other DICOM applications (required). For setting the correct AE Title please contact your DICOM network administrator.

**IP Address** - Enter the host name or IP Address of the DICOM node.

**Port** - Enter the port number of the DICOM node.



## STORE / STORE3D Screen

### Note:

2D JPEG Quality is only active when **2D Compression** is set to JPEG.

Cine JPEG Quality is only active when **Cine Compression** is set to JPEG.

Volume Compr. Quality is only active when **Volume Compr.** is set to lossy.

The screenshot shows the DICOM Configuration interface with the following settings:

- Services: STORE
- IP Address: 3.249.69.202
- Alias: MODICOM
- Port: 104
- Send sequ. (checked)
- AE Title: MODICOM
- Storage Commit: (empty)
- Color: Color
- Image Size: Original
- 2D Compression: None
- 2D JPEG Quality: high
- Cine Compression: JPEG
- Cine JPEG Quality: high
- Volume Compr.: None
- Volume Compr. Quality: high
- Send Image as: Image
- Send 2D Cine as: Multiframe
- Send 3D Volume as: Image
- Send 4D Cine as: Multiframe
- DICOM Image Type: default
- Multiframe: FPS Limit: Unlimited
- Send Measurements as: ---
- Include Scan Assistant Data: no

Buttons at the bottom: 4D View default, DICOM Station default, ViewPoint Default, Save&Exit, Exit.

If **Send sequ.** is checked and the **Scan Assistant** is activated:

- The sequentially “send order” of the images (first, second ...) is derived from the check item order as configured in the setup page (first item, second item ...).
- If more than one image is available on a check item the send order is defined by the store date (first stored, second stored and so on...).
- If more than one checklist is available: order as configured in the setup page.
- If more than one checklist group is available: order as configured in the setup page.
- Images stored without check item: send order: date, after the checklist items.
- If the Scan Assistant is deactivated it causes all data to be sent to this server sequentially. This means that only one transfer is active to this server at a time. *If one transfer fails, all subsequent transfers are stopped until the failed transfer succeeds or is removed from the queue.*

*Use for servers that cannot handle multiple associations, or do not sort the images by Image Number.*

Use for servers that have none of the limitations listed in the above paragraph.

- If **Send sequ.** is not checked, up to 5 data sets can be transferred at the same time. This means that transfer is faster. Images can arrive out of order in this case.

**Storage Commit** - The Storage Commit drop down list contains all currently added Storage Commit servers. The selected Storage Commit server is used for committing the images sent to this store server.

**4D View default** - Loads the default settings for 4D View®. The destination information must be entered manually.

**DICOM Station default** - Loads the default settings for DICOM Station. The destination information must be entered manually.

**Viewpoint default** - Loads the default settings for Viewpoint.

If the volume contains color information, the color part of the volume is compressed with a setting that is 5 points better than the selected setting, e.g. Setting Mid: color compression High, grey compression Mid

**Caution:** A lossy compression can reduce image quality which can lead to a false diagnosis!

If an image / multiframe cine is compressed using lossy JPEG compression, a yellow sign (Jxx; xx = compression factor, e.g. JH) is added to the image (but not to secondary capture images).

If a volume is compressed using lossy, a yellow sign (Wxx; xx = compression factor, e.g. W9) is added when reloading the image.

## MPPS

The Modality Performed Procedure Step MPPS allows you to select the **Store Server** and the **SR Server**.

Only the images sent to the selected **Store Server** are added to the image list of the MPPS completed (or discontinued) message.

**Note** When the MPPS server is created and selected, MPPS messages are created when an exam is started or ended.

## ST.COMMIT

Add a Storage Commit Server. These servers can then be selected in the drop down list of the **STORE-**, **STORE3D-** and **STR.REPORT** - Service.

## STR.REPORT

With the DICOM Structured Report it is possible to send OB, GYN, Vascular and Cardio data.

**Storage Commit** The Storage Commit drop down list contains all currently added Storage Commit servers. The selected Storage Commit server is used for committing the images sent to this store server.

**Combine OB & GYN** If the checkbox is enabled, the system sends the OB- and GYN - data into one file. If not enabled the files will be sent individually.

**Include Scan Assistant Data** Select yes or no (default) from the drop down menu.

**Viewpoint default** Loads the default settings for Viewpoint.

## QUERY RETRIEVE

Select the **Default Appl.** from the drop down menu.

The drop down menu contains exam applications available in patient dialog (Abdomen, OB, GYN, Cardio, Uro, Vascular, Neuro, Small Parts, Pediatric, Ortho). The selected exam application is used for all exams that are imported into the local archive from a remote query/retrieve server.

## WORKLIST

**Private Tags** Determines whether the private tags defined for communication with the Viewpoint - worklist are used when querying the worklist.

**Modality** Select either All or ULTRASOUND. No selection is also possible and defaults to "all".

### Add local data

*(Fields that are available in the worklist are taken from the worklist, fields that are only available in the data base are taken from the local data base.)*

- **yes:** Locally stored patient data and patient data from the worklist are merged.
- **no:** Data only contained in the worklist is used to populate the patient data fields. No locally stored data is used.
- **ask:** A dialog is shown whenever there is data from the worklist and from the local database available. Depending on the selection in the dialog, either the action described under yes or no is executed.

*Note Private Tags only work if the other system also supports Private Tags.*

## **REPORT**

**Note** *The bit rate (Bits per second) must be the same as on the receiving PC report station.*

**Viewpoint default** Loads the default settings for Viewpoint.

Select one of the following Transfer Modes.

- **Network:** Send the patient report to a PC report station via DICOM network.
- **Serial:** Send the patient report to a PC report station that is connected by serial port. The optional “PRY USB-RS232 Connection kit” must be connected to the system.

When this Transfer Mode is selected, different fields are available: COM Port, Flow control and Bits per second.

## Module 5 Preventive Maintenance

Preventive maintenance procedures are very important in a clinical setting. Be sure to follow the health care facilities documentation procedures.

### System Backup

System backup is very important. Backup the system anytime you are in front of it! Your backup is not complete without printouts!

*To minimize accidental loss of data, perform backup of the patient archive stored on the local hard drive at least once a week.*

The **Backup/Restore** function enables the user to:

- Copy/Restore the system configuration. System Configuration has two options:
  1. Small Backup (Scan Settings)
  2. Full System Configuration
- Copy/Restore the patient archive.

### Backup/Restore Database, Presets and Images

To access backup/restore:

*Note It is highly recommended to Backup the Full System Configuration and the Image Archive at least once a week.*

1. Press the **Utilities** key on the control console.
2. In the “Utilities” menu touch the **Setup** button to invoke the setup desktop on the screen.
3. On the right side of the screen select Backup and then click the **System Configuration** tab.

### Backup - SYSTEM CONFIGURATION



Settings and/or Full System Configuration can be saved to the following destinations:

- D: partition of internal hard disk
- DVD/CD+R/RW
- Mapped Network Drive.
- Any other drive connected to the system (e.g.; USB-Stick or external hard disk drive).

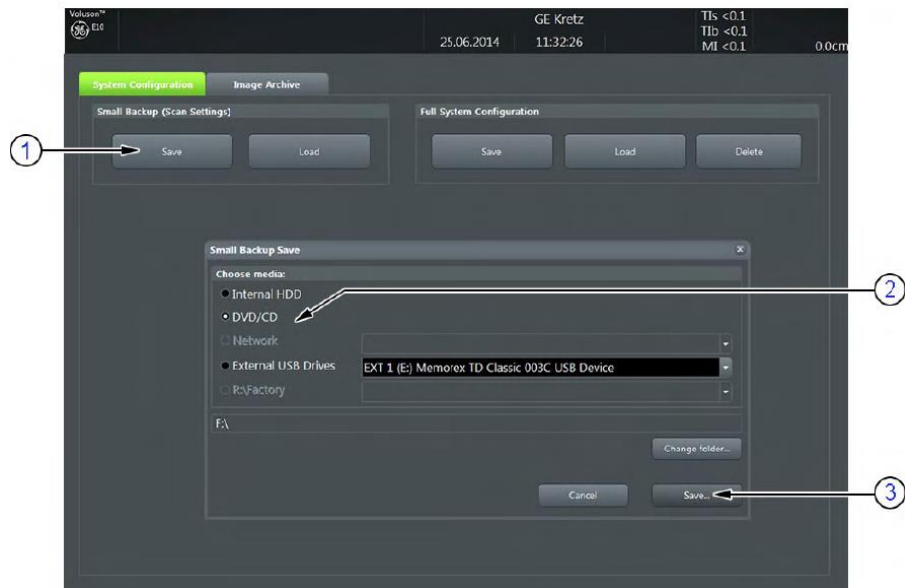
### **Save Small Backup (Scan Settings)**

The Image/Scan Settings contain:

- Application Settings
- 2D Factory and 2D User Presets
- 3D/4D Factory and 3D/4D User Presets
- Annotation Presets
- Scan Assistant Configuration
- Measure Configuration
- Biopsy Lines

To create a Small Backup:

- Insert a DVD/CD+R/RW into the drive or connect an external USB device.
- Press the **Utilities** key on the control console.
- In the “**Utilities**” menu touch the **Setup** button to invoke the setup desktop on the screen.
- On the right side of the screen select **Backup** and then click the **System Configuration** tab.
- Click the **Save** button (1) of the "**Small Backup** (Scan Settings)" group.



6. Select the desired **media** (2) and click **the Save** button (3).

7. Select the **New File...** key and enter a file name (without extension).

8. Click the **OK** key to start the process. When the saving has been completed, click **OK**.

### Load Backups

*The loading procedure overwrites existing image/scan settings on the local hard drive.*

Make sure to insert the correct System DVD. Additionally you can load the image settings from "D:\usersettings".

1. Insert a DVD/CD+R/RW into the drive or connect an external USB device.

2. Press the **Utilities** key on the control console.

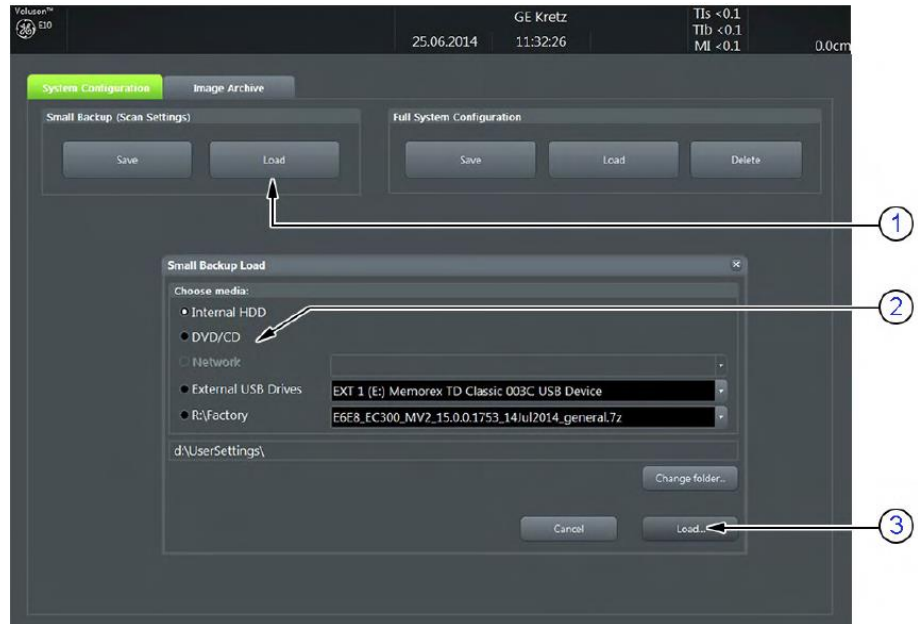
3. In the "**Utilities**" menu touch the **Setup** button to invoke the setup desktop on the screen.

4. On the right side of the screen select **Backup** and then click the **System Configuration** tab.

#### Load Small Backup (Scan Settings)

5. Click the Load button (1) of the "**Small Backup** (Scan Settings)"

group:

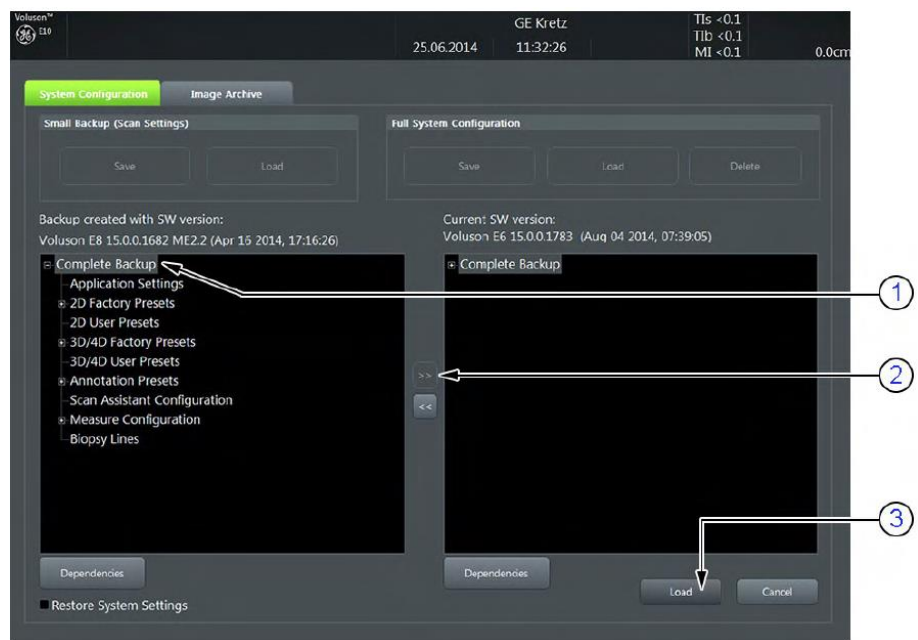


6. Choose the media (2) and click the **Load** button (3).

*Note If it is desired to load settings from media Internal HDD, click on the Change folder button, browse for the folder on "D:\usersettings" and then click the Load button.*

7. Select the appropriate file and click **OK**.

8. Select the desired loading procedure: **Complete Backup** or Click the **[+]** sign next to "Complete Backup" (1) to open the content tree:





**Note** To return selected items from the “Load Data” field to “Backup Data” field select the [←] button

3. Click the [+] sign and copy the desired content by clicking the [→] button; and so on ....

4. Confirm selection with the Load button (3).

Settings will be loaded and the ultrasound system Application Software will restart.

### **Backup Full System Configuration (Full Backup)**

*Note It is recommended to “Full Backup” system configuration data before upgrading the software and/or image settings (presets). This ensures that if settings need to be reloaded, will be the same ones the customer was using prior to service.*

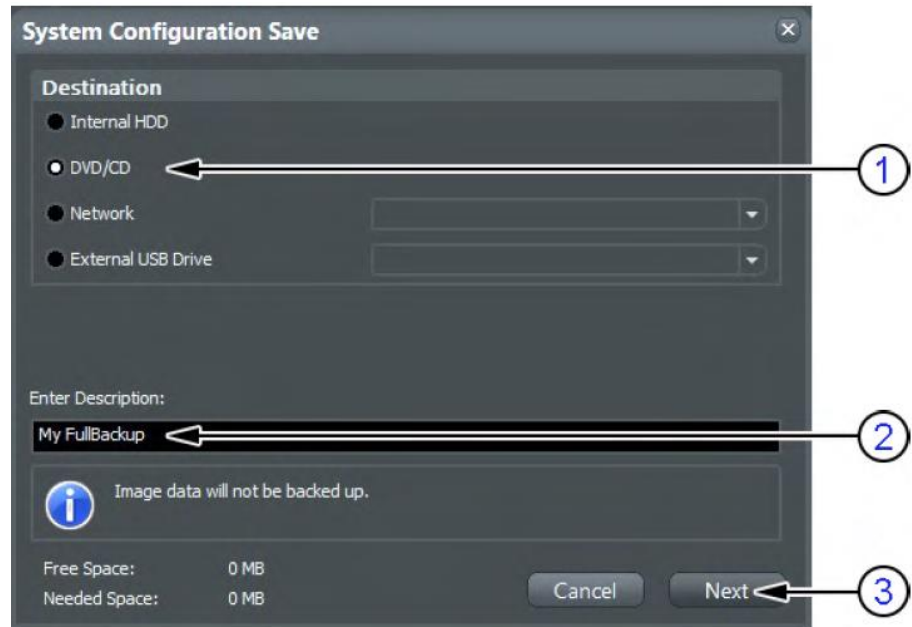
A backup of the Full System Configuration contains the following data:

- User Settings (databases and files containing User Programs, 2D/3D/4D Presets, gray curves etc.)
- System Settings (general "Setup" settings such as Language, Time/Date format, Button configuration, Annotation settings, Biopsy lines, Peripheral data, Video Norm, Archive configuration, etc.)
- Measure Configuration (user specific measure setup settings)
- Patient Archive (database containing patient demographic exam data and measurements) - no images
- V830 Settings (Options resp. Permanent Key that is specific for enabled software options and Demo Key)
- Image Transfer Configuration (DICOM configuration e.g., DICOM servers, AE Title, Station Name, etc.)
- Network Configuration (Network settings: IP address, Network Profiles, e-mail configuration, network printer, network drives, computer name)
- Service Platform (state of the Service Software)

To perform a full backup:

1. Press the **Utilities** key on the control console.
2. In the “**Utilities**” menu touch the **Setup** button to invoke the setup desktop on the screen.

3. On the right side of the screen select **Backup** and then click the **System Configuration** tab.
4. Click the **Save** button of the "**Full System Configuration**" group.
5. Choose the destination (1).



6. Enter the description of the Full Backup (2).

Note Image **data will not be backed up!** To backup the Image Archive, refer to [Section 4.4.6](#) on page 4-20 .

7. Click the **Next** button (3).

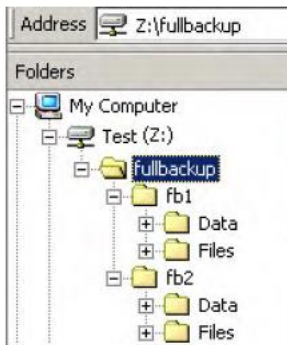
8. To start the backup process click **Yes**.

After copying the data, the Voluson E-Series reboots and the application starts again.

When the "Full Backup" is saved on a network drive it may be desirable to **move the data (e.g., for backup or maintenance)**. To map a network drive see [Section 3.13.7](#) on page 3-70 .

**The backups reside in sub folders of the main "fullbackup" -folder found at the root of the drive.** For Example: Backups on the mapped Network Drive are below path Z:\fullbackup.

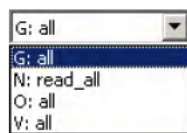
The directory structure of the full backup data is as follows:



The sub folders have the names fbX where X is a number (e.g., Z:\fullbackup\fb1).

The data resides within a directory structure within these sub folders. It is possible to move the fbX sub folders, even leaving gaps in the numeration sequence.

However, NO change MUST be made to the contents of the fbX folders itself, otherwise the backup data cannot be restored!



If the destination “**Other drive**” is selected, the available drives (e.g., external USB-memory stick) can be chosen from the pull-down menu.

When the backup is saved to an external USB-device, the system has to be informed about the removal of the hardware.



This is why every "Full Backup Save" and "Full Backup Delete" dialog has a **Stop USB Devices** button.

## External USB-Devices

USB sticks should not have any auto install software on it. Always erase any software from the device first by formatting it on a desktop PC prior to using it unless you are absolutely certain that the device is completely blank.

**Note** When connecting external USB devices, be sure to execute Safety Directions found in the Voluson E-Series Basic User Manual.

**Note** If an external drive was not recognized automatically after connecting it, click Rescan Drive.

**Caution:** Unplugging or ejecting USB devices without first stopping them can cause the system to crash and possibly result in loss of important data!!!

## Connect USB and Network Drives

When an external USB-storage device (such as an USB-memory stick or an external hard disk) is connected to the Voluson E-Series, the operating system detects the device and automatically installs a driver. During this process, several dialogs may pop up, starting with the “**Found New Hardware**” dialog box.

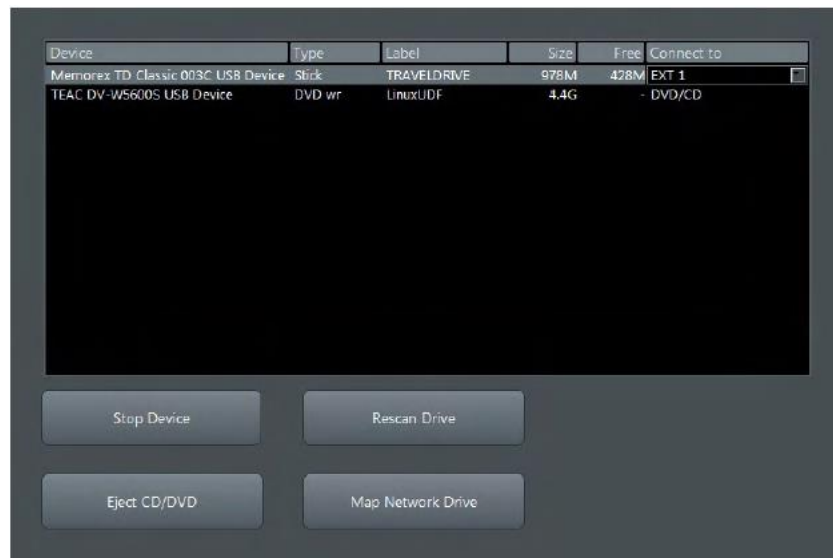
The device is then accessible using the drive letter the system assigned to it.

### Disconnection of External USB-Devices

Before an external USB-device such as a memory stick can be disconnected, the system has to be prepared the removal of the device!

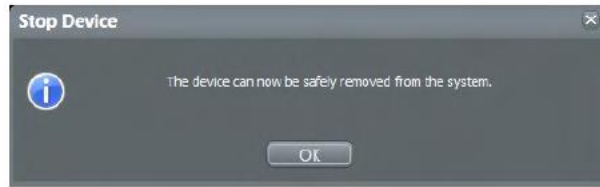
Before removing any device, you must press the **Eject** key on the keyboard.

When you press the **Eject** key on the keyboard, the following dialog window will be displayed:



The “**Connect USB and Network Drives**” window shows all USB and Network drives that are connected to the system. Use this dialog, to stop the USB-devices before they are physically disconnected.

To stop the external device, select it and then click the **Stop Device** button.



Confirm the "Stop Device" dialog with **OK** and Close the "**Connect USB and Network Drives**" window. The device can now be safely removed.

## Cleaning the Air Filters



Clean the system's air filter to ensure that a clogged filter does not cause the system to overheat and reduce system performance and reliability. GE recommends the filters be cleaned quarterly.

To remove the air filter reach behind the back handle and lift the filter upwards. To clean it use a vacuum and replace.

## Cleaning the Trackball

The optical trackball of the more

## Motherboard Battery



The motherboard battery should be tested as a part of normal maintenance. A CR2032 lithium coin battery (3V) is recommended by GE for replacement.

## Module 6 General Safety Precautions

This section is not intended to be an all-inclusive safety procedure guide. It is only brief overview of best practices that applies to all health care facilities and types of medical equipment. You should be familiar with the policies and procedures of the facility where you work AND the safety precautions and procedures described in the manufacturer's documentation for a particular OEM.

### *Electrical Safety*

The system is a Class I medical device with Type BF and Type CF isolated patient-applied parts. Only CF isolated transducers can be used for invasive (internal) exams.

The following are warnings recommended by the manufacturer:

- Grounding prevents shock hazards. The chassis is grounded with a three wire plug and cable which must be plugged into a grounded outlet.
- Never connect the system using a power strip or extension cord.
- The ultrasound system should never be connected to the same circuit as life-support devices.
- All devices that have patient contact: transducers, ECG leads and pencil probes that are not specifically labeled as defibrillation proof must be removed from contact with the patient before defibrillation.
- Non-medical peripherals such as printers should not be used within 1.5 meters (5ft) of a patient unless the device is powered with an isolated outlet on the back of the system or an isolated transformer that meets medical safety standards; IEC 60601-1.
- Wrist straps should not be worn when working on a system when the power turned on. The +5 Vdc supply is a very-high current supply. Use caution when troubleshooting.

### ***Electromagnetic Interference***

Electromagnetic Interference (EMI) between wireless electronic transmitting devices and medical equipment can cause degradation of the ultrasound image. The system is in compliance with existing EMI/EMC requirements. However, the use of this system in proximity of an electromagnetic field can cause degradation of the ultrasound image at times. Review the environment in which the system is being used, to identify possible sources of radiated emissions. Sources of these emissions can be from electrical devices used in the same or adjacent room. Communication devices that transmit or receive RF signals; cellular phones, pagers, radio, TV, or microwave transmission equipment located nearby can cause these emissions. If EMI from an outside source is causing disturbances, you may need to relocate your system. Electrosurgical units (ESUs), MRI's and many other medical devices introduce radio frequency (RF) electromagnetic fields to the environment. Because ultrasound imaging frequencies are in the RF range, ultrasound transducer circuits are also susceptible to RF interference. For example, the noise generated by an ESU in use can easily impair or eliminate the ultrasound's ability to capture an image. Some measures to reduce the chance of EMI interference include:

- Three-meter rule – no powered on cell phones, or pagers within three meters of the system while in operation.
- Locate the system away from other imaging equipment such as MRI's that produce strong electromagnetic fields.

### ***Electrostatic Discharge ESD Precautions***

Electrostatic discharge (ESD), commonly referred to as a static shock, is a naturally occurring phenomenon. Electrical charges naturally build up on individuals and can create static shocks. The human body can build up a charge as high as 25,000 volts, therefore a discharge from a system user or patient to the ultrasound system can cause damage to the system or transducers. Digital ICs are particularly vulnerable. Low humidity is a condition that favors the build-up of electrostatic charge.

The following are the most common causes of ESD:

- Moving equipment
- Moving people

- Low humidity (hot and dry conditions)
- Improper grounding
- Unshielded cables
- Poor connections

Use the following precautions in order to reduce ESD:

- Wrist straps
- Antistatic mats
- Antistatic spray on carpets or linoleum

Before handling a board or you can touch a grounded surface such as the power supply housing to discharge any built-up charge.

### **Fire Safety**

The following general fire safety practices are relevant for all electrical equipment:

- If there is any evidence of smoke or fire disconnect system power immediately.
- On electrical or chemical fires use only extinguishers that are specified for this use. Using water or other liquids is very dangerous and can lead to injury.

### **General Cautions**

The following are general cautions that apply to all ultrasound systems:

- Batteries must be handled as hazardous waste. Check that the cases are intact and the terminals are clean. Follow your facilities procedures regarding disposal should they become damaged.
- If the system has been stored below 10°C allow it to reach room temperature before connecting or turning on to prevent damaged caused by internal condensation.
- System transducers cannot be cleaned/decontaminated by any sort of heat process. Refer to manufacturer's specifications and hospital procedures for the particular transducer.



## Module 7 Troubleshooting

This module covers common troubleshooting tools and procedures for the Voluson E10 systems.

### Normal Power On/Boot Sequence

**Note:** *a probe should be connected to the system or the system will boot up in **no mode**.*

**Note:** *Do not cycle the circuit breaker ON-OFF-ON in less than five seconds. When turning the circuit breaker off you must wait until the ON/OFF button is no longer lit. The system should be completely de-energized before turning the circuit breaker ON again.*

**Note:** *The E9 functions on voltages from 100-240V and 50 or 60Hz. If using 220 V power, a center tapped power source is required.*

The following describes the normal power on/boot sequence for the Voluson E10 systems

The system has two power switches:

- The **Circuit Breaker Switch** is located on the back of the system next to the power cord plug-in. This allows to the system power supply to power up but does not turn on the system itself.
- The **On/Off button** is located on the user control panel at the front of the system. This switch initiates system Bootup.

### Connect AC (mains) Power to the Vivid E9/Logiq E9

Before connecting AC Power to the ultrasound unit you should perform the following preliminary checks of the power cord, voltage levels and compliance with electrical safety requirements.

- Ensure that the wall outlet is of appropriate type, and that the Mains Circuit Breaker is turned off.
- Verify that the power cable is without any visible scratches or any sign of damage.
- Verify that the on-site mains voltage is within the limits indicated on the rating label near the circuit breaker on the rear of the unit.
- Connect the Power Cable's to the power Inlet at the rear of the unit and lock the plug into position with the ACC Clamp.

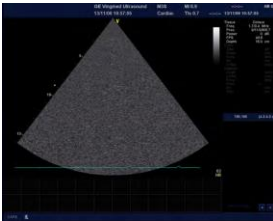
## Turn System ON

Switch ON the Mains power circuit breaker at the rear of the unit. The control panel ON/OFF button should become amber. You should also hear a “click” sound from the relays in the AC Power supply and the unit is ready to boot. The ON/OFF button will remain amber.

Press once on the ON/OFF button on the Operator Panel to boot the unit. The ON/OFF button turns green when it is pressed.

During a normal boot sequence, you will notice that:

- The unit’s ventilation fan starts on full speed, but slows down after a few seconds.
- Power is distributed to the peripherals, Operator Panel (Console), Monitor, FEP and BEP.
- Back end processor is turned ON and begins to load the software.
- The **Start Screen** displays on the monitor.
- A start-up bar indicating the time used for software loading, is displayed on the monitor.
- The software initiates and sets up the front end electronics.
- The backlight in the keyboard is lit.
- When the software load is complete the **2D** screen is displayed on the screen, as long as a probe has been connected, or a **No Mode** screen is displayed, indicating that no probe has been connected.



**2D Screen**

*Sleep mode is not a substitute for a regular shutdown. Shutdown the system completely at least once a day to prevent performance issues.*

## Sleep Mode

Sleep Mode is intended to reduce the boot up time (is less than 120 seconds) on portable studies. Sleep mode saves all memory content in the hard drive and shuts down. When booting up, memory content is then restored from the HDD.

## Troubleshooting Log/Image Capture

You should collect vital system information before starting any troubleshooting.

1. Press the Utilities key on the control console.
2. In the “Utilities” menu touch the Setup button to invoke the setup desktop on the screen.
3. On the right side of the screen select Administration and then click the System Info tab.

The following information should be noted:

- System Type
- System Serial number (also visible on label on back of the system)
- Application Software version
- Backup version (File name, Date of Factory Settings, Tune version, etc.)
- Additional information (e.g., Hardware ID, “Mainboard Type”, HW configuration, etc.)

All the above information can be found in the "System Info" page:

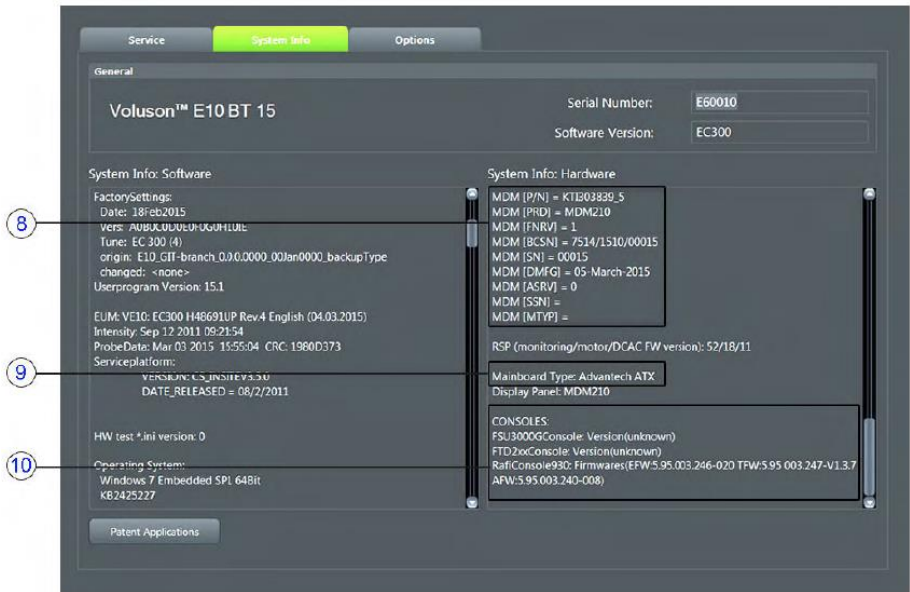
1. Serial Number
2. System Type
3. Software Version
4. Application Software
5. Hardware ID
6. Backup File Name
7. Factory Settings: Date & Tune version



8. Hardware configuration  
(board versions)

9. Mainboard Type (e.g.  
ADVANTECH ATX)

10. Console version



### Shortcuts List

Press the Ctrl + H key simultaneous to display the shortcuts list and a description of what they do. Some functions that appear on this list are for factory use only.

**Factory use ONLY!** These functions are not intended for the user.

Ctrl+ Alt + D

Ctrl + F8

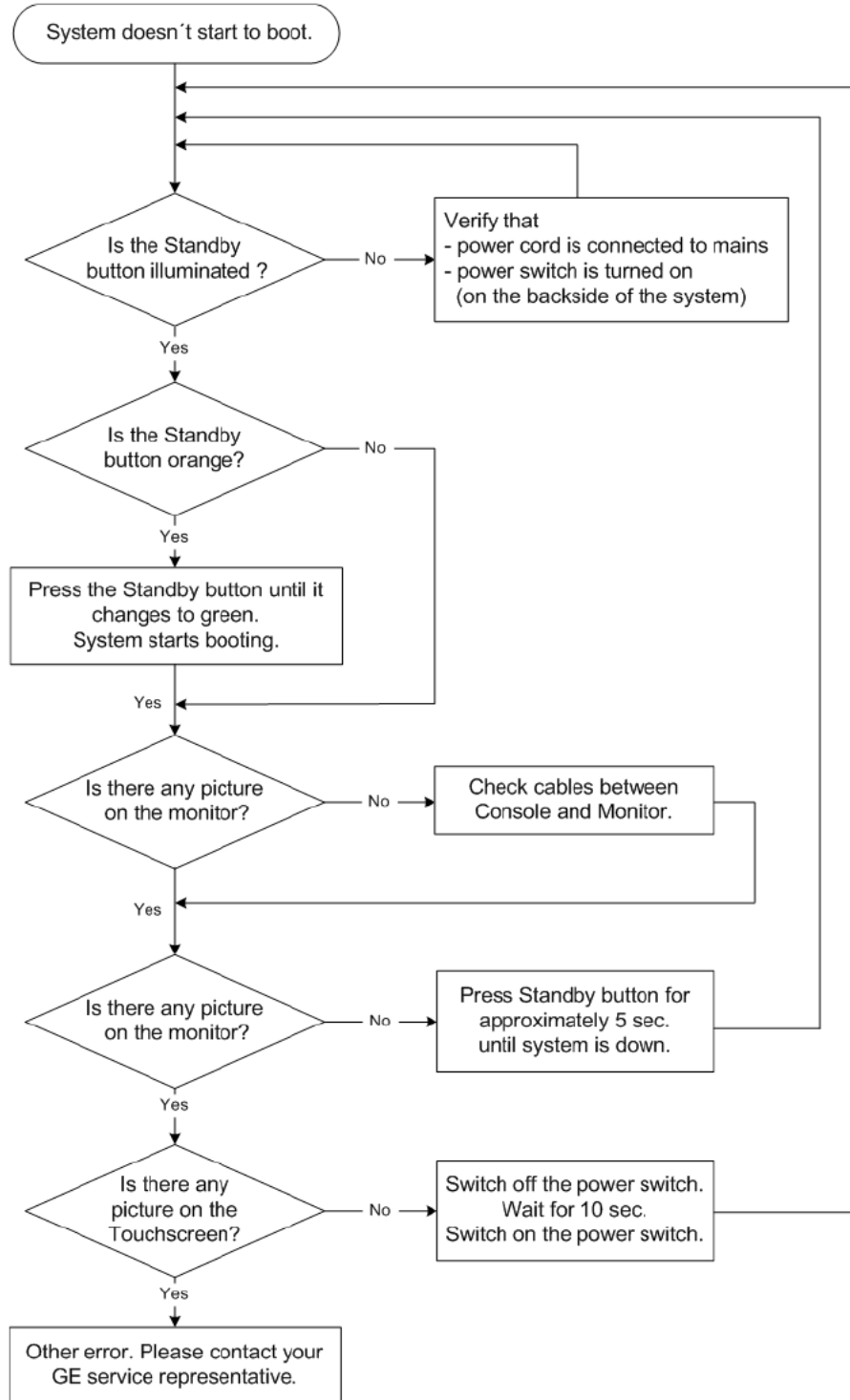
Shift + Ctrl + F11

Ctrl + Alt + F11



## System Does Not Boot-up

Trouble shooting tree:



## Monitor Troubleshooting

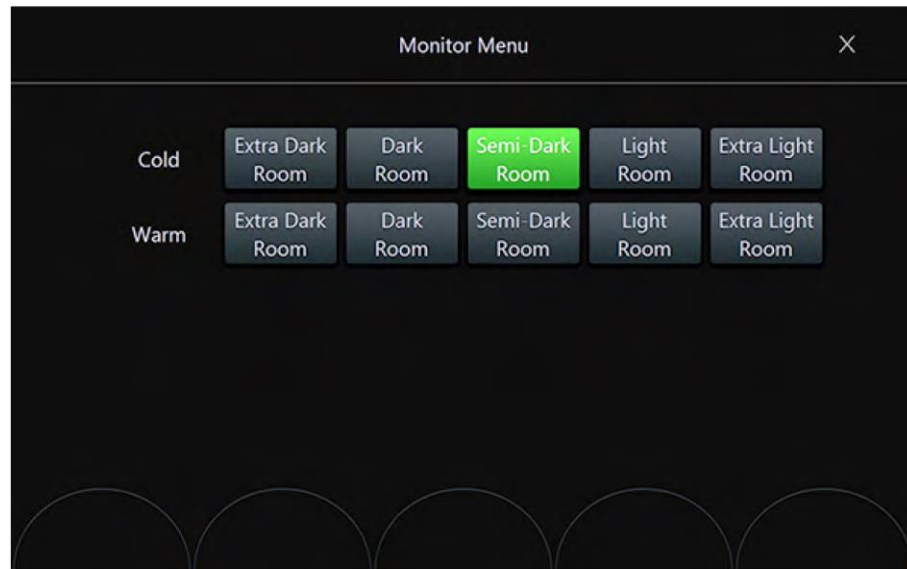
The following suggestions may be useful in troubleshooting monitor malfunctions:

Problem	Check
No Image	Is the power cord is properly connected?
	Is the video cable is properly connected?
	Are any pins on the video cable bent?
	Is the video signal present on the backplane?
Warning message: <b>“Wrong monitor type or monitor firmware detected! ...”</b> appears after startup.	<b>This referenced non-existent pages in the manul. Check the online help?</b>
Picture is fuzzy.	Adjust the picture contrast and picture brightness. Some SVGA cards having an excessive video output level will cause a fuzzy picture at the maximum contrast level.
Video test patterns are not clear, bright, parallel or square.	Replace the monitor.

### Load Default Monitor Settings

To load the default monitor settings:

1. Press the **Utilities** key on the control console.
2. In the **“Utilities”** menu touch the Monitor button to display the **“Monitor Menu”**.



3. Touch the **Semi-Dark Room** button to load default monitor settings for your system.

### **Monitor Test**

1. Press the **Utilities** key on the control console.
2. In the “**Utilities**” menu touch the **Setup** button to invoke the setup desktop on the screen.
3. On the right side of the screen select **Administration** and then click the **Service** tab.
4. Enter the password <SHE> and click the **Accept** button to display the **Service Tools** page.
5. Select the **Monitor Test** button in the “**Service Tools**” menu.
6. The screen becomes white.
  - WHITE should be displayed without any tint (discolor) or colored pixels.
7. Press the right/left trackball key repeatedly to step through RED, GREEN, BLUE, BLACK and GRAYSCALE.
  - Each color should be displayed correctly (without any tint or discolored pixels).

8. To exit the Monitor Test program, press ESC.

## **Trouble Shooting Operator Panel Issues**

This section covers common operator panel issues.

### ***No Audio***

Check volume settings in the application and also in Windows.

Use headphones, (the type that you use on a personal CD player or a laptop) to test the audio output directly from the back of the BEP.

- If no Audio is present on the BEP, reload software. If the problem persists, replace the BEP.
- Always measure the speakers' impedance; it should measure approximately 7 ohms. If speakers are bad, it is possible that the amplifier on the on the UI may be defective, too.

### ***No Video on LCD Display***

- If the video is too dim, has dimmed areas or there is no video at all, replace the HV LCD inverter.
- Check the cabling within the system.
- If the HV LCD inverter is burnt, there is a possibility that the Digital Video Card on the PC also got damaged; in that case you can replace the Video Card.
- Replace the Video Adapter inside the BEP.
- Replace the Back End Processor if the problem continues.
- Replace the Upper Panel Assembly.

### ***Wrong Key Activated on the Touch Panel***

- Calibrate touch panel.
- Replace Upper Panel Assembly.



### ***Touch Panel Not Responding***

- Calibrate the Touch Panel.
- Reload software.
- Replace Upper Panel Assembly.

### ***Probe Recognition***

Check all the probes on all the ports. Remove all the probes, and then check each probe singly in every port.

- If the problems persist with all the probes,
- If only one probe fails to be recognized, replace the probe.

## Module 8 Parts Replacement

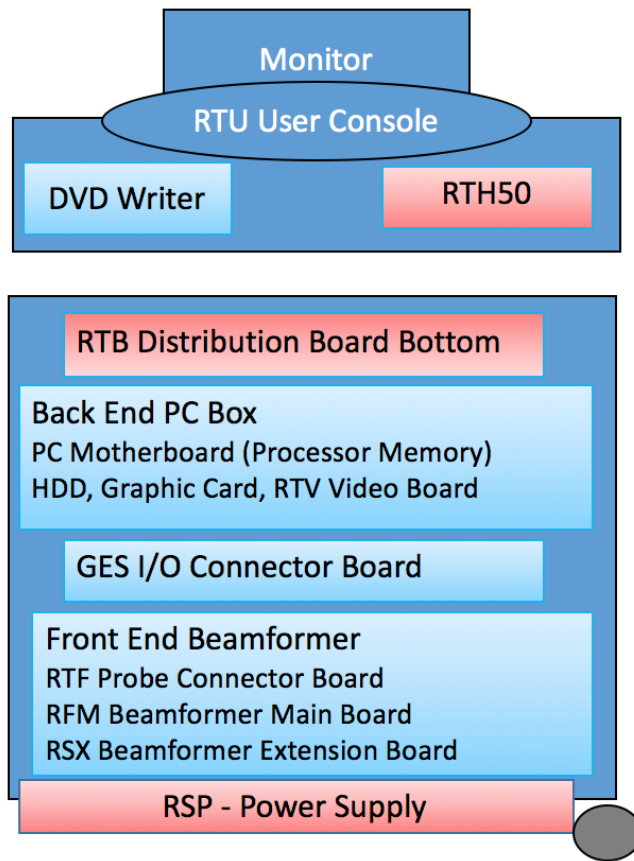
*Check the model number and other vital information before ordering parts for the system.*

This section provides procedures and information for replacing spare parts on the E10 systems. Always follow the standard ESD and safety procedures when replacing parts or modules. Pay close attention to the part number when replacing parts:

- Most parts are labeled with the part number.
- Always replace like for like or check compatibility.
- Visually inspect all parts before installing.
- Some parts are different depending on **BT level and/or SW**.

## System Layout

The following shows the basic layout of the Voluson E10 system:



## System Power Down

The system should be **completely** powered down before opening the chassis and beginning any parts replacement:

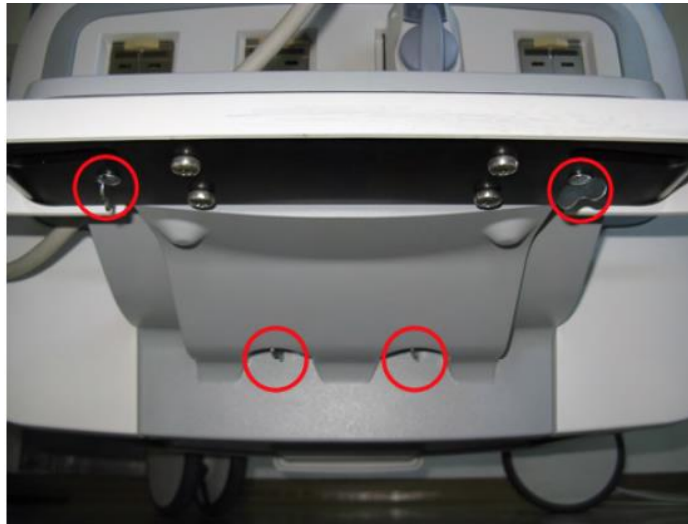
## Panel Removal

Panels should be removed in the following order:

### *Foot Rest*

To unlock:

- Turn the 4 quick release devices below the footrest 90°



- Remove the Footrest Cover & Wheel Axis Cover.



### Front Panel

To remove the front panel from the console:

- Gently remove the strip from around the probe openings on the front panel while the panel is still affixed to the console.

Remove Plastic Strip



- Remove the four screws from the holes shown below and lift out the panel.

Front Panel Screw Locations



### **Side Panel**

### **Back Panel**

After the side panel has been removed you can proceed to remove the back panel.



### **Boards and Modules**

Power supply

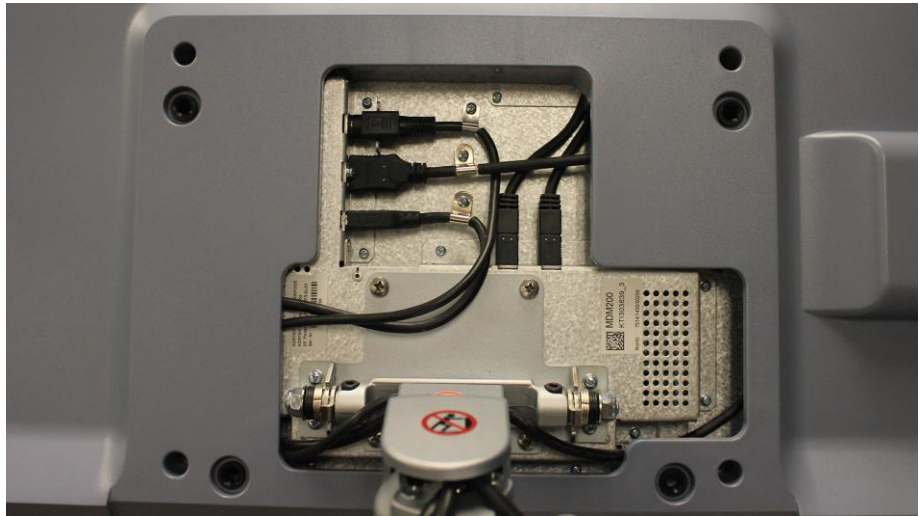
***Power Supply***

***Front End***

***Back End***

***Monitor and Arm Replacement***

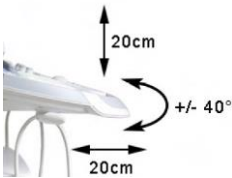
Lift cover off gently to dislodge from clips.



## Module 9 System Adjustments

This module covers adjustments that can be made to the GE E10 systems.

### Control Console Positioning



For ergonomic considerations the control console can be rotated, translated and adjusted in height.

- Height adjustment: 20 cm (7.9 inch)
- Translation adjustment: 20 cm (7.9 inch)
- Rotation adjustment: +/- 40°

#### Control Console Rotation



Press the Brake button inside of the handlebar opening to rotate/translate the console to the desired position. Press the Brake button again in order to secure the console against uncontrolled movement.

#### Control Console Height Adjustment



Height adjustment is done with the Lift UP / Lift DOWN buttons inside of the handlebar opening.

#### Video Monitor

*The monitor and it's housing are sold as separate FRUs.*

The Voluson E-Series system video monitor displays the ultrasound images on a 23" color LCD. The LCD Flat panel monitor is adjustable in relation to the user interface:

- Tilt: + 40° / - 90°
- Rotate: +/- 90°

## Glossary

**Apodization** – A weighting function used as means of reducing side lobes in the beam.

**Application Entity** – A node in a DICOM network.

**Back End** – System block on the user interface side that contains master controller, signal processing, image memory and video layout, peripheral and user interface.

**Beamforming** – A common signal processing technique used to enable directionally or spatially selected signals to be sent or received from sensor arrays.

**Cine** – The cine mode is a series of rapidly recorded images taken sequentially and displayed in a dynamic movie display format.

**Digital Imaging and Communications in Medicine** – A medical imaging standard for file format and network communications protocol for file sharing between entities capable of sending and receiving patient data and images in DICOM format.

**DisplayPort** – A digital display interface standard administered by the Video Electronics Standards Association (VESA).

**Doppler effect** – Change in the frequency of a periodic event (such as sound waves) due to a change in distance between the source and the observer.

**Doppler Range Gating** – Range gate circuit only allows Doppler shift data from a user specified area to be displayed as output.

**Dynamic Host Configuration Protocol** – A standardized network protocol used on IP networks for dynamically distributing network configuration parameters. IP addresses and networking parameters are requested automatically from a DHCP server, reducing the need to configure these settings manually.

**Electromagnetic Interference** – (EMI) is when a radio frequency (RF) transmitting device interferes with the operation of another electronic device. In a healthcare environment wireless EMI can cause medical equipment to malfunction.

**Extended Power Supply** – Supplies power to BEP for soft shutdown.

**Front End** – System block that collects data; probe interface, transmitter/receiver, beamformer, front end controller.

**Harmonics** – Ultrasound method that generates images using



twice the frequency of the transmitted sound.

**I<sup>2</sup>C** – Inter-IC bus, a two wire serial bus for communication between integrated circuits. Developed by Philips in the 1980's it is now an industry standard.

**In Plane Switching** – A type of thin film transistor LCD screen that has particularly good wide viewing angle and accurate color reproduction.

**Loops** – Multiframe objects (e.g. video)

**M Mode** – is also known as T-M mode or time-motion mode.

Ultrasound echoes are mapped to a gray scale display by intensity. Is derived from a stationary beam.

**Modality Performed Procedure Step** – The modality provides information about a performed study, the number of images that were scanned and the status of the exam. The information is shared between a digital modality and the PACS and RIS.

**Multiplexing** – Multiple signals transmitted over a single medium.

**Picture Archive and Communications Systems** – DICOM Medical imaging storage server that stores images from diagnostic devices such as MRI, ultrasound and X-rays.

**Phased Array Ultrasound (3D imaging)** – Sound waves are transmitted at different angles to obtain image.

**Physio** – Refers to ECG inputs.

**Protocol Data Units** – Message formats exchanged between peer entities within a layer. A PDU consists of protocol control information and user data.

**PS\_ON** – Refers to an active low signal used with all ATX and newer power supplies that use 20-24 pin motherboard connector. When high all voltages except 5V stand-by are disabled.

**Run-Length Encoding** – A lossless compression method implemented by specifying the number of times a particular intensity value is repeated.

**Synthetic Aperture** – An imaging method that improves resolution and depth of ultrasound images.

**Time Gain Compensation** – Uses an array of sliding tabs which control the gain, which compensates for the difference of the strength of the ultrasound returning from varied distances to make the ultrasound image appear uniformly lit from top to bottom.

**Thin Film Transistor** – A type of LCD display that uses active matrix technology.

**Tissue Velocity Imaging** – calculates and color-codes the velocities in tissue. The velocity is acquired by sampling of tissue Doppler velocity values at discrete points.

**QRS Detect** – QRS is ventricular depolarization part of a normal EKG waveform which is easiest to detect to count a single heart beat due to it having the highest amplitude.

**Wide eXtended Graphics Array** – Non standard resolution based on XGA display standards that have been widened to provide a wide screen aspect ratio.

## Acronyms

**These Acronyms are color coded according to type:**  
Standard Electronic Industry terms  
DICOM terms  
Company Specific Acronym  
Standard Ultrasound or Medical Terminology

AC – Alternating Current  
ACR – American College of Radiology  
AE – Application Entity  
ASIC – Application Specific Integrated Circuit  
ADC – Analog to Digital Converter  
ATCG – Real Time TGC analog Control bus  
ATGC – Advanced Analog Time Gain Compensation  
ATO – Automatic Tissue Optimization  
BEP – Back End Processor  
BEPPS – Back End Processor Power Supply  
BF – Body Floating  
B Mode – Brightness Mode  
BTU – British Thermal Unit  
CF – Cardiac Floating  
CLA – Curved Linear Array (transducer)  
CP – Control Panel  
CW – Continuous Wave (transducer)  
CMOS – Complementary Metal Oxide  
CSD – Common Service Desk  
CTO – Continuous Tissue Optimization  
DAC – Digital to Analog Converter  
DGC – Depth Gain Control (same as TGC)  
DHCP – Dynamic Host Configuration Protocol  
DICOM – Digital Imaging and Communications in Medicine  
DIMM – Dual Inline Memory Module  
DMA – Direct Memory Access  
DNS – Domain Name Server  
DSP – Digital Signal Processing  
ECG – Electrocardiogram  
EMC – ElectroMagnetic Compatibility  
EMI – ElectroMagnetic Interference  
ESD – ElectroStatic Discharge  
ESU – Electro Surgical Unit  
FEP – Front End Processor  
FMI – Field Modification Instruction  
4D MC – 4D Motor Controller  
FOV – Field of View  
FP – Front Panel  
FPD – Flat Panel Display

FPGA – Field Programmable Gate Array  
FRU – Field Replaceable Unit  
HDD – Hard Disk Drive  
HIS – Hospital Information System  
IC – Integrated Circuit  
HSS – High Speed Serial bus  
IEC – International Electrotechnical Commission  
IPS – In Plane Switching  
IT – Information Technology  
LCD – Liquid Crystal Display  
MPS – Main Power Supply  
MPPS – Modality Performed Procedure Step  
MRI – Magnetic Resonance Imaging  
OEM – Original Equipment Manufacturer  
OP – Operator Panel  
PACS – Picture Archive and Communications Systems  
PCI – Peripheral Component Interconnect  
PIC – Programmable Intelligent Processor  
PS – Power Supply  
PWT – Pulsed Wave Transducer  
RAM – Random Access Memory  
RC – Receive Beamformer and Controller Board  
RDD – CD-R Drive  
RIS – Radiology Information System  
RF – Radio Frequency  
RLE – Run Length Encoding  
ROI – Region of Interest  
RTF - Probe Control Board  
RTB - Distribution Board Bottom  
RTU – User Console Board  
RTV - Video Management Board  
SATA – Serial AT Attachment  
SCP – Service Class Provider  
SIP – Signal/Image Processing  
SVGA – Super Video Graphics Array  
TFT – Thin Film Transistor  
TGC – Time Gain Control or Time Gain Compensation  
TVI – Tissue Velocity Imaging  
UI – User Interface  
USB – Universal Serial Bus  
VCR – Video Cassette Recorder  
VCI – Volume Contrast Imaging

VGA – Variable Gain Amplifier

VI – Video Interface

WXGA – Wide eXtended Graphics Array

## Appendix 1 Network Configuration Worksheets

The DICOM server may need to be configured to recognize the ultrasound system. The storage device vendor needs to know the ultrasound system AET and port number (104).

You can print out these pages to gather information when preparing for network configuration. Most of the necessary information can be obtained from the system administrator or IT department of the facility.

### Checklist for Configuring Ultrasound System Network Parameters

You can obtain this information from the facility network administrator or IT department. The service person for the DICOM devices may also have the IP addresses for the subnet mask and gateway.

Parameter	Description
Alias	A unique identifier for the DIMAQ-IP host AE Title. The alias is only used only by the ultrasound system, and not by DICOM, the Alias makes it easier to switch between hosts if the machine is to be used in multiple subnets or networks.
AE Title	The AE Title of the DIMAQ-IP host.
Host Name	The full computer name of the DIMAQ-IP host.
Workgroup	The workgroup name of the DIMAQ-IP. An entry is always required for this parameter.
DHCP	Is Dynamic Host Configuration Protocol used? The parameter value is always either <b>Yes</b> or <b>No</b> .
Subnet Mask	The IP address of the subnet mask. The system needs this to see other nodes on the network. If no subnet mask is available, use 255.255.255.0

Parameter	Description
Gateway	The IP address for the gateway, which indicates where to direct TCP/IP traffic destined for another subnet. Not all systems require a gateway IP address.
AE Title	The AET for the storage device.
Port	The network port that the storage device uses to communicate with the ultrasound system.
Storage Commitment	Does the device support storage commitment?
Archive	Is the device intended as an archive device?

### Print Device Information

*Except for the print device logical names, you can obtain the information listed below from the device vendor or the facility DICOM administrator or IT group.*

Parameter	Description
Host Name	The host name of the print device.
TCP/IP Address	The IP address of the print device.
Logical Name	The name that displays in the Presets and the film sheet.
AE Title	The AET for the print device.
Port	The network port that the print device uses to

Parameter	Description
	communicate with the ultrasound system

To complete the DICOM Print Device Configuration you will also need to gather the following information from the device vendor:

- The type of print device.
- The film sheet format (for the Film Sheet Formats option; only required if the customer plans to use a format other than the default format).
- The media it uses: blue film, clear film, or paper (for the **Medium type** option).
- Whether the print device or a darkroom develops the film (for the **Film destination** option).

### **HIS/RIS Server Information**

*The HIS/RIS vendor needs to know the ultrasound system AET, which displays on the local AEs configuration screen under HIS/RIS.*

Except for the HIS/RIS server logical names, obtain the information listed below from the device vendor or the facility DICOM administrator or IT group.

Parameter	Description
Host Name	The host name of the HIS/RIS server.
TCP/IP Address	The IP address of the HIS/RIS server.
Logical Name	An arbitrary name that is required for the configuration but does not display in the user interface.
AE Title	The AET for the HIS/RIS server.
Port	The network port that the HIS/RIS server uses to communicate with the ultrasound system.



**DICOM Devices to Connect to System:**

**Note** that several types of servers can be connected, if the servers are on different ports you will need the corresponding port information.

DICOM (network) printer	Yes <input type="checkbox"/> No <input type="checkbox"/>
DICOM storage server	Yes <input type="checkbox"/> No <input type="checkbox"/>
DICOM commit server	Yes <input type="checkbox"/> No <input type="checkbox"/>
DICOM PPS server	Yes <input type="checkbox"/> No <input type="checkbox"/>
DICOM structured report server	Yes <input type="checkbox"/> No <input type="checkbox"/>
DICOM Analog Printer	Yes <input type="checkbox"/> No <input type="checkbox"/>

**Other Needed Information:**

Maximum Network Speed	
If a printer is to be connected the manufacturer and model number of the printer.	_____ _____
Minimum network-connection information.	
(Application Entity) AE title	Note: Case sensitive.
Station Name	Optional
System Location	Optional

Device Name	
Printer Information	
Number of copies	(usually one)
Film Size	specified
Film Medium	
Film Display Format	
Film Orientation	Portrait <input type="checkbox"/> Landscape <input type="checkbox"/>