GE Medical Systems

Technical Publications

Vivid *i*

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User Manual
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Operating Documentation

GE Medical Systems

Table of Contents

Introduction

Chapter 1
Getting started

Chapter 2
Basic scanning operations

Chapter 3
Scanning Modes

Chapter 4
Stress Echo

Chapter 5
Contrast Imaging

Chapter 6
Measurement and Analysis

Chapter 7
Purposely Left Empty

Chapter 8
Archiving

Chapter 9
Report

Chapter 10
Probes

Chapter 11
Peripherals

Chapter 12
Presets and System setup

Chapter 13
User maintenance

Chapter 14
Safety

Index

Introduction

The Vivid *i* ultrasound unit is a compact, high performance portable digital ultrasound imaging system.

The system provides image generation in 2D (B) Mode, Color Doppler, Power Doppler (Angio), M-Mode, Color M-Mode, PW and CW Doppler spectra, Tissue Velocity imaging, Tissue-Doppler imaging (TDI) and LVO Contrast option applications.

The fully digital architecture of the Vivid *i* unit allows optimal usage of all scanning modes and probe types, throughout the full spectrum of operating frequencies.

Attention

Read and understand all instructions in the User's Manual before attempting to use the Vivid *i* ultrasound unit. Keep the manual with the equipment at all time. Periodically review the procedures for operation and safety precautions.

⚠
CAUTION

For USA only:

United States law restricts this device to sale or use by, or on the order of a physician.

Safety

All information in Chapter 14, "Safety" on page 411, should be read and understood before operating the Vivid *i* **ultrasound unit**.

Interference caution

⚠
CAUTION

Use of devices that transmit radio waves near the unit could cause it to malfunction.

Devices not to be used near this equipment:

Devices which intrinsically transmit radio waves such as cellular phones, radio transceivers, mobile radio transmitters,

radio-controlled toys, and so on, should not be operated near the unit.

Medical staff in charge of the unit are required to instruct technicians, patients, and other people who may be around the unit, to fully comply with the above recommendations.

Indications for use

The Vivid *i* ultrasound unit is intended for the following applications:

- Abdominal
- Cardiac
- Small Organ
- Pediatric
- Fetal Heart
- Transesophageal
- Peripheral Vascular
- Neonatal
- Adult Cephalic

Contraindications

The Vivid *i* ultrasound unit is not intended for ophthalmic use or any use causing the acoustic beam to pass through the eye.

Manual contents

The Vivid *i* User's Manual is organized to provide the information needed to start scanning immediately.

Some of the functions or features described in this manual are optional and may not be available in the configuration of your specific system.

⚠️
CAUTION

The safety instruction must be reviewed before operation of the unit.

Finding information

Table of Contents, lists the main topics and their location.

Headers and Footers, give the chapter name and page number.

Index, provides an alphabetical and contextual list of topics.

Conventions used in this manual

2-column layout, the right column contains the main text. The left column contains notes, hints and warnings texts.

Keys and button, on the control panel are indicated by over and underlined text (ex. $\overline{2D}$ refers to the 2D mode key)

Bold type, describes button names on the screen.

Italic type: describes program windows, screens and dialogue boxes.

Icons, highlight safety issues as follow:

DANGER

Indicates that a specific hazard exists that, given inappropriate conditions or actions, will cause:
• Severe or fatal personal injury
• Substantial property damage

WARNING

Indicates that a specific hazard exists that, given inappropriate conditions or actions, will cause:
• Severe personal injury
• Substantial property damage

CAUTION

Indicates that a potential hazard may exist that, given inappropriate conditions or actions, can cause:
• Minor injury
• Property damage

Contact information

If additional information or assistance is needed, please contact the local distributor or the appropriate support resource listed bellow:

Europe GE Ultraschall KG Deutschland GmbH & Co. Beethovenstraße 239 Postfach 11 05 60 D-42655 Solingen	Tel: 0130 81 6370 Tel: (49)(0) 212-28-02-208
USA GE Medical Systems Ultrasound Service Engineering 4855 W. Electric Avenue Milwaukee, WI 53219 On-line Applications Support	Tel: (1) 800-437-1171 Fax: (1) 414-647-4090 Tel: (1) 800-682-5327 or (262) 524-5698
Canada GE Medical Systems Ultrasound Service Engineering 4855 W. Electric Avenue Milwaukee, WI 53219 On-line Applications Support	Tel: (1) 800-664-0732 Tel: (1) 800-682-5327 or (262) 524-5698
Asia GE Ultrasound Asia Service Department Ultrasound 298 Tiong Gahru Road # 15-01/06 Central Plaza Singapore 168730	Tel: (65) 291-8528 Fax: (65) 272-3997

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GE Medical Systems	Tel: (1) 305-735-2304
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4855 W. Electric Avenue	
Milwaukee, WI 53219	
On-line Applications Support	Tel: (1) 800-682-5327
	or (262) 524-5698
Brazil	
GE Ultrasound	Tel: (55.11) 887-8099
Rua Tomas Carvalhal, 711	Fax: (55.11) 887-9948
Paraiso	
Cep: 04006-002 - São Paulo, SP	

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Chapter 1
Getting started

Introduction

Only qualified physicians or ultrasound sonographers should perform scans of patients for medical diagnostic reasons. Request training, if needed.

An authorized GE representative will unpack and install the unit. Do not attempt to install the unit alone.

The Vivid *i* does not contain any operator serviceable internal components. Ensure that authorized personnel do not tamper with the unit.

Perform regular preventive maintenance. See 'System Care and Maintenance' for more information.

Maintain a clean environment. Turn OFF, and if possible, disconnect the system before cleaning the unit. See 'Cleaning the system' for more information.

Never set liquids on the unit to ensure that liquid does not drip into the control panel or unit.

⚠
WARNING

All the warnings in "Important safety considerations" on page 415, should be read and understood before operating the unit.

Preparing the unit for use

The Vivid *i* ultrasound unit must operate within the proper environment and in accordance with the requirements described in this section. Before using the system, ensure that the requirements are met.

Site requirements

Optimal operation of the unit can be obtained by implementing the following requirements:

Power requirements

The Vivid *i* ultrasound unit is powered either by its internal battery or by a separate power supply adaptor unit connected to a separate power outlet for any range of 100 – 230 VAC, 50–60 Hz.

⚠️
WARNING

Operating the unit with the wrong voltage range causes damages, voiding the factory warranty.

Operating Environment

Ensure that there is sufficient air flow around the Vivid *i* ultrasound unit when installed or operated.

Environmental requirements

The Vivid *i* ultrasound unit requires constant maintenance of its operational environment. Different temperature and humidity requirements are specified for operation, storage and transportation.

Requirement	Temperature	Humidity	Air Pressure
Operational	10–40 °C	30–85%	700–1060 hPa
Storage	-10–60 °C	30–95%	700–1060 hPa
Transport	-10–60 °C	30–95%	700–1060 hPa

Electromagnetic interferences

*The Vivid **i** ultrasound unit is approved for use in hospitals, clinics and other environmentally qualified facilities, in terms of the prevention of radio wave interference. Operation of the unit in an inappropriate environment can cause electronic interference to radios and television sets situated near the medical equipment.*

Ensure that the unit is protected from electromagnetic interferences as follows:

- Operate the unit at least 4.5 meters (fifteen feet) away from equipment that emits strong electromagnetic radiation.
- Shield the unit when operating it in the vicinity of radio broadcasting equipment, if necessary.

Connecting the unit

A GE-qualified person should perform the initial system installation.

Connecting the Vivid *i* ultrasound unit involves preliminary checks of the power adaptor unit and cord, voltage level and compliance with electrical safety requirements.

Use only power supply cords, cables and plugs provided by or designated by GE Medical Systems.

Ensure that the power cord and plug are intact and that the power plug is the proper hospital-grade type (where required).

When using the mains outlets, the unit should be connected to a fixed power socket which has the protective grounding connector. Never use an extension cord or adapter plug.

⚠
WARNING

Failure to provide an adequate earth circuit can cause electrical shock, resulting in serious injury.

Voltage level check

Check the label on the Vivid *i* AC power adaptor (Figure 1-1).
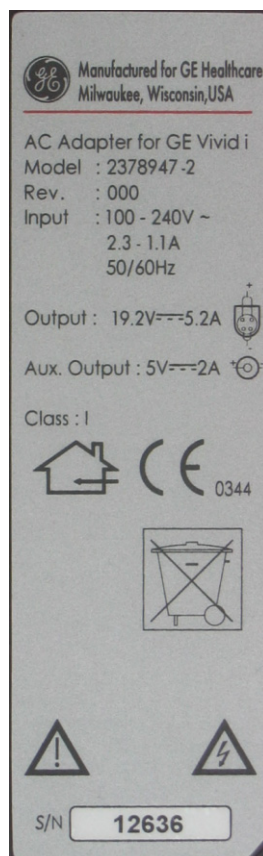
Figure 1-1: The rating label

Check the voltage range indicated on the label:

- 100–240 V, 1.08–0.45 A, 50/60 Hz

⚠️
WARNING

If the mains supply is not within the specified range, do not connect the unit to the power source. Contact the dealer to have the unit adjusted to the specific mains supply.

Connecting to the electrical outlet

The unit's power must be supplied from a separate, properly rated outlet to avoid risk of fire. Refer to "Power requirements" on page 9 for rating information.

The power cord should not, under any circumstances, be altered to a configuration rated less than that specified for the current.

Do not use an extension cord or adapter plug.

1. Connect the AC power adaptor output plug into the appropriate socket on the rear of the Vivid *i*.
2. Ensure that the wall outlet is of appropriate type.
3. Secure the power plug in the wall outlet.

AC Adapter

Use only the special AC Power adapter for Vivid i, specifically designed and approved by GE.

Be sure that nothing rests on the AC adapter's power cable and that the cable is not located where it can be tripped over or stepped on.

Place the AC power adapter in a ventilated area, such as a desk, when you use it to run the Vivid i.

Do not cover the AC power adapter with paper or other items that will reduce cooling; do not use the AC power adapter inside a carrying case.

Battery

The lithium ion battery provides power when an AC power source is not available. A battery in the battery bay is standard with the Vivid *i*. You can expect one hour of battery life with a single fully charged battery. Lithium ion batteries last longer than conventional batteries and do not require replacement as often.

Note: The battery is designed to work with Vivid i systems only. Only use the batteries authorized by GE.

The lithium ion technology used in the system's battery is significantly less hazardous to the environment than the lithium metal technology used in some other batteries (such a watch batteries). Used batteries should not be placed with common household waste products. Contact local authorities for the location of a chemical waste collection program nearest you.

⚠️ **WARNING**

The battery has a safety device. Do not disassemble or alter it.

Charge the batteries only when the ambient temperature is between 0° and 65° C (32° and 149° F) and discharge the batteries between -10° and 55° C (14° and 131° F).

Do not short-circuit the battery by directly connecting the battery terminals with metal objects.

Do not heat the battery or discard it in a fire.

Do not expose the battery to temperature over 60° C (140° F). Keep it away from fire and other heat sources.

Do not charge the battery near a heat source, e.g. fire or heaters.

Do not leave the battery in direct sunlight.

Do not pierce the battery with a sharp object, hit it, or step on it.

Do not use a damaged battery.

Do not solder a battery.

Do not connect the battery to an electrical outlet.

⚠️ **WARNING**

If the Vivid i is not being used on a monthly basis, the battery needs to be removed during lengthy non-use period.

⚠ **CAUTION**

To avoid the battery bursting, igniting, or fumes from the battery causing equipment damage, observe the following precautions:
* *Do not immerse the battery in water or allow it to get wet.*
* *Do not put the battery into a microwave oven or pressurized container.*
* *If the battery leaks or emits an odor, remove it from all possible flammable sources.*
* *If the battery emits an odor or heat, is deformed or discolored, or in a way appears abnormal during use, recharging or storage, immediately remove it and stop using it. If you have any questions about the battery, consult GE or your local representative.*

Storage of battery pack:
* *Short term (less than one month): 0° C (32°F) - 50° C (122°F)*
* *Long term (more than three months): 10° C (50° F) - 35° C (95°F).*
* *Use only GE recognized batteries.*

Using the Vivid *i* with a Battery

The Vivid *i* can be powered by two different power sources in three different ways:

1. AC power adapter only (without the battery)
2. AC power adapter and a battery (Battery being charged in the system)
3. Battery only (without power from the AC power adaptor)

The user has indications of the states of the power sources both by a graphic icon on bottom of display (while system is operating), and by a pair of LED lights which operate even while the system is OFF.

View Current Battery Status

When the system is running, a status icon is displayed in the system *Status* bar to indicate the current battery status.

Table 1-1: Battery status icons

Icon	Status Description
	AC Power is ON; no battery present
	AC Power is ON; battery is fully charged (80% - 100%)
	AC Power is ON; battery is partially charged (40% - 80%)
	AC Power is ON; battery is almost empty (10% - 40%)
	Battery in use - fully charged (80% - 100%)
	Battery in use - partly charged (40% - 80%)
	Battery in use - battery is discharged (25% - 40%)
	Battery in use -battery is almost empty (10% - 25%)

View Detailed Battery Status

In order to view further details about the battery status, click on the battery-status icon. A more detailed status description appears.

A special message may appear, suggestion to replace the battery soon. This message may appear when the battery has aged to such an extent that even after prolonged charging it will not hold enough charge.

Another special message may appear, suggestion to re-calibrate the battery soon.

Battery Re-calibration

Re-calibration may be required after prolonged usage of the battery, because its internal "fuel gauge" (capacity meter) may start to drift. When the battery is out of calibration the system does not read the correct charge stored in the battery. This may cause the battery to lose it's charge capacity. To prolong the battery's performance, the battery may be re-calibrated by using the special external battery-charger, or by using the system, through following step-by-step instructions provided by the system.

Battery Power Low Warning

Note: When the battery power is low and the user cannot charge the battery in time, the system automatically shuts down in 2 minutes. This protects the whole system. You need to save all un-saved data before the system shuts down or you may lose useful information.

If the battery is in use and the battery power is 10-12%, a warning message appears in the prompt line:

Figure 1-2: Low Battery Power Warning

When clicking on the battery icon above, the following message will appear:
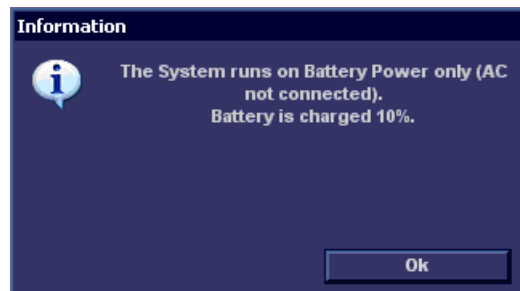
Figure 1-3: Battery 10% Message

If the battery continues to discharge below 10% the system will issue a warning message:
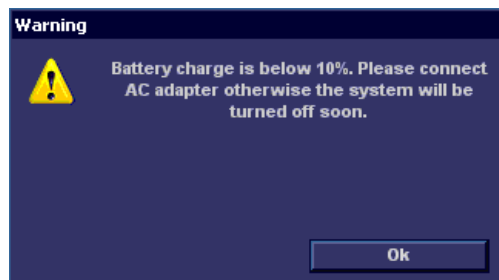
Figure 1-4: Battery Below 10% Warning

About 2 min. later the system will perform an automatic shutdown, preceded by a proper "Ending of exam" and storing of images to the local archive.
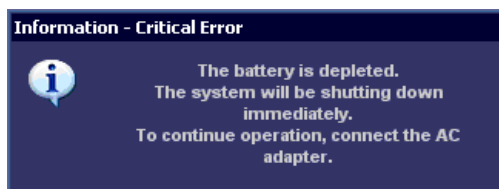
Figure 1-5: Critical Error Warning

The above message appears during system boot-up and subsequently the system turn off automatically.

Battery Re-charging

When the AC adapter is connected and the system is turned off, or is in standby mode, the battery is charging at the quickest rate. When system is scanning the battery is re-charging at a low rate. Some typical numbers are shown in table below:

Mode	Time it takes to add 10% charge to the battery
Off / Standby	~12 minutes
Freeze	~22 minutes
Scanning	~60 minutes

The external charger will recharge an almost empty battery in about two hours.

Peripherals/Accessory connection

The external Peripherals / accessories connectors are situated on the rear side of the unit See Figure 1-6.

Refer to page 343 for further information on peripherals.

Peripherals/Accessory Connector Panel

Vivid *i* peripherals and accessories can be properly connected using the rear connector panel.

⚠️
CAUTION

Use only approved peripherals, accessories or probes.

DO NOT connect any accessories or probes without approval by GE
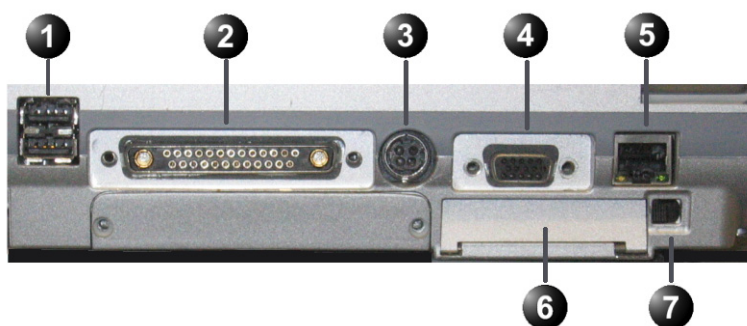
1. **Two interchangeable USB ports (digital printer, CD-RW and other peripherals**
2. **Docking connector - for future external devices**
3. **Port for DC IN (AC Power Adapter)**
4. **SVGA Output (VCR option or External monitor)**
5. **LAN 10/100 Base-TX Ethernet network connector**
6. **PCMCIA port for wireless card**
7. **Ejection lever for PCMCIA device**

Figure 1-6: Peripherals/Accessory Connector Panel

⚠️
WARNING

Accessory equipment connected to the analogue and digital interfaces must be certified according to the respective IEC standards (e.g. IEC 60950 for data processing equipment and IEC 60601-1 (1988) for medical equipment). Any person connecting additional equipment to the signal input part or output part is configuring the medical system, and is therefore responsible that the system complies with the requirements of the system standard IEC 60601-1-1 (2000). If in doubt, consult the technical service department or your local representative.

Do not touch the conducting parts of the USB or Ethernet cables when connecting equipment to the unit.

⚠️
CAUTION

The connection of equipment or transmission networks other than as specified in these instructions can result in electric shock hazard. Alternate connections will require verification of compatibility and conformity to IEC/EN 60601-1-1 by the installer.

Socket	Signal type	Device type	Note
SVGA Out	SVGA output RGB high resolution video	Computer monitor	
USB	Universal serial bus x2		
Ethernet	10/100 Base-TX Ethernet IEEE 8023 Network device	Network device	
Docking Bay Connector	Docking bay connector		
AC Adapter Input	DC voltage from AC adapter unit		

Table 1-2: Contents of the Rear Panel

Switching On/Off

To switch on the unit:

1. Make sure a charge battery is in place by checking the power indicator LED, or connect the appropriate AC power supply adapter output to the rear of the unit (see Figure 1-6).

2. Press ⊖ (on/off button) on the top right of the control panel (see Figure 1-9).
   After initialization the default scanning screen (2D mode) is displayed, using the active probe.
   If the battery is too weak, an appropriate message will display on screen accordingly.

Note: When turning ON a system while system is in standby, it takes a few seconds before it responds. Do not push the on/off button again during this period (A second push will initiate a full shutdown).

When used with the AC Power Adaptor, the system can be used regardless of the battery level. The battery is automatically charged when the system is operating with the AC Power Adaptor.

LEDs

There are two LEDs to indicate the status of the system.

Indicates power status.

After pressing the On/Standby switch, the system power is ON and this LED is lit.

Color: Green

Indicates battery status.

When the battery is charged, the LED is green.
When the battery power is low, the LED is orange.

Color: Green and Orange

Password Protection

Log In

During the turn-on process the system may require the user to enter a password in order to operate it. Personal IDs and associated passwords can be configured in the Vivid *i*. See "Presets and System setup" on page 351 for more information.

If IDs and passwords have been entered and the Use Auto Logon is *Off* (see "Users" on page 399 for details), the Operator Login Window appears, requesting for an ID and

password when Power up sequence is completed, or when it is required.
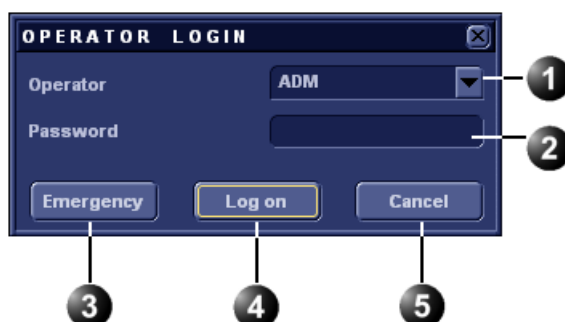
1. **Operator:**   Select the relevant Operator name.
2. **Password**   Enter the Operator's password.
3. **Emergency**   Data stored for the duration of the current examination only.
4. **Log on:**   Select type of Log on (for example, Standard logon).
5. **Cancel**   Cancel Log on.

Figure 1-7: Operator Login Window

Switching off the unit

When the Vivid *i* is switched off, the system performs an automatic shutdown sequence. The unit can be switched off into two states.

*   **Standby mode**: most of the system is powered down, but a certain portion of the unit remains energized. The standby mode allows a shorter reboot time when the system is used on a daily basis or moved from one place to another.
*   **Full shutdown**: the entire system is shut down. Full shutdown is recommended if the system is not intended to be used for a whole day or longer. It is recommended to **perform a full shutdown at least once a week**.

Full shutdown

After switching off the system, wait at least ten seconds before turning it on again.

1. Press ⊖ (on/off button) on the top left of the control panel. The *Exit dialogue window* is displayed.
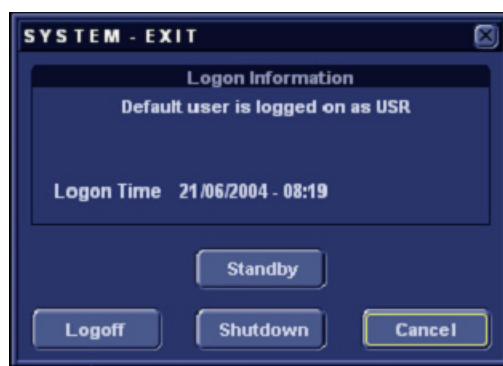
Figure 1-8: The Exit dialogue window

In case of total lock-up of the system, hold the on/off button down a few seconds to turn the system off.

2. Select **Shutdown**.
   The shutdown process takes a few seconds and is completed when the control panel illumination is turned off.

Standby mode

1. Press ⊖ (on/off button) on the top left of the control panel.
   The *Exit dialogue window* is displayed (Figure 1-8).

In case of total lock-up of the system, hold the on/off button down a few seconds to turn the system off.

2. Select **Standby**.
   The system enters *Standby* mode.
   The system remains in *Standby* mode for approximately 4 hours using the internal battery (assuming battery is fully charged and relatively new).
   Note: When the system is operating, if the power cable is removed from the wall outlet or the Power Adaptor is disconnected from the Vivid *i*, the system will continue to operate using the internal battery.
   When the display screen is folded and closed, the system will automatically shut-down and switch to *Standby* mode. Once the screen is opened the system will turn back on.
   If left for a long time while in standby-mode, the system will switch from *Standby* to full *Shut-down* mode.
   Note: Whenever the system is shut down fully or into standby mode, the system will automatically perform "End Exam" to save all data and images of current patient into the archiving system.

Turning on the system at the new location

1. In order to maintain the battery charge it is recommended to plug the AC cable into a proper power outlet. If a charged battery is in place, the power plug does not need to be plugged into the wall outlet.

2. Press ⊖ (on/off button) (Figure 1-9).

3. If the system does not turn ON, the battery may be drained. In this case, plug the power plug into the wall outlet and try again.

The system can be used regardless of the battery level. The battery is automatically charged when the system is plugged to the wall outlet. It takes about 2 hours to charge a completely discharged battery. This may gradually change as battery ages with time.

Moving and transporting the unit

Moving the unit on a Cart

To prepare the unit to be moved

1. Turn the system OFF either in Standby or Full Shutdown mode, and remove the AC power plug from the wall outlet.

2. Fold the LCD screen to the fully closed position.

Note the marks on each cable to reconnect them later.

3. Disconnect all cables linking the system or peripherals to any off-board peripheral devices and network.

4. Secure the unit's power cable on the Cart.

5. Place all probes securely on the cart. Ensure that the probe cables do not protrude from the unit or interfere with the wheels.

6. Ensure that no loose items are left on the unit

To ensure safety while moving the unit

1. Ensure that the LCD screen is in the locked position.

2. Proceed cautiously when crossing door or elevator thresholds. Do not attempt to move the unit using cables or probe connectors. Take extra care while moving the unit on inclines.

3. Ensure that the unit does not strike the walls or door frames.

4. Ensure the pathway is clear.

5. Move the unit slowly and carefully.

⚠
CAUTION

Avoid ramps that are steeper than 10 degrees.

For further assistance, read the Cart User's Manual.

Transporting the unit

Take extra care when transporting the unit by vehicle. In addition to the moving precautions listed on page 23, follow the procedure described below.

1. Disconnect all probes and secure them in their boxes.
2. Remove the Vivid *i* system from the Cart and place it in the travel bag supplied by GE, or an equivalent suitable travel bag.

Unit acclimation time

Following transport the unit may be very cold or hot. Allow the unit to acclimate before being switched on. Acclimation will take one hour for each 2.5 °C increment when the unit's temperature is below 10 °C or above 40 °C.

°C	0	2.5	5	7.5	10	35	40	42.5
°F	32	36.5	41	45.5	50	95	104	108.5
Hours	4	3	2	1	0	0	2	3
°C	45	47.5	50	52.5	55	57.5	60	
°F	113	117.5	122	126.5	131	135.5	140	
Hours	4	5	6	7	8	9	10	

System description

System overview
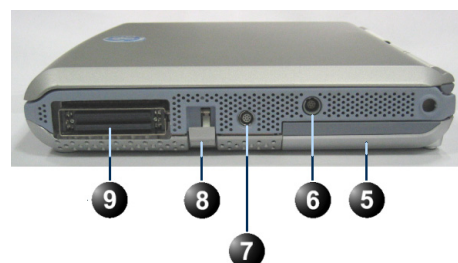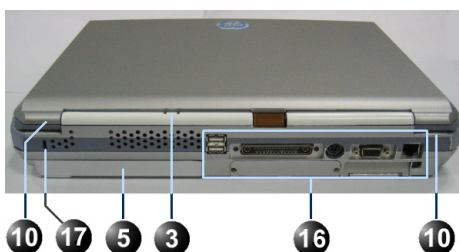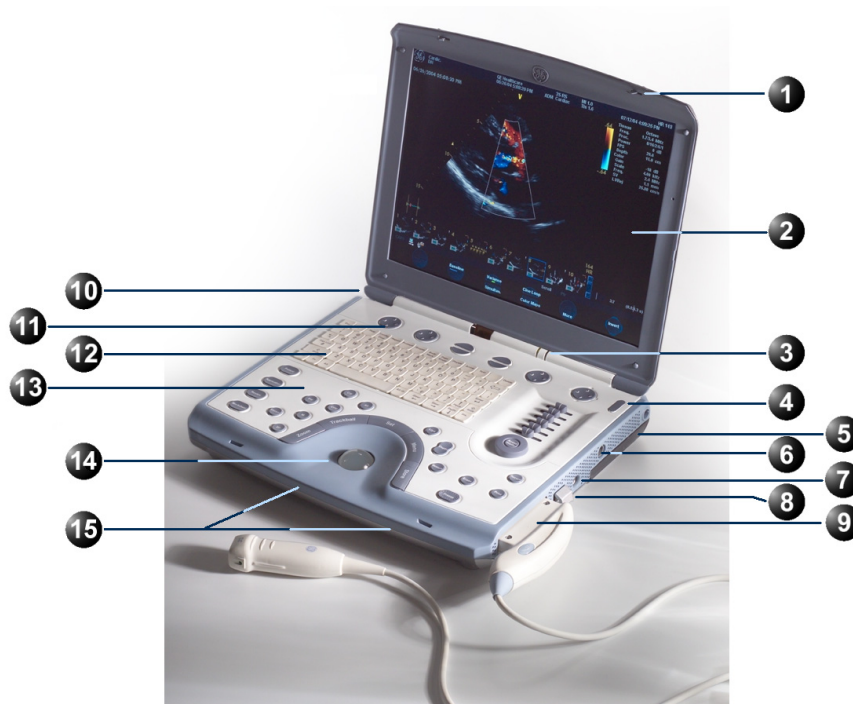
1. Display latch
2. LCD display
3. Power indicator
4. On/Off button
5. Battery
6. ECG cable connector
7. Pedoff probe connector
8. Probe locking handle
9. Probe connector

10. Monitor hinge
11. Soft menu buttons
12. Alpha-numeric keyboard
13. Functional keyboard
14. Trackball
15. Speakers
16. Rear panel connectors
17. Anti-theft cable insertion

Control panel

The following pictures illustrate the layout of the Vivid *i* control panel. The buttons and controls are grouped together for ease of use. A detailed description of the buttons is provided on the following pages.

1. **Assignable keys (soft-menu elements; part of the Extended keyboard)**
2. **Soft menu rocker**
3. **TGC sliders**
4. **GAIN rotary**
5. **Alphanumeric keyboard**
6. **Alphanumeric function keys: (*Help, Config, Annotate* ...)**
7. **Extended keyboard**
8. **Trackball**
9. **Trackball buttons**
10. **Mode selection keys**
11. **Navigation keys**
12. **Freeze keys**
13. **On/Off button**

Figure 1-9: The Vivid *i* Control Panel

Key illumination

The keys on the control panel are illuminated according to their availability:

*   **Illumination in green**: the key function is currently active.
*   **Illumination in yellow**: the key function is available (but not active) in the current state of the scanner.
*   **No illumination**: The key is not available in the current state of the scanner.

Power On/Off key

Key	Description
⏻	Turns the unit ON and OFF. Sets the unit to *Standby*.

Navigation keys

Key	Description
Patient	Displays the *Archiving* opening page. Enables the user to perform the following functions: • Create a new patient record • Edit the current patient's information • Browse the Patient List to search for patient records • End the current examination For further information, refer to page 46.
Application	Displays the Select Probe and Application dialog box that enables the users to select the desired **probe** and application **preset** for the current examination. For information about selecting probes, refer to page 50 and page 327.

Key	Description
Review	Brings the scanner into the Image review mode, that enables the user to select images from the clipboard for analysis, activate the image browser or enter the *Image Review screen* where bigger previews of the images are shown for image selection. Refer to page 229 for details on the review of images.
Worksheet	Displays the *Measurement worksheet* where the user may edit or delete measurements, change averaging etc. Refer to page 202 for details on how to operate the worksheet.

Scan Mode Selection keys
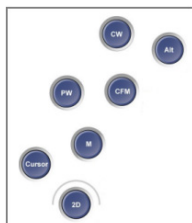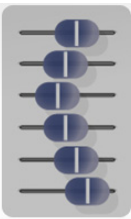
The following keys are used to select the required scan mode, and to select additional tools that enhance the application's capabilities. Refer to page 81 for detailed information about scanning.

	Key	Description
	2D	Displays the 2D live acquisition mode that is the default scanning screen for the unit. For further information on 2D scanning, refer to page 83.
M-Mode can be added from a 2D scan also in replay.	M	Displays the M-Mode examination screen and enables M-Mode functions. Used for viewing motion patterns. For further information, refer to page 90.
Color	CFM	Displays the examination screen in Color Flow Mapping mode. Used to display color-coded blood flow information. For further information, refer to page 95.
	PW	Displays the examination screen in Pulsed Wave Doppler mode. Used for displaying the Doppler spectrum of blood flow at a selected part of the anatomy. For further information, refer to page 101.
CW mode is not available on all scanning probes.	CW	Displays the examination screen in Continuous Wave Doppler mode. Allows examination of blood flow data all along the Doppler CW cursor. For further information, refer to page 101.
	Cursor	Toggles the cursor display on/off in 2D scanning mode.
	Alt	Depending on the options installed on the scanner, this key will bring up the menu for selection of additional scanning modes. One such option is the TVI option: Displays the tissue velocity overlay on 2D and M-Mode scans. If TVI is on, the Doppler modes (PW/CW) will also be optimized for tissue velocity. For further information, refer to page 104.

Basic Mode Parameter Adjustment Controls

The following controls are used to modify and adjust the unit's display to best suit the user's requirements, such as color, gain, zoom and image depth, according to the mode being operated by the user.

Controls	Description
Gain rotary	Controls the total gain of the active mode: gray scale images in 2D Mode, or the total gain of other activated modes, such as, M-Mode, Color, PW, or CW Doppler mode.
Active mode	In combined mode, switches between the mode specific assignable controls and total-gain of the currently used modes. ATO (Automatic tissue optimization) - while in 2D press the button to optimize 2D image automatically.
TGC	Six sliding keys that compensate for depth-related attenuation in an image. The upper slider corresponds to the smallest depth.
Depth	Controls the displayed depth of tissue scan. Has no effect in replay. When Zoom is active, this rocker switch controls the zoom magnification factor.
Steer ← Steer →	Changes the angle of the cursor on linear probes. The steering angles are fixed for each linear probe. This key has no effect with sector imaging probes.

Freeze keys

The freeze keys are used to freeze images and cine loops in all modes for on-line analysis and storage for future use.

Key	Description
Freeze	Stops or restarts all data acquisition. When scan is frozen, the Trackball can be used to scroll through the cine loop.
2D Freeze	Activates or freezes 2D mode. In simultaneous mode, pressing **2D FREEZE** will activate or deactivate the 2D image, leaving the other mode display unchanged. In freeze mode, stops/starts the cineloop.

Multiple Format Key

Key	Description
1/2/4	Enables multiple image display windows in which two or four images can be viewed simultaneously. When reducing the number of images, the active window will always been kept.

Measurement control

The following key is used to take measurements and perform calculations.

Key	Description
Measure	Activates the Measurement & Analysis (M&A) calculation program. This program is context sensitive and will display relevant measurements to the current mode and application. Also activates measurement tools (unassigned measurement). See page 155 for further details on M&A.

Print and Record Control

Key	Description
Record	For future use.
Print	Prints the current imaging screen content to a selected (configurable) printer. For more information about printing. Refer to page 349. The **PRINT** key can also be configured for alternative storing of images (Refer to page 386.).
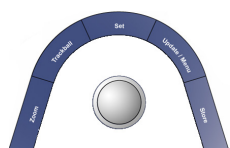
Trackball operation

The Trackball area consists of the trackball and five surrounding keys.

Key	Description
Trackball	Used for navigation and together with the surrounding keys, to move, select or activate objects on the screen.
Zoom	Controls image magnification. Press to activate Zoom mode; use trackball and **SET** button toggle to pan or change zoom factor. Zoom is available in both *Live* and *Replay*.
Trackball	Controls the trackball assignments between the mode-specific options. By pressing **TRACKBALL**, the trackball function will cycle through the possible assignments, which are indicated in the lower right corner of the screen (see page 58).

Key	Description
Set	Depending on the situation (see Figure 2-3, page 59):
	• Performs the selected control or highlighted menu item.
	• Toggles between the Trackball functions within the active group.
Update Menu	In Freeze, activates menu with additional options and controls not available from the assignable keys.
	In live mode, toggles between 2D imaging and live time-motion imaging (Doppler/M-Mode).
Store	Stores the currently active imaging window to disk. The stored information depends on the configuration of the current application.
	Stored images are shown on the clipboard.

Assignable keys (soft keys)

The functions of the assignable keys vary according to the mode and/or module in which the user is working.

Key	Description
Assignable Circular	Three 4-way knobs, whose mode-specific functions vary according to the scan mode and position that is currently active. This assignable knob is used to control variable parameters. The assigned functions are indicated above the knob on the LCD display. The mode-specific functions for these knobs are described in Chapter 3, "Scanning Modes" on page 81.

Key	Description
Assignable Buttons	Four assignable buttons, whose mode-specific functions vary according to the scan mode and position that is currently active. These assignable buttons are used as on/off toggles for different controls on the menu. The assigned functions are indicated above the button on the LCD display. The mode-specific functions for these buttons are described in Chapter 3, "Scanning Modes" on page 81.
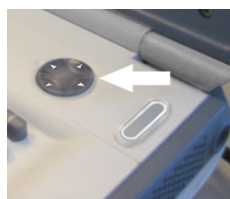
The soft menu rocker

Key	Description
Soft Menu Rocker	A 4-way rocker used to access mode-specific menus, select a menu option and adjust option-related values. • The vertical arrows are used to select the menu options. • The horizontal arrows are used to adjust the values. The mode-specific menus are described in Chapter 3, "Scanning Modes" on page 81.

The Alphanumeric Function keys

Key	Description
Help	Displays the on-line version of the user manual.
Config/Diag	Displays the configuration dialog box, allowing user configuration of various settings on the scanner. Diagnostics of the system is activated by pressing **Shift** > <u>CONFIG</u>.
Report	Displays the examination report.
Protocol	To enter the stress echo mode. The Protocol screen is displayed showing the default stress protocol for the current probe.
Biopsy	Biopsy is not available.
Bodymark	Displays the available body marks for the current application.
Page Erase	Erases all previously-typed annotations (and body marks).

Key	Description
Physio	Provides access to controls for ECG trace. The ECG controls appear on the soft-menu.
Arrow	Displays an arrow that can be used to point at a specific structure in the image.
Text	Enables text annotation to be inserted on the image. The annotations can be typed or selected from a (configurable) menu.
Delete	Can be used to delete text during text annotation.

List of shortcuts on alphanumeric keyboard

Key	Description
Alt+E	Allows to eject a device like MOD, CD or memory card.
Alt+L	Allows to adjust intensity of keyboard backlight.
Alt+P	Allows to view and control printer spooler.
Alt+S	Allows to view and control DICOM spooler. (see "DICOM spooler" on page 280) The DICOM spooler is used for checking the current job's status when a job is saved or when the total spooler status on the right of the Archive windows displays an error.
Alt+D	Allows to comment and save logfiles for diagnostics (see Chapter 13, "Generating a logfile" on page 408).
Alt+Q	Allows view a test pattern for screen adjustments (in previous versions this was activated by **Ctrl-Alt-P**).
Ctrl+Alt+Page +Erase (F7)	Allows to configure VGA output to external device (or VCR converter).
Ctrl+Alt+P	Allows view a test pattern for screen adjustments (on later versions this was changed to **Alt-Q**).

Key	Description
Alt+PgUp or Alt-PgDn	Allows to adjust screen's **brightness**.
Alt+Steer (<- or ->)	Allows to adjust screen's **contrast**.
Shift+Config	Allows to run various diagnostics.
Fn (function) key + PgUp or PgDn	Allows to view clipboard images sequentially forward or backwards.

The Scanning screen

1. **Current patient data**
2. **Date & time of original image**
3. **Institution**
4. **Operator ID**
5. **Application & Temperature indicator for TEE probe**
6. **Probe**
7. **Mechanical & Thermal Index**
8. **Current date & time**
9. **Heart rate**
10. **Parameter window - all modes**
11. **Greyscale/Color bar**
12. **Soft menu window**
13. **Clipboard navigator**
14. **Cine progress bar**
15. **Current menu name**
16. **Soft menu control button**

17. **Trackball assignment, Service and iLinq, Caps on/off**
18. **Soft menu toggle button**
19. **Clipboard image number**
20. **Loop icon**
21. **4-way soft menu control**
22. **Watermark area for screen calibration**
23. **Prompt/Status information**
24. **Clipboard**
25. **Heart rate**
26. **Depth scale**
27. **Focus marker**
28. **TEE Scan plan indicator**
29. **Probe orientation marker**
30. **Measurement result table (measurement mode)**
31. **Logo**

Figure 1-10: The scanning screen

The scanning screen is divided in several areas as follows:

The title bar

From the left:

Patient Information

Displays the information that uniquely identifies the patient, such as patient name, identification number and birth date. This information is entered in the *New patient window*, as described on page 46.

Institution name

The institution name is entered from the configuration package. See page 395 for more detailed information.

Operator ID

Identification code of the operator. See page 399 for creating operator ID's.

Date and time

Displays the current date and time or for a retrieved image, the date and time at which it was stored.

Probe and Application

Displays the currently selected probe and application or for retrieved image the probe and application that were used. See page 50 and page 334 for further information on how to select probe and application.

Live scanning related information

Displays, if available, the current values for

- Mechanical Index (MI), for the current active image
- Thermal Index (TI), for the current active image
- probe temperature (for TE probe)
- Heart rate (HR)

Archive Information

Displays the currently selected patient and image archives.

Parameters window

Displays scan mode or application specific parameters. In scanning mode the parameters for the active mode are highlighted. This window also displays zoom information and image groups in image browser.

Soft menu window

Displays the mode specific controls operated from the 4-way rocker on the control panel. The mode-specific menus are described in Chapter 3, "Scanning Modes" on page 81. For operating procedure of the 4-way rocker see page 57.

Clipboard

Displays the thumbnail images representing the acquired data during the current examination.

The status bar

Consists of four information fields as follows:

Service iLinq button (wrench icon)

Enable access to the GE Medical Systems on-line service center.

Connectivity status icon

Displays the network status: Connected or disconnected.

Power & Battery status

Displays the power status. Amount of battery charge and if AC adapter is connected (see page 14)

Prompt/status field

Displays system messages or prompts the user for actions.

Trackball assignments fields

Displays the available assignments of the trackball. The current assignment is highlighted.

The acquisition window

Displays the ultrasound image with relevant indicators such as depth, focus, probe orientation marker, physiological traces etc.

Connecting and disconnecting probes

Probes can be connected or changed at any time, regardless of whether the system is powered ON or OFF.

<table><tr><td>

⚠

CAUTION

</td><td>

Handle the probes gently while connecting and disconnecting.

</td></tr><tr><td>

⚠

WARNING

</td><td>

Do NOT touch the patient and any of the connectors on the ultrasound unit simultaneously, including ultrasound probe connectors.

</td></tr></table>

To connect a probe:

Probes can be connected or changed any time while the unit is on.

1. Place the probe's carrying case on a stable surface and open the case.
2. Carefully remove the probe and unwrap the probe cord. DO NOT allow the probe head to hang freely. impact to the probe head could result in irreparable damage.
3. Press the probe connector locking lever (refer to Figure 1-12) *downwards*.
4. Align the connector with the probe port and carefully push into place, as shown in Figure 1-11.

Figure 1-11: Probe Connection to the Vivid *i*

5. Lift the connector locking lever (see Figure 1-12) *upwards* to the full horizontal position to lock in place.
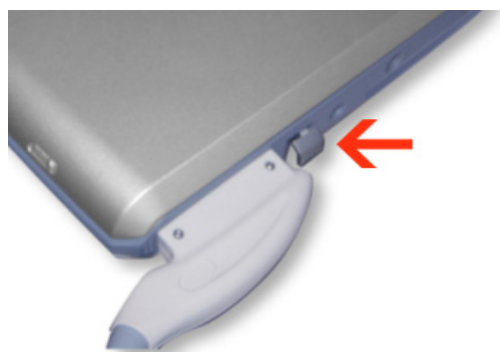
Figure 1-12: Probe Connection Locking Lever

6. Carefully position the probe cord so that it is free to move
    and is not resting on the floor.
    When the probe is connected, it is automatically activated.

![CAUTION symbol]
CAUTION

*Fault conditions can result in electric shock hazard. Do not touch
the surface of probe connectors which are exposed when the
probe is removed. Do not touch the patient when connecting or
disconnection a probe.*

Cable Handling

Take the following precaution with probe cables:

•   Do not bend the cable acutely.

Deactivating the Probe

Press the FREEZE key to deactivate the probe. When
deactivating the probe, the probe is automatically placed in
Standby mode.

Disconnecting the Probe

Probes can be disconnected at any time. It is recommended
that the probe should not be active when being disconnected.

To disconnect a probe:
1. Freeze the image by pressing FREEZE.
2. Press the connector locking lever *down* to unlock the
    connector.
3. Pull the probe and connector straight out of the probe port.

4. Carefully slide the probe and connector away form the probe port and around the right side of the keyboard.
5. Ensure the cable is free.
6. Be sure that the probe head is clean before placing the probe in its storage case.

Transporting Probes

When transporting a probe a long distance, store it in its carrying case.

Storing Probes

It is recommended that all probes be stored in the carrying case provided.

•   First place the probe connector into the carrying case
•   Carefully wind the cable into the carrying case.
•   Carefully place the probe head into the carrying case. **DO NOT** use excessive force or impact the probe face.

Adjusting the display monitor

The LCD screen brightness controls may need periodic adjustment due to changes in ambient light. On the bottom left corner of the screen you should be able to see a dark, yet visible, letter **V** which is called "Watermark" (see Figure 1-10, item 22). If the watermark is not visible it is because the screen is adjusted too dark relative to the surrounding bright ambient light conditions. In this situation the screen brightness should be adjusted.

To adjust the Brightness of the display monitor

On the alphanumeric keyboard press **ALT**+**PgUp** to increase brightness or **ALT**+**PgDown** to decrease brightness. The brightness adjustment tool appears at bottom of screen, as shown in Figure 1-13.

Figure 1-13: Brightness Control

In a totally dark room it is recommended to set brightness down all the way (all rectangles are empty).

When ambient light becomes brighter and watermark becomes less visible, increase the brightness till watermark is visible again

To adjust the Contrast of the display monitor

On the alphanumeric keyboard press **ALT**+**Steer->** to increase contrast or **ALT**+**Steer<-** to decrease contrast. The contrast adjustment tool appears at bottom of screen, as shown in Figure 1-14.

The default setting of the screen is recommended to be at maximal contrast setting, as shown in Figure 1-14.

Figure 1-14: Contrast Control

To adjust the color temperature (blue-tint) of the display monitor

On the alphanumeric keyboard press **ALT + >** to increase the amount of blue-tint n the LCD display. This will make the white shades shift a bit towards blue.

Press **ALT + <** in order to decrease the amount of blue tint on display.

The last setting will be always be saved by the system to become the default setting.

Starting an examination

Beginning an exam consists of three steps:

- Creating a new patient record or starting a new examination from an existing patient record (see below)
- Selecting Probe and Application (see page 50)
- Start scanning (see page 50)

Creating a new Patient record or starting an examination from an existing patient record

Starting an examination

1. Press **PATIENT**.
   The *Patient Handling* screen is displayed.
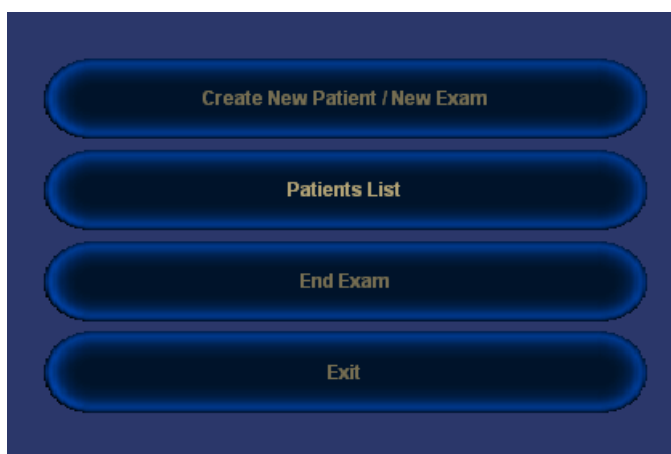
Figure 1-15: The Patient Handling Screen

2. Press **CREATE NEW PATIENT**.

To create an operator ID, see page 399.

If the unit is password protected a *Log In window* will appear asking for operator ID and password (as explained in Figure 1-16).

1. **Data stored only for the duration of the current examination**
2. **Select the operator**

Figure 1-16: The Operator login window

3. Press **Log on** when completed.
   The *Search/Create Patient window* is displayed (see Figure 1-17).
4. Type the patient **Last Name**, and/or **ID**.

△
CAUTION

Do NOT use '\' or '^' in patient information fields, as these characters might cause problems with some DICOM devices.

The unit can be configured to automatically generate a patient ID (see page 389).

When default configured, the system automatically searches to see if the patient is already in the database. The result of this search is displayed in the *Patient List field*.

If the Patient name is on the patient record list:

*To restrain the search to special category of patient record, press **More** and use the searching filters.*

1. Trackball to the actual patient and double-click the Trackball SET key (or press SET once and then **Select patient**).
   The unit is ready for scanning or the *Patient information window* is displayed (Figure 1-18) depending on system configuration (see page 389).

If the Patient name is not on the patient record list:

The automatic search tool displaying matching patient information in the Patient list can be turned off (see page 389).

1. Press **Create Patient**.
   The unit is ready for scanning or the *Patient information window* is displayed (Figure 1-18) depending on system configuration (see page 389).

If the unit is configured to display the *Patient information window*, follow the steps below:

1. Enter additional patient information if required.
   Select between **cardiac**, **vascular** etc. to enter application specific patient info (Displayed when the button **More** is depressed, see Figure 1-18.).

Press EXAM. LIST to display the previous examinations and diagnosis information for the selected patient. Enter additional patient information if required.

2. Press **Begin exam** or any active scanning key to start the examination.
   In the scanning screen, the patient information is displayed on the left side of the *Title bar* (see Figure 1-19).

1. **Press one of the headings to sort the list accordingly.**
2. **Select the column heading border and drag to adjust column width.**
3. **Select new archive and other pre-defined services.**
4. **Extended menu**
5. **The system can be configured to display the Advanced search tool as default (see page 389).**
6. **Expended Patient record displaying belonging examinations**

Figure 1-17: The Search/Create Patient window

1. **The date format is configurable (see page 395).**
2. **The window can be configured to display the expanded patient info as default (see page 389).**
3. **The Address field is configurable (see page 389).**
4. **Select patient information category.**

Figure 1-18: The Patient Information window
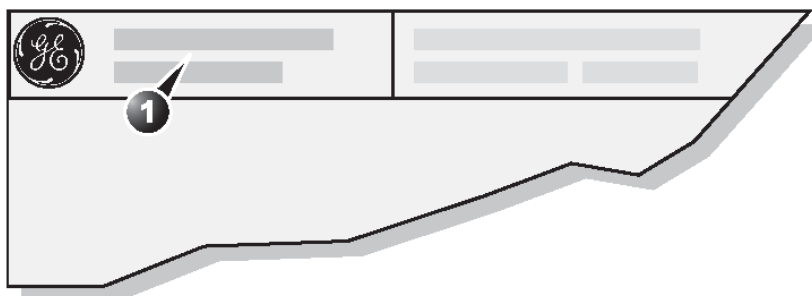
1. **The patient information on the scanning screen is configurable (see page 358).**

Figure 1-19: The Patient information on the scanning screen

Connectivity on the Vivid *i* ultrasound unit

The connectivity on the Vivid *i* Ultrasound unit is based on the Dataflow concept. A Dataflow is a set of pre-configured services (e.g. DICOM services like storage, worklist, verify etc. or other service types like video print, standard print or messaging). When starting an examination, the user selects a pre-configured Dataflow that will automatically customize the ultrasound unit to work according to the services associated to the Dataflow.

Selecting a Probe and an Application

Probes and their related applications are selected from the Probes and applications pop-up menus as described below. Only probes currently connected are displayed in the pop-up menu. Only applications appropriate for the type of probe selected are shown.

To select a probe and an application

1. Press **APPLICATION** on the control panel.
   A list of the connected probes is displayed.
2. Trackball to the desired probe.
3. Press **SET**.
   An *Application menu* for the selected probe is displayed.
4. Trackball to the desired application.
5. Press **SET** to launch the application.

*To select a probe with the default ap-plication, press **SET** twice on the actual probe.*

$\triangle$

CAUTION

Make sure that the probe and application names displayed on the screen correspond to the actual probe and application selection.

Check that the correct TI category is displayed (see Chapter 14, "Thermal Index" on page 421). TIB must be displayed when a fetal application is selected.

Chapter 2
Basic scanning operations

This chapter describes basic operations related to scanning. Some operations described in this chapter are fully described in the respective chapters throughout the manual.

This chapter includes the following information:

Assignable keys and Soft Menu Rocker

1. **Active mode & status**
2. **Filling gauge (progress bar)**
3. **Selected control shows highlighted frame**

Figure 2-1: A: the 4-Way Rocker; B: Soft Menu; C: the assignable keys on the control panel.

To toggle between modes in combined mode, press **ACTIVE MODE***.*

The function of the assignable keys and the controls assigned to the soft menu vary according to the mode in which the system is running. A detailed description of each function is provided with each scanning mode in the following imaging mode sections. In combined modes (i.e. combined Color flow and PW Doppler), one mode is active (live) while the other is frozen. In this case, the assignable keys and Gain rotary knob controls parameters associated with the active mode. Switching the active mode will change the key and Gain rotary knob assignments accordingly.

Using the Assignable Keys Soft Menu

The bottom of the display screen contains a graphics area of soft-menu and assignable keys. This area of the screen is designed to match a parallel set of physical buttons (the assignable keys [refer to Figure 2-1]), located on the upper portion of the control panel. An example of a soft-menu is shown in below.
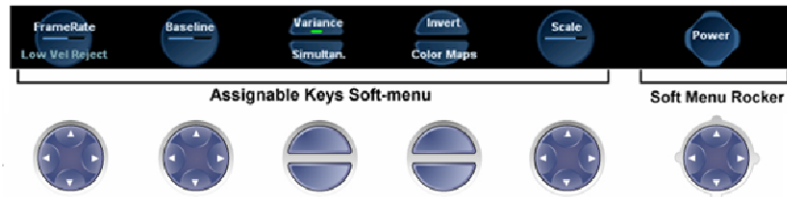
Figure 2-2: The Assignable Keys and Soft Menu

The soft-menu provides access and user control of different system parameters.

The contents of the soft-menu is different for every system *mode*. This provides access to the relevant settings in each of the different modes.

There are several different control key elements in the soft-menu area, as follows:

Variable Single parameter button

In this example, the "Baseline" parameter can be **increased** by pressing the *upper* or *right-hand* area of the corresponding assignable circular button on the keyboard. The same parameter can be **decreased** by pressing on the *lower* or *left-hand* area of the same button.

The bar in the center of the button graphic changes its length to reflect the change in the value of the controlled parameter.

An alternative method for modifying the parameter associated with this button is to click with the mouse pointer on the relevant area of the button graphic.

Variable Dual parameter button
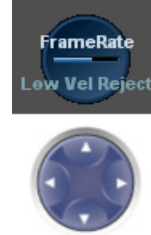
In this example the button has access to either **"Frame Rate"** or **"Low Vel. Reject"** parameters.

When the "Frame Rate" upper label is highlighted, the parameter "Frame Rate" can be **increased** by pressing on the *right-hand* area of the circular assignable button and **decreased** by pressing on the *left-hand* area of the button.

When pressing on the bottom area of the button, the bottom label ("Low vel. Reject" in this example) will be highlighted. In this case, from now on, pressing the right or left area of the circular assignable button will either increase or decrease respectively the value of the lower (highlighted) parameter.

At this point, pressing the upper part of the circular button will, again, associate the button with the upper labeled parameter.

An alternative method for modifying one of the parameters associated with this button is to click with the mouse pointer on the relevant area of the assignable button graphic.

On/Off Toggle button

In this example the active green indicator indicates that the Variance setting is set ON. The "Simultaneous" function is toggled OFF (there is no green indicator).

The user can press the matching upper button to toggle the "**Variance**" function ON or OFF.

User can press the matching lower button to toggle the "**Simultan**." function ON or OFF.

Alternatively, the user can click with the mouse pointer on the relevant button graphic to set the function ON or OFF

Soft Menu rocker button
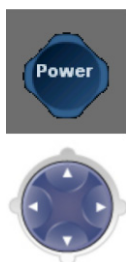
The circular button on the bottom-right area of the screen acts as a soft-menu rocker button. It has access to a different type of soft-menu which pops up on the *right* portion of the screen.

Using the Soft Menu Rocker

The **Soft menu Rocker** on the control panel enables the adjustment of controls mapped in the *Soft menu Window* (see Figure 2-1).

The first row of the soft menu indicates the name of the active mode and its status (freeze/live). The following rows list the mode-specific controls.

The relative setting of each control is indicated by a gauge bar filling the cell as the control value increases.

To select a control from the menu

1. Press any part of the 4-way rocker to display the soft menu.
2. Press the vertical arrows on the 4-way Rocker to navigate up or down through the menu.
    The frame of the selected row is highlighted.

To adjust values

Note: when soft menu is not accessed for a defined period of time it will time-out and disappear from the display.

•   Press one of the horizontal arrows on the 4-way Rocker to adjust the setting of the selected control.

    - **Right arrow** increases control setting.
    - **Left arrow** decreases control setting.

Trackball operation

Different functions can be assigned to the trackball depending on the current active mode. The trackball functions are organized in functional groups. The trackball functional groups are displayed in the lower right corner of the screen. Each group can have one or more controls that can be selected using the keys on the trackball area as described below.

The trackball area consists of:
- The **trackball**: used as a cursor control in acquisition mode, scrolling control in freeze mode and as a selecting tool (like a mouse cursor) in post-processing mode.
- The **ZOOM key**: enables quick access to control zoom position and/or size (see Figure 2-3).
- The **TRACKBALL key**: Toggles between the available trackball function assignments displayed in the *Status ba*r.
- The **SET key**: Performs the selected control or highlighted menu item.
- The **UPDATE MENU key**: enables quick access to various functions form a pop-up menu (see Figure 2-3).
- The **STORE key**: enables digital storage of information displayed in the currently-active image window (see Figure 2-3).

Trackball assignment

The trackball has a multi-mode function. The functions available from the trackball are mode dependent. The available trackball functions for the active mode are displayed on the right side of the *Status line* (Figure 2-3).

To change trackball assignment
- Press **TRACKBALL** in the Trackball area until the desired function is selected highlighted.

The system menu

The system menu enables a quick access to image related functions (see Figure 2-3).
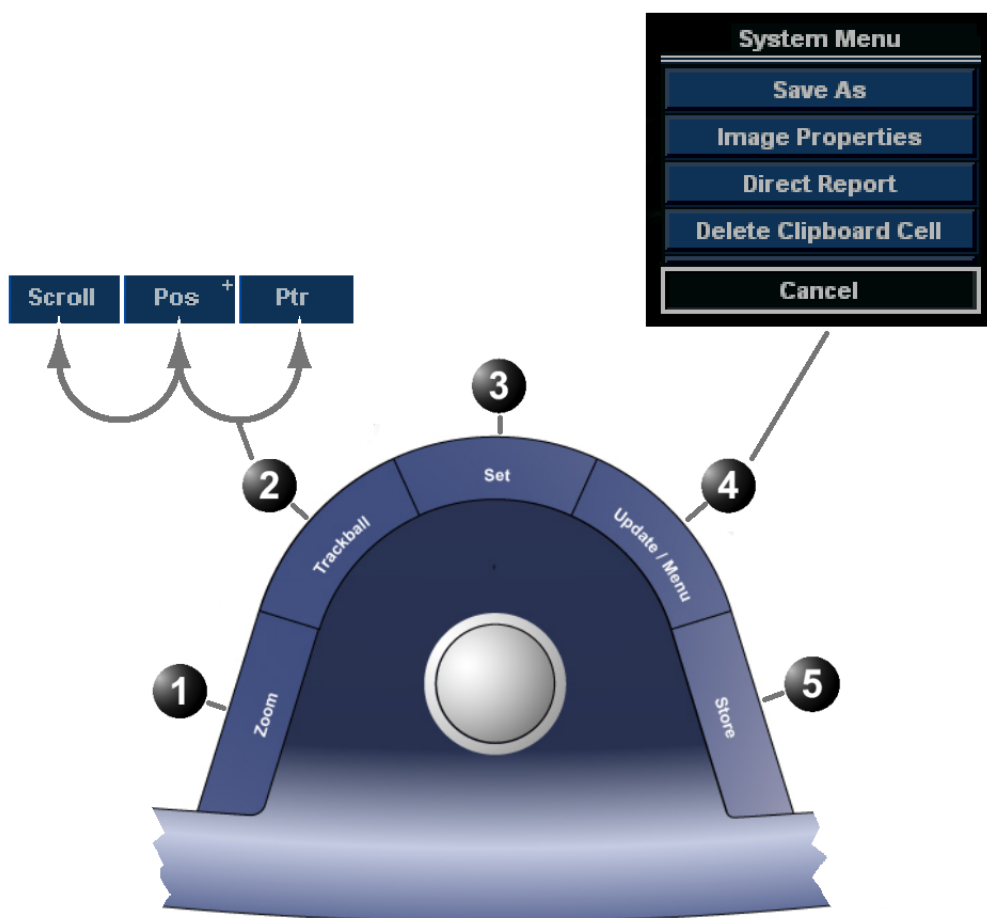
1. **Zoom key: select to enlarge or reduce the image size on the screen.**
2. **Trackball key: select trackball assignment from the functions available in the Status line.**
3. **Set key: perform the selected control or highlighted menu item**
4. **Update Menu key: select the operation to perform from the pop-up System menu.**
5. **Store key: store information displayed in the currently-active image window**

Figure 2-3: The Trackball area

Cineloop operation

When no ECG is connected, a cine gauge is displayed indicating the current frame. in the cineloop.

When the scan mode is frozen, the unit automatically displays cineloop boundary markers on either side of the last detected heart cycles. The cineloop boundaries can be adjusted using the cineloop assignable controls to cover one or more heart cycles.

Cineloop overview
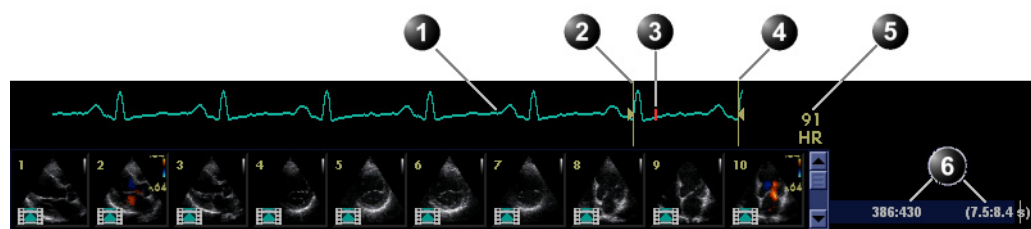
1. ECG
2. Left marker
3. Current frame
4. Right marker
5. Heart rate or Cine speed (in replay)
6. Cine frame number values

Figure 2-4: The cineloop controls display

1. **Assignable keys:**
    • **Left marker**
    • **Right marker**
    • **Cycle select**
    • **Number of cycles**
    • **First Cycle**
    • **Last Cycle**
    • **Sync**
    • **Cineloop**
    • **Select all**

2. **Image Store**

3. **Freeze: Start/stop cineloop**

4. **Trackball:**
    • **Scroll (in freeze)**
    • **Cine speed (in replay)**

Figure 2-5: The cineloop controls on the front panel

Cineloop controls

Cineloop assignable controls

Left / Right Marker

Move the left and right markers to expand or trim the cineloop boundaries.

Cycle select

Selects the heart cycle to be played back.

Number of cycle

Controls the number of heart cycles to be included in the loop.

Select All

Select all heart cycles.

First cycle / Last cycle

Selects the first or last heart cycle to be played back.

Cineloop

Starts cineloop acquisition.

Cineloop Freeze Control

2D Freeze

Toggles between replay and freeze modes.

Cineloop trackball controls

Scroll

When the scan mode is frozen, trackball to move the current marker and review the images

Cine speed

In cine replay mode, move the trackball left or right to adjust the speed of the cineloop playback.

Using cineloop

Selection of a cineloop

1. Press FREEZE.
   The left and right markers on the ECG trace are displayed on either side of the last detected heart cycle.
2. Press the 2D FREEZE button to un-freeze the cineloop and let it run between the default setting of left and right borders.
3. To modify setting of the left or right borders, press the CINELOOP assignable.
   The selected heart beat is played back.
4. Press on the assignable CYCLE SELECT to move from heart beat to heart beat to select the heart cycle of interest.

To jump directly to the first or to the last heart beat press the assignables FIRST CYCLE or LAST CYCLE.

5. Press on the assignable NUM CYCLES to increase or decrease the number of heart beats to be played back.
6. Adjust LEFT MARKER and RIGHT MARKER assignables to trim or expand the cineloop boundaries.

Adjustment of cineloop playback

1. If in freeze mode, press the assignable 2D FREEZE to start cineloop replay.
2. Use the **Trackball** to increase or decrease the speed of the cineloop playback.
   The speed factor is displayed on the right side of the ECG (see Figure 2-4).

To view a cineloop frame by frame

1. If not in freeze mode, press the 2D FREEZE button to freeze the cineloop.
2. Use the **Trackball** to scroll through the cineloop frame by frame.
   Or
   Use the Speed/Frame softkey button.

Storing images and cineloops

Images and cine-loops can be stored at any time during the scanning session. A thumbnail of the stored image is displayed on the clipboard on the scanning screen. An icon will also be displayed in the *Image Browser* and *Image Selection screens*.

The amount of data stored from 2D live is defined by the settings of the current application. The application setting controls the number of cycles included (or time span if ECG is not active), time span before R-wave etc. (refer to page 358 and page 360 for further information).

The amount of data stored in images from 2D replay is determined by the defined cineloop.

Images can be stored in either DICOM and GE Raw Data formats or DICOM format only, depending in the dataflow configuration (refer to page 377 for further information).

To store a single image

1. Press **FREEZE**.
2. Press **STORE** to store the image digitally.
   The thumbnail of the image is displayed on the clipboard. See also page 210 for further information.

To store a cineloop

While in scanning mode, press the **STORE** button to store the last heart-cycle loop. It is possible to configure this function in several ways. Cineloops may be stored directly or after preview, depending on how the system is configured.

While in cine-loop preview mode press **STORE** to store the selected loop.

Cineloop length and loop selection is adjustable in several ways. The procedure for cineloop storage is described on page 210.

Using removable media

The following removable media can be used for data storage:

- 5 1/4" Magneto Optical disk (from Sony only, 1.3, 2.3, 2.6, 5.4, 8.6 and 9.1 Gb)
- USB Flash Card
- CD-R (CD-RW is not supported.)
- DVD-R

Use only 24x or higher CD-R.

CAUTION

Recommendation concerning CD and DVD handling

To avoid data loss, never touch the recordable surface of a disk. Handle the disk only by the outer edge. Do not place it face down on a hard surface. Fingerprints or scratches will make the disk unusable. Before usage, verify that disk surface has no visible scratches. If there are any scratches, do NOT use the disk.

Writing on CD or DVD media

Use specifically recommended for writing on CD or DVD media. **Never** use a solvent-based permanent marker on such media. The following pens are recommended:

- Dixon Ticonderoga "Redi Sharp Plus"
- Sanford "Powermark"
- TDK "CD Writer"
- Smart and Friendly "CD Speed Marker"

Formatting removable media

MOD, CD-R and DVD-R media must be formatted before use, as described in below.

The formatting process will erase any data present on the disk.

CAUTION

To Format a removable media

Removable media used during Disk space management or Backup do not need to be formatted; the formatting process is part of these procedures.

1. Insert the media into the drive.

2. Press **CONFIG**.

3. If required, log on to the system. The Configuration package is opened.

4. Select the category **Connectivity** and select the sheet **Tools** (see Figure 2-6).

Figure 2-6: The Tools Sheet

5. Select the removable media from the *Media* pop-up menu.

6. Enter a name for the removable media in the *Label* field.
   NOTE: Only the following characters and signs can be used when labelling a media: A-Z, a-z, 0-9, underscore (_) and hyphen (-). Do not use more than 11 characters or signs. Do not use space.

7. Select **Format**. A confirmation window is displayed.

8. Select **OK** to continue.

9. Wait for the display of the *Information* window indicating that the formatting process is completed.

10. Select **OK** to continue.

11. Eject the media as described below.

Ejecting removable media

Do not eject the CD using the button on the CD drive.

1. Press $\overline{\text{ALT}}$+$\overline{\text{E}}$ to eject the disk.
    The *Eject device menu* is displayed (Figure 2-7).

Figure 2-7: The Eject device menu

2. Select the relevant media.
    The selected media is ejected.

⚠
CAUTION

When ejecting a MOD, the disk is half way ejected from the MOD station. To avoid unintentional automatic re-insertion, take out the MOD from the MOD station.

Zoom

The Vivid *i* supports Variable display zoom. The Display zoom magnifies the image display in both frozen and live 2D, M-Mode and combined modes with Doppler.

To Magnify an image

Zoom is available in live and replay.

1. Press the ZOOM button. The resulting magnified image appears in the acquisition window while the un-magnified image is displayed in the control window showing the outlined zoom region.
2. Use the **Trackball** to position the zoom area over the desired portion of the image.
3. When in 2D Mode or M-Mode, use the SET button to toggle between Zoom-Scale and Zoom-Location (panning). Both **Scale** and **Pan** are controlled by trackball.
4. When in Color or Doppler modes use the DEPTH button to scale the zoom, while trackball is used for panning.
5. To turn off the Display zoom, press the ZOOM button again.

Performing measurements

To perform measurements

• Press MEASURE to enter the Measurement mode.
  Refer to page 155 for further information.

Physiological ECG trace

The physiological module consists of a single connector, which can accept either a set of electrodes cable or an External-ECG cable, capable of handling external ECG signals from other diagnostic ECG devices.

The scanned image that is displayed is synchronized with the ECG trace. In M-Mode or Doppler, the traces are synchronized to that particular mode's sweep.

The operator can control the gain, the position and the sweep rate of the traces using the assignables on the control panel.

⚠
CAUTION

Use only GE Medical Systems accessories Conductive parts of electrodes and associated connectors for applied parts, including neutral electrodes should not contact other conductive parts, including earth.

Simultaneous use of two or more applied parts will cause summation of patient leakage currents.

Connecting the ECG

The ECG cable consists of a circular connector on one end of the cable and a triple color-coded electrode connectors on the other end. Each electrode cable hooks up to the appropriate stick-on electrode by a color-coded clip type connector.

The color-coding of the electrodes follows one of two standards that are common in different parts of the world. Refer to the following table:

AHA (USA)	IEC (Europe, Asia)
RA: White	L: Yellow
LA: Black	R: Red
RL: Green	N: Black

Connecting External ECG

A special External cable kit that can be ordered as p/n H45021DE. The kit contains a 20-foot coax cable with some additional connectors and adapters to allow interfacing with various external ECG monitors. The type of adapter

should match the connector recommended by the ECG monitor vendor.

Figure 2-8: The Patient ECG Connector Port

Physio controls

Physio assignable controls

Common controls

Horizontal sweep

Adjust the refresh rate of the physiological trace. This control is active only in 2D and color modes. The sweep speed of the physio traces in M-Mode and Doppler is identical to the M-Mode or Doppler horizontal sweep adjusted by the user.

Gain

Enables the user to change the amplitude of the physiological trace displayed on the screen.

Position

Enables the user to move the physiological trace on the screen.

ECG

Turns the ECG trace on and off.

Displaying the ECG trace

Cardiac applications

The ECG is turned on by default in all cardiac applications.

Other applications

1. Press **PHYSIO** on the control panel to get access to the ECG controls.
2. Press the assignable **ECG** to display the trace.

Adjusting the display of the ECG trace

Adjusting the ECG trace sweep speed

1. Press **PHYSIO** on the control panel.
2. Adjust the assignable button **HORIZONTAL SWEEP** to change the sweep speed.

Adjusting the ECG trace amplitude

The ECG signal's amplitude may vary between patients due to different skin moisture and other physiological parameters.

1. Press **PHYSIO** on the control panel.
2. Adjust the assignable button **GAIN** to adjust the amplitude of the trace.

Adjusting the ECG trace position

1. Press **PHYSIO** on the control panel.
2. Adjust the assignable button **POSITION** to move the trace vertically.

Annotations

Text annotations may be inserted anywhere on the screen. The annotation can be free text or a pre-selected text from a mode-specific annotation menu or a user-defined library.

⚠
CAUTION

Annotations (text, arrow or body mark) are created on separate layers. When viewing annotated images on a different system or when zooming the image, the position of the annotations on the image may be slightly changed.

1. **Select to display annotation for other applications**
2. **Exit**
3. **Draw an arrow**
4. **Edit previous annotation**
5. **Pre-defined application-specific annotations**
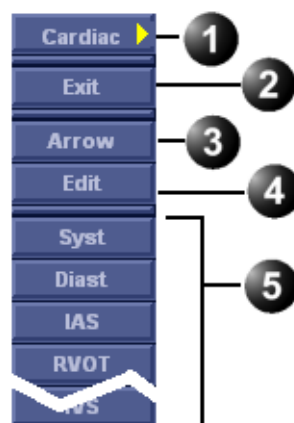
Figure 2-9: The mode-specific annotation menu

To insert an annotation

Free text

While typing, use **BACKSPACE** *to delete backward.*

1. Type the required text.
   A suggested word corresponding to the entered characters is displayed while typing. Press **TAB** to enter the suggested word.
2. Trackball the text entered to the insertion position.
3. Press **SET** to add the annotation.

Pre-defined annotation

Word selection from the Annotation menu
1. Press the alphanumeric key $\overline{\text{TEXT}}$.
   A list of application-specific pre-defined texts is displayed (see Figure 2-9).
   To display a list from another application, select the heading and choose another application.
2. Trackball to the required abbreviation.
3. Press $\overline{\text{SET}}$.
4. Trackball to the position at which the annotation is to be inserted.
5. Press $\overline{\text{SET}}$ to add the annotation.

To draw an arrow
1. Press **Arrow** in the *Annotation menu*.
2. Trackball to the start position of the arrow to draw.
3. Press $\overline{\text{SET}}$ to anchor the arrow.
4. Trackball to the end position of the arrow to draw.
5. Press $\overline{\text{SET}}$ to fix the arrow.

Word selection from the Library

Pre-defined text can be organized in a user configurable, application dependent library with three different sections. The user can easily select a pre-defined text from the Library using the $\overline{\text{ARROW}}$ keys.

Creating a Library
1. Press $\overline{\text{CONFIG}}$.
2. In the Configuration package, select **Meas/Text** category.
3. In the **Meas/Text** category, select **Customize**.
   The *Customize sheet* is displayed (see Figure 2-10).
4. Select a pre-defined text in the *Application pane*.
5. Select **Add** in the desired section.
6. Repeat step 4 and 5 to populate the library.
7. To remove a pre-defined text from the library, select the pre-defined text to remove and press **Del**.
8. To order the pre-defined text in a section, select the pre-defined text to move and select **Up** or **Down** buttons to move the word accordingly.

9. To exchange sections order, enter the sections to swap next to *Swap columns button* and press **Swap columns**.

10. Customized text may be added to the Application pane by the special window on the lower area of the *Customize sheet*.

11. Press **Save** to store the library.

1. **The Application pane**
2. **Library section**
3. **Insert selected pre-defined text in the section.**
4. **Remove selected pre-defined text from the section.**
5. **Move pre-defined text within the section.**
6. **Re-order sections.**
7. **Save Library**

Figure 2-10: The Customize sheet

Using the Library

1. Press any **ARROW** key.
   The pre-defined texts from the last used group are displayed in the *Status bar* at the bottom of the screen, with the active word within square brackets.

2. To select a pre-defined text within a section, press **ARROW UP** or **ARROW DOWN** until the desired word is selected.
3. To change section, Press **LEFT ARROW** until the desired section is displayed in the *Status bar*.
4. To insert the selected pre-defined text, press **RIGHT ARROW**.

To edit annotation

1. Press the alphanumeric key **TEXT**.
2. Press **Edit** in the *Annotation menu*.
   The pointer is changed to a cross marker.
3. Trackball to the annotation to edit.
4. Press **SET**.
   Once selected, the annotation can be moved freely.
   The text can be edited using the following alphanumeric keys:
   - **RIGHT ARROW**: moves the text cursor forward.
   - **LEFT ARROW**: moves the text cursor backward.
   - **TAB**: moves the text cursor by word forward.
   - **SHIFT** + **TAB**: moves the text cursor by word backward.
   - **BACKSPACE**: deletes backward.
   - **DELETE**: deletes the selected word.
   - **INSERT**: toggles the text entry state from overwrite to insert mode.
5. Do the appropriate changes to the annotation.
6. Press **SET** to anchor the edited annotation.

To erase annotation

To erase all annotations on the screen in one operation, press the alphanumeric key **PAGE ERASE**.

To erase annotation words one at a time, hit **DELETE** button on the alphanumeric keyboard. Each button-press will delete a single word in reversed order.

Configuration of the pre-defined annotation list

1. Press $\overline{\text{CONFIG}}$.
2. In the Configuration package, select **Meas/Text** category.
3. In the *Meas/Text category* select **Annotation**.
   The *Annotation sheet* is displayed where the user can add, delete or re-arrange the annotation text (see Figure 2-11).

To re-arrange the annotation list

1. Trackball to the actual annotation text.
2. Press $\overline{\text{SET}}$.
3. Press the relevant button (i.e. **Delete**, **Move up** or **Move down**) to apply change.
4. Press **save** to store the new annotation list.

To add an annotation text

1. Trackball to the text entry field (see Figure 2-11).
2. Press $\overline{\text{SET}}$ to activate the text cursor.
3. Type the new annotation text.
4. Press **add**.
   The new annotation text is added at the end of the list.
5. Press **save** to store the new annotation list.
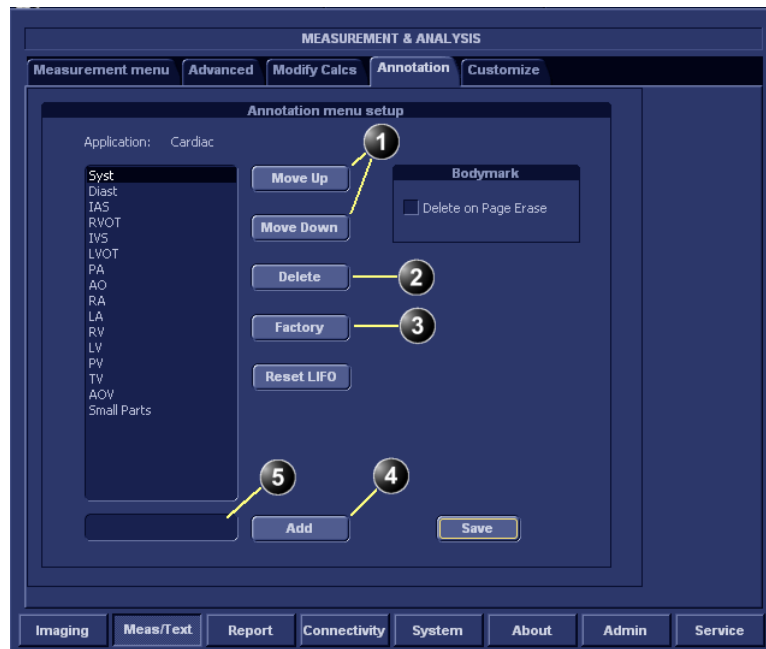
1. **Rearrange list**
2. **Delete selected text**
3. **Reset to factory default**
4. **Add new text to the list**
5. **Enter new text**

Figure 2-11: The Annotation Menu Configuration Dialog Box

Bodymarks

Bodymarks are small graphic images that represent the anatomy being examined. Using bodymarks, the user can indicate the position that the probe was in during the examination.

Inserting a bodymark

1. Press the alphanumeric key **BODYMARK**.
    The *Bodymark menu* is displayed showing a selection of bodymarks relative to the selected exam category.

1. **Select and display bodymark list for other applications**
2. **Exit bodymark menu**
3. **Erase bodymark**
4. **Bodymark list for the current application**
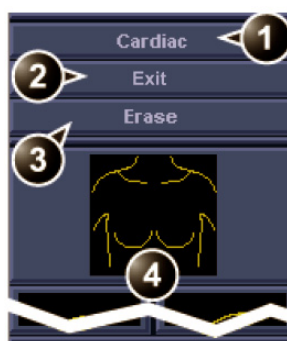
Figure 2-12: The Bodymark menu

2. Trackball to the desired bodymark and press **SET**.
    The bodymark with a probe marker is displayed on the scanning screen.

1. **Probe marker**

Figure 2-13: The bodymark with probe marker

3. Using the trackball, adjust the position of the probe marker and press **SET**.
4. Using the trackball, adjust the probe marker orientation and press **SET**.

Deleting a bodymark

1. Press the alphanumeric key $\overline{\text{BODYMARK}}$.
   The *Bodymark menu* is displayed

2. Select **Erase**.

When pressing $\overline{\text{PAGE ERASE}}$ on alphanumeric keyboard the bodymark will be erased, provided it has been configured this way.

To change the configuration
1. Press $\overline{\text{CONFIG}}$.

2. In the Configuration package, select **Meas/Text** category.

3. In the *Meas/Text category* select **Annotation** (see Figure 2-11).

4. Check or uncheck the "**Delete on Page erase**" option.

Chapter 3
Scanning Modes

Introduction

The Vivid *i* ultrasound scanner provides several basic scanning modes and several options for combining the use of these modes.

The following scanning modes are described in this chapter:
- 2D Mode Imaging
- M-Mode Imaging
- Anatomical M-Mode
- Color Mode Imaging
- Doppler Mode Imaging
- Angio
- Tissue Velocity Imaging

See page 210 for further information on image and cineloop storage.

When performing an examination using any of these modes, images and image sequences (cineloops) can be stored. The examination or part of it can also be stored on video tape, CD-R, DVD-R and other various media, depending on available options.

2D-Mode

2D-Mode overview
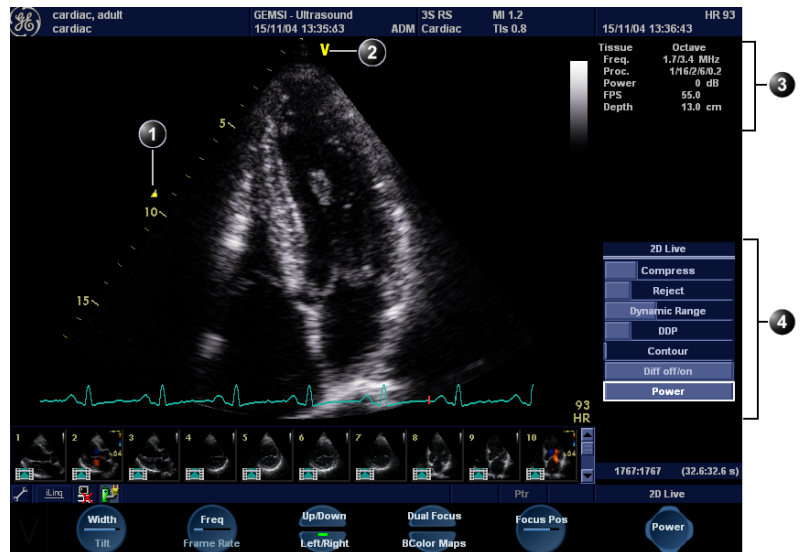
1. **Focus marker**
2. **Probe orientation marker**
3. **Status window**
4. **Soft menu**

Controls marked with **R** are also available in freeze and cine replay

Figure 3-1: The 2D screen (cardiac)

1. **Assignable keys:**
   - **Width**
   - **Frequency**
   - **Focus**
   - **Frame rate**
   - **Up/Down R**
   - **Left/Right R**
   - **Cineloop (in Freeze, only)**
   - **Dual focus**
   - **B color maps**
   - **Select all**
2. **Zoom**
3. **Depth**

4. **Soft menu**
   - **Compress R**
   - **Reject R**
   - **Dynamic Range**
   - **DDP R**
   - **Tilt**
   - **Speckle reduce**
   - **Contour**
   - **Diff On/Off**
   - **Power**
5. **Freeze**
6. **2D**
7. **Gain**

Figure 3-2: The 2D controls on the front panel

Note: The sweep speed information displayed in the bottom right corner of the image represents the user selected sweep speed and should be used only as a reference to confirm that the image was acquired at the selected sweep speed. It is not to be used for measurements or analysis. This is not an absolute value, but simply a reference number. Users performing studies using standardized protocols may find this sweep speed information useful for reading studies from other institutions.

The 2D mode displays a two-dimensional gray scale image of the tissue within the probe's field of view. 2D mode can be combined with:

In combined mode, press ACT. MODE to toggle between modes and access to the mode specific controls.

- M-Mode, see "M-Mode" on page 90
- Color Mode, see "Color Mode" on page 95
- CW or PW Doppler Mode, see "PW and CW Doppler" on page 101
- Color and Doppler Modes (triplex)

2D-Mode controls

2D assignable controls

Width

Controls the size or angular width of the 2D image sector. A smaller angle generally produces an image with a higher frame rate.

Focus

Changes the location of the focal point(s). A triangular focus marker indicates the depth of the focal point.

Frame rate

Adjusts frame rate (FPS). The relative setting of the frame rate is displayed in the status window. When adjusting frame rate, there is a trade off between spatial and temporal resolution.

Frequency

Enables the adjustment of the probe's operating frequency. The selected frequency is displayed in the status window. For some probes/applications the lowest frequency settings will be Octave imaging settings.

Invert

*   **Left/Right Invert**: enables a mirror image of the 2D image to be created. The left/right reference marker **V** moves to the other side of the image.
*   **Up/Down Invert**: enables the 2D image to be flipped 180 degrees.

Dual focus

Activates Dual focus mode. To adjust the location of the Dual focus, activate the FOCUS assignable.

Color maps

Displays a color map menu to optimize the greyscale presentation. The menu enables an option from a list of non-linear gray-curves or different 2D-colorized curves to be selected. Use the **trackball** to highlight a color map and press SET to activate the desired map.

Cineloop (in Freeze only)

Allocates different cineloop control functions to the assignable soft keys.

Gain

When rotated clockwise, increases the overall gain applied to the received echo signals equally for all depth.

Time Gain Compensation (TGC)

Compensates for depth-related attenuation in an image. The sliders nearest the operator affect the far field. TGC amplifies returning signals to correct for the attenuation caused by tissue at increasing depths.

Automatic Tissue Optimization (ATO)

ATO provides an automatic optimization of the 2D image by adjusting the gray scale curve. Press the 2D GAIN rotary to toggle ATO on or off. When activated, ATO is displayed in the information window.
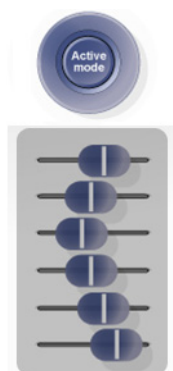
Depth

Sets the maximum (far field) distance that will be imaged. Decreasing the depth may allow higher frame rates.

2D Soft menu controls

Compress

Controls the amount of contrast in the 2D image. An index number is displayed in the status window to indicate the relative level of compression.

Reject

Adjust reject level. When this control is increased, low-level echoes are rejected and appear darker in the 2D image. An index number is displayed in the status window to indicate the relative level of rejection.

Dynamic Range

Enables control of the dynamic range or contrast of the image. When dynamic range is set high, the image is softer and more low-level data is visible.

DDP (Data Dependent Processing)

Performs temporal processing which reduces random noise without affecting the motion of significant tissue structures. An index number is displayed in the status window (under Proc) to indicate the relative DDP level.

Tilt

Enables the axis of the 2D image to be tilted to the left or right. By using this control in combination with angle control the image can be "aligned" to the direction of interest, and frame rates be optimized. By default the axis of symmetry of a 2D image is vertical. (Applicable only for cardiology applications).

Speckle reduce

Reduces the unwanted effects of speckle in the ultrasound image. Image speckle usually appears as a grainy texture in otherwise uniform areas of tissue. Its appearance is related to image system characteristics, rather than tissue characteristics, so that changes in system settings, such as probe type, frequency, depth, and others, can change the appearance of the speckle.

Too much speckle can impair image quality and make it difficult to see the desired detail in the image. Likewise, too much filtering of speckle can mask or obscure desired image detail. Extra care must be taken to select the optimal Speckle reduction level.

Contour

Controls image processing related to the extent of edge enhancement applied to an image.

Diff On/Off

Affects the level of reverberations in the image. When turned On, the frame rate (or the number of focal zones) will decrease, while the reverberations will be attenuated. (Applicable only for cardiology applications).

Power

When power is reduced, it reduces the signal-to-noise ratio, so that the image may become noisier.

Controls the amount of acoustic power applied in all modes. When power is set to maximum, it is equal to or less than the maximum acoustic power permitted by the FDA. The Thermal Index (TI) and the Mechanical Index (MI) are displayed on the screen.

Using 2D

Check the Display's brightness and contrast setting before adjusting the unit imaging controls (see page 44).

The 2D-Mode is the system's default mode.

1. Press $\overline{\overline{2D}}$ on the control panel to access 2D mode.

2. Optimize the image by adjusting the image controls described in the previous section.
   If necessary use preset for optimum performance with minimum adjustment.

Optimizing 2D

The following controls can be adjusted to optimize the 2D Mode display:

- Use the **Gain** and **TGC** controls to optimize the overall image.
- Use the **Depth** control to adjust the range to be imaged.
- Use the **Focus** control to center the focal point(s) around the region of interest.
- Use the **Frequency** (move to higher frequencies) or the **Frame rate** control (move to lower frame rate) to increase resolution in image
- Use the **Frequency** (move to lower frequency) to increase penetration.
- Use the **Reject** control to reduce noise in the image.
- Use the **DDP** control to optimize imaging in the blood flow regions and make a cleaner, less noisy image.

⚠

WARNING

Always use the minimum power required to obtain acceptable images in accordance with applicable guidelines and policies.

M-Mode

M-Mode overview
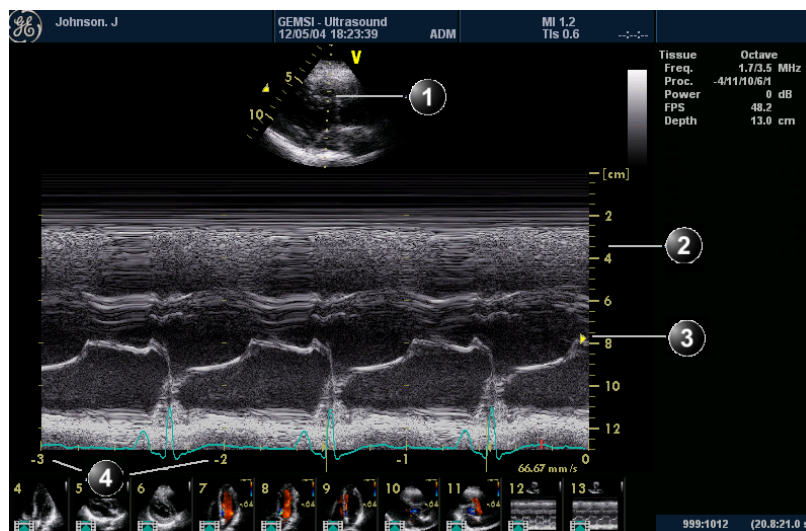
1. **Time motion cursor conventional M-Mode**
2. **Depth Scale**
3. **Focus Marker**
4. **Time Scale**

Figure 3-3: The cardiac M-Mode screen (top/bottom)

This unit has two types of M-Mode:

- Conventional M-Mode (MM): displays a distance/time plot of a cursor line in the axial plane of the 2D-image.
- Anatomical M-Mode (AMM): displays a distance/time plot from a cursor line, which is independent from the axial plane. AMM is available in greyscale, Color, TVI or in Tissue Tracking modes.

M-Mode and 2D Mode display areas can be side by side or top/bottom. Conventional M-Mode can be combined with Color (see "Color M-Mode overview" on page 96).

M-Mode controls

M-Mode assignable controls

Horizontal sweep

Adjusts the horizontal refresh rate of the M-Mode area of the display. Horizontal sweep does not change the acquisition resolution, so that user can change the horizontal sweep in replay (with no loss of quality).

On some low frequencies, the system switches automatically to second-harmonic mode. The word "Octave" appears in the status window.

Frequency/Resolution

Enables the adjustment of the probe's operating frequency. Rotate the knob clockwise to increase the frequency. The selected frequency is displayed in the status window. For some probes/applications the lowest frequency settings will be Octave imaging settings.

Focus

Changes the location of the focal point(s). A triangular focus marker indicates the depth of the focal point.

Contour

Controls image processing related to the extent of edge enhancement applied to an image.

Up/Down

Flips the M-Mode display 180 degrees.

Layout

Toggles the display arrangement to define relative dimensions of the 2D area, M-mode area, and their position which is either top/bottom or side-by-side.

Color maps

Displays a color map menu to optimize the greyscale presentation. The menu enables an option from a list of non-linear gray-curves or different colorized curves to be selected. Use the trackball to point to a color map and press <u>SET</u> to activate the desired map.

M-Mode Soft menu controls

Compress

Controls the amount of contrast in the image. An index number is displayed in the status window to indicate the relative level of compression.

Reject

Adjust reject level. When this control is increased, low-level echoes are rejected and appear darker in the image. An index number is displayed in the status window to indicate the relative level of rejection.

Power

When power is reduced, it reduces the signal-to-noise ratio, so that the image, spectrum or color scan may become noisier.

Controls the amount of acoustic power applied in all modes. When power is set to maximum, it is equal to or less than the maximum acoustic power permitted by the FDA. The Thermal Index (TI) and the Mechanical Index (MI) are displayed on the screen.

Dynamic Range

Enables control of the dynamic range or contrast of the image. When dynamic range is set to High, the image is softer and more low-level data is visible.

Using M-Mode

Conventional M-Mode (greyscale)

1. While in 2D-Mode press cursor on the control panel.
2. Use the **trackball** to position the cursor over the required area of the image.

Gain, Frequency, Focus, Dynamic Range and Compression affect also the 2D image.

3. Press $\overline{\text{MM}}$ - the M-mode sweep will start to sweep.
4. Press $\overline{\text{FREEZE}}$ to stop imaging.

OR

Gain, Frequency, Focus, Dynamic Range and Compression affect also the 2D image.

1. While in 2D-Mode press $\overline{\text{MM}}$ on the control panel. The M-mode sweep will start to sweep.
2. Use the **trackball** to position the cursor over the required area of the image.

Gain, Frequency, Focus, Dynamic Range and Compression affect also the 2D image.

3. Adjust horizontal sweep, Gain, Frequency, Focus, Dynamic Range, Compression and Contour to optimize the display if necessary.
4. Press FREEZE to stop imaging.

Conventional Color M-Mode

1. While in Color Mode press cursor on the control panel.
2. Use the **trackball** to position the cursor over the required area of the image.
3. Press MM - the Color M-mode sweep will start to sweep.
4. Press FREEZE to stop imaging.

OR

1. While in Color Mode press M on the control panel. The Color M-mode sweep will start to sweep.
2. Use the **trackball** to position the cursor over the required area of the image.
3. Adjust horizontal sweep, Gain, Frequency, Focus, Dynamic Range, Compression and Contour to optimize the display if necessary.
4. Press FREEZE to stop imaging.

Anatomical M-Mode

Anatomical M-Mode is *only available for cardiac applications*.

Anatomical M-Mode can also be used with previously acquired digitally stored 2D images.

1. Enter live M-mode.
2. Press the assignable AMM soft key to enter **Live Anatomical M-mode**. Continue to step 4 below.

OR

While in 2D-Live or 2D-Freeze modes, press ALT button and press the assignable AMM soft-key

OR

1. From the 2D Live, press FREEZE.
2. Press MM to access the **Freeze Anatomical M-Mode**.

*The Trackball assignable **Pos** (Position) is activated.*

3. Use the **trackball** to position the cursor over the required area of the image.

*The Trackball assignable **Angle** is activated.*

4. Press TRACKBALL to allow free rotation of the solid full-length cursor line throughout the 2D image.
5. Rotate the solid cursor line to the desired direction.

*The Trackball assignable **Pos** is activated.*

6. Press $\overline{\text{TRACKBALL}}$ twice and reposition the intersection point to the desired position along the cursor line.

7. Repeat steps 4. and 5. to change the angle of the solid cursor line if necessary.

The M-Mode area of the display updates as the M-Mode signal is constructed.

8. Press $\overline{\text{TRACKBALL}}$ to activate scrolling control on the trackball.

9. Use the **trackball** to scroll through the data acquired at that location. The M-Mode display will vary accordingly.

Optimizing M-Mode

Refer to page 360 about creating presets.

The use of preset gives optimum performance with minimum adjustment. If necessary, the following controls can be adjusted to further optimize the M-Mode display:

- Adjust **Horizontal sweep** to optimize the display resolution.
- Adjust **Gain** and **TGC** controls to adjust the range to be imaged.

*Except for **Contour**, all the controls listed in the optimizing M-Mode section will also affect the 2D image.*

- Use the **Frequency** (move to higher frequencies) or the **Frame rate** control (move to lower frame rate) to increase resolution in image.
- **Use the Frequency (move to lower frequency) to increase penetration**.
- Adjust **Focus** to move the focal point(s) around the region of interest in the M-Mode display.
- Adjust **Dynamic range** to optimize the useful range of incoming echoes to the available greyscale.
- Adjust **Compress** and **Contour** to further optimize the display.
- Adjust **Reject** to reduce noise while taking care not to eliminate significant low-level diagnostic information.

Color Mode

Color Mode overview
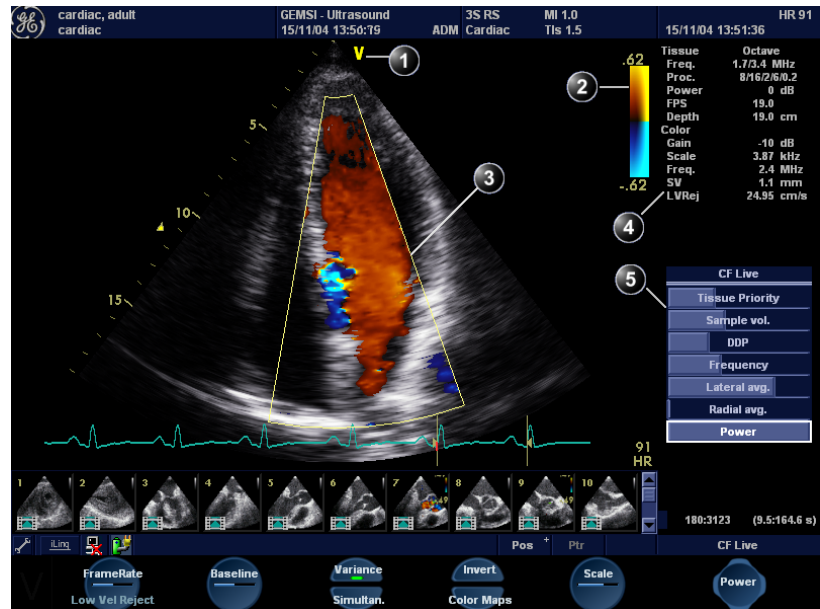
1. **Probe orientation marker**
2. **Color bar**
3. **Color sector marker**
4. **Status window**
5. **Soft menu**

Figure 3-4: The Color Mode screen

Color M-Mode overview
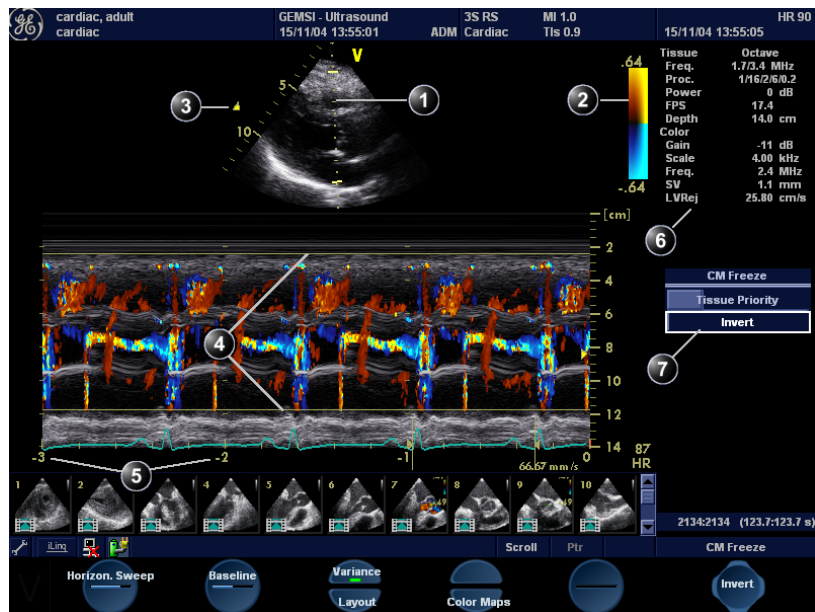
1. **Time motion cursors**
2. **Color bar**
3. **Focus marker**
4. **Flow sector marker**
5. **Time scale**
6. **Status window**
7. **Soft menu**

Figure 3-5: The Color M-Mode screen (top/bottom display)

Color Mode controls

Color Mode assignable controls

Horizontal sweep (Color M-Mode only)

Adjusts the horizontal refresh rate of the M-Mode area of the display.

Scale

Adjusts the repetition rate of the Doppler pulses transmitted to acquire the data for color flow mapping. The Scale (Nyquist limit) should be adjusted so that no aliasing occurs, while still having good resolution of velocities. The Nyquist limit should be somewhat above the maximum velocity found in the data.

Baseline

Adjusts the color map to emphasize flow either toward or away from the probe. Baseline is available in both Live and Freeze.

LVR (Low Velocity Rejection)

*Color data pro-
duced by very low
flow may cause in-
terference.*

LVR, also called Wall motion filter, enables the extent of low velocity removal to be adjusted.

Invert

Enables the color scheme assigned to positive and negative velocities to be inverted. Invert is available in live and cine replay.

Variance

Controls the amount of variance data added to a color display. Variance enables computer-aided detection of turbulent flow (e.g. jets or regurgitation). Variance is available in live and cine replay.

Color maps

Displays a menu of color map options. Use the **trackball** to point to a color map and press SET to activate the desired color map. Each color map is assigning different color hues to different velocities.

Cineloop (in Freeze, Color 2D mode only)

Allocates different cineloop control functions to the assignable soft keys.

Color-Mode Soft menu controls

Tissue priority

Emphasize either the color of the color mode or the greyscale tissue detail of the 2D image. Tissue priority is available in both Live and Freeze.

Sample volume

Adjusts the size of the color flow Doppler sampling area. Lower setting gives better flow resolution while a higher setting increases sensitivity and helps to locate turbulent flows.

Frequency

Enables the adjustment of the transmission frequency to control the sensitivity or the level of penetration. The selected frequency is displayed in the status window. Adjusting Frequency may affect Sample Volume and LVR settings.

Lateral Averaging (Color 2D only)

Smooths the image by averaging collected data along the same horizontal line. An increase of the lateral averaging will reduce noise, but this will also reduce the lateral resolution.

Radial Averaging

Use Averaging controls with caution so as not to obscure significant diagnostic information

Smooths the image by averaging collected data along the same radial line. An increase of the radial averaging will reduce noise, but this will also reduce the radial resolution.

Power

When power is reduced, it reduces the signal-to-noise ratio, so that the image may become noisier.

Controls the amount of acoustic power applied in all modes. When power is set to maximum, it is equal to or less than the maximum acoustic power permitted by the FDA. The Thermal Index (TI) and the Mechanical Index (MI) are displayed on the screen.

Trackball controls

ROI (Region Of Interest) size

When the trackball command **Size** is selected (see also "Trackball operation" on page 58), the height and width of the color area (or ROI) is adjusted from the trackball.

ROI (Region Of Interest) position

When the trackball command **Pos** (position) is selected (see also "Trackball operation" on page 58), the position of the color area (or ROI) is adjusted with the trackball.

Using Color Mode

Color 2D

1. From an optimized 2D image press COLOR.

The assignable controls of the trackball are displayed in the trackball status bar in the bottom right corner of the screen.

2. Use the **trackball** to position the ROI frame over the area to be examined.

3. Press SET. The instruction **Size** should be highlighted in the trackball status bar. If not, press SET again to select **Size**.
   NOTE: If the trackball control Pointer is selected, press TRACKBALL to be able to select between Position and Size controls.

4. Use the **trackball** to adjust the dimensions of the ROI.
   To enlarge or narrow the ROI, move the **trackball** to the left or right.
   To lengthen or shorten the ROI, move the **trackball** up or down.

5. Press SET when the desired size is obtained, to allow repositioning of the ROI if desired.

6. Press FREEZE to stop imaging.

Color M-Mode

1. From M-Mode press COLOR, or from Color-Mode press MM.

The assignable controls of the trackball are displayed in the trackball status bar.

2. Use the **trackball** to position the color area in the M-Mode display.

3. Press the SET button. The instruction **Size** should be highlighted in the trackball status bar. If not, press SET again to select **Size**.
   NOTE: If the trackball control Pointer is selected, press TRACKBALL to be able to select between Position and Size controls.

4. Use the **trackball** to adjust the dimension of the color area.
   To enlarge the color area, move the **trackball** up
   To narrow the color area, move the **trackball** down.

5. Press SET when the desired size is obtained.

Optimizing Color Mode

Refer to page 360 about creating presets.

The use of preset gives optimum performance with minimum adjustment. If necessary, the following controls can be adjusted to further optimize the Color Mode display:

- Adjust the **Active mode gain** to set the gain in the color flow area.

The scale value may affect FPS, Low Velocity Reject, and Sample Volume.

- Adjust **Scale** to the highest setting that provides adequate flow detection.
- Adjust *Low Velocity Reject* to remove low velocity blood flow and tissue movement that reduces image quality.
- Adjust **Variance** to detect flow disturbances.
- Adjust **Sample volume** (SV) to a low setting for better flow resolution, or a higher setting to more easily locate disturbed flows

Frequency setting may affect FPS, SV and Low Velocity Reject.

- Adjust **Frequency** to optimize the color flow display. Higher settings improve resolution. Lower settings improve depth penetration and sensitivity. This does not affect the frequency used for 2D and M-Mode.

The Power setting affects all other operating modes.

- Adjust **Power** to obtain an acceptable image using the lowest setting possible.

Adjust the following settings to further optimize display of the image:

- Use **Invert** to reverse the color assignments in the color flow area of the display.
- Use **Tissue priority** to emphasize either the color flow overlay, or the underlying greyscale tissue detail.
- Use **Baseline** to emphasize flow either toward or away from the probe.
- Use **Radial** and **Lateral Averaging** to reduce noise in the color flow area. Radial and Lateral Averaging smooths the image by averaging collected data along the same horizontal line. An increase of the lateral averaging will reduce noise, but this will also reduce the lateral resolution.

$\triangle$
CAUTION

Use all noise reduction controls with care. Excessive application may obscure low level diagnostic information.

PW and CW Doppler

PW and CW Doppler overview
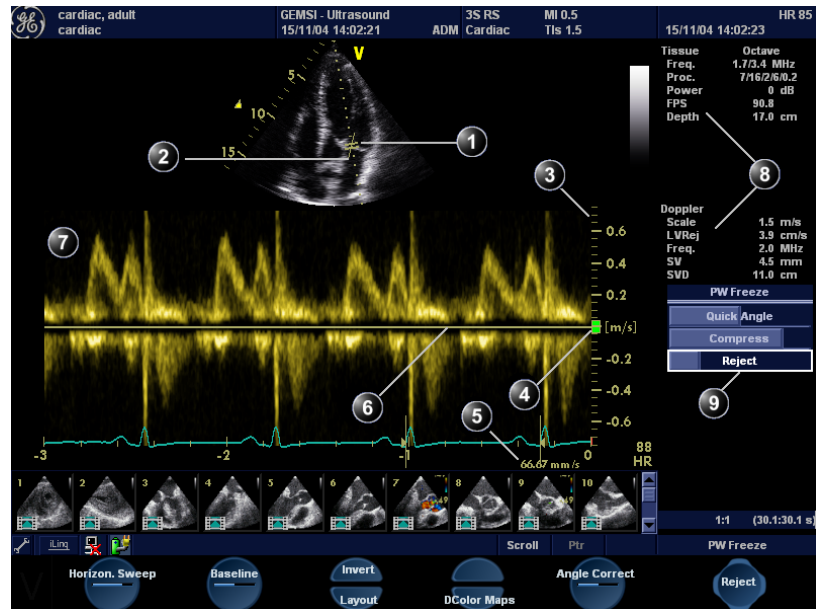
1.   **Sample volume (PW only)**
2.   **Angle correction marker**
3.   **Velocity scale**
4.   **Low velocity reject**
5.   **Nyquist velocity**
6.   **Doppler baseline**
7.   **Frequency scale (optional, see page 357)**
8.   **Status window**
9.   **Soft menu**

Figure 3-6: The PW/CW Doppler Mode screen

Note: The sweep speed information displayed in the bottom right corner of the image represents the user selected sweep speed and should be used only as a reference to confirm that the image was acquired at the selected sweep speed. It is not to be used for measurements or analysis. This is not an absolute value, but simply a reference number. Users performing studies using standardized protocols may find this

sweep speed information useful for reading studies from other institutions.

PW and CW Doppler controls

PW and CW Doppler assignable controls

Horizontal sweep

Adjusts the horizontal refresh rate of the Doppler area of the display. Horizontal sweep is available in live and cine replay.

Baseline

Enables the Doppler baseline to be shifted up and down. The default Doppler baseline is set at the center of the vertical aspect of the Doppler display, dividing evenly the flow toward and away from the probe. By adjusting the baseline a larger portion of the analysis is assigned to the flow direction present. Baseline is available in live and cine replay.

Maximum velocity depends on sample volume size, sample volume position and frequency settings.

Scale

Enables the vertical scale of the Doppler spectrum and the maximal detectable velocity to be modified. Velocity range directly controls the pulse repetition frequency, which is responsible for the setting of the Nyquist limit (the ability to detect maximum velocity without aliasing).

Low velocity reject

Enables the low velocity portions of the spectrum to be filtered, since the Doppler spectrum and audio may contain strong wall-motion signals. The amount of Low Velocity Reject. is indicated by the green vertical bar at the right end of the baseline.

If the Doppler mode is combined with Color mode, the color map will be also inverted.

Invert

Enables the Doppler spectrum to be flipped 180 degrees, so that negative velocities are displayed above the baseline and positive velocities below the baseline. Invert is available in live and cine replay.

ASO

Automatic Spectrum Optimization (ASO) is used to automatically adjust baseline and scale of current PW/CW spectrum to optimize the spectral display. It will avoid the

display of a folded spectrum and stretch the spectrum vertically as large as possible.

Optimization is instantly performed when the button is pressed.

LPRF (PW mode)

Sets the pulse repetition frequency for the PW Doppler acquisition of flow data. Enables toggling between high and low Pulse Repetition Frequency (PRF). When the Doppler PRF is raised beyond a certain limit, more than one Doppler gate is displayed on the screen.

Layout

Toggles the display arrangement to define relative dimensions of the 2D area, Doppler-spectrum area, and their position which is either top/bottom or side-by-side.

Color maps

Displays a drop down menu of different Doppler colorization maps. Use the **trackball** to select the desired map and press $\overline{\text{SET}}$ to activate the map.

PW/CW Doppler Soft menu controls

Quick angle and Angle correction

*In non-cardiac applications, **Angle correction** is controlled from the Trackball.*

Enables correction of the Doppler velocity scale by defining the angle between the Doppler beam and the investigated blood vessel or blood flow. A thin cross bar on the Doppler cursor will rotate as the control is adjusted. Angle correction is available in both Live and Freeze.

Quick angle adjusts the angle by 60 degrees.

Angle correction adjusts the angle between zero and 90 degrees with one degree increment.

Sample volume

In PW mode, set the longitudinal size of the region to be sampled for measurement. Adjusting Sample volume may affect the PRF (Nyquist limit) settings. SV does not apply to CW mode, where the volume sampled is the full length of the area indicated by the cursor line.

Compress

Enables control over the contrast of the Doppler spectrum. When compression is raised, the spectrum image becomes softer and some low level background noise may appear. Compress is available in both Live and Freeze.

Reject

Enables undesirable background noise to be removed from the Doppler spectrum resulting in a darker background. Reject is available in both Live and Freeze.

Frequency

Adjusts the transmission frequency in Doppler to control sensitivity or level of penetration. The selected frequency is displayed in the status window. Adjusting Frequency may affect Sample Volume (PW) and LVR settings.

Frame rate

Adjusts the frame rate. The relative setting of the frame rate is displayed in the status window (under 2D).

Power

When power is reduced, it reduces the signal-to-noise ratio, so that the image may become noisier.

Controls the amount of acoustic power applied in all modes. When power is set to maximum, it is equal to or less than the maximum acoustic power permitted by the FDA. The Thermal Index (TI) and the Mechanical Index (MI) are displayed on the screen.

Using PW/CW Doppler modes

Controls and operations for PW and CW mode are the same unless otherwise noted.

There are two ways to start PW/CW Doppler:

Alternative 1

1.   Press $\overline{PW}$ or $\overline{CW}$. A scanning screen is displayed with a Doppler cursor on the 2D mode image and a Doppler spectrum in the lower part of the screen.

2.   Use the **trackball** to position the Doppler cursor line and in PW the sample volume location over the area of interest.

Sample Volume adjustment may affect the Scale, Frame rate and LV rej. settings.

3. In PW, with the **Soft menu rocker key**, adjust the sample Volume (SV):
    To enlarge the SV, press the **Right arrow** of the rocker
    To narrow the SV, press the **Left arrow** of the rocker.

Alternative 2

1. Press CURSOR on the control panel. A cursor line is displayed on the 2D image.
2. With the **trackball** adjust the position of the cursor line.
3. Press PW or CW.

Optimizing PW/CW Doppler modes

Refer to page 360 about creating presets

The use of preset gives optimum performance with minimum adjustment. If necessary, the following controls can be adjusted to further optimize the PW/CW modes display:

*   Adjust the **Active mode gain** to set the gain in the spectral Doppler area.
*   Adjust **Low velocity reject** to reduce unwanted low velocity blood flow and tissue movement.
*   In PW mode, adjust **Sample volume** to low setting for better resolution, or higher setting to more easily locate the disturbed flows.
*   Adjust the **Compress** setting to balance the effect of stronger and weaker echoes and obtain the desired intensity display.

Frequency and Frame rate settings may affect the Low Velocity Reject.

*   Adjust **Frequency** to optimize flow display. Higher setting will improve resolution and the lower setting will increase the depth penetration.
*   Adjust **Frame rate** to a higher setting to improve motion detection, or to a lower setting to improve resolution.

The Doppler Power setting affects only Doppler operating modes.

*   Adjust Power to obtain an acceptable image using the lowest setting possible. This is particularly important in CW mode, as the energy duty cycle is 100% (constant).

$\triangle$

CAUTION

Use all noise reduction controls with care. Excessive application may obscure low level diagnostic information.

Adjust the following settings to further optimize the display of the image.

- Use the **Horizontal sweep** to optimize the sweep speed.
- To view signal detail, use the **Velocity range** to enlarge the vertical spectral Doppler trace.
- Use **Invert** to reverse the vertical component of the spectral Doppler area of the display.

*When **Zoom** is active while in **PW** or **CW** modes, use the **Depth** rocker button to adjust the zoom magnification factor*

- Use **Angle correction** to steer the ultrasound beam to the blood flow to be measured (Not typically required during cardiac studies).

Tissue Velocity Imaging (TVI)

TVI overview
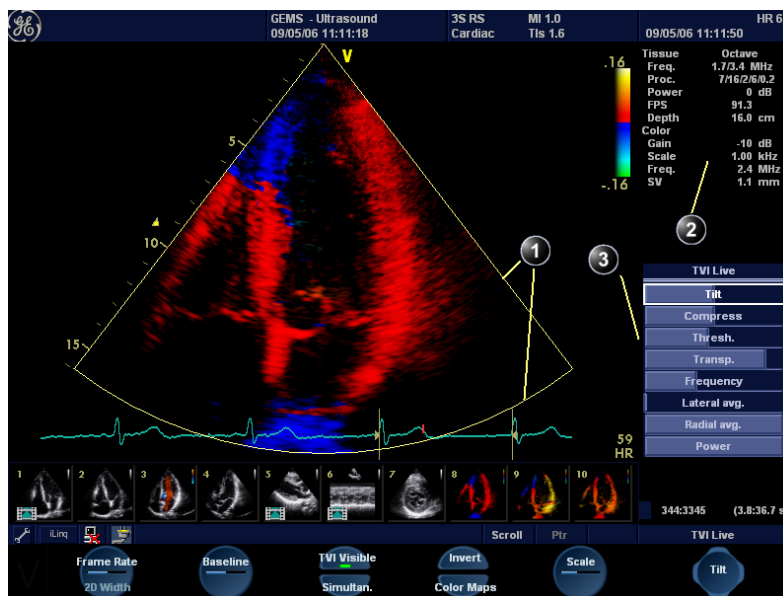
1. **TVI sector marker**
2. **Status window**
3. **Soft menu**

Figure 3-7: The TVI Mode screen

Tissue Velocity Imaging (TVI) calculates and color-codes the velocities in tissue. The tissue velocity information is acquired by sampling of tissue Doppler velocity values at discrete points. The information is stored in a combined format with greyscale imaging during one or several cardiac cycles with high temporal resolution.

TVI controls

TVI assignable controls

2D width

Controls the angular width of the 2D image sector.

Scale

Lower scale value allows greater depth and lower Nyquist limit.

Adjusts the repetition rate of the Doppler pulses transmitted to acquire the data for color mapping. The Scale value influences the Nyquist limit (the ability to detect maximal velocity without color-aliasing).

Baseline

Adjusts the color map to emphasize tissue motion either toward or away from the probe. Baseline is available in both Live and Freeze.

Frame rate

Controls the line density. When adjusting frame rate, there is a trade off between spatial and temporal resolution.

Invert

Enables the color scheme assigned to positive and negative tissue velocities to be inverted. Invert is available in live and cine replay.

Simultaneous

Enables simultaneous display of 2D image and 2D image with TVI color.

TVI visible

Turns TVI display on/off.

Cineloop (in Freeze only)

Starts cineloop acquisition.

Color maps

Displays a menu of color map options. Use the **trackball** to point a color map and press <u>SET</u> to activate a desired color map. Each color map is assigning different color hues to different velocities.

TVI Soft menu controls

Compress

Controls the amount of color compression. The color bar is adjusted accordingly.

Reject (low velocity rejection)

Adjust the cut-off level for the low velocity of TVI to be discarded when generating the color image.

Threshold

Controls the level of greyscale intensity that is used as a threshold for color.

Transparency

Controls the degree of transparency of the TVI color.

Frequency

Enables the adjustment of the transmission frequency to control the sensitivity or the level of penetration.

Lateral Averaging

Use Averaging controls with caution so as not to obscure significant diagnostic information

Smooths the image by averaging collected data along the same horizontal line. An increase of the lateral averaging will reduce noise, but this will also reduce the lateral resolution.

Radial Averaging

Smooths the image by averaging collected data along the same radial line. An increase of the radial averaging will reduce noise, but this will also reduce the radial resolution.

When power is reduced, it reduces the signal-to-noise ratio, so that the image may appear noisier.

Power

Controls the amount of acoustic power applied in all modes. When power is set to maximum, it is equal to or less than the maximum acoustic power level permitted by regulatory standards. The Thermal Index (TI) and the Mechanical Index (MI) are displayed on the screen.

Using TVI

1. Select the desired probe.
2. While in 2D mode press $\overline{\text{TVI}}$ on the control panel, then select TVI soft-key.
3. Use the **trackball** to position the ROI frame over the area to be examined.

The assignable controls of the trackball are displayed in the trackball status bar in the bottom right corner of the screen.

4. Press $\overline{\text{SET}}$. The instruction **Size** should be highlighted in the trackball status bar. If not, press $\overline{\text{SET}}$ again to select **Size**. *Note*: If the trackball control *Pointer* is selected, press $\overline{\text{TRACKBALL}}$ to be able to select between *Position* and *Size* controls.
5. Use the **trackball** to adjust the dimensions of the ROI. To enlarge or narrow the ROI, move the **trackball** to the left or right. To lengthen or shorten the ROI, move the **trackball** up or down.

Optimizing TVI

Refer to page 360 about creating presets.

The use of preset gives optimum performance with minimum adjustment. If necessary, the following controls can be adjusted to further optimize the TVI display:

The Scale value also affects the frame rate. There is a trade off between the frame rate and quantification noise.

- To reduce quantification noise (variance), the Nyquist limit should be as low as possible, without creating aliasing. To reduce the Nyquist limit: Reduce the **Scale** value from the assignables on the control panel.

PW will be optimized for Tissue Velocities when activated from inside TVI.

- TVI provides velocity information only in the beam direction. The apical view typically provides the best window since the beams are then approximately aligned to the longitudinal direction of the myocardium (except near the apex). To obtain radial or circumferential tissue velocities, a parasternal view must be used. However, from this window the beam cannot be aligned to the muscle for all the parts of the ventricle.

Tissue Tracking

Tissue Tracking overview
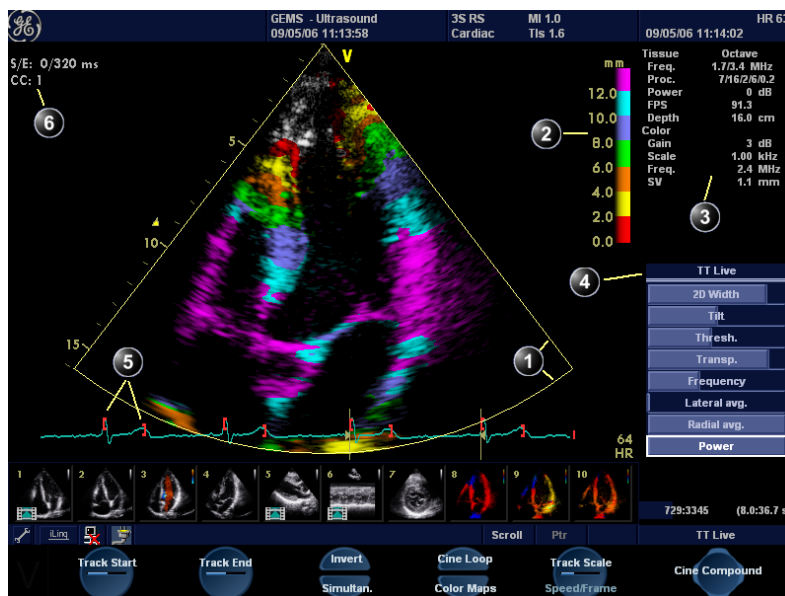
1. **Color sector marker**
2. **Tissue Tracking color bar**
3. **Status window**
4. **Soft menu**
5. **Track start and track end markers**
6. **Tracking start and end from R-peak**

Figure 3-8: The Tissue Tracking Mode screen

Tissue Tracking calculates and color-codes the displacement in the tissue over a given time interval, typically the systole. The displacement is defined as the distance the tissue move during this time interval. The displacement is found as the time integral (sum) of the tissue velocities during this interval.

Only displacements in the beam direction are found. Only positive (systolic) displacements are mapped into colors, negative displacements are mapped into greyscale.

Tissue Tracking controls

Tissue Tracking assignable controls

Tracking start

The time after ECG R-peak when the integration should start.

Tracking end

The time after tracking start when the integration should end.

Tracking scale

Controls the color cut-off value of max displacement displayed. The chosen values is shown on the color bar when the assignable is activated.

Frame rate

Controls the line density. When adjusting frame rate, there is a trade off between spatial and temporal resolution.

Invert

Enables the color scheme assigned to positive and negative tissue velocities to be inverted. Invert is available in live and cine replay.

Simultaneous

Enables simultaneous display of 2D image and 2D image with Tissue Tracking color.

Cineloop (in Freeze only)

Starts cineloop acquisition.

Color maps

Displays a menu of color map options. Use the **trackball** to point a color map and press <u>SET</u> to activate a desired color map.

Tissue Tracking Soft menu controls

2D width (More menu)

Controls the angular width of the 2D image sector.

Threshold

Controls the level of greyscale intensity that is used as a threshold for color.

Transparency

Controls the degree of transparency of the Tissue Tracking color.

Frequency

Enables the adjustment of the transmission frequency to control the sensitivity or the level of penetration.

Use Averaging controls with caution so as not to obscure significant diagnostic information

Lateral Averaging

Smooths the image by averaging collected data along the same horizontal line. An increase of the lateral averaging will reduce noise, but this will also reduce the lateral resolution.

Radial Averaging

Smooths the image by averaging collected data along the same radial line. An increase of the radial averaging will reduce noise, but this will also reduce the radial resolution.

Power

Controls the amount of acoustic power applied. When power is reduced the signal to noise ratio is reduced, so that the image may become noisier.

Cine Compound (Freeze only)

Calculates and displays cineloops generated from a temporal averaging of multiple consecutive heart cycles. The number of cycles averaged is controlled from the Soft menu rocker. The number of averaged cycles i displayed on the top left corner.

Using Tissue Tracking

1. From 2D or TVI Modes, press ALT on the control panel and select the TISSUE TRACKING assignable.
2. Adjust TRACKING START (assignable) close to the R-peak.
3. Adjust TRACKING END (assignable) near the T-wave.
4. Use the **trackball** to position the ROI frame over the area to be examined.

The assignable controls of the trackball are displayed in the trackball status bar in the bottom right corner of the screen.

5. Press SET. The instruction **Size** should be highlighted in the trackball status bar. If not, press SET again to select **Size**. *Note*: If the trackball control *Pointer* is selected, press TRACKBALL to be able to select between *Position* and *Size* controls.
6. Use the **trackball** to adjust the dimensions of the ROI.

Optimizing Tissue Tracking

- To reduce quantification noise (variance), the Nyquist limit should be as low as possible, without creating aliasing. To reduce the Nyquist limit, reduce the scale while in TVI.
- The main use of Tissue Tracking is to map positive systolic displacements. This means that TRACKING START and TRACKING END assignables should be adjusted to pick out the systolic phase of the cardiac cycle: Adjust **Tracking start** close to the R-Peak. Adjust **Tracking end** near the T-wave.
- Negative displacement can be mapped by pressing INVERT. TRACKING START and TRACKING END must then be adjusted to pick out the diastolic phase of the cardiac cycle.
- The maximum displacement that is color-coded can be adjusted using the TRACKING SCALE assignable. If set too low, most of the wall will show the color indicating maximum displacement. If set too high, the maximum displacement color is never reached.
- Tissue Tracking provides velocity information only in the beam direction. The apical view typically provides the best window since the beams are then approximately aligned to the longitudinal direction of the myocardium (except near the apex).

Additional scanning features

Compound

Compound is a process of combining two, three (default) or five frames from different steering angles into a single frame. The combined single image has the benefits of reduced speckle noise, reduced clutter, and continuity of specular reflectors. Therefore, this technique can improve contrast resolution.

Compound is available with linear probes in 2D mode only.

Using compound

1. Press the COMPOUND assigned key.
    A three frames compounded image is produced.
2. To change the number of compounded frames, adjust the COMPOUND FRAMES soft menu to two, three or five frames.

Chapter 4
Stress Echo

Introduction

The Vivid *i* ultrasound unit provides an integrated stress echo package, with the ability to perform image acquisition, review, image optimization, and wall segment scoring and reporting for a complete, efficient stress echo examination.

The stress package provides protocol templates for exercise, as well as, pharmacological stress examinations. In addition to preset factory protocol templates, templates can be created or modified to suit users' needs. Users can define various quad screen review groups, in any order and combination, that will suit their normal review protocol. When reviewing stress examination images, the images are viewed at their original image quality, and different post-processing and zoom factors may be applied to the images under review for effective image optimization. The protocol template may be configured for Continuous capture.

A stress echo examination consists of three steps:

Selection of a stress test protocol template

1. Press **PROTOCOL** to enter the stress echo mode.
   The *Protocol screen* is displayed (see Figure 4-1) showing the default stress protocol for the current probe.

To create or edit a template see page 137.

2. To use the current template:
   Turn freeze off to initiate scanning.
   To use another template:
   Press the assignable **TEMPLATE**.
   The template list is displayed.

3. Trackball to the desired template.

4. Press **SELECT**.

5. Turn freeze off to initiate scanning using the new template.
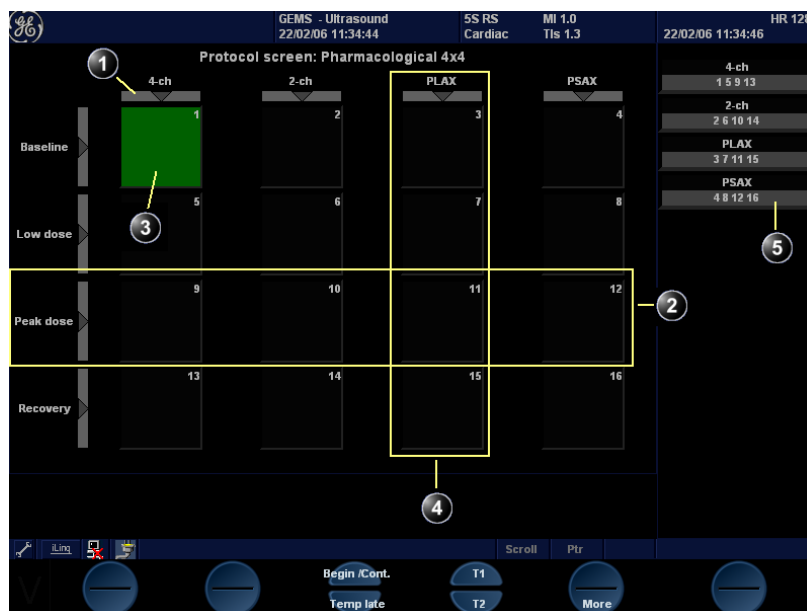
1. **Projection selection**
2. **Level**
3. **Current acquisition**
4. **Projection**
5. **Group of views**

Figure 4-1: The Protocol screen

Image acquisition

Images are acquired in a pre-defined order, according to the selected template. The highlighted cell (green) of the matrix, displayed in the *Clipboard window* indicates which view is currently being acquired (see Figure 4-2). The names of both the view and the level for the current cell is displayed on the top corner of the image area and under the template matrix.
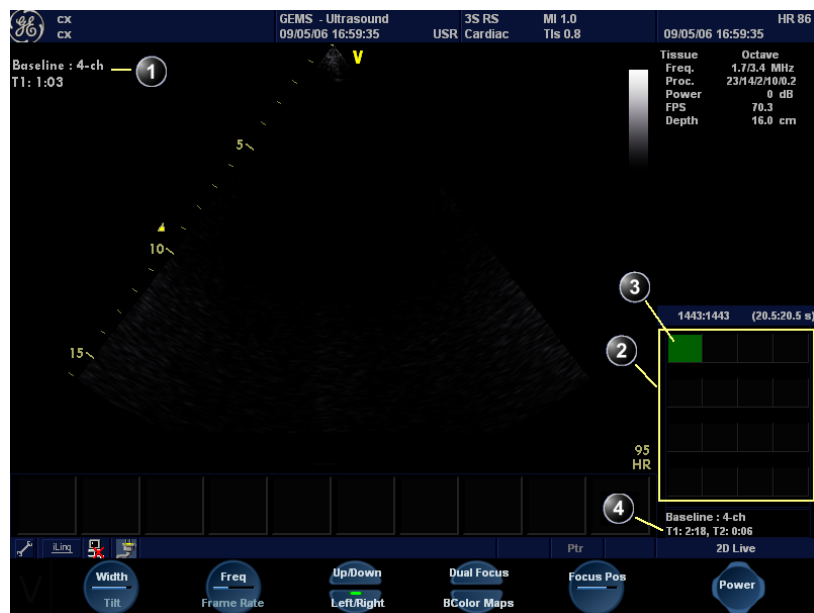
1. **Current view label**
2. **Template matrix**
3. **Current view (Green cell)**
4. **Timers**

Figure 4-2: The stress mode acquisition screen

Starting acquisition

1. Turn freeze off to initiate scanning.

2. Perform a scan that conforms with the view that is highlighted in the template matrix on the *Clipboard window*.

   If the selected template has the option **Smart Stress** turned on (see page 140), a subset of the image acquisition settings for each view in the baseline level will be stored and automatically reused in the corresponding views in the next levels.

3. Press STORE.

   • If the actual stress level is configured to preview cineloop before storing, use the cineloop controls to select the most appropriate heart cycle and, if desired adjust the loop markers (see "Cineloop operation" on page 60 for further information). Press STORE to save the selected cineloop.

   • If the actual stress level is not configured to preview cineloop before storing, the system will automatically store the last cardiac cycle.

   When storage of the cineloop is completed, the actual highlighted cell in the template matrix displays a 2D icon indicating that the view has been acquired. After storing the loop, the system automatically highlights the next view in the matrix to be acquired.

   Stress levels can be configured for side by side display/comparison of the reference loop from baseline or previous level and the loop to acquire (see Figure 4-3).

4. Repeat previous steps until all required views are completed.

$\triangle$

CAUTION

If using DICOM Server dataflow for stress-echo acquisition, images should not be saved to permanent archive before the complete protocol exam is acquired.

The template used can be configured so that analysis is automatically started, displaying the first protocol group. The wall segment scoring diagrams for each view is displayed in the *Parameters window* on the right side of the screen (see Figure 4-9, page 135).
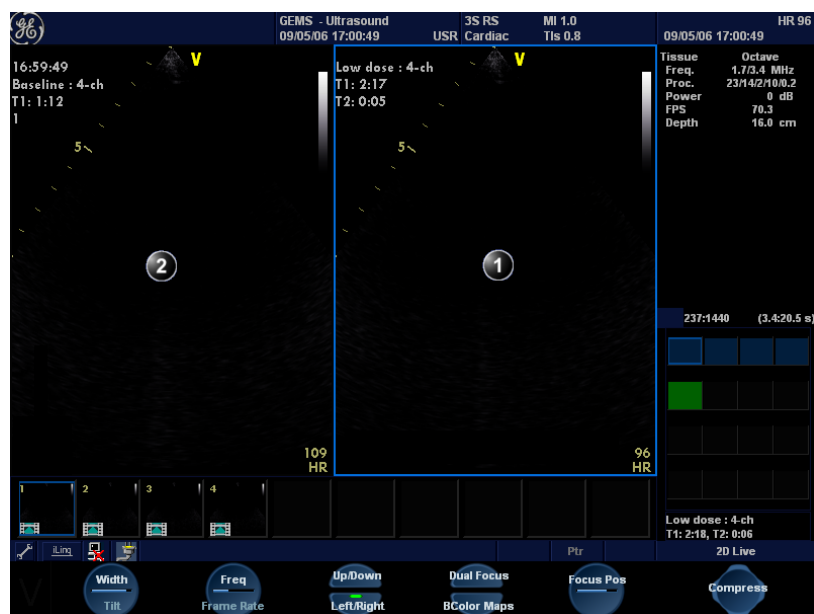
1. **Current acquisition loop**
2. **Corresponding reference loop**

Figure 4-3: Display of the Reference loop during acquisition

Protocol Pause function

During the stress acquisition it is possible to temporarily exit the protocol acquisition mode to acquire images in any mode outside the stress protocol.

1. To temporarily exit the protocol mode, press **PROTOCOL** twice.
2. Acquire the desired images outside the protocol.
3. Press **PROTOCOL** to restart the protocol acquisition mode and resume the stress acquisition.

Selecting a view during acquisition

A fixed protocol is provided for scanning, based on the selected template. The system automatically highlights the next view to be acquired in the template matrix, as images are stored. However, the order of scanning may be changed manually as follow:

Manual selection of a view during acquisition

1. Use the **arrow keys** on the alphanumeric keyboard to highlight the cell that represents the view that is to be acquired.
   The selected cell in the template matrix is highlighted in red, indicating non-default position and is blinking if it contains a previously stored acquisition.
2. Turn freeze off to initiate scanning.
3. Scan and save the selected loop as explained in the previous section.

After storage the system automatically highlights the next available view to be acquired.

Replacing an acquired image

1. Use the **arrow keys** on the alphanumeric keyboard to highlight the cell that represents the view that is to be replaced.
   The selected cell in the template matrix is highlighted in red, indicating non-default position.
2. Turn freeze off to initiate scanning.
3. Scan and save the selected loop as explained in the previous section.

After storage the system automatically highlights the next available view to be acquired.

Moving an acquired image

An Image can be moved from one cell to another during acquisition. There are two ways to move images:

Procedure 1

1. When in the *Protocol screen*, press MORE (assignable menu).
2. Press the assignable MOVE IMAGES.
3. Trackball to the image to move (source cell).
4. Press SELECT.
5. Trackball to the destination cell.
6. Press SELECT.
   The image is moved from the source cell to the destination cell.

Procedure 2
1. In the *Protocol screen*, trackball to the cell containing the image to move (source cell).
2. Press and hold down $\overline{\text{SELECT}}$.
3. With the $\overline{\text{SELECT}}$ key still depressed, trackball to the destination cell.
4. Release the $\overline{\text{SELECT}}$ key.
    The image is moved from the source cell to the destination cell.

Stored images cannot be moved.

If the destination cell contains an image, the images from the source and destination cells will be exchanged when moving an acquired image.

Timers

Two timers can be displayed in the *Stress mode acquisition screen*, beside the template matrix (see Figure 4-4).
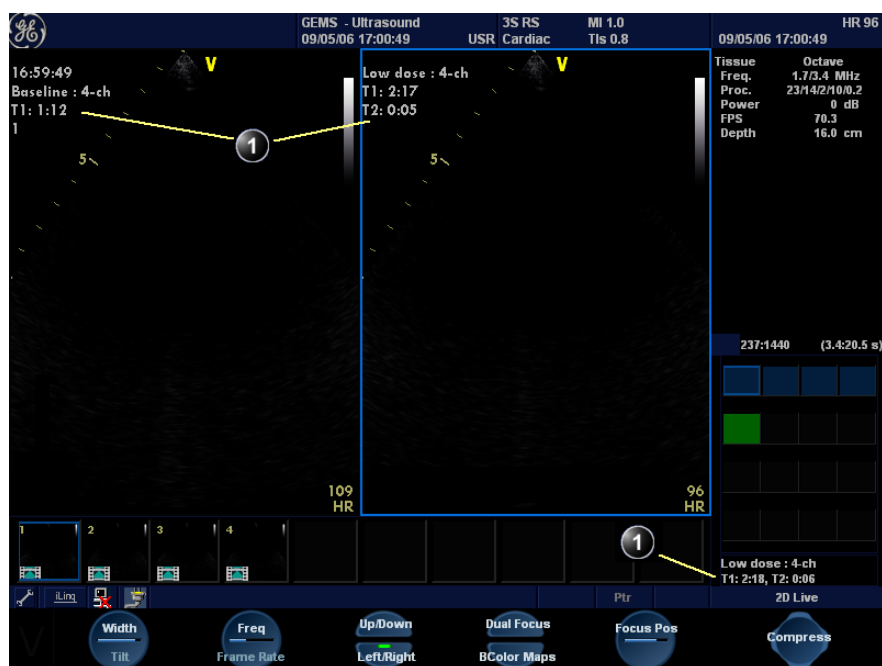
1. **Timers display**

Figure 4-4: The timers in the acquisition screen

- **T1** displays the elapsed time from the start of the stress examination.
- **T2** starts when entering live scanning on the second stress level

Both T1 and T2 timers can be manually stopped and restarted during the acquisition from the *System Menu* (Press **MENU** on the control panel).

The display of T1 and T2 is user-configurable (see page 137).

Continuous capture mode

Continuous capture mode enables the user to perform acquisition continuously for all views at any level depending on the selected template configuration. Continuous capture consists of temporary saving images acquired in a storage buffer. To enable best possible use of the limited storage buffer capacity, a Pause/Capture mode is provided, as opposed to the normal Freeze/Scan mode. The Pause mode enables scanning and live display on the screen, without any capture, thereby leaving the buffer available.

To run Continuous capture, the user has to select a template where this feature is activated (see page 137 about template configuration).

The buffer bar

When entering a level with Continuous capture enabled, a *Buffer bar* is displayed in the *Info window* (see Figure 4-5). The *Buffer bar* displays the following information:

- The unit's scanning state:
  - **PAUSE** (live scanning without storing)
  - **CAPTURE** (live scanning with storing to buffer)
- The percentage of the buffer that is filled
- The buffer filling progression showed by a green filling gauge
- The capturing sessions, reflected by the red lines along the Buffer bar
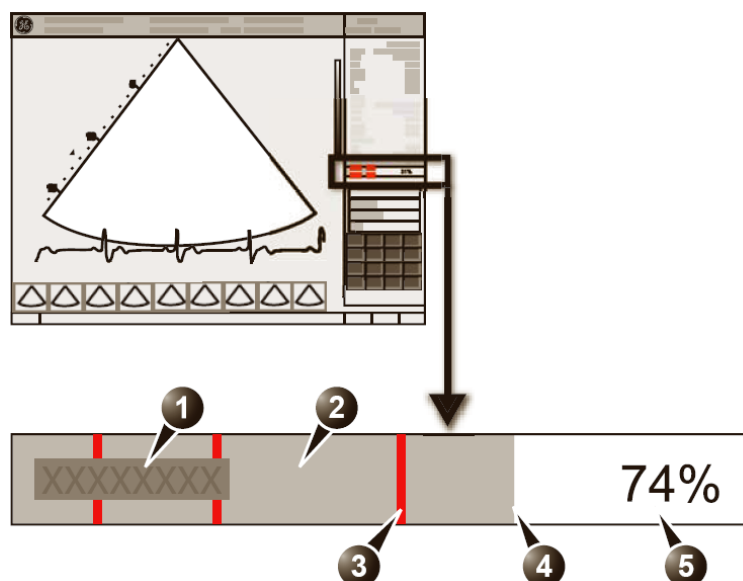
1. **Scanner's state**
2. **Capture session**
3. **Pause session**
4. **Buffer gauge**
5. **Percentage of filled buffer**

Figure 4-5: The buffer bar in Continuous capture

Controlling the capture process

When entering a stress level with Continuous capture enabled, the unit is automatically set in Pause mode.

1. Press **IMAGE STORE** or **2D FREEZE** to start image capture. "Capture" is displayed in the buffer bar, the gauge starts filling and the percentage of filled memory buffer increases (see Figure 4-5, page 127).

2. Press **IMAGE STORE** or **2D FREEZE** again to stop capture. "Pause" is displayed in the buffer bar.

When 90% of the memory buffer is filled up, the text display in the buffer bar turns red.

The unit enters Freeze mode automatically once the buffer is full and the captured loops are displayed in the *Continuous capture selection screen* (see below).

Running Continuous capture

1. Do all your pre-stress acquisitions in the Cardiac application.

*The application **Exercise** should be used in order to get maximum continuous capture buffer.*

2. Press PROTOCOL to enter the stress echo mode. The *Protocol screen* is displayed (see Figure 4-1, page 119).

3. Press **Template**. The template list is displayed.

4. Select the template **Exercise 2x4**.

*The Exercise protocol template is automatically selected when the application **Exercise** is active.*

5. Press **Begin/Cont**.

6. Acquire the resting loops in all four views.

7. Once the fourth loop is acquired the system enter into a waiting mode where Continuous Capture is in pause state awaiting the patient to exercise.

8. When the patient is back on the bed, press IMAGE STORE or 2D FREEZE. The Continuous capture acquisition is started.

9. Acquire all your views. The memory buffer gauge increases (Figure 4-5). When memory filling exceeds 90%, the percent number turns red.

10. Press FREEZE to finish.

11. Press the SELECT CYCLE assignable. The *Continuous capture selection screen* is displayed (see Figure 4-6, page 131). If the buffer is filled up the system will automatically display the *Continuous capture selection screen*. Refer to the next section if additional image acquisition is necessary after the buffer is filled up.

12. Assign the cineloops to the four views (see page 131). A dialogue window is displayed asking whether the entire Continuous capture acquisition should be saved or not.

*Using **Store all** to save the entire loop may take up to 15 seconds on Local-Arch-IntHD and several minutes on LocalArch-MOD.*

13. Press **Delete** to discard the loop
OR
Press **Select later** if you want to reselect any loops (open the capture again from the *Protocol screen*).
OR
Press **Store all** to keep the entire loop.

14. Perform Analysis and scoring (see page 133).

Continuous capture with additional image acquisition

If the buffer is filled up before all the image acquisitions are done, additional loops can be stored in the clipboard before doing image assignment to the views:

1. Perform Continuous capture as described above (steps 1 to 10).

2. If the buffer is not filled up: press MORE and PROTOCOL PAUSE, or the PROT. IN/OUT key on the control panel. Live scanning is activated.
   If the buffer is filled up: press **Select later** in the *Continuous capture selection screen*. Live scanning is activated.

3. Perform the additional acquisition (e.g. CFM, Doppler). Images will be stored outside the protocol.

4. In order to resume the stress echo exam and assign loops for the views from the Continuous capture buffer, press PROTOCOL.

5. Press on the **Continuous capture icon** on the lower left corner of the *Protocol screen*.
   The *Continuous capture selection screen* is displayed.

6. Assign the cineloops to the views (see page 131).
   A dialogue window is displayed asking whether the entire Continuous capture acquisition should be saved or not.

7. Press **Delete** to discard the loop
   OR
   Press **Store all** to keep the entire loop.
   The normal procedure is to discard the loop. The loop is very big and will take a lot of disk space.

8. Perform Analysis and scoring (see page 133).

Postponed image assignment

The assignment of the cineloops to the views can be done on a later stage on a stored Continuous capture acquisition.

1. Perform Continuous capture as described in "Running Continuous capture" on page 128 (steps 1 to 11).

2. Press **Store all**.
    The entire Continuous capture acquisition is stored. The examination can be ended and the image assignment, analysis and scoring can be done on a later stage.

3. Re-open the examination if necessary.

4. Press **PROTOCOL**.
    The *Protocol screen* is displayed.

5. Press on the **Continuous capture icon** on the lower left corner of the *Protocol screen*.
    The *Continuous capture selection screen* is displayed.

6. Assign the cineloops to the views (see page 131).

7. Press **Done** when finished.

8. Perform Analysis and scoring (see page 133).

9. When exiting this patient a dialogue window is displayed asking whether the remaining continuous capture images should be deleted.

    •   Press **Yes** to delete the remaining continuous capture images

        OR

    •   Press **No** to keep the entire continuous capture acquisition.

    The normal procedure is to delete the remaining images as they take a lot of disk space.

Restart capture from the Continuous capture selection screen

•   Press **RESTART CAPTURE**.

    The recording in memory is deleted and the Continuous capture is started again.

Resume Continuous capture

•   Press **CONTINUE CAPTURE**.

    Resumes Continuous capture recording (only if the Continuous capture buffer is not full).

Assigning and storing the loops

The cineloops captured in the buffer are assigned to the stress protocol views and stored from the *Continuous capture selection screen* (see Figure 4-6).
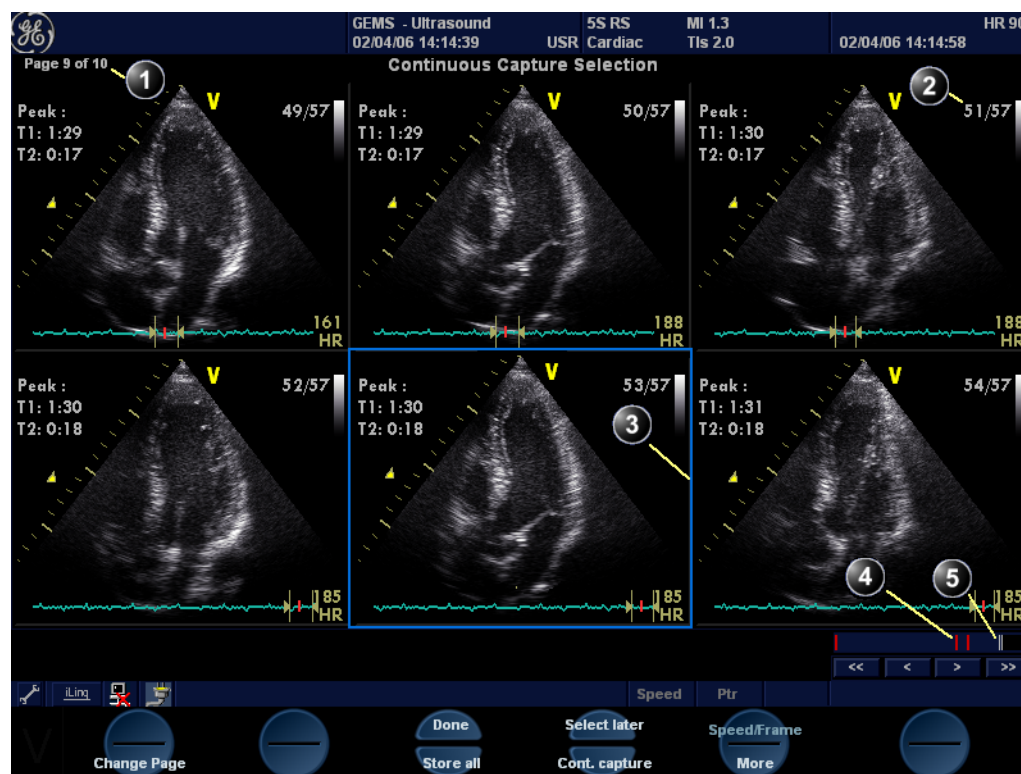
1. **Rotate** CHANGE PAGE **assignable to display other pages.**
2. **Cycle number and total number of cycles**
3. **Highlighted loop**
4. **Red bar: pause session**
5. **Grey gauge: position of the highlighted loop within the buffer area**

Figure 4-6: The Continuous capture selection screen

Assigning a cineloop to a view
1. Trackball to the desired loop in order to assign it to a particular view of the stress template.
   The frame of the loop is highlighted.
2. Press SELECT.
   A pop-up menu is displayed with the view names of the template (see Figure 4-7).

3. Trackball to the required view name.

4. Press **SELECT**.
   The name of the view is displayed above the timers in the loop window.

5. Repeat steps Figure 1 through Figure 4 to assign loops to the other views of the level.

6. Press the assignable **DONE** when completed.
   A dialogue window is displayed asking whether the entire Continuous capture acquisition should be saved or not.

7. Press **Delete** to discard the loop
   OR
   Press **Store all** to keep the entire loop.
   The normal procedure is to discard the loop. The loop is very big and will take a lot of disk space.

Saving the entire loop takes 5 to 10 seconds on Loca-lArch-IntHD and several minutes on LocalArch-MOD.
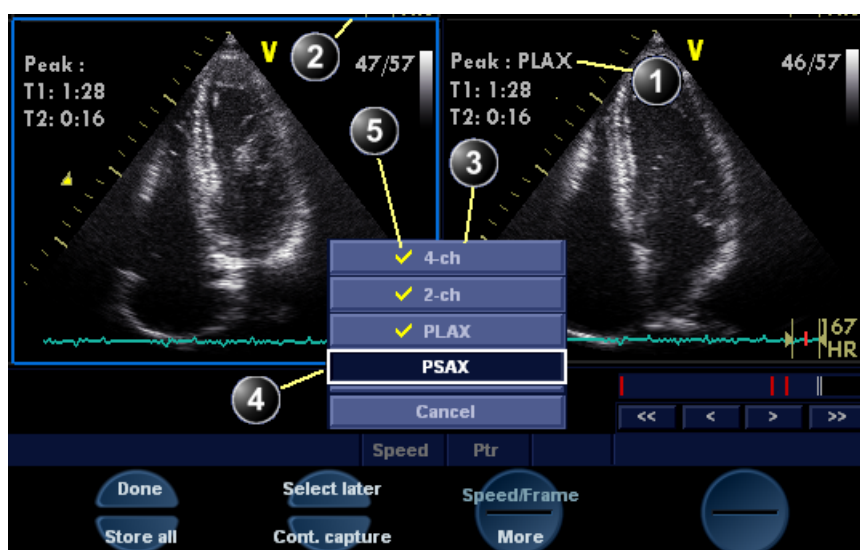
1. **Assigned loop**
2. **Highlighted loop**
3. **Views pop-up menu**
4. **Highlighted views**
5. **Already assigned view**

Figure 4-7: Loop assignment in Continuous capture

Analysis

Analysis consists of viewing previously saved loops and assigning scores to each cardiac segment, in order to quantify the function of the muscle, or wall motion.

Depending on the protocol configuration, the analysis stage can be started automatically after completion of the stress test or it can be started manually. In this case, the usual procedure consists of sequentially opening all image groups (if defined) and perform scoring from image to image.

The quad screen is the standard display for comparing heart cycles (Figure 4-9). The heart cycle loops in the display are synchronized to enable comparison. Each loop in the quad screen can be magnified, using the zoom control (see page 68).

Image selection for analysis

Images can be selected manually or from a pre-defined group in the *Protocol screen*.

Selection of images from a group

If groups of images have been defined in the protocol template (see page 143), the user can select a group of images for analysis and sequentially analyze all images from all groups from within the *analysis screen* (see Figure 4-9, page 135).

1. In a stress examination, press PROTOCOL.
    A preview of the acquisitions is displayed.
2. Trackball to a group in the *Group list*.
    The frame of the images belonging to the group are highlighted.
3. Press SELECT to open images in the *Analyze screen* (see page 135).

1. **Select a Projection**
2. **Select an image**
3. **Select and open an Image group**
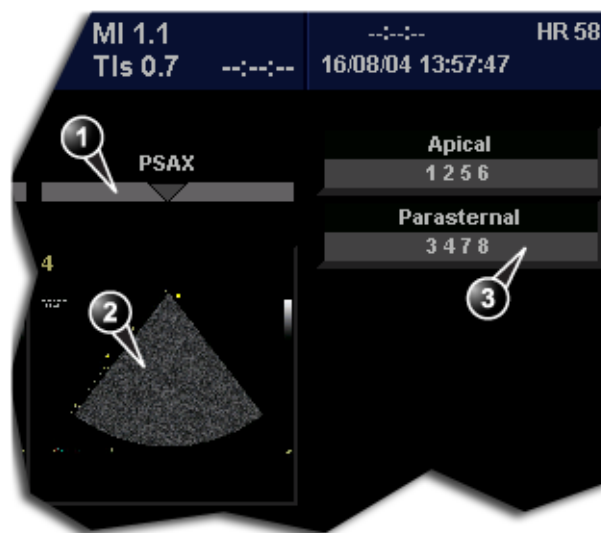
Figure 4-8: Image selection from the Protocol screen

Manual selection of images in the Analysis screen
1. When currently in protocol analysis in the *Stress analysis quad screen* (Figure 4-9), hold down SHIFT while performing steps 2 to 4.
2. Trackball to the first image to select in the *Template matrix*.
3. Press SELECT.
    The selected loop is displayed in the *Stress analyze screen* and the next window in the quad screen is automatically selected.
4. Repeat steps 2 and 3 to select other images.
5. Depress SHIFT.

Manual selection of images in the Protocol screen
1. In a stress examination, press PROTOCOL.
    A preview of the acquisitions is displayed.
2. Trackball to the first image to select.
3. Press SELECT.
    The frame of the selected loop is highlighted.
4. Repeat steps 2 and 3 to select other images.

Alternative: Double click on the last selected image to open images.

5. Press $\overline{\text{ANALYZE}}$ to open images in the *Analyze screen* (see page 135).

Scoring acquired loops

1. After image selection (see page 133), press $\overline{\text{ANALYZE}}$. The *Stress Echo Analysis screen* is displayed (see Figure 4-9).
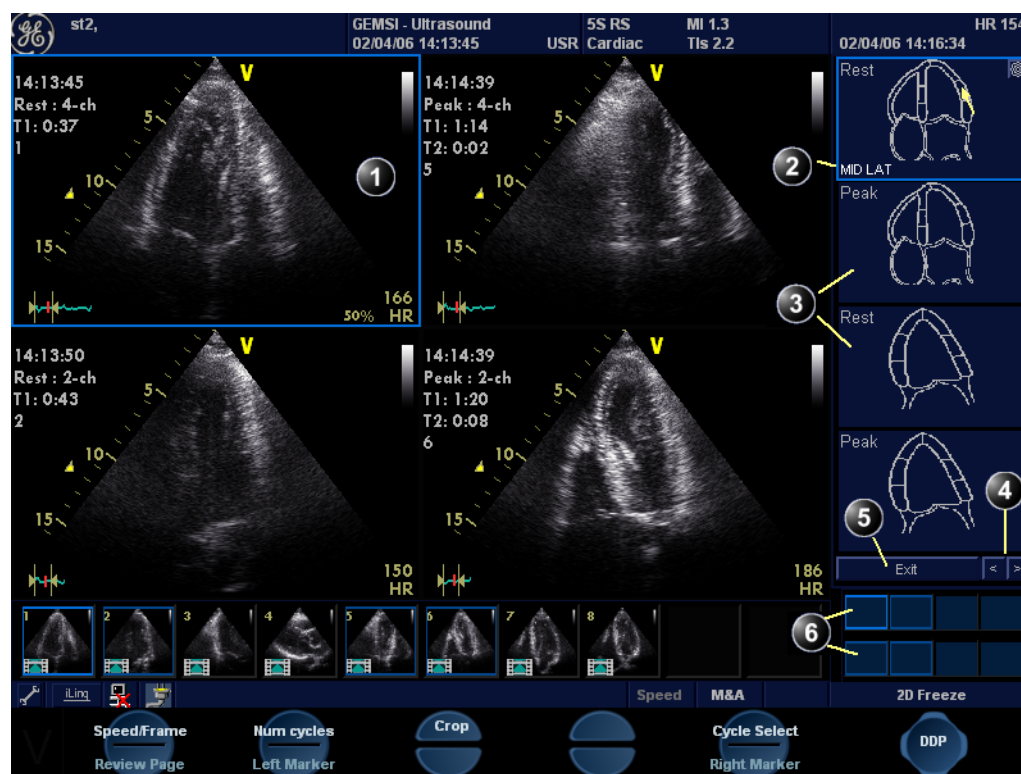
1. **Selected loop (highlighted frame)**
2. **Highlighted segment name**
3. **Wall segment diagrams**
4. **Change page or enter next image group**
5. **Exit Wall motion scoring**
6. **displayed loops (highlighted frames)**

Figure 4-9: The stress echo analysis screen (Quad screen)

To edit a score, select it and choose a new score.

2. Trackball to a segment in one of the scoring diagrams and press $\overline{\text{SELECT}}$.
The *Score pop-up list* is displayed (see Figure 4-10).

3. Trackball to a score.

4. Press **SELECT**.

   The score is displayed in the relevant segment area in the diagram (see Figure 4-10).

5. Repeat steps 1 through 3 to score relevant segments.

6. Rotate the assignable **CHANGE PAGE** to display next group of images.

7. Repeat steps 1 through 3 to score relevant segments on the new loops.

1. **Selected segment**
2. **Selected score**
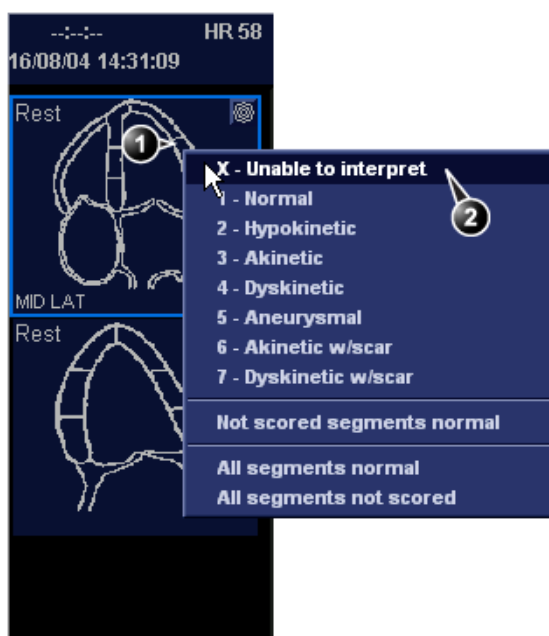
1. **Scored segment**

Figure 4-10: Segment scoring

Editing/creating a template

The stress package provides protocol templates for exercise as well as pharmacological stress examinations. The user can create new templates or modify existing templates to suit the individual needs. Up to ten projections and fourteen stress levels can be created in a template.

Templates created may be temporary, used only during the current examination, or saved as new templates, for future use and reference. The editions that may be performed include:

- Adding/deleting levels and projections, page 141
- Assigning new labels to levels and projections, page 142
- Defining level options, page 142
- Defining new groups, page 143

Templates are edited/created from the *Template editor screen*.

Entering the Template editor screen

1. Press PROTOCOL to enter the stress echo mode.
2. Press the assignable TEMPLATE.
   The *Template pop-up menu* is displayed.
3. Trackball to **Template Editor**.
4. Press SELECT.
   The *Template editor screen* is displayed (see Figure 4-11).

Template editor screen overview
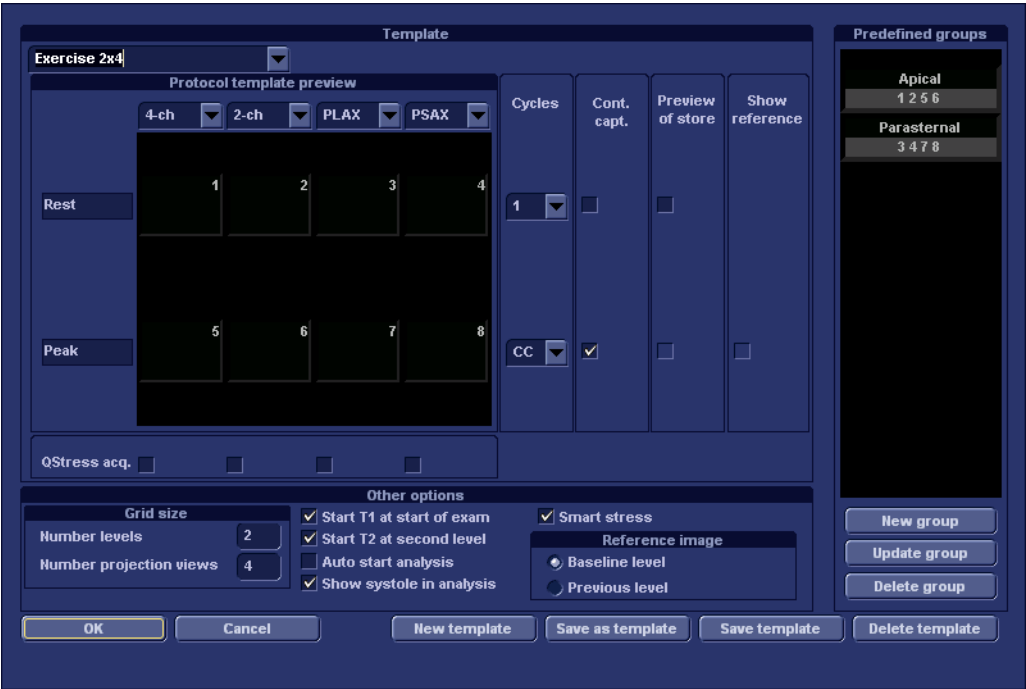
Figure 4-11: The Template editor screen
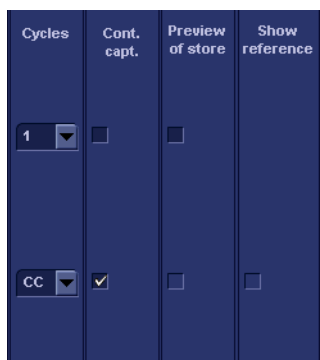
Template

Parameter	Description
Exercise 2x4	**Template:** • Select a pre-defined template from the pop-up menu. The *Protocol template preview* (see below) is updated accordingly.
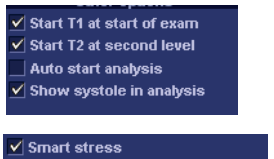
Protocol template preview

Parameter	Description
	Protocol template preview: • displays an updated preview of the template accordingly to the settings applied. • To change *Projection* and *Stress level labels*, select a pre-defined label from the pop-up menu or press **SET** in the actual label field and type a new name.
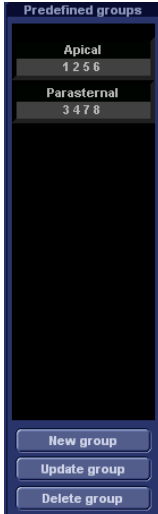
Template settings

Parameter	Description
	Template settings: • **Cycles**: select the number of cineloop heart cycles to store for each level from the drop-down menu. • **Continuous capture**: ☑: enables continuous image acquisition throughout the level. The images acquired are temporarily stored in the unit's storage buffer. • **Preview of store**: ☑: enables review and adjustment of cineloops before storage (see page 211 for further information). • **Show reference**: ☑: displays a dual screen with the reference level (first or previous level) on the left and the live image on the right.

Other options

Parameter	Description
Grid size Number levels 2 Number projection views 4	**Grid size:** • Enter the number of levels and projections for the selected template.
☑ Start T1 at start of exam ☑ Start T2 at second level ☐ Auto start analysis ☑ Show systole in analysis ☑ Smart stress	**Timers:** • ☑: starts T1 and T2 timers automatically **Auto-start analysis:** • ☑: displays the *Stress Echo Analysis screen* when the last acquisition is performed. **Smart Stress:** • ☑: stores a subset of the image acquisition settings (geometry incl. zoom, gain, compress, reject, power etc.) for each view in the protocol. Smart Stress enables to set image acquisition settings for each view at baseline level and automatically get the same image settings in the corresponding views in the next levels. In Continuous capture acquisition at peak stress, the active cell must be moved manually through the views using the arrow buttons (or foot pedal).
Reference image ● Baseline level ○ Previous level	**Reference image**: • When **Show Reference** is selected (see page 139), selects either corresponding baseline loop or corresponding loop from the previous level to be displayed as reference image during acquisition.

Pre-defined groups

Parameter	Description
Predefined groups Apical 1 2 5 6 Parasternal 3 4 7 8 New group Update group Delete group	**Pre-defined groups:** • Shows the image groups created. • **New group**: creates a new image group. Select the desired images on the template preview (see page 143). • **Update group**: edits a selected group after new loop selection on the template preview (see page 143). • **Delete group**: deletes selected group (see page 143).

Editing/Creating a template

Selecting a base template to edit

Determine the required number of projections and levels you need and select the most appropriate foundation template.

1. Trackball to the *Template pop-up menu* on the upper left corner of the *Template editor screen*.

2. Press $\overline{\text{SELECT}}$ on the arrow.
   The *Template pop-up menu* is displayed.

3. Trackball to the base template to edit.

4. Press $\overline{\text{SELECT}}$.
   The selected template is displayed in the *Protocol template preview field*, showing the levels and projections and their labels.

Adding/deleting levels and projections

1. Enter the number of levels and projections in the *Grid size field* (see Figure 4-11).
   The new grid size is displayed in the *Protocol template preview field*.

2. Press **New Template** to create a new template.
   Or
   Press **Save Template** to update the base template.

Display timer(s)

• Check the box(es) to display timer(s) as specified (see Figure 4-11).

Start analysis automatically

• Check **Auto start analysis** to display the Stress Echo Analysis s*creen* when the last acquisition is performed.

Assigning new labels to levels and projections

1. In the *Protocol template preview field*, Trackball to the *Label field* that is to be changed.
2. Select the *Label pop-up menu* and press $\overline{\text{SELECT}}$ on the desired pre-defined label.
   Or
   • If the Label field is empty:
     Press $\overline{\text{SELECT}}$ and enter the label or projection name.
   • If the Label field has a name to be changed:
     Press $\overline{\text{SELECT}}$ twice (double-click) to highlight the text to be replaced and enter the new label or projection name.

Configuring levels

The following options can be set up for each level:

Number of cycles to be stored in the cineloop:
• Enter the desired number in the *Cycles field*.
   Up to four cycles/cineloop can be stored.

Continuous capture
• Check **Continuous capture** if continuous image acquisition throughout the level is desired.
   When Continuous capture is selected, preview of cineloop and reference display (see below) during acquisition are not possible.

Preview of store
• Check **Preview of store** if review and adjustment of cineloops before storage is desired.

Show reference
• Check **Show reference** if the display of the corresponding reference loop is desired during acquisition (dual screen mode).

Adding a group

1. In the *Protocol template preview field* select the cells to be part of the group.
2. In the *Pre-defined group field*, press **New group**.
   A dialogue box is displayed asking the user to enter a name for the new group.
3. Enter the group name.
4. Press **OK**.
   The new group is displayed in the *Pre-defined group field*.

Updating an existing group

A selected group is highlighted by a yellow frame.

1. In the *Pre-defined group field*, select the group to edit.
   The selected cell are highlighted in the *Protocol template preview field*.
2. Either select (a) new cell(s) to add to the group or deselect (an) existing cell(s) to remove from the group.
3. Press **Update group** in the *Pre-defined group field*.
   The display in the *Protocol template preview field* is updated accordingly.

Deleting a group

A selected group is highlighted by a yellow frame.

1. In the *Pre-defined group field*, select the group to delete.
2. Press **Delete group**.
   The group is removed from the list in the *Pre-defined group field*.

Chapter 5
Contrast Imaging

Introduction

Vivid *i* supports **Left Ventricular Contrast imaging**: Optimized for endocardial border detection and assessment of wall motion and wall thickening.

⚠

WARNING

Appropriate training

Only physicians or echo technicians who have received appropriate training can use the Contrast applications.

⚠

WARNING

Always read and follow carefully the manufacturer instructions on the contrast agent label.

Cardiac imaging

The only contrast acquisition application available for cardiac imaging is **Left Ventricular Contrast imaging**. The LV Contrast (LVO) application is optimized for endocardial border detection and assessment of wall motion and wall thickening. This application requires the LVO Contrast option to be enabled.

Non-cardiac imaging

The following non-cardiac contrast acquisition applications are available.

- **Vascular Contrast imaging**: optimized to visualize contrast in larger vessels, e.g. carotid artery. Requires the Vascular/Abdominal Contrast option enabled.
- **Abdominal Contrast imaging**: optimized to visualize contrast in non-beating organs, e.g. liver and kidneys. Requires the Vascular/Abdominal Contrast option enabled.

⚠️
WARNING

Misdiagnosis based on image artifacts

Misdiagnosis in ultrasound contrast images may be caused by several artifacts, most importantly:

Motion artifacts: gives rise to signals independently of contrast presence. This may be caused by patient movement; including respiration, or by probe movement influenced by the operator.

Regional drop outs: caused by unintentional destruction of the contrast agent, too low concentration of contrast agent, poor acoustic penetration due to rib/lung shadows or system failing to detect the contrast agent due to erroneous settings induced by the operator.

Tissue harmonics: gives contrast-like signals independently of the presence of contrast agent.

Data acquisition

Left Ventricular Contrast Imaging

The Left Ventricular (LV) Contrast application has an optimized system preset for optimal resolution of endocardial borders and for optimal assessment of wall motion and wall thickening.

The LV Contrast application may help to identify LV thrombus and evaluate wall motion.

LV Contrast overview

1. **Status window**
2. **Soft menu**
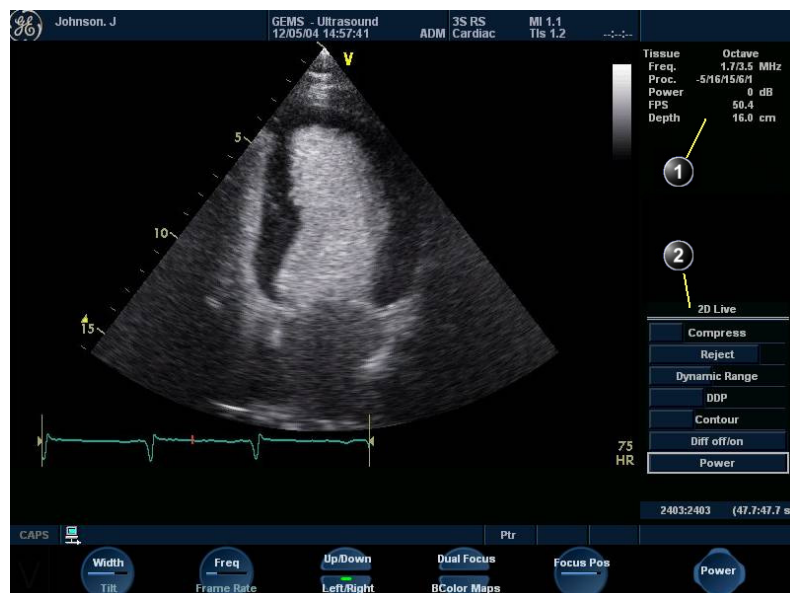
Figure 5-1: The LV Contrast acquisition screen

LV Contrast controls

LV Contrast assignable controls

Width

Controls the size and angular width of the image sector. A smaller angle generally produces a scan with a higher frame rate.

Frequency

Enables the adjustment of the probe's operating frequency. A higher frequency gives better resolution. Frequency is also used to switch between Octave (single-pulse) and CPI (Coded Phase inversion - multi-pulse).

Focus

Changes the location of the focal point. A triangular marker on the depth scale along the image sector indicates the position of the focal point.

Two triangular markers pointing towards each other (><) indicate that Coded Phase Inversion (CPI) is being used. CPI is a multi-pulse technique with focus at the indicated depth.

Frame rate

Lower frame rate gives better resolution.

Controls the line density.

Up/Down

Enables the 2D image to be flipped 180 degrees.

Left/Right

Enables the display of a mirrored image. When applied, the reference marker **V** moves to the other side of the image.

T1/T2 (Timers)

Contrast timer: press $\overline{\text{T1}}$ once to start the timer, press again to stop the timer. A second timer ($\overline{\text{T2}}$) is available from the *More menu*.

B Color maps

Displays a 2D maps menu to optimized the grey scale presentation. The menu enables an option from a list of non-linear grey-curves or different 2D-colorized curves to be selected.

LV Contrast Soft menu controls

Power

Controls the amount of acoustic power applied to the transmitted pulse.

Too high Power level will destroy the contrast agent.

Compress

Controls the degree of image contrast.

Reject

Controls the Echo rejection level. When increased, low level echoes are rejected and appear darker in the 2D image.

Dynamic Range

Controls the image contrast. A high dynamic range setting gives a softer image.

Tilt

Enables the axis of the 2D image to be tilted to the left or to the right. By default the axis of the 2D image is vertical.

Edge Enhance

Controls the image processing related to the extent of edge enhancement applied.

The Diff control decreases the frame rate and the number of focal zones when turned on.

Diff on/off

Affects the level of reverberation in the image. The reverberation in the image is reduced when Diff control is turned on.

DDP (Data Dependant Processing)

Performs temporal processing, which reduces random noise without affecting the motion of significant tissue structures.

Running LV Contrast

The LV Contrast application works with the 3S-RS, 5S-RS, and 6T-RS probes.

1. Press APPLICATION on the control panel.
    A list of the connected probes is displayed.
    The *Application menu* for the selected probe is listed.
2. Trackball to **LV Contrast** application.
3. Press SET to launch the application.
4. Perform the acquisition.

⚠️

WARNING

Always read and follow carefully the manufacturer instructions on the contrast agent label.

Optimizing LV Contrast

The default setting for the LV contrast application is optimized for contrast detection and not tissue imaging. Therefore, with some patients it may be difficult to orient the probe before the contrast agent arrives. In this case we recommend to stay in the Cardiac application until the contrast agent is observed in the right ventricle and quickly switch to the LV Contrast application.

If a swirling pattern is observed and persists after the LV cavity has been filled with contrast, the power should be reduced until homogenous opacification is obtained

⚠️

CAUTION

Too high Power setting will destroy the contrast agent in the LV cavity.

Vascular Contrast Imaging

Vascular Contrast is intended for visualization of ultrasound contrast agents in large vessels (e.g. carotid artery and femoral artery).

The Vascular Contrast application works with the 8L probe.

The application uses Coded Phase Inversion (CPI) (greyscale) to maximize the contrast detection and visualization.

Note: This system is designed for compatibility with commercially available contrast agents. Because the availability of these agents is subject to government regulation and approval, product features intended for use with these agents may not be commercially marketed nor made available before the contrast agent is approved for use.

⚠
CAUTION

This application may not be available on your system. Contrast agent for this application are undergoing clinical trial and therefore, not yet available in the United States.

Note: the Vascular Contrast application requires the Vascular/Abdominal Contrast option enabled.

Abdominal Contrast Imaging

Abdominal Contrast is intended for visualization of ultrasound contrast agents in abdominal organs (e.g. liver or kidney).

The Abdominal Contrast application works with the 3C and 4C probes.

The application uses Coded Phase Inversion (CPI) (greyscale) to maximize the contrast detection and visualization.

Note: This system is designed for compatibility with commercially available contrast agents. Because the availability of these agents is subject to government regulation and approval, product features intended for use with these agents may not be commercially marketed nor made available before the contrast agent is approved for use.

$\triangle$

CAUTION

This application may not be available on your system. Contrast agent for this application are undergoing clinical trial and therefore, not yet available in the United States.

Note: the Abdominal Contrast application requires the Vascular/Abdominal Contrast option enabled.

Chapter 6
Measurement and Analysis

Introduction

A study is a set of related measurements, or measurements that are logically grouped together. The measurements in a study are sometimes used in a formula to calculate new parameters (e.g. biplane volume with EF, SV and CO).

The Vivid *i* Ultrasound unit provides functionality for two measurement conventions:

• **Assign and Measure (Measure Protocols)**: the user selects a study consisting in a set of pre-labeled measurements related to the active scanning mode and clinical application. The user is prompted through the measurements in the order of the measurement labels. This convention is started from the **MEASURE** button on the control panel. A set of tools is implemented to make the measurement process as fast and easy as possible for the user:

  • The user is guided through the study: an auto-sequence functionality automatically selects the next measurement in a study.

  • The selected measurement is highlighted in the *Measurement menu*.

  • The performed measurement is indicated in the *Measurement menu*.

The studies and their parameters are user-configurable. The user can create its own studies containing the relevant measurements only (see page 365).

• **Measure and Assign (Free style)**: the user performs a measurement and assigns a label.

⚠
CAUTION

Only assigned measurements will be saved. Measurements without assignment will be lost when scanning is resumed.

About Measurement results display

Be aware of the following:

- Measurement results display

  By default the system always displays absolute values for parameters measured in Doppler. This means that values from above and below baseline will all be displayed as positive results.
  For Cardiac this behavior cannot be changed. For non-Cardiac the Absolute Value setting can be turned off in **Config** -> **Meas/Text** -> **Advanced**, by setting the attribute **Absolute Value** to Off.

- Calculated parameters

  For calculated parameters the system uses signed values in calculation formulas, and displays the absolute value of the result.

The Assign and Measure modality

In this measurement modality, the user selects a study consisting in a set of related pre-labelled measurements.

Starting the Assign and Measure modality

1. Press MEASURE on the control panel.
    The *Measurement Menu* is displayed in the *Parameters window* (see example Figure 6-2).
    The trackball cursor is in the scanning window, ready for starting measurement.

1. **Active application**
2. **Study**
3. **Selected study**
4. **Opened study**
5. **Measurements related to the area study for the cardiac application**

Figure 6-1: Example of a measurement study

Entering a study and performing measurements

1. Press MEASURE on the front panel to enter the **Assign and Measure** modality.
    The *Measurement menu* with a list of studies is displayed in the *Parameters window* (see example Figure 6-2).

2. Select any required study (other than **Generic** study which is reserved for the *Measure and Assign* modality).

3. Within the selected study, select the required parameter which you intend to measure.

4. Perform the measurement. The parameter's name and measured value will appear in the result window.

To perform a measurement from another study

1. Trackball to the required study.

2. Press SET on the trackball area.
    The study folder is opened displaying the measurements related to this study. Other related studies may also be available from within the study.

3. Trackball to the measurement to perform.

4. Press SET on the trackball area to activate the measurement tool.
    The cursor is moved back to the scanning window.

5. Perform the measurement.
    Completed measurements are marked with a check mark (Figure 6-2).
    When the measurement operation is completed the next measurement on the list is automatically selected.

To skip a measurement in a study

1. Trackball to the desired measurement

2. Press SET to activate the measurement tool.

1. **Performed measurement**
2. **Next measurement is automatically selected**

Figure 6-2: Display of a performed measurement (example)

Measure and Assign modality

In this measurement modality, the user performs a measurement and assign a label.

⚠
CAUTION

Only assigned measurements will be saved.

Starting the Measure and Assign modality

1. Press MEASURE on the control panel.
   The *Measurement Menu* is displayed in the *Parameters window* (see example Figure 6-3).

2. Select the **Generic** study if not already selected, and trackball to the required measurement tool.

3. Press SET on the trackball area to activate the measurement tool.
   The cursor is moved back to the scanning window, ready for measurement.

1. **Measurement tools**
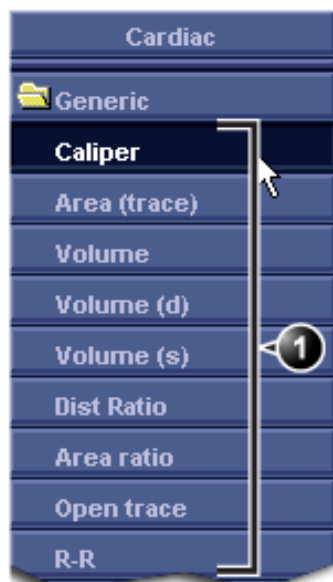
Figure 6-3: The 2D Mode Measurement tools (Cardiac application)

Post-measurement assignment labels

Each type of measurement, within each mode, can be associated with a set of pre-defined parameter labels. Parameter labels can be assigned to the highlighted measurement by the user.

To assign a parameter label to a measurement:

1. Trackball to the actual measurement in the *Measurement result table* (see Figure 6-4).

*The selection of a measurement without pre-defined labels will not display the **Parameter label menu**.*

2. Press SET.
   A *Parameter label menu* is displayed.

3. Trackball through the *Parameter label menu* to highlight the required label.

4. Press SET to assign the highlighted parameter label to the measurement.

The assigned measurements may be reviewed in the Worksheet (see page 202). Up to five assigned measurements with the same label can be stored in the patient archive.

⚠
CAUTION

Only assigned measurements will be saved. Measurements without assignment will be lost when scanning is resumed.

1. Parameter Label menu
2. Selected label

Assignment

3. Assigned measurement
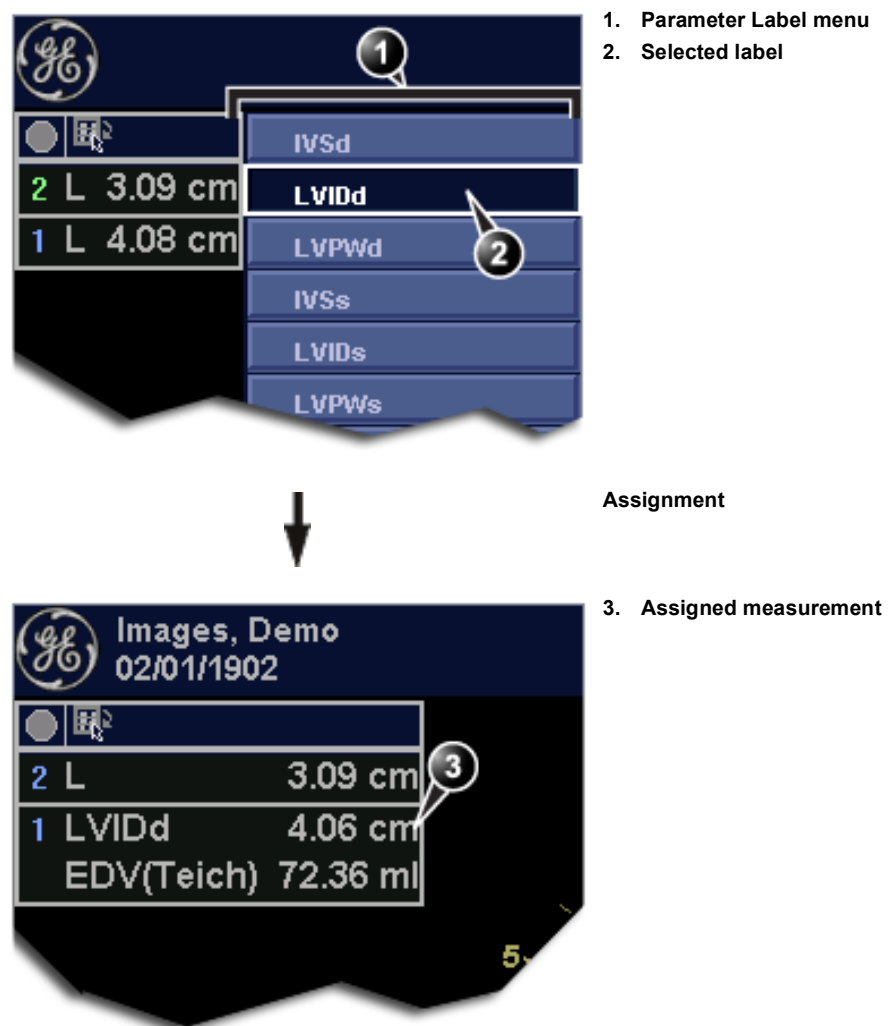
Figure 6-4: Measurement assignment

To assign a user-defined parameter label

1. Trackball to the actual measurement in the *Measurement result table* (see Figure 6-4).

2. Press $\overline{SET}$.
   A *Parameter label menu* is displayed.

3. Trackball to **User** and press $\overline{SET}$.
   The *Enter new parameter window* is displayed.
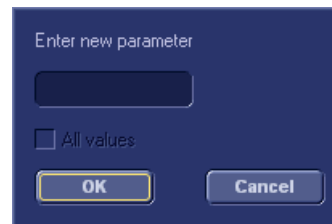
Figure 6-5: The Enter new parameter window

4. Type a name for the parameter label.

5. Press **OK**.
   The user defined parameter label is assigned to the selected measurement.

Cardiac measurements

2D Measurements

2D Length measurements

1. Generate the 2D image.
2. Press FREEZE to stop the cineloop.
3. Press MEASURE on the Control Panel.
4. Select **Caliper** in the *Measurement Menu* (see Figure 6-1).
5. Trackball the cursor to the start point of the measurement.
6. Press SET to anchor the start point of the measurement.

*See the **Status bar** to get the next step to perform.*

7. Trackball the cursor to the measurement end point.
   The current distance value is displayed in the *Measurement result table* and is instantaneously updated when moving the cursor.

The measurement display color on the 2D image changes from green to blue after completion of the measurement.

8. Press SET to anchor the end point of the measurement.
   The measurement result is displayed in the *Measurement result table*.
9. To assign a label to the measurement, see page 163.
10. Repeat steps 5 through 8 to make additional length measurements.

The measurements displayed on the 2D image and the corresponding results are numbered.

2D length measurement ratio

1. Generate the 2D image.
2. Press FREEZE to stop the cineloop.
3. Press MEASURE on the Control Panel.
4. Select **Dist. ratio** in the *Measurement Menu* (see Figure 6-1).
5. Perform two length measurements as described in steps 5 through 8 in the above section.
   The measurement results including the ratio (%) of the two measured lengths are displayed in the *Measurement result table*.

Editing 2D Length measurements

1. Trackball the cursor to one of the anchor points of the measurement to modify.
2. Double-click the $\overline{\text{SET}}$ key to select the anchor point. The selected marker turns green and is unanchored.
3. With the **Trackball**, reposition the marker.
4. Press $\overline{\text{SET}}$ to anchor.

2D Area measurements

1. Generate the 2D image.
2. Press $\overline{\text{FREEZE}}$ to stop the cineloop.
3. Press $\overline{\text{MEASURE}}$ on the Control Panel.
4. Select **Area (trace)** in the *Measurement Menu* (see Figure 6-1).
5. Trackball the cursor to the start point of the measurement.

*See the **Status bar** to get the next step to perform.*

6. Press $\overline{\text{SET}}$ to anchor the start point of the measurement.
7. Trace the area (planetary) with the **Trackball**.

The measurement display color on the 2D image changes from green to blue after completion of the measurement.

The current area and circumference values are displayed in the *Measurement result table* and are instantaneously updated when moving the cursor.

8. Press $\overline{\text{SET}}$ to complete the measurement. The measurement result is displayed in the *Measurement result table*.
9. To assign a label to the measurement, see page 163.

The measurements displayed on the 2D image and the corresponding results are numbered.

10. Repeat steps 5 through 8 to make additional area measurements.

2D area measurement ratio

1. Generate the 2D image.
2. Press $\overline{\text{FREEZE}}$ to stop the cineloop.
3. Press $\overline{\text{MEASURE}}$ on the Control Panel.
4. Select **Area ratio** in the *Measurement Menu* (see Figure 6-1).
5. Perform two area measurements as described in steps 5 through 8 in the above section.

*See the **Status bar** to get the next step to perform.*

The measurement results including the ratio (%) of the two measured areas are displayed in the *Measurement result table*.

Editing 2D Area measurements

1. Trackball the cursor to the anchor point of the area measurement to modify.
2. Press $\overline{\text{SET}}$ twice (Double-click) to select the anchor point. The selected marker turns green and is unanchored.
3. With the **Trackball**, reposition the marker.
4. Press the $\overline{\text{SET}}$ to anchor.

2D Volume measurements

The measurements described in this section enable volume measurement in a defined zone. The measurements tool generates results by two methods:

*For measurement formulae, refer to the **Reference Manual**.*

- Method of Disk (displayed as **Vmod** in the *Measurement result table*), known as Simpson's method.
- Area/Length method (displayed as **Va-l** in the *Measurement result table*).

To perform a volume measurement:
1. Generate the 2D image.
2. Press $\overline{\text{FREEZE}}$ to stop the cineloop.
3. Press $\overline{\text{MEASURE}}$ on the Control Panel.
4. Select **Volume** in the *Measurement Menu* (see Figure 6-1).
5. Trackball the cursor to the start point where a volume is to be measured.

*See the **Status bar** to get the next step to perform.*

6. Press $\overline{\text{SET}}$ to anchor the start point of the measurement.
7. Trackball the cursor to draw the length. Use the trackball to outline the area of interest.
8. Press $\overline{\text{SET}}$ to anchor the second point. A third caliper will appear, marking the length of the ROI.
9. If required, drag the cursor with the **Trackball** to modify the length marker.

The current area, circumference and Area/Length Volume (Va-l) values are displayed in the *Measurement result table* (see Figure 6-1) and are instantaneously updated when moving the cursor.

The measurement display color on the 2D image changes from green to blue after completion of the measurement.

10. Press $\overline{\text{SET}}$ to complete the measurement. The measurement results including Vmod (Simpson) are displayed in the *Measurement result table* (see Figure 6-1).

The measurements displayed on the 2D image and the corresponding results are numbered.

11. To assign a label to the measurement, see page 163.

12. Repeat steps 5 through 10 to make additional volume measurements.

2D Depth measurements

The measurements described in this section enable depth measurement from the probe to a selected point.

To perform a depth measurement:
1. Generate the 2D image.

2. Press **FREEZE** to stop the cineloop.

3. Press **MEASURE** on the Control Panel.

See the Status bar to get the next step to perform.

4. Press the assignable **POINT** to select the depth measurement function.

5. Trackball the cursor to the position to measure.
The current distance from the probe is displayed in the *Measurement result table* and is instantaneously updated when moving the cursor.

The measurements displayed on the 2D image and the corresponding results are numbered.

6. Press **SET** to anchor the point.
The depth value (cm) is displayed in the *Measurement result table*.

M-Mode Measurements

In M-Mode, the user can perform distance and time measurements. This measurement package has also the following pre-defined measurement studies:

- LA/Ao
- LV
- RV

M-Mode Length measurements

1. Generate the M-Mode image.
2. Press FREEZE to stop the cineloop.
3. Press MEASURE on the Control Panel.
4. Select **caliper** in the *Measurement Menu*.
5. Trackball the cursor to the start point of the measurement.
6. Press SET to anchor the start point of the measurement.

*See the **Status bar** to get the next step to perform.*

7. Trackball the cursor to the measurement end point. The current distance value is displayed in the *Measurement result table* and is instantaneously updated when moving the cursor.
8. Press SET to anchor the end point of the measurement.

The measurement display color on the M-Mode changes from green to blue after completion of the measurement.

The measurement result is displayed in the *Measurement result table*.

9. To assign a label to the measurement, see page 163.
10. Repeat steps 5 through 8 to make additional length measurements.

The measurements displayed on the M-Mode image and the corresponding results are numbered.

Editing M-Mode Length measurements

1. Trackball the cursor to one of the anchor points of the measurement to modify.
2. Press SET twice (double-click). The selected marker turns green and is unanchored.
3. With the **Trackball**, reposition the marker to a new position.
4. Press SET.

Ao/LA study

1. Generate the M-Mode image.
2. Press **FREEZE** to stop the cineloop.
3. Press **MEASURE** on the Control Panel.
4. Select **Ao/LA** in the *Measurement Menu*.
5. Trackball the cursor along the time axis to the required point to start measurement of Aorta root diameter.

*See the **Status bar** to get the next step to perform.*

6. Press **SET**.
   The starting point for the measurement is anchored.
7. Trackball to the end point of the measurement.

The current value is updated while moving the cursor.

8. Press **SET**.
   The measurement end point is anchored and the value is displayed in the *Measurement result table*.
   A new free-moving cursor is displayed on the image, ready for the next measurement.
9. Repeat steps 5, through 8 to measure Left Atrium.
   The LA value is displayed in the *Measurement result table*.
   The Ao/LA ratio is displayed in the *Measurement result table*.

LV study

The LV study consists of measurements in fixed-time mode in both systole and diastole of:

- Interventricular septum thickness (IVS)
- Left ventricular internal dimension (LVID)
- Left ventricular posterior wall thickness (LVPW)

The following parameters are also calculated:

- EDV (End diastole volume)
- ESV (End systole volume)
- SV (Stroke volume)
- EF (Ejection Fraction)
- FS (Fractional Shortening)

To perform LV study
1. Generate the M-Mode image.
2. Press **FREEZE** to stop the cineloop.
3. Press **MEASURE** on the Control Panel.
4. Select **LV study** in the *Measurement Menu*.

5. Trackball the cursor along the time axis to the required point to start measurement of IVSd.
6. Press $\overline{SET}$. The starting point for the measurement is anchored.
7. Trackball to the end point of the measurement.
8. Press $\overline{SET}$. The IVSd measurement end point is anchored and the value is displayed in the *Measurement result table*.

The end point of the IVSd is also the start point for the LVIDd.

1. Trackball to the end point of the LVIDd measurement.
2. Press $\overline{SET}$. The LVIDd measurement end point is anchored and the value is displayed in the *Measurement result table*.

The end point of the LVIDd is also the start point for the LVPWd.

1. Trackball to the end point of the LVPWd measurement.
2. Press $\overline{SET}$. The LVPWd measurement end point is anchored and the value is displayed in the *Measurement result table*.
3. Repeat steps 5, through 2 to measure IVS, LVID and LVPW in systole.

RV study

The RV study consists of measurement in fixed-time mode of Right ventricular internal dimension (RVID) in both diastole and systole.

To perform RV study
1. Generate the M-Mode image.
2. Press $\overline{FREEZE}$ to stop the cineloop.
3. Press $\overline{MEASURE}$ on the Control Panel.
4. Select **RV study** in the *Measurement Menu*.
5. Trackball the cursor along the time axis to the required point to start measurement of RVIDd.
6. Press $\overline{SET}$. The starting point for the measurement is anchored.

The current value is updated while moving the cursor.

7. Trackball to the end point of the measurement.
8. Press $\overline{SET}$. The measurement end point is anchored and the RVIDs measurement value is displayed in the *Measurement result table*.

A new free-moving cursor is displayed on the image, ready for the next measurement.

9. Repeat steps 5, through 8 to measure RVIDs.
   Both the RVIDd and RVIDs values are displayed in the *Measurement result table*.

Doppler Measurements

The following measurements may be calculated on Doppler mode spectra:

*For measurement formulae, refer to the **Reference Manual**.*

- Maximum (peak) and mean velocity
- Maximum and mean pressure gradient
- Pressure half-time (PHT)
- Velocity time integral (VTI)
- Mitral valve area (MVA), derived from PHT

Velocity and Pressure point measurements

1. Generate the spectrum to be measured.
2. Press **FREEZE** to stop the cineloop.
3. Press **MEASURE** on the Control Panel.
4. Select **Point Caliper** in the *Measurement Menu*.
5. Trackball the cursor to the position to measure.
   The current velocity is displayed in the *Measurement result table* and is instantaneously updated when moving the cursor.

The measurement display on the spectrum and the corresponding results are numbered.

6. Press **SET** to anchor the point.
   The velocity (m/s) and pressure (mmHg) values are displayed in the *Measurement result table*.

Velocity and Pressure caliper measurements

1. Generate the spectrum to be measured.
2. Press **FREEZE** to stop the cineloop.
3. Press **MEASURE** on the Control Panel.
4. Select **Caliper** in the *Measurement Menu*.
5. Trackball the cursor to the start point of the measurement.
6. Press **SET** to anchor the start point of the measurement.
7. Trackball the cursor to the measurement end point.

The current velocity and pressure values are displayed in the *Measurement result table* and are instantaneously updated when moving the cursor.

The measurement display color on the spectrum changes from green to red after completion of the measurement.

8. Press $\overline{SET}$ to anchor the end point of the measurement. The following measurement results are displayed in the *Measurement result table*:

    •   Velocity and pressure at anchor point positions

    •   Velocity (V3) and pressure (p3) differences between anchor point position

    •   Time difference (dT) between anchored points position

The measurement display on the spectrum and the corresponding result are numbered.

9. To assign a label to the measurement, see page 163.

10. Repeat steps 5 through 8 to make additional measurements.

Manual Doppler trace measurements

Adjust Compress and reject controls to optimize the Doppler signal.

1. Generate the spectrum to be measured.

2. Press $\overline{FREEZE}$ to stop the cineloop.

3. Press $\overline{MEASURE}$ on the Control Panel.

4. Select **Manual trace** in the *Measurement Menu*. A vertical green cursor is displayed on the spectrum.

5. Trackball the cursor to the start point on the left side of the trace.

6. Press $\overline{SET}$ to anchor the start point of the measurement.

7. With the **trackball**, trace the Doppler envelope. The trace can be adjusted, while tracing, by moving the cursor backward to erase portion of the trace (or the entire trace) and then create the trace again.

The measurement display color on spectrum changes from green to red after completion of the measurement.

8. Press $\overline{SET}$ to complete the trace. The following measurement results are displayed in the *Measurement result table*:

    •   Maximum and mean Velocities

    •   Maximum and mean pressures

    •   Env. Ti

    •   Velocity time integral (VTI)

9. Trackball the cursor to the start point of the next heart beat.

10. Press the $\overline{SET}$ to anchor the next heart beat starting point. The heart rate (BPM) is displayed in the *Measurement result table*.

Automatic Doppler trace measurements

Adjust Compress and reject controls to optimize the Doppler signal.

1. Generate the spectrum to be measured.
2. Press **FREEZE** to stop the cineloop.
3. Press **MEASURE** on the Control Panel.
4. Select **Auto Trace** in the *Measurement Menu*.
   A vertical green cursor is displayed on the spectrum.
5. Trackball the cursor to the starting point.
6. Press **SET** to anchor the start point of the measurement.
7. Trackball to the end trace position.
8. Press **SET** to anchor the end point of the trace.
   The trace is automatically generated and the following measurements are displayed in the *Measurement result table*:
   - Maximum and mean Velocities
   - Maximum and mean pressures
   - Env. Ti
   - Velocity time integral (VTI)
9. Trackball the cursor to the next heart beat.
10. Press **SET** to anchor the next heart beat starting point.
    The heart rate (BPM) is displayed in the *Measurement result table*.

MV E/A ratio

Adjust Compress and reject controls to optimize the Doppler signal.

1. Generate the spectrum to be measured.
2. Press **FREEZE** to stop the cineloop.
3. Press **MEASURE** on the Control Panel.
4. Select **MV E/A ratio** in the *Measurement Menu*.
5. Trackball the cursor to the peak of the E wave.
6. Press **SET** to anchor the point.
7. **Drag** cursor to baseline to mark dT.
8. Press **SET** on the trackball area to anchor the second point.
9. Trackball the cursor to the peak of A wave.
10. Press **SET** to anchor the point.
    the velocity at peak for E and A waves and the calculated E/A ratio are displayed in the *Measurement result table*.

Event timing measurements

Event timing enables the time measurement for opening and closure of the Aorta and Mitral valves, as referred to the start to the QRS complex.

Event timing can be performed on a Doppler spectrum or an M-Mode acquisition showing the corresponding valves. The procedure is similar on both modes.

1. Generate the spectrum to be measured.
2. Press FREEZE to stop the cineloop.
3. Press MEASURE on the Control Panel.
4. Select **Event Timing** in the *Measurement menu*.
   The following event timing measurements are available (with the first measurement on the list selected):
   - **AVO**: Aortic Valve Opening
   - **AVC**: Aortic Valve Closure
   - **MVO**: Mitral Valve Opening
   - **MVC**: Mitral Valve Closure
5. Trackball the cursor to the corresponding point on the spectrum for the selected measurement.
6. Press SET to anchor the point.
   The event timing measurement (ms) is displayed in the *Measurement result table*.

Vascular measurements

B-Mode measurements

The following instructions assume that you first scan the patient and press **FREEZE**.

% Stenosis

% Stenosis by diameter
1. Press **MEASURE** on the control panel.
2. Open **% Stenosis** in the *Measurement menu*.
3. Select **% Sten (Diam)**.
4. Make a distance measurement of the inner area of the blood vessel.
5. Make a distance measurement of the outer area of the blood vessel.
   The distance measurements and the % Stenosis are displayed in the *Measurement result table*.

% Stenosis by area
1. Press **MEASURE** on the control panel.
2. Open **% Stenosis** in the *Measurement menu*.
3. Select **% Sten (Area)**.
4. Make a trace measurement of the inner area of the blood vessel.
5. Make a trace measurement of the outer area of the blood vessel.
   The area measurements and the % Stenosis are displayed in the *Measurement result table*.

Volume

The volume calculation can be made from one, two or three distance measurements.
1. Press **MEASURE** on the control panel.
2. Select **Volume** in the *Measurement menu*.
3. When doing volume calculation from three distance measurements (i.e. biplane volume), the measurements should be done in dual mode displaying a sagittal and an axial view. One measurement is usually made in the sagittal plane and two measurements in the axial plane.

When doing volume calculation from one or two distance measurements, make one or two distance measurements and press **MENU**.
The distance measurement(s) and the volume calculation are displayed in the *Measurement result table*.

A/B Ratio

In B-Mode, A/B Ratio can be measured by diameter or area.

A/B Ratio by diameter
1. Press **MEASURE** on the control panel.
2. Open **A/B Ratio** in the *Measurement menu*.
3. Select between:
   • **Ratio (Diam)**
   • **Ratio (Area)**
4. Make the corresponding two measurements.
   The measurements and the corresponding A/B Ratio are displayed in the *Measurement result table*.

Intima-Media Thickness

The Intima-Media Thickness (IMT) is calculated based on automatic contour detection of the Intima and Media layers on a user-defined search region along the vessel wall. Multiple IMT measurements are made between pairs of intima and adventitia points along the wall (Figure 6-6). IMT can be measured both on the posterior and the anterior walls of the vessel.

The IMT measurement is available with linear probes only.

Note: due to the physical properties of ultrasound imaging, the posterior IMT measurement is generally more accurate than the anterior IMT measurement.

The following parameters are calculated:
• Average IMT
• Maximum IMT
• Minimum IMT
• Standard deviation of IMT measurements
• Number of successful IMT measurements

1. Vessel lumen
2. Vessel wall
3. Lumen-Intima boundary
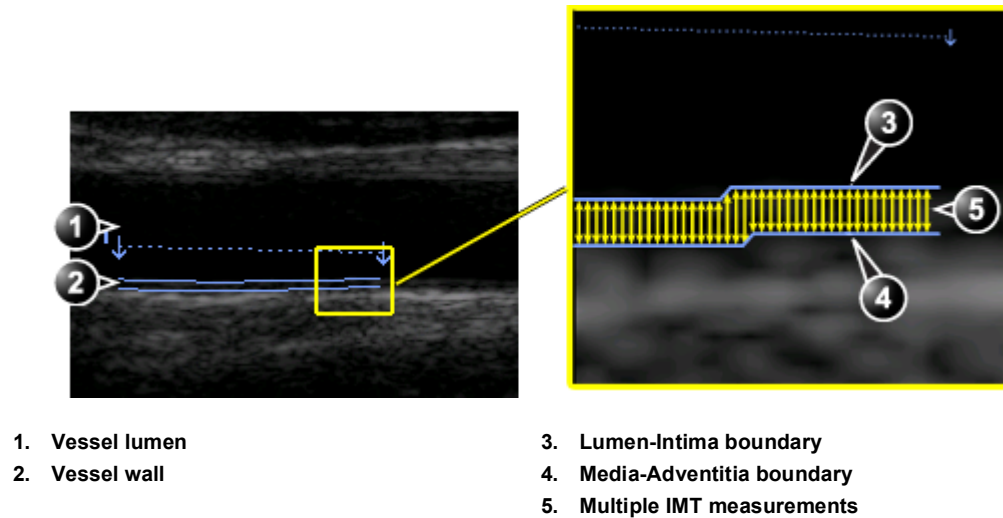4. Media-Adventitia boundary
5. Multiple IMT measurements

Figure 6-6: IMT measurement (Posterior wall)

IMT Measurement procedure

The following procedure describes the posterior IMT measurement.

1. Acquire a longitudinal scan of the carotid artery and optimize the image.
2. Press **FREEZE**.
3. Scroll to an end-diastolic frame where the intima layer is clearly visible.
4. Press **MEASURE**.
5. Select the appropriate IMT measurement. If measuring the IMT of the posterior wall of the right common carotid select **Rt** and **CCA IMT Post** (Figure 6-7).

Figure 6-7: IMT Measurement menu (Right Common Carotid Posterior IMT measurement tool)

6. Place the cursor in the artery closer to the posterior wall and press SET to anchor the start of the search region (Figure 6-8, left).

7. Move the cursor parallel to the artery to define the end point of the search region. Make sure the Intima and Media layers are within the search region (indicated by the lower dotted line in Figure 6-8, left).
    Press SET to anchor the point. For the posterior wall the contour detector searches for the leading edges of the intima and adventitia layers. The detected contours are drawn in the image (Figure 6-8, right).
    The measurement calculations are displayed in the *Measurement result Table*.
    Note: if the Intima and Media layers are not within the search region, the contour is not drawn. Select (double click) and move the anchored points closer to the Intima layer.
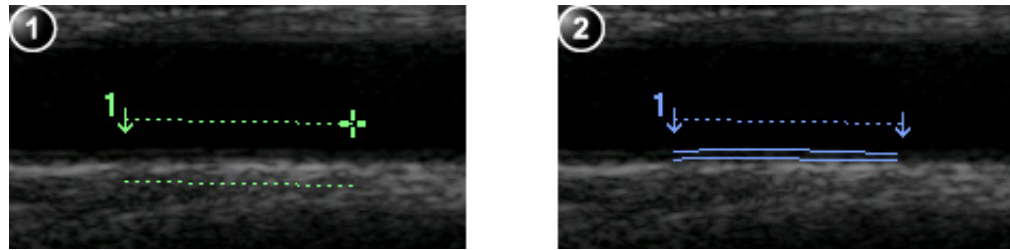
1. **Measurement segment**   2. **IMT trace**

Figure 6-8: IMT Measurement segment and traces

8. If the contour is not optimal, the following assigned control may be adjusted to improve border detection:

   • TRACE FIT: the traces are modified according to different threshold values.

   If the contour is still not optimal, try to perform the IMT measurement on another frame, preferably close to the end diastole.

IMT trace approval

Since the IMT measurements are done semiautomatically, the operator has to approve the detection by visual inspection before storing the results in worksheet and report.

• If the traces fit both layers of the intima-media walls, approve the measurement by selecting **Transfer** in the *Measurement menu*.

   Once transferred, the calculations can be viewed in the worksheet and report.
   Note: measurements that are not approved will not be saved.
   Note: any image adjustments (e.g. Gain or zoom) on approved (transferred) measurements will unassign the measurements. Press **Transfer** to approve the measurements again.

M-Mode Measurements

The following instructions assume that you first scan the patient and press <u>FREEZE</u>.

% Stenosis

1. Press <u>MEASURE</u> on the control panel.
2. Select **% Stenosis** in the *Measurement menu*.
3. Make a distance measurement of the inner area of the blood vessel.
4. Make a distance measurement of the outer area of the blood vessel.
   The distance measurements and the % Stenosis are displayed in the *Measurement result table*.

A/B Ratio

In M-Mode, A/B Ratio can be measured by diameter, time or velocity.

1. Press <u>MEASURE</u> on the control panel.
2. Open **A/B Ratio** in the *Measurement menu*.
3. Select between:
   • **Ratio (Diam**
   • **Ratio (Time)**
   • **Ratio (Velocity)**
4. Make the corresponding two measurements.
   The measurements and the corresponding A/B Ratio are displayed in the *Measurement result table*.

Doppler measurements

The system can detect the trace automatically or the user can draw the trace manually.

Auto vascular calculation

The system performs calculation automatically on the spectrum trace.

The auto vascular calculation can operate in live, freeze or be turned off (**Live**, **Frozen** and **Off** commands in the *Measurements menu*).

From the *Modify Calcs menu*, the user can:
*   select the calculations to be displayed in the *Measurement result table*.
*   set the calculations that should be default when an exam is started (**Save as default** command).
*   turn on the automatically detected trace to display max and/or mean trace (**Max** and **Mean** commands).
*   display forward flow, reverse flow or both flows (**Above**, **Below** and **Both** commands).

Setting up auto vascular calculation
1. Press **MEASURE**.
    The *Vascular measurement menu* is displayed (Figure 6-9).
2. Press **Auto** and select between:
    *   **Live**: calculation displayed on the real-time image.
    *   **Freeze**: calculation displayed on the frozen image.
    *   **Off**: auto vascular calculation is turned off.
3. Press **Modify Calcs**.
    The *Modify Calcs menu* is displayed (Figure 6-9).
4. Select:
    *   **Above**, **Below** or **Both** to select the spectrum to perform the calculations on, i.e. above or below the baseline or both.
    *   **Max** and/or **Mean** to display max and/or mean velocities.
5. In the *Modify Calcs menu*, select the measurements and calculations to be displayed in the *Measurement result table*.

6. Press **Save as default** to set the selected calculations to be default when a new study or exam is started.
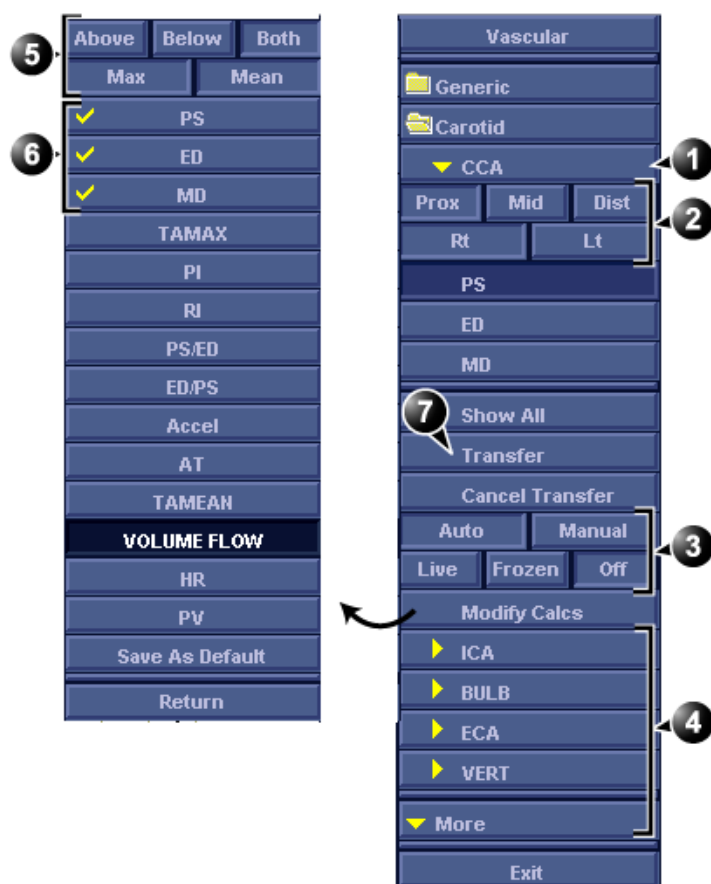
1. **Selected vessel**
2. **Vessel location parameters**
3. **Manual/auto calculation controls**
4. **Other vessels**

5. **Trace parameters**
6. **Selected measurements and calculation to appear in the *Measurement result table*.**
7. **Assign measurement and calculation**

Figure 6-9: Vascular measurement menu (example)

Using Auto vascular calculation
1. Perform the scan and press <u>FREEZE</u>.
   The system performs the calculation automatically and the pre-defined measurements and calculation are displayed in the *Measurement result table*.

2. The following controls may be adjusted from the control panel:
   - $\underline{\text{CYCLE SELECT}}$: change the selected cycle.
   - $\underline{\text{TRACE SENSITIVITY}}$: optimize the trace contour.
   - $\underline{\text{CURSOR SELECT}}$: select Peak systolic or End diastolic marker. The selected marker can be moved to a new location. Press $\underline{\text{SET}}$ to anchor the marker to its new location.

Assigning auto calculations

1. In the *Vascular Measurement menu* (Figure 6-9), select:
   - The actual vessel name
   - **Prox**, **Mid** or **Dist**: the location of the vessel (Proximal, Middle or Distal).
   - **Rt** or **Lt**: right or left side of the patient.
2. Press **Transfer** to assign the measurements and calculations.

*To undo the assignment, press **Cancel transfer**.*

The *Measurement result table* is updated accordingly and the measurements and calculations are added to the worksheet and report.

Manual vascular calculation

When doing manual measurements, the system can detect the trace automatically or it can be drawn by the user. This is controlled by the **Auto** and **Manual** commands is the *Measurement menu*.

The following instructions assume that you first scan the patient and press $\underline{\text{FREEZE}}$.

1. Adjust the vessel location parameters in the *Vascular measurement menu* (Figure 6-9).
2. Select the measurement to be performed from the *Measurement menu* or from the *Show All menu* for additional measurements.
3. Perform the measurement as described below.

Acceleration, Acceleration time (AT)

1. Select **Accel** or **AT**.
2. Position the caliper at the start point and press $\underline{\text{SET}}$ to anchor the caliper.

3. Position the second caliper at the end point and press **SET** to anchor the caliper and complete the measurement.
The acceleration and/or the acceleration time is displayed in the *Measurement result table*.

Heart rate

Heart rate is calculated by selecting two identical points over two heart cycles.

1. Select **HR**.
2. Position the caliper at a recognizable point in the first cycle and press **SET** to anchor the caliper.
3. Position the second caliper at the identical point in the second cycle and press **SET** to anchor the caliper and complete the measurement.
The Heart rate is displayed in the *Measurement result table*.

Peak systole (PS), End diastole (ED) and Mid diastole (MD)

1. Select **PS**, **ED** or **MD**.
2. Position the caliper at the corresponding measurement point and press **SET** to complete the measurement.
The selected measurement is displayed in the *Measurement result table*.

Pulsatility index (PI)

With Auto trace on

1. Select **PI**.
2. Position the caliper at the beginning of the wave form and press **SET** to anchor the caliper.
3. Position the second caliper at end diastole and press **SET**.
A trace is displayed between the two calipers and PS, ED, MD, TAMAX, PI and RI are displayed in the *Measurement result table*.

With Manual trace on

1. Select **PI**.
2. Position the caliper at the beginning of the wave form and press **SET** to anchor the caliper.
3. Using the trackball, draw the trace to the end diastole and press **SET**.
The trace is displayed and PS, ED, MD, TAMAX, PI and RI are displayed in the *Measurement result table*.

Peak systole/End diastole (PS/ED) and End diastole/Peak systole (ED/PS) ratio

1. Select **PS/ED** or **ED/PS**.

2. Position the caliper at Peak systole or End systole and press $\overline{\text{SET}}$ to anchor the caliper.

3. Position the second caliper at End diastole or Peak systole and press $\overline{\text{SET}}$ to anchor the caliper and complete the measurement.
    The Peak systole, End diastole and PS/ED or ED/PS ratio are displayed in the *Measurement result table*.

Resistive index (RI)

1. Select **RI**.

2. Position the caliper at Peak systole and press $\overline{\text{SET}}$ to anchor the caliper.

3. Position the second caliper at end diastole and press $\overline{\text{SET}}$.
    The Peak systole, End diastole and RI are displayed in the *Measurement result table*.

TAMAX/TAMEAN/Volume Flow

 With Auto trace on

1. Select **TAMAX**, **TAMEAN** or **Volume Flow**.

2. Position the caliper at the start point and press $\overline{\text{SET}}$ to anchor the caliper.

3. Position the second caliper at the end point and press $\overline{\text{SET}}$ to anchor the caliper and complete the measurement.
    A trace is displayed between the two calipers and corresponding measurements are displayed in the *Measurement result table*.

 With Manual trace on

1. Select **TAMAX**, **TAMEAN** or **Volume Flow**.

2. Position the caliper at the start point and press $\overline{\text{SET}}$ to anchor the caliper.

3. Using the trackball, draw the trace to the end point and press $\overline{\text{SET}}$.
    The trace is displayed and the corresponding measurements are displayed in the *Measurement result table*.

Measurement package configuration

A list of all cardiac calculations with needed measurements and location in the Measurement package can be found in the Reference manual.

There are many more measurements and parameters in the measurement package than shown in the default *Measurement menu*. Use the configuration system to set up the measurements that should be available in the *Measurement menu* and which parameters should be calculated.

The following example based on calculation of AV CO (Cardiac Output by Aortic Flow) describes how to configure the measurement package so that necessary measurements and the resulting calculations are displayed on screen.

Measurement package configuration - example

Calculation of Cardiac Output by Aortic Flow requires measurement of:

- AV diameter located in the folder *Dimension* (2D mode)
- AV VTI located in the folder *Aortic* (Doppler AV Trace).
- Heart rate

If a calculated parameter (e.g. AV CO in AV Trace measurement) requires another parameter to be calculated (e.g. AV Diam) the user must first measure the required parameter (e.g. AV Diam) before the dependent parameter (e.g. AV CO in AV Trace) gets calculated.

Configuration of the Measurement menu

If the AV diameter measurement is not present in the folder *Dimension* in the *Measurement menu*, follow the following procedure:

1. Press $\overline{\text{CONFIG}}$ and select the category **Meas/Text**. The *Measurement menu sheet* is displayed (see Figure 6-10).
2. AV Diam is a 2D measurement, make sure that **2D** is checked in the *Measurement sheet*.
3. Select folder **Dimension** in the *Measurement menu*.

A list of all available measurements for the selected folder is displayed in the *Measurement menu sheet*.

4. Check the box in front of **AV Diam**.
The AV Diam measurement is displayed in the folder *Dimension* in the *Measurement menu*.

5. For the AV VTI measurement, check **Doppler** in the *Measurement menu sheet* and select the folder **Aortic** in the *Measurement menu*.

6. Check the box in front of **AV Trace**.
The AV Trace measurement is displayed in the folder *Aortic* in the *Measurement menu*.

1. **Select the scanning mode for the measurement to add to the Measurement menu.**
2. **Select the folder for the measurement to add.**
3. **Select the measurement to add.**

Figure 6-10: Configuration of the Measurement menu

Configuration of the Measurement result table

If AV CO calculation is not displayed in the *Measurement result table*, follow the following procedure:

1. Press CONFIG and select the category **Meas/Text**.
    The *Measurement menu sheet* is displayed.

2. The AV CO calculation is based on Doppler AV Trace measurement in the folder *Aortic*, check **Doppler** in the *Measurement menu sheet* and select the folder **Aortic**.

3. In the folder *Aortic*, select **AV Trace** measurement.
    A list of all available calculations for the selected measurement is displayed in the *Measurement menu sheet*.

4. Check the box in front of **AV CO**.
    The AV CO calculation will be displayed in the *Measurement result table*.

Normal values

Normal values can be defined by the user for all parameters. A Normal value can be either a range or a threshold. Normal values entered are grouped by measurement category (e.g. Cardiac, Pediatry etc.)

Normal values are displayed in the report.

To define a Normal value
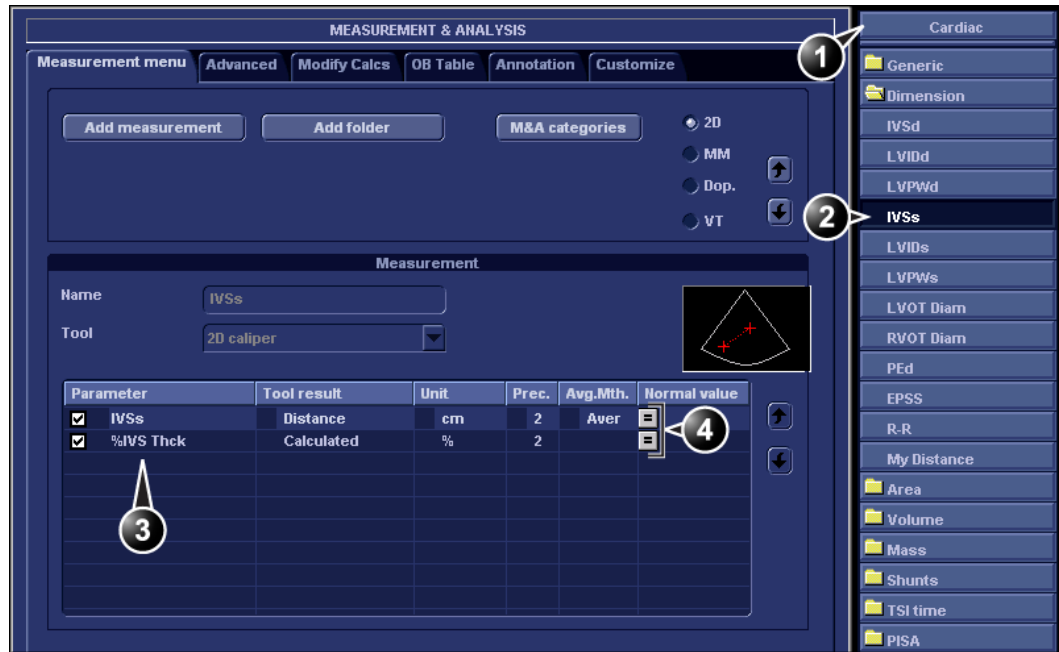
1. **Measurement category**
2. **Selected measurement**
3. **Parameters**
4. **Press to define Normal value**

Figure 6-11: Adding Normal value

1. Press $\overline{\text{CONFIG}}$ and select the **Config** category **Measure/Text**.
    The *Measurement menu sheet* is displayed (Figure 6-11).

2. In the *Measurement menu*, browse to the measurement of interest.
    The parameters for the selected measurements are displayed in the *Measurement menu sheet*.
    Note: to change Measurement category, press the **Heading** in the *Measurement menu* and select another Measurement category.

3. Select $\boxed{=}$ in the *Normal value column*.
    The *Normal value window* is displayed.
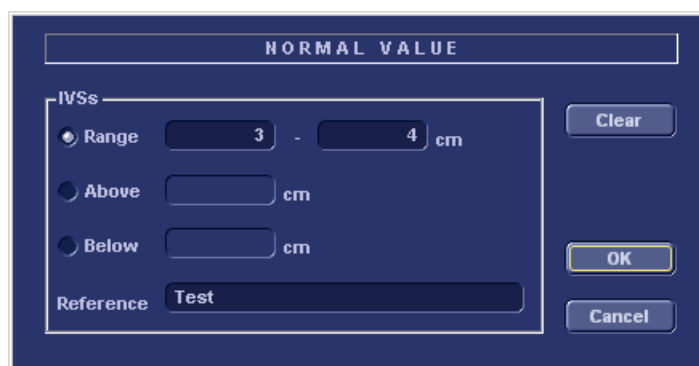
Figure 6-12: The Normal value window

4. In the *Normal value window*:
    • Select the Normal value type (Range, Above or Below).
    • Type in the Normal value.
    • Optionally enter a reference for the Normal value.
5. Select **OK**.
    The Normal value is displayed in the *Measurement menu sheet*.

To display Normal values and references in the Report, the Report template must be configured to show Normal values (see page 190). Measurements outside the Normal value are highlighted in the Report.

User-defined formulas

User-defined formulas can be created using existing measurements or by defining new measurements. The following example describes the creation of a formula based on existing measurements.

△

CAUTION

GE Ultrasound does not take any responsibility for the correctness of the user-defined functions.

User-defined formula - example

The workflow for user-defined formula is:

- If the user-defined formula is based on several measurements of different types, create a user-defined folder in the *Measurement menu* so that all measurements and the formula are grouped together. If the formula is based on a single measurement you may select an existing appropriate folder.
- Add the measurement(s) needed for the formula to the user-defined (or existing) folder.
- Create the formula based on the added measurements.

The following procedure describes the creation of user-defined LIMP formula as follow: My LIMP = (MCO-AVET)/AVET.

Creation of a user-defined folder
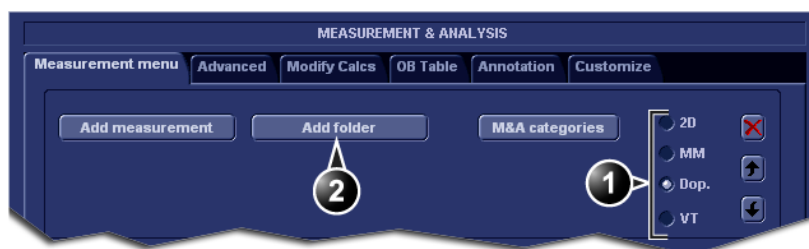
1. Select the appropriate scanning mode.
2. Create a folder in the Measurement menu.

Figure 6-13: The Measurement menu sheet

1. Press CONFIG and select the category **Meas/Text**.
2. MCO and AVET are Doppler measurements, select **Doppler** in the *Measurement menu sheet*.
3. Select **Add folder**.
4. Give the folder a name (e.g. "My Folder").

Adding measurements
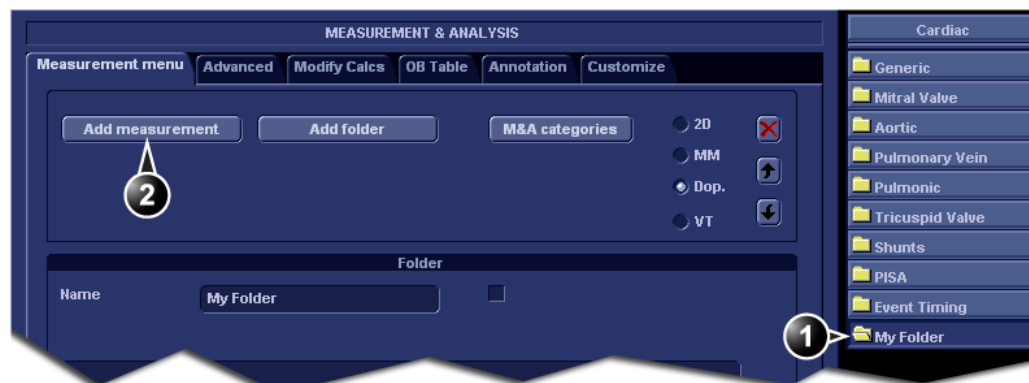
1. Select the user-defined folder.
2. Press Add measurement.

Figure 6-14: The Measurement menu sheet

1. Select the user-defined folder (e.g. "My Folder") in the *Measurement menu*.

2. Press **Add Measurement** in the *Measurement menu sheet*.
   The *Add measure window* is displayed.
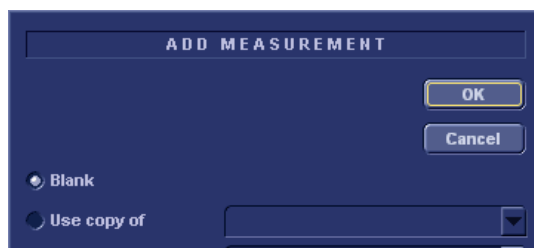
Figure 6-15: The Add measure window

3. MCO and AVET are measurements that already exist on the system, check **Use copy of** and select **MCO** from the drop down menu.

4. Select **OK** to add the MCO measurement.

5. Repeat steps 2 to 4 to add the AVET measurement.

Creation of the formula

1. **Select the last measurement.**
2. **Double click and enter the formula name.**
3. **Select "=" to create the formula.**

Figure 6-16: The Measurement menu sheet

The formula for this example is as follow:
My LIMP = (MCO-AVET)/AVET

1. In the user-defined folder (e.g. "My folder"), select the last measurement created (e.g. AVET).

2. Double-click **(Name)** in the last line in the *Parameter list* in the *Measurement menu sheet*.

3. Enter the name for the formula (e.g. My LIMP).

4. Select ▣.
   The *Edit formula window* is displayed.

Figure 6-17: The Edit formula window

5. Select "**(**" from the *Operators drop-down menu*.

6. In the *Doppler drop-down list*, select
   MCO [My Folder, MCO].
   Make sure to select the measurement located in the user defined folder (e.g. "My Folder").

7. Select "**-**" from the *Operators drop-down menu*.

8. In the *Doppler drop-down list*, select
   AVET [My Folder, AVET].

9. Select "**)**" from the *Operators drop-down menu*.

10. Select "*/*" from the *Operators drop-down menu*.

11. In the *Doppler drop-down list*, select
    AVET [My Folder, AVET].
    The Formula line should display: *({MCO}-{AVET})/{AVET}*.
    No units are necessary since the formula is a ratio (see also "About units" on page 199).

12. Press **Check** to make sure that the syntax for the formula is correct.

User-defined measurements

Some user-defined formula may require measurements that do not exist on the system. The following example based on a generic distance measurement illustrates how to create user-defined measurements.
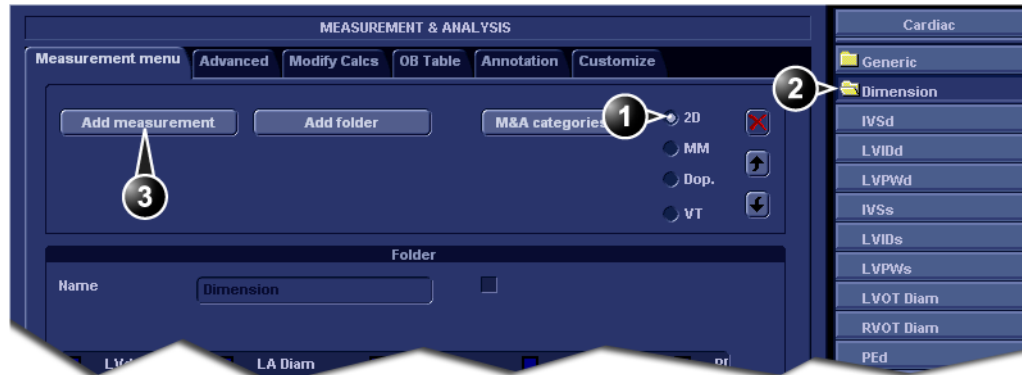
1. Select the appropriate scanning mode.
2. Select the appropriate folder.
3. Press Add measurement.

Figure 6-18: The Measurement menu sheet

1. Press $\overline{\text{CONFIG}}$ and select the category **Meas/Text**.

2. In the *Measurement menu sheet*, select the appropriate scanning mode for the measurement to be created (e.g. 2D).

3. Select the appropriate folder in the *Measurement menu* (e.g. Dimension).

4. Press **Add Measurement** in the *Measurement menu sheet*.
   The *Add measure window* is displayed.
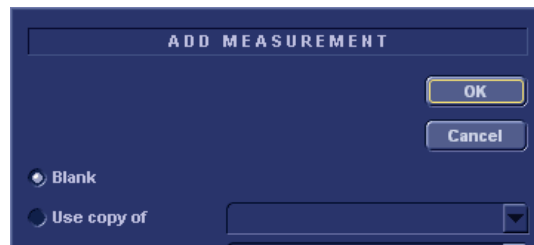
Figure 6-19: The Add measure window

5. Check **Blank** and press **OK**.
The *Measurement menu sheet* is updated.
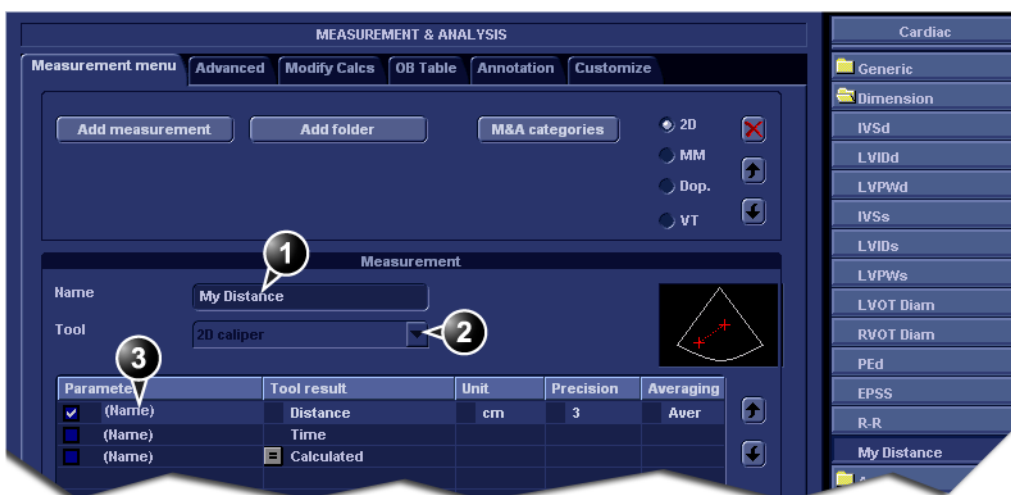
1. **Enter a name for the measurement.**
2. **Select the appropriate measurement tool.**
3. **Double click and enter the formula name.**

Figure 6-20: The Measurement menu sheet

6. In the *Measurement menu sheet*, enter the name for the measurement (e.g. My Distance).

7. Select the appropriate measurement tool in the drop-down menu, next to **Tool** (e.g. 2D Caliper).

8. Double-click **(Name)** in the appropriate parameter (e.g. Distance) and enter a name for the parameter (e.g. My Length).
If desired change the unit and the number of decimals for the measurement by double clicking the values under *Unit* and *Precision* (see also "About units" on page 199).

About units

Be aware of the following:

*   All units are calculated in SI units (see table below).
*   If no unit is specified in the *Edit formula window* when defining a formula, the displayed value will be in SI unit.

To define a different unit

1. When creating a formula, enter the desired unit the resulting value should use. E.g. if Y in the formula Y=f(x) is to be displayed in cm, enter cm in the *Unit* field.
    The *Unit* field is case sensitive, make sure to enter the exact unit as shown in the table below (Alternative unit column).
2. When creating the formula, be sure that all parameters (all the X's in Y=f(x)) are in SI units. All default parameters in the system are in SI units.
    If the resulting value of a user-defined formula is set to be displayed in a unit that is not SI, you must apply the correct conversion factor to all the parameters (X's).
    Example: if you have the formula Y=a*X and you set the formula result to be in cm, you have to convert the parameter X from meter (default SI unit) to cm by multiplying the parameter by 100. The formula with a result in cm should be defined as follow: Y=a*X*100.

Calculation	SI	Alternative unit
Time	s	ms - msec - min - h
Ratio	%	
Frequency	bpm	
Angle	rad	deg - grad
Distance	m	cm - dm - cm - mm - inch - feet- pixels
Velocity	m/s	dm/s - cm/s - mm/s - inch/s
Acceleration	m/s^2	dm/s2 - cm/s2 - mm/s2 - inch/s2
Area	m^2	dm2 - cm2 - cm^2 - mm2 - inch2
Volume	m^3	dm3 - cm3 - l - dl - cl - ml - gallon - quart

Calculation	SI	Alternative unit
Volume flow	m³/s	dm3/s - cm3/s - l/s dl/s - cl/s - ml/s - m3/min dm3/min - cm3/min - l/min - L/min - dl/min cl/min - ml/min - ml/m2
Pressure	mmHg	Pa - kPa - bar - torr - atm - psi
Pressure/time	mmHg/s	mmHg/s
Mass	kg	g - ounce - pound
Other		mmHG - Date - WeekDay - Day - NoUnit l/minm2 - g/m2 - cm/m2

Measurement result table

The display of the *Measurement result table* can be minimized and moved to prevent the table obscuring parts of the ultrasound image.

Minimizing the Measurement result table

1. Trackball to the symbol 🔘 on the heading of the *Measurement result table* (see Figure 6-21).
2. Press SET.

*Repeat step 1 to enlarge the **Measurement result table**.*

The *Measurement result table* is minimized to the heading bar.

Moving the Measurement result table

1. Trackball to the symbol 🔲 on the heading of the *Measurement result table* (see Figure 6-21).

2. Press **SET** to grab the table.

3. Trackball the *Measurement result table* to a new position.

4. Press **SET** to anchor the table.

1. **Minimize/maximize table**
2. **Move table**
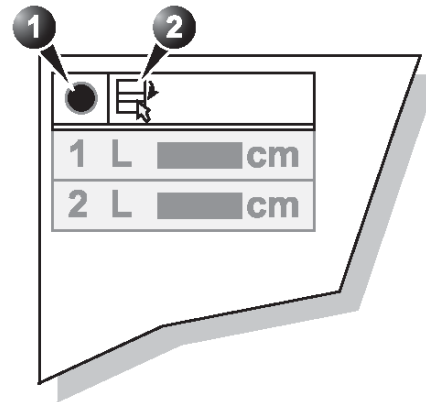
Figure 6-21: Measurement result table display tools

Deleting measurements

1. Trackball to the measurement to delete in the *Measurement result table* and press **SET**.
   A menu is displayed.

2. Select **Delete Measurement**.

Worksheet

The worksheet function enables the user to review, edit, delete or print data independently of a report. All measurements and calculations taken during the examination can be viewed at any time using the worksheet.

Overview

1. Measurement type
2. Measurement parameter
3. Value: Averaging, Max, Min or Last
4. Measured / calculated values
5. Value type
6. Measurement type selection

Figure 6-22: The Worksheet screen (Cardiac)

Using Worksheet

• Press $\overline{\text{WORKSHEET}}$ on the control panel and select the measurement type (see Figure 6-22).

To scroll through pages

• Select $\overline{\text{PAGE DOWN}}$ or $\overline{\text{PAGE UP}}$.

To select the type of value

1. Trackball to the relevant cell in the *Method column*.
2. Press $\overline{\text{SET}}$.
   A pop-up menu is displayed showing the different options available (Figure 6-23).

1. Average of the measurements taken

2. Maximum measurement

3. Minimum measurement.

4. Last measurement that was taken

Figure 6-23: The Calculation method options list.

3. Trackball to the required option.
4. Press $\overline{\text{SET}}$.
   The value is updated accordingly.

Excluding or including measurements

One or more measurement values from a set of measurements for a parameter can be excluded when doing average calculation.

To exclude a measurement

1. Trackball to the measurement value to exclude.
2. Press $\overline{\text{UPDATE MENU}}$.
   The *Worksheet menu* is displayed.

When excluded the measurement display turns grey.

3. Trackball to **Exclude Value**.
4. Press $\overline{\text{SET}}$.

To include a measurement
1. Trackball to the measurement value to include.
2. Press $\overline{\text{UPDATE MENU}}$.
   The *Worksheet menu* is displayed.
3. Trackball to **Include Value**.
4. Press $\overline{\text{SET}}$.

Manually changing a value

Individual measured values can be manually changed using the alphanumeric keyboard.

To manually change a value
1. Trackball to the value that is to be changed.
2. Press $\overline{\text{SET}}$.
3. Use the alphanumeric keyboard to enter the required value.

*An asterisk indicates that the value has been manually altered. The calculation type is changed to **Edit**.*

To restore automatic calculation
1. Trackball to the relevant cell in the *Method column*.
2. Press $\overline{\text{SET}}$.
   A pop-up menu is displayed showing the different calculation options available (Figure 6-23).
3. Press $\overline{\text{SET}}$.
   The value is re-calculated according the method selected.

Deleting measurement parameter

1. Trackball to the measurement parameter to delete.
2. Press $\overline{\text{UPDATE MENU}}$.
   The *Worksheet menu* is displayed.
3. Trackball to **Delete Value**.
4. Press $\overline{\text{SET}}$.

Chapter 7
Purposely Left Empty

For Future purposes

Chapter 8
Archiving

Introduction

During an examination, the operator stores data, images and cineloops for immediate purposes. The Vivid *i* ultrasound unit includes an integrated patient archiving system for data and image storage.

△

CAUTION

Do not use the internal hard drive for long-term image storage.

The Vivid *i* ultrasound unit enables also storing of data and images to external databases (EchoServer, Magneto Optical (MO) disk, CD-R or DVD-R). The patient and image archives are set by the selected dataflow (see page 377 about available dataflows and default dataflow selection).

Storing images and cineloops

DICOM images are stored to formatted Magneto Optical disks separately from patient data.

Images and cineloops that are stored during a current examination are displayed as thumbnails on the clipboard (see Figure 8-1). When an image is stored, all the additional information that is displayed is saved with it (i.e. probe and application selected, image setting, annotations or measurements...).

The image archive is set by the dataflow selected (see page 377 about available dataflows and default dataflow selection).

△
CAUTION

Do not use the internal hard drive for long-term image storage.

A formatted (see page 388) Magneto Optical Disk is recommended for image archive.

△
CAUTION

If working off-line with a dataflow pointing to a DICOM server, the images stored during the examination will have to be manually resent in the DICOM spooler (page 280) when reconnecting the unit. Resend all jobs that are failed or on hold (See page 280 for more information on DICOM spooler.).

In addition, stored images and cineloops can be saved to a removable media in the standard formats JPEG, AVI (cineloop), MPEG and DICOM (see page 212).
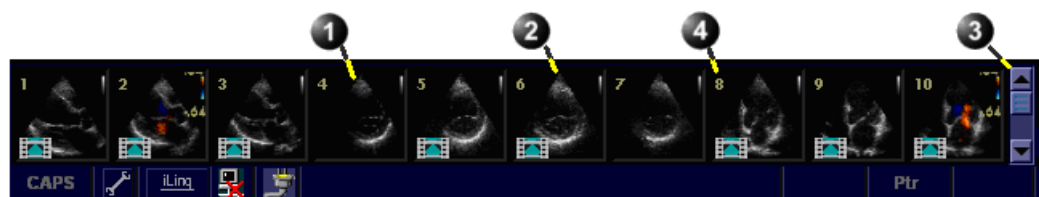
1. **Single image stored**
2. **Cineloop stored Scrolling tool**
3. **Scrolling tool**
4. **Serial number of image**

Figure 8-1: The Clipboard on the scanning screen

Storing an image

Images are displayed chronologically on the clipboard.

1. While scanning in any mode, press $\overline{\text{FREEZE}}$.
2. Trackball to scroll through the cineloop and select the required image.
3. Press $\overline{\text{STORE}}$.
   The image is stored and a thumbnail is displayed on the clipboard. A serial number appears on each thumbnail, start from "1" in chronological order (see Figure 8-1).

Storing a cineloop

A cineloop is a sequence of images recorded over a certain time frame. The time frame can be adjusted to cover one or more heart cycles. The stored cineloops are displayed chronologically on the clipboard. Cineloops can be stored at any time during the scanning session. The user can choose to preview the cineloop before storage or save the cineloop directly as described below.

Preview and storage of a cineloop

1. While scanning in any mode, press $\overline{\text{FREEZE}}$.
2. Press the Assignable $\overline{\text{CINELOOP}}$.
3. Determine the best cineloop to store using the assignables (see page 60 for further information on cineloop operation).
4. Press $\overline{\text{STORE}}$.
   The cineloop is stored and a thumbnail is displayed on the clipboard. The "loop" icon appears on the thumbnail image indicating that the image stored is a loop (see Figure 8-1). A serial number appears on each thumbnail, starting from "1" in chronological order.

Direct storage of a cineloop

Depending on whether the system has been configured to enable or disable the **Preview Loop before store** function (see page 358), the following procedures enable the cineloop to be stored directly.

Storing cineloop without preview

The function **Preview Loop before store** is disabled (see page 358).

• While scanning, press $\overline{\text{STORE}}$.

The last valid cineloop is stored in the archive and a thumbnail is displayed on the clipboard.
Scanning resumes immediately.

Storing cineloop with preview

The function **Preview Loop before store** is enabled (see page 358).

1. While scanning, press $\overline{\text{STORE}}$.
The last valid cineloop is previewed on the screen (but not stored).
2. If desired, press $\overline{\text{CINELOOP}}$ and adjust the cineloop to be stored using the assignables (see page 60).
3. Press $\overline{\text{STORE}}$ to save the cineloop.
A thumbnail is displayed on the clipboard.

Saving stored images and cineloops to a standard format

Stored images and cineloops can be saved to a removable media in the following standard formats:

• **Still images**: JPEG, MPEG, DICOM and RawDICOM (Raw data + DICOM)
• **Cineloops**: AVI, MPEG, DICOM and RawDICOM (Raw data + DICOM)

Images can also be stored as MPEG format on a CD-R using the Export function as described on page 214.

Procedure:

1. Trackball to the required image or loop icon on the clipboard.
2. Press $\overline{\text{SET}}$.
The selected image is displayed.
3. Press $\overline{\text{UPDATE/MENU}}$ on the control panel.
The *System menu* is displayed.

Figure 8-2: The System menu

4. Trackball to **Save as**.

5. Press $\overline{\text{SET}}$.
   The *Save as menu* is displayed.
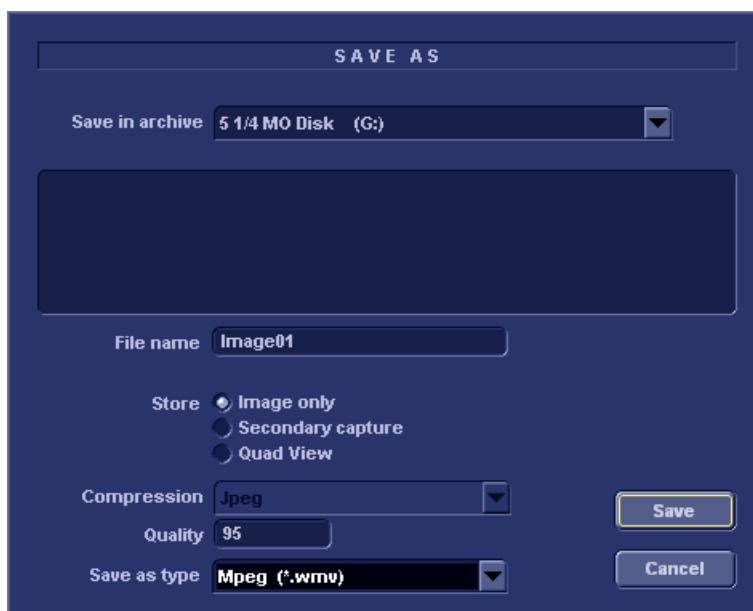
Figure 8-3: The Save as menu

6. Select the desired removable media from the *Save in archive pull-down menu*.

7. Enter a file name in the *File name field*.
   If the image or cineloop is saved as DICOM or RawDICOM the file name is automatically generated to follow the DICOM standard.

8. Select between:

   • **Store image only**: saves the image or cineloop only.

   • **Store secondary capture**: creates a still image of the image area and the Title bar.

The secondary capture is not available when saving images as DICOM or RawDICOM.

9. Select the image compression type (JPEG or RIe) or no compression.

10. Enter in the desired **Image quality** (between 10 and 100). A high quality setting will give a lower compression.

11. In the *Save as type* field select one of the following formats:
    • **RawDICOM**: saves the still image or cineloop in both GE raw format and DICOM format.
    • **DICOM**: saves the still image or cineloop in pure DICOM format.
    • **JPEG**: saves a still image in JPEG format.
    • **MPEG**: saves the still image or cineloop in MPEG format
    • **AVI**: saves the cineloop in AVI format.

12. Press **Save**.
    A file is saved in the selected archive.

MPEGVue/eVue

MPEGVue/eVue enables the user to export or save an exam (images, measurements and reports) into MPEG format readable from a regular Windows computer together with a special MPEG viewer.

MPEG exams can be created using the Export function (MPEGVue) or by using the dataflow *Local Archive - Int.HD/eVue* (eVue).

The MPEGVue option is used to create MPEG exams on finished exams. The eVue option is used to create MPEG exams when performing the exam, upon saving the images.

Creating an MPEG exam using the Export function (MPEGVue)

Refer to "Exporting patient records/examinations" on page 255.

Creating a MPEGVue exam using the dataflow Local Archive - Int. HD/eVue (eVue)

The dataflow must be configured before first time use as follows:

1. Press $\overline{\text{CONFIG}}$ and log on as administrator.

2. Select the **Connectivity** category and **Dataflow** subgroup. The *Dataflow sheet* is displayed.

3. Select the dataflow **Local Archive - Int. HD/eVue** in the *Name* pull-down menu.
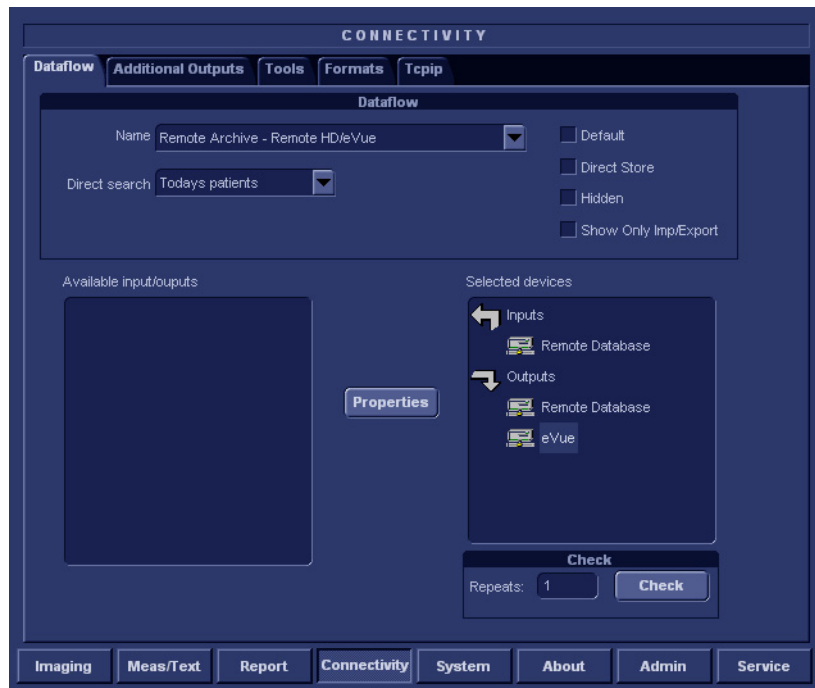
Figure 8-4: The Dataflow Sheet

4. Select the **eVue** device in the *Selected devices* pane and press **Properties**.
The *eVue properties* window is displayed.
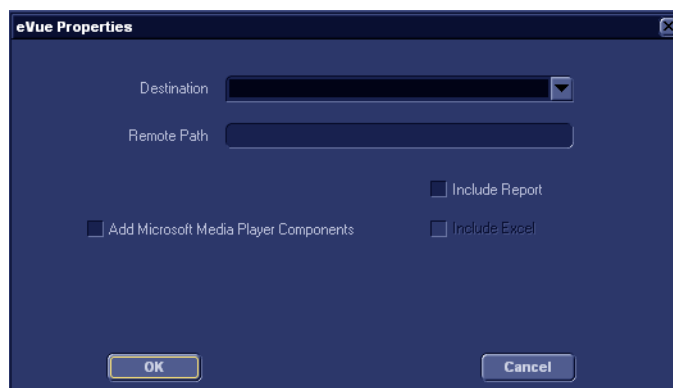
Figure 8-5: The eVue properties window

*Remote paths of network volumes must be entered once in the Remote path field before they can be selected from the **Destination** Pull-down menu.*

5. Select a removable media or a network volume remote path as the destination in the *Destination* pull-down menu.

6. Check the options as required.

7. Select **OK** and press CONFIG.

To create an MPEG exam using the dataflow Local Archive-Int. HD/eVue

1. Press ARCHIVE.
   The *Search/Create patient* window is displayed.

2. Select the dataflow **Local Archive - Int. HD/eVue**.

3. Perform an exam.

When saving an image, it is stored as raw data to the local machine, an MPEG copy is created and stored to the destination set during the configuration of the dataflow.

Reading an MPEG exam

A MPEG exam can be read from any computer with Windows 98/2000/XP, provided that DirectX 8.1 or later and Windows Media Player 7.1 or later are installed.

Refer to the MPEGvue User Manual for details on reading MPEG exams on a computer.

Retrieving and editing archived information

Locating a patient record

To create an operator ID, see page 399.

1. Press <u>PATIENT</u> on control panel.
   If the unit is password protected a *Log In window*
   (Figure 8-6) will appear asking for user ID, and password.

1. Select the operator
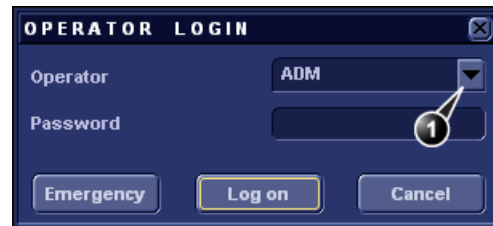
Figure 8-6: The Operator login window

The unit can be configured to automatically generate a patient ID (see page 389)

2. Press **Log on** when completed.
   The *Archive entry* screen is displayed (Figure 8-7).
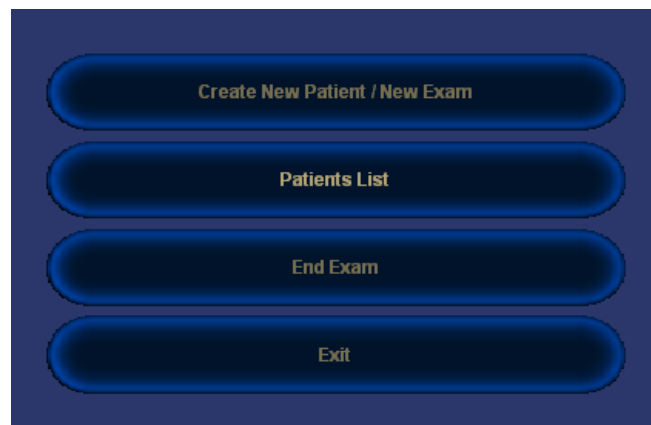
Figure 8-7: Archive entry screen

3. Click the **Create New Patient** button.
   The *Search/Create patient* window is displayed
   (Figure 8-8).

4. Type the patient **Last Name**, and/or **ID**.

⚠
CAUTION

Do NOT use '\' or '^' in patient information fields, as these characters might cause problems with some DICOM devices.

The automatic searching tool displaying matching patient information in the Patient list can be turned off (see page 389)

When default configured, the system automatically searches to see if the patient is already in the database. The result of this search is displayed in the *Patient list field.*

5. Trackball to the actual patient and press the Trackball SET key.
    The patient record is highlighted.

6. Press SELECT PATIENT
    Or
    Press **[+]** in front of the actual patient record and select the desired examination.
    The *Examination List window* for the actual patient is displayed (refer to Figure 8-10).

1. **Press one of the headings to sort the list accordingly.**
2. **Select new archive and other pre-defined services**
3. **Extended menu**
4. **Select the column heading border and drag to adjust column width**
5. **Expended Patient record displaying belonging examinations**

The Search/Create patient window may be slightly different depending on the Dataflow selected

Figure 8-8: The Search/Create Patient window

Advanced search

To restrain the search to a specific patient group, one or more filters may be applied to the search. The table below shows the filters applicable to a patient search:

Searching filter
Echolab
Diag. code
Date of birth (time span)
Examination date (time span)
Current date
Images
Stress examinations
Report

Searching with filter:

1. Trackball to the **More** button in the *Search/Create Patient window*.
2. Press $\overline{\text{SET}}$ on the control panel.
   The *Search/Create Patient window* is extended displaying the searching filters (see Figure 8-9).
3. Type the information in the required searching filter field.
4. Type the patient **Last Name**, and/or **ID**.
   The matching data is displayed in the *Patient list* when the automatic search function is turned on.

Sorting data

The search result can be sorted according to the fields displayed in the patient list, in ascending or descending order.

To sort data:
1. In the *Patient list field*, Trackball to the field header by which the sort is to be performed (Figure 8-9, page 220).
2. Press $\overline{\text{SET}}$ on the control panel.
   The patient list is sorted in ascending order according to the field selected.

3. Press $\overline{\text{SET}}$ once more.
The patient list is sorted in descending order according to the field selected.

1. **Press one of the headings to sort the list accordingly.**
2. **Select new archive and other pre-defined services**
3. **The system can be configured to display the Advanced search tool as default (see page 389)**
4. **Select the column heading border and drag to adjust column width**
5. **Expended Patient record displaying belonging examinations**

The Search/Create patient window may be slightly different depending on the Dataflow selected.

Figure 8-9: The extended Search/Create Patient window

Printing the patient list

1. In the *Search/Create patient* window, select **More** to display the additional menu.
2. Select **Print Patients**.
The displayed patient list is printed.

Selecting a patient record and editing data in the archive

After locating the patient in the database (see page 217 page 220), the user must select the patient record, to be able to review and edit archived data.

Selecting a patient record from the patient list

1. In the *Search/Create patient window*, trackball to the actual patient and press the Trackball SET key.
   The patient record is highlighted.

2. Press SELECT PATIENT.
   The *Examination List window* is displayed showing previous examinations and diagnosis information related to the selected patient (see Figure 8-10).
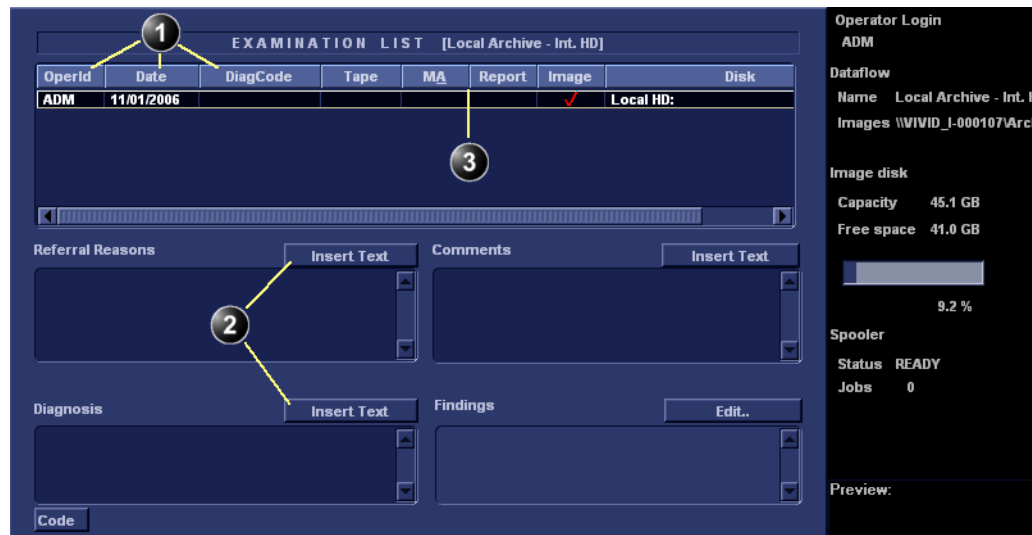
1. The information displayed in the Patient list is configurable (see page 389).
2. Insert pre-defined text in the Comment field
3. Select the column heading border and drag to adjust column width

Figure 8-10: The Examination list window

Editing Referral Reasons, Comments and Diagnosis

The user can edit the actual text in the *Examination List window* using the alphanumeric keyboard and by inserting pre-defined text input.

⚠

CAUTION

The user is responsible for patient demographic data, diagnostic information or any other patient related information entered in the database.

Text edition
1. In the *Examination list window* (Figure 8-10), trackball to the required field.
2. Press SET.

Use the Arrow keys to move text marker.

3. Using the alphanumeric keyboard, edit the information.
4. Press ARCHIVE on the control panel to quit the archive.

Inserting pre-defined text input
1. In the *Examination list window*, trackball to **Insert Text** over the actual field.
2. Press SET.
   The *Insert text window* is displayed (see Figure 8-11). The pre-defined text list is organized in a three level hierarchy. Selecting one item in the first column displays pre-defined text entries related to the selected text in the second and third column.
3. Navigate through the pre-defined text list by selecting items in the columns and double-click on the desired pre-defined text to be inserted. If an entry in the third column is inserted, the selected text in the second column is also inserted. Press **More>>** to display the full text for the selected entry.

Figure 8-11: The Insert text window

Creating, editing and deleting text input

These features are described in "The Comment texts sheet" on page 374.

Diagnosis code

Entering a Diagnosis code

1. In the *Examination list window*, select **Code** (see Figure 8-10).
   The *Entered Code window* is displayed.

2. Select **Add**.
   The *Code list window* is displayed.

3. Double-click the code to enter.
   The selected code is displayed in the *Examination list window*.

1. **The Entered Code window**

2. **The Code list window**

Figure 8-12: Entering Diagnosis codes

Deleting an entered Diagnosis code

1. In the *Examination list window*, select **Code** (see Figure 8-10).
   The *Entered Code window* is displayed.

2. In the *Entered Code window*, select the code to delete and press **Delete**.

Creating a Diagnosis code

1. In the *Examination list window*, select **Code** (see Figure 8-10)
   The *Entered Code window* is displayed.

2. Select **Add**.

The *Code List* window is displayed.

3. Select **New**.
4. Enter the new code.
5. Select **Done** to exit.

See also "The diagnostic codes sheet" on page 373.

Editing Demographic details

⚠ WARNING

If you modify the Patient ID, Last name, First name or Date of birth on a patient in the archive, be aware that the contents of the archived images for that patient is not updated. If the images are still in the buffer and not yet archived, the image files are updated if you modify any patient information, but not if the images are archived. So if any of these images are later on exported to DICOM media or DICOM server, they will still contain the original patient information, as it was before you did the modification in the archive. The system does not alter the contents of the image files at all when doing DICOM export.**

1. Press the PATIENT button on the control panel.
2. Select **Patient Details**.
   The *Patient information window* is displayed.
3. Trackball to the field to edit.
4. Press SET on the control panel.
5. Using the alphanumeric keyboard, edit the information.

⚠ CAUTION

Do NOT use '\' or '^' in patient information fields, as these characters might cause problems with some DICOM devices.

Alternative: Press any active scanning mode key.

6. Press the EXAM LIST assignable to go back to the *Examination list window.* **OR**
   Press PATIENT on the control panel to quit the archive.

Deleting archived information

To delete a patient record

1. Press **PATIENT** on the Front panel.
2. Select **Patient List**.
   The *Search/Create Patient window* is displayed (Figure 8-8, page 218).
3. Type the patient Last Name, and/or ID.
4. Trackball to the actual patient record.
5. Press **SET** to highlight the patient record to delete.
6. Press **Delete** in the *Search/Create Patient window*.
   A dialogue box is displayed asking for confirmation of the deletion (Figure 8-13).
7. Trackball to **OK** and press **SET** on the control panel.
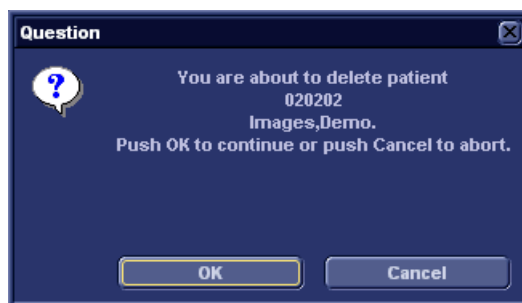
Figure 8-13: Delete patient record confirmation prompt

To delete an examination

1. Press **PATIENT** on the Front panel.
2. Select **Patient List**.
   The *Search/Create Patient window* is displayed (Figure 8-8, page 218).
3. Type the patient Last Name, and/or ID depending on system configuration.
4. Trackball to the actual patient record and double-click the Trackball **SET** key (or press **SET** once and **SELECT PATIENT**) to select the patient.
   The *Examination list window* is displayed.
5. Trackball to the examination to delete.
6. Press the trackball **SET** key.

7. Press **More** in the *Examination list window* (see Figure 8-10, page 221).

8. Press **Del Exam** to delete the examination.
A warning message is displayed asking the user to confirm the action to perform (see Figure 8-14).

9. Trackball to **OK** and press $\overline{SET}$ to delete the selected examination.
Trackball to **Cancel** and press $\overline{SET}$ to abort deletion.
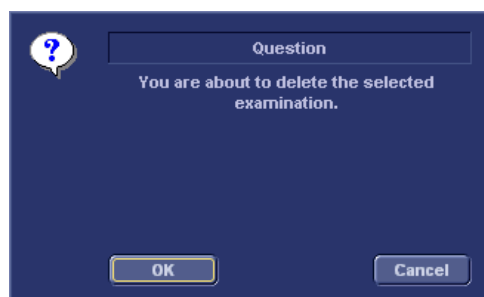
Figure 8-14: Delete Examination prompt

To delete an image

1. Press $\overline{PATIENT}$ on the Front panel.

2. Select **Patient List.**
The *Search/Create Patient window* is displayed.

3. Type the patient Last Name, and/or ID.

4. Trackball to the required patient to highlight the record.

5. Press the trackball $\overline{SET}$ button.
The *Examination list window* is displayed.

6. Trackball to the actual examination in the *Examination list window*.

7. Press the trackball $\overline{SET}$ button.

8. Press $\overline{REVIEW}$.
The images for the selected examination are displayed on the *Review screen* (Figure 8-17, page 230).

Repeat steps 9 and 10 to delete several images.

9. Trackball to the image to delete.

10. Press $\overline{SET}$ on the control panel.

11. Press **Delete**.
A pop-up dialog box is displayed asking for confirmation of the deletion.

12. Trackball to **OK** and press $\overline{SET}$ on the control panel.
The image is deleted.

To delete an image from the clipboard

1. If in live, press FREEZE.
2. Press TRACKBALL until the Pointer tool is selected.
3. Move the pointer over and select the image to delete in the clipboard.
4. Press the **Update/Menu** button.
5. Select **Delete clipboard cell** from the *Update menu*.
    A pop-up dialog box is displayed asking for confirmation of the deletion.
6. Trackball to **OK** and press SET on the control panel.
    The image is deleted.

Moving examinations

An examination can be moved from one patient record to another. This feature should only be used if an examination was performed and stored to a wrong patient record.

⚠
CAUTION

When moving an examination, verify that the target patient record is correct.

1. In the *Search/Create Patient window* press **[+]** in front of the patient record containing the examination(s) to move (see Figure 8-8, page 218).
2. Select the examination to move.
3. Press the **More** soft button in the lower, right-hand corner of the *Search/Create Patient window*.
4. Press the **Move Exam** soft button.
    The *Move exam window* is displayed.

Figure 8-15: The Move exam window

5. Search and select the target patient record.

6. Press **Move Exam**.
A warning message is displayed asking the user to confirm the action to perform (see Figure 8-16).

⚠ *Make sure that the patient record selected is correct.*

CAUTION
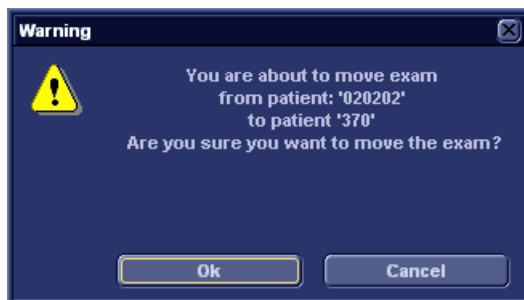
Figure 8-16: Moving examination prompt

7. Trackball to **OK** and press S̄ĒT̄.
An information window is displayed to confirm the operation.

8. Press **OK**.

Review images in archive

There are two ways to access to archived images:

- Review the images from a selected examination.
- Select images from the *Image list screen* displaying all the images sorted by examination sessions for the actual patient.

Review the images from a selected examination

1. In the *Examination list window* (see Figure 8-10, page 221), trackball to the actual examination.
2. Press SET on the control panel to highlight the examination.
3. Press REVIEW on the control panel.
   The stored images for the selected examination are displayed in the *Review screen* (see Figure 8-17).

To analyze images:

1. Press SET on the images to analyze.
2. Press ANALYZE.
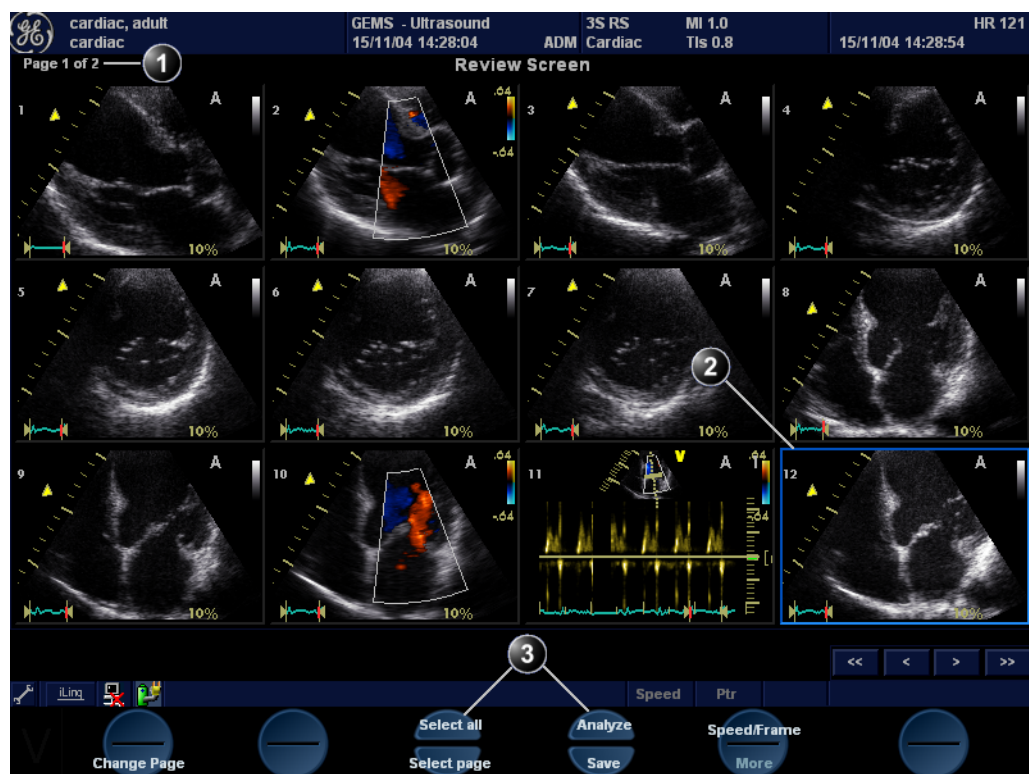
1. Page number
2. Selected image (bold frame)
3. Selection tools

Figure 8-17: The Review screen

Select images from the Image list screen

The procedure described below enables the analysis of images belonging to different examinations for a selected patient record. If images are stored on multiple removable media, they have to be restored to the local hard drive prior to review as described below.

1. In the *Examination list window* (see Figure 8-10, page 221), press **Image list**.
   The *Image list screen* is displayed (see Figure 8-20) showing thumbnails of stored images for the actual patient sorted by examination.

If the images are stored on a removable media that is not mounted, the image thumbnail is replaced by a symbol.

2. Press $\overline{SET}$ on the images to review or press $\overline{ANALYSE}$ to review all images.

   • If all images are available the images are displayed for review.

   • If some of the images are not available locally the *Restore images window* is displayed.
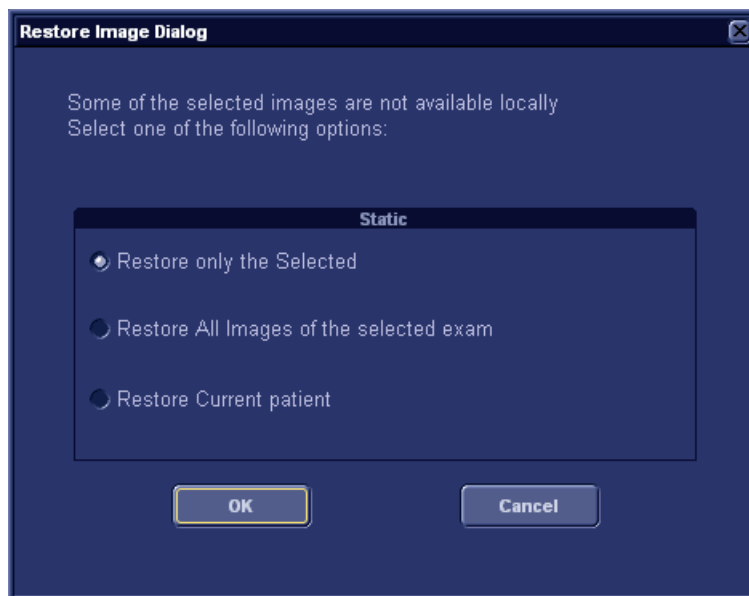
Figure 8-18: The Restore images window

3. Select between:

   • **Restore only the selected images**: only selected images that are not available locally are restored.

   • **Restore all images of the selected exam**: all images that are not available locally in the exams where an image was selected are restored.

   • **Restore current patient**: restores all images in all examinations.

4. Press **OK**.
   The *Insert media window* is displayed.

Figure 8-19: The Insert media window

5. Insert the required media.
6. Select between:
   - **OK**: the images on the mounted media are restored on the local hard drive. If not all the required images are on the inserted media, the user is prompted to insert another media until all required images are restored on the hard drive.
   - **Skip media**: the images stored on the media required are not restored. If not all the required images are on the inserted media, the user is prompted to insert another media until all required images are restored on the hard drive.
   - **Cancel**: no images are restored.

   The selected images are displayed for review.
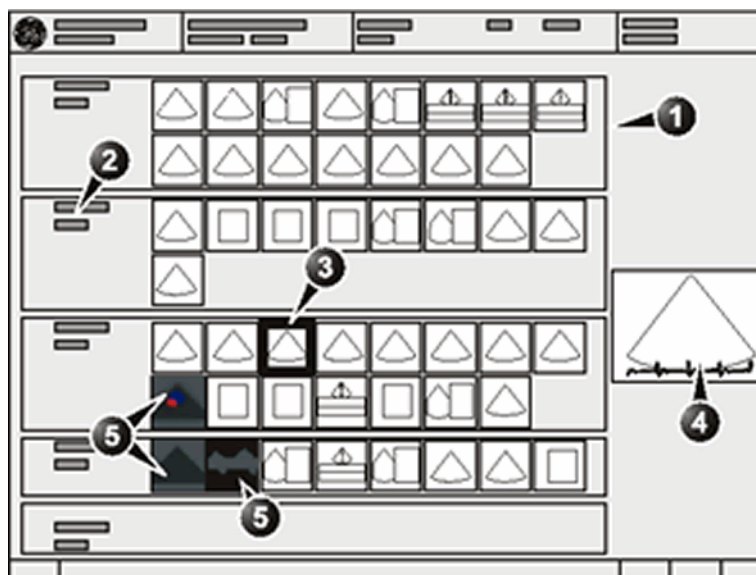
1. **Examination**
2. **Examination date and archive location**
3. **Selected image**
4. **Preview of selected image**
5. **Missing images**

Figure 8-20: The Image list screen

Connectivity

This section describes the communication and connection options for the Vivid *i* ultrasound unit with other devices in the hospital information system. This section covers the procedures for configuration and optimal data management from a Vivid *i* in the following scenarios:

- A stand-alone Vivid *i* (page 237).
- A Vivid *i* and one or several EchoPAC PC workstations in a sneaker net environment (page 238).
- A Vivid *i* and an EchoPAC PC workstations in a direct connect environment (page 240).
- A Vivid *i* and a DICOM server in a network (page 246).
- A Vivid *i* and one or more PC stations in MPEGvue or eVue environment.

The dataflow concept

Communication between the Vivid *i* ultrasound unit and other information providers on the network takes the form of dataflows. Selecting a dataflow will automatically customize the ultrasound unit to work according to the services associated with this dataflow. Each dataflow defines the location and format of patient information. Patient information can include demographic data and images, as well as reports, measurement and analysis data. By utilizing dataflows, the user can configure the Vivid *i* ultrasound unit to optimally meet the connectivity needs of the facility, while keeping the user interface unchanged. The dataflow concept allows the flexibility of data to be obtained from various sources and allows data to flow to various output sources.

Dataflow examples

Refer to "Dataflow" on page 377 for a complete list and description of supported dataflows.

Stand-alone scanner

The figure below illustrates two different dataflows for a stand-alone scanner.

A: **LocalArchive-Int.HD dataflow:**

The local database is used for patient archiving. Images are stored to internal hard drive.
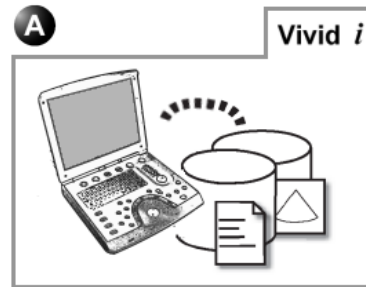
Figure 8-21: Stand-alone scanner dataflows

Scanner in a network

The figure below illustrates two different dataflows for a scanner connected to a network.

B: **RemoteArch-Remote HD dataflow**:

A remote database (here EchoPAC PC) is used for patient archiving. Images are stored to a remote archive (here EchoPAC PC).
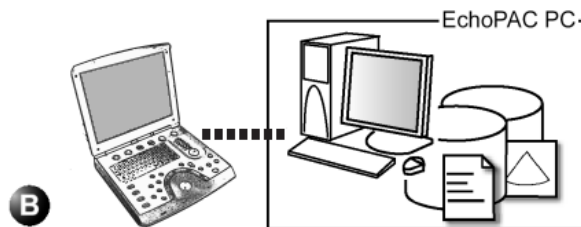
C: **Worklist/LocalArchive-DICOM Server/Int.HD dataflow:**

Search in the DICOM Modality Worklist, the patient found is copied into the local database. Images are stored to a DICOM server and to the internal hard drive.
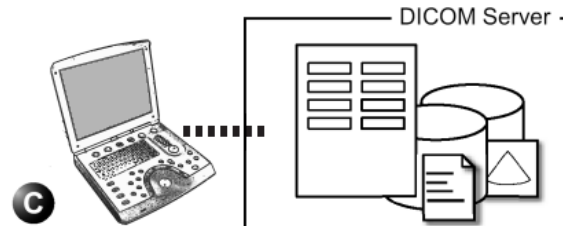
Figure 8-22: Scanner in a network dataflows (example)

Dataflow selection

Select a dataflow from the *Search/Create Patient window* (see "Creating a new Patient record or starting an examination from an existing patient record" on page 46) or configure the system with a **default** dataflow from the Configuration management package as described below.

Default dataflow selection
1. Press CONFIG and log on as administrator if required.
2. Select the **Connectivity** category and **Dataflow** subgroup. The *Dataflow sheet* is displayed (see Figure 8-23).
3. Select the desired dataflow in the *Name pull-down menu* and check the option **Default**.
4. Press CONFIG to exit the Configuration management package.

1. **Select Connectivity category**
2. **Select Dataflow subgroup**
3. **Select a dataflow**
4. **Default option for the selected dataflow**

Figure 8-23: Default dataflow setting

Stand-alone scanner scenario

In this scenario images will most likely be reviewed from images stored in the internal archive. If digital images are stored, they should be stored on the scanner's internal hard drive.
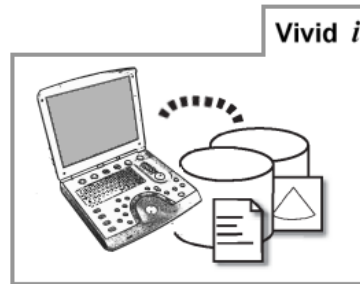
Figure 8-24: Stand-alone scanner with LocalArchive-Int.HD dataflow

Data management

Data acquisition
- Select the **LocalArchive-Int.HD** dataflow as default dataflow.

  In this configuration the local database is used for patient archiving. Images are stored to internal hard drive.

Image review

The same dataflow is used for review on the system.

A stand-alone scanner and a stand-alone EchoPAC PC environment

In this scenario the EchoPAC PC (one or several) is used for review of studies acquired on one or more Vivid *i* without being connected via a private or a local area network.

Images can be stored on the scanner's internal hard drive (recommended) or on a dedicated MOD.

Images stored on the internal hard drive
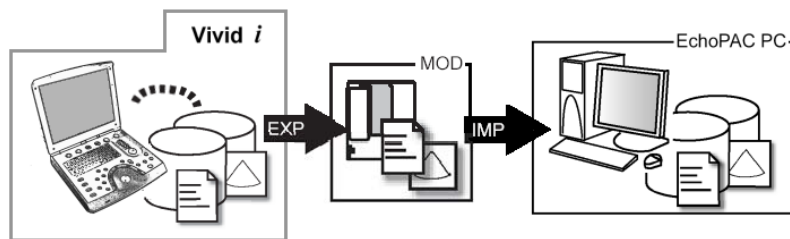
Vivid *i*: dataflow LocalArchive-IntHD
EXP: export from LocalArchive-Int.HD to Removable MOD Archive
IMP: import from Removable MOD Archive to LocalArchive-Int.HD
EchoPAC PC: dataflow LocalArchive-Int.HD

Figure 8-25: A stand alone scanner and a stand alone EchoPAC PC environment with images stored on the scanner's hard drive

In this configuration images are first stored on the scanner's hard drive and then exported from the scanner's hard drive to a MOD and finally imported from the MOD to the EchoPAC PC's internal hard drive.

Data management

Scanner's dataflow configuration
- Select the **LocalArchive-Int.HD** dataflow as default dataflow.

    The local database is used for patient archiving. Images are stored to internal hard drive.

Export from Vivid *i*
- Export the data (images, demographics, measurements and report) for the patient(s) to be reviewed on a blank

dedicated formatted MOD as described in "Export/Import patient records/examinations" on page 255.

Export from **LocalArchive-Int.HD** to **Removable MOD Archive**.

Make sure that the option **Copy images** is checked.

Import on EchoPAC PC

1. Select the **LocalArchive-Int.HD** dataflow on the EchoPAC PC (can be configured as default dataflow).

The MOD dedicated to Export/Import can be reformatted and reused.

2. Import the data from the Export/import MOD to EchoPAC PC internal hard drive using the Import function as described in the workstation user manual.
    Import from **Removable MOD Archive** to **LocalArchive-Int.HD**
    Make sure that the option **Copy images** is checked.

3. Press **Archive** and select the patient to be reviewed.

Stand-alone scanner and a stand-alone DICOM workstation

In this scenario a DICOM workstation is used for review of studies acquired on one a Vivid i without being connected via a private or a local area network.
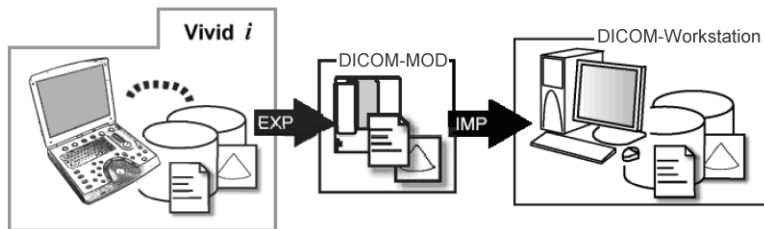
Figure 8-26: A stand-alone scanner stand-alone DICOM workstation

Data management

Scanner's dataflow configuration

1. Select the **LocalArchive-Int.HD** dataflow as default dataflow. The local database is used for patient archiving. Images are stored to internal hard drive.

2. Export the data to the DICOM MOD using the following settings: export from **LocalArchive-Int.HD** to **Pure DICOM MOD** (see 'Export/Import patient records/examinations' on page X.

A scanner and EchoPAC PC in a direct connect environment

In this scenario the data is transferred from the Vivid *i* to a dedicated EchoPAC PC workstation over the Ethernet (either in a peer-to-peer connection with a crossover cable, or in a network). The database from the EchoPAC PC is used as the master and images are stored directly to the EchoPAC PC internal hard drive. In this configuration the scanner is just an intermediate acquisition unit which after completion of a study, will not contain any patient information, measurements or images.

Up to three scanners can be connected to one EchoPAC PC if the workstation has the EchoPAC Share option enabled.
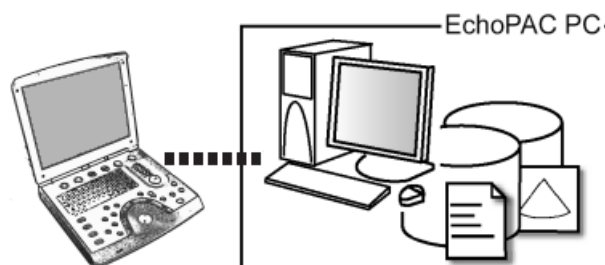
Vivid *i*: dataflow RemoteArch-RemoteHD
EchoPAC PC: dataflow LocalArchive-Int.HD

Figure 8-27: A scanner and EchoPAC PC in a direct connect environment (peer to peer or network)

The acquisition can be done online or offline. Both situations are described below.

Scanner's connectivity configuration

If working in a peer-to-peer connection with a crossover cable between a Vivid *i* and an EchoPac PC, the default delivery TCP/IP settings should be used.

If working in a network, follow the procedure described below to configure the scanner.

Scanner's TCP/IP settings

To be able to use the network functions when connected to a hospital network, the scanner must have a proper network address. Typically source for this information in the network administrator.

1. Press CONFIG and log on as administrator.

2. Select the **Connectivity** category and **TCP/IP** subgroup. The *TCP-IP subgroup* is displayed.

1. Computer name: device's name of type VIVID7-00nnnn or ECHOPAC7-00nnnn, where "nnnn" is the system's serial number. Do not change the computer name.

2. IP settings: system IP settings

3. Remote archive setup: remote archive IP address and name (EchoPAC PC or EchoServer)

4. Save TCP/IP settings. The changes will be effective after the system is rebooted.

Figure 8-28: TCP/IP setting

3. In the *IP settings area* enter:
   - The IP address for the scanner
   - The subnet mask for the scanner
   - The IP address for the Default Gateway

---

4. In the *Remote archive setup area* enter:
   - The IP address for the remote archive
   - The name of the remote archive
5. Press **Save settings** and reboot the system.

Direct connect with online acquisition

Data management

Scanner's dataflow configuration
- Select the **RemoteArch-RemoteHD** dataflow as default dataflow.

   When saving the study on the scanner, the images are transferred from the scanner's image buffer to the hard drive of the EchoPAC PC. Patient demographics, measurements and reports are transferred on the fly when entering the information on the Vivid *i*.

Review on the EchoPAC PC workstation
1. Select the **LocalArchive-Int.HD** dataflow on the EchoPAC PC (can be configured as default dataflow).

⚠
CAUTION

Do NOT open a study on the EchoPAC PC workstation before the study is closed on the scanner.

2. Press **Archive** and select the patient to be reviewed.

Direct connect with offline acquisition

Data management

Scanner's dataflow configuration for offline acquisition

- When offline, select the **LocalArchive-IntHD** dataflow.

  The local database is used for patient archiving. Images are stored to internal hard drive.

Export examinations done offline from the scanner to EchoPAC PC

- When reconnected, export the data (images, demographics, measurements and report) for the examination(s) done offline to EchoPAC PC as describes in "Export/Import patient records/examinations" on page 255.

*Press **Today** to display today's exams to ease the search.*

  Export from **LocalArchive-Int.HD** to **RemoteArch-RemoteHD**.
  Make sure that the option **Copy images** is checked.

The examination done offline can now be reviewed on the workstation.

A scanner and EchoPAC PC in a network environment

In this scenario the Vivid *i* is configured to work with an ImageVault 3 or an EchoServer 7 patient demographics and image server in a network environment. Images are first saved on the local image buffer on the scanner and transferred to the server when saving the examination.

The acquisition can be done online or offline. Both situations are described below.

Network environment with online acquisition

Data management

Scanner's dataflow configuration

•   Select the **RemoteArch-RemoteHD** dataflow as default dataflow in the sublevel *Dataflow* in the subgroup *Connectivity* of the Configuration management package (see page 377 and following pages).

When saving the study on the scanner, the images are transferred from the scanner's image buffer to the server. Patient demographics, measurements and reports are transferred on the fly when entering the information on the Vivid *i*.

Review on the EchoPAC PC workstation

1.   Select the **RemoteArch-RemoteHD** dataflow on the EchoPAC PC (can be configured as default dataflow).

⚠
CAUTION

Do NOT open a study on the EchoPAC PC workstation before the study is closed on the scanner.

2.   Press **Archive** and select the patient to be reviewed.

Network environment with offline acquisition

Data management

Scanner's dataflow configuration for offline acquisition

- When offline, select the **LocalArchive-IntHD** dataflow.

  The local database is used for patient archiving. Images are stored to internal hard drive.

Export examinations done offline from the scanner to the server

- When reconnected, export the data (images, demographics, measurements and report) for the examination(s) done offline to the server as described in "Export/Import patient records/examinations" on page 255.

  Export from **LocalArchive-Int.HD** to **RemoteArch-RemoteHD**.
  Make sure that the option **Copy images** is checked.
  To free space in the internal hard drive on the scanner, check the command **Delete selected patient(s) after copy** in the *Export patient window* (see Figure 8-36, page 257).

The examination done offline can now be reviewed on the workstation.

A scanner and a DICOM server in a network

In this scenario the Vivid *i* is configured to work with a DICOM server in a network environment. Images are first saved on the local image buffer on the scanner. At the end of the examination the images are sent to the DICOM server via a DICOM spooler.

The DICOM server dataflow supported are:
- **DICOM server:** images are stored to a DICOM server
- **Local Archive - Int HD/DICOM Server**: the local archive is used for patient archiving. Images are stored to the internal hard drive and to a DICOM server.
- **Remote Archive - Remote HD/DICOM Server**: a remote database is used for patient archiving. Images are stored to a network image volume and to a DICOM server.
- **Worklist/Local Archive - DICOM Server/Int HD**: search in a 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 volume on the local hard drive.
- **Worklist/Remote Archive - DICOM Server/Remote HD**: search in a DICOM Modality Worklist, the patient found is copied into a remote database. The patient information and the examination results are stored to a remote database. Images are stored to a DICOM server and to an image network volume as pure DICOM in both locations.
- **Query/Retrieve**: retrieve images from a DICOM server based on query parameters.

This scenario requires that the scanner is configured to be connected to the DICOM server as described below.

Scanner's connectivity configuration

The scanner's TCP/IP settings must be configured as described in "Scanner's TCP/IP settings" on page 241.

In addition, to work against the DICOM server the following information has to be entered in the scanner:

- The DICOM server IP address
- The DICOM server port number
- The DICOM server AE title (the server's name)

Typically source for this information in the network administrator.

Setup of the DICOM server in the scanner's configuration management package

DICOM dataflow selection

1. Press **CONFIG** and log on as administrator.
2. Select the **Connectivity** category and **Dataflow** subgroup. The *Dataflow sheet* is displayed.
3. Select the DICOM dataflow to configure in the *Name pull-down menu* (see Figure 8-29).
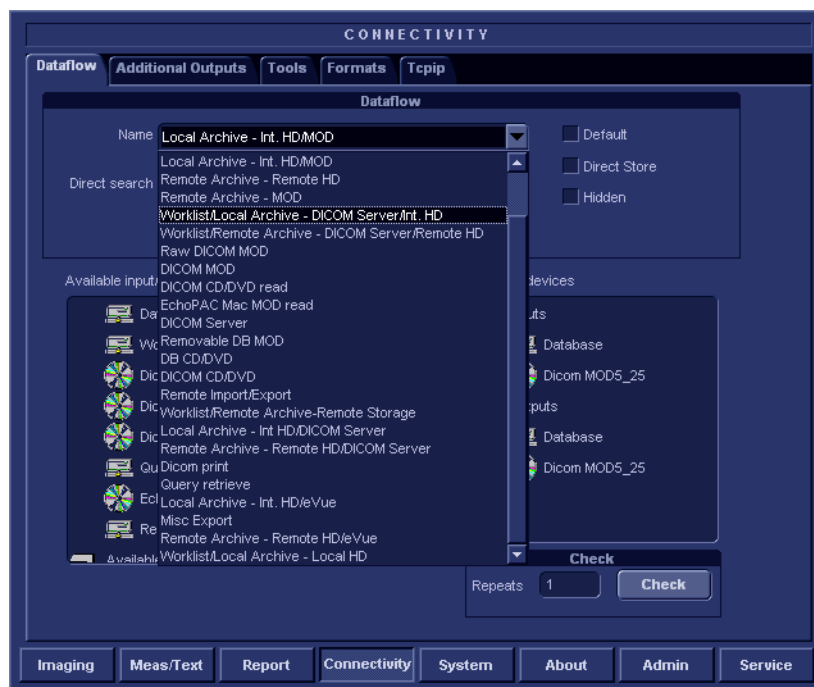
Figure 8-29: The Dataflow sheet

DICOM devices configuration

Depending on the DICOM dataflow selected, one or several DICOM devices may have to be configured.

1. Select a DICOM device in the *Selected devices pane* and press **Properties** (see Figure 8-30).
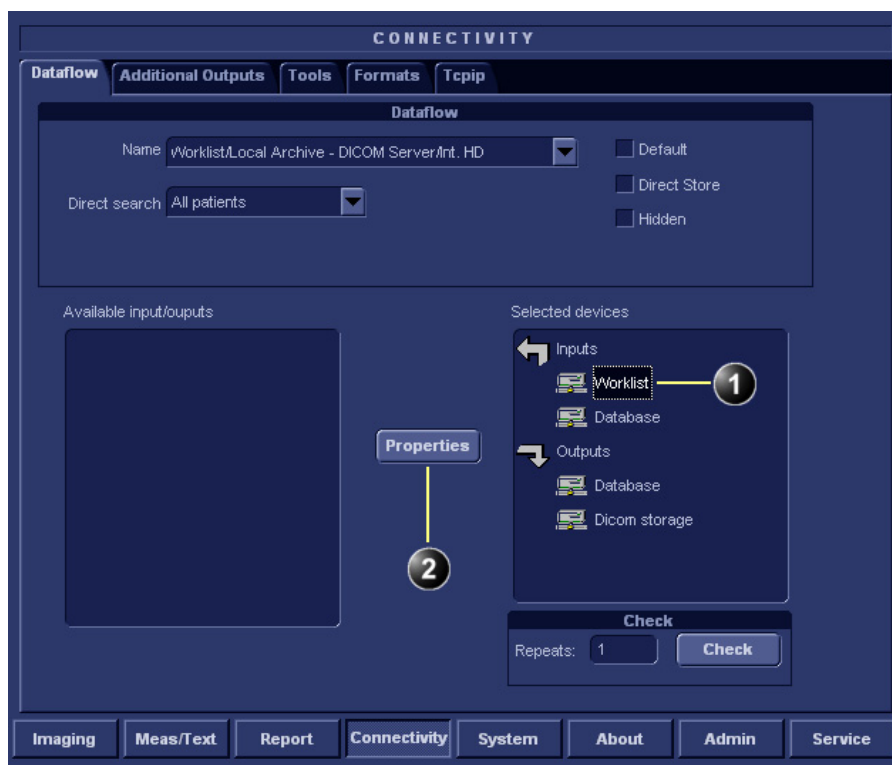
1. Select the DICOM device.   2. Press Properties.

Figure 8-30: Display of the DICOM device Properties window

The *Properties window* for the selected DICOM device is displayed (Figure 8-31).
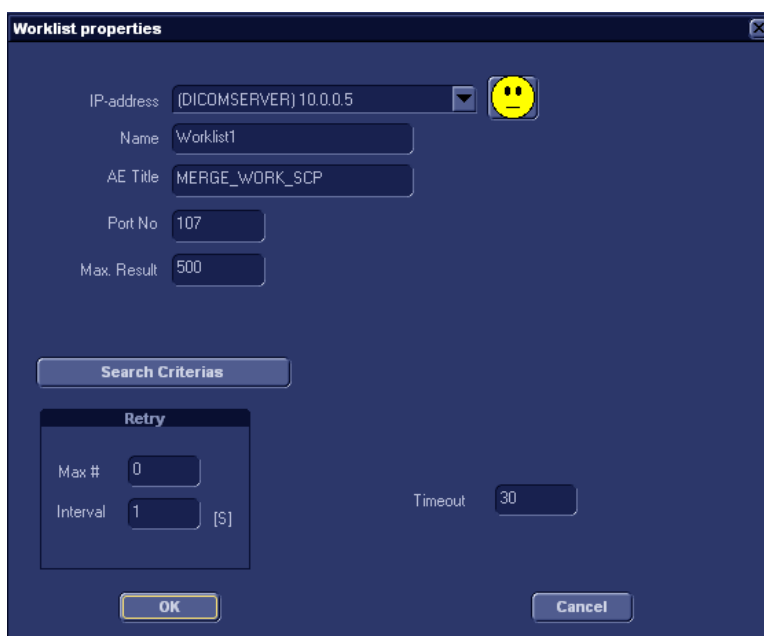
Figure 8-31: DICOM worklist properties window

2. Select the DICOM server from the *IP-address pull-down menu*.
   Follow the steps below if the IP address settings for the DICOM server need to be modified or created:

   • Select **<Modify>** from the *IP-address pull-down menu*.

     The *IPs window* is displayed.

   • Select the DICOM server and press **Modify** in the *IPs window* (or press **Add** if creating a new IP address).

     The *Enter name and IP window* is displayed.

   • Enter the name and/or IP address of the server and press **OK** to return to the *Properties window*.
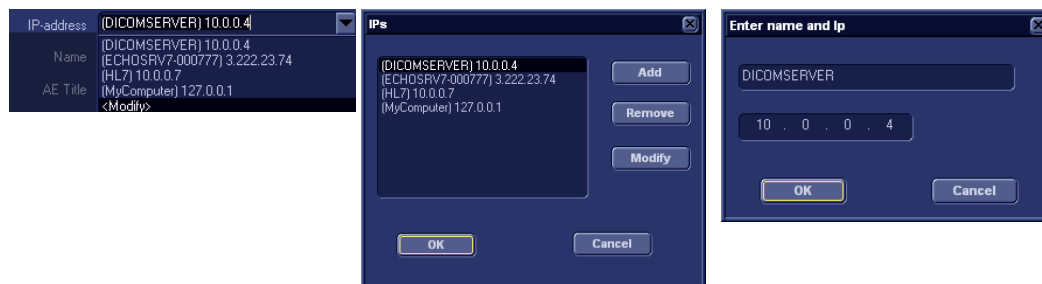
Figure 8-32: Modifying/Creating the IP address

3. In the *Properties window*, enter:
    *   The DICOM server **AE title**. This entry is case sensitive and must match exactly.
    *   The DICOM server **port**

    For some DICOM servers, the default **Timeout** setting may be too low.
    When configuring the DICOM storage device, the following image settings should be entered in the *Properties window*:
    *   Check **DICOM SR** if required (see below).
    *   Keep **Reopen per image** unchecked.
    *   Keep **Allow raw data** unchecked.
    *   Set **Max Frame rate** to 30.
    *   Keep **Only Black and White** unchecked.
    *   Set **Compression** to JPEG.
    *   Set **Quality** to 95.
    *   Check **Allow multiframe**.

DICOM SR

DICOM Structured Reporting (SR) is a standardized format for medical results. Vivid *i* and EchoPAC PC support the specialized form for Adult Echo Ultrasound ("Supplement 72") for M&A results.

With the DICOM SR support, M&A for an exam can be sent at the end of the exam or when exported from local archive. The destination can be either a server on the network (Storage

SCP) or a removable media (DICOM Media) depending on the DICOM dataflow selected.

"Supplement 72" does not support all M&A results from Vivid *i* and EchoPAC PC. "Supplement 72" limits the information that is possible to send to the following:

- Publicly coded parameters, no pediatric or fetal cardiac or unassigned measurement. Refer to the Vivid *i* Reference manual for a complete list of supported parameters.
- Basic modes: 2D, M-mode, Color Flow, PW and CW Doppler.
- Publicly coded methods, not Modified Simpson or Bullet.

  Refer to the Vivid *i* Reference manual for a complete list of supported methods.
- Basic derivations (Average, Last), no references between the derived measurements and the ones they were made from.
- Wall Motion Scoring: individual segment scores only according to 16-segment model, no graded Hypokinesis (only Hypokinesis is used).

Activating DICOM SR

DICOM SR must be activated for each DICOM device.

1. Press $\overline{\text{CONFIG}}$ and log on as administrator.
2. Select the **Connectivity** category and **Dataflow** subgroup. The *Dataflow sheet* is displayed.
3. Select the DICOM dataflow to configure in the *Name* pull-down menu (see Figure 8-29).
4. Select a DICOM storage device in the *Selected devices* pane and press **Properties**.
   The *Properties* window for the selected DICOM stogare device is displayed.
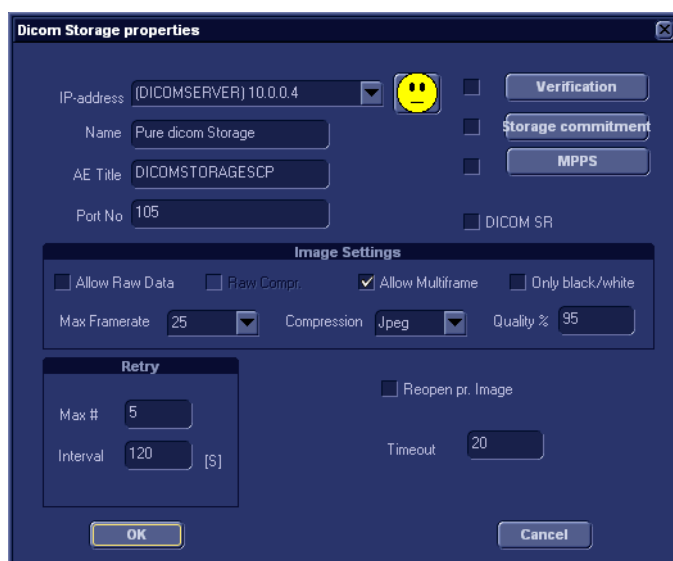
Figure 8-33: DICOM storage properties window

5.   Check the option **DICOM SR**.

6.   Select **OK**.

7.   Press <u>CONFIG</u>.

Adjusting the Search criteria

When selecting a DICOM Worklist dataflow or Query/Retrieve, search criteria can be set for the system to use when searching the database.

1.   Press <u>CONFIG</u> and log on as administrator.

2.   Select the **Connectivity** category and **Dataflow** subgroup. The *Dataflow sheet* is displayed (see Figure 8-34).

3.   Select a DICOM Worklist dataflow or the Query/Retrieve dataflow.

4.   Select the Worklist or Query/Retrieve device in the *Selected devices pane* and press **Properties**. The *Properties window* for the selected DICOM device is displayed.

5.   Press **Search criteria**. The *Search criteria window* is displayed.

6.   Select a Search criteria from the *Select tag pull-down menu*.

7. Enter a value if required or leave blank if not to be used. This entry is case sensitive and must match exactly.

8. Press **Add to list**.

9. Press **OK** to close the Search criteria window.

1. **The dataflow sheet**
2. **The Properties window for the Worklist device.**
3. **The Search criteria window**

Figure 8-34: Adjusting the Search criteria

Checking the connection to the DICOM server

1. In the Dataflow sheet, select the DICOM device to verify the connection to.

2. Press **Check**.
   The verification process may takes several seconds.
   - A green check mark is displayed in front of the DICOM device if the verification is successful.
   - A red cross is displayed in front of the DICOM device if the verification failed.

Data management (DICOM dataflows)

Performing a study

Online scanner

1. In the Search/Create patient window, select a DICOM dataflow.

2. If a DICOM worklist dataflow is selected, enter a search criteria and press $\overline{\text{QUERY}}$. The patient list is updated.

3. Select or create a new patient and perform the examination in a usual manner. During the examination images are temporarily stored in the local buffer on the system.

4. At the end of the study press $\overline{\text{END EXAM}}$ on the Control panel. The save images dialogue window is displayed.

5. Press $\overline{\text{ALL}}$ to save all images on the DICOM server or press $\overline{\text{SELECT}}$ to display the Image review screen where to select specific images to be saved. The images are transferred to the server via the DICOM spooler.

6. Press $\overline{\text{F4}}$ or $\overline{\text{ALT+S}}$ to display the DICOM spooler (see "DICOM spooler" on page 280 for further details).

Offline scanner

When working offline the images are stored in the DICOM spooler. Images are sent to the DICOM server when re-connecting the system to the network.

1. If a DICOM worklist dataflow is selected, the patient list must be queried before the system is disconnected.

2. After offline acquisition, the images stored on the DICOM spooler are automatically sent to the DICOM server when connecting the system. Press $\overline{\text{F4}}$ or $\overline{\text{ALT+S}}$ to display the DICOM spooler (see "DICOM spooler" on page 280 for further details).

Export/Import patient records/examinations

Patient records/examinations from the local archive on one system (Vivid *i* or EchoPAC PC) can be exported to the local archive on another system via a removable media. Patient records/examinations from the local archive can also be exported directly to a remote archive (Echo server, DICOM server or EchoPAC PC depending on the environment). In addition patient records/examinations from a remote archive (Echo server or EchoPAC PC depending on the environment) can be exported to a removable media or to a DICOM server. Database information (patient and report archives) can be exported with or without images. No data is deleted from the source archive when exporting data unless the command **Delete selected patient(s) after copy** is checked in the Export patient window (see Figure 8-36, page 257).

Similarly, patient records/examinations from the local archive on one system can be imported to the local archive on another system via a removable media. Database information can be imported with or without images. No data is deleted from the source archive when importing data. In addition patient records from a removable archive can be imported to a remote archive (Echo server).

⚠
CAUTION

If an examination is opened, it must be closed before performing Export/Import of patient records/examinations to guarantee that all data is included in the transfer.

Exporting patient records/examinations

1. Insert a removable media in the drive.
2. Press PATIENT on the Front panel, then select **Patient List**. The *Search/Create Patient window* is displayed (Figure 8-8, page 218).
3. Select the source archive in the *Dataflow field*:
    - **LocalArchive-Int.HD**: exports data from the local archive.
    - **RemoteArch-RemoteHD**: exports data from an Echo server.
4. Press **Export** in the *Search/Create Patient window*. The *Export dialogue window* is displayed.
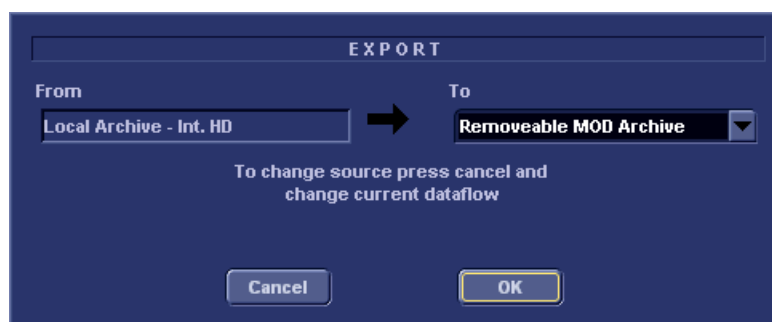
Figure 8-35: The Export Dialogue window

5. Select one of the following destinations from the
    Destination drop-down menu:

    • **MOD Archive**: exports raw and DICOM (if present) data
      to a removable MOD.

    • **Pure DICOM MOD525**: export DICOM data only to a
      removable MOD.

    • **CD/DVD Archive**: exports raw and DICOM (if present)
      data to a CD/DVD.

    • **DICOM CD/DVD**: export DICOM data only to a
      CD/DVD-R/W.

    • **Remote Import/Export Archive**: exports raw and
      DICOM (if present) data to an Echo server (network) or
      EchoPAC PC (direct connect or network).

    • **DICOM Server**: exports DICOM data only to a DICOM
      server.

    • **Excel file**: exports data to a spreadsheet. The export
      destination must be configured (see page 261).

    • **DICOM Print**: prints images to a DICOM printer via
      DICOM spooler.

    • **MPEGvue**: exports examinations to MPEGVue format
      readable from a regular computer. Ultrasound images
      are stored as MPEG, and saved reports as CHM-files.
      The export destination must be configured (see
      page 260).

6. Press **OK**.

Figure 8-36: The Export patient window

The following situations may occur:

- The system is checking that the removable media is inserted. If not, a dialogue window is displayed prompting the user to insert a media.

  Insert media and select **Retry**.

Figure 8-37: Insert media window

- The system is checking if the destination media is empty and needs to be formatted. If yes an *Information window* is displayed asking the user whether or not to format the media.

Figure 8-38: Media Formatting window

- If desired enter a new label and select OK.

  Note: Only the following characters and signs can be used when labelling a media: A - Z, a - z, 0 - 9, "_" and "-". Do not use more than 11 characters or signs. Do not use space.

- If the media is not empty, the *Add files* window is displayed.
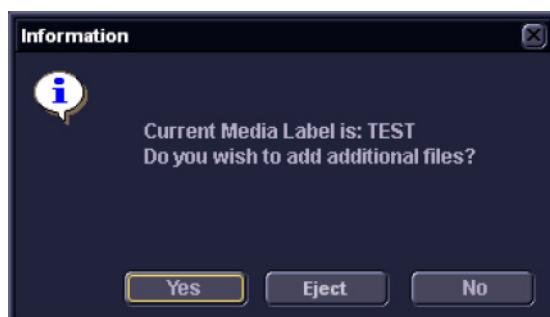
Figure 8-39: Add files window

Select Yes.

The system is preparing the media to allow addition of new files.

The Export patient window is displayed (see Figure 8-36, page 257).

7. Search and Select the patient records/examinations to export in the *Patient list*.

   The following selection methods can be used:

   - Press and hold down $\overline{\text{SHIFT}}$ while selecting patient records/examinations to select several consecutive items at a time.

- Press and hold down $\overline{\text{CTRL}}$ while selecting patient records/examinations to select several discrete items.
- Press **Select all** in the *Export patient window* to export all patient records.

- Press **Today** to display today's examinations and select the actual examinations.
- Fill in the *Exam between field* to display the patient records done during a specific time period and select the actual records.
- Fill in the *Born between field* to display the patient records of patients born during a specific time period and select the actual records.

8. Adjust the following settings (if available) as desired:
   - **Delete selected patient(s) after copy**
   - **Copy images**

9. Press **Copy**.
   If one or more patient examination is already present in the destination archive the *Export/Import conflict window* is displayed (see Figure 8-40). For each conflicting item, select:
   Keep: to keep the existing examination in the destination archive.
   Replace: to replace the existing examination with the corresponding item in the source archive.

Last name	First name	Pat. id	Exam Date	Keep	Replace
Images	Demo	020202	15/02/2002	○	●
Images	Demo	020202	21/02/2002	○	●
Images	Demo	020202	03/02/2003	○	●
Images	Demo	020202	24/04/2003	○	●

Figure 8-40: The Export/Import conflict window

Press **OK** to resume export.

A progress indicator is displayed. When done a status window is displayed showing the number of patient records that have been successfully exported.

10. Press **OK**.

A check mark is displayed in the *Copied field* in the *Export patient window* for each item exported.

A status message is displayed for each item exported. Make sure that the operation was successful for each item exported.

11. Press **Done** in the *Export patient window* to complete the process.

Do not eject the CD using the button on the CD drive.

12. Press **ALT**+**E** to eject the disk.

The *Eject device menu* is displayed.

Figure 8-41: The Eject device menu

13. Select the relevant media.

The selected removable media is ejected.

Export Configuration

The destination for Export of patient records to Excel and MPEG must be configured prior to use. This is done from the *Dataflow sheet* in the Configuration package. To display the *Dataflow sheet*:

1. Press **CONFIG** and log on as administrator.

2. Select **Connectivity** category and **Dataflow** subgroup. The *Dataflow sheet* is displayed (Figure 8-4, page 215).

3. If not already checked, select the option **Show only Imp/Export**. This will display only the dataflows related to the Import/Export function.

4. Select the dataflow **Misc Export** in the *Name* pull-down menu.
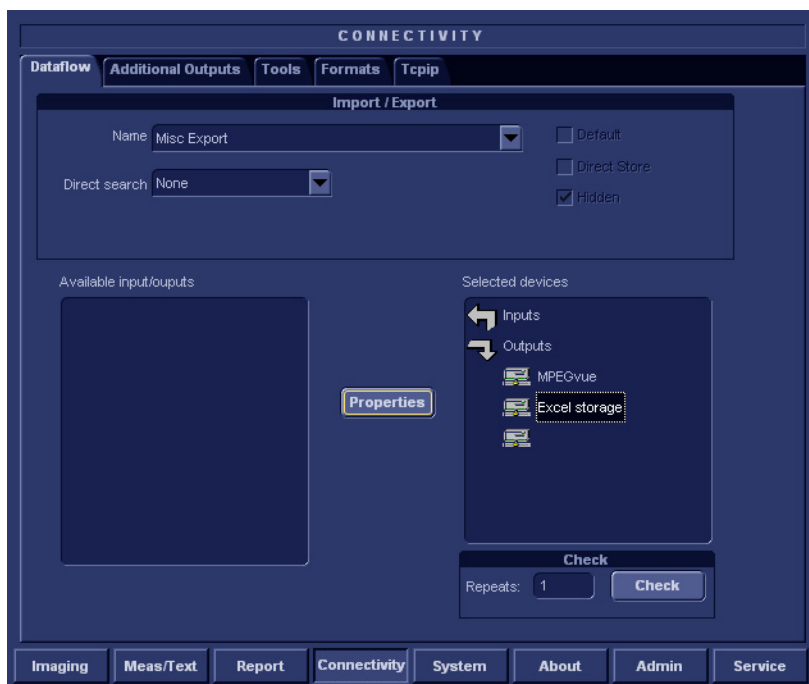
Figure 8-42: The Dataflow Sheet

Configuring an Excel Export

1. Select the **Excel storage** device in the *Selected devices* pane and press **Properties**.
    The *Excel properties* window is displayed.
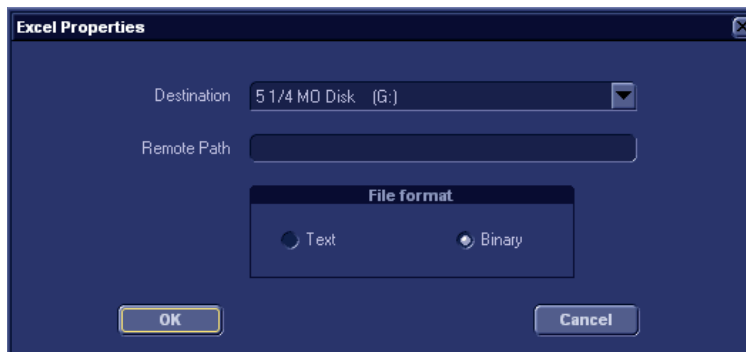
Figure 8-43: The Excel properties window

*Remote paths of network volumes must be entered once in the **Remote Path** field before they can be selected from the **Destination** pull-down menu.*

2. Select a removable media or a network volume remote path as the destination in the *Destination* pull-down menu.
3. Select **OK** and press CONFIG.

Export to an MPEGVue Configuration
1. Select the **eVue** device in the *Selected devices* pane and press **Properties**.
   The *eVue properties* window is displayed (Figure 8-5, page 216).

*Remote paths of network volumes must be entered once in the **Remote Path** field before they can be selected from the **Destination** pull-down menu.*

2. Select a removable media or a network volume remote path as the destination in the *Destination* pull-down menu.
3. Check the options as required.
4. Select **OK** and press CONFIG.

Exporting to HL7
1. Press PATIENT on the Front panel, then select Patient List.
   The Search/Create Patient window is displayed.

*Remote paths of network volumes must be entered once in the **Remote Path** field before they can be selected from the **Destination** pull-down menu.*

2. Select a patient record in the Search/Create Patient window. The Examination list window is displayed.

Importing patient records/examinations

1. Insert the removable media of the source archive in the corresponding drive (MO drive or CD-ROM).

2. Press <u>PATIENT</u> on the Front panel, then select **Patient List**. The *Search/Create Patient window* is displayed (Figure 8-8, page 218).

3. Select destination archive in the *Dataflow field*:

    *   **LocalArchive-Int.HD**: imports data to the local archive.
    *   **RemoteArch-RemoteHD**: imports data to an Echo server (network) or an EchoPAC PC (direct connect).

4. Press **Import** in the *Search/Create Patient window*. The *Import dialogue window* is displayed (see Figure 8-44).
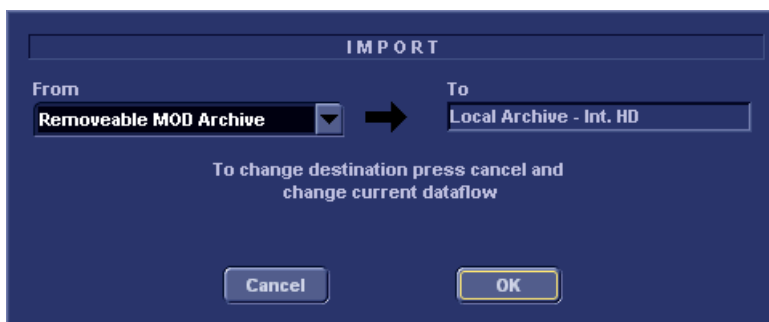
Figure 8-44: The Import Dialogue window

5. Select one of the following source archive from the *Source drop-down menu*:

    *   **MOD Archive**: imports raw and DICOM data (if present) from a MOD.
    *   **DICOM MOD525**: imports DICOM data only from a MOD.
    *   **CD/DVD Archive**: imports raw and DICOM data (if present) from a CD/DVD-R.
    *   **DICOM CD/DVD**: imports DICOM data only from a CD/DVD-R/W.
    *   **Remote Import/Export Archive**: imports raw and DICOM (if present) data from an Echo server (network) or EchoPAC PC (direct connect or network).
    *   **Query Retrieve**: imports data from a DICOM server.

6. Press **OK**.

The *Import patient window* is displayed (see Figure 8-45).

Figure 8-45: The Import patient window

7. Search and select the patient records to import in the *Patient list*.

    The following selection methods can be used:

    •   Press and hold down SHIFT while selecting patient records/examinations to select several consecutive items at a time.

    •   Press and hold down CTRL while selecting patient records/examinations to select several discrete items.

    •   Press **Select all** in the *Import patient window* to export all patient records.

    •   Press **Today** to display today's examinations and select the actual examinations.

    •   Fill out the *Exam between field* to display the patient records done during a specific time period and select the actual records.

    •   Fill out the *Born between field* to display the patient records of patients born during a specific time period and select the actual records.

*Press **More** to display the extended Import patient window if necessary.*

8. Adjust the following settings as desired:

   • **Copy images**

9. Press **Copy**.

   If one or more patient examination is already present in the destination archive the *Export/Import conflict window* is displayed (see Figure 8-40). For each conflicting item, select:

   Keep: to keep the existing examination in the destination archive.

   Replace: to replace the existing examination with the corresponding item in the source archive.

Figure 8-46: The Export/Import conflict window

Press **OK** to resume import.

A progress indicator is displayed. When done a status window is displayed showing the number of patient records that have been successfully imported.

10. Press **OK**.

    A check mark is displayed in the *Copied field* in the *Import patient window* for each item imported.

    A status message is displayed for each item imported. Make sure that the operation was successful for each item imported.

11. Press **Done** in the *Import patient window* to complete the process.

Disk Management

The Disk management function allows the user to manage hard disk space while maintaining the patient database on the system. The Disk management function can be used to move, copy or delete images and reports from the oldest patient records (configurable). The Disk management function has also an auto-purge feature that automatically deletes images and reports that have already been copied if the local hard disk is approaching its capacity limit.

When moving or copying files a copy of the patient archive is also created on the media.

Three different disk management scenarios are possible depending on the system configuration:

- **Disk management is set to move files**: the user runs the Disk management function on a regular basis to move images and reports from older patient records to removable media or to a network volume. Using this setting, moved images and reports are deleted from the local hard drive and copied to the specified destination. This scenario prevents the local disk to fill up and keeps images and reports from the most recent patient records on the local disk. Using this scenario, the user can control what should remain on the system while keeping the disk free space at an operational level.

- **Disk management is set to copy files**: the user runs the Disk management function on a regular basis to copy images and reports from older patient records to removable media or to a network volume. To prevent the local disk to fill up, the auto-purge function automatically deletes files that were previously copied when the disk free space has reached the minimum allowed limit. This scenario lets the system automatically manage the disk space on the system.

  Note: When using this setting, the images location displayed in the **Examination list** screen is the selected destination for the copy operation, even if the images are still present on the local hard drive. When reviewing the exam, the original images is retrieved from the local hard drive as long as they are available there. When the images are deleted from the local hard drive by the auto-purge function, the copied images are retrieved.

- **Disk management is set to delete files**: the user runs the Disk management function on a regular basis to delete images and reports from older patient records.

Ensure that you have established a data management protocol for your office/institution. The user MUST manage the removable media used when running Disk management by keeping a log and by creating a media filing system.

A person should be in charge of performing the process. The Disk management system can be set up so that a reminder is displayed at a regular time span.

Configuring the Disk management function

Configuration of the Disk management system can only be done by user with administration rights.

1. Press CONFIG.
   If required, log on as administrator.
2. Select the **Admin** category.
3. In the *Admin category*, select the sheet **Data Management**.
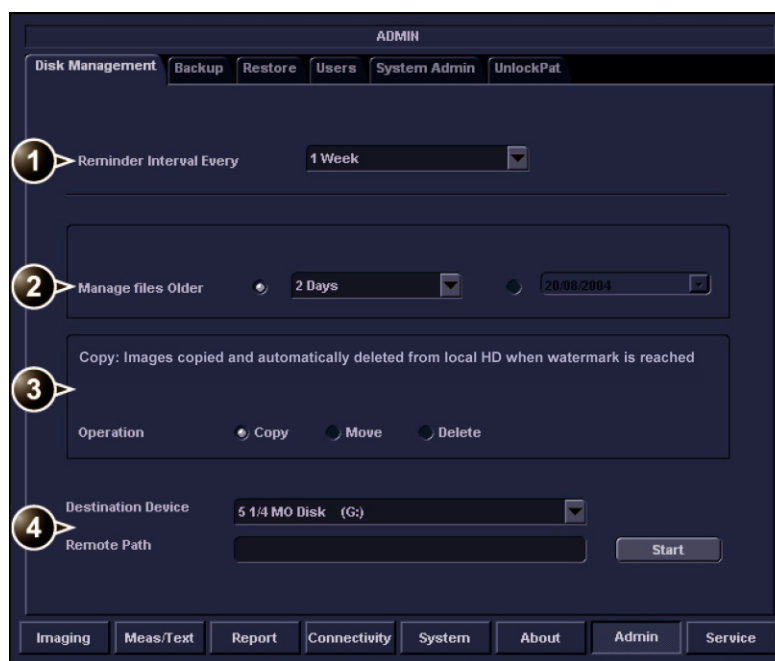
1. **Sets the reminder time interval for running Disk management**
2. **Sets the files to be managed based on the examination dates**
3. **Sets the Disk management to copy, move or delete images**
4. **Sets the destination device**

Figure 8-47: The Disk management sheet

Disk management schedule settings

- Next to **Reminder interval**, specify the number of days/weeks you want the system to prompt you to perform disk management. This setting should be set based on the activity of your office/institution. If **None** is selected, no reminder is displayed.

Disk management settings

1. Select a number of days, weeks or months or a specific date next to **Manage files older than**. Only files older than the specified setting are copied or moved. If **None** is selected, all files are copied or moved.

2. Next to **Operation**, select one of the following options:
   - **Copy**: the images and reports from the examinations older than the specified setting defined in step 1 are copied to the specified destination. After using this setting, the files exist in two locations, the local hard drive and the media used to copy to.
   - **Move**: the images and reports from the examinations older than the specified setting defined in step 1 are copied to the specified destination, verified and then deleted from the local hard drive. After using this setting, the files exist in one location, the media used to move the files to. They are removed from the local hard drive.
   - **Delete**: the images and reports from the examinations older than the specified setting defined in step 1 are deleted from the hard drive.

Destination device settings

*To be able to select a network shared folder in the **Destination device** field, its path must have been entered once in the field next to **Remote path**.*

- Next to **Destination device**, select a removable media or a network shared folder.

△

CAUTION

If using removable media, it is recommended to use dedicated media to the Disk management process. Removable media used for data backup must not be used when performing Disk management.

Do not use the same removable media on several systems.

Running the Disk management function

The Disk management function can be run at any time. In addition, the user may be prompted to run Disk management if the time since the last Disk management operation performed has reached the setting for the Reminder interval (see page 268), or if the local hard drive is about to reach its capacity limit.

Disk management manual start

1. Press __PATIENT__ on the control panel, then select **Patient list**. The *Search/Create patient* window is displayed.

2. Press **More** in the *Search/Create patient* window to display additional menu options and select **Disk management**. The *Disk management welcome* screen is displayed (Figure 8-48). The Disk management operation will either copy, remove or delete files from the local archives depending on the Disk management configuration (see page 267). Make sure that the correct configuration is set.
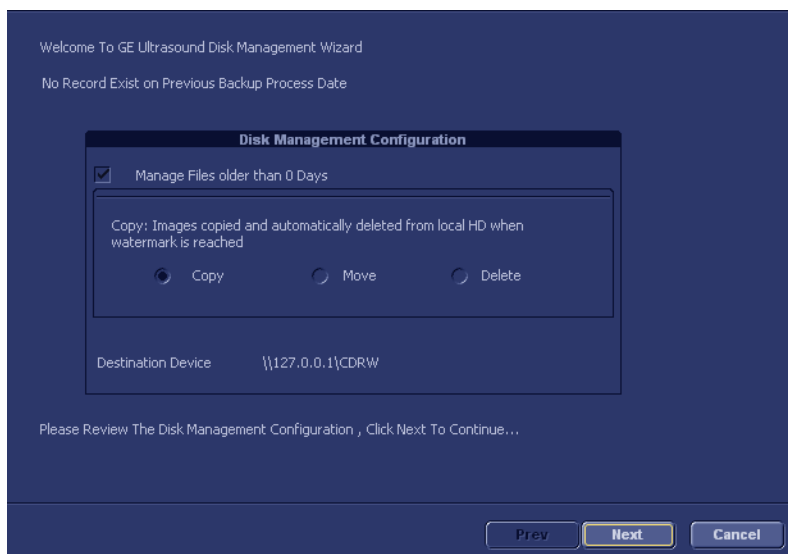
Figure 8-48: The Disk management welcome screen

3. Press **Next**.
    The *Storage size information* window is displayed (Figure 8-49). Verify the information displayed. If using removable media, the operation may require several

media as specified on the screen. Make sure to gather the necessary number of disks.
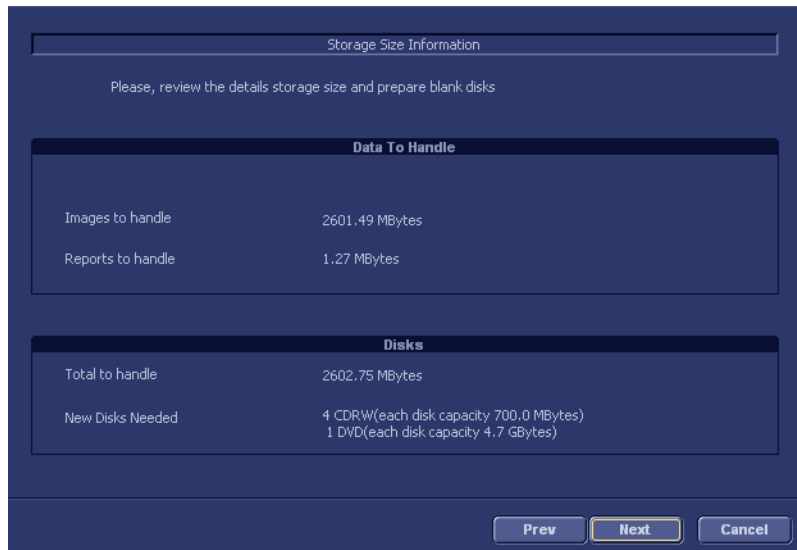
Figure 8-49: The Storage size information window

The media does not need to be formatted.

4. Insert a removable media into the specified drive. The disk does not need to be formatted.

5. Press **Next**.
    The *Copying files* window is displayed (Figure 8-50).
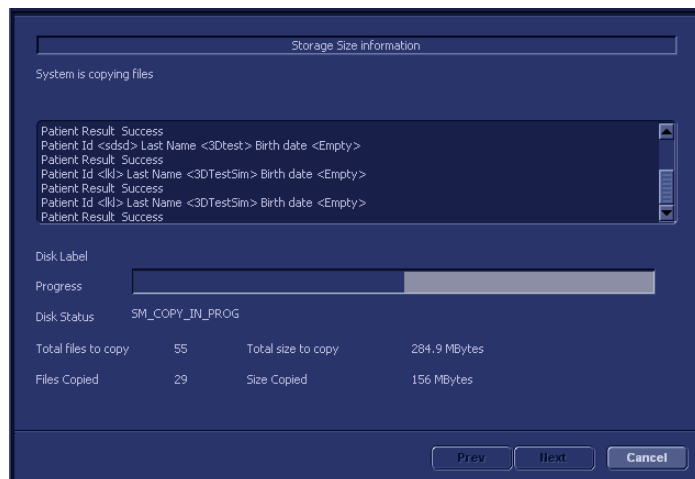
Figure 8-50: The copying files window

The system automatically formats and labels new disks. If the media contains backup or export data, a Warning window is displayed.

6. Select one of the following options:

    *   **Cancel**: the Disk management process is stopped.
    *   **Eject**: the media is ejected, a new media must be inserted to resume the Disk management process.
    *   **OK**: (Export disk only) the export data on the disk is deleted and the Disk management process is resumed. This choice is not available if the disk contains backup data.

    The information displayed on the *Copying files* window is updated while the files are being copied.

7. If more than one media is necessary the filled media is ejected and a dialogue window is displayed asking the user to label the ejected disk and insert a new media. Press **OK** after the new media is inserted. The operation is resumed. When all the files are copied, the media is automatically ejected.

8. Press **Next** to continue.
    The *Summary* window is displayed (Figure 8-51), showing a list of the disks used.

Figure 8-51: The summary window

- Select **Print summary** to print the list for archiving purpose.
- Select **Detailed summary** to display the list of the patient records copied.

9. Make sure that all media are physically labeled according to the list displayed in the *Summary window*. The media label should also have an identification of the system the Disk management was run from.

10. Press **Done** to complete the Disk management operation and file the media.

Data Backup and Restore

The Backup/Restore function enables the user to:
- Copy/Restore the patient archive.
- Copy/Restore the system configuration. The Copy/Restore system configuration feature enables the user to configure several units with identical presets, providing that the units have the same software version.

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

DANGER

GE Medical Systems is not responsible for lost data if the suggested backup procedures are not followed and will not aid in the recovery of lost data.

There is no backup function for the images or reports (no creation of a safety copy). For long-term storage, images and reports should be moved to removable MOD or to a network shared folder using the Disk management procedure (see page 266).

CAUTION

DO NOT use the local hard drive for long-term image storage.

The backup of the patient archive on the hard drive and the system configuration is done from the configuration management package as described on page 274.

Data from Backup/Restore disks may be restored to the local hard drive using the Restore procedure as described on page 278.

Only users with administration rights (see page 399) have access to the backup/Restore function.

Backup procedure

1. Press PATIENT on the control panel, then select **Patient list**. The *Operator login* window is displayed.
2. Select the operator with administration rights, enter the password and press **Log on**.
   The *Search/Create patient* window is displayed.
3. In the *Search/Create patient*, select the dataflow **Local Archive - Int. HD** (Figure 8-52).

Figure 8-52: Dataflow selection for backup

4. Press CONFIG.
5. Select the category **Admin**.
6. Select the **Backup** sheet (Figure 8-53).
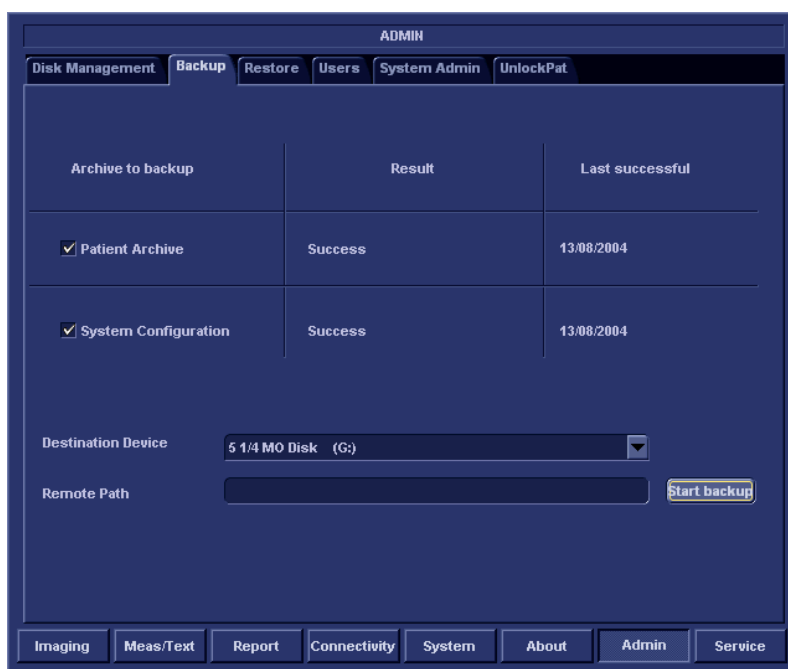
Figure 8-53: The Backup sheet

7. In the *Backup sheet,* select one of the following options:
   - **Patient archive**: to backup the patient records.
   - **System configuration**: to copy system settings and user presets.

*To be able to select a shared network folder, the path (of type: \\server-name\share-na me) must be entered once in the **Remote Path field**.*

8. Select a removable media or a shared network folder as destination.

9. If the backup is done to a removable media, insert a dedicated media in the drive.

10. Select **Start backup**.
    The following situations may occur:
    - The system is checking that the removable media is inserted. If not, a dialogue window is displayed (Figure 8-54) prompting the user to insert a media.

Figure 8-54: Insert media prompt

Insert the media and select **OK**.

• The system is checking if the media needs to be formatted. If yes, the media is automatically formatted. An *Information window* is displayed (Figure 8-55) showing the media label.
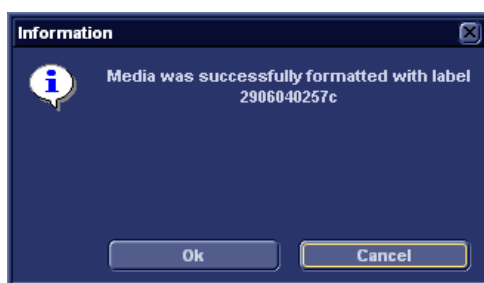
Figure 8-55: Media formatted with label

Write down the label and select **OK**.

• The system is checking if there is already a backup or a Disk management copy on the media. If the following error message is displayed, the disk is ejected and the user is asked to use a new media that does not contain any backup or Disk management data.
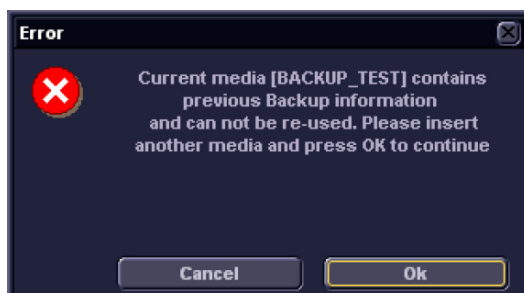
Figure 8-56: Replace backup prompt

- Insert a new media and select OK.

  Note: to reuse a Backup media when performing a new archive backup, the media has to be re-formatted first.

11. During backup, *Progress* windows are displayed (Figure 8-57), showing the current operation being performed.
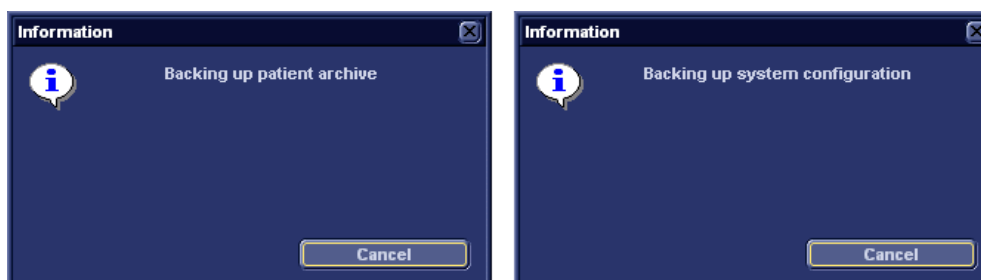
Figure 8-57: Backup progress windows

12. At the end of the process, the media is ejected and the *Backup completed* window (Figure 8-58) is displayed.
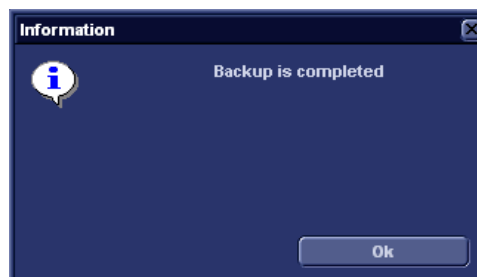
Figure 8-58: Backup completed window

Select **OK**.
The Backup result is displayed on the *Backup sheet* (Figure 8-59).

Figure 8-59: Backup result

13. Make sure to physically label the media. An identification of the system should also be noted on the media and a backup log should be kept.
File the media in a safe place.

Restore procedure

1. Press **CONFIG**.
2. Select the category **Admin**.
3. Select the **Restore** sheet (Figure 8-60).
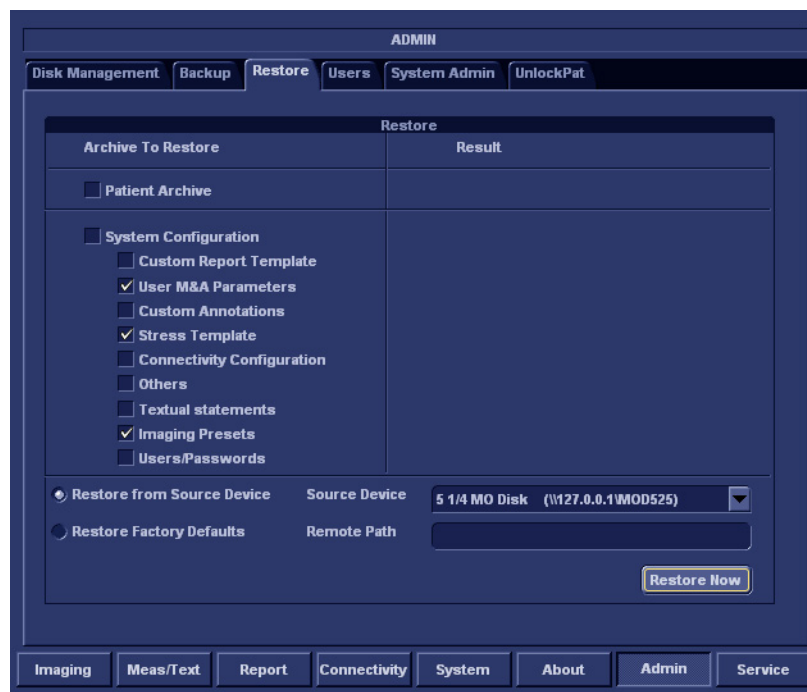
Figure 8-60: The Restore sheet

4. In the *Restore sheet,* select one of the following options:
   - **Patient archive**: to restore the patient records.
   - **System configuration**: to restore all system settings and user presets.

   OR

   - One or several **System configuration items** to restore parts of the system settings and user presets (see Figure 8-60).
5. Make sure that **Restore from Source Device** is selected.

6. Select the appropriate **Source device**.

<table>
<tr><td>⚠
CAUTION</td><td>*The Restore procedure OVERWRITES the existing data on the local hard drive. Make sure to select the correct device.*</td></tr>
</table>

7. If restore is done from a backup on a removable media, insert the media in the drive.

8. Select **Restore now**.
Depending on the selection, one or two *Restore confirmation* windows are displayed (Figure 8-61):

Figure 8-61: Restore confirmation windows

9. Ensure that the correct source is selected an select **OK**.
The selected items are copied to the systems. If items from the system configuration are restored the system needs to be rebooted. The *Reboot system* window is displayed (Figure 8-62).
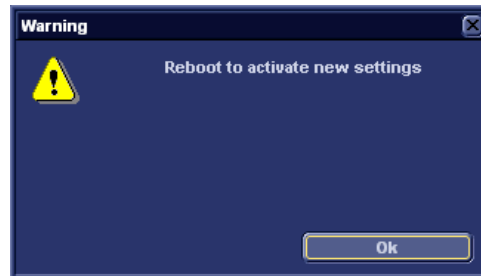
Figure 8-62: Reboot system prompt

10. Select **OK** to reboot the system.

DICOM spooler

DICOM spooler displays the current DICOM output jobs. The jobs may be Storage, Print, Modality Performed Procedure Step or Storage Commitment. The DICOM spooler is used for checking the current job's status when a job is saved or when the total spooler status on the right of the *Archive windows* displays an error.

From the DICOM spooler the user can also:

- **Delete** non-active jobs
- **Resend** a job that has failed or is in hold
- **Send** a job that has failed or is in hold, to a new destination.
- **Hold** a job that is not active.

The job's status displayed in the *DICOM spooler window* can be:

- **Pending**: the job is complete, waiting to be active.
- **Hold**: the job is complete, but suspended, waiting for a user action.
- the job is incomplete, waiting for more images.
- **Append**: : the job is incomplete, waiting for more images (Direct store function).
- **Active**: the job is complete and connected to the destination device.
- **Failed**: the job is complete but one or more images failed to transmit to the destination device.
- **Done**: the job is saved to the destination device. The jobs that are done are removed from the spooler after a while.

Starting the DICOM spooler

- On the alphanumeric keyboard, press and hold down the <u>ALT</u> key and press <u>S</u>.

  The *DICOM spooler window* is displayed (see Figure 8-63).

The *DICOM spooler window* is automatically updated. Press **Refresh** to update the information displayed at any time.

Figure 8-63: The DICOM job spooler window

Deleting a job

Only non-active jobs can be deleted.

1. Trackball to the job to delete in the *DICOM job spooler window*.
   Note: Several jobs can be selected.
2. Press SET.
3. Trackball to **Delete**.
4. Press SET.

Resending a job

Only jobs that failed or are in hold can be resent.

1. Trackball to the job to re-send in the *DICOM job spooler window*.
   Note: Several jobs can be selected.
2. Press SET.
3. Trackball to **Resend**.
4. Press SET.

Sending a job to a new destination

Only jobs that failed or are in hold can be sent to a new destination.

1. Trackball to the job to send in the *DICOM job spooler window*.
2. Press **SET**.
3. Trackball to **Send to...**.
4. Press **SET**.
   A dialogue window is displayed.
5. Select the new destination from the *Destination popup menu*.
6. Trackball to **Send**.
7. Press **SET**.

Holding a job

1. Trackball to the job to hold in the DICOM job spooler window.
   Note: several jobs can be selected. Only inactive jobs can be set on hold.
2. Press SET.
3. Trackball to Hold.
4. Press SET.

To undo hold, press Resend.

Chapter 9
Report

Introduction

The Vivid *i* system enables the creation of patient and examination reports containing measurements, images and analysis that were made during the examination. The layout of the reports is defined by generic templates delivered with the system. Custom templates can also be made.

Saved reports are *read-only*. Therefore it is recommended that the data be carefully reviewed before the report is saved. Use the worksheet (see page 202) to facilitate the review and adjustment of data before generating a report. The final report can be printed on a regular laser printer.

Creating a report

Reports summarize data obtained in the examination. They can contain data and images.

Once generated, the report can be viewed, images can be added, wall segment diagrams can be assigned, and text can be entered in the free text fields. All other information must be changed from the *Patient information window* and the *Worksheet screen*.

Working with the report function

*   Press <u>REPORT</u>.

    The default template for the current examination is displayed (see Figure 9-1). The information entered during the examination in automatically filled out (e.g. demographic, Diagnosis, Comments etc.)
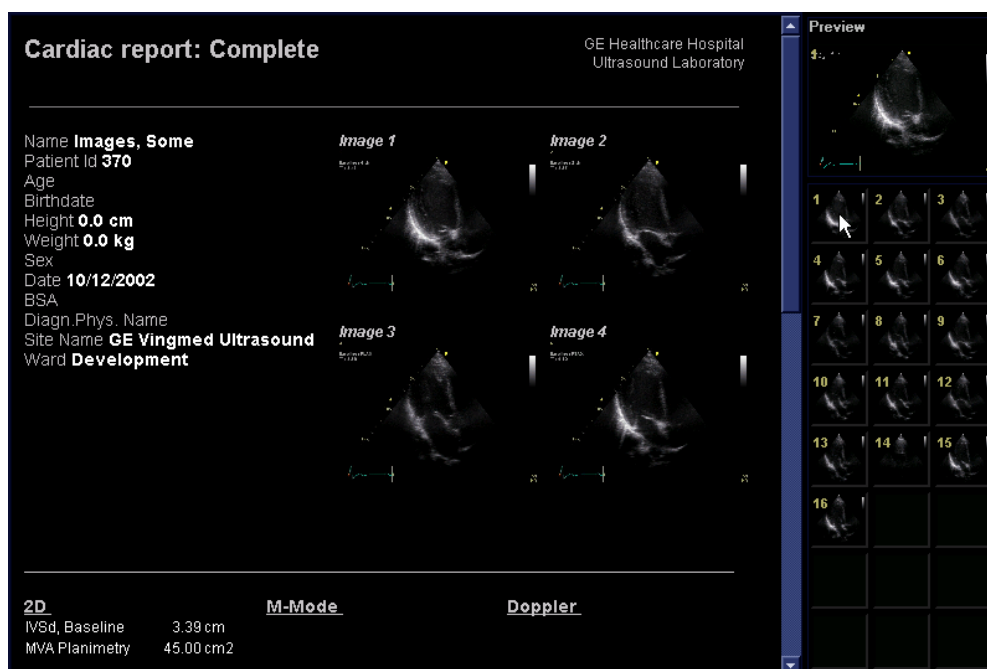
1. **Assigned keys**
   • **Print**
   • **Store**
   • **Retrieve**
   • **Template**
   <u>**MORE**</u> menu

   • **Insert Text**
   • **Save as**
   • **Delete**
   • **Designer**

Figure 9-1: The Report screen and assigned keys

To choose another report template

1. Press the assignable $\overline{\text{TEMPLATE}}$.
   The *Template selection menu* is displayed showing the available report templates organized by application.

2. Do one of the following:
   - Select a template from the current application template list.
   - Select another application and select the desired template from the sub-menu displayed.

   Note: From a sub-menu, select **Back** to return to the current application template list.

The selected template is displayed on the screen.

Note: After selecting a different report template the selected template becomes the default template which will be selected next time

To change patient information

1. Trackball to heading of the information to change.
   The trackball marker is changed to a hand with pointing finger 🖑.

2. Press $\overline{\text{SET}}$ on the *Trackball area*.
   The original location of the data is displayed.

3. Change the information entered if required.

4. Press $\overline{\text{REPORT}}$ when completed.

To add an image to the report

Images are inserted in the report by dragging a selected image from the clipboard into an *Image container* in the report.

1. Trackball to the Image of interest in the *Image clipboard*.

2. Press and hold down the $\overline{\text{SET}}$ key, and using the trackball, drag the selected image in the *Image container* in the report.

3. To move images between image containers, press and hold down the $\overline{\text{SET}}$ key, and using the trackball, drag the selected image to the new location.

4. To remove an image from the report, press and hold down the $\overline{\text{SET}}$ key, and using the trackball, drag the selected image back to the clipboard.

To print a report

Only members of the user group "Cardiologist" are allowed to print a report (see page 399).

*   Press <u>PRINT</u>.

    The report is printed on the default printer. A status window is displayed showing the printing process.
    For printer configuration, see Chapter 11, "Peripherals" on page 343 .

To store a report

Only members of the user group "Cardiologist" are allowed to store a report (see page 399).

1. Press <u>STORE</u>.
    The report is stored in the Report archive.
    A confirmation window is displayed when completed.
2. Press **OK**.

Alternative storage

Reports can also be saved in a user-defined locations in the following formats:

*   **Compiled HTML (.CHM) files**: readable from any web browser.
*   **Portable Document Format (.PDF) files**: readable with Adobe Acrobat reader (not available on EchoPAC PC).

1. Press <u>MORE</u>.
    The additional controls are displayed (Figure 9-1).
2. Press <u>SAVE AS</u>.
    The *Save as dialogue window* is displayed.
3. Select the destination folder from the *Save in pull down menu*.
    The default location is the *Export folder*.
    The *Report archive folder* is selected by default.
    The default name for the report is of type:
    <exam DICOM UID>
4. Select **PDF** or **CHM** format from the *Save as type pull down menu*.
5. Press <u>SAVE</u>.

Retrieving an archived report

1. Press RETRIEVE.
   A list of the available reports for the actual examination is displayed.
   The default name for a report is of type:
   <template type>_<store date>_<store time>
   To display the current report, select **Show active exam**.
2. Trackball to the report to retrieve.
3. Press SET.

Deleting an archived report

Only members of the user group "Cardiologist" are allowed to store a report (see page 399).

1. Press MORE.
   The additional controls are displayed (Figure 9-1).
2. Press DELETE.
   A list of the available reports for the actual examination is displayed.
   The default name for a report is of type:
   <template type>_<store date>_<store time>
3. Trackball to the report to delete.
4. Press SET.

Structured Findings

Structured Findings is a feature that enables the user to insert pre-configured structured diagnostic statements and codes (e.g. Billing, Accreditation) in the patient report and create a conclusion based on the inserted statements.

Prerequisite

To be able to insert structured diagnostic statements and create a conclusion in a patient record, the report template used must have assigned fields for the structured findings, the codes and the conclusion.

To create the assigned fields in a report template:

1. Press **REPORT**.
2. Press **TEMPLATE** and select the desired report template.
3. Press **MORE** and **DESIGNER**.
   The *Report designer screen* is displayed.
4. Select the location in the report template where to insert the Structured findings fields.
5. Select **Insert** and **Archive Information**.
   The *Archive information box* is displayed (Figure 9-2).
6. Double-click on **Select All** under all three parameter fields in the *Archive information box* to deselect all parameters.
7. Select **Structured findings**, **Findings conclusion Indication codes** and **Billing codes** in the *Exam Information field* (Figure 9-2).
8. Select **OK**.
9. Save the Report template and exit the Report designer.

Figure 9-2: The Archive information box

Starting Structured Findings

1. Press **REPORT**.
   Make sure the current template has a Structured Findings field and a Conclusion field defined or select another template if necessary.
2. Press **MORE** and **FINDINGS**.
   The *Structured Findings window* is displayed (Figure 9-5).

Structured Findings structure

The diagnostic statements are organized in tab folders (see Figure 9-3). Each tab folder may contain:

• Underlying tab folders that contain Tab sheets.

• Tab sheets that contain diagnostic statements.
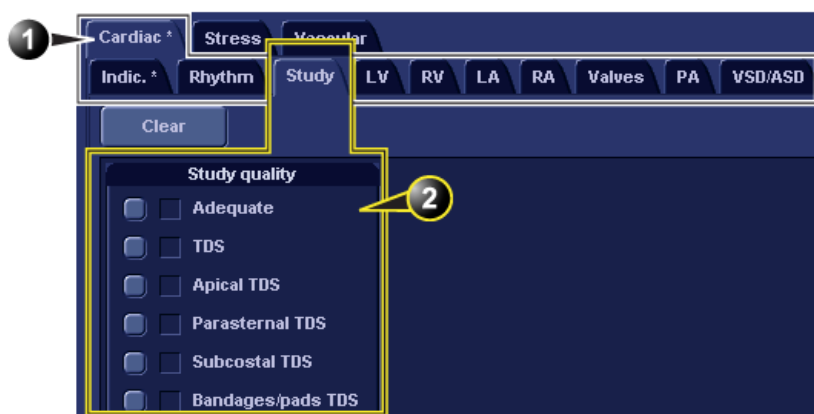
1. **Tab folder with underlying tab sheets**
2. **Tab sheet**

Figure 9-3: Structured findings structure

There are three types of diagnostic statements (see
Figure 9-4):

- Check box statement: when selected the statement is
  included in the report.
- Combo box statement: create a statement by selecting one
  alternative text among several choices.
- Statement group: create several statements by selecting
  multiple check box statements.

1. Check box statement
2. Combo box statement
3. Statement group

Figure 9-4: Diagnostic statement types

Using Structured Findings

1. Start Structured Findings (see page 291).
2. Browse to the tab sheet containing the statements of interest.
3. To insert a statement in the report (Findings field):
   - Check box statement: select the statement.
   - Combo box statement: select an alternative text in the combo box next to the statement.
   - Statement group: select the statements of interest within the group.

   A preview of the selected statement(s) is displayed in the *Findings preview field* (see Figure 9-5). The statement text in the preview field can be edited. This will apply only for the current report.
   Once a statement is selected an asterisk is displayed on the tab of the current sheet and folder.
   Note: select **Normal** to select only normal statements from the current tab sheet (see page 300 for more information on how to define normal statements).

Note: select **Clear** to deselect all statements from the current tab sheet.

To insert a conclusion statement in the report:

• Press the Conclusion button in front of the statement of interest.

A preview of the selected conclusion statement is displayed in the *Conclusion preview field* (see Figure 9-5). Conclusion statements are displayed in a numbered list. The list can be reordered: triple-click on the conclusion statement to move in the Conclusion preview field and use the ARROW UP or ARROW DOWN key to move the statement up or down.
The conclusion statements can be reordered using drag and drop procedure in the *Conclusion preview field*. The conclusion text in the preview field can be edited. This will apply only for the current report.
Note: pressing the Conclusion button in front of a statement that was not previously selected results in simultaneously inserting the finding statement and create the conclusion.

4. Press **OK**.
   The report for the current patient is displayed with the selected findings, conclusion statement(s) and associated codes (if any).
   Note: Some diagnostic statements have measurements values in the body text referred by a tag (e.g. the {EF} tag refers to EF measurement). These statements require that the actual measurement is done to display correctly in the report.

1. **Statement inserted in the Conclusion and Findings field.**
2. **Statement inserted in the Findings field only.**
3. **Findings preview field**
4. **Conclusion preview field**
5. **Remove all selections.**
6. **Insert normal findings for the current tab sheet.**

Figure 9-5: Structured Findings window

Global selection of normal statements

It is possible to select all normal statements from all tab sheets.

1. Place the cursor in the *Statement field*, press $\overline{\text{UPDATE MENU}}$ on the control panel and select **All normal**.
All statements defined as normal are selected from all the tab sheets. An asterisk is displayed on the tab of all the tab sheets that contain normal statements.
Note: this operation will remove any other "non-normal" previously selected statements.

2. To remove all statements at once, place the cursor in the *Statement field*, press $\overline{\text{UPDATE MENU}}$ and select **Clear all**.

Structured Findings configuration

Structured Findings configuration is used to:

- Create, edit or delete finding statements, conclusion statements and codes.
- Organize the diagnostic statements in the *Structured Findings screen*.
- Define the normal diagnostic statements.

Accessing the Structured Findings configuration screen

1. Press $\overline{\text{CONFIG}}$ and select the **Report** category.
2. Select the **Structured Findings** tab.
The *Structured Findings configuration screen* is displayed (Figure 9-6).

Or from within Structured Findings:

- Press $\overline{\text{UPDATE MENU}}$ on the control panel and select **Config**.

1. **Structured Findings structure tree:**
   - 🗂 **tab folder**   📑 **Combo box statement**
   - 📁 **tab sheet**   🎬 **Statement group**
   - ☑ **Check box statement**
2. **Tab or statement label**
3. **Findings text**
4. **Conclusion text**
5. **Codes for the selected statement**
6. **Move, create or delete statement.**
7. **Create folder, Combo box or statement groups**
8. **Enter a variable in statement or conclusion text**
9. **Hide selected tab or statement from the Structured Finding window**
10. **Set the selected statement as normal**
11. **Rest factory default findings**
12. **Export/import findings.**

Figure 9-6: Structured Findings configuration screen

Creation of a tab folder

The following procedure describes how to create a new top level tab folder.
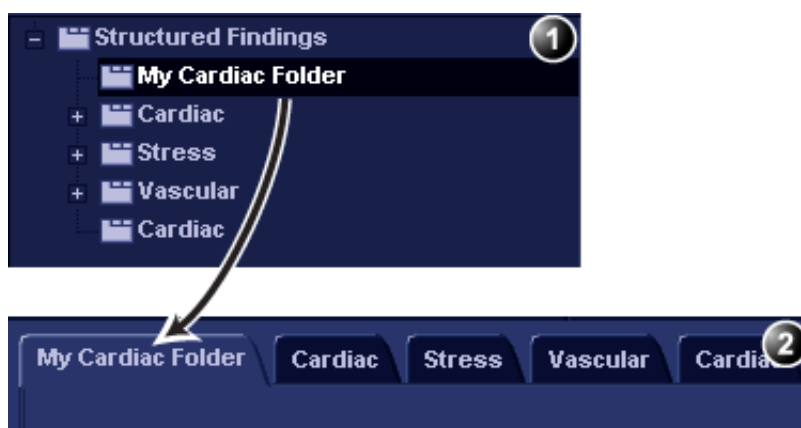
1. Configuration window
2. Structured findings window

Figure 9-7: New tab folder

1. In the *Structured Findings configuration window* (Figure 9-6), select the Structured Findings tab folder.
2. Select **Add**.
   A new entry is created in the Structured Findings tab folder. The new entry is by default a tab sheet (▭).
3. Select **Enable one more tab level** to change the new entry to a tab folder (▭).
   A warning message is displayed. Select **OK**.
4. With the new entry selected, follow the following steps:
   - Enter a name in the *Label field* (tab name).
   - Enter a description in the *Findings text field*. The description will be displayed in the report as a heading when selecting a statement from the underlying tab sheets. The system is always using the Findings text from the highest item in the structure as a heading for the selected underlying statements.
   - Enter the appropriate codes.

Note: to enter several codes separate each code by a space.

5. Press **Up** or **Down** to move the tab in the structure tree (or do drag and drop).

Creation of a tab sheet

The following procedure described how to create a tab sheet in a tab folder.

1. **Configuration window**
2. **Structured findings window**

Figure 9-8: New tab sheet

1. Make sure that the tab folder is selected and press **Add**. A new entry is created in the tab folder. The new entry is by default a tab sheet ( ).
2. With the new entry selected, follow the following steps:
   • Enter a name in the *Label field* (tab name).
   • Enter a description in the *Findings text field*.
   If required:
   • Enter the appropriate codes.
     Note: to enter several codes separate each code by a space.

Adding statements in the tab sheet

Check box statement

The following procedure describes how to create a check box statement.
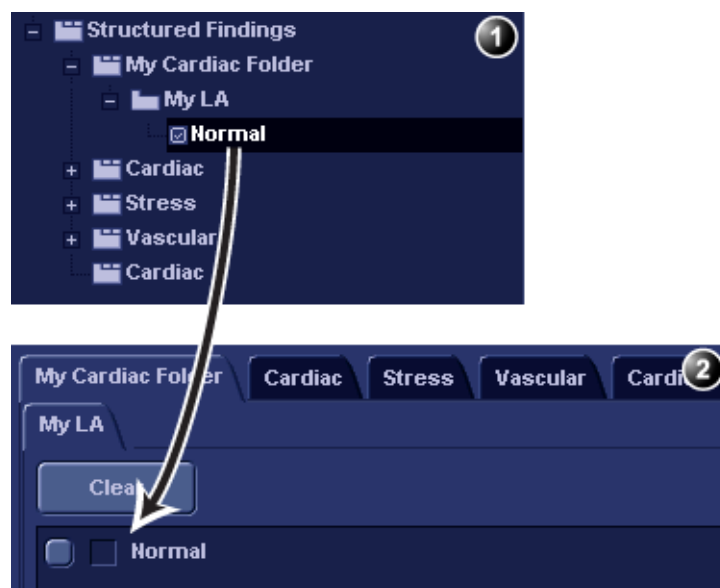
1. Configuration window
2. Structured findings window

Figure 9-9: New check box statement

1. Make sure that the tab sheet is selected and press **Add**. A new entry is created in the tab sheet. The new entry is by default a check box statement (☑).
2. With the new entry selected, follow the following steps:
   - Enter a name in the *Label field* (statement name).
   - Enter the full statement in the *Findings text field*.
   - Enter a conclusion in the *Conclusion text field* (optional).
     Note: if the *Conclusion text field* is left empty, the statement text will be used as conclusion when selected.

   If required:
   - Enter the appropriate codes.

Note: to enter several codes separate each code by a space.

- Check **Include findings in normal report** to define the statement as normal.

  All statements within the selected tab sheet that have this option checked will be included in the report when **Normal** is selected in the *Structured Findings window* (see "Using Structured Findings" on page 293).

Combo box statement

The following procedure describes how to create a combo box statement.
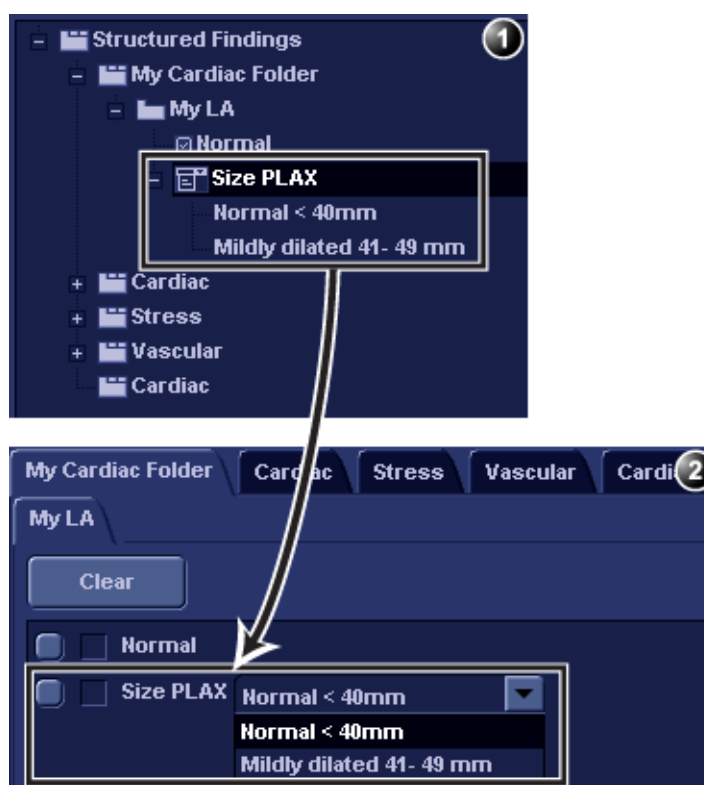
1. **Configuration window**
2. **Structured findings window**

Figure 9-10: New combo box statement

1. Create a new statement as described above. A check box statement is created by default.
2. With the new statement selected, press **Add**.
A new underlying entry is created and the parent statement is changed to a Combo box statement (■).
3. With the new underlying entry selected, follow the following steps:
   - Enter a name in the *Label field*.
   - Enter a text in the *Findings text field*.
   - Enter a conclusion in the *Conclusion text field* (optional).
4. Repeat the procedure from step 2 to create as many underlying statements as necessary. Each underlying statement will be a selectable entry in the combo box.

Statement group

Statement groups are created by changing a combo statement to a statement group.

1. Create a combo box statement as described above.
2. Make sure the combo box statement is selected and deselect the option **Enable pull-downs**.
The combo box statement is changed to a statement group (■). Each underlaying entries are changed to check box statements.

Editing a statement

Tab label, statements and statement alternative texts can be edited.

1. In the *Structured Findings configuration window* (Figure 9-6), select the item to edit.
2. Make the required changes.

Inserting variable parameters in a statement

Variable parameters such as patient name, institution name, measurement values etc. can be inserted in a statement as tagged information.

To insert variable parameters in a statement:

1. Place the cursor at the required position in the *Findings text field* (or *Conclusion text field*).

2. Press **Insert parameter**.
   The *Insert parameter window* is displayed (see Figure 9-11).

3. Browse and select the actual parameter to insert.
   Note: for measurement values, select first the scanning mode.

4. Press **OK**.
   The selected parameter is inserted in the statement as a tag (e.g. the {EF} tag refers to EF measurement)
   Note: to display correctly in the report, the actual parameter value must exist, e.g. if a measurement value is included in a statement as a variable parameter, a measurement value must exist for the current patient, otherwise the parameter name is displayed.
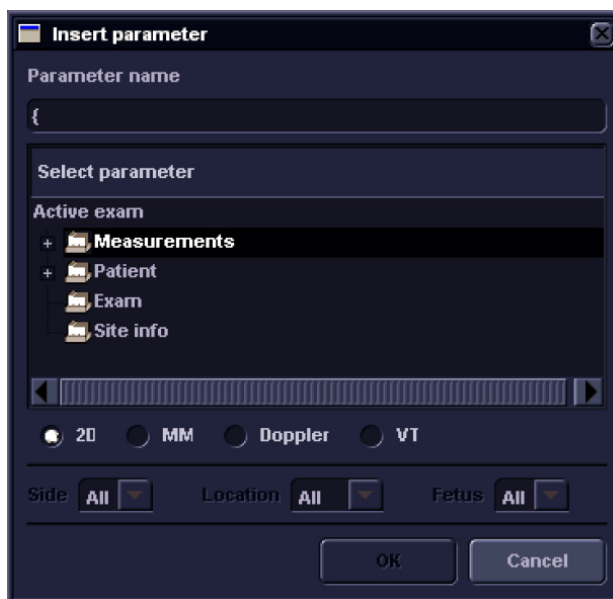
Figure 9-11: Insert parameter window

Copy of a statement

Tab folders, tab sheets and statements can be copied from one location to another. The word "Copied" is added to the copied item name.

1. In the *Structured Findings configuration window* (Figure 9-6), select the item to copy.
2. Select **Copy**.
3. Select the item to contain the copy.
4. Select **Paste**.

Note: if the item to copy cannot be copied in the selected location, the operation is ignored.

Note: copy can be done by drag-and-drop, while holding **CTRL** depressed.

Deletion of a statement

Tab folders, tab sheets and statements can be deleted.

$\triangle$
CAUTION

Deletion cannot be undone.

1. In the *Structured Findings configuration window* (Figure 9-6), select the item to delete.
2. Select **Delete**.
   The selected item is deleted.

Factory reset

All statements can be reset back to the factory default.

$\triangle$
CAUTION

Factory reset cannot be undone.

1. Select **Reset**.
   The *Reset statements window* is displayed.
2. Select:
   • **Yes** to reset all statement to the factory default (No undo).
   • **No** to cancel the operation.

Exporting/Importing statements

Diagnostic statements can be exported from one system and imported on another system.

Exporting statements

1. In the *Structured Findings configuration window* (Figure 9-6), select **Export**.
    A browsing window is displayed.

2. Browse to a destination and select **Save**.

Importing statements

⚠
CAUTION

Importing statements will replace the current statements. If necessary, backup the current statements by exporting them before performing import.

1. In the *Structured Findings configuration window* (Figure 9-6), select **Import**.
    A browsing window is displayed.

2. Browse to a destination and select **Open**.

Direct report

Direct report enables the user to insert comments at any time during the examination that will be part of the final report.

Direct report provides also an overview over the measurements completed.

Creating comments

1. Press UPDATE MENU.
2. Select **Direct report** (see Figure 9-12).
3. In the *Direct report screen*, select the comment type.
4. Type your comments in the *Text field*.
5. To add a measurement in the comment, double-click a measurement in the *Measurement overview field*.

1. **Open Direct report**
2. **Select the type of information**
3. **Create/insert pre-defined text**
4. **Text field**
5. **List of measurements completed**
6. **Exits the Direct report**

Figure 9-12: The Direct report

Inserting pre-defined text input

1. Select the insertion point in the *Text field*.
2. Select **Insert text**.
   The *Insert text window* is displayed (see Figure 9-13).

Figure 9-13: The Insert text window

   The pre-defined text list is organized in a three level
   hierarchy. Selecting one item in the first column displays
   pre-defined text entries related to the selected text in the
   second and third column.
3. Navigate through the pre-defined text list by selecting items
   in the columns and double-click on the desired pre-defined
   text to be inserted. If an entry in the third column is inserted,
   the selected text in the second column is also inserted.
   Press **More>>** to display the full text for the selected entry.

Creating pre-defined text inputs

This feature is described in "The Comment texts sheet" on
page 374.

Report designer

The Report designer software package enables the user to create report templates that best suit its needs.

Designing a report template consists of choosing the information to display in the report (e.g. header, footer, logo, patient information, images, measurements etc.) and arrange it in the report viewer.

The Report designer function is based on the information container concept: each type of information is included within a container with parameters that can be configured (size, color, font properties, information to display etc.)

Accessing the Report designer

1. Press REPORT on the Control panel.
    The *Report screen* is displayed.
2. Press DESIGNER.
    The *Report designer screen* is displayed with the selected template in the *Report template design area* (see Figure 9-14).

Report designer overview

1. **Menu bar**
2. **Report template design area**
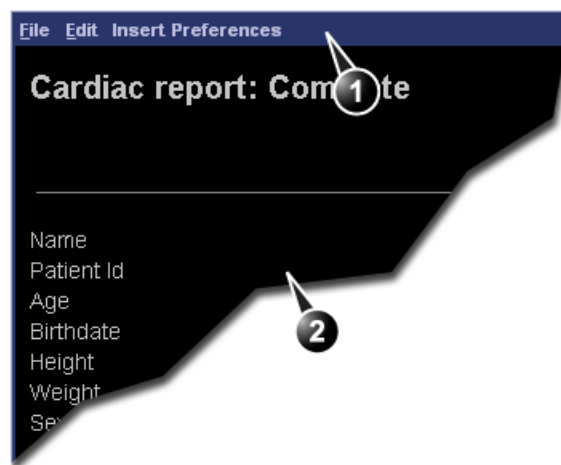
Figure 9-14: The Report designer screen

The menu bar

Menu	Description
File	• **New**: start working on an new template • **Save**: save the template using the same name. Factory report templates cannot be overwritten. • **Save as**: save the template using a new name. • **Page setup**: define printing orientation and header/footer for the printed report. • **Print Preview**: display a print preview of the report template. • **Exit**: exit the Report designer and returns to the report function. The user can choose whether to save the updates or restore the original template.

Menu	Description
Edit	• **Delete**: remove the selected object from the report template. • **Undo**: restore the previous state of the report template.

Menu	Description
Insert	• **Page Break**: insert a new page in the report template. • **Table**: configure and insert a table in the report template. • **Logo**: select and insert a logo to the report template. • **Archive info**: select and insert data from the following categories: Patient information Exam information Site information • **Anatomical graphics**: select and insert an anatomicalgraphic (cardiac, vascular or TEE). • **Image**: create a container for the display of ultrasound images. • **Wall motion analysis**: insert a container for the display of Stress Echo analysis results (cut planes Bull's eye and scoring table). • **OB/GYN**: insert OB graph. • **Measurements**: insert a container for the display of measurements and calculations. When creating a measurement container, the user is prompted through a configuration procedure enabling the selection of mode specific measurements and/or calculations. • **Text field**: insert a container where the user can write in the report. • **Fixed text**: insert a container with static text. The text typed during the creation of the container will be displayed in the report.

Menu	Description
Preferences	• **Page color**: sets the default background color for the template page.

Designing a report template

Starting template designing

1. Start the Report designer (see page 308).
2. Press **File** and select **New** to display a blank page or use the current report template as basis template.

Setting the layout preferences

Adjusting the report page color background
1. Press **Customize** and select **Page Color**.
   The *Color selection window* is displayed.
2. Select the desired color.
3. Press **OK**.

Header and footer in the printed report

This function is described on page 320.

Inserting an information container in the report template body

The different type of information to be included in a report are grouped in information containers. Designing a report template consists in inserting and configuring the different information containers in the template page in an ordered manner.

Information containers can be inserted either:
- Directly into the report template body: this procedure does not allow side-by-side insertion, the information container will normally cover the width of the report template page.
- Within a table: this procedure allows side-by-side insertion of several information containers.

Inserting a table

1. Press the **Left mouse button** at the desired insertion point in the *Report template design area*.
2. Press **Insert** and select **Table**.
   The *Container properties window* is displayed (see Figure 9-15).
3. Adjust the parameters as desired.
4. Press **OK**.

The table is displayed in the template.

Note: To modify an inserted table, double-click in an empty area in the table. A selection menu is displayed where the user can add, delete a row or a column or open the *Table properties window*.
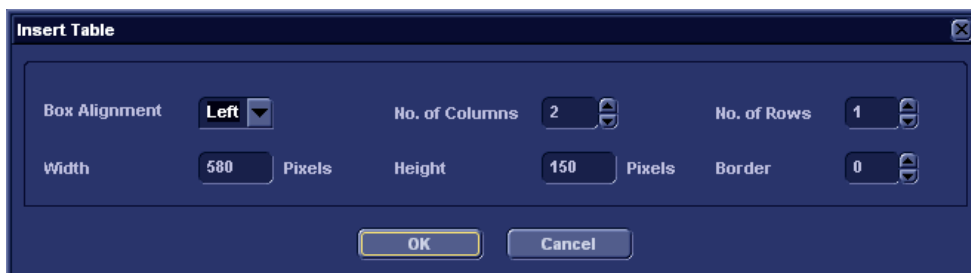
Figure 9-15: The Table properties window

Inserting a logo

1. Provide the hospital logo in JPEG or Bitmap format onto a CD or MO disk.
2. Select the location where to insert the logo (a table cell or directly in the report template).
3. Select **Insert** and **Logo**.
    The *Logo box* is displayed.
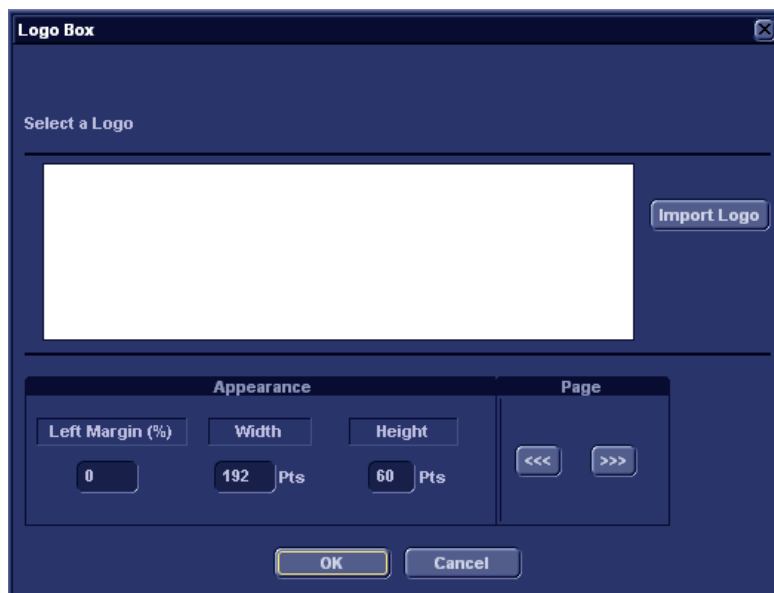
Figure 9-16: The Logo box

4. Select a logo, or if not available, select **Import logo**. Browse and select the logo and select **OK**.

5. Specify the appearance.

6. Select **OK**.

Inserting fixed text

Fixed text is an entry that cannot be changed in the report (e.g. hospital information).

1. Select the location where to insert the fixed text (a table cell or directly in the report template).

2. Select **Insert** and **Fixed text**. The *Fixed text box* is displayed.
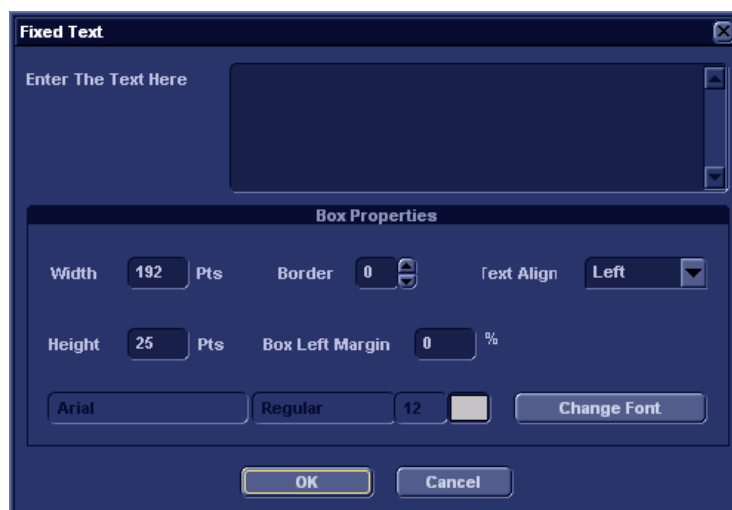
Figure 9-17: The Fixed text box

3. Enter the text and specify the appearance.

4. Select **OK**.

Inserting archive information

Archive information contains all the objects of the different information menus (Patient, Exam, Study and Site Information).

You may display the archive information over two columns using a table container as described below.

1. Insert a table for the archive information to the desired location (a table cell or directly in the report template).
2. Select the first table cell.
3. Select **Insert** and **Archive information**.
    The *Archive information box* is displayed.
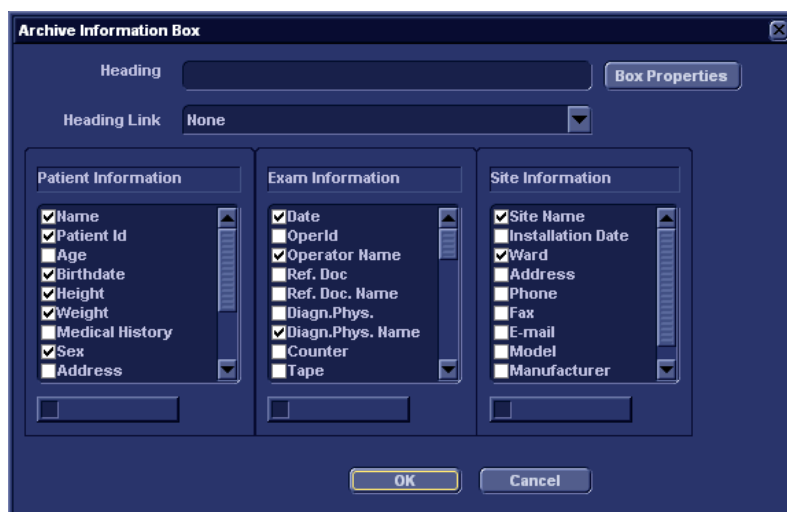
Figure 9-18: The Archive information box

4. If desired, enter a heading and select a heading link from the pull-down menu.
5. Select the Information parameters to be displayed in the first cell.
    Select **Box properties** to change the font, alignment, appearance, etc.
6. Select **OK**.
7. Select the next table cell and repeat steps 3 to 6 to enter the remaining archive information.

Inserting an image container

1. Select the location where to insert the fixed text (a table cell or directly in the report template).
2. Select **Insert** and **Image**.
    The *Ultrasound image box* is displayed.
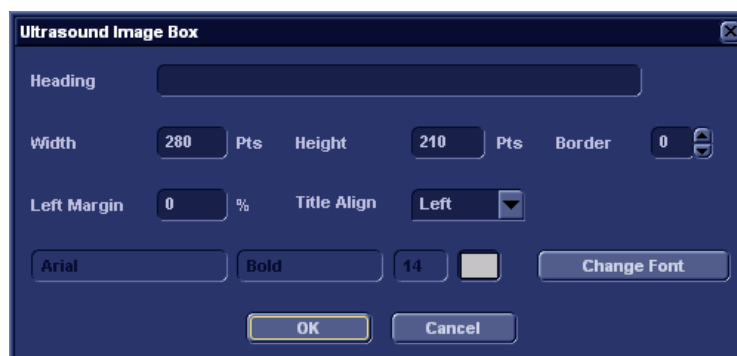
Figure 9-19: The Ultrasound image box

3. If desired, enter a heading, set the container size and specify the text appearance.
4. Select **OK**.

Inserting measurement containers

You may display the measurements over several columns using a table container as described below.

1. Insert a table for the measurements to the desired location.
2. Select the first table cell.
3. Select **Insert** and **Measurements**.
    The *Measurement box* is displayed.
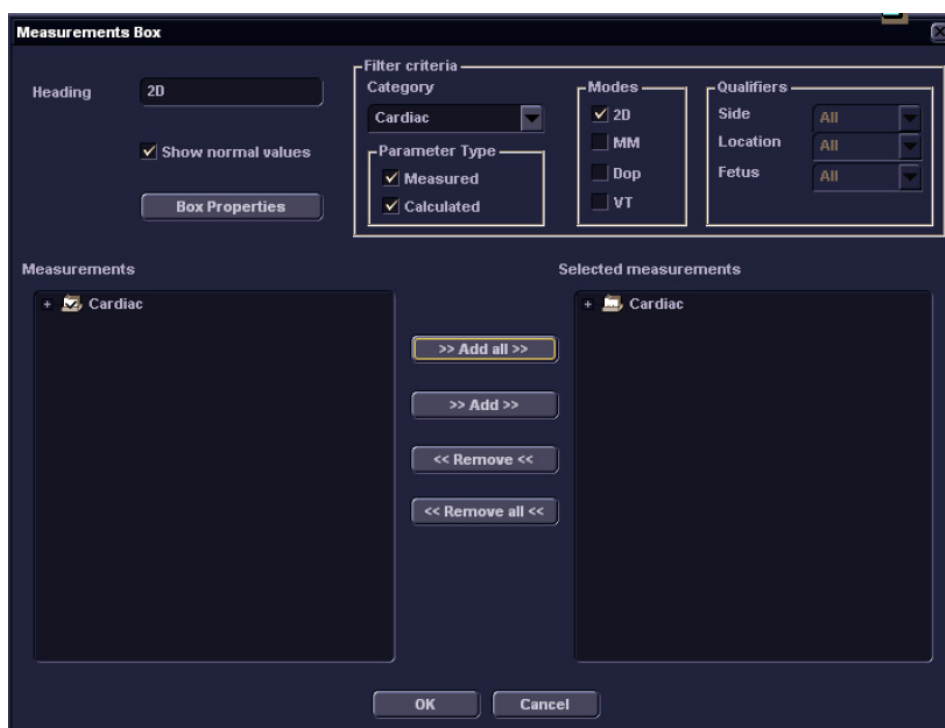
Figure 9-20: The Measurements box

4. Enter a heading (e.g. 2D).

5. Using the *Filter criteria*, define the type of measurements to be entered (e.g. Cardiac, 2D, measured and calculated). Select **Show normal value** to display user-defined Normal value next to the measurements in the Report (see page 190 for more information).
   Note: References for the normal values can be displayed in the report by checking **Normal value references** from **Insert -> Archive Info** (see page 314)

6. From the measurement list, select the measurement to insert and press **Add**. Both single measurements or a folder may be added.

7. The list of the inserted measurements is displayed in the *Selected measurement list* on the right side.

8. Press **OK**.

9. Select the next table cell and repeat steps 3 to 8 to insert several measurements.

Inserting text fields

Text fields are:

- Containers for Referral reasons, Comments and Diagnosis information.
- Containers for free text, where the user can type information in the report.

1. Select the location where to insert the text field container (a table cell or directly in the report template).
2. Select **Insert** and **Text field**.
   The *Text field box* is displayed.

Figure 9-21: The Text field box

3. Enter a heading.
4. From the *Display field*, select one of the following options:
   - **Referral reasons**: displays the information entered in the Direct report (see page 306) or in the *Examination list window*.
   - **Comments**: displays the information entered in the Direct report (see page 306) or in the *Examination list window*.

- **Diagnosis**: displays the information entered in the Direct report (see page 306) or in the *Examination list window*.
- **Free text 1-8**: creates an empty free text container.

5. If desired, adjust the font settings for the header and data.

Inserting Wall motion scoring analysis containers

Two different containers must be inserted for the Wall motion scoring analysis:

- A Wall motion scoring diagrams container (Cut planes or Bull's eyes)
- A Wall motion scoring table

Inserting Wall motion scoring diagrams container

1. Select the location where to insert the free text container (a table cell or directly in the report template).
2. Select **Insert, Wall motion analysis** and select between **Cut planes** and **Bull's eye**.
   The corresponding *Wall motion scoring box* is displayed.
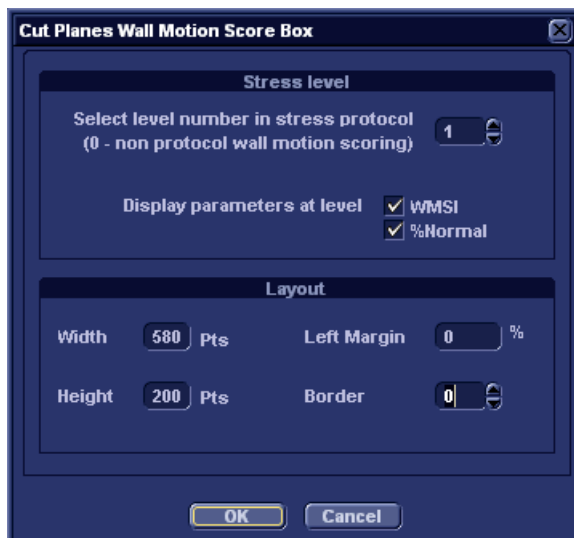
Figure 9-22: The Wall motion scoring box (Cut planes)

3. Adjust the parameters and select **OK**.

The scoring diagrams are inserted in the report template.

Inserting Wall motion scoring diagrams container

1. Place the cursor right below the *Wall motion scoring diagrams container*.

2. Select **Insert, Wall motion analysis** and select **Score table box**.
    The *Score table box* is displayed.
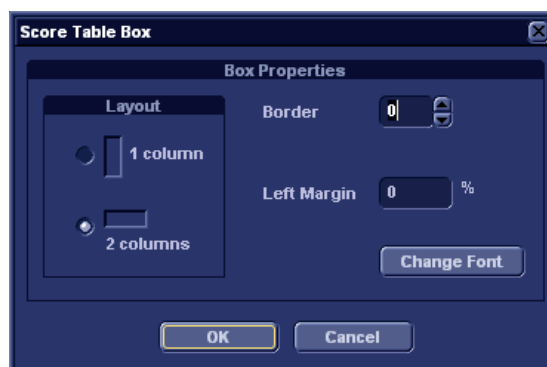
Figure 9-23: The Score table box

3. Adjust the layout parameters in the *Score table box* and select **OK**.

The *Score table* is inserted in the report template.

Editing the information container

Resizing the information container

1. Move the **Mouse cursor** over the border of the container to resize.
    The mouse cursor is changed to a cross ✛.

2. Press **Left mouse button** once.
    The container is displayed with anchor squares on the sides and at the corners.

3. Resize the container by dragging from the anchor points.

Editing the information container properties

Modifying the container's specific properties

1. Move the **Mouse cursor** over the border of the container to edit.
    The mouse cursor is changed to a cross ✛.

2. Double-click on the **Left mouse button**.
    The *Container box* is displayed.

3. Adjust the parameters specific to the selected container.
   Note: Some information containers have additional parameters that may be adjusted by selecting **Box properties**.

Inserting a new page

1. In the template, position the Mouse cursor at the insertion point.
2. Press the **Left mouse button**.
3. Press **Insert** and select **Page Break**.

Inserting header and footer

Header and footer may be defined to be displayed in the printed report. The header and footer are not visible in the on screen report.

To insert header and footer in the printed report:

1. Select **File** and **Page setup**.
   The *Page setup box* is displayed.
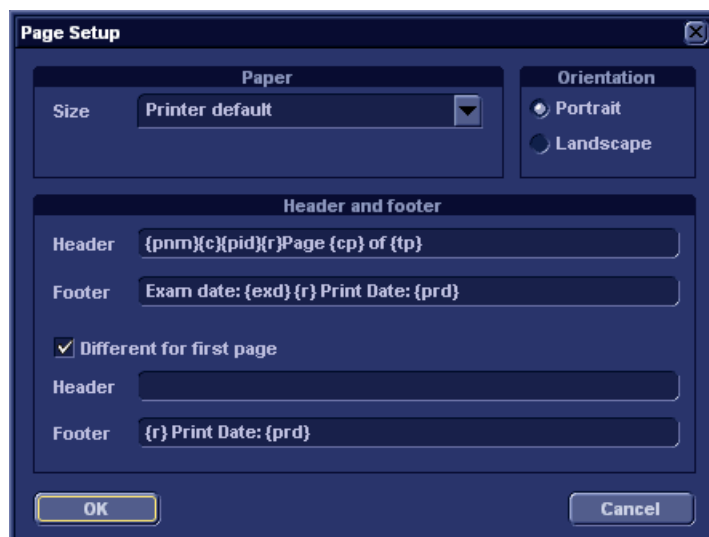
Figure 9-24: The Page setup box

2. Adjust the printing orientation.
3. Define the header and footer for the printed report, by typing text and entering the required variables listed in the table below.

Check **Different on first page** and create a specific header/footer for the first page.

4. Select **OK**.
   To check the display of the header and footer, select **File** and **Print preview**.

Variable	Description
{pid}	Patient ID
{pnm}	Patient name
{pdb}	Patient date of birth
{exd}	Examination date
{prd}	Current date (printing date)
{prt}	Current time (printing time)
{cp}	Current page
{tp}	Page count
{c}	Subsequent entries are centered
{r}	Subsequent entries are right aligned

Saving the report template

Replace an existing template

Factory templates cannot be overwritten.

1. Press **File** and select **Save**.
   A dialogue window is displayed asking for confirmation.
2. Select:
   - **Yes** to save the report template
   - **No** to discard the report template
   - **Cancel** to go back to the Report designer without saving the report template.

Save existing template with a new name

1. Press **File** and select **Save as**.
   The *Save as template window* is displayed.

Figure 9-25: The Save as template window

2. Enter a name for the template.
3. Press **OK**.
   The template is saved.

To exit the Report designer

1. Select **File** and **Exit**.
   The *Exit window* is displayed.
2. In the *Exit window*, select one of the following:
   - **Yes**: to save the report template and exit the application.
   - **No**: to exit the application without saving the changes made in the report template.
   - **Cancel**: to return to the application.

Report templates management

This section describes:

- Configuration of the *Template selection menu*.
- Deletion of user-defined report templates.
- Export/import of user-defined report templates.

The report templates management is done from the *Report templates sheet* in the system configuration package.

To access to the *Report templates sheet*:

1. Press CONFIG and select the **Report** category.
   The *Report category sheet* is displayed.

Figure 9-26: The Report template sheet

Configuration of the Template selection menu

The *Template selection menu* displays the application specific report templates that can be selected when creating a report. The *Template selection menu* can be configured to display only the templates of interest.

Inserting a template in the Templates selection menu

1. Press CONFIG and select **Report**.
   The Report template sheet is displayed (Figure 9-26)

2. In the *Available templates field* (left field), select the template to insert in the *Template selection menu*.

3. Next to *Section*, select the appropriate application.

4. Press the **Right arrow button** [➔].
   The selected template is inserted in the *Template selection menu*.
   Note: Double-clicking on a template in the *Available template field* will also insert the template in the *Template menu*.

Removing a template from the Template selection menu

1. In the *Report template menu field* (right field), select the template to remove.

2. Press the **Left arrow button** [◀].
   The selected template is removed from the *Template selection menu*.
   Note: Double-clicking on a template in the *Available template field* will also insert the template in the *Template menu*.

Sorting the templates in the Template selection menu

1. In the *Report template menu field*, select the template to move.

2. Press the **Up** or **Down arrow buttons** [∧][∨].
   The selected template is moved accordingly in the Template selection menu.

Deleting a report template from the system

Only user-defined report templates can be deleted from the system.

1. In the *Available templates field* (left field), select the report to delete (Figure 9-26).

2. Press **Delete**.
    A Confirmation window is displayed.

3. Select **Yes** to delete the report template.

Export/Import of Report templates

User-defined report templates can be exported to a removable media and imported from the removable media into another system (Vivid *i* / EchoPAC PC).

Export of Report templates

1. Insert a removable media into the drive.

2. Press CONFIG and select **Report**.
    The Report template sheet is displayed (Figure 9-26, page 323).

3. Select **Export Templates**.
    The available user-defined templates are displayed in the *Export template dialogue window*.
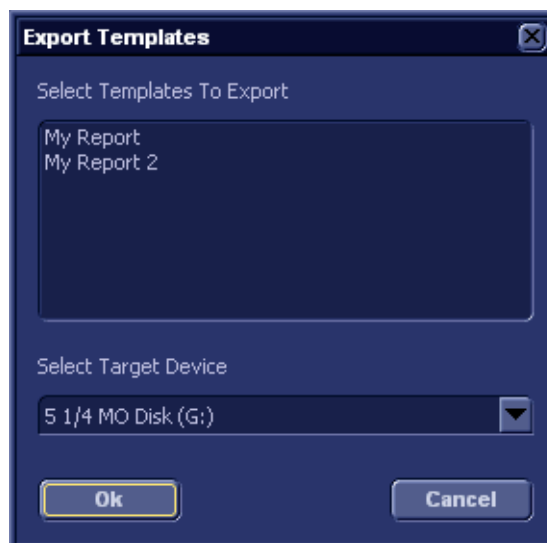
Figure 9-27: The Export template dialogue window

4. Select the template(s) to export. Multiple selection can be done using **SHIFT** or **CTR** key.

5. Select the desired removable media under *Select target device*.

6. Press **OK**.
   A Confirmation window is displayed.

7. Press **OK**.
   The selected template(s) are exported to the removable media.

8. Press **ALT** + **E** and select the media to eject.

Import of Report templates

1. Insert the removable media with the report template(s) to import.

2. Press **CONFIG** and select **Report**.
   The Report template sheet is displayed (Figure 9-26, page 323).

3. Select **Import Templates**.
   The *Import template window* is displayed.

Figure 9-28: The Import template window

4. Select the source device from the pull-down menu.

5. Press **OK**.
   A Confirmation window is displayed.

6. Press **OK**.
   The templates are imported into the system.

7. Press **ALT** + **E** and select the media to eject.

Chapter 10
Probes

Probe overview

The Vivid *i* ultrasound unit supports four types of probes:

- Phased Array Sector
- Linear Array
- Curved Array (Convex)
- Continuous Wave Doppler

Supported probes

Phased Array Sector probes

Probe	Mode	Intended use	Technical data		Image
3S-RS	2D mode M-Mode Color Flow CW Doppler PW Doppler	Cardiology Coronary Transcranial Abdomen Fatal Heart	Frequency: Foot print:	1.5–3.6 MHz 18 x 24 mm	
5S-RS	2D mode M-Mode Color Flow CW Doppler PW Doppler	Cardiology Coronary Pediatric Fatal Heart	Frequency: Foot print:	2.0–5.0 MHz 18 x 24 mm	
7S-RS	2D mode M-Mode Color Flow CW Doppler PW Doppler	Cardiology Pediatric heart Coronary Neonatal head	Frequency: Foot print:	3.5–8.0 MHz 15 x 21 mm	
10S-RS	2D mode M-Mode Color Flow CW Doppler PW Doppler	Cardiology Pediatric heart Coronary Neonatal head	Frequency: Foot print:	5.0–11.5 MHz 10 x 14 mm	

Linear Array probes

Probe	Mode	Intended use	Technical data		Image
8L-RS	2D mode M-Mode Color Flow PW Doppler	Peripheral vascular Small parts	Frequency: Foot print:	4.0–13.3 MHz 17 x 58 mm	
12L-RS	2D mode M-Mode Color Flow PW Doppler	Peripheral vascular Small parts	Frequency: Foot print:	6.0–13.3 MHz 17 x 49 mm	
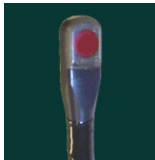
Curved Array (Convex) probes

Probe	Mode	Intended use	Technical data		Image
3C-RS	2D mode M-Mode Color Flow PW Doppler	Abdomen Aorto-Iliac Fetal Heart Renal	Frequency: Foot print: FOV:	1.8–6.0 MHz 15 x 62 mm 65 degrees	
4C-RS	2D mode M-Mode Color Flow PW Doppler	Abdomen Fetal Heart Renal	Frequency: Foot print: FOV:	1.8–6.0 MHz 17 x 65 mm 58 degrees	
8C-RS	2D mode M-Mode Color Flow PW Doppler	Pediatrics Neonatal Head Carotid Small parts	Frequency: Foot print: FOV:	4.0-11.0 MHz 26 x 10 mm 133 degrees	

Doppler probes

Probe	Mode	Intended use	Technical data	Image
2D-RS (P2D)	CW Doppler	Cardiology	Frequency: 2.0 MHz	
6D-RS (P6D)	CW Doppler	Vascular	Frequency: 6.0 MHz	

Multiplane Transesophageal Phased Array probe

Probe	Mode	Intended use	Technical data	Image
6T-RS	2D mode M-Mode Color Flow CW Doppler PW Doppler	Transesophageal Cardiology	Frequency: 2.9–8.0 MHz	
9T-RS	2D mode M-Mode Color Flow CW Doppler PW Doppler	Transesophageal Cardiology	Frequency: 3.0–10.0 MHz	

Maximum probe temperature

Probe	Max Temp
3S -RS	32.3
5S-RS	34.6
7S-RS	32.3
10S-RS	30
8L-RS	32
12L-RS	32.5
3C-RS	33.2
4C-RS	32.7
8C-RS	33.3
6T-RS	39
9T-RS	36.9
2D-RS	26
6D-RS	26.2

Notes: Lens temperature measured under following conditions per IEC 60601-2-37 Amd.1:

1. Thermocouple was placed at the geometric center of the lens.

Thermal phantom made with tissue-mimicking material as referenced in IEC60601-2-37 Amd 1: Annex II.2

2. a: Thermal phantom at 37 °C for non-external probes.
   b: Thermal phantom at 33 °C (or 23 °C) for external probes. (Temperature rise is measured and added to 33 °C if the phantom is at 23 °C).
   c: P2D and P6D with probe transmitting in air, no phantom.

3. Probe placed upright in contact with above thermal phantom.

4. Auto-freeze capability is disabled.

5. Lens temperature is monitored for 30 minutes.

6. a: Measurement uncertainty for probes with temperature sensor: 0.3 °C
   b: Measurement uncertainty and probe variation for other probes: 2 °C

Probe orientation

Some probes are provided with a green light (LED) orientation marking near their head (see Figure 10-1). Probes which do not have a LED have an indentation (notch) for orientation on the probe housing. This LED, or notch, corresponds with the **V** mark on the scanning screen. The **V** mark indicates the orientation of the probe to the scan.

1. **LED**
2. **Notch**

3. **V-mark on screen: indicates the orientation of the probe to the scan.**
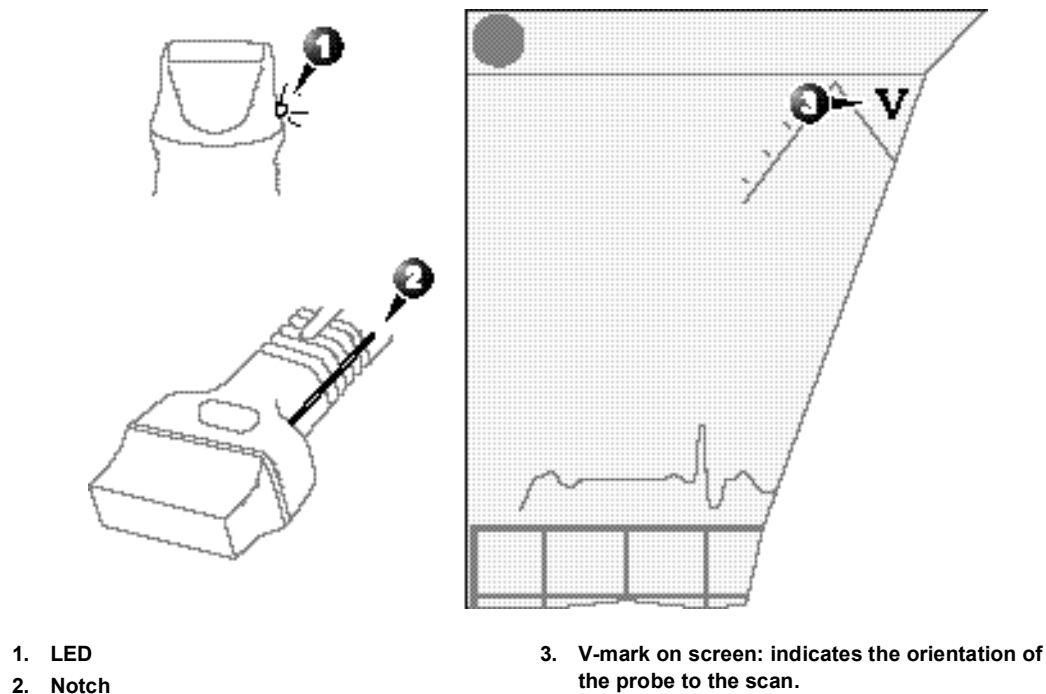
Figure 10-1: Orientation marking on probe and on screen

Probe labelling

Each probe is labelled with the following information:
- Name of distributor and manufacturer
- Operating frequency
- Model number
- Probe serial number
- Year of manufacture

The probe name is displayed on the probe housing.

1. **CE mark**
2. **Probe name**

Figure 10-2: Probe labelling (examples)

Probe Integration

This section covers:
- Connecting the probe
- Activating the probe
- Disconnecting the probe

Connecting the probe

Probes can be connected at any time, whether the unit is on or off.

<table>
<tr>
<td>⚠
CAUTION</td>
<td>Do not allow the probe head to hang freely. Impact to the probe head may result in irreparable damage.</td>
</tr>
</table>

<table>
<tr>
<td>⚠
WARNING</td>
<td>Do NOT touch the patient and any of the connectors on the ultrasound unit simultaneously, including ultrasound probe connectors.</td>
</tr>
</table>

To connect a probe

1. Hold the probe connector horizontally with the cable pointing towards you.
2. The lever on the Vivid *i* should be *down* all the way.
3. Align the connector with the probe port and carefully push into place.
4. Lift the lever on the Vivid *i up* all the way.
5. Position the probe cable so that it is not resting on the floor.

<table>
<tr>
<td>⚠
CAUTION</td>
<td>Take the following precautions with the probe cables:
• Keep free from the wheels.
• Do not bend cable sharply.</td>
</tr>
</table>

Activating the probe

When a probe is connected to the unit it is automatically detected.

To select a probe and an application

1. Press $\overline{\text{APPLICATION}}$ on the control panel. A list of the connected probes will pop up. The list will contain the name of the probe in the main connector and the name of the CW pencil probe connected to the small connector.

2. Trackball to the desired probe.
   An application menu for the desired probe is then listed.

3. Trackball to the desired application

4. Press $\overline{\text{SET}}$ to launch the application.

⚠
CAUTION

Make sure that the probe and application names displayed on the screen correspond to the actual probe and application selection.

Check that the correct TI category is displayed (see "Thermal Index" on page 421). TIB must be displayed when a fetal application is selected.

Disconnecting the probe

To disconnect probes

The probes that are not connected to the unit should be stored in their storage case.

1. Push the locking lever on the Vivid *i* all the way *down*.

2. Remove the connector from the port.

3. Ensure that the probe head is clean before placing the probe in its storage case.

Care and Maintenance

This section covers:
- Planned maintenance
- Probe inspection
- Probe cleaning
- Probe disinfection

Planned maintenance

⚠️
CAUTION

Improper handling can lead to early probe failure and electric shock hazards.

DO follow the specific cleaning and disinfection procedures provided in this chapter and the germicide manufacturers instructions.

Failure to do so will void probe warranty.

⚠️
CAUTION

Transesophageal and intraoperative probes require a special handling. Refer to the user documentation enclosed with these probes.

It is recommended to keep a maintenance log and note all probe malfunctions. Follow the maintenance schedule below to ensure optimum operation and safety:

After each use
- Inspect the probe
- Clean the probe
- If required disinfect the probe

Before each use
- Inspect the probe

Inspecting the probe

⚠️
CAUTION

If any damage is found, DO NOT use the probe until it has been inspected and released for further use by a GE service representative.

After each use

1. Inspect the lens, the probe housing and the cable (Figure 10-3.

2. Look for damage that might allow liquid into the probe.

Before each use

1. Inspect the lens, the probe housing and the cable (Figure 10-3).

2. Look for damage that might allow liquid into the probe.

3. Test the functionality of the probe.

1. **Housing**
2. **Strain relief**
3. **Seal**
4. **Lens**
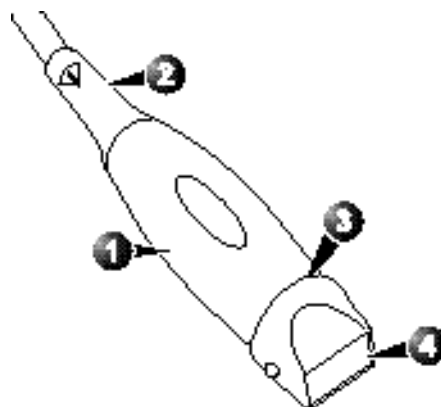
Figure 10-3: Probe parts

Cleaning and disinfecting probes

Transesophageal and intraoperative probes require a special handling. Refer to the user documentation enclosed with these probes.

Cleaning probes

Cleaning procedure
1. Disconnect the probe from the unit.
2. Remove the coupling gel by wiping the probe lens with a soft cloth.
3. Wipe the probe and cable with a soft cloth moisten in a warm soap and water solution (<80 ºF/27 ºC).
4. Wipe the probe and cable with a soft cloth moisten in clean water (<80 ºF/27 ºC) until all soap is removed.
5. Wipe dry with a soft towel.

Disinfecting probes

In order to provide users with options in choosing a germicide, GE Medical Systems routinely reviews new medical germicides for compatibility with the materials used in the transducer housing, cable and lens. Although a necessary step in protecting patients and employees from disease transmission, liquid chemical germicides must also be selected to minimize potential damage to the transducer.

Refer to the Probe Care Card enclosed in the probe case or to http://www.gemedicalsystems.com/rad/us/probe_care.html for the latest list of compatible cleaning solutions and disinfectants.

Low-level disinfection
• After cleaning, the probe and cable may be wiped with a tissue sprayed with a recommended disinfectant.

Use additional precautions (e.g. gloves and gown) when decontaminating an infected probe.

High-level disinfection

High-level Disinfection destroys vegetative bacteria; lipid & non-lipid viruses, fungi and, depending highly on time of contact, is effective on bacterial spores. This is required for endocavity (TV, TR, and TE) probes after contact with mucosal membrane.

High-level disinfection procedure

Follow the manufacturer's instructions for storage, use and disposal of the disinfection solution.

1. Prepare the germicide solution according to the manufacturer's instructions.

⚠
WARNING

Use only germicides that are listed in the Probe Care Card enclosed with the probe. In addition, refer to the local / national regulations.

Do not steam autoclave or subject the probe to Ethylene Oxide (ETO).

2. Place the cleaned dried probe in contact with the germicide for the time duration specified by the manufacturer.

⚠
WARNING

Do not immerse the probe in liquid beyond the level specified for that probe (see Figure 10-4).

Never immerse the probe connector or probe adapters in liquid.

The probe should not be exposed to the germicide longer than specified to achieve the desired effect.

DO NOT soak or saturate probes with solutions containing alcohol, bleach, ammonium chloride compounds. In addition TE probes must not be immersed in solutions containing hydrogen peroxide.

3. Rinse the part of the probe which was in contact with the germicide according to the germicide manufacturer's instructions.
4. Wipe dry with a soft towel or air dry the probe.

⚠
WARNING

CREUTZFELD-JACOB DISEASE

Neurological use on patients with this disease must be avoided. If a probe becomes contaminated, there is no adequate disinfecting means.

1. **Fluid level**
2. **Contact face with patient environment**
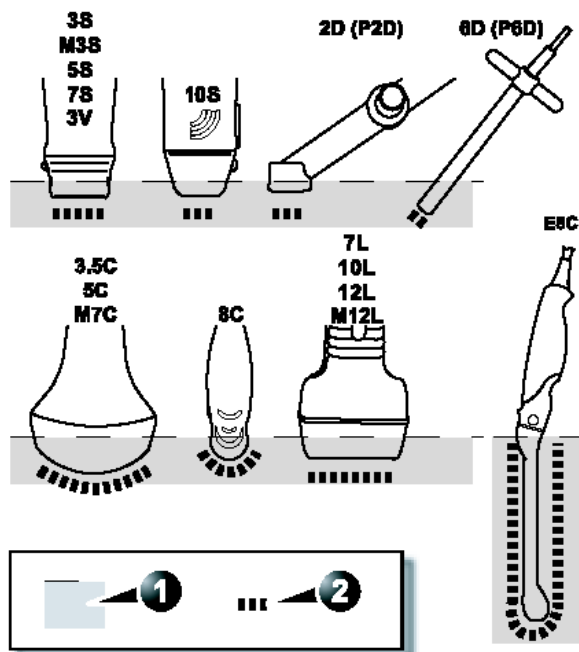
Figure 10-4: Probe immersion levels

Probe safety

This section includes information on hazards to both the user and the equipment, as follow:

*   Electrical hazards
*   Mechanical hazards
*   Biological hazards

Electrical hazards

Probes are driven by electricity, which can injure the patient or user when exposed to contact with conductive solution.

⚠️
WARNING

Do not immerse the probe into any liquid beyond the level shown in Figure 10-4. Never immerse the probe connector or adaptors into any liquid.

Do not subject the probe to mechanical shock or impact, which may result in cracks or chips in the housing and degrade performance.

Inspect the probe before and after each use, as described on page 337, for damage or degradation to the housing, strain relief, lens and seal.

DO NOT apply excessive force to the probe cable, to prevent insulation failure.

Electrical leakage checks should be performed regularly by a GE service representative or qualified hospital personnel, according to the procedures described in EN 60601-1/IEC 60601-1 §19.

Mechanical hazards

Take precaution to avoid mechanical hazards.

⚠️
WARNING

Observe immersion levels as displayed in Figure 10-4, page 340.

Inspect probes for sharp edges or rough surfaces that could injure sensitive tissue.

DO NOT bend or pull the cable forcefully, to avoid mechanical shock or impact to the probe.

Biological hazards

⚠
CAUTION

Transesophageal probes require a special handling. Refer to the user documentation enclosed with these probes.

To minimize disease transmission, legally marketed and sterile pyrogen-free sheaths should be used for each probe recommended for intra-cavity procedures.

Adequate cleaning and disinfection are essential to prevent disease transmission. It is the responsibility of the user to verify and maintain the effectiveness of the infection control procedures in use.

Chapter 11
Peripherals

Introduction

This chapter provides information on peripherals that can operate with the Vivid *i* ultrasound unit, as follows:

- VCR
- Color Thermal Video Printer
- Black & White Thermal Video Printer

△
CAUTION

Use only GE Medical Systems approved internal equipment when replacing an *internal* peripheral.

***External* peripheral equipment must be CE marked and in compliance with related standards (EN 60601-1 or EN 60950). Conformance to EN 60601-1-1 (2000) must be verified.**

All devices meeting IEC60950 must be kept outside of the patient environment, as defined in IEC60601-1-1 (2000), unless it, according to IEC60601-1-1 (2000), is equipped with additional protective earth or extra isolating transformer. Commercial devices such as laser cameras, printers, VCRs and external monitors, usually exceed allowable leakage current limits and, when plugged into separate AC outlets, are in violation of patient safety standards. Suitable electrical isolation of such external AC outlets, or providing the device with extra protective earth, will be required in order to meet UL2601-1 and IEC60601-1 standards for electrical leakage.

⚠
WARNING

When using peripheral device, observe all warnings and cautions given in peripheral operator manuals.

Battery Charger

CH5000V, Desktop SmartCharger/Calibrator.

Instructions for Use

The CH5000V is a standalone desktop smart, standard battery charger designed to work with the GE Medical Systems Vivid *i* smart battery packs. It has the added ability to re-calibrate the fuel gauge on the battery pack maintain full fuel gauge accuracy throughout the entire life of the battery.

What's in the box?

1. One CH5000V desktop charger/calibrator.
2. One 24V 2.5A DC power supply with universal mains input.
3. One mains cable.
    - N. American chargers (CH5000VA) are packed with a US 2-pin mains cord
    - European Chargers (CH5000VE) are packed with a European 2-pin mains cord
    - UK Chargers (CH5000VU) are packed with a UK 3-pin mains cord
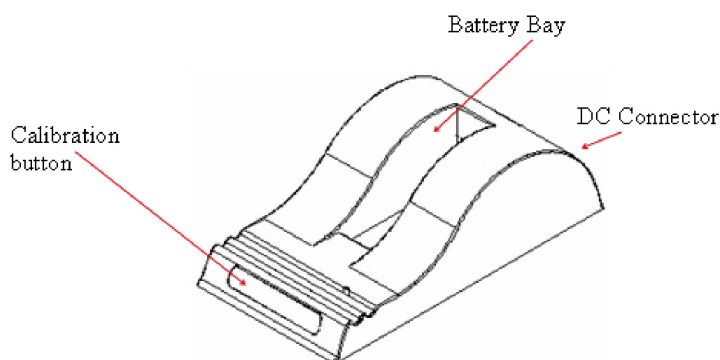
Figure 11-1: Battery Charger

Safety

1. Do not expose the charger or power supply to water or liquids; this is not a sealed case.
2. Do not open the charger or power supply case; no user serviceable parts are inside.
3. Do not cover the fan exhaust or obstruct the airflow, this will cause overheating.
4. Use only the manufacturer's power supply and observe terminal polarity.
5. Place the charger in a cool spot, away from external heat sources.
6. Caution - during re-calibration the charger may become warm.

Using your Charger

Place the charger on a flat, level surface away from sources of heat and moisture. Plug the DC connector from the power supply into the back of the charger and connect the power supply to the mains AC supply using the cable supplied.

Place the battery into the battery bay ensuring that the connector is fully seated. The LEDs in the status window will provide status information and the charger will automatically begin charging.

The status of the battery is indicated by the LEDs visible in the status window:

	Green flashing	Battery charging
	Green solid	Battery fully charged
	Blue flashing	Battery in calibration mode
	Blue solid	Battery fuel gauge calibrated
	Red flashing	Battery fuel gauge in need of re-calibration
	Red solid	Error

Recharge and Re-calibration Time

From fully discharged, the Vivid *i* battery will take 4.5 hours to recharge.

Re-calibration will take between 9 and 13.5 hours to complete depending on the state of charge of the battery when inserted. Re-calibration consists of a calibration charge, followed by a calibration discharge. Finally the battery is given a regular charge. A calibration cycle will be faster if the battery is fully charged to begin with. Calibration is re-started each time the button is pressed, so it is not recommended to press the re-calibration button part way through the re-calibration cycle.

Re-calibration Explained

• If the battery fuel gauge is in need of re-calibration, the red LED on the CH5000V will flash upon insertion of the battery. This indicator provides feedback to the user on the accuracy of the fuel gauge and avoids unnecessary battery calibration cycles.

• The user has the option to calibrate the fuel gauge and charge the battery, or to only charge the battery. This option is given because a re-calibration cycle is longer than a charge cycle.

• To re-calibrate the battery, press the calibrate button. No action is required if only a recharge is required, as the charger will automatically begin to charge the battery.

• The blue calibration LED will flash to indicate that the battery is undergoing the re-calibration cycle. There may be a short delay before the calibration begins. During calibration the discharge resistors will heat up and the fan will operate to maintain temperature within acceptable limits.

• At the end of this procedure the blue LED will stay constant indicating a fully charged, fully calibrated battery. The most common cause of calibration failure is overheating of the pack during discharge. Please keep the charger away from direct sunlight or heat sources.

• The fuel gauge in the battery uses a highly accurate voltmeter, ammeter and time clock to measure charge flow in & out of the battery pack. In addition there are algorithms to compensate for the effects of discharge rate, discharge

temperature, self-discharge and charging efficiency, etc. All this combines to provide a highly accurate fuel gauging system.

- As the battery ages, the amount of available capacity shrinks - so each cycle the "full" point gets a little bit less. *Imagine if the fuel tank in your car got smaller as your car got older - you'd need to occasionally re-calibrate your car's fuel gauge too*.

- What's more, if the battery only sees partial charges and discharges during use, the fuel gauge may not see a "full" or "empty" reference point for some time and must rely increasingly on its calculated figure. So the fuel gauging system may be subject to drift during use. *This is like navigating by dead reckoning - after a few course changes, the minor errors in your execution of the course become amplified and your true position can drift from your calculated position*.

In use, the fuel gauge mathematically works out the battery's remaining capacity and it keeps track of the overall accuracy of the system. In this way the battery not only provides fuel gauge data, but can also tell how reliable the estimate is.

Calculated Position

True Position
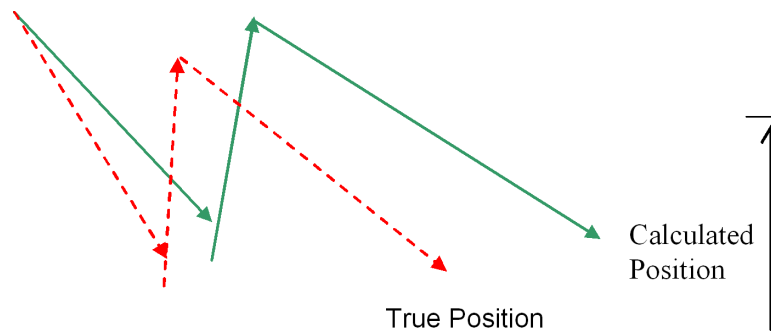
Figure 11-2: Fuel Gauging

If the fuel gauge accuracy drifts too far, the battery will notify the charger upon insertion and the charger flashes the red LED to notify the user.

So re-calibration is used to re-set the fuel gauge algorithms, re-establish the full and empty points, and re-calculate the actual capacity in the battery. In this way, the accuracy and reliability of the fuel gauge will be retained throughout the life of the battery.

Printing

The Vivid *i* ultrasound unit can support a color and a black & white thermal video printer. The printer devices are controlled from the PRINT key on the control panel.

The PRINT key can also be configured to perform alternative storage (i.e. storage to DICOM media or secondary capture). See page 386 for configuration of the PRINT key.

To print an image

For details on the Thermal video printers operation, consult the manufacturer operator manual provided with the printer.

• Press PRINT on the Control panel.

The image displayed on the screen is printed on B&W or Color printer, depending on the key assignment configuration (see page 386).

Specifications for peripherals

Please refer to the documentation accompanying the peripherals.

Chapter 12
Presets and System setup

Introduction

This chapter describes the configuration management package of the Vivid *i* ultrasound unit. The Vivid *i* configuration package enables users to customize the global configuration for the unit and the application-specific settings.

In addition, users with administration rights have access to the local archive backup function, local archive restore function and creation of users.

Note: the default factory password for the "ADM" user is **ulsadm** (case sensitive).

The configuration management package consists of a *Setup dialogue window* divided in different setup categories with sublevels.

The table below summarizes the contents and access rights of the different categories and sublevels of the Vivid *i* configuration package:

Category and sublevel	Description	access	Refer to
Imaging			page 358
• Global	Sets the cineloop controls and display. Sets the patient information display. Sets the scan information displayed on the video record.	All	
• Application	Configures the probe and application specific settings.	All	
• Application menu	Configures the *Application menu*.	All	
Measure / Text			page 365

Category and sublevel	Description	access	Refer to
• Measurement menu • Advanced • Modify calculations	Configures the *Measurement menu* by selecting and defining the sequence of the measurements and calculation to perform. Creates user-defined measurements Configures vascular Doppler calculations to be performed.	All	
• Annotation • Customize	Configures the Annotation menu and create pre-defined annotation.	All	
Report			page 372
• Templates	• Configures the *Report templates menu* by selecting and ordering the templates to show in the menu.	All	
• Diagnostic codes	Create or delete pre-defined text input for the referral reasons and diagnosis.	All	
• Comment texts	Create or delete pre-defined text input for the comments.	All	
Connectivity			page 377
• Dataflow	Create new dataflows or configure existing dataflows.	Admin	
• Additional outputs	Configure the **PRINT** key.	Admin	
• Tools	Formats removable media.	All	
• Formats	Configures the *Examination list window display* and other options related to the patient management.	All	
• TCP-IP	Sets the Transmission Protocol/Internet Protocol.	Admin	
System			page 395

Category and sublevel	Description	access	Refer to
• Settings	Sets the date and time format, language and units.	Admin	
• Test	Enables testing of the different parts of the unit.	Admin	
About	Displays information about the software, hardware and probes.	All	page 397
Administration			page 398
• Backup	Local archive and system configuration backup.	Admin	
• Restore	Restore local archive and system configuration from a backup.	Admin	
• Users	Operator and referring staff registration, operator's rights settings.	Admin	
• Unlock patient	Unlock patient records that were not properly finished.	Admin	
Service	This sheet is for service staff only. Deals with printer definition and keyboard configuration.	Admin	

Starting the Configuration package

To access the Configuration package the user has to log on as a specific user (see page 399). This ensures user-specific and user-defined settings and presets to be used.

The access to the entire configuration package is user configuration dependent (see page 399).

To open the Configuration package

1. Press CONFIG on the alphanumeric keyboard.
   The *Log In window* is displayed asking for operator ID and password (see Figure 12-1).
2. Select **Log on** when completed.
   The *Setup dialogue window* is displayed (see Figure 12-2).

1. **Select the operator**
2. **Type password**

Figure 12-1: The Operator login window

Overview

The configuration management package consists of a *Setup dialogue window* divided in different setup categories with sublevels (sheets labelled with tab).

The functionality of each configuration category and associated sublevels are described on the following pages.

1. **Sublevel tabs for the selected Setup category.**
2. **Setup categories**
3. **Selected Setup category**
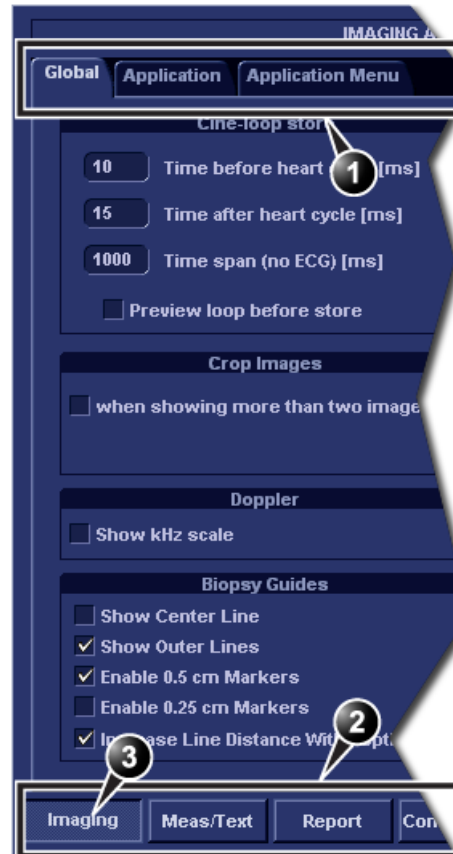
Figure 12-2: The Setup dialogue window structure

Imaging

- **Global**: enables the user to configure display-related settings.
- **Application**: enables configuration of the probe and application specific settings.
- **Application menu**: enables configuration of the Measurement menu.

The Global setup sheet
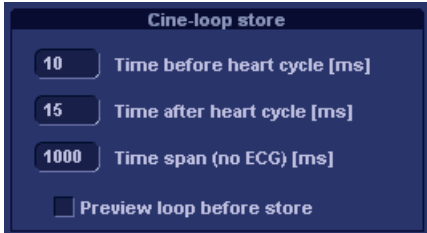
Figure 12-3: The Global setup sheet

Cineloop store

Parameter	Description
Cine-loop store 10 — Time before heart cycle [ms] 15 — Time after heart cycle [ms] 1000 — Time span (no ECG) [ms] ☐ Preview loop before store	**Cineloop store:** • **Time before/after heart cycle**: sets the total storage time span of the cineloop in ECG mode. • **Time span (no ECG)**: sets the total storage time span of the cineloop with no ECG. • **Preview loop before store**: when selected enable review of cineloops before storage.
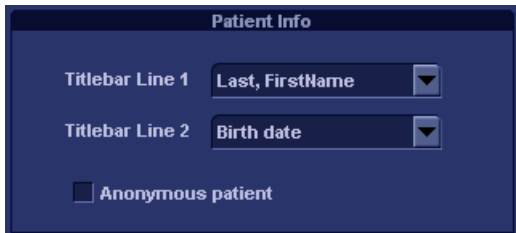
Crop images

Parameter	Description
Crop Images ☐ when showing more than two images	**Crop images:** ☑: In the *Analysis screen*, removes top and bottom of the image when more than two images have been selected.

Doppler

Parameter	Description
Doppler ☑ Show kHz scale	**Doppler:** • **Show KHz scale**: when selected, displays the KHz scale on the left side of the Doppler spectrum (see page 101).

Patient Info

Parameter	Description
Patient Info Titlebar Line 1 Last, FirstName ▼ Titlebar Line 2 Birth date ▼ ☐ Anonymous patient	**Patient Info:** • **Title bar Line 1 & 2**: selects from the pop-up menu the patient information to display on the scanning screen's *Title bar* (see page 49). • **Anonymous patient**: when checked, no patient information is displayed on the scanning screen's *Title bar*.

Scan Info

Parameter	Description
	Scan Info: • selects scan information on the video record.

Application

The Application category enables the configuration of probe/application specific settings (presets). The application-specific settings can be stored and used as default presets with this probe.
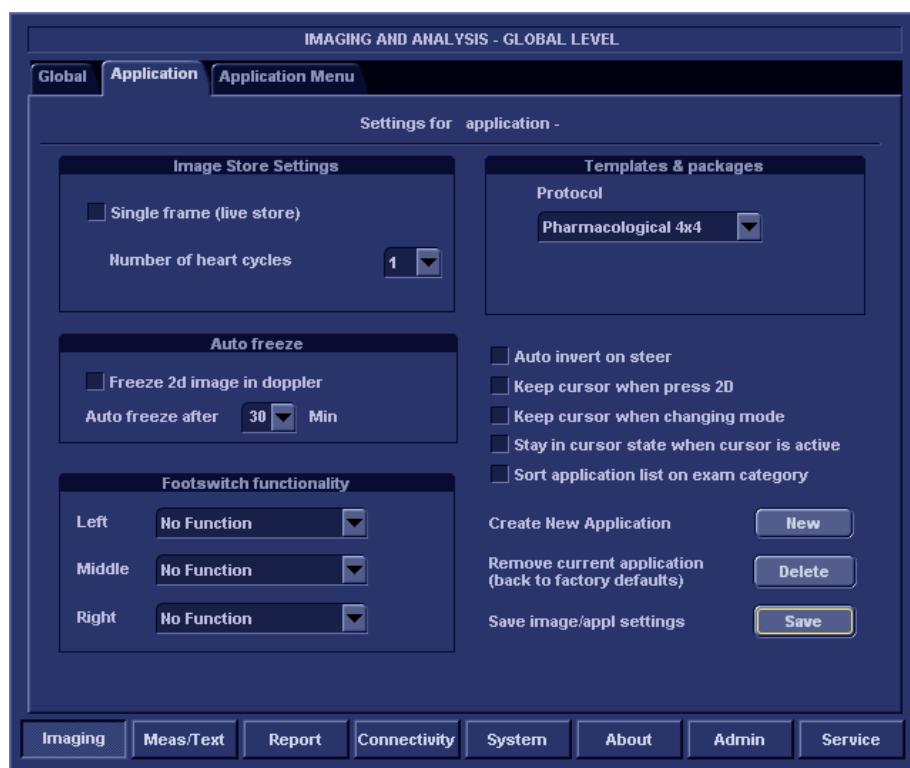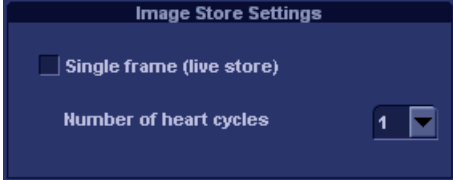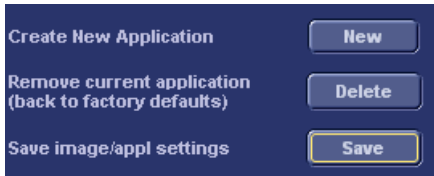
Figure 12-4: The Application setup sheet (example)

The Probe/application configuration parameters

Parameter	Description

Image Store Settings
 	
☐ Single frame (live store)
 	
Number of heart cycles   1 ▼
	Image Store settings:
	• Single frame (live store):
	  ☐: Store cineloop.
	  ☑: Store single frame image only.
	• Number of heart cycles:
	  Select the number of heart cycles to store (Single frame must be unchecked).

Auto freeze ☐ Freeze 2d image in doppler Auto freeze after 30 ▼ Min	**Auto freeze:** • **Freeze 2D image in Doppler**: the last 2D or color flow image is displayed when entering in Doppler mode. • **Auto freeze after**: sets the time after which the system enters in freeze when not in use.
Templates & packages Protocol Pharmacological 4x4 ▼	**Templates and Packages:** Defines the default stress protocol associated to the application. Select the default Protocol to be associated to the selected application from the *pop-up menu*.
☑ Auto invert on steer	**Auto invert on steer:** In Color flow, the color bar is inverted when steering the color flow sector angle.

Parameter	Description
Create New Application — New Remove current application (back to factory defaults) — Delete Save image/appl settings — Save	**Create new application:** Press **New** to create a new Application. A dialogue window is displayed where the operator is asked to give a name to the new application. **Remove current application:** Press **Delete** to remove the current application. Factory Application settings cannot be deleted. **Save image/appl. settings** Press **Save** to store the changes applied to the current setting. Not applicable on factory application settings.

Create a new Application

The application created is probe dependant. Select the desired probe before configuring a new application.

1. Press **APPLICATION** on the Control panel.
2. Trackball to **Preset...** in the *Application pop-up menu*.
   The *Application setup sheet* (see Figure 12-4) is displayed.
3. **Adjust** the parameters as desired (see page 361).
4. Press **New**.
   A *Dialogue window* is displayed.
5. **Enter** a name for the new application.
6. Press **OK**

To edit an application

1. Press **APPLICATION** and select the application to edit.
2. Press **APPLICATION** again.
3. Trackball to **Preset...** in the *Application pop-up menu*.
   The *Application setup sheet* (see Figure 12-4) is displayed.
4. Change the parameters as desired (see page 361).
5. Press **Save** to store the changes.
   Applicable only on user-defined applications.

Deletion of an Application

1. Press <u>APPLICATION</u> and select the application to delete.
2. Press <u>APPLICATION</u> again.
3. Trackball to **Preset...** in the *Application pop-up menu*.
   The *Application setup sheet* (see Figure 12-4) is displayed.
4. Press **Delete** to remove the selected application.

Application menu

The Application menu category enables rearrangement of the the *Application menu* to best suit the user's requirements.

The Application menu is a two-levels pop-up menu. The first level called **Application**, displays the most frequently used applications in any desired order. The second level called **More...** displays the less frequently used applications.
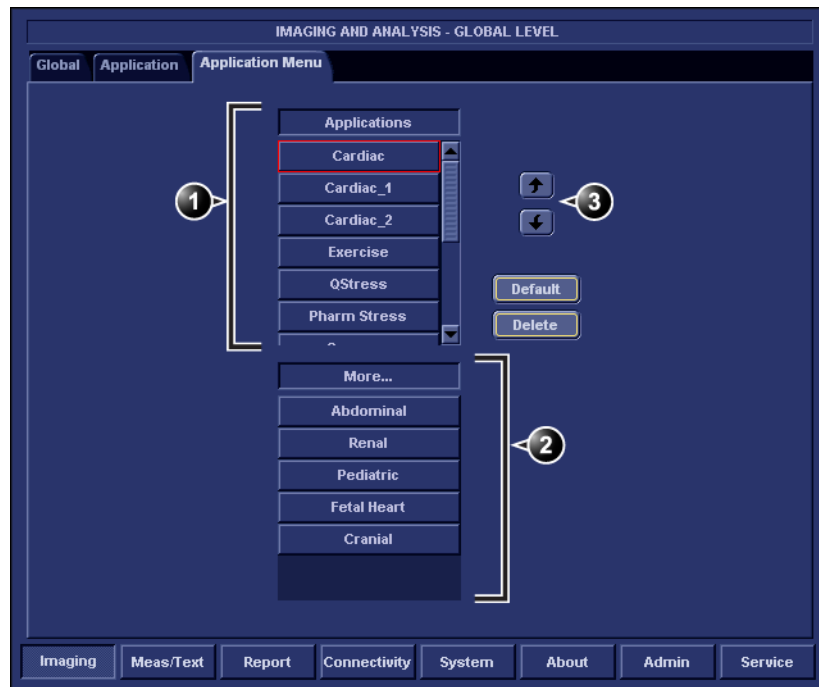
1. **First menu level**   3. **Moving tools**
2. **Second menu level**

Figure 12-5: The Application menu setup sheet (example)

Configuration of the Application menu

The Application menu can be configured by moving the applications up and down inside the pop-up menu and from one level to the other.

To move an application inside one level
1. Trackball to the application to move.

2. Press SET.

3. Press ⬆.
   The application is moved one step up.

*Press **Default** to get factory setting.*

4. Press ⬇.
   The application is moved one step down.

To move an application from one level to the other
1. Trackball to the application to move.

2. Press SET.

3. Press as many times as necessary:

   • ⬆ if the application to move is in the *More menu*

   • ⬇ if the application to move is in the *Applications menu*

   till the application has moved to the other menu.

Measure Text

The Measure/Text category deals with the following:

- Configuration of the *Measurement menu* (see page 368)
- Creation of user-defined measurements (see page 193)
- Configuration of Measurement tools (see page 370)
- Configuration of the vascular Doppler calculation (see page 371)
- Configuration of the Annotation function (see page 76)

The measurement menu sheet
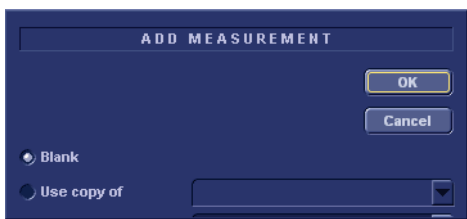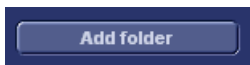
The *Measurement sheet* enables the organization of the Factory default *Measurement menu* and the creation of user-defined Measurements.
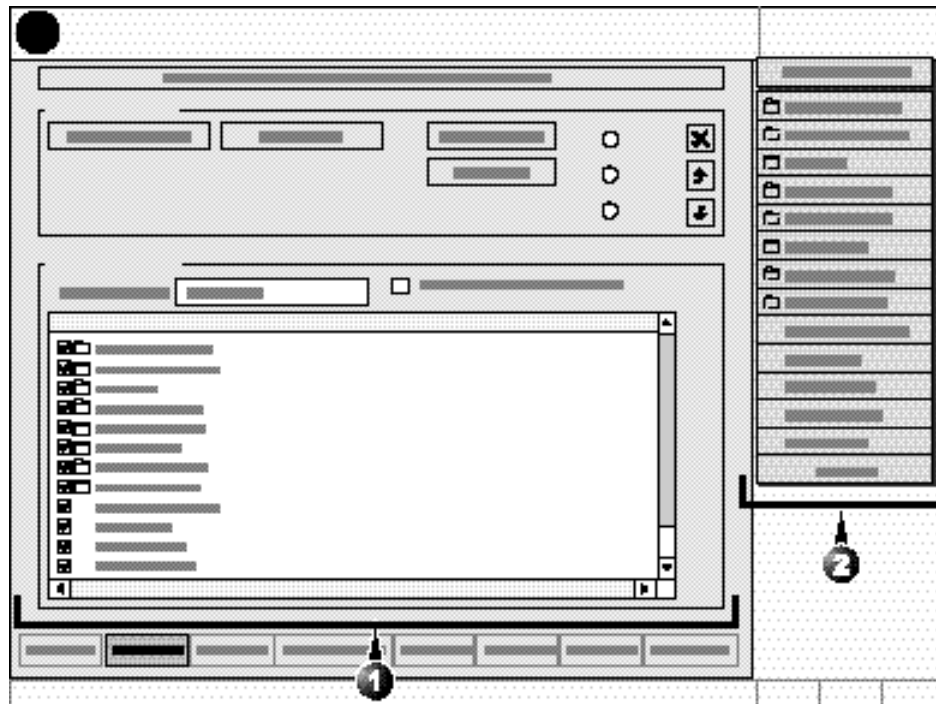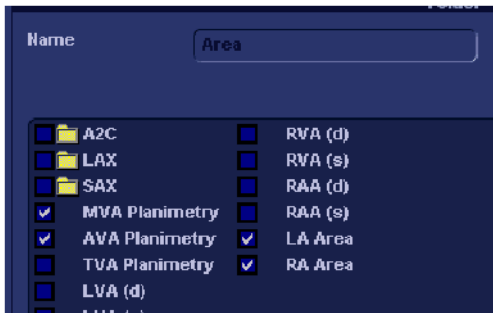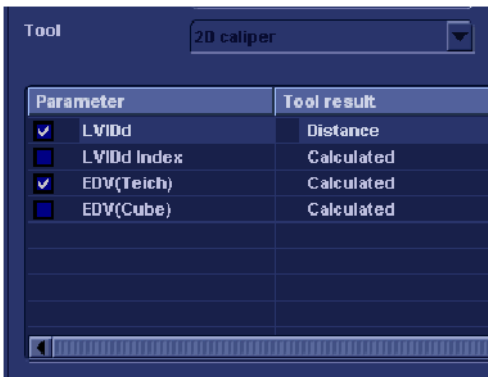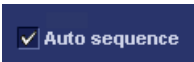
1. **Configuration window (see next pages for details)**
2. **The measurement menu (displays updated configuration)**

Figure 12-6: The Measurement menu setup sheet

Parameter	Description
	Add measurement: Create or select from the pop-up list a measurement to be added to a folder (see page 189).
	Add folder: Enables the user to create its own folder with the desired measurements. The folder is displayed the *Measurement menu*.
	M&A Categories: Enables selection of the measurement categories to display in the Measurement menu. Only checked items will be displayed. • **Create Copy**: Enables copy of a selected measurement category (selection is done by selecting the category name). • **Delete**: enables deletion of user-defined measurement categories. • **Factory Default**: restores factory display.
	2D, MM and Dop. radio buttons: Enables the display of mode related *Measurement menu* in the configuration window.
	Configuration tools: **Deletes** selected entry (folder or measurement) in the *Measurement menu*. The factory entries cannot be deleted. **Moves** selected measurement or folder up or down inside the *Measurement menu*.

Parameter	Description
	Folder: Displayed when a folder is selected in the *Measurement Menu*. Shows the entire contents of a selected folder. • ☑: the items is displayed in the *Measurement menu*. • ☐: The item is hidden from the *Measurement menu*.
	Measurement: Displayed when a measurement is selected in the *Measurement Menu*. Shows all the parameters related to the selected measurement. • ☑: the items is displayed in the *Measurement menu*. • ☐: The item is hidden from the *Measurement menu*. Only checked parameters will be displayed in the *Measurement result window*, the worksheet and the report.
	Auto sequence: ☑: Prompts the next measurement in the folder.

Configuration of the Measurement menu

There are many more measurements and parameters in the measurement package than shown in the default *Measurement menu*. Use the configuration system to set up the measurements that should be available in the *Measurement menu* and which parameters should be calculated (see also "Measurement package configuration" on page 188).

Display of the Measurement categories

1. Press **M&A categories** in the *Configuration window*.
   The M&A categories are displayed in a pop-up window (see page 366).
2. Check the categories to be displayed.
   Uncheck the categories to hide.

To copy a Measurement category

1. Press **M&A categories** in the *Configuration window*.
   The M&A categories are displayed in a pop-up window (see page 366).
2. Move the trackball marker over the M&A category name.
3. Press $\overline{\text{SET}}$ to highlight the category.
4. Press **Create copy**.
   A copy of the selected measurement category is displayed in the *Measurement menu*.

Factory Measure-ment categories cannot be renamed.

To rename the Measurement category:
1. Select the Measurement category in the *Measurement menu*.
2. **Enter** a new name in the Measurement field.

Selection of a Measurement category

1. Trackball to the Measurement menu heading.
2. Press $\overline{\text{SET}}$.
   The measurement categories are displayed in a sub-menu.
3. Trackball to the measurement category of interest.
4. Press $\overline{\text{SET}}$.
   The measurement category is displayed.

Moving an item in the Measurement menu

1. Trackball to the entry to move into the *Measurement menu*.
2. Press S̄ĒT.
3. Press ⬆ or ⬇ to move the selection up or down inside the *Measurement menu*.

Deleting an item in the Measurement menu

Only user created items can be deleted.

1. Trackball to the entry to delete in the *Measurement menu*.
2. Press S̄ĒT.
3. Press ✖ to delete the item.

Display/hide a folder or a measurement in the Measurement menu

The Measurement menu (Folders and Measurements) can be configured to display only the entries (folders and measurements) of interest.

To hide a folder or a measurement:
• **Uncheck** the actual folder or measurement in the *Folder* or *Measurement field* in the *Configuration window*.

To display a hidden folder or measurement:
• **Check** the actual folder or measurement in the *Folder* or *Measurement field* in the *Configuration window*.

Creating a user-defined folder

1. If the folder is to be inside another folder, select the actual folder in the *Measurement menu*.
2. Press **Add folder**.
   The *Measurement menu* is updated.
3. Select the new folder and **Enter** the folder name in the *Name text field*.

Adding a measurement to a folder

The user can either add a pre-defined measurement or create a new measurement with user-defined parameters to a folder (see page 189 for more information).

The Advanced sheet

The *Advanced sheet* enables further configuration of the Measurement function. The settings are divided into application specific parameters and global parameters.
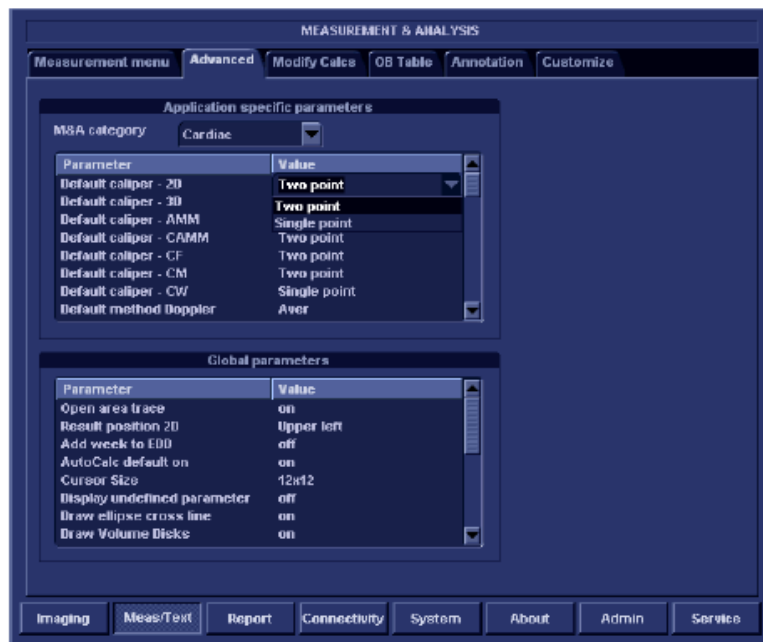
Figure 12-7: The Advanced sheet

Parameter configuration

1. If configuring application specific parameters, select an application from the *M&A category pull-down menu*.

When pointing at a parameter an explanation label is displayed.

2. Select the configuration value next to the parameter to configure.
   A pull-down menu is displayed (see Figure 12-7).

3. Select a new value from the pull-down menu.

The Modify Calculations sheet

The *Modify Calculations sheet* is used to configure the calculations to be performed when doing a Doppler vascular measurements.

Figure 12-8: The Modify Calculations sheet

Parameter configuration

The following example describes how to configure the Carotid Doppler calculations:

1. In the *Modify Calculations sheet*, select **Vascular** next to *M&A Categories*.
    The *Vascular measurement category* is displayed.
2. Select **Carotid**.
    The available calculations are displayed.
3. Check the desired calculations to be performed.
4. Select **Save**.

Report

The *Report configuration category* is divided in three sheets:

• **Templates**: enables the configuration of the *Template selection menu* and the export/import of user-defined templates. See "Report templates management" on page 323 for more information.

• **Diagnostic codes**: enables the creation of pre-defined text inputs to be used in the *Diagnosis information field* in the *Examination list window* (see Figure 8-10, page 221).

• **Comment texts**: enables the creation of pre-defines text inputs to be used in the *Comment information field* in the *Examination list window* (see Figure 8-10, page 221).

• **Structured findings**: enables the insertion of pre-configured structured diagnosis statements and Billing/Accreditation codes in the patient report (see "Structured Findings" on page 290).

The diagnostic codes sheet

This sheet enables the creation (and deletion) of text inputs that can be used when entering diagnostic codes in the *Examination list window* (see Figure 8-10, page 221).

1. List of text inputs
2. Text input name
3. Text input display area (free text area)
4. Create a text input

Figure 12-9: The Diagnostic codes sheet

Creating a diagnostic codes

1. Select **New text** to create a new diagnostic code (see Figure 12-9).
2. In the *Code field* enter a name for the diagnostic code.
3. Trackball to the *Text input display area*.
4. Press SET.
5. Enter the text.

To add a diagnostic code to an examination refer to "Diagnosis code" on page 223

Deleting a diagnostic code

1. In the *Code list field*, trackball to the diagnostic code to delete (see Figure 12-9).
2. Press $\overline{\text{SET}}$.
3. Trackball to **Delete**.
4. Press $\overline{\text{SET}}$.

The Comment texts sheet

This sheet enables the creation (and deletion) of text inputs that can be used when entering comments in the *Examination list window* (see Figure 8-10, page 221) or in the Direct report.
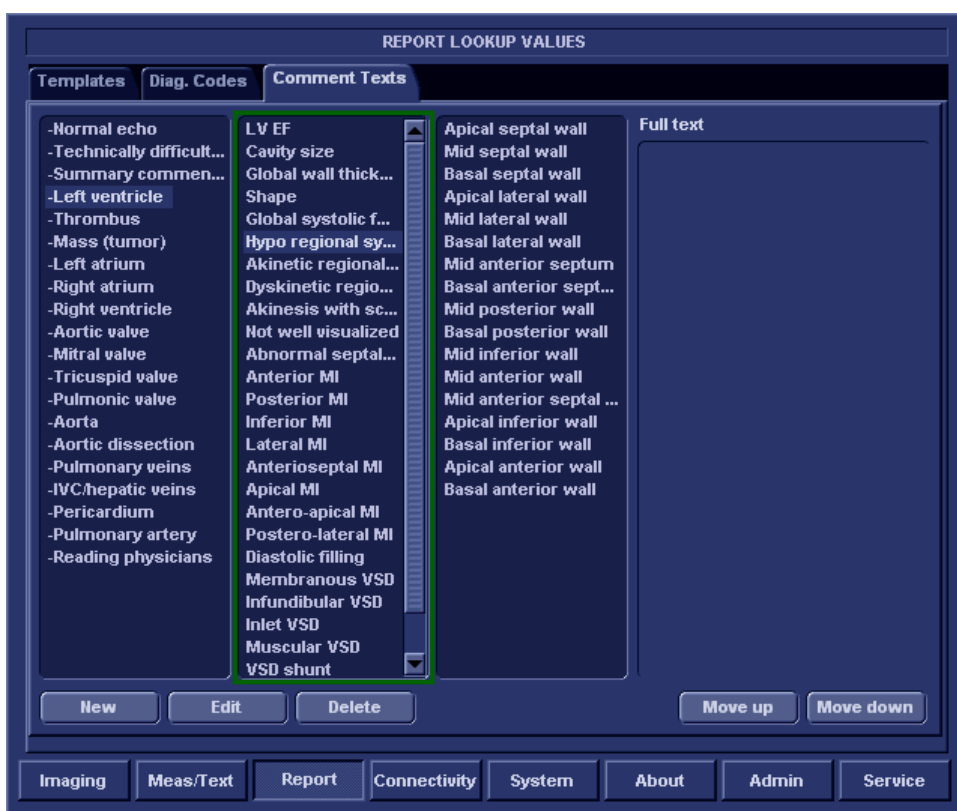
Figure 12-10: The Comment texts sheet

The pre-defined text list is organized in a three level hierarchy. Selecting one item in the first column displays pre-defined text entries related to the selected text in the second and third column.

Creating pre-defined text input

First level

1. Select the first level.

2. Press **New**.
    The *Enter new text window* is displayed.
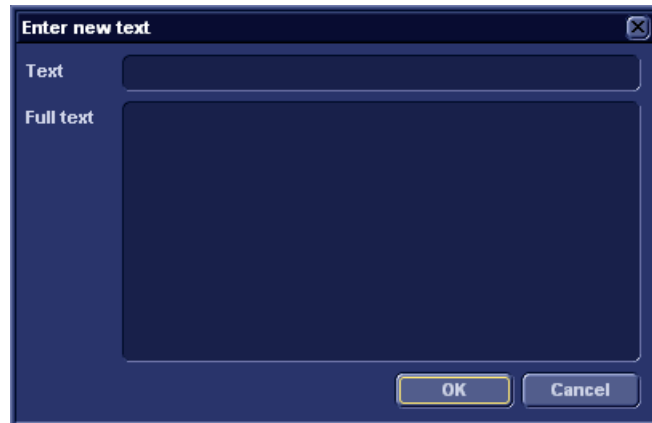
Figure 12-11: The Enter new text window

3. Enter a title in the *Text field*.
    Enter the pre-defined text in the *Full text field*.

4. Press **OK**.

Second and third level

1. Select an item in the first column.
    The pre-defined text input to be created in the second and third column will be related to this selection only.

2. Select the second or third column.

3. Press **New**.
    The *Enter new text window* is displayed (Figure 12-11).

4. Enter a title in the *Text field*.
    Enter the pre-defined text in the *Full text field*.

5. Press **OK**.

Editing a pre-defined text input

1. Select the term to edit in one of the columns.
2. Press **Edit**.
3. The *Edit text window* is displayed.
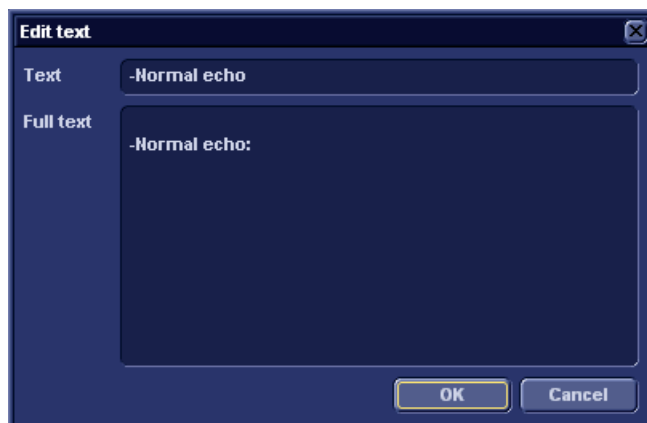
Figure 12-12: The Edit text window

4. Edit the text in <u>both</u> the *Text* and *Full text fields.*
5. Press **OK**.

Deleting a pre-defined text input

1. Select the item to delete in one of the columns.
2. Press **Delete**.
3. A *Confirmation window* is displayed.
4. Press **Yes**.
   The selected text input is deleted including the belonging text inputs.

Connectivity

This configuration setup category deals with:

- **Dataflow**: connection and communication setup of the ultrasound unit with other devices.
- **Additional output**: configuration of the $\overline{\text{PRINT}}$ and $\overline{\text{ALT}}$ keys on the control panel.
- **Tools**: formatting of removable media
- **Formats**: configuration of the *Examination list window* and other tools related to patient management.
- **TCPIP**: internet protocol configuration

Dataflow

Communication between the Vivid *i* ultrasound unit and other information providers on the network takes the form of dataflows. Each dataflow defines the transfer of patient information and images from an input source to the unit, and from the unit to one or several output sources.

A dataflow is a set of pre-configured settings. Selecting a dataflow will automatically customize the unit to work according to the settings associated with this dataflow.

Dataflows are configured in the *Dataflow sublevel sheet* in the *Connectivity setup category* as described below. The *Dataflow sublevel sheet* is only available to users with administration rights.
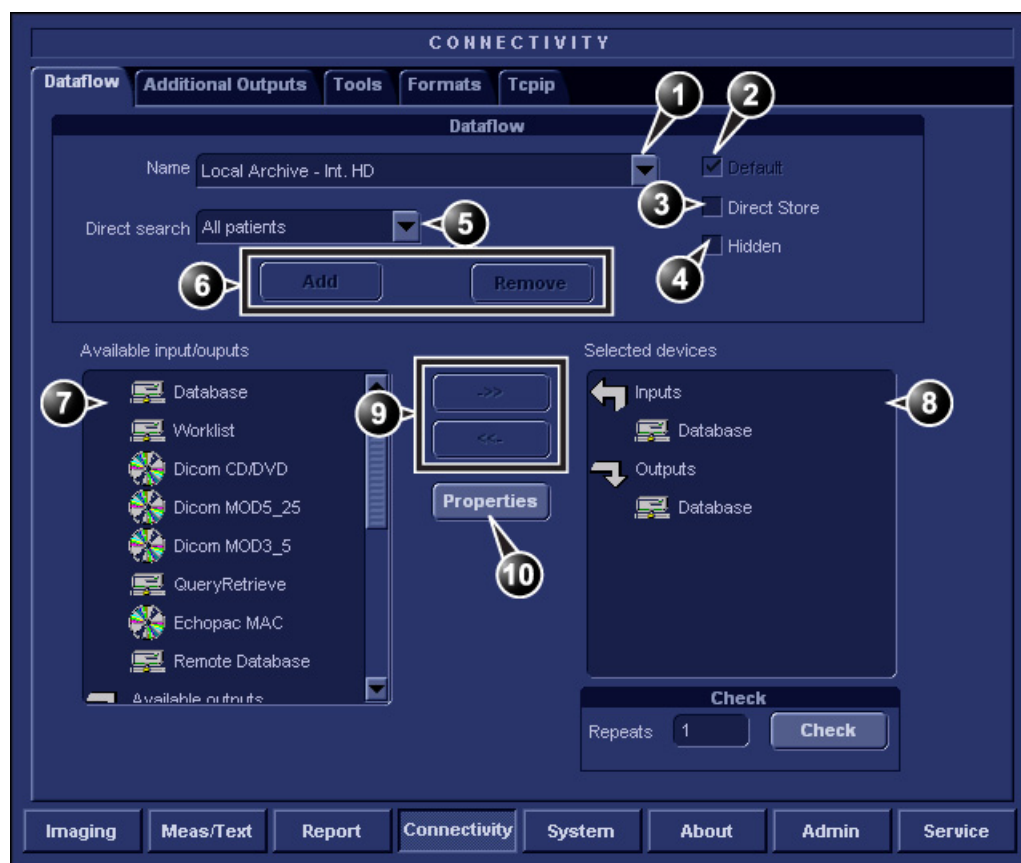
1. **Select a dataflow to edit**
   Factory defined dataflows cannot be edited.

2. **Use selected dataflow as default**

3. **Store data directly to archive**

4. **Hide selected dataflow from the list of available dataflow**

5. **Option for the search function. In the Search/Create patient window select between None, All patients and Today's patient**

6. **Add/Remove a user-defined dataflow**

7. **Available input/output devices that can be assigned to the current dataflow**

8. **Input/output devices assigned to the current dataflow**

9. **Add/remove selected device to/from the current dataflow (user-defined dataflows only)**

10. **Adjust the settings for the selected assigned device**

Figure 12-13: The sublevel Dataflow (example)

Dataflows available

A set of pre-defined dataflows is available on the unit as listed in the table below. Input/output devices cannot be added/removed to/from the pre-defined dataflows. However the settings for the devices can be adjusted (see page 384).

	Dataflow	Description
	No Archive	Enables to perform an examination without storing the data to the archive.
	LocalArchive-Int.HD	**Local archive internal hard drive** The local database is used for patient archiving. Images are stored to internal hard drive.
	LocalArchive-MOD	**Local archive Magneto Optical Disk (MOD)** The local database is used for patient archiving. Images are stored to a MOD. The stored image files will consist of raw data only, together with a single-frame DICOM preview image (no DICOM multi-frame is stored).
	LocalArchive-Int.HD/MOD	**Local archive internal hard drive and Magneto Optical Disk** The local database is used for patient archiving. Images are stored to the internal hard drive and to a MOD as DICOM Media. The stored image files, both to internal hard drive and to the MOD, will consist of both DICOM (multi-frame if cineloop) and raw data.
	Local Archive - Int HD/DICOM Server	The local archive is used for patient archiving. Images are stored to the internal hard drive and to a DICOM server. Some of the measurements are stored if DICOM SR is turned on (see page 250)

	Dataflow	Description
	RemoteArch-RemoteHD	**Remote archive remote hard drive** A remote database (either on EchoPAC workstation or on EchoServer) is used for patient archiving. Images are stored to a network image volume (either internal HD on EchoPAC workstation or EchoServer volume).
	Remote Archive - Remote HD/DICOM Server	A remote database is used for patient archiving. Images are stored to a network image volume and to a DICOM server. Some of the measurements are stored if DICOM SR is turned on (see page 250)
This dataflow cannot be used with an ImageVault 3.0 server.	**RemoteArchive-MOD**	Remote archive Magneto Optical Disk A remote database (either on EchoPAC workstation or on EchoServer) is used for patient archiving. Images are stored to a MOD.
WL-LA-DServ: the local database is not searched, only the DICOM Modality Worklist.	**Worklist/LocalArchive-DICOMServer/Int.HD**	**Modality Worklist local archive DICOM server and local hard drive** 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 the database. Images are stored to a DICOM Server and to an image volume on the local hard drive. Some of the measurements are stored if DICOM SR is turned on (see page 250)

	Dataflow	Description
	Worklist/RemoteArchive-DICOMServer/RemoteHD	Modality Worklist remote archive DICOM server and remote hard drive
		Search in the DICOM Modality Worklist, the patient found is copied into a remote database. The patient information and examination results are stored to a remote database. Images are stored to a DICOM Server and to an image network volume as pure DICOM in both locations.
		Some of the measurements are stored if DICOM SR is turned on (see page 250)
	Worklist/Remote Archive - Remote Storage	This dataflow is used in a network environment that includes Vivid HL7 Gateway. The patient list in the *Search/Create Patient window* is coming from Vivid HL7 Gateway through DICOM Modality Worklist. All patient data and images are stored to EchoServer.
	Raw DICOM MOD	Raw image format to/from a DICOM Magneto Optical Disk
		Read/Write images in raw format from/to a DICOM formatted 5.25" MO-disk.
		Some of the measurements are stored if DICOM SR is turned on (see page 250).
	DICOM MOD	Pure DICOM image format to/from a DICOM Magneto Optical Disk
		Read/Write images in "pure" DICOM format from/to a DICOM formatted 5.25" MO-disk.
		Some of the measurements are stored if DICOM SR is turned on (see page 250).

	Dataflow	Description
	DICOM CD/DVD read	DICOM CD/DVD read Read DICOM Media from the CD/DVD-drive. Read-only dataflow, no data can be stored.
	DICOM Server	DICOM server Store pure DICOM images to a DICOM device. Some of the measurements are stored if DICOM SR is turned on (see page 250).
	DICOM Print	DICOM Print Send images to a DICOM printer.
	Query Retrieve	Query Retrieve Retrieve images from a DICOM server
	LocalArchive-Int.HD/ eVue	The local database is used for patient archiving. Images are stored to internal hard drive and a MPEG exam is created to the configured destination.
	RemoteArch-RemoteHD/ eVue	A remote database (either on EchoPAC workstation or on EchoServer) is used for patient archiving. Images are stored to a network image volume (either internal HD on EchoPAC workstation or EchoServer volume) and a MPEG exam is created to the configured destination.

To select the default dataflow

1. Select the dataflow in the *Name drop-down menu*. (see Figure 12-13).
2. **Check** the *Default box*.
    The dataflow will be selected by default when restarting the unit.
3. **Check** the *Direct Store box* to have data stored automatically to the archive (no buffer storage).

To create a new dataflow

1. Press **Add**.
   The *Add dataflow window* is displayed.

Figure 12-14: The Add dataflow window

2. Enter a name for the new dataflow.

3. Press **OK**.

4. Select an **Input device** in the *Available inputs/outputs field* and press the **Right arrow button** to assign the service to the dataflow.

5. Repeat step 4 to assign input/output devices as desired. Most dataflows consist of one input device and one or several output devices. However in two cases it is possible to have two input devices, when defining a dataflow with DICOM Worklist or DICOM Query/Retrieve in combination with a database.

6. Adjust the device's parameters as described below.

7. To remove a device from the dataflow, select the device in the *Selected devices field* and press the **Left arrow button**.

Adjusting the assigned devices

1. Select the device in the *Selected devices field*.
2. Press **Properties**.
   The *Properties window* is displayed.
3. Adjust the device specific parameters as desired (see table below). Not all the settings listed below apply to all devices.

General settings	Definition
Name	Free text: give a descriptive name for the device.
IP address	Select from drop-down menu
Database Name	Automatically selected according to the IP address
File destination	Automatically selected according to the IP address
Removable	Check the entry is the media is removable.

Image settings	Definition
Allow raw data	☑: save data in both raw and DICOM format. ☐: save data in DICOM format only.
Max Framerate	Select 25, 30 or Full from the pop-up menu. Full (original acquisition) is default.
Compression	Select compression type or no compression.
Quality	Set picture quality from 1 to 100%. A low picture quality level allows high data compression, while a high picture quality restrains the compression.
Allow Multiframe	☑: allow cineloop storage.

Connection settings	Definition
Retry	Set maximum number of connection tentatives, time interval between tentatives and time-out.

DICOM settings	Definition
AE Title	The Application Entity Title is set during DICOM configuration. Refer to the network specifications.

DICOM settings	Definition
Port	The Port no. is allocated during DICOM configuration. Refer to your network specifications.
Verification	Verify the connection to another DICOM application
Storage commitment	Send a request to a PACS, asking it to permanently archive image(s)
MPPS	Modality Perform Procedure Step: send information (typically to a HIS) that a scheduled exam has been started, performed or interrupted.

Additional outputs

The *Additional outputs sheet* deals with configuration of the
<u>PRINT</u> and <u>ALT</u> keys on the control panel. Several outputs (e.g.
Video Print, Laser print, DICOM storage etc.) can be
associated to the keys (i.e. hitting <u>PRINT</u> can result in printing a
Color video print and storage to a DICOM media).

1. **Select between <u>PRINT</u> and <u>ALT</u> keys.**
2. **Available output devices that can be assigned
    to the current button.**
3. **Output devices assigned to the current button.**
4. **Add or remove selected device to/from the
    current button.**
5. **Adjust the device settings for the selected
    assigned device**
6. **Select the type of images to produce and adjust
    image settings.**
7. **Printer configuration (see page 349)**

Figure 12-15: The sublevel Additional outputs (example)

The image configuration parameters

The table below gives a list of the configuration parameters.

Print/Alt. Print key configuration
1. In *Button field* select **Print** or **Alt. Print**.

2. Select an **output device** in the *available outputs field* and press the **Right arrow button** to assign the service to the dataflow. The *Properties window* is displayed

3. Adjust the device specific parameters and select **OK**. Some of the settings can be changed directly in the *Image to Produce field* in the sublevel Additional outputs.

4. Adjust the image specific parameters (see the table below).

Configuration parameter	
Format	Select between: • Raw DICOM • DICOM
Image compression	Select compression mode from the pop-up menu.
Quality	When JPEG compression is selected, adjust the picture quality between 1 and 100%. A low picture quality level allows high data compression, while a high picture quality restrains the compression.
Image frames	Select between: • **Single**: stores single frame only • **Multiple**: stores cineloop • **Secondary Capture**: screen shot
Capture Area	Select between: • Video Area (1) • Whole Screen (2)

To remove a device, select the device in the *Selected devices field* and press the **Left arrow button**.

Tools

The *Tools sublevel sheet* deals with:

- formatting of removable media (MO disk, CD-R, DVD-R).
- Creation or re-creation of a DICOM directory on a removable media containing DICOM images.
- Enter a remote path of a network shared folder (\\server-name\share-name) for:
  - Export of system error log file
  - Save as function for images
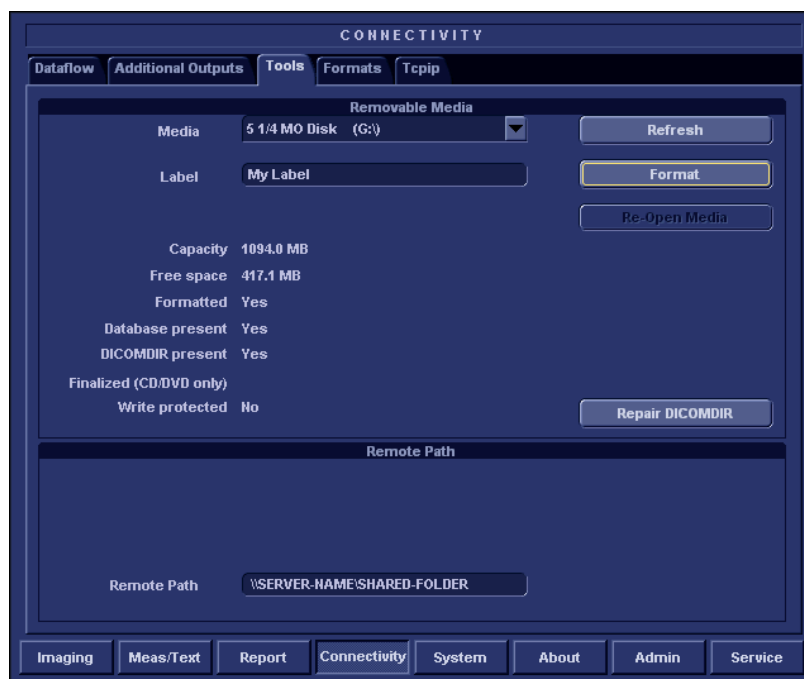
Figure 12-16: The sublevel Tools

Creation of a DICOM directory

1. Insert the media in the drive.
2. Select **Repair DICOM DIR**.
   Wait for the display of the *Information window* indicating that the process is completed.

Formats

The *Formats sublevel* enables configuration of the *Examination list window* (see Figure 8-10, page 221) and other tools related to patient management, as described below.

Figure 12-17: The sublevel Formats (example)

Configuration of the Examination list window

The user can configure the examination list displayed in the *Examination list window* (see Figure 8-10, page 221) by deleting, adding columns and change the information type displayed in each column.

Column configuration

To adjust column width, select and drag column heading border.

1. Trackball to the column to edit.
2. Press the $\overline{\text{SET}}$ key in the trackball area.
   A sub-menu is displayed (see Figure 12-18).
3. Select the action to perform:
   - **Insert**: creates a new column
   - **Delete**: removes selected column
   - select the desired information to be displayed in the selected column.

1. **Insert new column to the left of the selected column**
2. **Delete selected column**
3. **Select column heading**
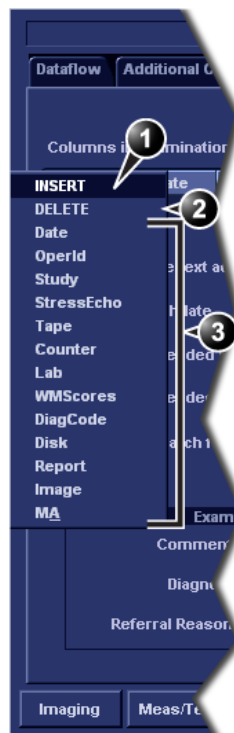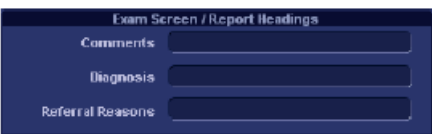
Figure 12-18: Configuration of the Examination list window

Other configuration settings

Parameter	Description
☑ Use free text addresses	**Use free text addresses:** In the *Patient information window* (see page 49), ☑: The address information (e.g. street, city etc.) is entered in type-specific fields. ☐: The address information is entered in a single field (free text).
☑ Use birthdate	**Use Date of birth:** In the *Patient information window* (see page 49), enter either the patient age or the birth date: ☑: Enter age (Date of birth field not available) ☐: Enter Date of birth, the age is calculated.
☑ Use extended search dialog	**Use extended patient dialog:** In the *Patient information window* (see page 49), ☑: The entire patient information data is displayed. ☐: Patient information data displayed is restricted to a minimum (e.g. name and Patient ID). When unchecked, press **More** to display the entire patient information data.
☑ Use extended search dialog	**Use extended search dialog:** In the *Search/Create Patient window* (see page 48, page 218 and page 220), ☑: All the searching filters are displayed as default. ☐: The searching criteria are restricted to a minimum. When unchecked, press **More** to display all the searching filters.

Parameter	Description
☐ Auto search for patient	**Auto search for patient:** In the *Search/Create Patient window* (see page 48, page 218 and page 220), ☑: The system searches automatically through the patient archive selected while entering patient information. ☐: The system searches through the patient archive after pressing **SET**.
☑ Predefined text directory	**Pre-defined text directly:** In the *Examination list window* (see page 221), ☑: the Insert text key launches pre-defined text input. ☐: the **Insert text** key open the extended text field.
☑ Examination List on Archive button	**Examination list on Archive button** When a patient is selected, pressing **ARCHIVE** will: ☑: open the *Examination list window* for the selected patient. ☐: open the *Patient Information window* for the selected patient.
☑ Automatic generation of patient ID	**Automatic generation of patient ID:** In the *Search/Create Patient window* (page 48), ☑: Patient ID is not required when entering a new patient in the archive. The system generates automatically an ID number. ☐: Patient ID is required when entering a new patient in the archive.
☐ Request acknowledge of End Exam action	**Request acknowledge of End Exam action:** ☑: The user is asked to confirm action when ending an examination.

Parameter	Description
☑ Go directly to scanning from search	**Go directly to scanning from search:** ☑: The unit goes directly to the *Scanning screen* after selecting/creating patient record. ☐: The unit displays the *Patient information window* after selecting/creating patient record for further information entry. The user must press **Begin Exam** to enter the *Scanning screen*.
☐ Save all images on end exam	**Save all images on end exam:** ☑: All images on the clipboard are automatically saved when ending an examination. A dialogue window is displayed when ending an exam where the user can select between: • Store all images • Select images to store • Store no images
Exam Screen / Report Headings Comments Diagnosis Referral Reasons	**Exam screen/Report headings:** Enter user-defined headings for Comments, Diagnosis and Referral reasons fields.
DICOM images ☑ Add visible patient info in DICOM images	**DICOM images:** ☑: Displays patient information (name, date of birth and ID) on DICOM images.

TCP-IP

This configuration category enables the user with administration rights to set the Transmission Protocol/Internet Protocol for the system and connected remote archive.

1. **Computer name: device's name of type VIVID_I-00nnnn or ECHOPAC7-00nnnn, where "nnnn" is the system's serial number. Do not change the computer name.**
2. **IP settings: system IP settings**
3. **Remote archive setup: remote archive IP address and name (EchoPAC PC or EchoServer)**
4. **Save TCP/IP settings. The changes will be effective after the system is rebooted.**
5. **Advanced DICOM log: creates a detailed DICOM related report log. Should be used only if DICOM issues are registered (see page 408 about report log generation).**

Figure 12-19: The sublevel TCP/IP

System

This configuration category is divided in two sheets:

- **System Settings**: enables the user to set the date and time, choose the measurement unit and language for the system and enter basic information about the organization, such as the institution name and department.
- **Test**: enables testing of the different parts of the unit.

This sheet is accessible to users with administration rights only.

The system settings

Figure 12-20: The System settings setup sheet
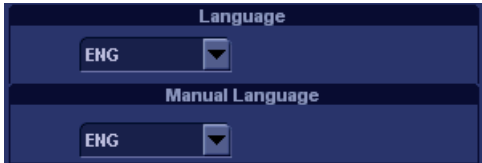
Location

Parameter	Description
	Location: • **Hospital**: Enter the hospital name (up to 64 characters). This information is displayed on the scanning screen's *Title bar* (up to 24 characters) and on the image properties of all saved images. • **Department**: Enter the department name (up to 64 characters). This information is displayed on the image properties of all saved images.

Date and Time

Parameter	Description
  Changes done on the date or time format will be effective only after rebooting the system.	**Date and Time:** • **Date**: sets the date. Select the correct date from the pop-up window. • **Time**: sets the time. Press the arrow head buttons to set the time (hour, min, sec). • **Time Format**: select the desired format (24 or 12 AM/PM) from the pop-up menu. • **Date Format**: select the desired format (EU or US) from the pop-up menu. • **Default Century**: select the desired format (1900, 2000 or None) from the pop-up menu. **1900**: the number 19 is automatically displayed when entering the year in the patient date of birth (to edit century, press **BACKSPACE** twice). **2000**: the number 20 is automatically displayed when entering the year in the patient date of birth (to edit century, press **BACKSPACE** twice). **None**: four digits must be typed when entering the patient year of birth.

Languages

Parameter	Description
Language ENG ▼ **Manual Language** ENG ▼	**Language:** Select the desired language for the system from the pop-up menu. **Manual language:** Select the desired language for the Online manual. If not available the English manual will be displayed as default.

Units

Parameter	Description
Units Metric ▼	**Units:** Select the desired units (Metric or US) from the pop-up menu.

About

The About sheet gives informations about the ultrasound unit concerning:

•   software

•   hardware

•   Probes

Administration

The Admin. category deals with the following:

- **Disk management**: enables the management of the hard disk space while maintaining the patient database on the system (see page 270).
- **Backup**: enables the backup procedures for local patient, and report archives as well as system and user-defined configuration (see page 274).
- **Restore**: enables data retrieving of patient and report archives as well as system and user-defined configuration (presets) from a backup (see page 278).
- **Users**: deals with operators registration, operator's rights setting and registration of staff related to an examination (e.g. referral doctors, sonographers etc.)
- **System Administration**: keeps track of all the options implemented in the unit.
- **Unlock patient**: enables to unlock patient records that were not properly terminated (see page 402).

Users

The *Users sheet* deals with operators registration, operator's rights setting and registration of referring members related to examinations (e.g. referring and diagnosing physicians).

Figure 12-21: The Users setup sheet

Users are divided in groups with different rights. There are two types of groups:

- **User groups**: members of these groups (see table below) are allowed to login on the system when selected together with the group Operator. They have group specific rights.
- **Referring groups**: members of these groups (Diagnosing physician and Referring doctor) are not allowed to login on the system. They are registered as references that can be associated to a patient record.

Table 12-1: The User groups

Group	Right (see definition below)				
	Create	Print report	Store report	Admin	Service
Cardiologist	+	+	+		Activated with a Dongle
Physician	+	+			
Sonographer	+	+			
Fellow	+	+			
Sys Admin	+	+		+	
Hosp admin		+			
GE admin	+	+		+	

The rights associated to the user groups are:

Right	Definition
Create and delete	• Create, update and delete a patient record • Create, update and delete an examination • Create, update and delete an user or a referring member • Import/Export patient records, examinations • Move examinations
Print report	• Print a report
Store report	• Store a report
Admin	• System administration
Service	• Access to the service platform

Creating a user or a referring member

1. Press **New**
2. Enter the user's information.
3. Select the type of user/referring member in *Member of Group(s)*.

To be able to login on the system, the group Operator MUST be selected.

Editing an user configuration

1. Select the actual user in the *User list*.
2. Make the desired changes.
3. Press $\overline{\text{CONFIG}}$ or any active scanning key to exit the Configuration management package.

Deleting a user

1. Select the actual user in the *User list*.
2. Press **Delete**.
   The user is removed from the *User list*.

Auto logon and auto logoff

Auto logon
• Select the desired logon setup from the pull down menu:
   • **Disabled**: no default user is selected when logging on.
   • **Last user**: the last user is selected automatically when logging on.
   • **A specific user**: select one of the users to be the default user when logging on.

Auto logoff
• Set the time span (from 10 min) for the system to automatically log off when not in use.

Unlock Patient

If for any reason an examination is not properly finished, the patient record is locked and cannot be opened again unless it is unlocked.

Figure 12-22: The Unlock Patient sheet

To unlock patient records:

1. Press **CONFIG**.
2. Select the category **Admin**.
3. In the *Admin category*, select the sheet **Unlock patient**.
4. In the *Unlock patient sheet*, select the patient records to unlock
   You can search for a specific patient record or a group of patient record using the searching filters.
5. Select **Unlock** to unlock the selected patient record(s), or select **Unlock All** to unlock all patient records.
   A *Confirmation window* is displayed.
6. Select **OK**.

Chapter 13
User maintenance

System Care and Maintenance

Having been determined by GE Medical Systems engineers that your Vivid *i* system has no high-wearing components likely to fail due to frequent use, no Periodic Maintenance Inspections are mandatory. However, some Customer Quality Assurance Programs may require additional tasks and/or inspections to be performed at periods of frequency different from those listed in this manual.

⚠️
CAUTION

The user must ensure that safety inspections are performed at least every 12 months according to the requirements of the patient safety standard IEC 60601-1 (1988).

Only trained persons are allowed to perform the safety inspections mentioned above.

Technical descriptions are available on request.

To ensure that the Vivid *i* unit constantly operates at maximum efficiency we recommend that the following procedures be observed as part of the customer's internal routine maintenance program.

Inspecting the system

⚠️
CAUTION

If any defects are observed or malfunctions occur, DO NOT operate the equipment, and inform a qualified service person.

Monthly

Examine the following on a monthly basis (or whenever there is a reason to assume that any issue may have occurred):

- Connectors on cables, for any mechanical defects
- Entire length of electrical and power cables, for cuts or abrasions
- Equipment, for loose or missing hardware
- Control panel for defects

⚠️
WARNING

To avoid electrical shock hazard, do not remove panels or covers from the unit.

Virus Protection

To minimize virus vulnerability Vivid *i* is configured with a minimal set of open ports and with all network services not actively used by the system closed down. This significantly reduces the risk of a virus attack on Vivid *i*. GE is continuously judging the need for additional actions to reduce vulnerability of equipment, this includes vulnerability scanning of our products and evaluation of new security patches for the third party technology used. Microsoft (and other) security patches that addresses serious issues with Vivid *i* will be made available to customers after GE verification of those patches.

Cleaning the unit

General Cleaning

Frequent and diligent cleaning of the Vivid *i* ultrasound unit reduces the risk of spreading infection from person to person, and also helps to maintain a clean working environment.

⚠
CAUTION

When performing Cleaning Procedures, to prevent the risk of system damage, always observe the following precautions:
- Use only recommended cleaning materials and solutions.
- Do not use any solutions or products not listed in the Vivid *i* User Manual.
- Do not spray any liquid directly onto the Vivid *i* covers, LCD Display or keyboard!
- Do not allow any liquid to drip or seep into the system.
- Prior to cleaning, turn OFF power to the system.

LCD Display Cover

On a weekly basis, moisten a soft, non-abrasive folded cloth or sponge with a mild, general purpose, non-abrasive soap and water solution. **Do not use any solution containing abrasive powder or strong chemicals such as acid or alkaline**. Squeeze excess liquid from the cloth/sponge, them wipe down the top, front, back and both sides of the unit. ***Do not spray any liquid directly onto the unit!***
1. Rinse the cloth/sponge with clean running water and wipe the unit surfaces again.
2. Use a dry, soft, lint-free cloth to dry the unit surfaces.

3. Wait for the unit surfaces to dry completely.

Note: In the event that disinfection is required or any stubborn stains remain, remove them with a soft, dust-free cloth on which a small quantity of isopropyl rubbing alcohol has been absorbed, as described below for cleaning the Keyboard.

LCD Display

On a weekly basis, gently wipe the LCD Display with a dry, soft, lint-free non-abrasive folded cloth.

Note: In the event that you see a scratch-like mark on the LCD Display, this may be a stain transferred from the Keyboard or Trackball when the LCD Display Cover was pressed from the outside. Proceed as follows:

Wipe or dust the stain gently with a soft, dry cloth. If the stain remains, moisten a soft, lint-free cloth with water or a 50-50 mixture of isopropyl alcohol and water that does not contain impurities. Wring out as much of the liquid as possible then wipe the LCD Display again. ***Do not let any liquid drip into the computer!***

Be sure to dry the LCD Display before closing the cover.

Control Panel and Keyboard

Control Panel:

On a weekly basis, moisten a soft, non-abrasive folded cloth or sponge with a mild, general purpose, non-abrasive soap and water solution or general purpose disinfectant. **Do not use any solution containing abrasive powder or strong chemicals such as acid or alkaline**.

Squeeze excess liquid from the cloth/sponge, them wipe down the Control Panel.

Do not spray any liquid directly onto the Control Panel!

1. Rinse the cloth/sponge with clean running water and wipe the Control Panel again.
2. Use a dry, soft, lint-free cloth to dry the Control Panel.
3. Wait for the Control Panel surfaces to dry completely.

Keyboard:

Clean the keyboard as described (above) for cleaning the Control Panel.

Note: In the event that disinfection is required or any stubborn stains remain, absorb a small quantity of isopropyl rubbing alcohol on a soft, dust-free cloth.

Wipe the surface of the keycaps with the cloth, making sure that no liquid drips on or between the keys. Allow to dry.

Magneto Optical Disk (MOD)

Clean the drive head and media with the vendor-supplied cleaning kit. Advised to repeat this often, to prevent future problems. MOD disks must be stored away from dust and cigarette smoke. Do not use alcohol or benzene to clean the MOD cartridge.

DVD - CD-RW Drive

Clean the drive head and media with the vendor-supplied cleaning kit. Advise the user to repeat this often, to prevent future problems. CDs must be stored away from dust and cigarette smoke. Do not use alcohol or benzene to clean the CD drive.

Peripherals

Clean the peripherals in accordance with the respective manufacturer's directions.

Prevention of static electricity interference

Interference from static electricity can damage electronic components in the system. The following measures help to reduce the likelihood of electrostatic discharge:

- Wipe the alphanumeric keyboard and monitor with lint-free tissue or a soft cloth dampened with anti-static spray on a monthly basis.
- Spray carpets with anti-static spray because constant walking on carpets in or near the scanning room may be a source of static electricity.

System self-test

The Vivid *i* ultrasound unit is designed for reliable operation and consistent, high-quality performance. Automatic self-testing facilities are provided to monitor system operation and to detect malfunction as soon as possible, thereby eliminating unnecessary downtime. The detection of any serious malfunction may result in immediate interruption of scanner operation.

System malfunction

In the event of error or system malfunction the user may generate and export a log file to a removable media as described below and contact authorized service personnel.

Generating a logfile

1. Press $\overline{\text{ALT}}$ - $\overline{\text{D}}$ on the alphanumeric keyboard.
    The *Problem description dialogue window* is displayed (see Figure 13-1).

2. Type in a description of the problem. Notes should be made regarding the selected probe, the imaging mode and the application that was being used at the time of malfunction. If applicable, try to describe the button or key pushing sequence that immediately preceded the problem. Check the mention *System lockup* if applicable.

3. Press **Save** to create a logfile.
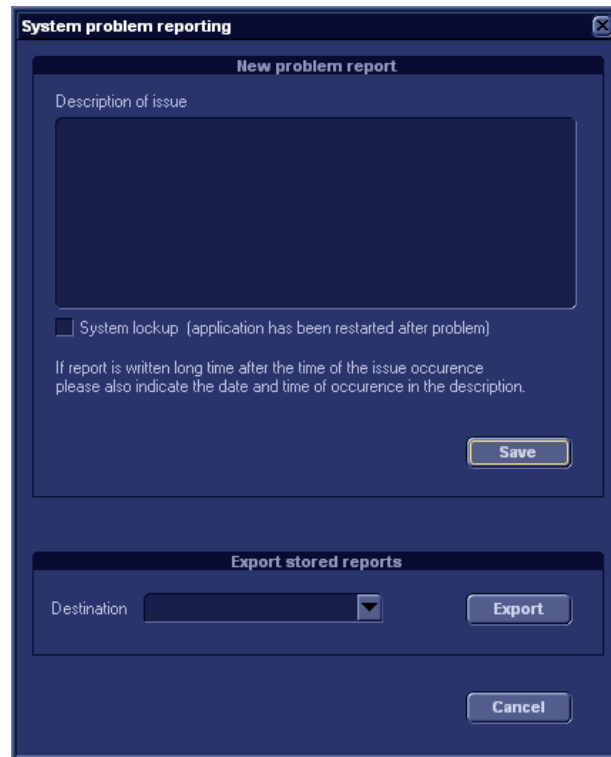
Figure 13-1: The Problem description dialogue window

Exporting the logfile

1. Press $\overline{\text{ALT}}$ - $\overline{\text{D}}$ on the alphanumeric keyboard to display the *Problem description dialogue window* again.

2. Select the destination where to export the logfile (MOD or CD-R).

3. Press **Export**.
   A Zip file (named "logfile_<date>_<time>.zip") is copied on to the selected removable media.

Chapter 14
Safety

Introduction

This section describes the important safety measures which should be taken before operating the Vivid *i* ultrasound unit. Procedures for simple care and maintenance of the unit are also described.

Various levels of safety precautions may be found on the equipment, and different levels of severity are identified by one of the following icons that precede precautionary statements in the text.

The following icons are used to indicate precautions:

DANGER

Indicates that a specific hazard exists that, given inappropriate conditions or actions, will cause:
• Severe or fatal personal injury
• Substantial property damage

WARNING

Indicates that a specific hazard exists that, given inappropriate conditions or actions, will cause:
• Severe or fatal personal injury
• Substantial property damage

CAUTION

Indicates that a potential hazard may exist that, given inappropriate conditions or actions, can cause:
• Minor injury
• Property damage

⚠	Marks sections or chapters in the user manual which give information related to components on the ultrasound unit or to accessories marked with this same label (see also page 419).

Other precautions or prudent-use recommendations are indicated in the note sections in the left column. These are:

•　　Use of the Vivid *i* ultrasound unit as a prescription device, under the order of a physician.

•　　Maintaining an optimum unit environment.

•　　Reference to the User's Manual.

Owner responsibility

⚠️
CAUTION

For USA only:

Federal law restricts this device to use by, or on the orders of, a physician.

It is the responsibility of the owner to ensure that anyone operating the system reads and understands this section of the manual. However, there is no representation that the act of reading this manual renders the reader qualified to operate, inspect, test, align, calibrate, troubleshoot, repair or modify the system. The owner should make certain that only properly trained, fully-qualified service personnel undertake the installation, maintenance, troubleshooting, calibration and repair of the equipment.

The owner of the Vivid *i* ultrasound unit should ensure that only properly trained, fully qualified personnel are authorized to operate the system. Before authorizing anyone to operate the system, it should be verified that the person has read, and fully understands, the operating instructions contained in this manual. It is advisable to maintain a list of authorized operators.

Should the system fail to operate correctly, or if the unit does not respond to the commands described in this manual, the operator should contact the nearest field GE Ultrasound Service Office.

For information about specific requirements and regulations applicable to the use of electronic medical equipment, consult the local, state and federal agencies.

Important safety considerations

Notice against user modification

Never modify this product, including system components, software, cables, and so on. User modification may cause safety hazards and degradation in system performance. All modification must be done by a GE qualified person.

The equipment is not suitable for use in the presence of flammable anesthetic mixture with air or with Oxygen or Nitrous Oxide.

This section includes considerations for the following:

- Patient safety
- Personnel and equipment safety

The information contained in this section is intended to familiarize the user with the hazards associated with the use of the unit, and to alert them to the extent to which injury and damage may occur if the precautions are not observed.

Users are obligated to familiarize themselves with these safety considerations and to avoid conditions that could result in injury or damage.

Regulatory information

The GE Healthcare Ultrasound product families are tested to meet all applicable requirements in relevant EU Directives and European/International standards. (See "Standards used" below.) Any changes to accessories, peripheral units or any other part of the system must be approved by the manufacturer: GE Vingmed Ultrasound. **Ignoring this advice may compromise the regulatory approvals obtained for the product.**

Please consult your local GE Vingmed Ultrasound representative for further details.

Standards used

The Vivid *i* ultrasound unit is a Class I device, type BF, according to Sub-clause 14 of IEC 60601-1 (1988), and Class A Group 1 device, according to Sub-clause 4 of CISPR11 ED.3.2. To fulfill the requirements of relevant EC directives and/or European Harmonized/International standards, the following documents/standards have been used:

Standard/Directive	Scope
93/42/EEC	Medical Devices Directive (MDD)
EN 55011/ CISPR11+A2 ED3.2	Emitted noise according to Class A requirements + Electromagnetic Susceptibility
IEC 60601-1: 1988+A1+A2 EN 60601-1: 1990+A1+A2 UL 60601-1 (2003) CAN/CSA-C22.2 No. 601.1-M90+U1+U2	Medical Electrical Equipment, Part 1; General Requirements for Safety "CLASSIFIED BY UNDERWRITERS LABORATORIES INC. WITH RESPECT TO ELECTRICAL SHOCK, FIRE AND MECHANICAL HAZARDS ONLY IN ACCORDANCE WITH UL60601-1 AND CAN/CSA C22.2 NO.601.1"
IEC 1157/ EN 61157/ (1994)	Requirements for the declaration of the acoustic output of medical diagnostic ultrasonic equipment.
IEC/EN 60601-1-2 (2001)	Medical Electrical Equipment - part 2. Collateral standard: Electromagnetic compatibility - Requirements and tests.

IEC/EN 60601-1-2-37 (2001)	Medical Electrical Equipment - part 2: "Particular requirements for the safety of ultrasound medical diagnostics and monitoring equipment", (2001).
IEC/EN 60601-2-27	Medical electrical equipment - Part 2: Particular requirements for the safety of electrocardiographic monitoring equipment.
IEC/EN 60601-1-4	Medical electrical equipment: Part 1-4: General requirements for collateral standard: Programmable electrical medical systems
ISO 10993-1	Biological evaluation of medical devices
ISO 13485	Quality management standards for medical devices

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Device labels

Label Icon Description

The following table describes the purpose and location of
safety labels and other important information provided on the
equipment.

Label	Purpose	Location
Identification Plate	Manufacturer's name and address Model Electrical ratings Device Listing/Certification Labels	Bottom of unit
	Equipment Type BF, in which protection against electric shock does not rely on basic insulation only. Provides additional safety precautions such as double insulation or reinforced insulation, because there is no provision for protective earthing or reliance upon installation conditions.	Probe connectors.
	Equipment Type CF, indicates equipment having a floating applied part having a degree of protection suitable for direct cardiac contact.	ECG connector
$C \epsilon$ **0344**		Bottom of unit.
∼	Alternating current	Various
	This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.	Bottom Cover

Label	Purpose	Location
⏚	Protective earth (ground)	Internal
⏛	Earth (ground)	Internal
▽	Equipotentiality: indicates terminal to be used for connecting equipotential conductors when interconnecting (grounding) with other equipment.	Bottom of unit
⚠	Attention - Consult accompanying documents: alerts the user to refer to the user documentation when complete information cannot be provided on the label.	Various
⚡	CAUTION - Dangerous voltage: used to indicate electric shock hazards.	Various
⏻ ON/OFF:	Apply a short push on the ON/OFF button to shut down the system.	Keyboard

Classifications

Type of protection against electric shock:

- Class I Equipment—AC Adapter (*1)
- Class I Equipment—Vivid-*i* Console (*1)

Degree of protection against electric shock:

- Type BF Applied part (*3) (for Probes marked with BF symbol)
- Continuous Operation
- System is Ordinary Equipment (IPX0)
- Probes are IPX1

*1. Class I Equipment

EQUIPMENT in which protection against electric shock does not rely on BASIC INSULATION only, but includes a protective earth ground. This additional safety precaution prevents exposed metal parts from becoming LIVE in the event of an insulation failure.

*2. Class II Equipment

EQUIPMENT in which protection against electric shock does not rely on BASIC INSULATION only, but in which additional safety precautions such as DOUBLE INSULATION or REINFORCED INSULATION are provided.

*3. Type BF Applied Part

TYPE B APPLIED PART providing a specified degree of protection against electric shock, with particular regard to allowable LEAKAGE CURRENT.

Table 14-1: Type BF Equipment

	Normal Mode	**Single Fault Condition**
Patient Leakage Current	Less than 100 microA	Less than 500 microA

Acoustic output

Definition of the acoustic output parameters

Thermal Index

TI is an estimate of the temperature increase of soft tissue or bone. There are three thermal index categories:

- TIS: Soft tissue thermal index. The main TI category. Used for applications that do not image bone.
- TIB: Bone thermal index (bone located in a focal region). Used for fetal application.
- TIC: Cranial bone thermal index (bone located close to the surface). Used for transcranial application.

Mechanical Index

MI is the estimated likelihood of tissue damage due to cavitation. The absolute maximum limits of the MI is 1.9 as set by the FDA 510 (k) guidance of 1997.

Ispta

The Ispta is the Spatial Peak Temporal Average Intensity. The absolute maximum limit of Ispta is 720 MW/cm^2 as set by the FDA 510(k) guidance of 1997.

ALARA

Ultrasound procedures should be performed using output levels and exposure times As Low As Reasonably Achievable (ALARA) while acquiring clinical information.

Training

During each ultrasound examination the user is expected to weigh the medical benefit of the diagnostic information that would be obtained against the risk of potential harmful effects. Once an optimal image is achieved, the need for increasing acoustic output or prolonging the exposure cannot be justified. It is recommended that all users receive proper training in applications before performing them in a clinical setting.

Contact the GE Ultrasound sales representative for training assistance.

Safety statement

GE Vingmed Ultrasound safety statement

Although no harmful biological effects have been demonstrated for ultrasound frequencies, intensities and exposure times used in examination with the GE Vingmed Vivid *i* system, GE Vingmed Ultrasound recommends using the lowest acoustic output settings which will produce diagnostically acceptable information.

System controls affecting acoustic output

The operator controls that directly affect the acoustic output are discussed in the Acoustic Output Data Tables in the Reference Manual. These tables show the highest possible acoustic intensity for a given mode, obtainable only when the maximum combination of control settings is selected. Most settings result in a much lower output. It is important to note the following:

- The duration of an ultrasound examination is as important as the acoustic output, since patient exposure to output is directly related to the exposure time.
- Better image quality yields faster clinical results, making it possible to complete the relevant ultrasound examination more rapidly. Therefore, any control that improves the quality of the examination can help to reduce patient exposure, even though it may not directly affect acoustic output.

Probe selection

As long as the appropriate application is available, any probe can be used with the knowledge that the intensities fall at, or below, those stated in the Acoustic Output Data Tables. The duration of patient exposure is most likely minimized with the use of a probe that is optimized to provide resolution and focal depth, appropriate to the examination.

Application selection

Selecting the probe and application preset appropriate to a particular ultrasound examination automatically provides acoustic output limits within FDA guidelines for that application. Other parameters which optimize performance for the selected application are also set automatically, and should assist in reducing the patient exposure time. See page 50, for information on selecting probes and application presets.

Changing imaging modes

Acoustic output depends on the imaging mode selected. The choice of mode (2D, M-Mode, Doppler or Color Flow) determines whether the ultrasound beam is stationary or in motion. This greatly affects the energy absorbed by the tissue.

See Chapter 3, "Scanning Modes" on page 81, for complete information on changing imaging modes.

When operating in a combined mode, such as 2D and M-Mode, the total acoustic output comprises contributions from each individual mode. Depending on the modes in use, either or both output indices may be affected.

The user can override the default settings, but care should be taken to observe the displayed MI and TI values.

Power

It is possible to change the power in all operating modes so that the operator can use the ALARA principle.

Patient safety

Patient identification

⚠
WARNING

The concerns listed in this section can seriously affect the safety of the patient undergoing a diagnostic ultrasound examination.

Always include proper identification with all patient data and verify the accuracy of the patient's name and/or identity number when entering such data. Ensure that the correct patient ID is provided on all recorded data and hard copy prints. Identification errors could result in an incorrect diagnosis.

Diagnostic information

The images and calculations provided by the system are intended for use by competent users, as a diagnostic tool. They are explicitly not to be regarded as the sole, irrefutable basis for clinical diagnosis. Users are encouraged to study the literature and reach their own professional conclusions regarding the clinical utility of the system.

The user should be aware of the product specifications and of the system accuracy and stability limitations. These limitations must be considered before making any decision based on quantitative values. If in doubt, the nearest GE Ultrasound Service Office should be consulted.

Equipment malfunction or incorrect settings can result in measurement errors or failure to detect details in the image. The user must become thoroughly familiar with the operation of the unit in order to optimize its performance and to recognize possible malfunctions. Application training is available through the sales representative.

⚠
CAUTION

Be certain to ensure privacy data of patient information.

Mechanical hazards

Damaged probes or improper use and manipulation of the transesophageal probe may result in injury or increased risk of infection. Inspect probes frequently for sharp, pointed or rough surface damage that could cause injury or tear protective barriers (gloves and sheaths).

Transesophageal probe safety

Never use excessive force when manipulating the transesophageal probe. The detailed operator manual enclosed with the transesophageal probe must be read carefully.

Electrical Hazard

A damaged probe may increase the risk of electric shock if conductive solutions come in contact with internal live pads. Inspect probes often for cracks or openings in the housing and holes in and around the acoustic lens, or other damage that could allow moisture to enter. Become familiar with the use and care precautions described in Chapter 10, "Probes" on page 327.

Personnel and equipment safety

⚠️
DANGER

The hazards listed below can seriously affect the safety of personnel and equipment during a diagnostic ultrasound examination.

Explosion hazard

Never operate the equipment in the presence of flammable or explosive liquids, vapors or gases. Malfunctions in the unit, or sparks generated by fan motors, can electrically ignite these substances. Operators should be aware of the following points to prevent such explosion hazards.

- If flammable substances are detected in the environment, do not plug in or turn on the system.
- If flammable substances are detected after the system has been turned on, do not attempt to turn off the unit, or to unplug it.
- If flammable substances are detected, evacuate and ventilate the area before turning off the unit.

Electrical hazard

⚠️
WARNING

The internal circuits of the unit use high voltages, capable of causing serious injury or death by electrical shock.

To avoid injury

- Do not remove the unit's protective covers. No user-serviceable parts are inside. If servicing is required, contact qualified technical personnel.
- Connect the attachment plug to a hospital-grade grounding outlet to ensure adequate grounding.
- Do not place liquids on or above the unit. Conductive fluids seeping into the active circuit components may cause a short-circuit, which could result in an electrical fire.
- An electrical hazard may exist if any light, monitor or visual indicator remains on after the unit is turned off.

Fuses blown within 36 hours of being replaced may indicate a malfunctioning electrical circuit within the system. In this event,

the unit must be checked by GE Ultrasound service personnel. No attempt should be made to replace the fuses with others of a higher rating.

Biological hazard

For patient and personnel safety, beware of biological hazards while performing transesophageal procedures. To avoid the risk of disease transmission:

- Use protective barriers (gloves and probe sheaths) whenever necessary. Follow sterile procedures as required.
- Thoroughly clean probes and reusable accessories after each patient examination and disinfect or sterilize as needed. Refer to Chapter 10, "Probes" on page 327, for probe use and care instructions.
- Follow all in-house infection control policies as they apply to personnel and equipment.

Pacemaker hazard

The possibility of the system interfering with pacemakers is minimal. However, as this system generates high frequency electrical signals, the operator should be aware of the potential hazard this could cause.

Electrical safety

Device classifications

The Vivid *i* ultrasound unit is a Class I device, type BF, according to Sub-clause 14 of IEC 60601-1 (1988).

Internally connected peripheral devices

The system, together with peripheral devices, such as video tape recorders and printers, meets UL2601-1 and IEC 60601-1 (1988) standards for electrical isolation and safety. These standards are applicable only when the specified peripheral devices are plugged into the AC outlets provided in the unit.

Internally connected battery

Remove the primary battery if the internal battery in not likely to be used for some time.

External Connection of other peripheral devices

⚠
CAUTION

External devices can be used only if CE marked and in compliance with related standards (EN 60601-1 or EN 60950). Conformance to EN 60601-1-1 (2000) must be verified.

External devices meeting EN 60950 should be kept outside of the patient environment, as defined in IEC 60601-1-1 (2000).

Other external devices, such as laser cameras, printers, VCRs and external monitors, usually exceed allowable leakage limits and, when plugged into separate AC outlets that are then connected to the unit, are in violation of patient safety standards. Suitable electrical isolation of such external AC outlets may be required in order to meet UL2601-1 and IEC 60601-1 (1988) standards for electrical leakage.

Allergic reactions to latex-containing medical devices

Due to reports of severe allergic reactions to medical devices containing latex (natural rubber), the FDA advises health-care professionals to identify latex-sensitive patients, and be prepared to treat allergic reactions promptly. Latex is a component of many medical devices, including surgical and examination gloves, catheters, incubation tubes, anesthesia masks and dental dams. Patient reaction to latex has ranged from contact urticaria, to systemic anaphylaxis.

For more details regarding allergic reaction to latex, refer to *FDA Medical Alert MDA91-1*, March 29.

Electromagnetic Compatibility (EMC)

NOTE: This unit carries the CE mark. It complies with regulatory requirements of the European Directive 93/42/EEC concerning medical devices. It also complies with emission limits for a Group 1, Class A Medical Device as stated in EN 60601-1-2 (2001) (IEC 60601-1-2 (2001).

All types of electronic equipment may characteristically cause electromagnetic interference with other equipment, transmitted either through air or connecting cables. The term Electromagnetic Compatibility (EMC), indicates the capability of the equipment to curb electromagnetic influence from other equipment, while at the same time not affecting other equipment with similar electromagnetic radiation.

Radiated or conducted EMC can cause distortion, degradation, or artifacts in the ultrasound image which could potentially obscure diagnostic information.

There is no guarantee that interference will not occur in a particular installation. If this equipment is found to cause or respond to interference, which may be determined by turning equipment on and off, qualified service personnel should attempt to correct the problem by one or more of the following measures:

- Re-orient or re-locate the affected device.
- Increase the separation between the unit and the affected device.
- Power the equipment from a source other than that of the affected device.
- Consult the service representative for further suggestions.

The manufacturer is not responsible for any interference or responses caused by the use of interconnecting cables other than those recommended, or by unauthorized changes or modifications to this unit. Unauthorized changes or modifications could void the user's authority to operate the equipment.

To comply with the regulations on electromagnetic interference, all interconnecting cables to peripheral devices must be shielded and properly grounded. Use of cables not properly shielded and grounded may result in the equipment causing or

responding to radio frequency interference, in violation of the European Union Medical Device Directive and FCC regulations.

Do not use devices which intentionally transmit RF signals, for example, cellular phones, transceivers, or radio controlled products, in the vicinity of this equipment as it may cause performance outside the published specifications. Keep the power to these types of devices turned off when near this equipment.

Environmental protection

System disposal

To be added

Battery disposal

To be added

Index

Numerics

A

B

Index

Index

R

Index

GE Medical Systems