GE Medical Systems

Technical Publications

EchoPAC PC
version 3.0.x

$\mathsf{C}\,\mathsf{E}_{0470}$

User's Manual

GE Medical Systems

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Introduction

EchoPAC PC is a post processing program designed for ultrasound image review, analysis and reporting. EchoPAC PC allows post-processing of DICOM ultrasound images and raw data images from GE ultrasound scanners.

Main functionality

EchoPAC PC offers the following functionality:

- Read/display DICOM ultrasound and GE raw data images.
- Ultrasound image optimization, as on a scanner.
- Measurement and analysis
- Advanced quantitative analysis, based on raw data such as quantitative TVI, contrast and stress analysis (research options)
- Image storage
- Patient record database
- Report generator

Indications for use

EchoPAC PC is a workstation with post-processing and data archiving capability compatible with the Vivid 7 ultrasound unit.

EchoPAC PC takes special advantage of the easy access to ultrasound raw data provided from the Vivid 7, enabling full image post-processing.

EchoPAC PC has also access to ultrasound data through DICOM Media Interchange allowing import from removable media and storage to removable media of DICOM images (single or multiframe).

EchoPAC PC captures scan data from basic ultrasound application such as adult and pediatric cardiac, stress echo-cardiography, transesophageal and intra-operative imaging.

EchoPAC PC product range

The EchoPAC PC product range consists of:

- **EchoPAC PC Workstation**: a turnkey solution consisting of hardware and software in a complete package.
- **EchoPAC PC Software Only**: only the software to be installed on any PC that fulfills minimum requirements.

The EchoPAC PC Workstation and The EchoPAC PC Software Only have the same clinical functionality, except for the following features that are not available in EchoPAC PC Software Only:

- No writing directly to CD-RW (Must be done by other software packages).
- The TCPIP settings cannot be configured within the application (it must be done in Windows).
- InSite/iLink is not available.
- Removable media cannot be formatted within the application.
- Removable media cannot be ejected from within the application.
- The printer setup cannot be done from within the application.
- The Computer name cannot be set from within the application.

Important

⚠
CAUTION

To ensure optimal performance, do NOT attempt to install any software on the EchoPAC PC workstation.

⚠
CAUTION

The EchoPAC PC workstation must NOT be placed inside the patient environment (refer to local regulations and EN 60601-1-1 (2000)).

1. **Patient environment**
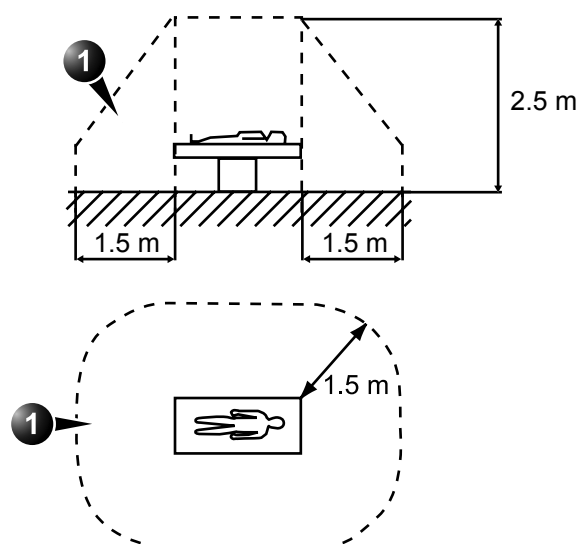
Figure 1-1: The patient environment

Manual contents

The EchoPAC PC User manual is organized to quickly provide the information needed for patient management and ultrasound image post processing using the EchoPAC PC software.

Finding information

Data has been arranged in a format that will assist the user in finding information easily and quickly.

Table of Contents: list the main topics and their location.

Headers and footers: displays the chapter name and page number.

References: cross references are noted in the text.

Index: Extensive tool that provides easy reference to ideas, topics, terms, titles, headings and cross references.

Conventions used in this manual

The following typographic conventions are used in the indication of different types of information:

2-columns layout: the right column contains the main text, the left column contains additional notes and warning texts.

Bold type: describes button name on the screen.

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

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
Latin and South America GE Medical Systems Ultrasound Service Engineering 4855 W. Electric Avenue Milwaukee, WI 53219 On-line Applications Support	Tel: (1) 305-735-2304 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	

Chapter 1
Getting started

Contents

Launching EchoPAC PC

To start EchoPAC PC:

1. Start the EchoPAC PC workstation.
   The unit undergoes an initialization sequence and the *Operator login dialogue box* is displayed (see Figure 1-1).

2. Enter the required information and press **Log on**.
   The *Search/Create patient window* is displayed with the default dataflow selected (see Figure 2-1, page 13).

1. Select the operator

2. Enter password
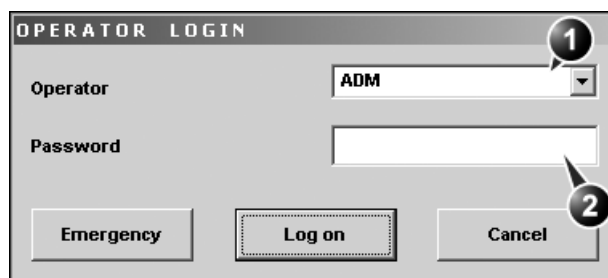
Figure 1-1: The Operator login windows

⚠
CAUTION

For user of EchoPAC PC Software Only:

It is possible in Windows to start several instances of EchoPAC PC. I.e. the same application is launched more than once. It is strongly recommended not to do this, as this will cause several functions and features in EchoPAC PC not to work properly. Only ONE instance of EchoPAC PC should be running.

EchoPAC PC overview

EchoPAC PC is build on eight different main screens that can be entered by selecting the buttons in the top of the window (see Figure 1-2).

1. **Selected screen**
2. **Archive**
   • **Search patient**
   • **Create patient**
3. **Patient:**
   • **Patient info**
   • **Examination list**
   • **Medical info**
4. **Image Browser:**
   • **Displays a thumbnail overview of all images stored for the current patient record**
5. **Review:**
   • **Displays all images of the selected examination**
6. **Protocol:**
   • **Review protocol based examinations**

7. **Image Analysis:**
   • **Image optimization**
   • **Measurements**
   • **Quantitative analysis**
8. **Worksheet:**
   • **Measurements listing**
9. **Report:**
   • **Summarizes data from examination**
10. **Config:**
    • **EchoPAC PC configuration**
11. **Help:**
    • **Displays on-line user documentation**
12. **Exit**

Figure 1-2: The EchoPAC PC navigation buttons

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EP092537-02

Chapter 2
Patient record management

Contents

Searching a Patient record

When the login procedure is completed, the *Search/Create patient window* is displayed (see Figure 2-1).

About dataflow

Refer to page 204 for further information on connectivity setup.

The connectivity on EchoPAC PC is based on the dataflow concept. Each dataflow defines the transfer of patient information from an input source to the unit, and from the unit to an output source. Patient information can include demographic data and images, as well as reports and Measurement and Analysis data. A dataflow is a set of pre-configured services. When beginning a search, the user selects a pre-configured dataflow (see page 204 about connectivity) that will automatically customize EchoPAC PC to work according to the services associated to the dataflow and search in the archive associated.

To find a patient record

EchoPAC PC can be configured to generate patient ID.

1. Type the patient **Last Name**, and/or **ID**.
    When default configured, EchoPAC PC automatically searches to see if the patient is already in the database. The result of this search is displayed in the *Patient list field*.

The automatic searching tool displaying matching patient information in the Patient list can be turned off.

2. If necessary, select another **dataflow** to search in other databases.

3. In the *Patient list field*, Double-click the desired patient record (or click once on the patient record and press **Select Patient**)
    Or
    Press **[+]** in front of the actual patient record and select the desired examination.
    The *Examination List window* is displayed (see Figure 2-2).

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 217)**
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 2-1: The Search/Create Patient window

1. **The information displayed in the Patient list is configurable (see page 217).**
2. **Go to Search/Create Patient window (see page 13)**
3. **Insert pre-defined text in the Comment field**
4. **Select the column heading border and drag to adjust column width**

Figure 2-2: The Examination list window

Advanced search

The list of searching filters may vary depending on the dataflow selected

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

Searching filter
Date of birth (time span)
Examination date (time span)
Current date
Images
Stress examinations
Report

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*, click on the **header** by which the sort is to be performed (Figure 2-1, page 13).
   The patient list is sorted in ascending order according to the field selected.
2. Click once more on the **header**.
   The patient list is sorted in descending order according to the field selected.

Editing Referral Reasons, Comments and Diagnosis

The user can edit the actual text in the *Examination List window* (see Figure 2-2) using the alphanumeric keyboard and by inserting pre-defined text input.

Text edition

1. In the *Examination list window* (Figure 2-2), click in the required field to activate the text marker.

2. Using the alphanumeric keyboard, edit the information.

Use the Arrow keys to move text marker.

Inserting pre-defined text input

1. In the *Examination list window*, press **Insert Text** for the actual field.
    The *Pre-defined texts list* is displayed, showing the abbreviation for the pre-defined text inputs (see Figure 2-3). The list has two levels, expand the list by selecting **[+]** in front of a top level text input.

*The **Insert Text** key can be configured to display an extended writing field (see page 217). In this configuration, the pre-defined text input function is started from within this new window.*

2. Select the pre-defined text input to insert.
    The entire text is displayed as a preview (see Figure 2-3).

3. Double click on the selection.
    The text is inserted in the main text at the cursor position.

Creating text input

1. In the *Examination list window*, press **Insert Text** for the actual field.
    The *Pre-defined texts list* is displayed (see Figure 2-3).

2. Press **New text** in the *Pre-defined texts list* to create a new top level text input
    or
    select a top level text input and select **New subtext** to create a sublevel text input.
    The *Text input window* is displayed.

*The Code is the abbreviation shown in the **Pre-defined texts list**.*

3. Type an abbreviation in the *Code field*.

4. Type the text input in the *Full text window*.

5. Press **OK** to confirm and exit.
    The *Pre-defined texts list* is updated accordingly.
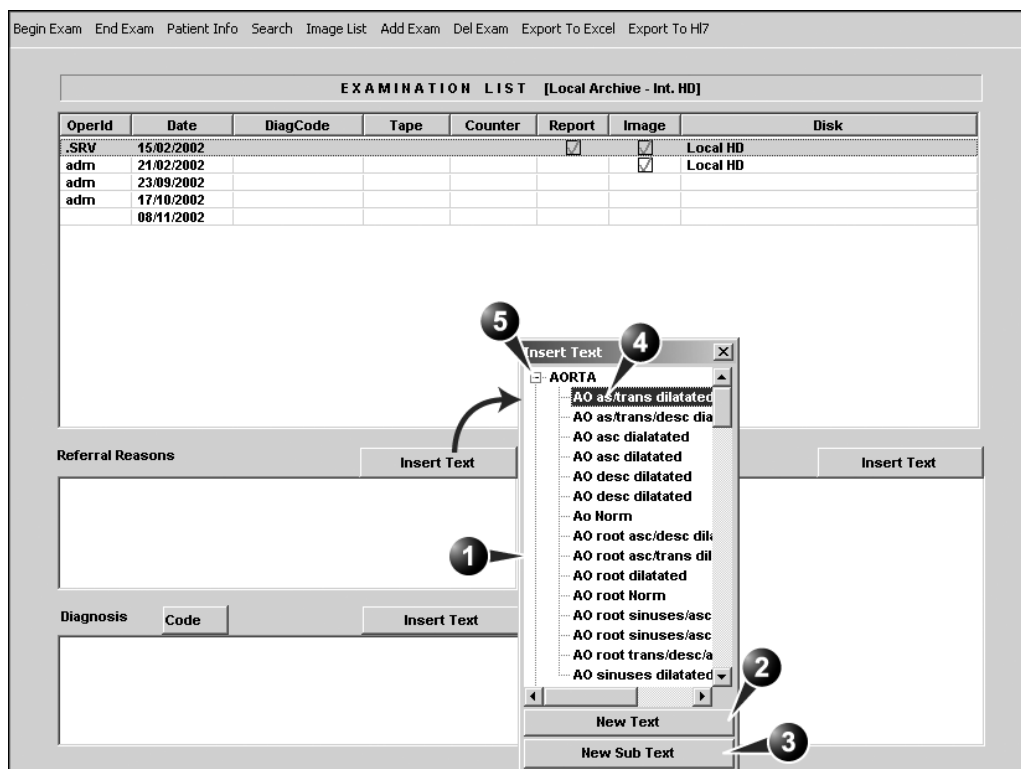
1. Pre-defined text input list
2. Create top level text input
3. Create sublevel text input
4. Highlighted text input
5. Expanded text input

Figure 2-3: The pre-defined text input tool

Editing demographic data

⚠
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.

The demographic data for a selected patient record can be edited from the *Patient Information window*.

⚠
CAUTION

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

1. Select a patient record (see page 12) and press **Patient Info** in the *Examination List window* (see Figure 2-2). The *Patient information window* is displayed (see Figure 2-4).
2. Edit the information using the keyboard or by choosing a new selection from the drop-down menus. Select the patient information category to enter application specific patient information (Displayed when the button **More** is depressed, see Figure 2-4.).

1. **The date format is configurable (see page 222).**
2. **The window can be configured to display the expanded patient info as default (see page 217).**
3. **The Address field is configurable (see page 217).**
4. **Select patient information category.**

Figure 2-4: The Patient information window

Creating a new Patient record

EchoPAC PC can be configured to generate patient ID.

1. In the *Search/Create Patient window* (see Figure 2-1), enter patient **Last Name**, and/or **ID**.

2. press **Create Patient**.
    The *Patient Information window* is displayed (see Figure 2-4).

3. Enter the necessary patient information.

⚠

CAUTION

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

Deleting archived information

Deleting a patient record

1. Select the patient record to delete (see page 12).
2. In the *Search create Patient window* (Figure 2-1, page 13), press **Delete**.
   A dialogue window is displayed asking for confirmation.
3. Press **OK** to delete the patient record.

Deleting an examination

1. Select the examination to delete (see page 12).
2. In the *Examination list window* (see Figure 2-2), select **Del Exam**.
   A dialogue window is displayed asking for confirmation.
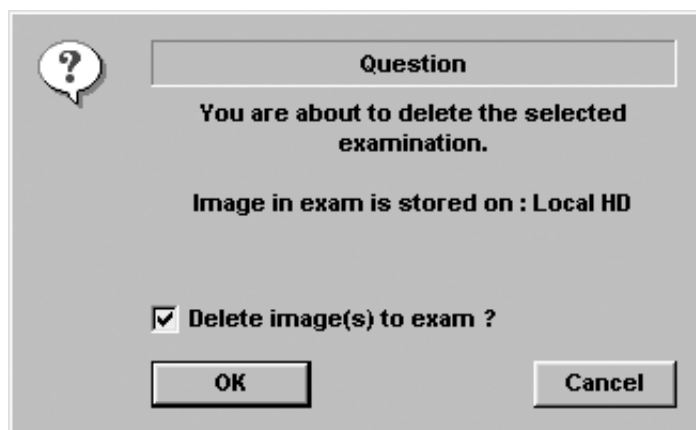
Figure 2-5: Delete Examination prompt

Moving examinations

Examinations can be moved from one patient record to another.

1. In the *Search/Create Patient window* press **[+]** in front of the patient record containing the examination(s) to move (see Figure 2-1, page 13).

2. Select the examination to move.
   To select several examinations, press and hold down C̄T̄R̄L̄ or S̄H̄ĪF̄T̄ while selecting.

3. Press **Move Exam**.
   The *Move exam window* is displayed.

Figure 2-6: The Move exam window

4. Search and select the target patient record.

5. Press **Move Exam**.

A warning message is displayed asking the user to confirm the action to perform (see Figure 2-7).

Warning

You are about to move exam
'exam '6' on patient '020202'' to Patient '030203'
Are you sure you want to move the exam??

Ok   Cancel
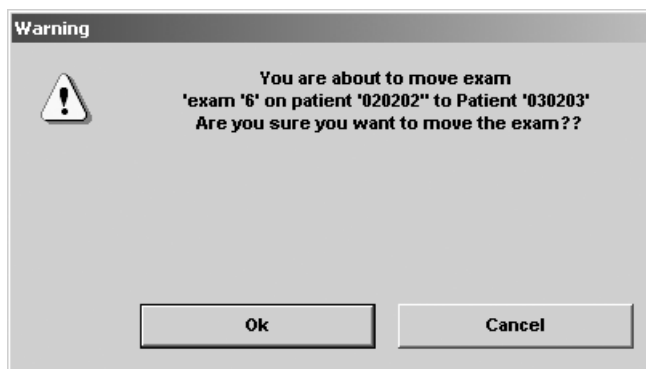
Figure 2-7: Moving examination prompt

6. Press **OK**.
   An information window is displayed to confirm the operation.
7. Press **OK**.

Using removable media

The following removable media can be used for data storage:
- 5 1/4" Magneto Optical disk (1.3, 5.4 and 8.6 Gb)
- 3 1/2" Magneto Optical disk (1.3 Gb), option
- Zip disk (250 Mb), option
- CD-R (CD-RW is not supported)

⚠
CAUTION

The 9.1 Gb MOD is not supported on the EchoPAC PC.

⚠
CAUTION

Use only 24x or higher CD-R.

Recommendation concerning CD-R handling

To avoid data loss, never touch the recordable surface of a CD-R. 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 CD-R surface has no visible scratches. If there are any scratches, do NOT use the CD-R.

⚠
CAUTION

Avoid using CD-R to store patient data. The CD-R can be used for storage of images for presentation purposes.

Formatting removable media

Removable media have to be formatted prior to use as described in 'Tools' on page 215.

Ejecting removable media

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

1. Press <u>ALT</u>+<u>E</u> to eject the disk.
   The *Eject device menu* is displayed.
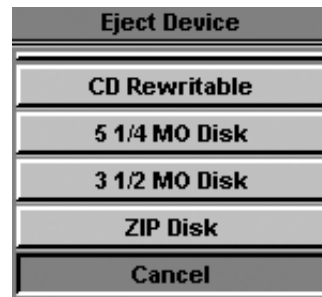
Figure 2-8: The Eject device menu

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

Export/Import patient records/examinations

Patient records/examinations from the local archive on one system (EchoPAC PC or EchoPAC PC) can be exported to the local archive on another system via a formatted Magneto Optical (MO) disk or CD-R. 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 2-10, page 28).

Similarly, patient records/examinations from the local archive on one system can be imported to the local archive on another system via a formatted MO disk or CD-R. 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).

Exporting patient records/examinations

1. Insert a blank formatted (see page 215) removable media in the drive.
2. Press **Archive**.
   The *Search/Create Patient window* is displayed (see Figure 2-1, page 13).
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 2-9: The Export Dialogue window

5. Select one of the following destinations from the
    Destination drop-down menu:

    •   **Removable MOD Archive**: exports raw and DICOM (if
        present) data to a removable MOD.

    •   **Pure DICOM MOD525/350 RW**: export DICOM data
        only to a removable MOD.

    •   **Removable CD Archive**: exports raw and DICOM (if
        present) data to a CD-R.

    •   **Pure DICOM CD-R**: export DICOM data only to a CD-R.

    •   **Remote Import/Export Archive**: exports raw and
        DICOM (if present) data to an Echo server (network) or
        Vivid 7 (direct connect).

    •   **Pure DICOM Storage**: exports DICOM data only to a
        DICOM server.

    •   **Excel file**: exports data to a spreadsheet. The excel file
        is stored in the location defined in the *Sublevel Tools* in
        the Configuration package (see page 215).

    •   **HL7**: exports examination results to the "Vivid HL7
        Gateway", which "feeds" the results to HIS through HL7
        protocol. M&A and diagnosis-codes are stored as an
        Excel file, reports are stored as CHM-files.

        The file path to the shared volume on "Vivid HL7
        Gateway" must be pre-configured in the *Sublevel Tools*
        in the Configuration package (see page 215).

    •   **DICOM Print**: prints images to a DICOM printer via
        DICOM spooler.

- **MPEGvue**: converts ultrasound images to MPEG format readable from a regular computer and export them to a CD.

6. Press **OK**.
    The *Export patient window* is displayed (see Figure 2-10).

Figure 2-10: The Export patient window

7. Search and Select the patient records to export 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 *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 as desired:
   - **Delete selected patient(s) after copy**
   - **Copy images**
   - **Copy only exams with on-line images**: when checked only selected examinations with accessible images will be copied.

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 2-11). 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 2-11: 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 patient exported (see Figure 2-10).
    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.
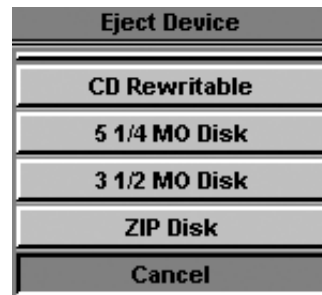
Figure 2-12: The Eject device menu

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

Importing patient records/examinations

1. Insert the removable media of the source archive in the corresponding drive (MO drive, Zip drive or CD-ROM).

2. Press **Archive**.
   The *Search/Create Patient window* is displayed (see Figure 2-1, page 13).

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 a Vivid 7 (direct connect).

4. Press **Import** in the *Search/Create Patient window*.
   The *Import dialogue window* is displayed (see Figure 2-13).

Figure 2-13: The Import Dialogue window

5. Select one of the following source archive from the *Source drop-down menu*:
   - **Removable MOD Archive**: imports raw and DICOM data (if present) from a MOD.
   - **Pure DICOM MOD525/350 RW**: imports DICOM data only from a MOD.
   - **Removable CD Archive**: imports raw and DICOM data (if present) from a CD-R.
   - **Pure DICOM CD-R**: imports DICOM data only from a CD-R.
   - **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 2-14).

Last Name	First Name	Patient ID	Birthdate	Exam Date	Copied	Status Msg
⊞ Test	Try	2323		07/01/2003		

Figure 2-14: 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.

8. Adjust the following settings as desired:

- **Copy images**

- **Copy only exams with on-line images**: when checked only selected examinations with accessible images will be copied.

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 2-11). 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.
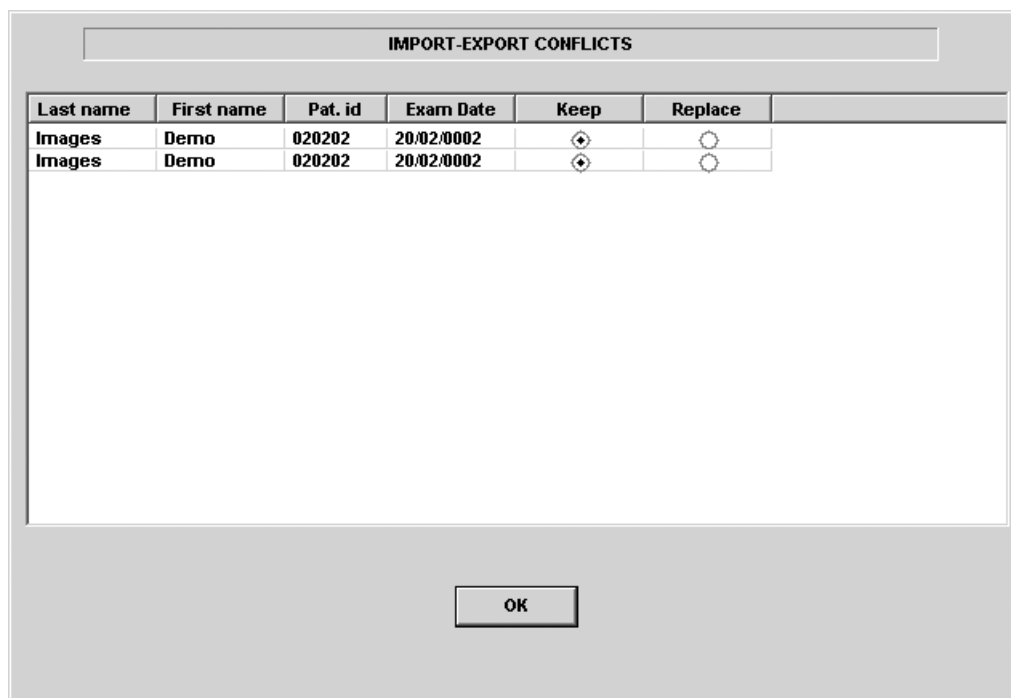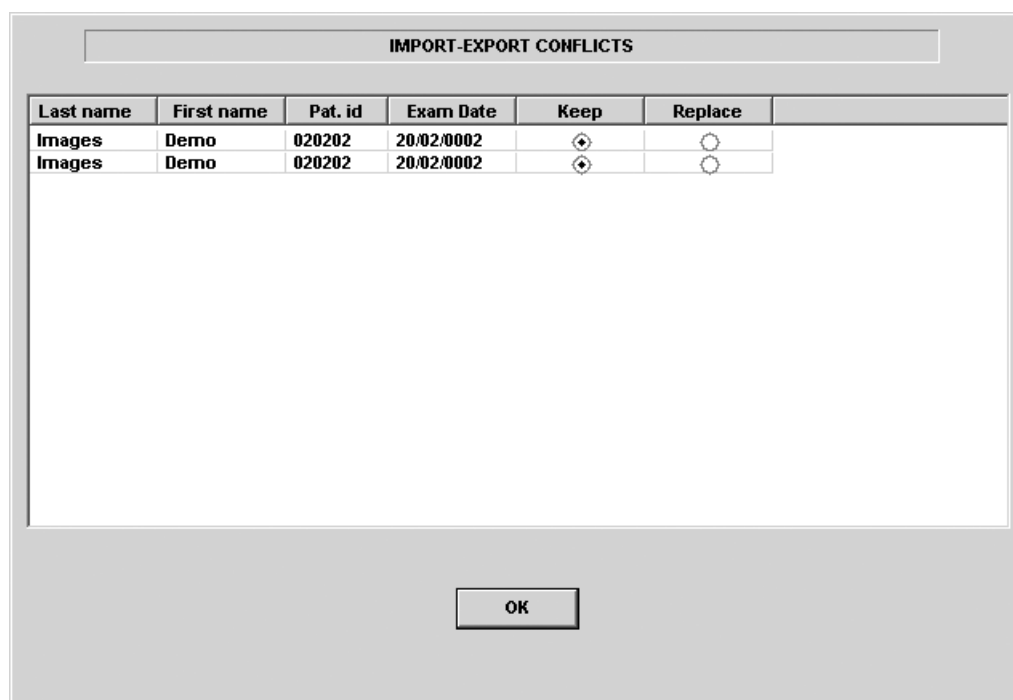
Figure 2-15: The Export/Import conflict window

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.

Data Backup and restore

The Backup/Restore function enables the user to:

- Copy/Restore the patient archive (patient database).
- Move images and stored reports from the local harddrive to MO disks.
- Copy/Restore the system configuration.

To minimize accidental loss of data, perform backup of the patient archive (patient data and reports) stored on the local harddrive at least **once a week**.

⚠

WARNING

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 (no creation of a safety copy). For long-term storage, images should be moved to MO disks when performing backup as described below.

The backup of the patient archive on the harddrive and the system configuration is done from the configuration management package as described on page 37.

Data from Backup/Restore disks may be restored to the local harddrive using the Restore procedure as described on page 41.

Only users with administration rights (see page 229) have access to the backup function.

Data backup for EchoPAC PC Software Only

Moving images

EchoPAC PC Software Only:

Moving images from the local harddrive to a removable media can only be done using the procedure described in 'Backup procedure' on page 37. DO NOT attempt to move/copy images in Windows Explorer as the image pointers in the patient database will not be updated for the images in the new location. If you copy images in Windows Explorer and delete

the original images you will not be able to retrieve the images again.

Backup of patient archive

EchoPAC PC Software Only:

Backup of the patient archive should be done using the procedure described in 'Backup procedure' on page 37.

Backup procedure

⚠️
CAUTION

Use a blank dedicated MO disk when doing a backup. This MO disk should only be used for backup/restore purpose (Do not use this MO disk when doing Export or Save as.). The backup procedure will OVERWRITE the existing data on the MO disk.

When formatting the MO disk, give it a logical name and make sure to physically label the disk with the mention "Backup". A labelling convention should be followed so that each MO disk gets a unique label.

If moving images, make sure to have enough formatted MO disks before disponible.

1. Insert a formatted (see page 215) MO disk in the MO drive.
2. Press **Config**.
   The *Log In window* is displayed asking for operator ID and password.
3. Select the user with administration rights and enter the password.
4. Select **Log on**.
   The *Setup dialogue window* is displayed.
5. Select the *Admin setup category*. The *Backup sheet* is displayed (Figure 2-16).
6. Select:
   • **Patient archive** to backup patient records.
   • **System setting** to copy system settings and user presets. The system configuration backup can be used to configure several EchoPAC PC units with identical presets, providing the units have the same software version.
   • **Move oldest images** to move images and reports from the local harddrive onto MO disks. Adjust the time span next to **Older than** to move images and reports older than that setting.
7. Select the MO disk as destination.
8. Press **Backup Now**.

- The system is checking that the MO disk is inserted. If not, a dialogue window is displayed prompting the user to insert a MO disk. Press **OK** to resume backup.

- The system is checking that the MO disk is formatted. If not, a dialogue window is displayed prompting the user to format the disk.

- The system is checking the available space on MO disk for the patient archive. If there is not sufficient free space a dialogue window is displayed. Press **OK**, the media is ejected and insert a new formatted MO disk.

A progress dialogue is displayed showing the current operation being performed.
If the amount of data exceeds the capacity of the MO disk the user is prompted to insert a new (formatted) MO disk.
At the end of the process a status for each item is displayed in the *Result column*.
If errors occur during backup, a list of the patient records/ examinations that could not be backed up is displayed.

1. Select the item to backup
2. Select and adjust the Move images function
3. Select the MO disk as backup destination
4. Start backup
5. Adjust the backup reminder

Figure 2-16: The Backup sheet

Set up backup reminder

1. In the *Backup sheet*, select the time interval (or none) for the backup reminder next to **Backup interval**.
   When the backup reminder time expires a reminder is displayed when starting the system to prompt the user to take a backup.
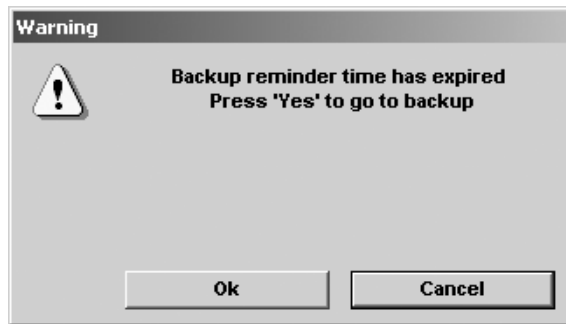
Figure 2-17: The Backup reminder prompt

Restore procedure

1. Insert the <u>Backup/Restore</u> MO disk in the MO drive.

△
CAUTION

The Restore procedure will OVERWRITE the existing database on the local harddrive. Make sure to insert the right MO disk.

2. Press **Config** on the alphanumeric keyboard.
   The *Log In window* is displayed asking for operator ID and password.
3. Select the user with administration rights and enter the password.
4. Select **Log on**.
   The *Setup dialogue window* is displayed.
5. Select the *Admin setup category*.
6. Select the *Restore sheet* in the *Admin setup category* (Figure 2-18).
7. Select:
   • **Patient archive** to restore patient records and reports.
   • **System setting** to restore/copy system settings and user presets.
8. Make sure that the Backup/Restore MO disk is inserted in the MO drive and selected as the source.
9. Press **Restore Now**.
   The process status for each item is displayed in the *Result column*.

1. Select the item to restore
2. Select the Backup/Restore disk
3. Start restoring data
4. Reset the system setting to factory default.

Figure 2-18: The Restore setup sheet

Chapter 3
Image Management

Contents

Introduction

EchoPAC PC allows post-processing of DICOM ultrasound images and raw data images from GE ultrasound scanners.

The user selects the images to analyze from the *Image browser screen* (displays a thumbnail overview of all stored images sorted by examination for the current patient) or from the *Review screen* (displays all images for the current examination) or from the *Protocol screen* for examinations based on protocol studies.

The main features of the EchoPAC PC image analysis package are:

- **Image optimization**: adjusts image settings such as Compress, Reject, Tissue priority, zooming, image rotation, cineloop replay adjustment...etc.

- **Measurement and Analysis**: performs either single measurement with post-assignment or protocol based pre-assigned measurements (see Chapter 4, 'Measurements and Analysis' on page 83).

- **Review and analyze protocol studies** such as Stress echo examinations including quantitative stress echo analysis (see Chapter 5, 'Stress echo analysis' on page 103).

- **Quantitative analysis** of Tissue Velocity, Tissue Tracking and contrast imaging data (see Chapter 6, 'Quantitative Analysis' on page 127).

Image review

Images can be reviewed from the *Image browser screen* or from the *Images review screen*.

- The *Image browser screen* displays a thumbnail overview of all stored images sorted by examination session for the current patient. The user can preview and group images from one or more examinations for the current selected patient to enable comparison analysis.

- The *Image review screen* displays all images for the current examination.

Review from the Image browser 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*, press **Image list** or the **Image browser** menu button.
   The *Image browser screen* is displayed (see Figure 3-3) showing thumbnails of stored images for the current patient sorted by examination sessions.
   If the images are stored on a removable media that is not mounted, the image thumbnail is replaced by a symbol.

2. Move the **Mouse cursor** over a thumbnail to display a preview of the image.

3. Select the images to review or press **Analyze** 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.
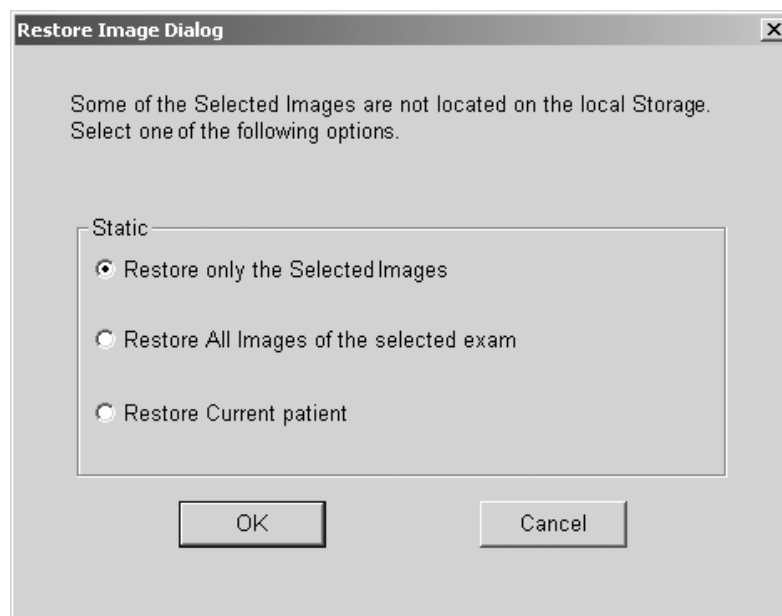
Figure 3-1: The Restore images window

4. 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.

5. Press **OK**.
   The *Insert media window* is displayed.
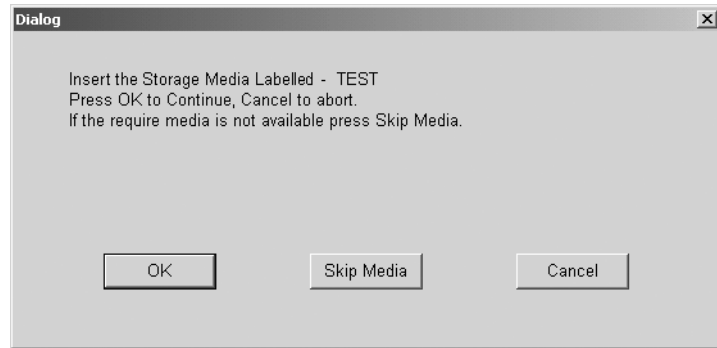
Figure 3-2: The Insert media window

6.   Insert the required media.

7.   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**
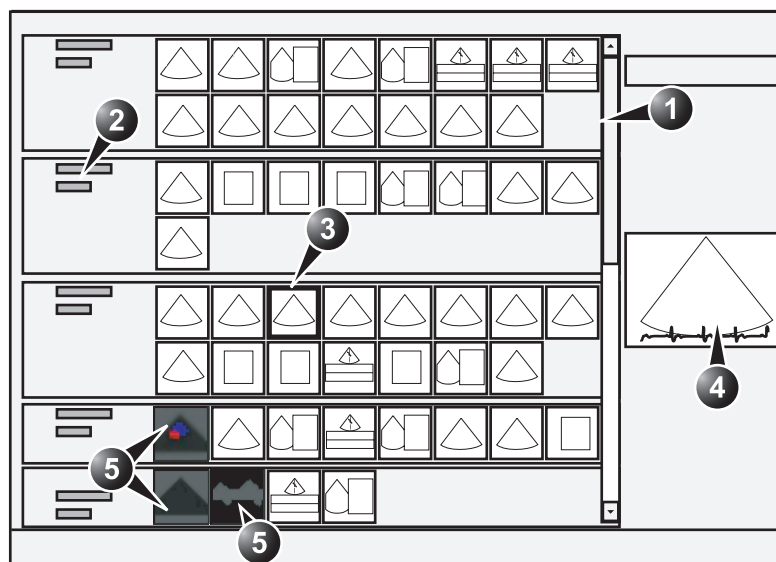
Figure 3-3: The Image browser screen

Review from the Review screen

1. In the *Examination list window*, select an examination and press the Review menu button.
    The *Review screen* is displayed showing all images for the current examination (see Figure 3-4).
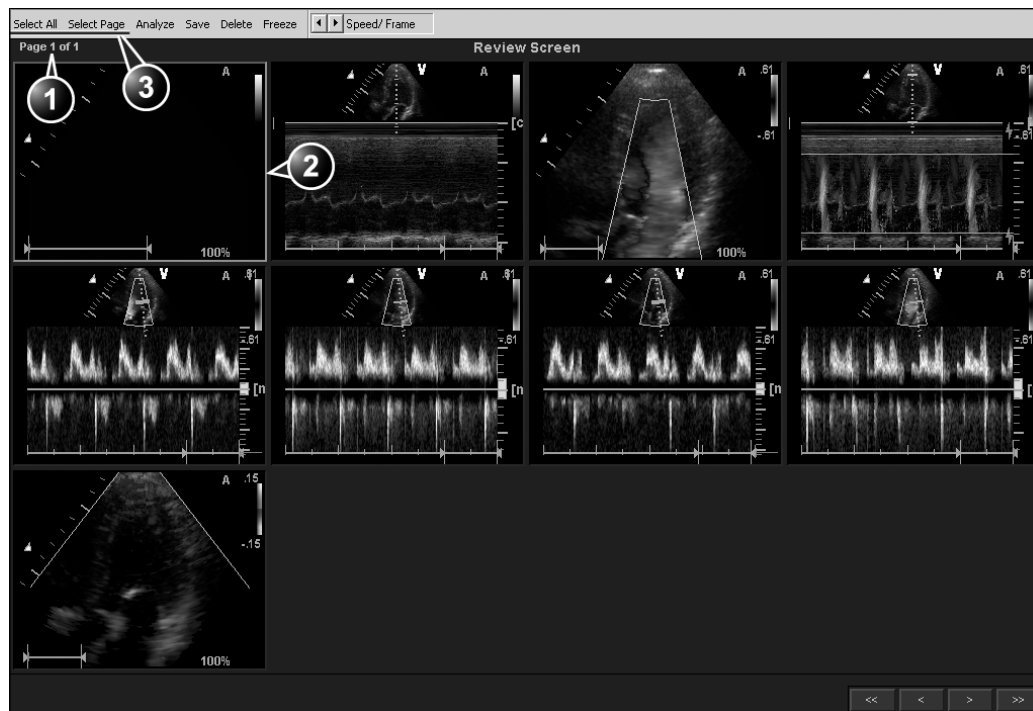
1. **Page number**   3. **Selection tools**
2. **Selected image (bold frame)**

Figure 3-4: The Review screen

Working with grouped images

Grouping images

1. From the *Image browser screen*, click once on each **image thumbnail** of the images to group.
    The selected image thumbnails are displayed with a highlighted frame.
2. Press **New Group**.

A dialogue box is displayed prompting the user to name the group (see Figure 3-5).

1. Images belonging to the selected group

2. Enter a name for the group
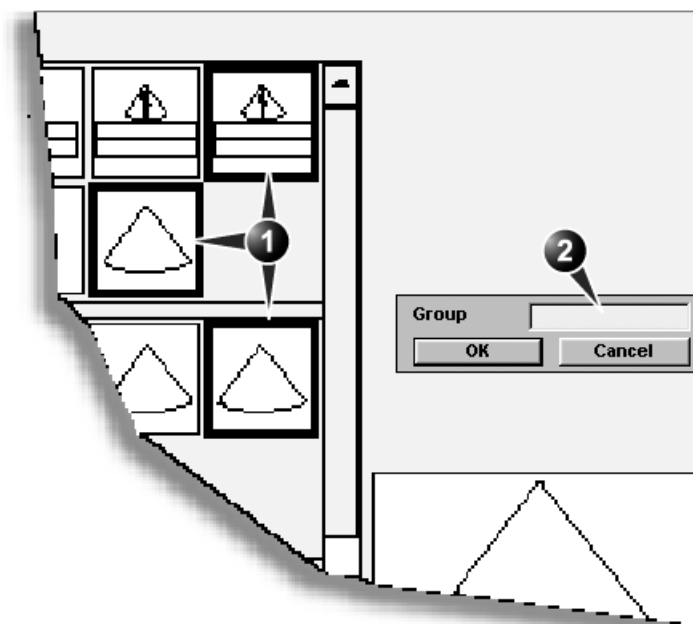
Figure 3-5: Creating a group of images in the Image browser screen

3. Type a name for the group.
4. Press **OK**.
   The group list on the right side of the screen is updated.
5. To select the group, press on the group in the *Group list*. Both the group name and the belonging image thumbnails are highlighted (see Figure 3-6).
6. Select **Analyze** to start analysis (see Chapter 4, 'Measurements and Analysis' on page 83).

1. **Images belonging to the selected group**
2. **Selected group**
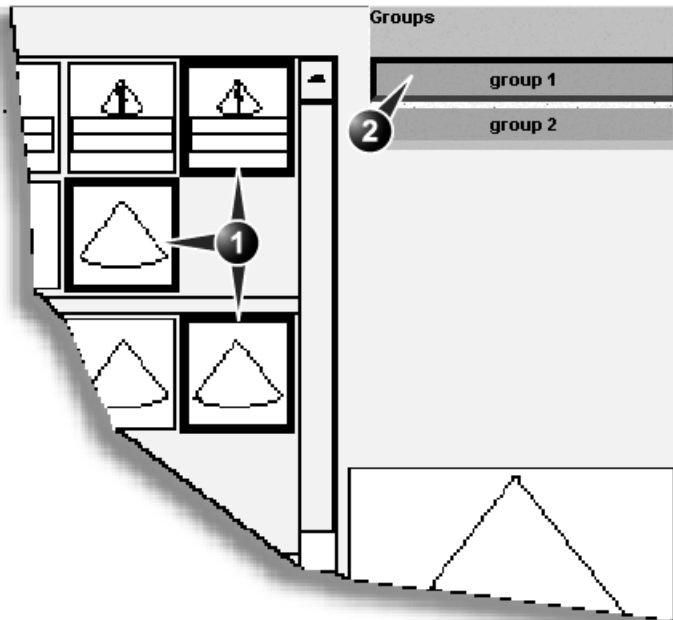
Figure 3-6: Selecting a group of images in the Image browser screen

To update an image group

1. Select the **group** to update from the *Group list*.
    Both the group name and the belonging image thumbnails are highlighted.
2. • To add images to the group: select the **image thumbnails**.
    • To remove images from the group: deselect the **image thumbnails**.
3. Press **Update Group**.

To delete an image group

1. Select the **group** to delete from the *Group list*.
2. Press **Delete Group**.
    The *Group list* is updated accordingly.

Image optimization

Image optimization is performed in the *Image analysis screen* after selection of the image of interest in the *Image browser screen*, the *Review screen* or the *Protocol screen*.

From the *Image browser screen*, the user can analyze images from different examination sessions for the selected patient.

From the *Review screen* the user analyzes images from the currently selected examination.

From the *Protocol screen* the user can analyze images from a stress echo examination.

Image analysis screen overview

The *Image analysis screen* consists of:

*   a *Display window* showing up to 12 ultrasound images (single frame and cineloop), see Figure 3-7.
*   a Control panel for image optimization and analysis. The control panel is mode-dependent (see Figure 3-8 through Figure 3-12).
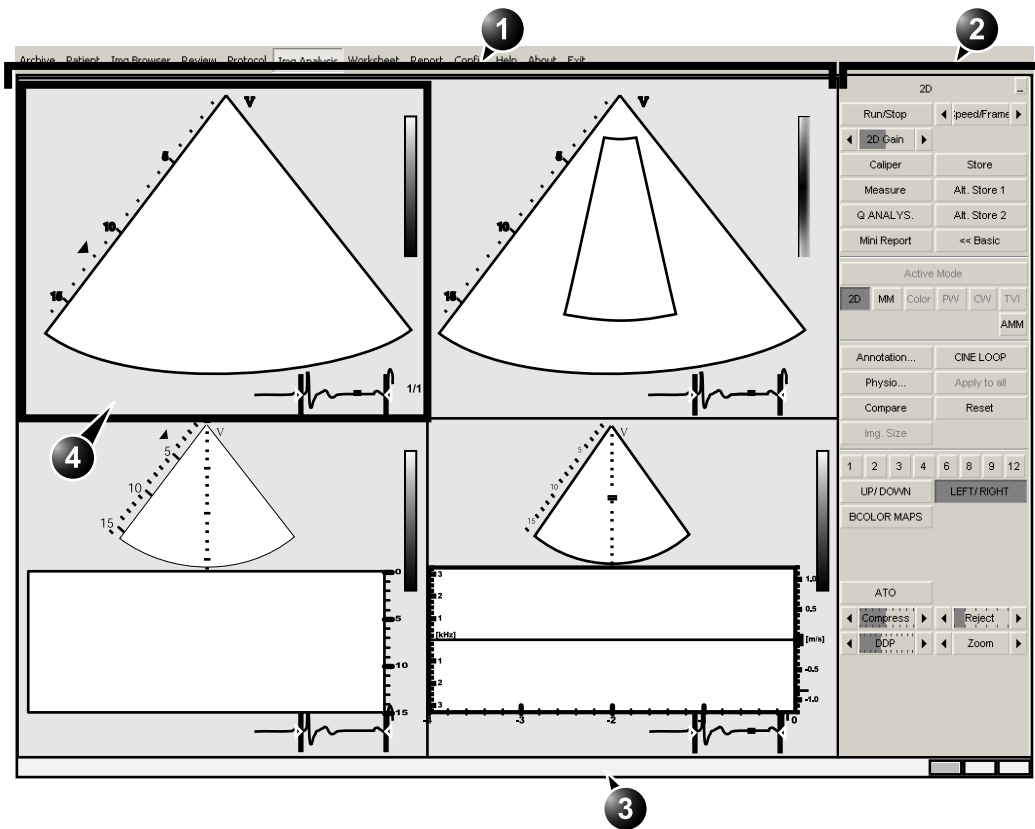
1. **Display window** 4. **Selected image (Highlighted frame)**
2. **Control panel**
3. **Status bar**

Figure 3-7: The Analysis screen

Control panel overview

The control panel can be displayed in three states:

*   **Minimized**: displays only a few controls. This setting enables maximum image display area.
*   **Basic**: displays a selection of mode specific controls.
*   **Advanced**: displays all the mode specific controls.

Control panel display

Switch between minimized and basic/advanced display
1. Press the button on the upper left corner of the control panel.

Switch between basic and advanced display
1. When the advanced control panel is displayed, press
    << Basic
    When the basic control panel is displayed, press
    Advanced >>.

Advanced

Basic

Minimized

Figure 3-8: The 2D control panel

Advanced   Basic
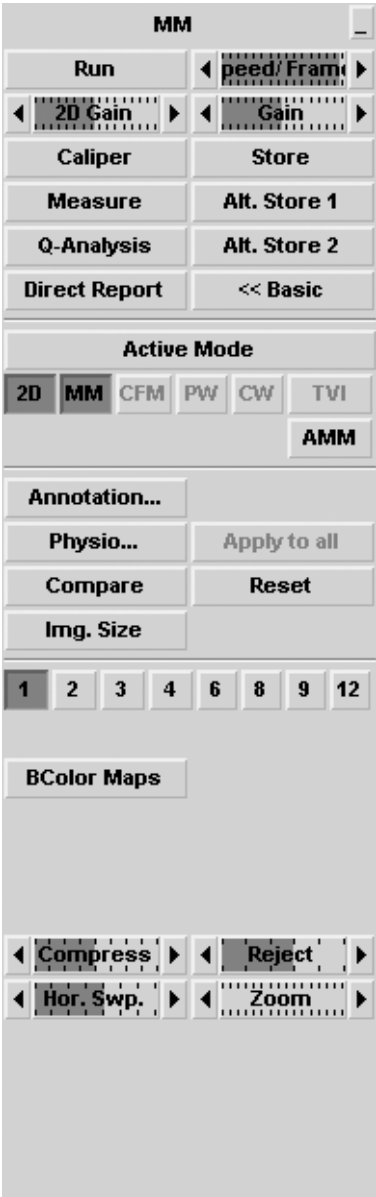
Figure 3-9: The M-Mode control panel

Advanced
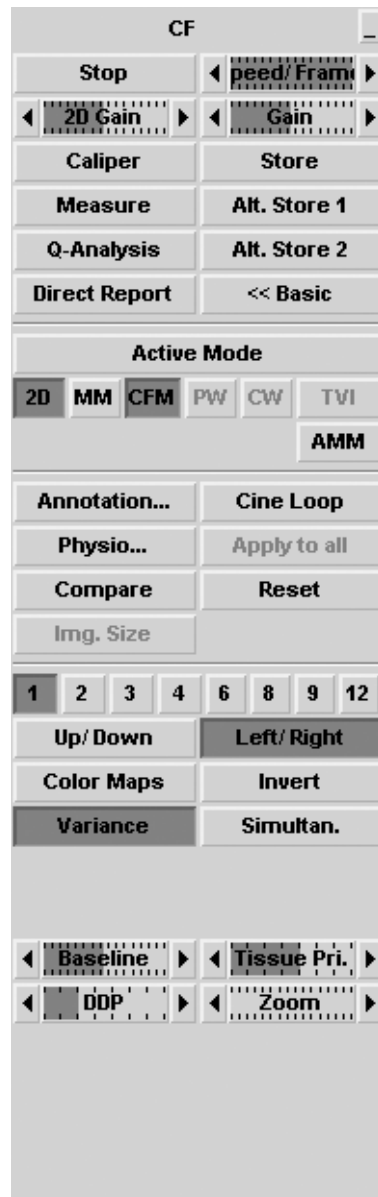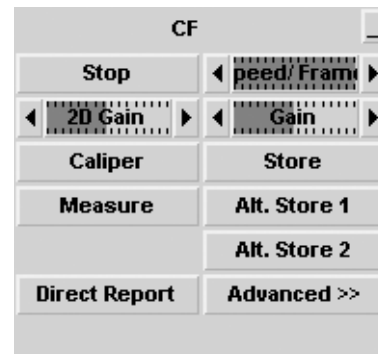
Basic

Minimized

Figure 3-10: The 2D Color control panel
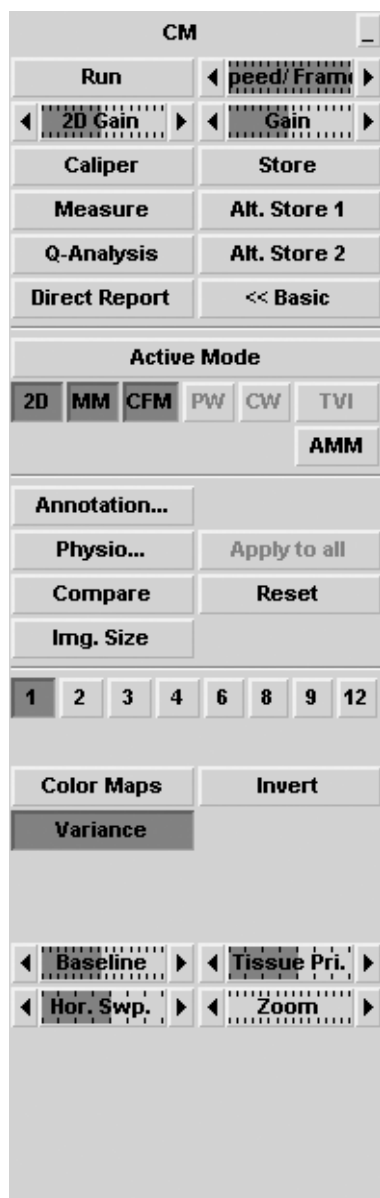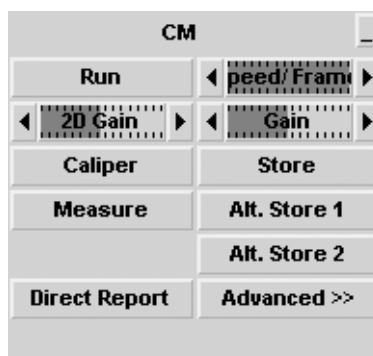
Advanced

Basic

Minimized

Figure 3-11: The M-Mode Color control panel

Advanced
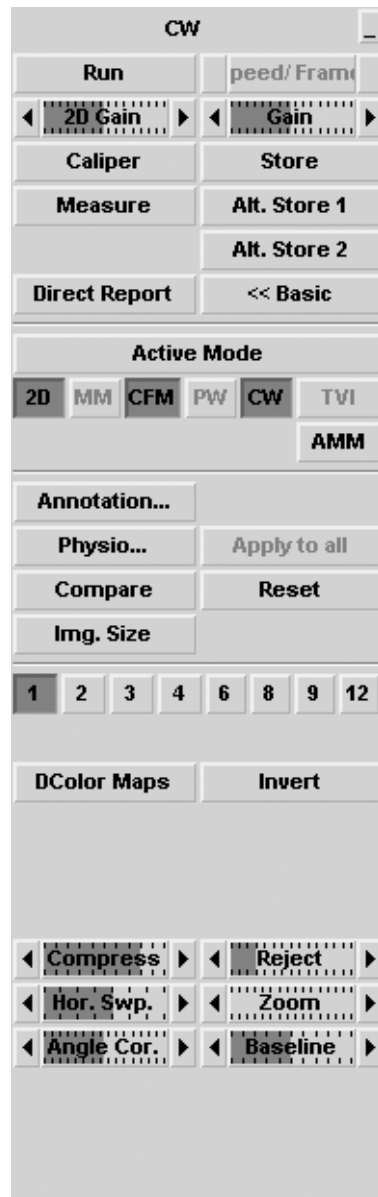
Basic
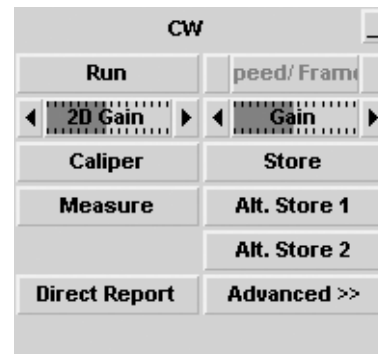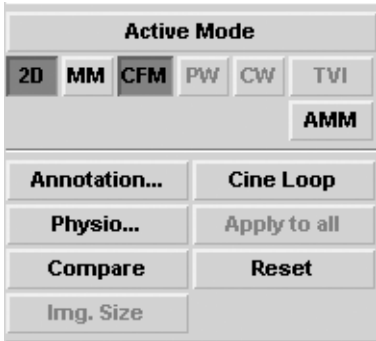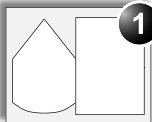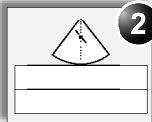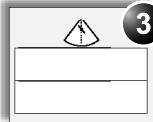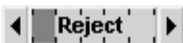
Minimized
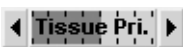
Figure 3-12: The Doppler Spectrum control panel

Control	Description
	Run/Stop Cineloop (All modes): Starts and stops the cineloop (shortcut: **ALT** + **R** or **SPACE BAR**). When running, use **Speed/Frame** to adjust the cine speed. When stopped, use **Speed/Frame** to scroll through the cineloop. **2D Gain (All modes):** Tissue gain **Gain (All modes but 2D):** Gain for the active mode. **Caliper (All modes):** Activates measurement tool (unassigned measurement). **Measure (All modes):** Activates the Measurement & Analysis (M&A) calculation program (protocol based pre-assigned measurements). **Quantitative Analysis (2D, 2D Color):** Starts the Quantitative analysis program for TVI and contrast applications (see page 127). **Direct report (All modes):** Displays the Direct report where the user can enter comments, diagnosis and Ref. reason information while doing image analysis. The Direct report displays also an overview of the measurements performed. **Store (All modes):** Stores the currently active image to disk. **Alt. Store 1 and 2 (All modes):** Stores the image to an alternative media. This function is configurable. **Basic/Advanced:** Displays the basic or advanced control panel.

Control	Description
Active Mode 2D **MM** **CFM** PW CW TVI **AMM** Annotation... Cine Loop Physio... Apply to all Compare Reset Img. Size	**Active mode (Color, M-Mode, Doppler):** In combined mode, switches between modes to activate the mode specific controls. **Mode selection (All modes):** In combined mode, select the mode to display. **Annotation:** Enables the insertion/deletion of body marks, arrows and text in the selected image. **Physio:** Enables to display/hide and adjust the physiological traces. **Compare (All modes):** Displays a copy of the selected cineloop. Enables frame by frame comparison of the selected cineloop (independent scrolling). **Image size (Doppler, M-Mode):** Toggles the display priority of 2D Mode or Doppler/M-Mode and top/bottom (1) or side by side display with 2D priority (2) or time-motion priority (3) when working in combined mode. **Cineloop:** Displays the cineloop controls (see (page 66)). **Apply to All (All modes):** Applies changes on all opened images. Works for the following controls: Up/Down, Left/Right, Invert, Variance, Persistence, Tissue priority, Gain, Compress, Reject, Baseline, Mode selection and Color Map. **Reset (All modes):** Restore all controls to original setting.

Control	Description
	1 to 12:
	Select the number of images to display.
	Up/down (2D, 2D Color, M-Mode):
	Flips the image 180 degrees.
	Map (All modes):
	Selects mode specific color map from the pop-up menu.
	Variance (2D Color):
	Controls the amount of variance data added to a color display. Variance enables computer-aided detection of turbulent flow (e.g. jets or regurgitation).
	Left/Right (2D, 2D Color):
	Creates a mirror image of the original image. The left/right reference marker **V** moves to the other side of the image.
	Invert (2D Color, Doppler):
	Enables the color scheme assigned to positive and negative velocities to be inverted.
	Simultaneous (2D Color, TVI modes):
	Enables simultaneous display of 2D image and color image.
	Compress (All modes):
	Controls the amount of contrast.
	DDP (2D, 2D Color):
	Performs temporal processing which reduces random noise without affecting the motion of significant tissue structures.
	Reject (All modes):
	Discards low levels echoes when increased.
	Zoom (All modes):
	Magnifies the image display in both frozen and live (see page 66).
	Horizontal sweep (M-Mode, Doppler):
	Controls the time scale in the time-motion display.

Control	Description
◀ Tissue Pri. ▶	**Tissue priority (2D Color):** Emphasize either the color of the color mode or the greyscale tissue detail of the 2D image.
◀ Angle Cor. ▶	**Angle Correct. (Doppler):** Enables stepwise angle correction (by 2 degrees) of the Doppler velocity scale.
◀ Transp. ▶	**Transparency (All TVI modes):** Controls the degree of transparency of the color display.
◀ Thresh. ▶	**Threshold (All TVI modes):** Controls the level of greyscale intensity that is used as a threshold for color.
◀ TT Start ▶ ◀ TT End ▶ ◀ SI Start ▶ ◀ SI End ▶	**TT Start (Tissue Tracking), Strain Start (Strain):** The time after ECG R-peak when the mode specific calculation starts. **TT End (Tissue Tracking), Strain End (Strain):** The time after Track or Strain End when the mode specific calculation should end.
◀ TT Scale ▶	**TT scale (Tissue Tracking):** Controls the color cut-off value of max displacement displayed.
◀ SI Length ▶	**SI length (Strain rate, Strain):** Determines the Strain/Strain rate sample volume size.
◀ SRI Reject ▶ ◀ SI Reject ▶	**SRI reject (Strain rate), SI reject** Adjusts the cut-off level of the low tissue velocity to be discarded. Rejected values are uncolored (Strain) or green (Strain rate).
◀ Cine Comp. ▶	**Cine compound (All TVI modes):** Calculates and displays cineloops generated from a temporal averaging of multiple consecutive heart cycles.

Control	Description
◀ SI Scale ▶ ◀ SRI Scale ▶	**SI scale (Strain), SRI scale:** Define the scale for the color coding for strain or strain rate.
◀ TSI Start ▶ ◀ TSI End ▶	**TSI start (Tissue Synchronization Imaging):** The time from the onset of QRS when TSI starts, indicated by a red marker on the ECG. The default value is set to approximate the time for start ejection and by the value on the left side of the color bar. **TSI end:** The time after TSI start when TSI ends, indicated by a red marker on the ECG. The default value is set to approximate the aortic valve closure and by the value on the right side of the color bar.
◀ TSI Alg. ▶	**TSI algorithms (Tissue Synchronization Imaging):** Enables the display of the following TSI features: • Time to peak positive velocity: color-codes at what time the tissue velocity reaches its peak positive value. • Time to onset of positive velocity: color-codes at what time the velocity increases above a given TSI Threshold (default 0 cm/s). • Time to peak negative Strain rate: color-codes at what time the tissue strain rate reaches its peak negative value.
◀ TSI Thresh. ▶	**TSI Threshold (Tissue Synchronization Imaging):** Controls the minimum value to detect.

Image controls adjustment

Controls with multiple settings can be adjusted in two ways as shown in (Figure 3-13).

1. **Decrease stepwise**
2. **Increase stepwise**
3. **Select setting on the scale**
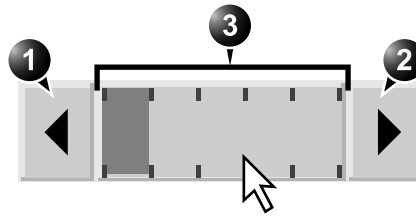
Figure 3-13: Image control adjustment

Image optimization

1. Select the **image** of interest.
   The control panel displays the mode specific controls.
2. If necessary display the advanced control panel (see page 54).
3. If applicable, deselect **Run Cineloop** to freeze the image and scroll through the cineloop using the **Speed/Frame** control or by dragging the frame marker on the ECG to display the desired image.
4. In dual modes, press **Image size** until the desired display is shown (see page 61).
   Press **Active mode** to toggle between modes. The control panel is updated accordingly.
5. Adjust the mode specific image controls to optimize the display.
6. Press **Store** to save the changes.

Zoom function

1. Select inside the **Zoom scale** or press the **Zoom increase button**.
   OR
   Press **ARROW UP**.
   A portion of the selected image is magnified and a situation picture is displayed showing the outlined zoom region.
2. Press and hold down the **Left mouse button** while moving the mouse upward to increase magnification or downward to decrease magnification.
   OR
   Press **ARROW UP** to magnify or **ARROW DOWN** to decrease magnification.
3. Press and hold down **SHIFT** and the **Left mouse button** while moving the mouse to move the zoomed area.
   OR
   Press **SHIFT** and **RIGHT ARROW** or **LEFT ARROW**.

Optimizing cineloop

The cineloop boundaries can be adjusted by dragging the left and right markers on the ECG or by using the cineloop controls as described below.

Cineloop overview

1. **ECG**
2. **Loop display**
3. **Left marker: drag to move.**
4. **Current frame: in freeze, drag to select frame or select frame on ECG.**
5. **Right marker: drag to move.**
6. **Cine speed (replay)**
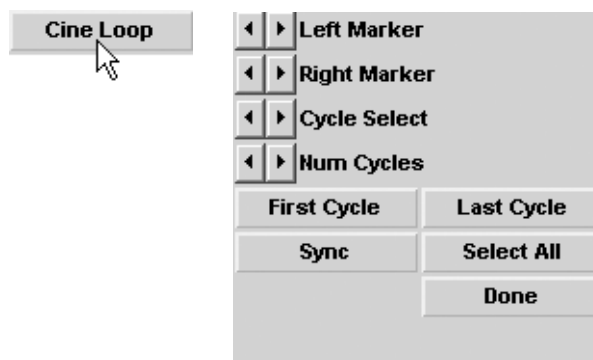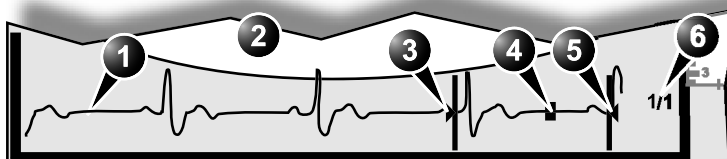
Figure 3-14: The cineloop display and controls

To run/stop a cineloop
1. Press **Run/Stop** or **ALT** + **R** or **SPACE BAR**.

Cineloop adjustment
1. Select a **cineloop**.

2. If necessary, press **Run/Stop** to freeze the cineloop.

3. Press **Cineloop**.
   The cineloop controls are displayed on the control panel (see Figure 3-14).

4. Using the **Cycle select** control, 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 First cycle or Last cycle button.

5. Using the **Num cycles**, adjust the number of heart cycle to incorporate to the cineloop.

6. Using the **Left marker** and **Right right** controls, trim or expand the cineloop boundaries.

7. Check **Sync** to synchronize all the cineloop.

8.   Press **Done** to return to the *Image Analysis screen*.

Generated Anatomical M-Mode

Anatomical M-Mode (AMM) displays can be generated from raw data 2D, 2D Color and TVI images.

To generate Anatomical M-Mode images

1. In the *Image analysis screen*, select a 2D, 2D Color or TVI image.
2. Select **MM** or **AMM**.
   The *Display window* is updated with an M-Mode image.
   The 2D sector displays a time motion cursor for the AMM.
3. Adjust the AMM cursor position and angle as shown in Figure 3-15.
   All other controls are similar to conventional M-Mode (see page 54 and followings).
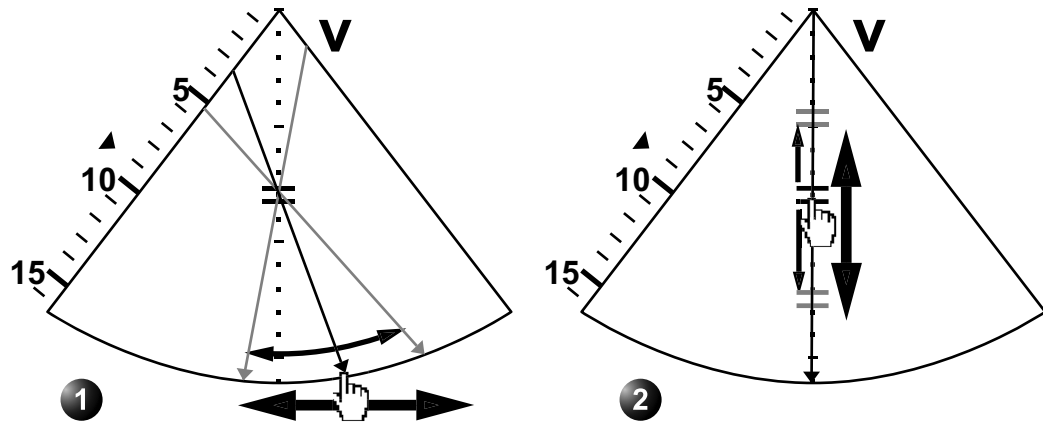
1. **AMM cursor angle adjustment**   2. **AMM cursor position adjustment**

Figure 3-15: Adjustment of the AMM cursor

Direct report

Direct report enables the user to write comments during image analysis that will be part of the final report.

Direct report provides also an overview over the measurements completed.

Creating comments

1. Press **Direct report** (see Figure 3-16).
2. Select the comment type.
3. Type your comments in the *Text 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**
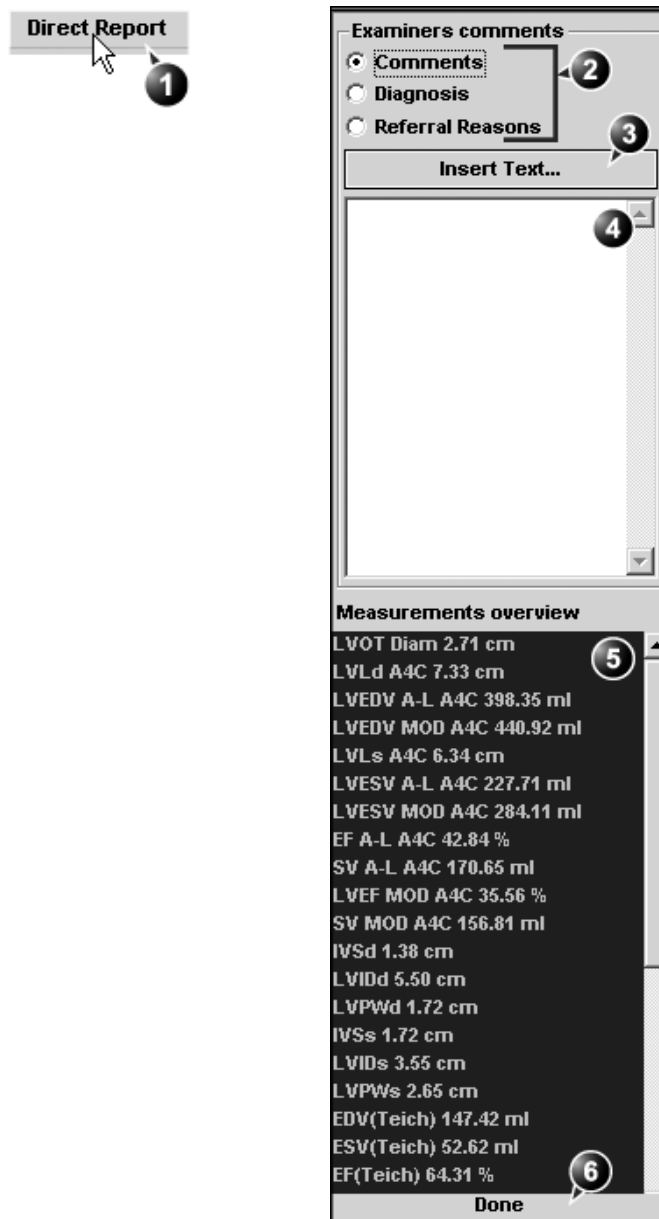
Figure 3-16: The Direct report

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 3-17).
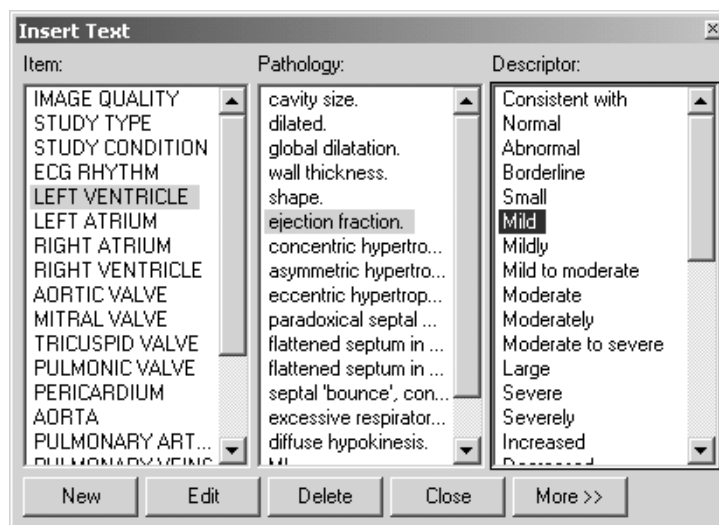
Figure 3-17: The Insert text window

The pre-defined text list is organized in a three level hierarchy. Selecting one item in column one (**Item**) displays a specific pre-defined text list in column two (**Pathology**) related to the item selected. Likewise selecting a pathology term in column two displays a specific pre-defined text list in column three (**Descriptor**) related to the pathology selected.

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 a descriptor is selected, both the descriptor and the pathology texts are inserted.
    Press **More>>** to display the full text for the selected term.

Creating pre-defined text input

Creating a new Item (first level)

1. Select the first level.
2. Press **New**.
    The *Enter new text window* is displayed.

Figure 3-18: The Enter new text window

3.   Enter a title for the item in the *Text field*.
Enter the pre-defined text in the *Full text field*.

4.   Press **OK**.

New Pathology text
1.   Select the item in the first column.

2.   Select the second column.

3.   Press **New**.
The *Enter new text window* is displayed (Figure 3-18).

4.   Enter a title for the Pathology in the *Text field*.
Enter the pre-defined text in the *Full text field*.

5.   Press **OK**.

New Descriptor text
1.   Select the item in the first column.

2.   Select the Pathology term in the second column.

3.   Select the third column.

4.   Press **New**.
The *Enter new text window* is displayed (Figure 3-18).

5.   Enter a title for the Descriptor in the *Text field*.
Enter the pre-defined text in the *Full text field*.

6.   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.
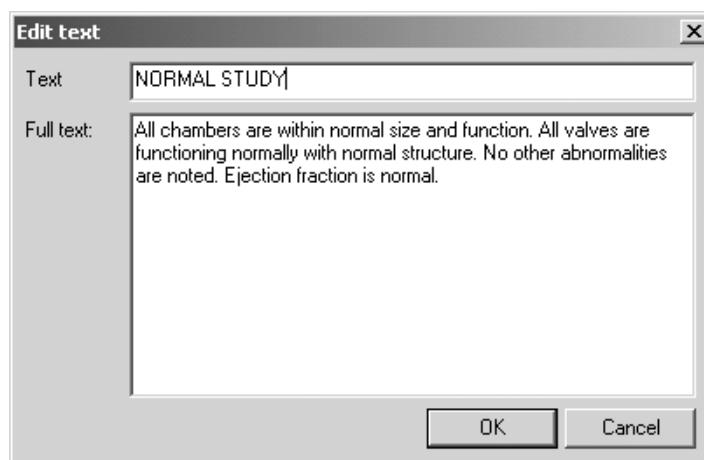
Figure 3-19: The Edit text window

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 term 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.

Saving stored images and cineloops to a standard format

Stored images and cineloops can be saved to a formatted (see page 215) MOD or a CD-R in the following standard formats:

- **Still images**: JPEG, DICOM and RawDICOM (Raw data + DICOM)
- **Cineloops**: AVI, 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 77.

Procedure:

1. In the Image analysis screen. select the required image or loop.
2. Press the **Right mouse button**.
   The *System menu* is displayed.

Figure 3-20: The System menu

3. Select **Save as**.
   The *Save as menu* is displayed.
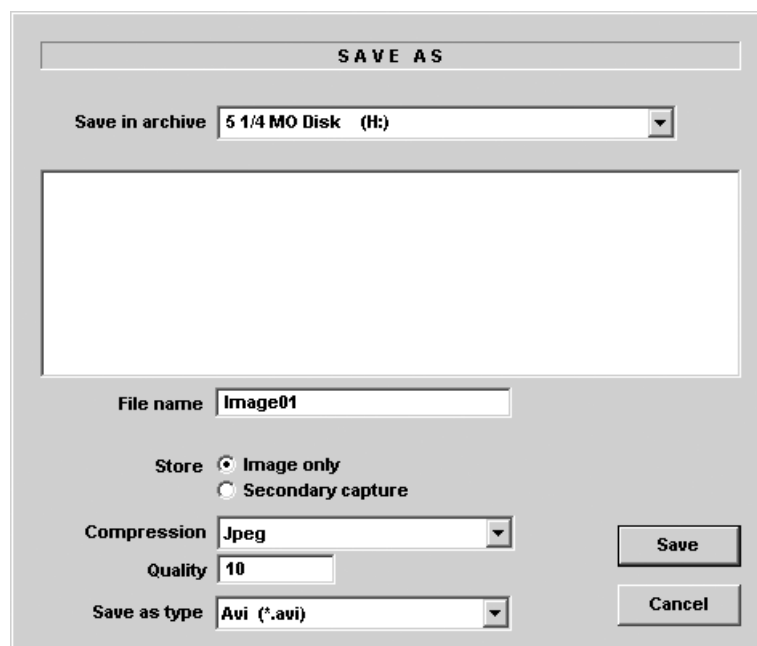
Figure 3-21: The Save as menu

4.   Select the desired removable media from the *Save in archive pull-down menu*.

5.   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.

6.   Select between:

     • **Store image only**: saves the image or cineloop only.

     • **Store secondary capture**: creates a still image of the entire screen.

     The secondary capture is not available when saving images as DICOM or RawDICOM.

7.   Select the image compression type (JPEG or RIe) or no compression.

8.   Enter in the desired **Image quality** (between 10 and 100). A high quality setting will give a lower compression.

9.   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.
- **AVI**: saves the cineloop in AVI format.

10. Press **Save**.
    A file is saved in the selected archive.

MPEGvue

MPEGvue enables the user to convert ultrasound images to MPEG format and create a CD that is readable from a regular computer.

Creating a MPEGvue CD

EchoPAC PC Workstation

1. Insert a formatted CD-R in the drive.
2. Export the actual patient records as described on page 26. Make sure to select **MPEGvue** as the export destination.

EchoPAC PC Software Only:

When export patient records to MPEGvue on EchoPAC PC Software Only, the data is stored to a folder called *MPEGvue* on the local harddisk. This folder is located in *Archive/Export*. To make a MPEGvue CD, the entire contents of the *MPEGvue folder* must be written to the CD. After creating the CD, the *MPEGvue folder* should be deleted, otherwise its content will be added to the next MPEGvue export.

Reading MPEGvue CD

MPEGvue CD can be read form any computer with Windows 98/2000/XP, provided that DirectX 8.1 or later and Windows Media Player 7.1 or later are installed.

1. Insert the MPEGvue CD in the computer CD drive.
   The *MPEGvue Patient list* is displayed.

ID	NAME	Exam Date ①	Num. Images
QTS030303093645	Patient1, Test	03/03/2003	14
QTS06032003	Patient2, Test	06/03/2003	25
QTS07032003	Patient3, Test	07/03/2003	35

1. Select the examination date.

Figure 3-22: The MPEGvue Patient list

2. Select the desired examination date to display the belonging images.
The *MPEGvue screen* is displayed (Figure 3-23).
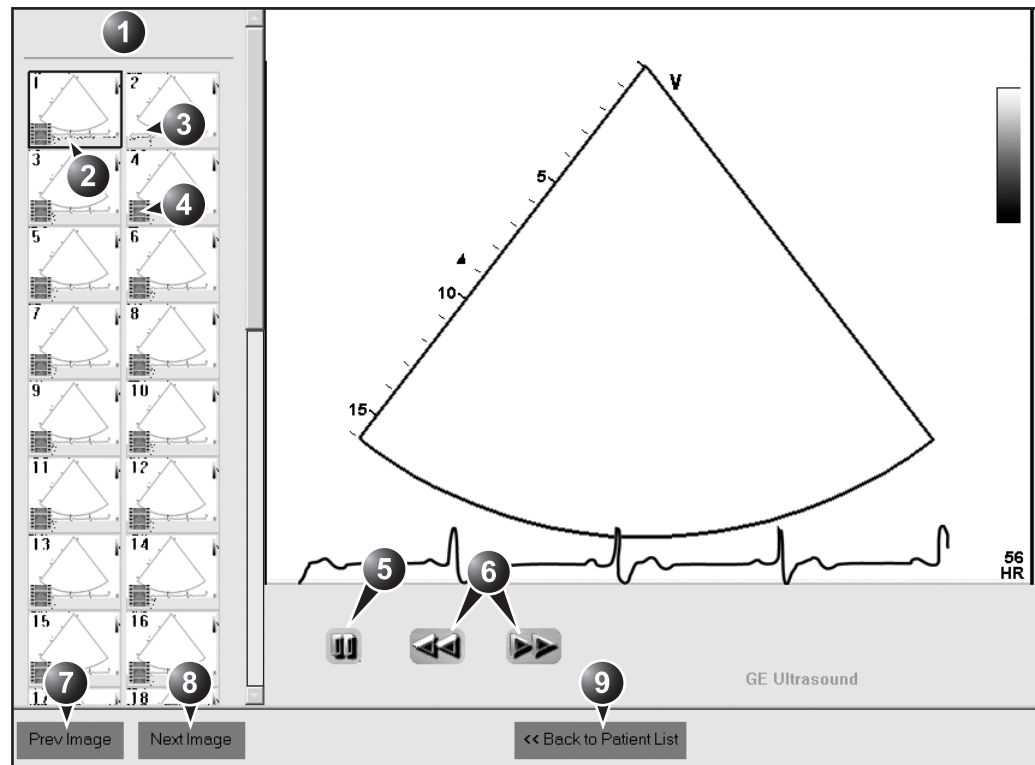
1. **Clipboard: select the image to display**
2. **Selected image**
3. **Single frame image**
4. **Cineloop**
5. **Freeze/run cineloop**

6. **Scrolling tool when in Freeze**
7. **Display previous image**
8. **Display next image**
9. **Display the MPEGvue patient list**

Figure 3-23: The MPEGvue screen

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.

The job's status displayed in the *DICOM spooler window* can be:

- **Pending**: the job is complete, waiting to be active.
- **In hold**: the job is incomplete, waiting for more images.
- **In progress**: the job is connected to the destination device but is waiting for more images (Direct store function).
- **Active**: the job is complete but one or more images failed to transmit to the destination device.
- **Failed**: the job is complete but failed to connect 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

1. Press and hold down the $\overline{\text{ALT}}$ key and press $\overline{\text{S}}$.
   The *DICOM spooler window* is displayed (see Figure 3-24).

The *DICOM spooler window* is automatically updated every minute. Press **Refresh** to update the information displayed at any time.
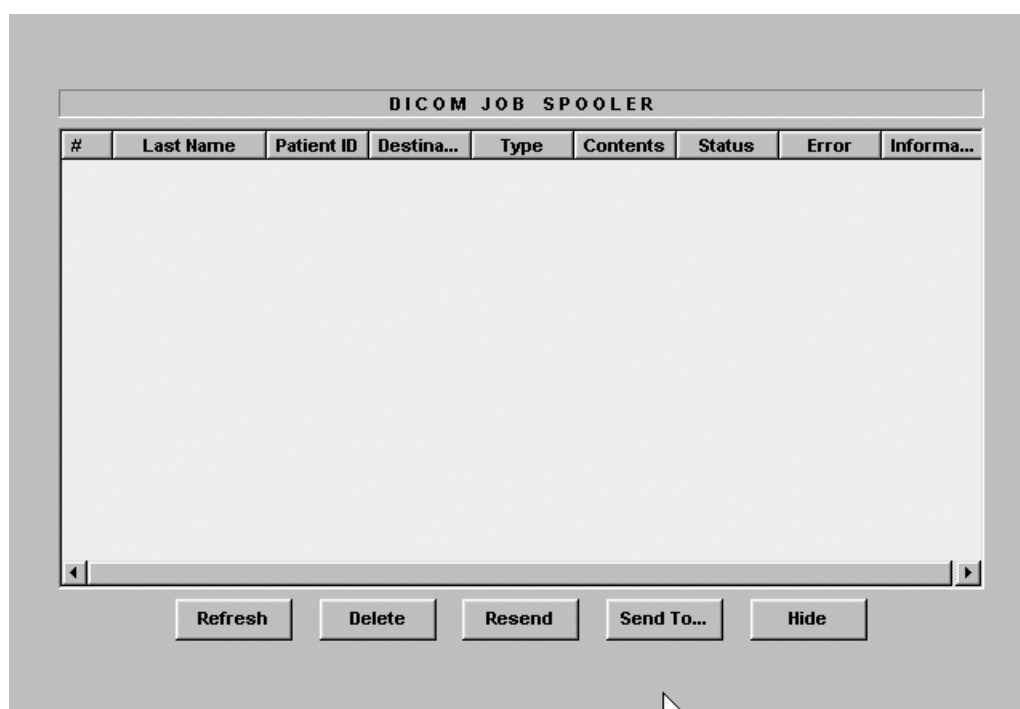
Figure 3-24: The DICOM job spooler window

Deleting a job

Only non-active jobs can be deleted.

1. Select the job to delete in the *DICOM job spooler window*.
2. Press **Delete**.

Resending a job

Only jobs that failed or are in hold can resent.

1. Select the job to resend in the *DICOM job spooler window*.
2. Press **Resend**.
3. Press **SELECT**.

Sending a job to a new destination

Only jobs that failed or are in hold can be sent to a new destination.

1. Select the job to send in the *DICOM job spooler window*.
2. Press **Send to...**.
   A dialogue window is displayed.
3. Select the new destination from the *Destination popup menu*.
4. Press **Send**.

Chapter 4
Measurements and Analysis

Contents:

Introduction

EchoPAC PC provides functionality for two measurement conventions:

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).

- **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 measurements labels. This convention is started from the **Measure** button. 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.

- **Measure and Assign (Free style)**: the user performs a measurement and assigns a label. This convention is started either from the buttons **Measure** or **Caliper**.

⚠️
CAUTION

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

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. In the *Image analysis screen*, click on **Measure**.
   The *Measurement Menu* is displayed over the control panel (see example Figure 4-1).
   The cursor is in the display window, ready for starting measurement.

Measurements and Analysis

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

The studies are configurable (see page 190).
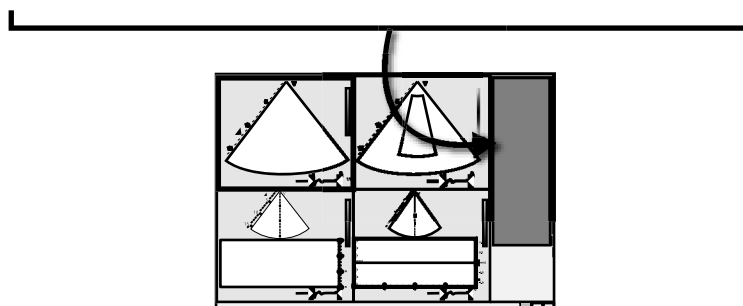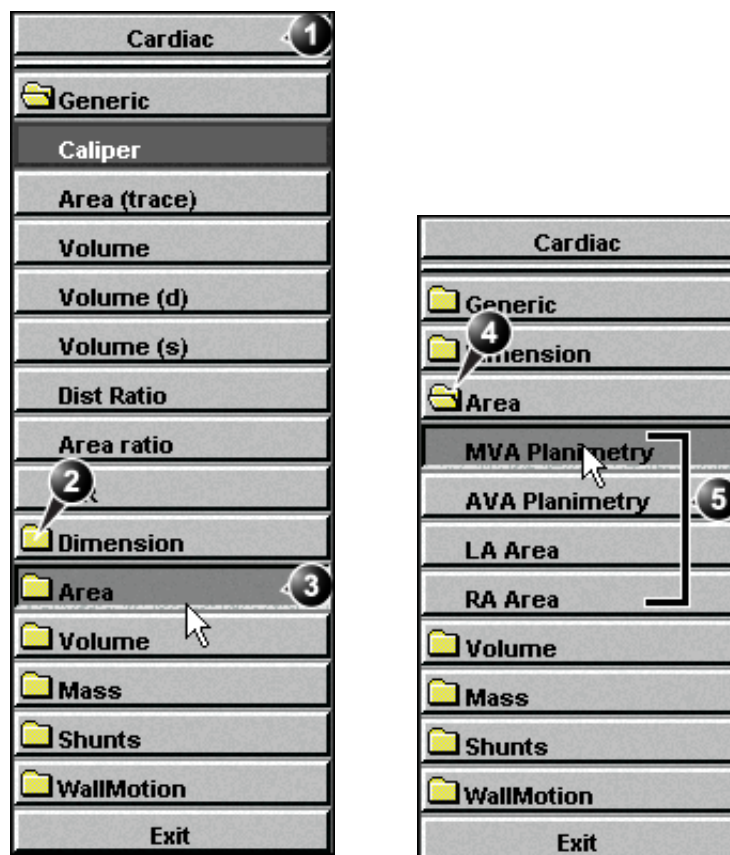
Figure 4-1: Example of a measurement study

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 4-1). When entering the Measurement mode for the first time, the Caliper tool is selected by default. When re-entering the Measurement mode, the first measurement in the actual study that has not been performed is selected by default.

To perform a measurement from another study:

1. Select to the required study.
   The study folder is opened, displaying the measurements related to this study. Other related studies may also be available from within this study.

2. Select the measurement to perform.

3. Perform the measurement.
   Completed measurements are marked with a check mark Figure 4-2). When the measurement operation is completed the next measurement on the list is automatically selected.

To skip a measurement in a study

1. Select the desired measurement.

1. **Performed measurement**
2. **Next measurement is automatically selected**
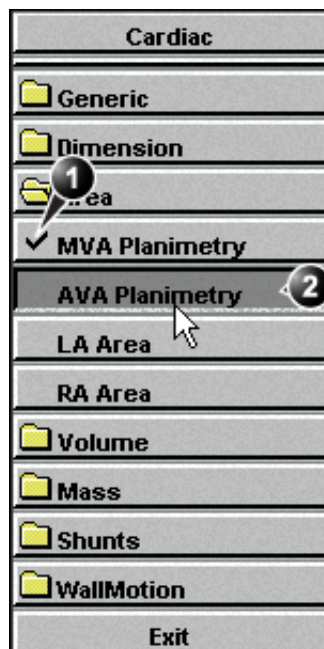
Figure 4-2: Display of a performed measurement (example)

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

Alternative: Select **Caliper** *on the control panel and select the measurement tool from the assignables.*

1. In the *Image analysis screen*, click on **Measure**. The *Measurement Menu* is displayed over the control panel.
2. If not already selected, select the actual measurement tool (see Figure 4-3).

1.   Measurement tools
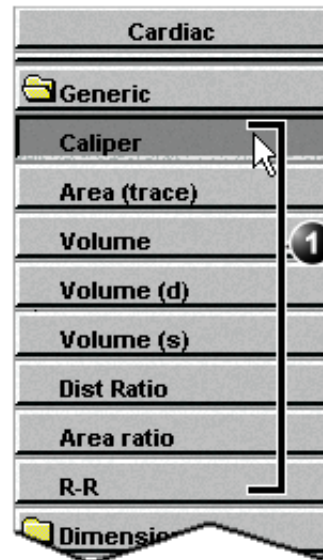
Figure 4-3: the 2D Mode Measurement tools (Cardiac application)

Performing measurements

2D Measurements

2D Length measurements

1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

2. Press **Measure**.

3. Select **Caliper** in the *Measurement Menu* (see Figure 4-3).

4. Move the cursor to the start point of the measurement.

5. Press the **Left mouse button** to anchor the start point of the measurement.

6. Move 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.

7. Press the **Left mouse button** to anchor the end point of the measurement.
The measurement result is displayed in the *Measurement result table*.

8. To assign a label to the measurement, see page 99.

9. Repeat steps 5 through 8 to make additional length measurements.

2D length measurement ratio

1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

2. Press **Measure**.

3. Select **Dist. ratio** in the *Measurement Menu* (see Figure 4-3).

4. Perform two length measurements as described 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. Double click on the anchor point to move.

2. Drag the anchor point to a new position.

Alternative: Press **Caliper** *and select* **Caliper** *from the pull-down menu.*

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

The measurements displayed on the 2D image and the corresponding results are numbered.

Alternative: Press **Caliper** *and select* **Dist Ratio** *from the pull-down menu.*

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

3. Press the **Left mouse button** to anchor the point at the new location.

2D Area measurements
1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

Alternative: Press Caliper and select Area from the pull-down menu.

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

2. Press **Measure**.
3. Select **Area** in the *Measurement Menu* (see Figure 4-3).
4. Move the cursor to the start point of the measurement.
5. Press the **Left mouse button** to anchor the start point of the measurement.
6. Trace the area (planetary) by dragging the mouse.
   The current area and circumference values are displayed in the *Measurement result table* and are instantaneously updated when moving the cursor.
7. Press the **Left mouse button** to complete the measurement.
   The measurement result is displayed in the *Measurement result table*.

The measurements displayed on the 2D image and the corresponding results are numbered.

8. To assign a label to the measurement, see page 99.
9. Repeat steps 4 through 7 to make additional area measurements.

2D area measurement ratio
1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

Alternative: Press Caliper and select Area Ratio from the pull-down menu.

2. Press **Measure**.
3. Select **Area ratio** in the *Measurement Menu* (see Figure 4-3).
4. Perform two area measurements as described in the above section.
   The measurement results including the ratio (%) of the two measured areas are displayed in the *Measurement result table*.

Editing 2D Area measurements
1. Double click on the anchor point to move.
   The selected marker turns green and is unanchored.
2. Drag the anchor point to a new position.

3. Press the **Left mouse button** to anchor the point at the new location.

2D Volume measurements

The measurements described in this section enable volume measurement in a defined zone. The measurements tool generates results by two methods:

- 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. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

Alternative: Press ***Caliper*** *and select* ***Volume*** *from the pull-down menu.*

2. Press **Measure**.

3. Select **Volume** in the *Measurement Menu* (see Figure 4-3).

4. Move the cursor to the start point of the measurement.

5. Press the **Left mouse button** to anchor the start point of the measurement.

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

6. Draw the length by dragging the mouse.

7. Press the **Left mouse button** to anchor the second point.

8. Drag the mouse to outline the area of interest.
   The current area, circumference and Area/Length Volume (Va-l) values are displayed in the *Measurement result table* and are instantaneously updated when moving the cursor.

9. Press the **Left mouse button** to complete the measurement.

The measurements displayed on the 2D image and the corresponding results are numbered.

The measurement results including Vmod (Simpson) are displayed in the *Measurement result table*.

10. To assign a label to the measurement, see page 99.

11. Repeat steps 4 through 9 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. If necessary, deselect **Run cineloop** to freeze the image

and scroll through the cineloop using the **Frame slider** to select the desired frame.

2. Press **Measure**.

3. Select **Point** in the *Measurement Menu* (see Figure 4-3).

4. Move 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.

5. Press the **Left mouse button** 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. Press **Measure**.

2. Select **caliper** in the *Measurement Menu*.

3. Move the cursor to the start point of the measurement.

4. Press the **Left mouse button** to anchor the point.

5. Move 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.

6. Press the **Left mouse button** to anchor the end point of the measurement.

The measurements displayed on the M-Mode image and the corresponding results are numbered.

   The measurement result is displayed in the *Measurement result table*.

7. To assign a label to the measurement, see page 99.

8. Repeat steps 3 through 6 to make additional length measurements.

Editing M-Mode Length measurements

1. Double click on the anchor point to move.
   The selected marker turns green and is unanchored.

2. Drag the anchor point to a new position.

3. Press the **Left mouse button** to anchor the point at the new location.

Ao/LA study

1. Press **Measure**.

2. Select **Ao/LA** in the *Measurement Menu*.

3. Move the cursor along the time axis to the required point to start measurement of Aorta root diameter.

4. Press the **Left mouse button** to anchor the starting point for the measurement.

5. Move to the measurement end point.

6. Press the **Left mouse button** to anchor the measurement end point.
   The Aorta root diameter measurement value is displayed in the *Measurement result table*.
   A new free-moving cursor is displayed on the image, ready for the next measurement.

7. Repeat steps 3, through 6 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)

To perform LV study

1. Press **Measure**.

2. Select **LV study** in the *Measurement Menu*.

3. Move the cursor along the time axis to the required point to start measurement of IVSd.

4. Press the **Left mouse button** to anchor the point.

5. Move to the end point of the measurement.

6. Press the **Left mouse button** to anchor the measurement end point.
   The IVSd measurement value is displayed in the *Measurement result table*.

The end point of the IVSd is also the start point for the LVIDd.

1. Move to the end point of the LVIDd measurement.

2. Press the **Left mouse button** to anchor the point.
   The LVIDd measurement value is displayed in the *Measurement result table*.

The end point of the LVIDd is also the start point for the LVPWd.

1. Move to the end point of the LVPWd measurement.

2. Press the **Left mouse button** to anchor the point.
   The LVPWd measurement value is displayed in the *Measurement result table*.

3. Repeat steps 3, 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. Press **Measure**.

2. Select **LV study** in the *Measurement Menu*.

3. Move the cursor along the time axis to the required point to start measurement of RVIDd.

4. Press the **Left mouse button** to anchor the measurement starting point.

5. Move to the end point of the measurement.

6. Press the **Left mouse button** to anchor the measurement end point.
   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.

7. Repeat steps 3, through 6 to measure RVIDs.
    The RVIDs value is displayed in the *Measurement result table*.

Doppler Measurements

The following measurements may be calculated on Doppler mode spectra:

*   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

*Alternative: Press **Caliper** and select **Point Caliper** from the pull-down menu.*

1. Press **Measure**.
2. Select **Point Caliper** in the *Measurement Menu*.
3. Move 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.
4. Press the **Left mouse button** to anchor the point.
    The velocity (m/s) and pressure (mmHg) values are displayed in the *Measurement result table*.

Velocity and Pressure caliper measurements

*Alternative: Press **Caliper** and select **Caliper** from the pull-down menu.*

1. Press **Measure**.
2. Select **Point Caliper** in the *Measurement Menu*.
3. Move the cursor to the start point of the measurement.
4. Press the **Left mouse button** to anchor the start point of the measurement.

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

5. Move 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.
6. Press the **Left mouse button** to anchor the end point of the measurement.
    The following measurement results are displayed in the *Measurement result table*:

The measurement display on the spectrum and the corresponding result are numbered.

- Velocity and pressure at anchor point positions
- Velocity (V3) and pressure (p3) differences between anchor point position
- Time difference (dT) between anchored points position

7. To assign a label to the measurement, see page 99.

8. Repeat steps 3 through 6 to make additional measurements.

Manual Doppler trace measurements

Alternative: Press Caliper and select Manual trace from the pull-down menu.

1. Press **Measure**.

2. Select **Manual trace** in the *Measurement Menu*.
   A vertical green cursor is displayed on the spectrum.

3. Move the cursor to the start point on the left side of the trace.

4. Press the **Left mouse button** to anchor the start point of the measurement.

5. 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.

6. Press the **Left mouse button** 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)

7. Move the cursor to the start point of the next heart beat.

8. Press the **Left mouse button** to anchor the next heart beat starting point.
   The heart rate (BPM) is displayed in the *Measurement result table*.

Automatic Doppler trace measurements

Alternative: Press Caliper and select Auto trace from the pull-down menu.

1. Press **Measure**.

2. Select **Auto trace** in the *Measurement Menu*.
   A vertical green cursor is displayed on the spectrum.

3. Move the cursor to the starting point.

4. Press the **Left mouse button** to anchor the start point of the measurement.

Measurements and Analysis

5. Move to the end trace position.

6. Press the **Left mouse button** 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)

7. Move the cursor to the next heart beat.

8. Press the **Left mouse button** to anchor the next heart beat starting point.
   The heart rate (BPM) is displayed in the *Measurement result table*.

MV E/A ratio

1. Press **Measure**.

2. Select **MV E/A ratio** in the *Measurement Menu*.

3. Move the cursor to the peak of the E wave.

4. Press the **Left mouse button** to anchor the point.

5. Drag cursor to baseline to mark dT.

6. Press the **Left mouse button** to anchor the second point.

7. Move the cursor to the peak of A wave.

8. Press the **Left mouse button** 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*.

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:

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

1. Select to the actual measurement in the *Measurement result table* (see Figure 4-4).
    A *Parameter label menu* is displayed.

2. Select the required label in the *Parameter label menu*.

The assigned measurements may be reviewed in the Worksheet (see Chapter 7, 'Worksheet' on page 161). Up to five assigned measurements with the same label can be stored in the patient archive.
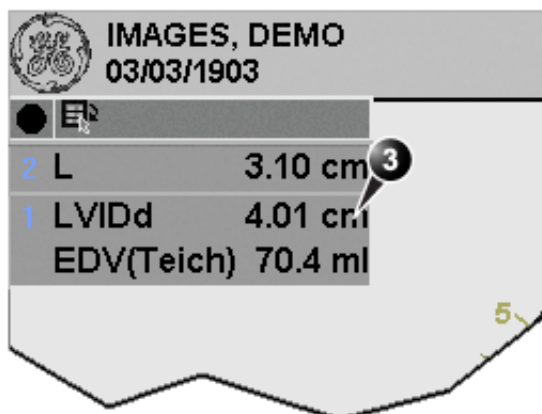
△
CAUTION

Only assigned measurements will be saved. Measurements without assignment will be lost when scanning is resumed.
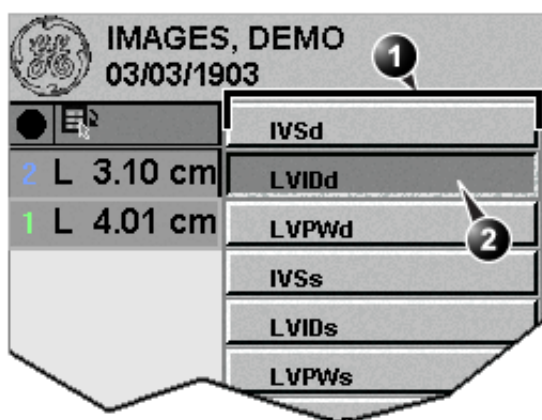
1. Parameter Label menu
2. Selected label

Assignment

3. Assigned
   measurement

Figure 4-4: Measurement assignment

Controlling the Measurement result table display

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. Move the **Mouse cursor** to the symbol ⬤ on the heading of the *Measurement result table* (see Figure 4-5).

*Repeat step 1 to enlarge the **Measurement result table**.*

2. Press the **Left mouse button**.
   The *Measurement result table* is minimized to the heading bar.

Moving the Measurement result table

1. Move the **Mouse cursor** to the symbol on the heading of the *Measurement result table* (see Figure 4-5).
2. Press the **Left mouse button** to grab the table.
3. Move the *Measurement result table* to a new position.
4. Press the **Left mouse button** to anchor the table.
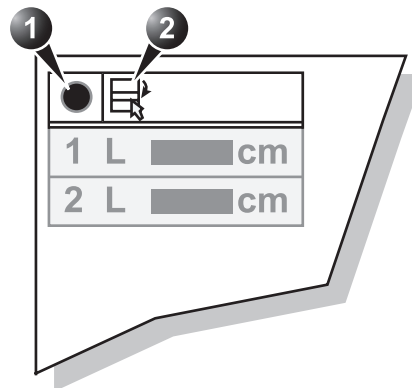
1. Minimize/maximize table
2. Move table

Figure 4-5: Measurement result table display tools

Chapter 5
# Stress echo analysis

Contents

Introduction

EchoPAC PC provides an integrated stress echo package, with the ability to review, perform wall segment scoring and report for a complete efficient stress echo analysis. Users can define various quad screen review groups, in any order and combination, that will suit their normal review protocol.

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. In addition to standard wall motion scoring analysis, the user can perform quantitative stress analysis based on tissue velocity information (TVI).

Review of protocol studies

Image acquisitions based on a protocol study (e.g. stress echo examinations) can be reviewed from the *Protocol screen* (see Figure 5-1).
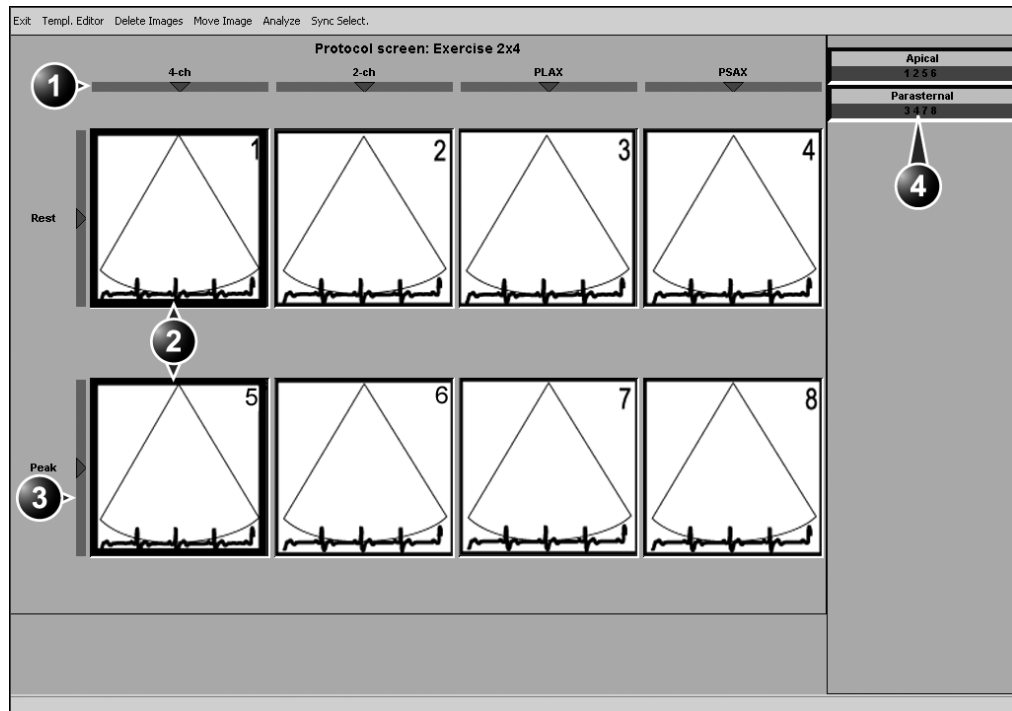
1. Projection selection
2. Selected loops
3. Level selection
4. Group of views

Figure 5-1: The Protocol screen

Selecting images for analysis

Images can be selected manually or from a pre-defined group in the *Protocol screen* (Figure 5-1).

Selection of images from a group

If groups of images have been defined in the protocol template (see page 124), the user can select a group of images for

analysis and sequentially analyze all images from all groups from within the *Image analysis screen* (see page 108).

1. Move the **Mouse cursor** over the group in the *Group list* to select the images.
    Both the group name and the belonging images are highlighted.

2. Select the group to start analysis of the selected group of images.

1. Select a Projection

2. Select an image

3. Select and open an Image group
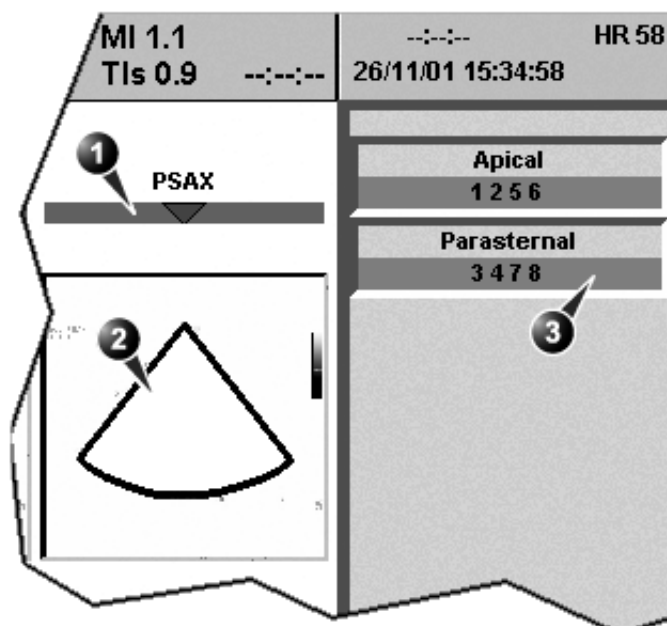
Figure 5-2: Image selection from the Protocol screen

Manual selection of images in the Analysis screen

1. When currently in protocol analysis in the *Stress analysis quad screen* (Figure 5-3, page 109), hold down **Shift** while performing steps 2 and 3.

2. Select the first image in the *Template matrix*.
    The selected loop is displayed in the *Stress analyze screen* and the next window in the quad screen is automatically selected.

3. Repeat step 2 to select other images.

4.   Depress $\overline{\text{SHIFT}}$.

Manual selection of images in the Protocol screen

To select a level (or a projection), click on the selection button close to the heading, see Figure 5-1.

1.   In the *Protocol screen*, click once on the images of interest. The selected images are displayed with a highlighted frame (see Figure 5-1).

2.   Select **Analyze** to start analysis.

Loop synchronization

To select a level (or a projection), click on the selection button close to the heading, see Figure 5-2.

1.   In the Protocol screen, select the loop to synchronize.

2.   Click **Sync. Selected**.
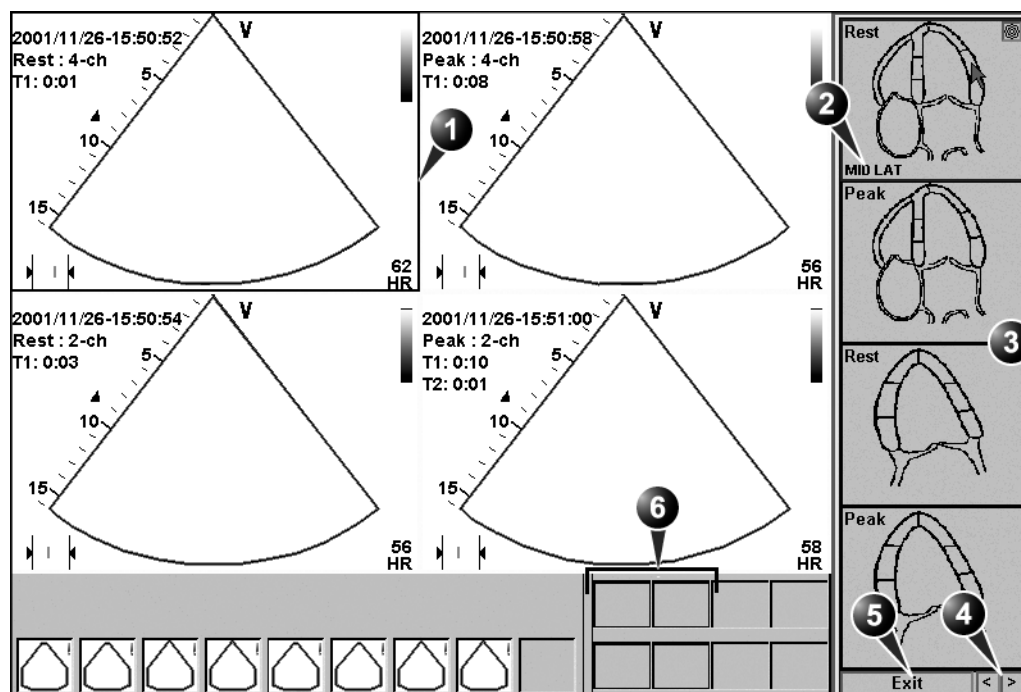
Stress echo analysis

Stress echo analysis consists of viewing previously saved loops and assigning a score to each cardiac segment, in order to quantify the function of the muscle.

The usual procedure consists of sequentially opening all image groups and perform scoring from image to image.

Starting analysis

Up to 12 cineloops can be displayed simultaneously.

1. From The *Protocol screen* (see Figure 5-1, page 105), select the first image group (see page 105).

2. press **Start Analysis**.
   The *Stress Echo analysis screen* is displayed (see Figure 5-3) showing the first four images and the corresponding scoring diagrams.

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 5-3: The Stress Echo Analysis screen

Scoring

1. Click on a **segment** in one of the scoring diagrams. The *Score popup list* is displayed (see Figure 5-4).

If the segment scored is displayed in more than one diagram, the score is displayed in the other diagram(s).

2. Select the **score** from the *Score popup list*. The score is displayed in the relevant segment area in the diagram.

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

4. Press **Next page** ▷ to access to the next images in the group or to the next group.

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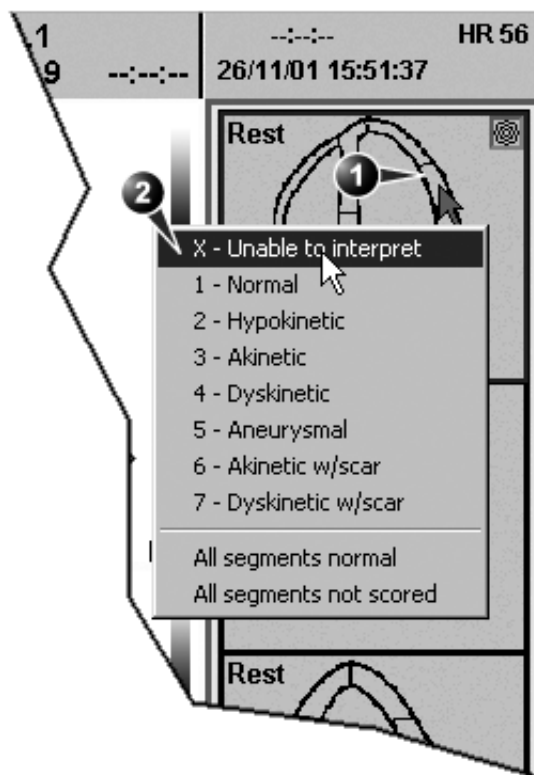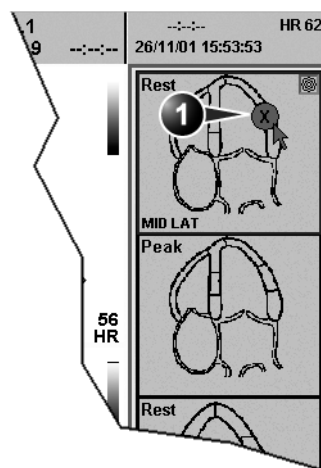

1. **Scored segment**

Figure 5-4: Segment scoring

Image optimization

During analysis, the user can adjust the images by exiting the *Stress Echo analysis screen*.

To optimize images

1. Press **Exit** in the *Stress Echo analysis screen*.
    The *2D control panel* is displayed.
2. Select a loop.
3. If necessary, deselect **Run Cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to display the desired image.
4. Check **Apply to all** if global adjustment is desired.
5. Adjust the image controls to optimize the display.

Zoom function

The image can be magnified as described in 'Zoom function' on page 66.

Quantitative TVI Stress echo analysis

⚠️
WARNING

QTVI Stress analysis is meant as a guide to wall motion scoring.

Diagnosis must not be based on results achieved by QTVI Stress analysis only.

EchoPAC PC provides a Quantitative TVI (QTVI) Stress analysis package based on Tissue velocity information (TVI). The TVI data is stored in a combined format with grey scale imaging during stress examination.

When selecting a template supporting TVI data acquisition, the ultrasound unit will automatically store TVI information, generally for the apical views of the stress examination.

The QTVI Stress analysis option currently applies only to Dobutamine stress-echo.

Wall Motion Scoring remains the basis for the diagnosis of CAD in stress echocardiography. QTVI Stress may be used as a guidance tool to check this interpretation.

The current version of QTVI Stress is based on the assessment of peak velocity at peak dobutamine stress (see reference 1 on page 118). The normal ranges have been validated in the "average" patient presenting for stress testing. The velocity cutoff values for the Vpeak measurement will not work in the following cases:

- Submaximal stress (<85% predicted max HR)
- Patients at extremes of age (<40 or >70)
- Previous myocardial infarction / revascularization
- Previous heart-failure / cardiomyopathy / hypertrophy / arrhythmia / aortic regurgitation

The velocity cutoff values are based on placing the sample volume at center of each cardiac segment at start of systole, the left ventricle myocardial segments are defined by the American Society of Echocardiography 16 segments model. However, the velocity cutoff model does not cover the apical segments (due to low velocities and segment orientation), (see side note).

Tissue Doppler does not have perfect site-specificity because of tethering by adjacent segments. Thus, although an ischemic segment has little thickening (and therefore could be expected to show low velocity), measured velocity may be influenced by local tethering, reflecting contraction in surrounding segments. Conversely, a normal segment may have its velocity reduced by an adjacent segment with reduced velocity. This tethering effect may decrease the sensitivity for single vessel disease, but nonetheless the sensitivity and specificity of the cut-offs are approximately 80% (see reference 1 on page 118).

Three different analysis tools based on TVI data are available:

- **'Vpeak measurement' on page 114**, enables the display of a tissue velocity trace for a selected region of a previously scored segment through the entire heart cycle. In addition Vpeak is color-coded on the 2D image. From the velocity trace, the user can estimate the peak systolic velocity (see reference 1 on page 118). This tool is available in views from peak levels only and only when a segment has been scored in one of these views.

- **'Tissue Tracking' on page 117**, enables visualization of the systolic contraction of the heart by color-coding the myocardial displacement through the systole.

- **'Quantitative analysis' on page 118**, enables further quantitative analysis based on multiple tissue velocity traces. The quantitative analysis is described in Chapter 6, 'Quantitative Analysis' on page 127.

Accessing QTVI Stress analysis tools

The three QTVI Stress analysis tools are entered by pressing a dedicated button on the scoring diagram (see Figure 5-5) of the selected view. Only views with TVI data acquired will display QTVI Stress tools buttons on the respective diagrams.
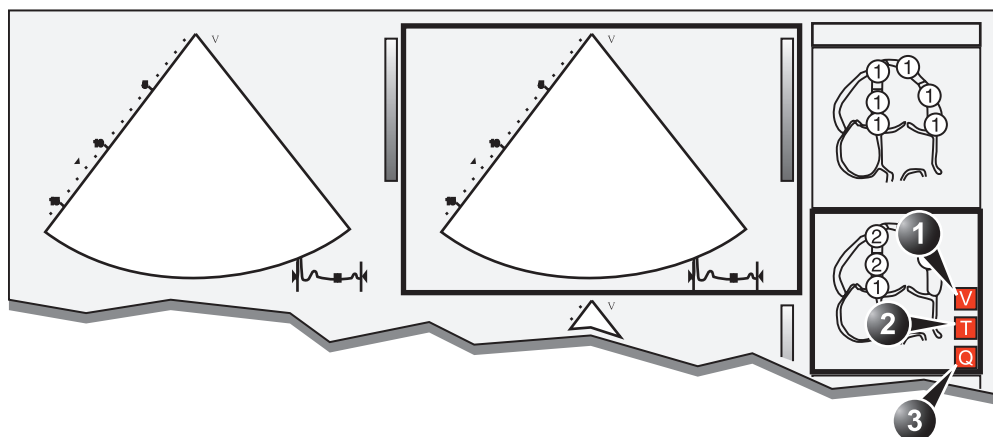
1. **Vpeak measurement (V-peak measurement is displayed in views from peak levels and only after scoring.)**

2. **Tissue Tracking**

3. **Quantitative analysis**

Figure 5-5: Q-stress tools buttons

Vpeak measurement

This tool enables the user to generate a tissue velocity profile for a given wall segment through the entire heart cycle and display color-coded Vpeak in tissue. From the velocity trace, the user can determine whether the systolic Vpeak is over or under a clinically determined velocity threshold (see reference 1 on page 118) to confirm the wall motion scoring.

⚠

CAUTION

QTVI Stress can be used only in conjunction with wall motion scoring analysis, as a guiding tool.

When activating QTVI Stress, the measurement applies only to the latest completed scoring, i.e. for a particular segment at a given level and projection view. The scoring bullet in the segment is highlighted accordingly.

To display a Vpeak measurement

1. Perform segment scoring as described on page 109. When performing scoring i a view from a peak level, the Vpeak measurement button (**V**) is displayed in the corresponding diagram.

2. In the *Scoring diagram*, press **V**.
   The trackball cursor is changed to sampling area and the scored peak views are updated showing:

   - A diagram with the current segment highlighted (scoring bullet with a ring) and the segment's velocity cutoff (see Figure 5-6).

See page 116 for further information on Vpeak measurement interpretation.

   - Color-coded velocity in tissue. The color-coding convention is as follow:

     - **Green**: Velocities above threshold value + 5%

     - **Yellow**: Velocities near threshold (+/- 5% interval)

     - **White**: Velocities below threshold value - 5%

3. A result window to display tissue velocity profile, shown when moving the sampling area in the view.

4. In the 2D sector, move the sampling point over the wall area corresponding to the current segment (shown as the highlighted segment in the diagram).
   A tissue velocity profile for the actual segment is generated in the *Result window* (see Figure 5-6).

5. Press **Next** or **Previous** to analyze other segments in the peak view,
   OR
   Select another **scoring bullet** in the diagram in one of the peak views.

Turn-off the Vpeak measurement tool

1. Select the **V** button in one of the peak view scoring

diagrams.
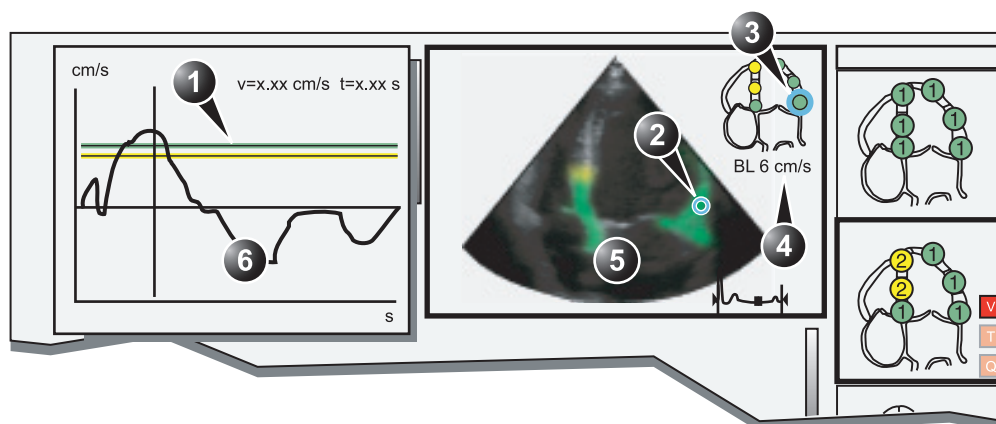
1. **Threshold for current segment (green)**
2. **Sampling point**
3. **Current segment**
4. **Vpeak threshold for current segment**

5. **Color-coded tissue velocity:**
6. **Result window with tissue velocity profile**

Color-coding (velocity thresholds and tissue):
   • **Green: velocities above threshold value**
   • **Yellow: velocities near threshold (0 to -10% interval)**
   • **White: velocities below threshold value - 10%**

Figure 5-6: Vpeak Q-stress display

V-peak measurement interpretation

The systolic Vpeak in the tissue velocity profile is automatically
detected and highlighted by a vertical bar (see Figure 5-6). The
automatically detected Vpeak should be visually verified by the
user. In addition Vpeak thresholds are displayed as color-
coded horizontal lines. These thresholds represent statistical
guideline values for peak velocity at peak stress level
(Dobutamine stress procedure) for the three apical views. Only
threshold values for basal and mid-segments for each apical
view are defined (see reference 1 on page 118). The result is
highlighted by a color-coding of the thresholds lines, the color-
coding in the 2D image and the scoring bullet (see Figure 5-6).

Tissue Tracking

Tissue Tracking calculates and color-codes the displacement in tissue over a given time interval. The displacement is found as the time integral (sum) of the tissue velocities during the given time interval. The color-coded displacements calculated in the myocardium are displayed as color overlay in the respective acquisition window.

By studying the color patterns generated in the different segments, the user can confirm the standard segmental wall motion scoring (see page 109) at peak levels.

To display Tissue Tracking

1. Select a loop with TVI data (usually an apical view at peak level).

2. In the corresponding *Wall segment diagram*, press **T** (see Figure 5-5, page 114).
   The Tissue Tracking color overlay is displayed in the acquisition window.
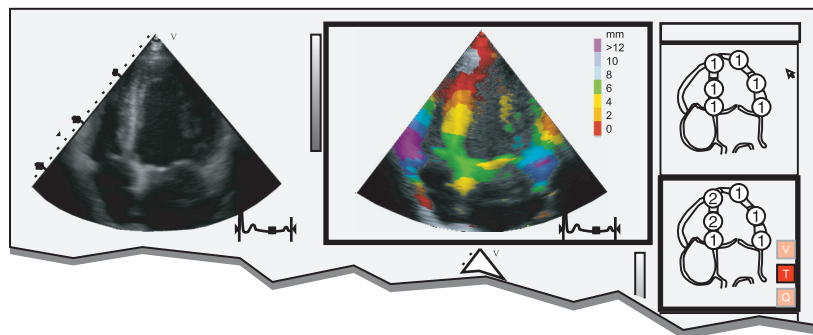
Figure 5-7: Tissue Tracking display

Quantitative analysis

Quantitative analysis enables further analysis based on multiple tissue velocity traces. Quantitative analysis is performed using the Quantitative analysis package described in Chapter 6, 'Quantitative Analysis' on page 127.

To start quantitative analysis

1. Select a loop with TVI data (usually an apical view at peak level).
2. In the corresponding **Wall segment diagram**, press **Q** (see Figure 5-5, page 114) to launch the Quantitative analysis package (see page 130).

References

1. **Application of Tissue Doppler to Interpretation of Dubotamine Echocardiography and Comparison With Quantitative Coronary Angiography.** Cain P, Baglin T, Case C, Spicer D, Short L. and Marwick T H. *Am. J. Cardiol. 2001; 87: 525-531*

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.

The templates created can be used for acquisition on the scanner. The editing that may be performed includes:

- Adding/deleting levels and projections, see page 123.
- Assigning new labels to levels and/or projections, see page 124.
- Defining level options, see page 124.
- Defining new image groups, see page 124

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

Template editor screen overview

1. In the *Protocol screen*, select **Template Editor**.
   The Template Editor screen is displayed (see Figure 5-8).
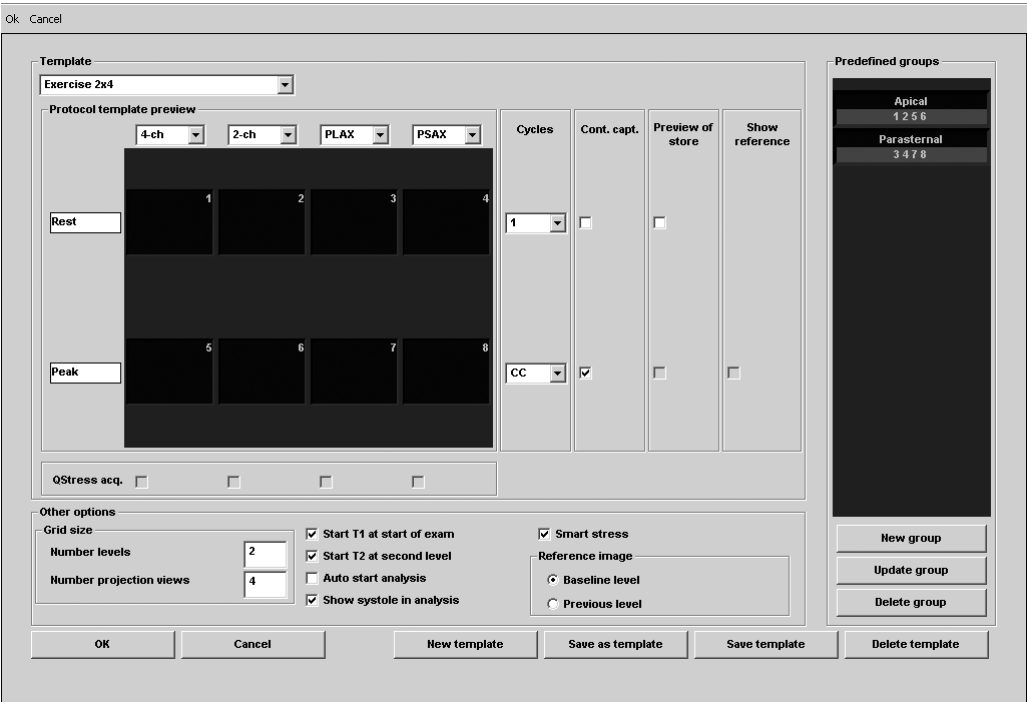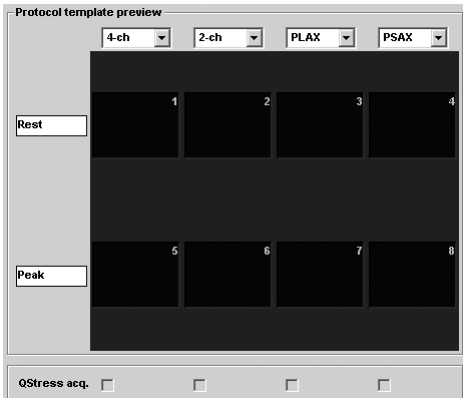
Figure 5-8: The Template editor screen
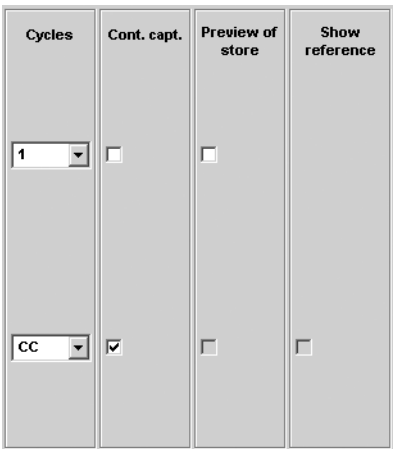
Template

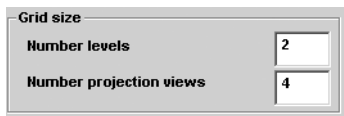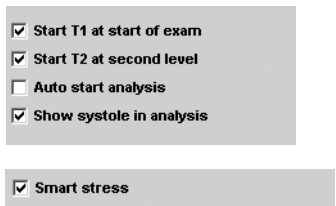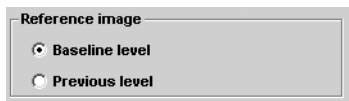| Parameter	Description
	Template: • select a pre-defined template from the pop-up menu. The *Protocol template preview* (see below) is updated accordingly.

Protocol template preview

Parameter	Description
	Protocol template preview: • displays an updated preview of the template accordingly to the settings applied. • To edit *Projection* and *Stress level labels*, select a pre-defined label from the pop-up menu or click on the label to edit and type a new name.

Template settings

Parameter	Description
	Template settings: • **Cycles**: selects 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. • **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 121), 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 124). • **Update group**: edits a selected group after new loop selection on the template preview (see page 125). • **Delete group**: deletes selected group (seepage 125).

Selecting a base template to edit

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

1. Select the **template** to edit in the *Template popup menu*. The selected template is displayed in the *Protocol template preview field*, showing the levels and projections and their labels (see Figure 5-8).

Adding/deleting levels and projections

1. Enter the number of levels and projections in the *Grid size field* (see Figure 5-8).
   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)

1. Check the box(es) to display timer(s) as specified (see Figure 5-8).

Start analysis automatically

1. Check **Auto start analysis** to display the *Stress Echo Analysis screen* when the last acquisition is performed.

Assigning new labels to levels and projections

1. In the *Protocol template preview field*, select a pre-defined label from the pop-up menu
    OR
    double-click on the **Label** to highlight the text that is to be changed and type a new name.

Configuring levels

After configuration, press either New Template or Update Template.

The following options can be set up for each level:

Number of cycles to be stored in the cineloop:

1. Enter the desired number in the *Cycles field*.
    Up to four cycles/cineloop can be stored.

Continuous capture

1. 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

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

Show reference

1. 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 6
Quantitative Analysis

Contents

Introduction

The quantitative analysis software package is designed for analysis of TVI, Tissue Tracking, Strain, Strain rate and Contrast related raw data.

The main features of these options are:

For TVI:

- Multiple Time -motion trace display from selected points in the myocardium.
- Arbitrary Curved anatomical M-Mode

For Tissue Tracking:

- Multiple tissue displacement trace display from selected segments in the myocardium.
- Arbitrary Curved anatomical M-Mode

For Strain rate:

- Multiple Strain rate (Rate of deformation (s-1)) trace display from selected segments in the myocardium.
- Arbitrary Curved anatomical M-Mode

For Strain:

- Multiple Strain (extend of tissue deformation (%)) trace display from selected segments in the myocardium.
- Arbitrary Curved anatomical M-Mode

For Contrast:

- Time-Intensity analysis from multiple region of interest
- Curve fitting
- Arbitrary Curved anatomical M-Mode

If not otherwise specified, the topics described in this chapter are applicable for both TVI and contrast data.

Accessing the Quantitative analysis package

The Quantitative Analysis application is entered from the *Image analysis screen* (see page 52).

1. In the *Image analysis screen*, select a TVI or Contrast acquisition.

2. Press **Quantitative Analysis**.
   The *Quantitative analysis screen* is displayed.

Overview

1. **Color cineloop window**
2. **Tissue cineloop window**
3. **Analysis window**
4. **Sample Area**
5. **Time at cursor position and velocity at cursor position**
6. **Control panel**
7. **Sample area tools**
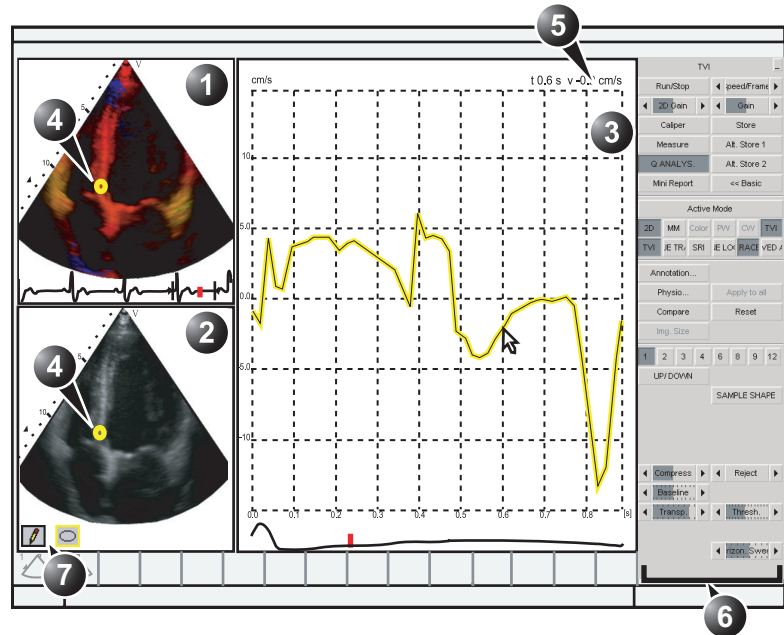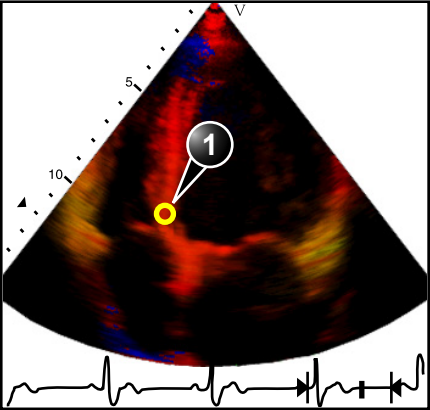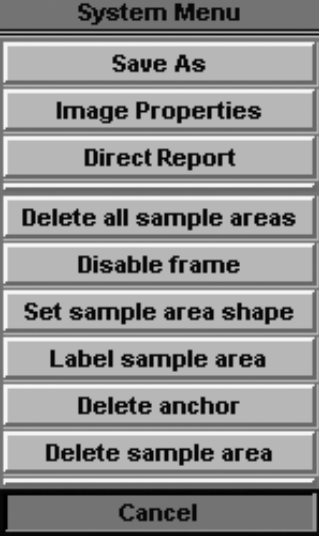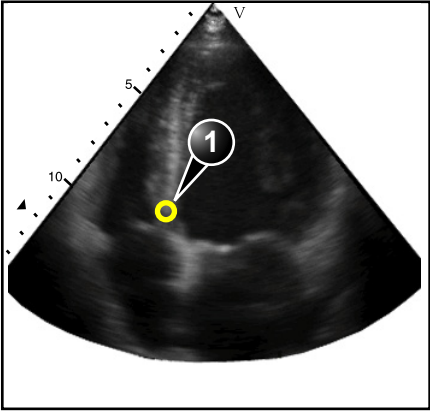
Figure 6-1: The Quantitative analysis window (here with TVI data)
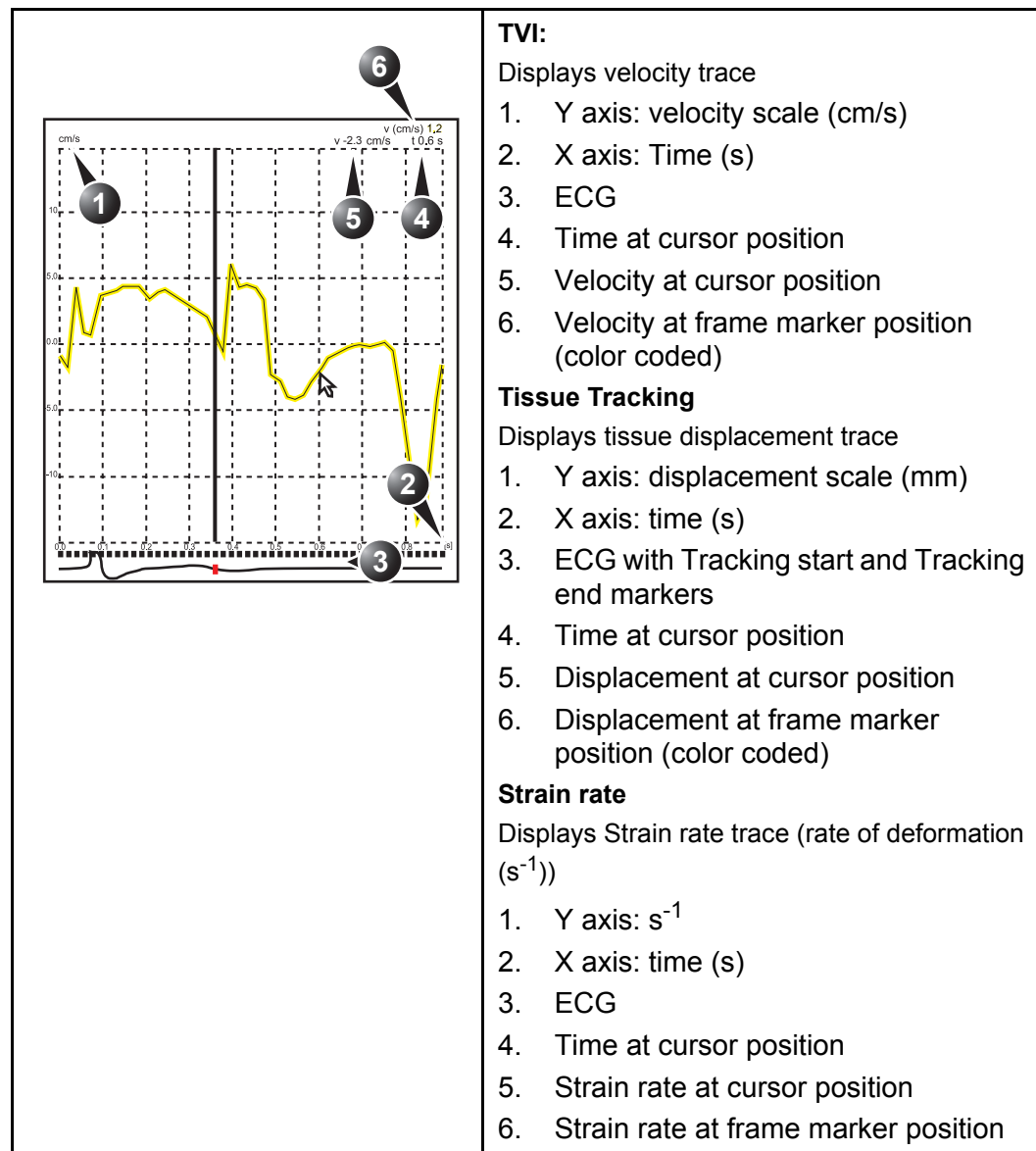
The color cineloop window
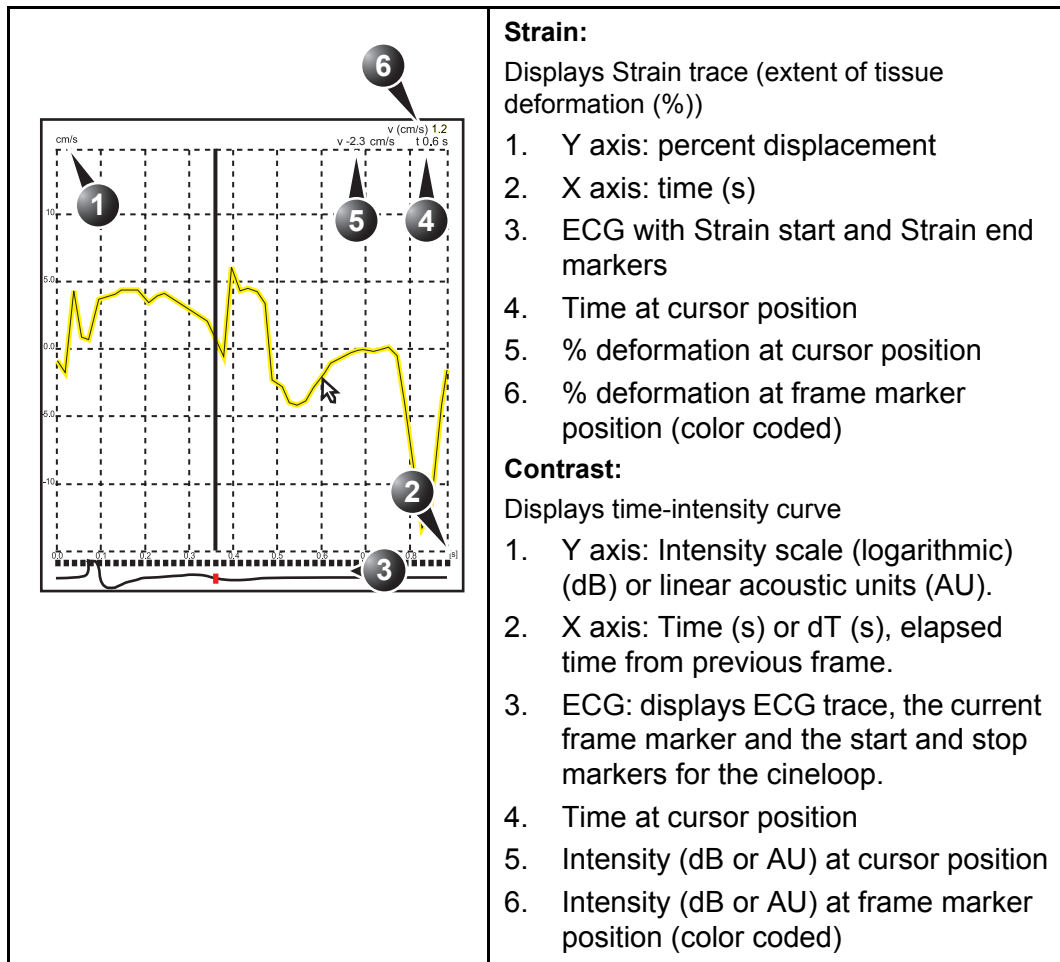
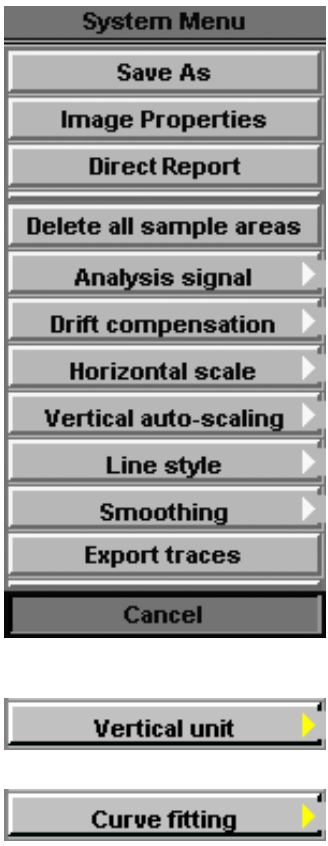|	Displays TVI, Tissue Tracking, Strain, Strain rate or Angio color-coded data.
	Sample area (1): Indicates sampling position of the velocity (TVI), displacement (Tissue Tracking), percent deformation (Strain), deformation rate (Strain rate) or intensity (Contrast) trace. The sample area is color-coded: the first sample area is yellow, the second green...etc.
  a) Shown only when a sample area is selected (pointed at). b) With Contrast data only. c) Shown only when pointing at an anchored sample area.	**The cineloop windows system menu** This menu is entered by pressing the right mouse button when the cursor is within one of the *Cineloop windows*. • **Delete all Sample areas**: removes all traces at once. • **Disable frame**[b]: the current frame is excluded from the cineloop display. • **Set Sample area Shape**[a]: enables resizing of a selected sample area by setting height, width and tilt angle. The trackball marker must be pointed at an anchored sample area. • **Label Sample area...**[a]: set a descriptive name to the sample area. The label is useful for identification of the sample area when exporting data. • **Delete anchor**[c]: remove anchoring from a dynamic sample area (see also page 138 and page 139). • **Delete Sample area**[a]: removes selected sample area from the *Cineloop window* and belonging trace in the *Analysis window*. The trackball marker must be pointed at an anchored sample area. • **Cancel**: exits the *System menu*.

The Tissue cineloop window

	Displays 2D data **Sample area (1):** Indicates sampling position of the velocity (TVI), displacement (Tissue Tracking), percent deformation (Strain), deformation rate (Strain rate) or intensity (Contrast) trace. The sample area is color-coded: the first sample area is yellow, the second green...etc.
	Sample area tools: • : creates a sample area based on freehand drawing. • : creates a sample area with a pre-defined circular/elliptic shape (configurable, see page 143)

The analysis window

TVI:

Displays velocity trace

1. Y axis: velocity scale (cm/s)
2. X axis: Time (s)
3. ECG
4. Time at cursor position
5. Velocity at cursor position
6. Velocity at frame marker position (color coded)

Tissue Tracking

Displays tissue displacement trace

1. Y axis: displacement scale (mm)
2. X axis: time (s)
3. ECG with Tracking start and Tracking end markers
4. Time at cursor position
5. Displacement at cursor position
6. Displacement at frame marker position (color coded)

Strain rate

Displays Strain rate trace (rate of deformation (s^{-1}))

1. Y axis: s^{-1}
2. X axis: time (s)
3. ECG
4. Time at cursor position
5. Strain rate at cursor position
6. Strain rate at frame marker position

Strain:

Displays Strain trace (extent of tissue deformation (%))

1.   Y axis: percent displacement
2.   X axis: time (s)
3.   ECG with Strain start and Strain end markers
4.   Time at cursor position
5.   % deformation at cursor position
6.   % deformation at frame marker position (color coded)

Contrast:

Displays time-intensity curve

1.   Y axis: Intensity scale (logarithmic) (dB) or linear acoustic units (AU).
2.   X axis: Time (s) or dT (s), elapsed time from previous frame.
3.   ECG: displays ECG trace, the current frame marker and the start and stop markers for the cineloop.
4.   Time at cursor position
5.   Intensity (dB or AU) at cursor position
6.   Intensity (dB or AU) at frame marker position (color coded)

	The analysis window system menu:
System Menu	This menu is entered by pressing the right mouse button when the mouse cursor is within one of the analysis window.
Save As	• **Delete all Sample areas**: removes all traces at once.
Image Properties	• **Analysis signal**: toggles trace display between velocity, displacement, strain rate, stain or greyscale intensity curves.
Direct Report	• **Drift compensation**: compensates drifting of strain or Tissue Tracking curves by either resetting the curve to zero at the tracking start point (cycle resetting) or by linear compensation throughout the cycle (linear compensation)
Delete all sample areas	
Analysis signal ▶	
Drift compensation ▶	
Horizontal scale ▶	• **Horizontal scale**: set horizontal unit as time (s) or time interval (dt) between frames.
Vertical auto-scaling ▶	• **Vertical auto-scaling**: selects between full unit range or a range according to the maximum and minimum values of the displayed trace(s).
Line style ▶	
Smoothing ▶	• **Vertical unit**[a]: toggles between logarithmic (dB) and linear acoustical units (AU).
Export traces	• **Line style**: selects between solid line only or solid line with square markers at each data point.
Cancel	

• **Smoothing**: smooths the trace displayed by applying a filter over a defined time window. Both the filter type and time window are user-selectable. The type of filter available is depending on the analysis signal displayed.

Vertical unit ▶

Curve fitting ▶

[a] With contrast data only.

[b] Shown only in zoom mode.

• **Export traces**: saves trace data in ASCII format, readable in spreadsheet programs. If present, trace data for physiological traces are also exported.

• **Curve fitting**[a]: toggles between Wash-in, Wash-out and off.

• **Unzoom**[b]: restores full analysis window display when in zoom mode.

• **Cancel**: exits the *System menu*.

The control panel

The control panel is mode dependent. Refer to page 54 for control description.

Generation of a trace

Up to eight traces can be generated.

About the sample area

The sample area can be in three different states:

The free sample area disappears when the QA cursor is moved over a static anchored frame.

- **Free sample area**: freely moving sample area (QA cursor) before anchoring.
- **Static sample area**: the free sample area is anchored by pressing the left mouse button.
- **Dynamic anchored sample area**: the sample area is anchored in two or more frames (see Manual tracking below). In these particular frames, the sample area is displayed with an anchor. The sample area moves smoothly between the anchored positions when playing/ scrolling the cineloop.

To generate a trace

Trace from a pre-defined sample area

The trace and sample area are color-coded. First generated trace is yellow, second green...etc.

1. If necessary, select the sample area **Shape button** 🔘.
2. Move the Mouse cursor to one of the *Cineloop windows*. The mouse cursor is changed to a sample area (white circle). A preview of the trace (in white) is displayed in the *Analysis window*.
3. Press the **Left mouse button** to anchor the sample area. In this frame the sample are is marked with an anchor. If the cineloop has more than one heart cycle a sample area will also be anchored in the corresponding frame in the next heart cycles.
   The trace is updated accordingly in the *Analysis window*.

The Strain cursor

In Strain and Strain rate modes, the sample area displays a Strain cursor showing the segment along the beam direction that is used for Strain and Strain rate calculations. Make sure that the Strain cursor is within the myocardium when anchoring the sample area.

Trace from a freehand sample area

1. Select the **Pencil button** 🖊.
2. Move the Mouse cursor to one of the *Cineloop windows*. The mouse cursor is changed to a cross.
3. Press and hold down the **Left mouse button** while drawing a sample area.
4. Release the **Left mouse button**.
   The sample area is automatically closed.
   The trace is updated accordingly in the *Analysis window*.

Manual tracking of the sample area (dynamic anchored sample area)

A sample area can be moved within the loop to ensure that data in the trace are generated from the same anatomical location during the cyclic motion of the heart.

1. Place a sample area over a region of interest.
   Note the anatomical location of the sample area.
2. Using the **Frame slider** (or **F3** and **F4** keys), scroll to a new frame.
3. Select the **sample area**.
   The sample area is unanchored.
4. Drag the **sample area** to the corresponding anatomical location in the new frame.
5. Press the **Left mouse button** to anchor the sample area to the location.

In the original frame and this particular frame the sample area is marked with an anchor.

   When the sample area is anchored in more than one frame, linear interpolation is performed, so that the sample area is smoothly moved between the anchored positions in the selected frames when running the cineloop.
6. Scroll through the cineloop and control that the sample area follows the moving anatomical structure.
7. Add anchored sample areas in several frames to obtain a more accurate displacement of the sample area.

To move a dynamic anchored sample area

In these frames the sample area is marked with an anchor.

1. Using the **Frame slider** (or **F3** and **F4** keys), browse through the cineloop to display one of the frames where the

sample area was anchored.

2. Select the **sample area** to move, in one of the *Cineloop windows*.
    The sample area is unanchored.

3. Drag the **sample area** to a new location.

4. Press the **Left mouse button** to anchor the sample area to the new location.

Zooming in the Analysis window

1. In the *Analysis window*, press and hold down the **Left mouse button** while dragging the **Mouse cursor** to define the zooming area.

2. Release the **Left mouse button**.
    The selected area is displayed in the *Analysis window*.

To unzoom

1. Press the **Right mouse button**.
    The *System menu* is displayed.

2. Select **Unzoom**.

Deletion of a trace

The user can delete all traces at once or one at a time.

To delete all traces

1. Press the **Right mouse button**.
    The *System menu* is displayed.

2. Select **Delete all traces**.

To delete one specific trace

1. Place the **Mouse cursor** on the sample area to delete.

Alternatively, press **Delete** *or* **Backspace**.

2. Press the **Right mouse button**.
    The *System menu* is displayed.

3. Select **Delete trace**.

Frame disabling

Frame disabling excludes the actual frame from the cineloop display. Frame disabling is available only with contrast data. There are two ways to disable a frame.

Disabling frames from the frame marker

To re-enable a frame: **select** *the corresponding frame marker.*

1. Select the **Frame marker** beneath the *Analysis window* (see Figure 6-2).
    The frame marker turns red (disabled frame).

disabling successive frames at a time

To re-enable successive frames: **press the left mouse button** *and drag over the frame markers.*

1. Press the **Left mouse button** and drag the **Mouse cursor** over the frame markers of the frames to disable.
    The frame markers turn red (disabled frames).

ECG triggered frame disabling

In a multi-cycle acquisition, the user may deselect all frames in all heart cycles but a selected one. This function can be used for example to select a particular systolic frame for each heart cycle.

1. Scroll through the cineloop to identify the cardiac phase to analyze or identify the cardiac phase on the ECG trace.

2. Press the **Right mouse button** on the frame marker of the frame of interest in one of the heart cycles (see Figure 6-2).

The *System menu* is displayed.

3. Select **ECG triggering**.
    All frames in all heart cycles are disabled except for the selected and corresponding frames in the other heart cycles.

Disabling frames in the cineloop windows

1. Press the **Right mouse button**.
    The *System menu* is displayed.

2. Select **Disable frame**.
    The current frame is disabled and the corresponding frame marker is displayed in red.

Re-enabling all frames

1. Press the **Right mouse button** over the *Frame marker axis*.

2. Select **Enable all frames**.

1. **Analysis window**
2. **Frame marker axis**
3. **Enabled frame (green marker)**
4. **Disabled frame (red marker)**
5. **ECG**
6. **Current frame**
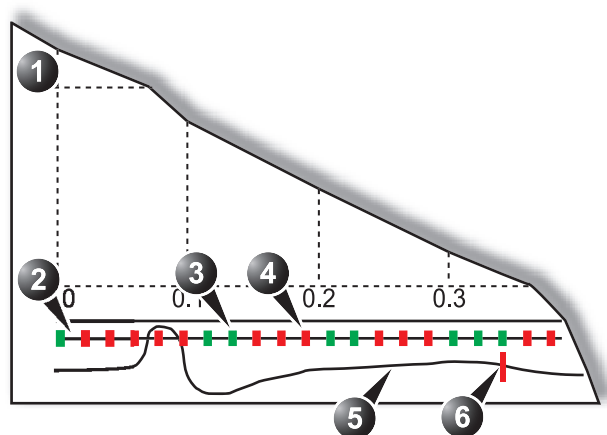
Figure 6-2: Frame disabling

Optimizing sample area

The sample area can be reshaped and labelled.

Reshaping a sample area

1. Place the **Mouse cursor** over the actual Sample area.

2. Press the **Right mouse button**.
   The *System menu* is displayed.

3. Select **Set Sample area shape**.
   A *Dialogue window* is displayed where the user can adjust the height, the width and the angle of the sample area (see Figure 6-3).
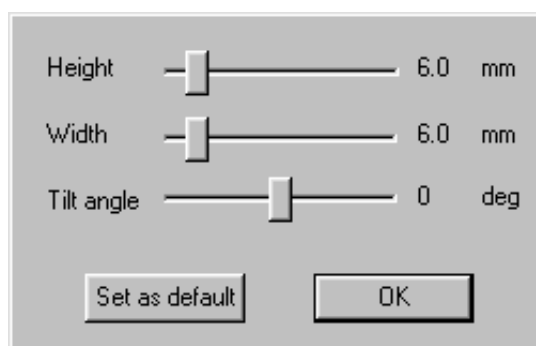
Figure 6-3: The sample area reshaping window

4. Drag the sliders to adjust the shape of the sample area as desired.

5. Press **OK** to return to the *Quantitative analysis screen* and use the settings for the current analysis only.
   OR
   Press **Set as default** to return to the *Quantitative analysis screen* and keep the settings as default.

Labelling a sample area

The sample area label is used to identify data associated to the sample area when exporting to a spreadsheet program.

1. Place the **Mouse cursor** over the actual **sample area**.

2. Press the **Right mouse button**.
   The *System menu* is displayed.

3. Select **Label Sample area...**.

A *Dialogue window* with a free text field is displayed.

1. Free text
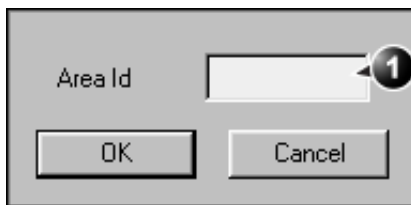
Figure 6-4: The sample area labelling window

4. Type a name for the **sample area**.
5. Press **OK** to return to the *Quantitative analysis screen*.

Optimizing the trace display

Optimizing the Y-axis

Auto-scaling

The system can be configured to display the full unit range or a range according to the maximum and minimum values of the displayed trace(s) (auto-scaling function). In addition, the auto-scaling function can be set to be live update (updates while the sample area is moved) or delayed (updated when the sample area is anchored).

Setting the auto-scaling function
1. Press the **Right mouse button** in the *Analysis window*. The *System menu* is displayed.
2. Select **Vertical auto-scaling**. The *Vertical autoscaling menu* is displayed.
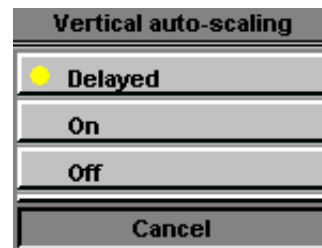
Figure 6-5: The Vertical Auto-scaling menu

3. Select one of the following options:
    *   **Delayed**: autoscaling takes place after anchoring the sample area.
    *   **On**: autoscaling while moving the sample area.
    *   **Off**: displays full scale.

Vertical units

Applicable with contrast data only.

When analyzing contrast data, the Y-axis can be set to display either logarithmic scale (dB) or linear, acoustical units (AU) for both tissue intensity (2D) or Angio intensity data.

Selecting the Y-axis unit

1. Press the **Right mouse button** in the *Analysis window*.
    The *System menu* is displayed.

2. Select **Vertical unit**.
    The *Vertical unit menu* is displayed.
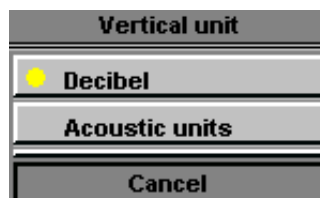
Figure 6-6: The Vertical unit menu

3. Select the desired option.

Trace smoothing

The system can smooth the traces displayed by applying a filter over a defined time window. The type of filter available is depending on the analysis signal displayed.

Smoothing trace(s)

1. Press the **Right mouse button** in the *Analysis window*.
    The *System menu* is displayed.

2. Select **Smoothing**.
    The *Smoothing menu* is displayed.

3. Select a smoothing filter.
    The trace display is updated.

Switching modes or traces

The user can toggle between TVI, Tissue Tracking, Strain rate or Strain modes to access to the mode specific controls (soft menu and assignable) or display alternative traces from within a selected mode.

To switch mode

1. Select the desired mode (TVI, Tissue Tracking, Strain rate or Strain from the control panel.
    The *Color cineloop window* and the *Analysis window* are updated accordingly. The settings specific for the selected mode can be adjusted by pressing **Settings** in the *TVI modes field*.

To switch trace

1. Press the **Right mouse button** in the *Analysis window*.
    The *System menu* is displayed.

2. Select **Analysis signal**.
    The *Analysis signal menu* is displayed.
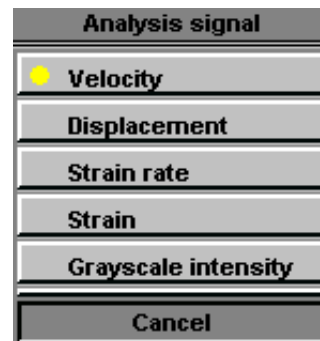
Figure 6-7: The Analysis signal menu

3. Select the desired trace.
    The Analysis window is updated with the selected trace.

Curve fitting analysis

Curve fitting analysis is used to estimate local myocardial perfusion rate using ultrasound contrast agents.

The analysis is based on two algorithms:

- **Wash-in curve fitting**: find and estimate local perfusion rate using contrast agent.

  Exponential wash-in is described by the function:
  $y(t)=A[1-e-kt]+B$, where:

  - **A** (dB or AU) is the intensity from the contrast agent.
  - **B** (dB or AU) is the intensity at time t = 0 (defined as the time of left marker). This corresponds to the tissue (baseline) signal if no contrast is present at the selected starting point.
  - **k** (1/s) is a time constant.

- **Wash-out curve fitting**: find and estimate the wash-out rate of contrast agent locally (e.g. LV or myocardium). Exponential wash-out is described by the function:

  $y(t)=Ae-kt+B$, where:

  - **A** (dB or AU) is the intensity from the contrast agent.
  - **B** (dB or AU) is the intensity from the tissue = baseline signal.
  - **k** (1/s) is a time constant.

Note that A+B = contrast + tissue = plateau level.

Note that A+B is the initial intensity level.
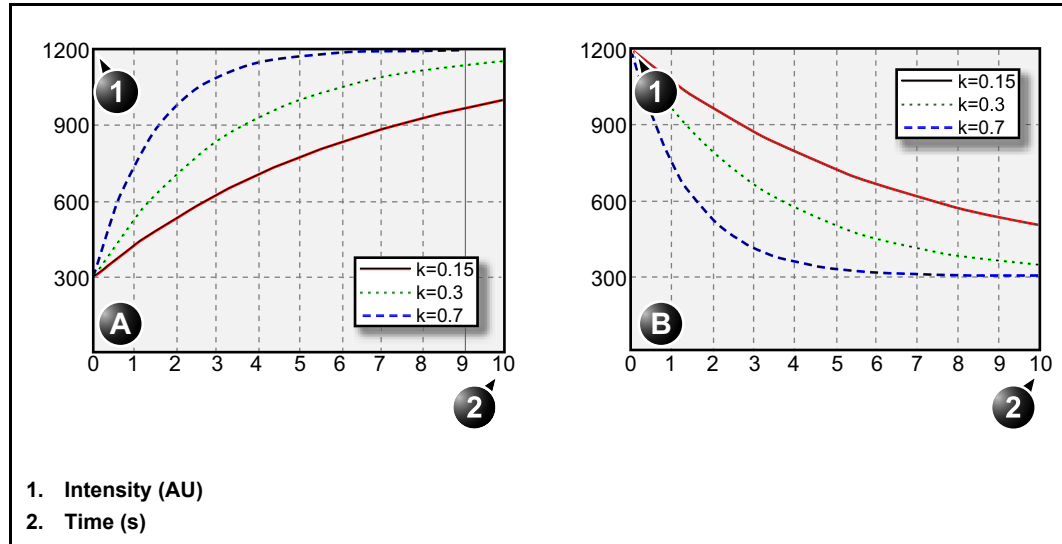
Figure 6-8: :Curve fitting examples, A) wash-in, B) wash-out A=900 AU, B=300 AU for all curves

Wash-in curve fitting analysis

Overview

The purpose of wash-in curve fitting analysis is to find and estimate local perfusion rate using contrast agent. There are two methods to obtain this information:

- Use the Real-time Myocardial Contrast application with low transmit power (MI 0.1). Applying **Flash** will destroy most or all contrast within the imaging plane. The period of low power imaging immediately following the flash will contain the information on how fast contrast agent washes into different segments of the myocardium. By storing data 5 to 10 seconds after Flash and performing curve fitting to this data set, the user can explore myocardial perfusion.

- Use the myocardial Contrast application in triggered mode. This imaging mode is destructive for the contrast agent, and the interval between each frame determines the image intensity. Vary the triggering interval to obtain information regarding how fast the contrast agent washes into the myocardium after destruction.

Performing wash-in curve fit

From a contrast examination in Quantitative analysis:

1. Disable frames that are significantly different (i.e. because of respiration or probe movements), see page 141.

Up to eight different sample areas may be generated in the myocardium.

2. In one of the *Cineloop windows*, Anchor a **sample area** in the myocardium.

3. If desired, reshape the **sample area** as described on page 143.

Refer to page 139 for further details

4. Because of heart motion, the sample area in each frame has to be adjusted manually to be located inside the myocardium (Manual tracking of the sample area). The signals originating from the heart cavities are typically 10 to 20 times stronger than the signals from the myocardium, and will have a major effect on the averaging of signals in the sample area.

5. Using the **Frame slider** (or **F3** and **F4** keys), browse through the cineloop to ensure that the sample area is in the same anatomical position in all frames.

6. Use the **Horizontal sweep slider** and scroll through the cineloop to visualize a specific part of the data, typically the region immediately after Flash.

7. Adjust the **left** and **right markers** to apply curve fitting to a specific region.

8. Press the **Right mouse button** in the *Analysis window*. The *System menu* is displayed.

9. Select **Curve fitting**. The *Curve fitting menu* is displayed.
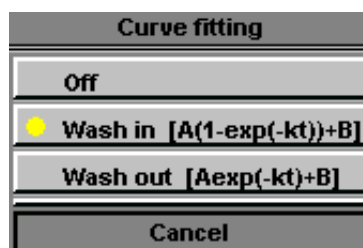
Figure 6-9: The Curve fitting menu

10. Select **Wash-in**. The Wash-in curve is displayed in the *Analysis window* (see Figure 6-10).

1. **Parameter window**
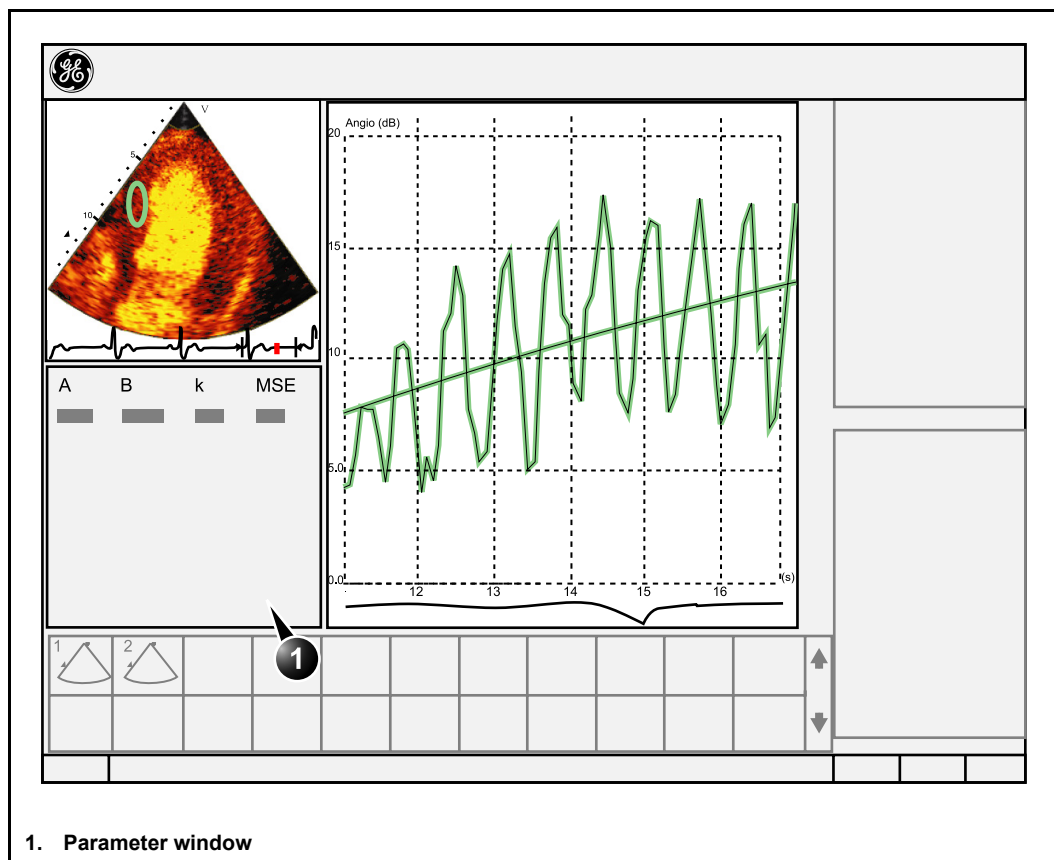
Figure 6-10: Wash-in curve fit of Real Time MC data

Wash-in curve fitting using varying triggering intervals

If the data set contains frames with uneven time intervals, e.g. triggered images with increasing triggering intervals, it is possible to plot the data using the time interval (dt) on the X-axis.

1. Disable unwanted frames (see page 141). Curve fitting will be performed using all enabled frames.

Up to eight different sample areas may be generated in the myocardium.

2. In one of the *Cineloop windows*, Anchor one or more sample areas in the myocardium.

3. If desired, reshape the sample areas as described on page 143.

4. Perform **manual tracking** (see page 139) of the sample areas on all frames to ensure that the sample area is inside the myocardium.

5. Press the **Right mouse button** in the *Analysis window*. The *System menu* is displayed.

6. Select **Horizontal scale**. The *Horizontal scale menu* is displayed.

7. Select **dT scaling**. The X-axis in the *Analysis window* is updated accordingly.

8. Press again the **Right mouse button** in the *Analysis window*.

9. Select **Curve fitting**. The *Curve fitting menu* is displayed.
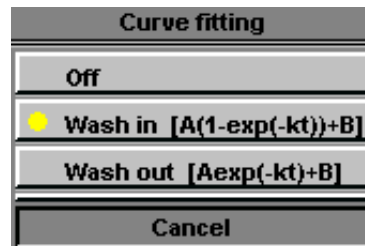
Figure 6-11: The Curve fitting menu

10. Select **Wash-in**. The Wash-in curve is displayed in the *Analysis window*.

1. **Parameter window**
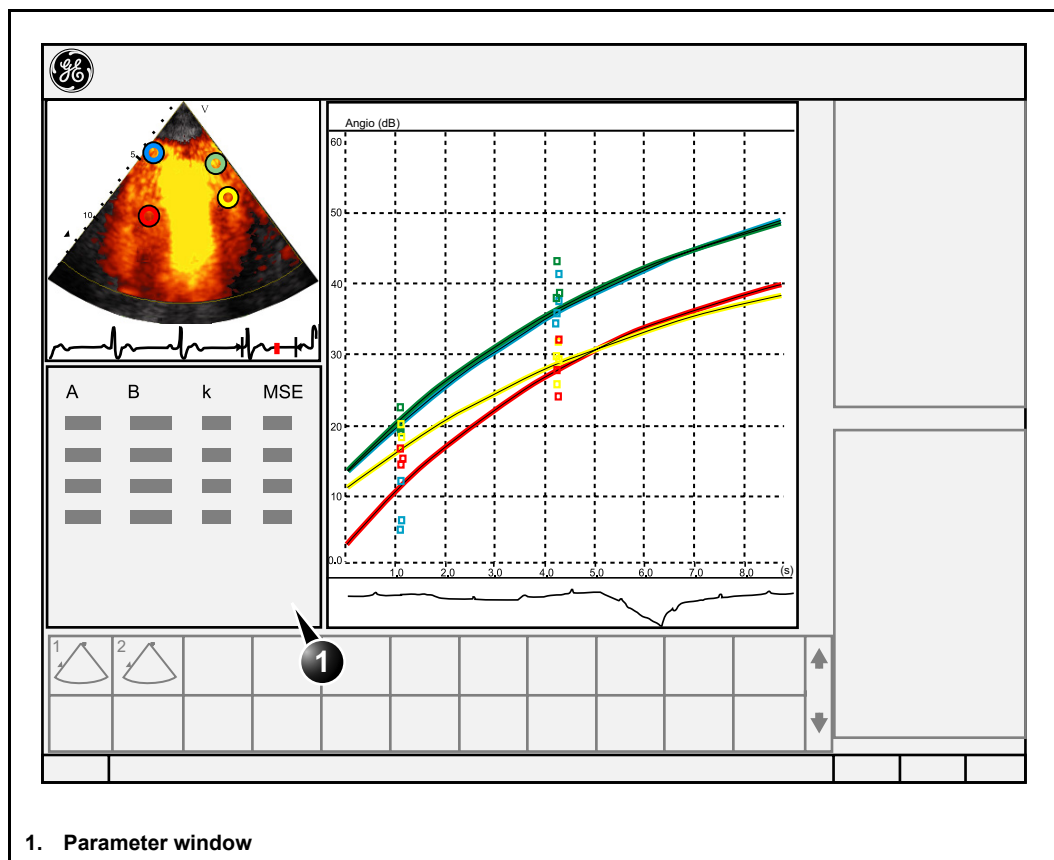
Figure 6-12: Wash-in curve fitting after varying triggering interval

Wash-out curve fitting analysis

Overview

The purpose of wash-out curve fitting analysis is to find and estimate a local wash-out rate. The analysis may be used for wash-out of contrast from LV or myocardium.

Performing wash-out curve fitting

From a contrast examination in Quantitative analysis:

Up to eight different sample areas may be generated in the myocardium.

1. Disable frames that are significantly different (i.e. because of respiration or probe movements), see page 141.

2. In one of the *Cineloop windows*, Anchor a sample area in the myocardium.

3. If desired, reshape the sample area as described on page 143.

Refer to 'Manual tracking of the sample area (dynamic anchored sample area)' on page 139 for further details.

4. Because of heart motion, the sample area in each frame has to be adjusted manually to be located inside the myocardium (Manual tracking of the sample area). The signals originating from the heart cavities are typically 10 to 20 times stronger than the signals from the myocardium, and will have a major effect on the averaging of signals in the sample area.

5. Using the **Frame slider** (or **F3** and **F4** keys), browse through the cineloop to ensure that the sample area is in the same anatomical position in all frames.

6. Use the **Horizontal sweep slider** and scroll through the cineloop to visualize a specific part of the data,.

7. Adjust the **left** and **right markers** to apply curve fitting to a specific region.

8. Press the **Right mouse button** in the *Analysis window*. The *System menu* is displayed.

9. Select **Curve fitting**. The *Curve fitting menu* is displayed.

Figure 6-13: The Curve fitting menu

10. Select **Wash-out**.
    The Wash-out curve is displayed in the *Analysis window* (see Figure 6-14).
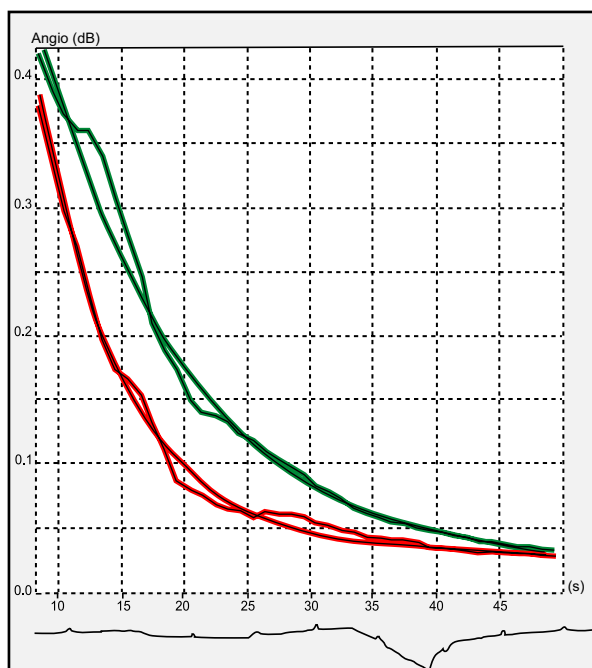
Figure 6-14: Wash-out curve fit of two sample regions in an in-vitro experiment

Anatomical M-Mode

Introduction

M-Mode applied to TVI, Tissue tracking, Strain rate, Strain or intensity data (Contrast) calculates and color/codes data accordingly along a path drawn by the operator.

Using Anatomical M-Mode

1. Select **CAMM** on the control panel.
2. In one of the *Cineloop windows*, anchor the first point of the path.
3. Move the **Mouse cursor** to the location for the next anchoring point of the path.

*To edit a path under construction, **follow the line backward** and retrace the path.*

4. Press the **Left mouse button** to anchor the second point. A path with two anchor points will give a straight anatomical M-Mode profile. By creating more than two anchor points, the user can bend the path and obtain a curved anatomical M-Mode profile.
5. Double click the **Left mouse button** to end the trace.

*Adjust the **Horizontal sweep** and scroll through the cineloop to optimize the display to the portion of interest.*

The color-coded display of the corresponding data calculated along the path is shown in the *Analysis window* (see Figure 6-15).

1. **Cineloop window**   3. **Path anchor point**
2. **Analysis window**   4. **Time scale**
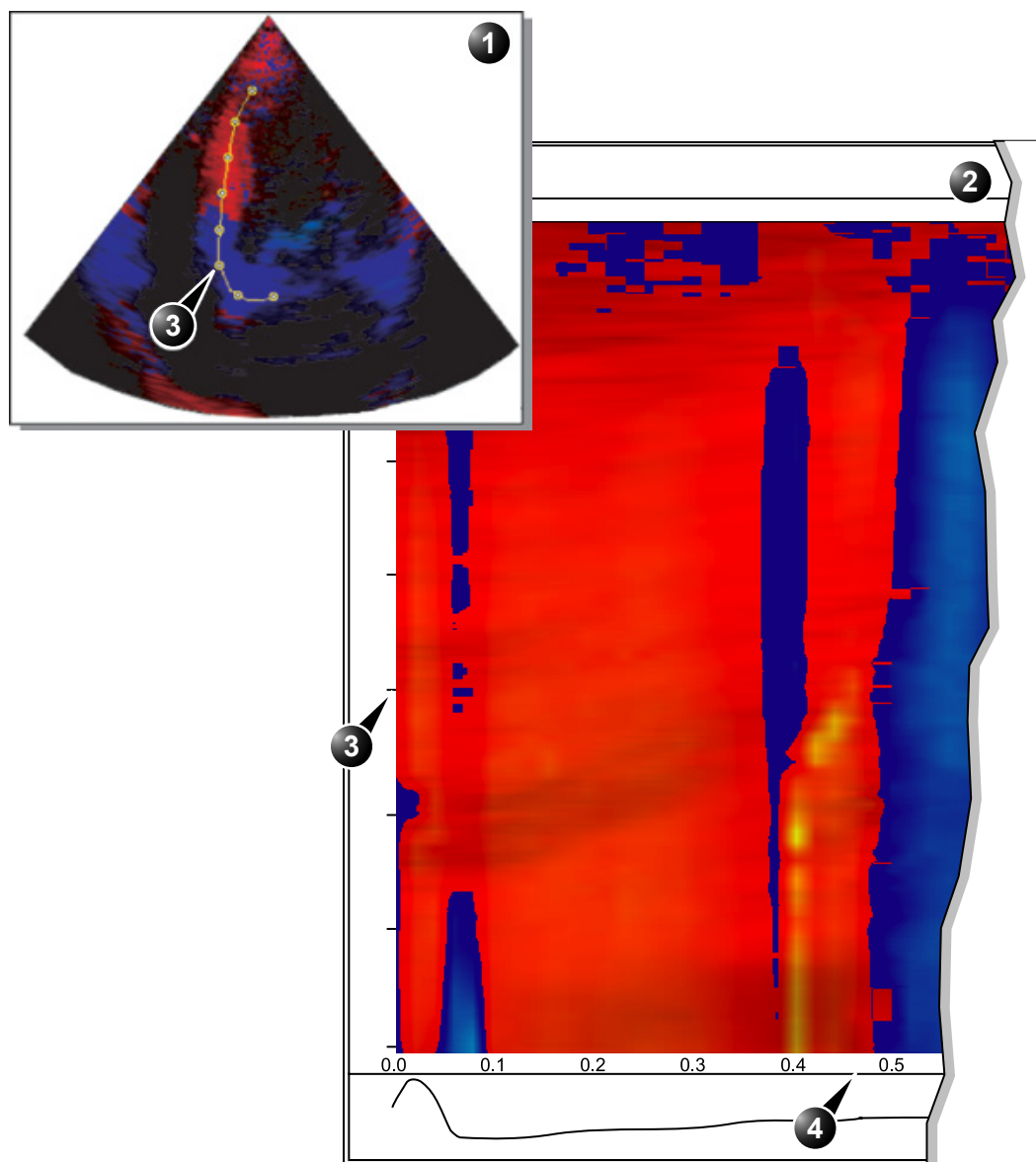
Figure 6-15: The anatomical M-Mode display (here TVI data)

Optimizing Anatomical M-Mode

Edition of the curve

The drawn Anatomical M-Mode path can be edited by moving
the anchor points.

To move an anchor point

1. Select the anchor point to move.
2. Move the anchor point to a new position.
3. Press the **Left mouse button** to anchor the point to its new
   location.

Chapter 7
Worksheet

Contents

Introduction

The worksheet function enables the user to review, edit, delete or print measurement 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 7-1: The Worksheet screen

Using Worksheet

1. Press **Worksheet** and select the measurement type.

To scroll through pages

1. Press **Page up** or **Page down**.

To select the type of value

1. Select the relevant cell in the *Method column* (see Figure 7-2).
   A pop-up menu is displayed showing the different options available (Figure 7-2).

2. Select the required option.
   The value is updated accordingly

1. **Average of the measurements taken**
2. **Maximum measurement**
3. **Minimum measurement.**
4. **Last measurement that was taken**
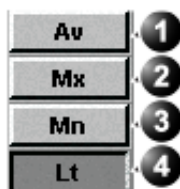
Figure 7-2: The Calculation method options list.

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/include a measurement

1. Move the cursor over the measurement value to exclude/include.

2. Press the **Right mouse button** and select **Exclude value/Include value** in the displayed menu.

Manually changing a value

Individual measured values can be manually changed using the alphanumeric keyboard.

To manually change a value

1. Move the cursor over the value that is to be changed.
2. Press the **Left mouse button**.
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. Move the cursor to the relevant cell in the *Method column*.
2. Press the **Left mouse button**.
   A pop-up menu is displayed showing the different calculation options available (Figure 7-2).
3. Select the required option.
   The value is updated accordingly

Deleting measurement parameter

1. Move the cursor over the value that is to be deleted.
2. Press the **Right mouse button** and select **Delete value** in the displayed menu.

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Chapter 8
Report

This chapter includes the following information:

Introduction

The EchoPAC review station enables the generation of patient reports, based on the examination performed and the analysis that were made during the examination. The reports are generated using the data that is stored in the system, using pre-selected templates.

Saved reports are *read-only*. Therefore it is recommended that the data be carefully reviewed before the report is created. Use the worksheet (see page 161) 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 and the patient's personal data can be modified. The examination data itself cannot be changed.

Working with the report function

1. Select **Report**.
    The default template is displayed. The information entered during the creation on the patient record is automatically filled in (e.g. demographic, Diagnosis, Comments...etc.). The report entries, such as **Name**, **Date of Birth**, **Diagnosis** and so on are hot linked to the original screen from which the data was taken. This data can be modified in the report by selecting the heading.
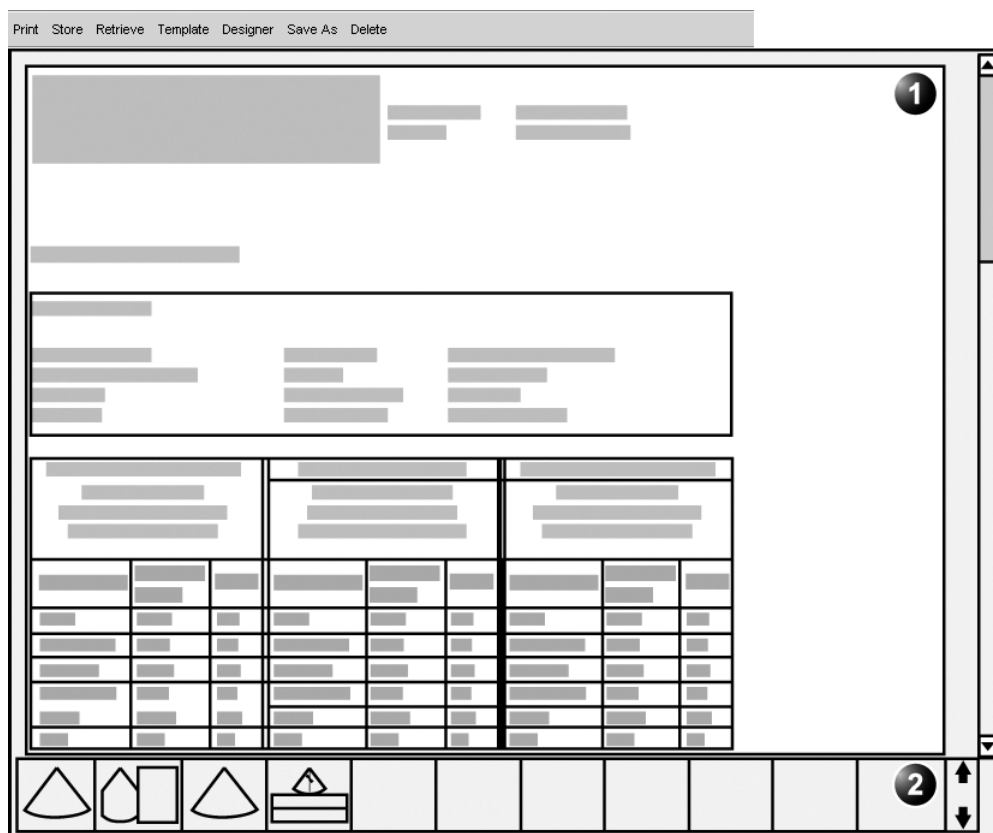
1. **Report for the current examination**
2. **Clipboard with images from the current examination**

Figure 8-1: The Report screen

To change patient information

1. Move the **Mouse cursor** over the heading of the information to change.
   The mouse cursor marker is changed to a hand with pointing finger 🖑.
2. Press the **Left mouse button**.
   The original location of the data is displayed.
3. Change the information entered if required.
4. Press **Report** when completed.

To choose another report template

1. Press **Template**.
    A list of available templates is displayed.
2. Select the desired template.

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. Move the **mouse marker** over the image of interest.
2. Press and hold down the **Left mouse button** and drag the image in the *Image container* in the report.
3. Depress the **Left mouse button**.

To print a report

1. Press **Print**.
    The report is printed on the default printer. A status window is displayed showing the printing process.

To save a report

Only members of the user group "Cardiologist" are allowed to store a report (see page 229).

1. Press **Store**.
    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.

1. Press **Save as**.
    The *Save as dialogue window* is displayed.
2. Select the destination folder from the *Save in pull down menu*.
    The *Report archive folder* is selected by default.

3. Enter a file name.
4. Select **PDF** or **CHM** format from the *Save as type pull down menu*.
5. Press **Save**.

Retrieving an archived report

1. Press **Retrieve**.
   A list of the available reports for the actual examination is displayed.
2. Select the report to retrieve.

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**.
2. Press **Designer** in the *Report screen*.
   The *Report designer screen* is displayed with the selected template in the *Report template design area* (see Figure 8-2).

Report designer overview

The Report designer screen

1. **Menu bar**
2. **Report template design area**
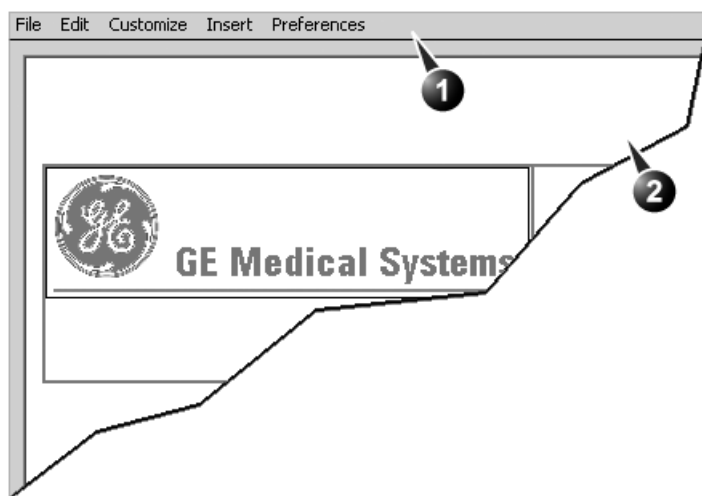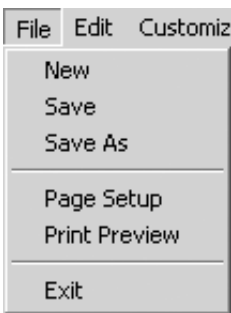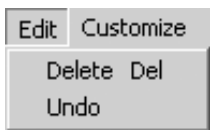
Figure 8-2: The Report designer screen

The menu bar
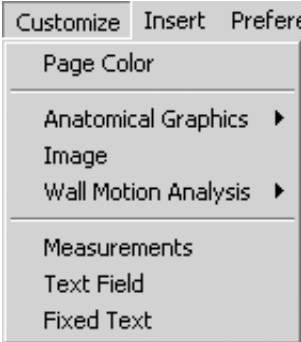
The File menu

Menu	Description
File Edit Customiz New Save Save As Page Setup Print Preview Exit	• **New**: display an empty template. • **Save**: save the template using the same name and exits the Report designer. Factory report templates cannot be overwritten. • **Save as**: save the template using a new name and exits the Report designer. • **Page setup**: display the printing version of the template where the user can adjust parameters specific to the paper version (i.e margins). • **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.

The Edit menu

Menu	Description
Edit Customize Delete Del Undo	• **Delete**: remove the selected object from the report template. • **Undo**: restore the previous state of the report template.

The Customize menu

Menu	Description
Customize Insert Prefere Page Color Anatomical Graphics ▶ Image Wall Motion Analysis ▶ Measurements Text Field Fixed Text	• **Page Color**: sets the default background color for the template page. • **Anatomical graphics**: select and insert an anatomical graphic (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). • **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.

The Insert menu

Menu	Description
Insert Preferences Page Break Table Logo Archive Info	• **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

Designing a report template

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.

Starting template designing

1. Start the Report designer (see page 173).
2. Press **File** and select **New** to display a default page or use the current report template as basis template.

Setting the layout preferences

Adjusting the default fonts and container background colors
1. Press **Preferences**.
   The *Preferences dialogue window* is displayed (see Figure 8-3).
2. Select a container and adjust the parameters as desired.
3. Repeat step 2 for each information container.

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**.
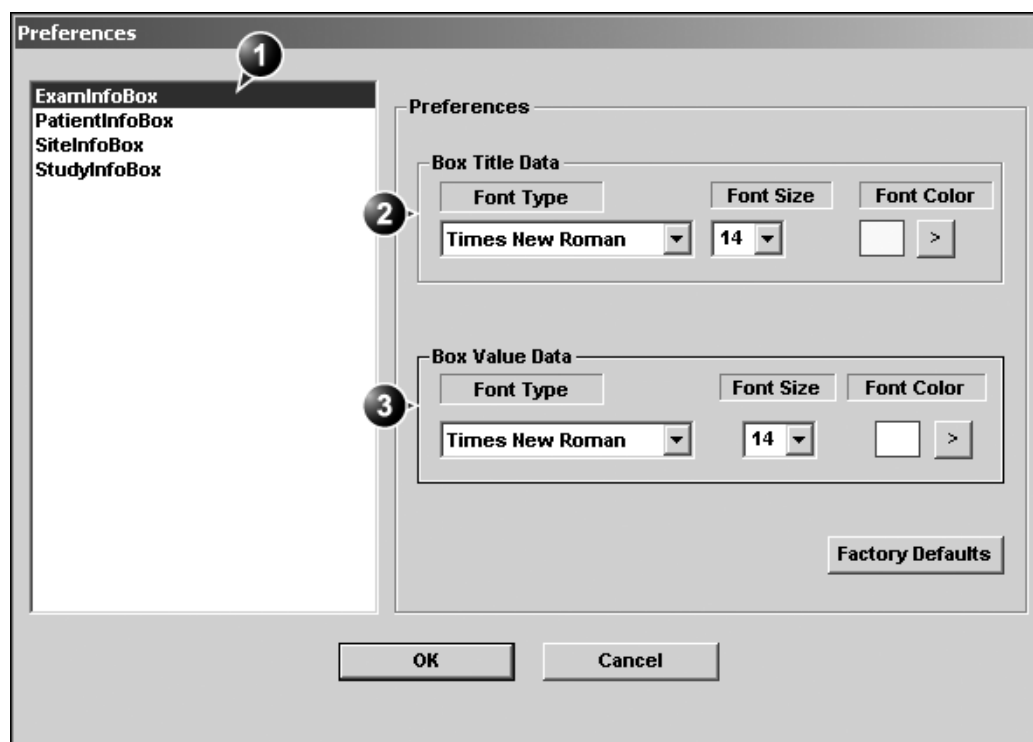
1. Select a container
2. Adjust the container's title font parameters
3. Adjust the container's core text font parameters

Figure 8-3: The Preferences dialogue window

Inserting an information container in the report template body

Procedure for a single insertion
1. Press the **Left mouse button** at the desired insertion point in the *Report template design area*.
2. Press **Customize** or **Insert** and select the actual information container.
   The *Container properties window* is displayed.
3. Adjust the parameters as required.
4. If the default layout parameters have to been changed, press **Box Properties**. Adjust as desired (see page 180) and press **OK**.

5. Press **OK** in the Container properties window.
    The container is added to the template.

Procedure for multiple side by side insertion

To insert two or more information containers <u>side by side</u>, a table with multiple cells must be created first.

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 8-4).
3. Adjust the parameters as desired.
4. Press **OK**.
    The container is displayed in the template.
5. Insert the information containers of interest within each cell as described in the previous section.
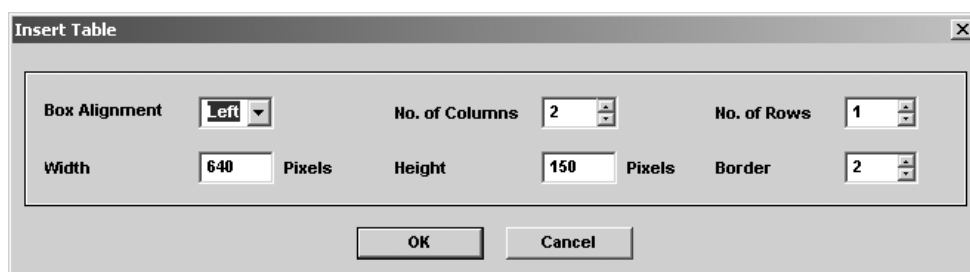
Figure 8-4: The Table properties window

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 properties window* is displayed.

3. Adjust the parameters specific to the selected container.

Modifying the layout properties

1. Press **Box properties** in the *Container properties window*.
   The Box properties window is displayed (see Figure 8-5).

2. Set the options as desired.

3. Press **OK**.

Figure 8-5: The Box properties window (example)

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**.

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.

   Selecting **Yes** or **No** will quit the Report designer and display the Report function.

Save existing template with a new name

1. Press **File** and select **Save as**.
   The *Save as template window* is displayed.
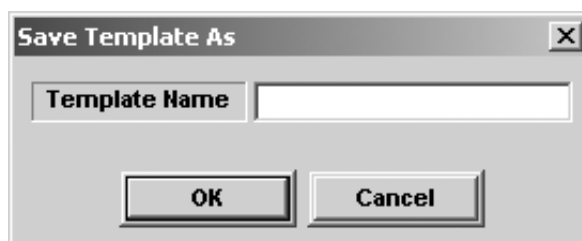
 Figure 8-6: The Save as template window

2. Enter a name for the template.
3. Press **OK**.
   The template is saved and the *Report screen* is displayed.

Chapter 9
Program configuration

Contents

Introduction

This chapter describes the configuration management package of EchoPAC PC workstation. The EchoPAC PC configuration package enables the user to customize the global configuration for the workstation.

In addition, users with administration rights have access to the local archive backup function, local archive restore function and creation of users.

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 EchoPAC PC configuration package:

Category and sublevel	Description	access	Refer to
Imaging			page 188
• Global	Sets the cineloop controls and display. Sets the patient information display.	All	
Measure	Configures *Measurement menu* by selecting and defining the sequence of the measurements and calculation to perform. The selected measurements and calculation are displayed in the worksheet.	All	page 190
Report			page 198
• 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	

Category and sublevel	Description	access	Refer to
• Comment texts	Create or delete pre-defined text input for the comments.	All	
Connectivity			page 204
• Dataflow	Create new dataflows or configure existing dataflows.	Admin	
• Additional outputs	Configure the **Alt. Store 1** and **Alt. Store 2** keys.	Admin	
• Tools	Formats and verifies removable media.	All	
• Formats	Configures the *Examination list window display* and other options related to the patient management.	All	
• TCPIP	Sets the Transmission Protocol/ Internet Protocol.	Admin	
System			page 222
• 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 227
Administration			page 228
• 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	
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 229). 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 229).

To open the Configuration package

1. Select **config**.
   The *Log In window* is displayed asking for operator ID and password (see Figure 9-1).

2. Select **Log on** when completed.
   The *Setup dialogue window* is displayed (see Figure 9-2).

1. **Select the operator**
2. **Type password**
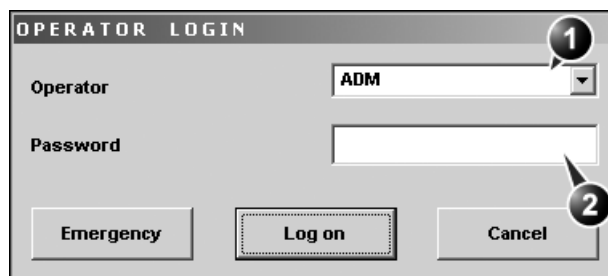
Figure 9-1: The Operator login window

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**
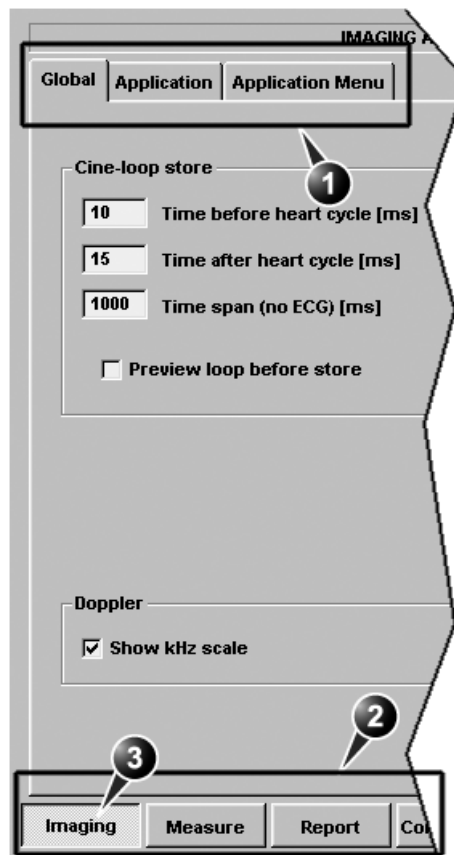
Figure 9-2: The Setup dialogue window structure

Imaging

The *Imaging configuration category* enables the user to configure display-related settings.

The Global setup sheet

Figure 9-3: The Global setup sheet
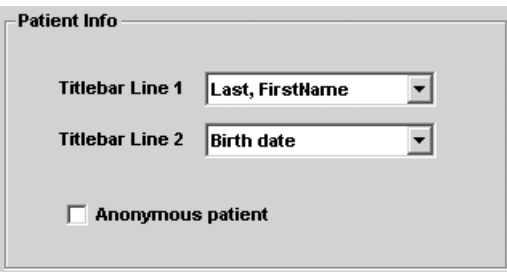
Crop images

Parameter	Description
	Crop images: ☑: In the *Analysis screen*, removes top and bottom of the image when more than two images have been selected.
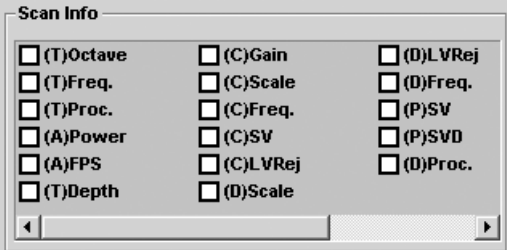
Doppler

Parameter	Description
Doppler ☐ Show kHz scale	**Doppler:** • Show KHz scale: when selected, displays the KHz scale on the left side of the Doppler spectrum.

Patient Info

Parameter	Description
Patient Info Titlebar Line 1 Last, FirstName ▼ Titlebar Line 2 Birth date ▼ ☐ Anonymous patient	**Patient Info:** • **Title bar Line1 & 2**: selects from the pop-up menu the patient information to display on the *Title bar.* • **Anonymous patient**: when checked, no patient information is displayed on the *Title bar*.

Scan Info

Parameter	Description
Scan Info ☐ (T)Octave ☐ (C)Gain ☐ (D)LVRej ☐ (T)Freq. ☐ (C)Scale ☐ (D)Freq. ☐ (T)Proc. ☐ (C)Freq. ☐ (P)SV ☐ (A)Power ☐ (C)SV ☐ (P)SVD ☐ (A)FPS ☐ (C)LVRej ☐ (D)Proc. ☐ (T)Depth ☐ (D)Scale	**Scan Info:** • ☑ : displays scan information on the video record.

Measure
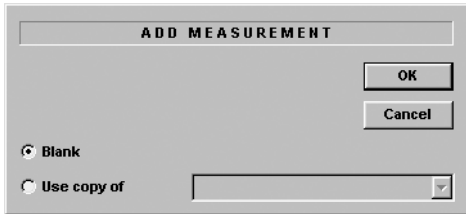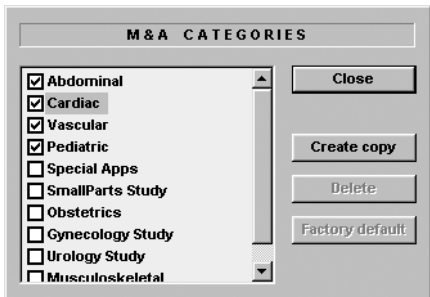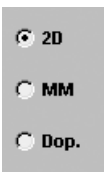
The *Measure setup category* enables the organization of the Factory default *Measurement menu* or the creation of user-defined *Measurement menus* to best suit the user's requirements.
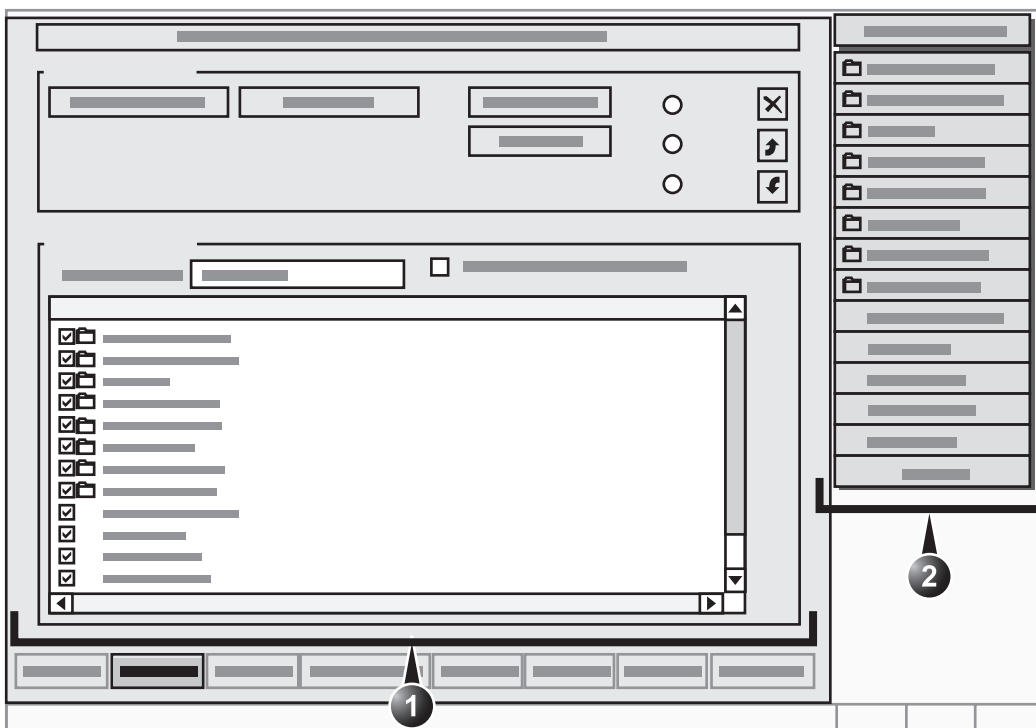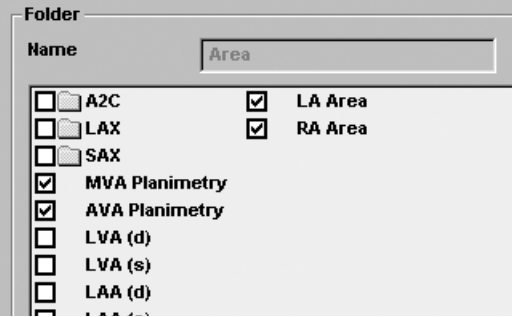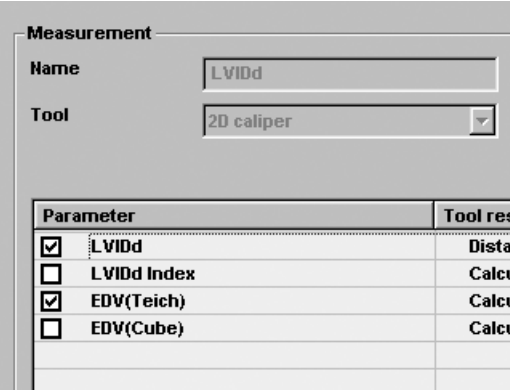
1. Configuration window (see next pages for details)

2. The measurement menu (displays updated configuration)

Figure 9-4: The Measurement menu setup sheet

Parameter	Description
ADD MEASUREMENT OK Cancel ○ Blank ○ Use copy of	**Add measure:** Create or select from the pop-up list a measurement to be added to a folder.
Add folder	**Add folder:** Enables the user to create its own folder with the desired measurements. The folder is displayed the *Measurement menu*.
M & A CATEGORIES ☑ Abdominal Close ☑ Cardiac ☑ Vascular ☑ Pediatric Create copy ☐ Special Apps ☐ SmallParts Study Delete ☐ Obstetrics ☐ Gynecology Study Factory default ☐ Urology Study ☐ Musculoskeletal	**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 ○ Dop.	**2D, MM and Dop. radio buttons:** Enables the display of mode related *Measurement menu* in the configuration window.

Parameter	Description
	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*.
	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

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 191).

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 191).

2. Select the M&A category name.

3. 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. Select to the Measurement menu heading.
    The measurement categories are displayed in a sub-
    menu.

2. Select to the measurement category of interest.
    The measurement category is displayed.

Moving an item in the Measurement menu

1. Select the entry to move into the *Measurement menu*.

2. 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 delet-
ed.*

1. Select the entry to delete in the *Measurement menu*.

2. 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:
1. Uncheck the actual folder or measurement in the *Folder* or *Measurement field* in the *Configuration window*.

To display a hidden folder or measurement:
1. 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.

1. Select the folder in the *Measurement menu*.
2. Press **Add Measure**.
    The Add measurement dialogue window is displayed (Figure 9-5).
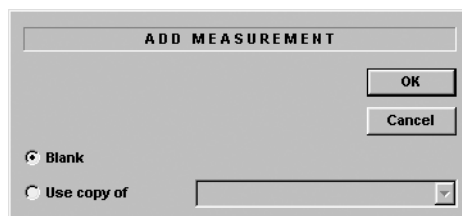
Figure 9-5: The Add Measurement dialogue window

To add an existing measurement with pre-defined parameters
1. select **Use Copy of**.
2. Select the measurement in the pop-up menu.
3. Press **OK**.

To create a measurement with user-defined parameters
1. In the *Add measurement dialogue window*, select **Blank**.
2. Press **OK**.
3. In the *Measurement field*, enter the measurement name.
4. Select the desired measurement type in the *Tool pop-up menu*.
   The actual measurement parameters are displayed.
5. Select the first parameter in the *Parameter column*.
6. Enter a name for the parameter.

Adding a user-defined function to a measurement

1. Select the actual measurement in the *Measurement menu*.
   The parameters related to the measurement are listed in *Parameter list*.
2. Press twice on an empty line at the bottom of the *Parameter list*.
   The free text cursor is activated.
3. Enter a name for the parameter.
4. Select the Parameter line once again.
   The *Edit Formula dialogue window* is displayed.

Figure 9-6: The Edit formula dialogue window

5. Create a formula by selecting parameters, operators and functions.
Unit: All results are calculated in SI units. If the unit is not specified or not one in the table below, the displayed value will be in SI units. All conversions to other units must include a conversion factor in the formula. If the unit is one in the table below, the conversion factor will be included in the formula.

⚠
CAUTION

Make sure that the formula gives a SI unit that is compatible with the conversion unit.

6. Press **Check** to control the formula.
7. Press **OK** to store the parameter.

⚠
CAUTION

GE Ultrasound do not take any responsibility for the correctness of the user-defined functions.

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
Volume flow	m^3/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

Calculation	SI	Alternative unit
Mass	kg	g - ounce - pound
Other		mmHG - Date - WeekDay - Day - NoUnit l/minm2 - g/m2 - cm/m2

Report

The *Report configuration category* is divided in three sheets:

- **Templates**: enables the configuration of the *Template selection menu*.
- **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 2-2, page 14).
- **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 2-2, page 14).

The Report templates sheet
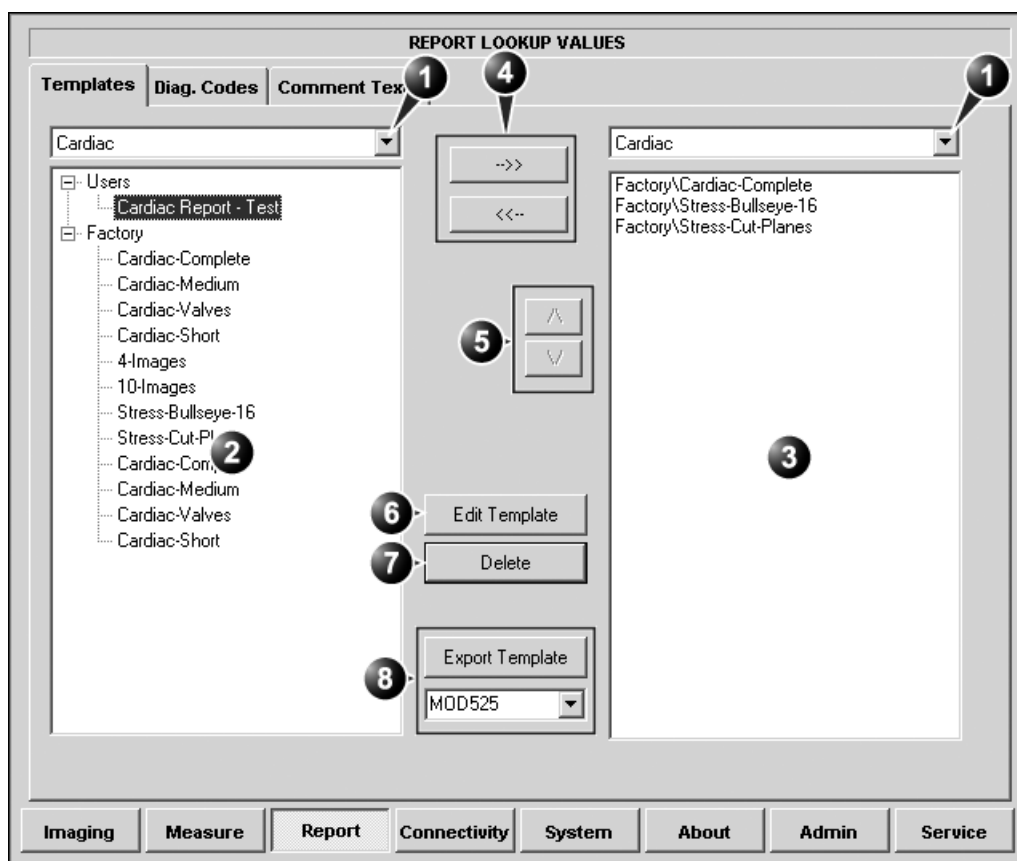
1. **Application selection pop-up menu**
2. **List of factory and user-defined report templates for the selected application**
3. **List of report templates shown in the *Template selection menu* for the selected application**
4. **Add/remove selected template to/from the *Template selection menu*.**
5. **Move selected template up/down in the *Template selection menu*.**
6. **Open selected template in the template designer.**
7. **Delete selected template (user-defined templates only)**
8. **Export template to MOD or CD-R**

Figure 9-7: The Report templates sheet

Configuration of the Template selection menu

The configuration of the Template selection menu is done by:

• Selecting the application specific *Template list* (left field) and the application specific *Template selection menu* (right field).

• Inserting or removing report templates to/from the *Template selection menu*.

• Sorting the report templates in the *Template selection menu*.

Procedure

Selecting the application specific template list and Template selection menu:

1. Select the desired application from the *Application selection pop-up menu* over the list of report templates (left field, see Figure 9-7).
The list of factory and user-defined report templates (left field, see Figure 9-7) is updated showing the available templates for the selected application.

2. Likewise select the application for the *Template selection menu* (right field, see Figure 9-7).

Inserting a template to the Template selection menu

1. Select the template to insert in the *Template list* (left field).

2. Press the **Right arrow button**.The selected template is inserted in the *Template selection menu* (right field). ☐ -» ☐

Removing a template from the Template selection menu

1. Select the template to remove in the *Template selection menu* (right field).

2. Press the **Left arrow button** ☐ «- ☐.The selected template is removed from the *Template selection menu* (right field).

Sorting the templates in the Template selection menu

1. Select the template to move in the *Template selection menu* (right field).

2. Press the **Up** or **Down arrow buttons** ☐ ∧ ☐ ☐ ∨ ☐.The selected template is moved accordingly in the *Template selection menu*.

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 2-2, page 14).
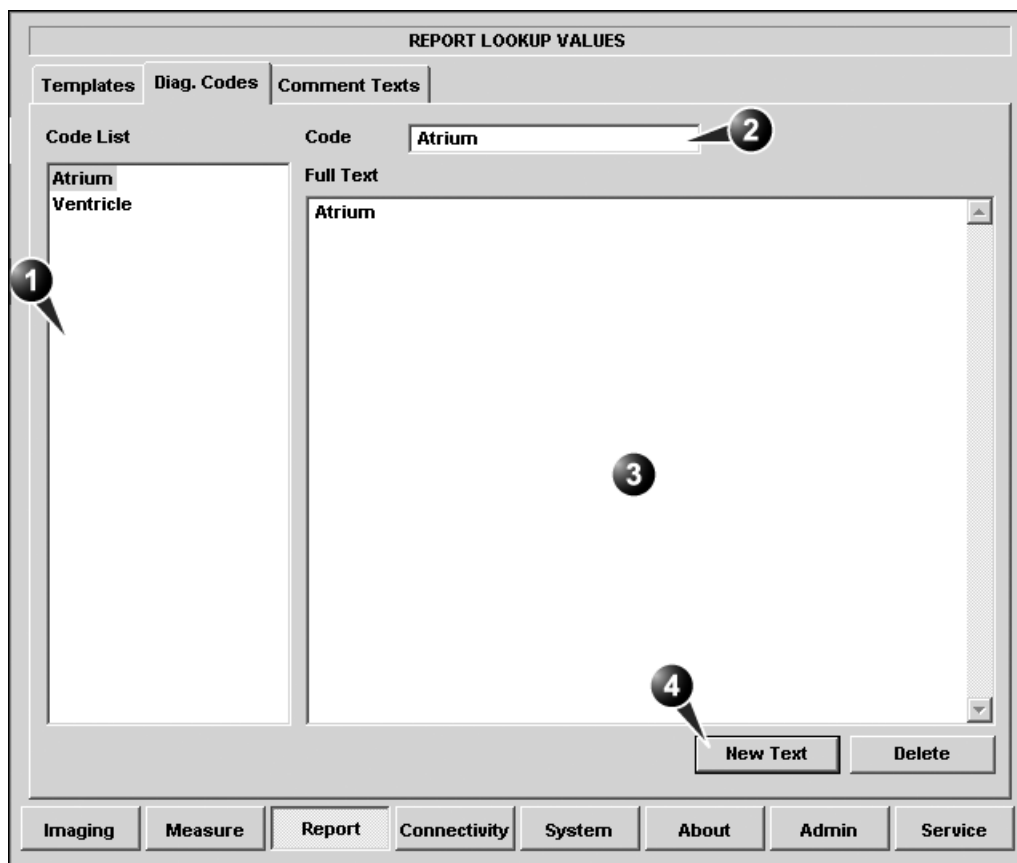
1. List of text inputs
2. Text input name
3. Text input display area (free test area)

4. Create a text input

Figure 9-8: The Diagnostic codes sheet

Creating a text input

1. Press **New Text** (see Figure 9-8).
2. In the *Code field* enter a name for the text input.

3. Move the **Mouse cursor** in the *Text input display area*.

4. Press the **Left mouse button**.

5. Enter the text.
   The new text input is created and can be selected when entering diagnostic information in the *Examination list window* (see page 16 for more information about diagnostic information entry).

Deleting a text input

1. In the *Code list field*, select the text input to delete (see Figure 9-8).

2. Press **Delete**.

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 2-2, page 14).

Figure 9-9: The Comment texts sheet

Refer to 'Direct report' on page 70 for more information on creating, editing and deleting comment text inputs.

Connectivity

This configuration setup category deals with:

- **Dataflow**: connection and communication setup of the EchoPAC PC with other devices.
- **Additional outputs**: configuration of the **Alt. Store 1** and **Alt. Store 2** buttons.
- **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 EchoPAC PC 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 workstation, and from the workstation to an output source.

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.
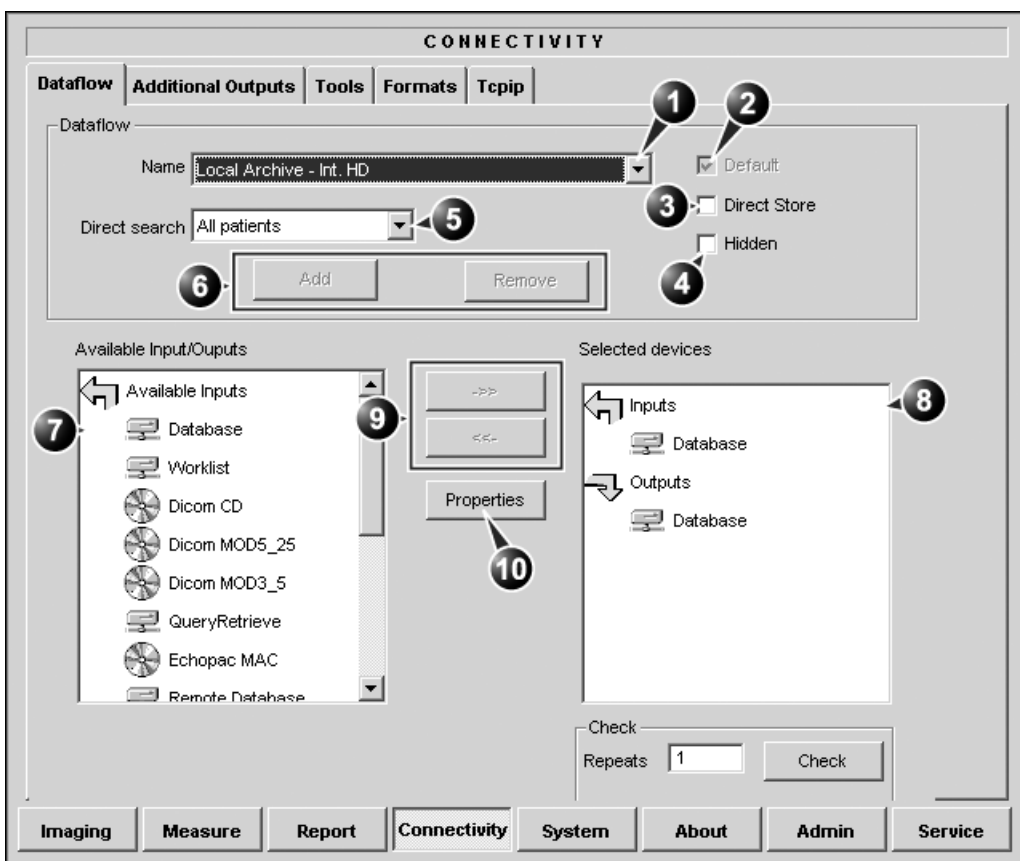
1. **Select a dataflow to edit**
   Factory defined dataflows cannot be edited.
2. **Use selected dataflow as default**
3. **Store data directly to archive**
4. **Hide selected dataflow from the list of available dataflow**
5. **Option for the search function. In the Search/ Create patient window select 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 9-10: 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 210).

	Dataflow	Description
	No Archive	Enables to perform an examination without storing the data to the archive.
	LocalArchive-Int.HD	**Local archive internal harddrive** The local database is used for patient archiving. Images are stored to internal harddrive.
	LocalArchive-MOD	**Local archive Magneto Optical Disk (MOD)** The local database is used for patient archiving. Images are stored to a MOD.
	RemoteArch-RemoteHD	**Remote archive remote harddrive** 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).
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.
	DICOM MOD 3.5	DICOM 3.5" Magneto Optical Disk Read DICOM Media from the 3.5" MO-drive.
	DICOM MOD 5.25	DICOM 5.25" Magneto Optical Disk Read DICOM Media from the 5.25" MO-drive.

	Dataflow	Description
	DICOM CD read	DICOM CD read Read DICOM Media from the CD-drive.
EP MAC MOD: the MOD must be PC-formatted. Only images can be read.	**EchoPAC Mac MOD read**	EchoPAC Macintosh Magneto Optical Disk read Read MOD from EchoPAC (Macintosh).
	DICOM Print	DICOM Print Send images to a DICOM printer.
	Query Retrieve	Query Retrieve Retrieve images from a DICOM server

To select the default dataflow

1. Select the dataflow in the *Name drop-down menu*. (see Figure 9-10).
2. **Check** the *Default box*.
   The dataflow will be selected by default when restarting the unit.

To create a new dataflow

1. Press **Add**.
   The *Add dataflow window* is displayed.

Figure 9-11: 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 *Button sheet* deals with configuration of the **Alt. store 1** and **Alt. store 2** buttons. Several outputs (e.g. Video Print, Laser print, DICOM storage...etc.) can be associated to these buttons (i.e. pressing **Alt. store 1** or **2** can result in printing a Color video print and storage to a DICOM media).
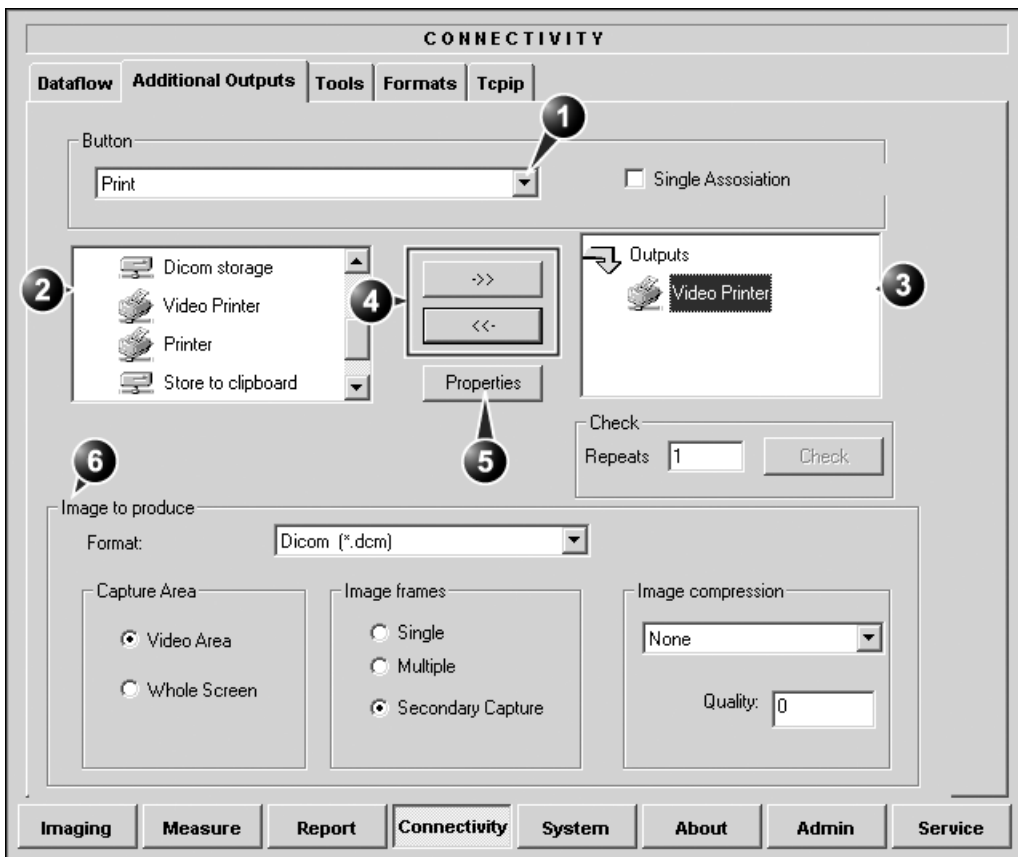
1. Select between Alt. store 1 and Alt. store 2 buttons.
2. Available output devices that can be assigned to the current button.
3. Output devices assigned to the current button.
4. Add or remove selected device to/from the current button.
5. Adjust the device settings for the selected assigned device
6. Select the type of images to produce and adjust image settings. These settings will overrule the adjustment made in the *Properties window*.
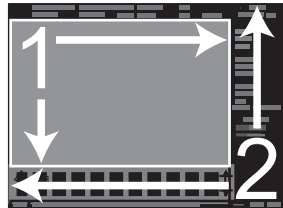
Figure 9-12: The sublevel Additional outputs (example)

The image configuration parameters

The table below gives a list of the configuration parameters.

To configure the Alt. store 1 and Alt. store 2 buttons
1. In *Button field* select **Alt. store 1** or **Alt. store 2**.
2. Select an **output device** in the *available outputs field* and press the **Right arrow button** to assign the service to the dataflow.
3. Press **Properties**.
   The *Properties window* is displayed.
4. Adjust the device specific parameters as desired.
   Some of the settings can be changed directly in the *Image to Produce field* in the sublevel Additional outputs.

Configuration parameter	
Format	Select between: • Raw DICOM • DICOM • AVI • JPEG
Image frames	Select between: • **Single**: stores single frame only • **Multiple**: stores cineloop • **Secondary Capture**: screen shot
Image compression	Select compression mode from the pop-up menu.
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.
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 or ZIP disk).
- verification of DICOM directory on removable media.

1. Select removable media to verify/format
2. Label a new removable MO disk (free text)
3. Verify DICOM directory on removable DICOM disk
4. Start formatting
5. Install a DICOM viewer
6. Select the device for patient information exported as Excel
7. Set the path for the repository for HL7 export (format: \\server-name\share-name)
8. Set a user-defined remote path for Save as function and export to Excel.

Figure 9-13: The sublevel Tools

$\triangle$

CAUTION

CD-RW is not supported, only CD-R (recordable).

Formatting a removable media

1. Select the removable media from the *Media pop-up menu*.
2. Enter a name for the removable media in the *Label field*.
3. Check **DICOM viewer** is desired.
   DICOM viewer enables the display of DICOM images from the removable media without the need of any other software.
4. Press **Format**.
5. Wait for the display of the *Information window* indicating that the formatting process is completed.
6. Press $\overline{\text{ALT}}$+$\overline{\text{E}}$ to eject the disk.

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

Verifying a removable media

1. Insert the removable media to verify.
2. Select the pre-configured removable media from the *Media pop-up menu*.
3. Press **Verify**.
   The unit is verifying the DICOM directory on the selected media.

Formats

The Formats sublevel enables configuration of the *Examination list window* (see Figure 2-2, page 14) and other tools related to patient management, as described below.
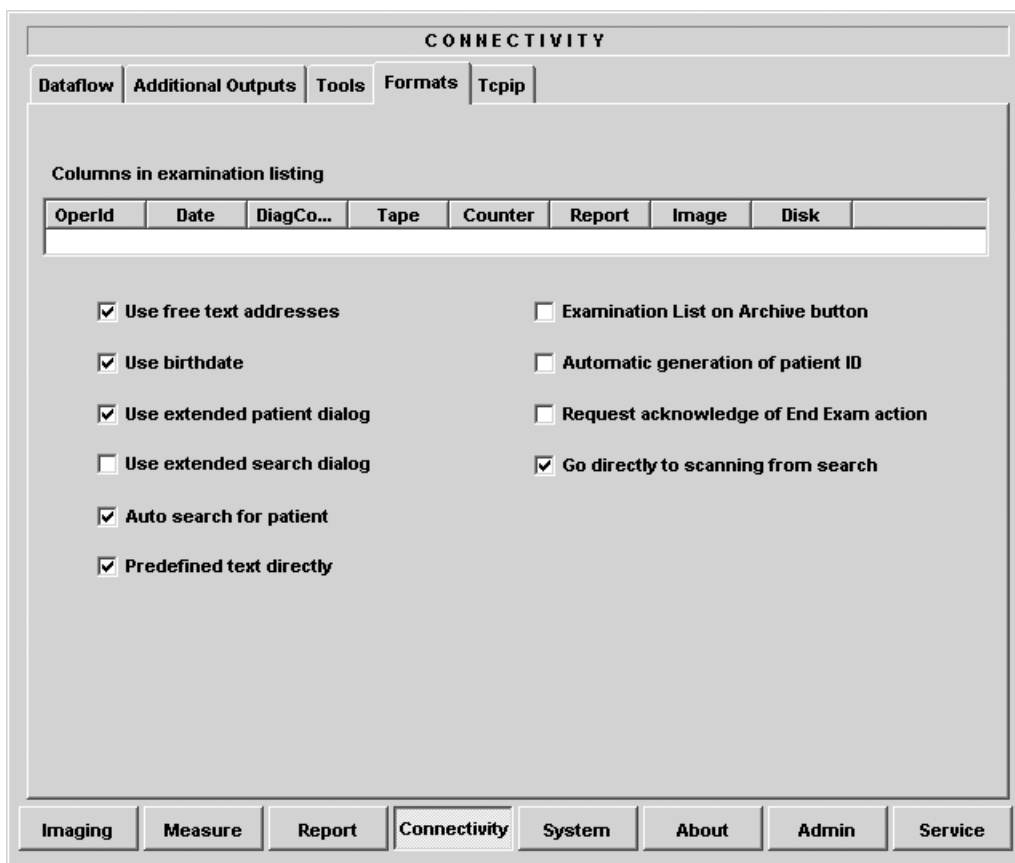
Figure 9-14: The sublevel Formats (example)

Configuration of the Examination list window

The user can configure the examination list displayed in the *Examination list window* (see Figure 2-2, page 14) 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.   Select to the column to edit.
     A sub-menu is displayed (see Figure 9-15).

2.   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**
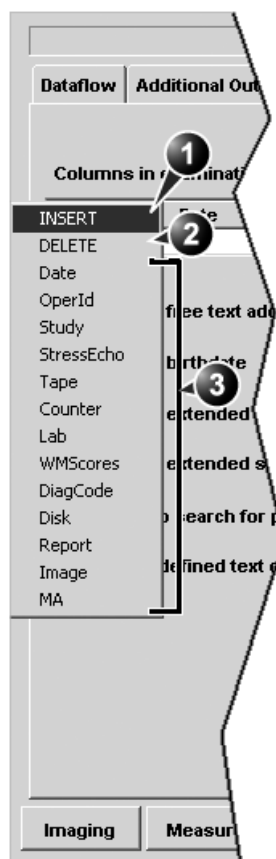
Figure 9-15: Configuration of the Examination list window

Other configuration settings

Parameter	Description
☑ Use free text addresses	**Use free text addresses:** In the *Patient information window* (see Figure 2-4, page 19), ☐: 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 Figure 2-4, page 19), enter either the patient age or the birth date: ☐: Enter age (birth date field not available) ☑: Enter birth date, the age is calculated.
☑ Use extended patient dialog	**Use extended patient dialog:** In the *Patient information window* (see Figure 2-4, page 19), ☑: 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 Figure 2-1, page 13), ☑: 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 Figure 2-1, page 13) ☑: The system searches automatically through the patient archive selected while entering patient information. ☐: The system searches through the patient archive after pressing enter.
☑ Predefined text directly	**Pre-defined text directly:** In the *Examination list window* (see Figure 2-2, page 14) ☑: the **Insert text** button launches pre-defined text input. ☐: the **Insert text** button open the extended text field.
☐ Examination List on Archive button	**Examination list on Patient button** When a patient is selected, pressing **Patient** 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* (see Figure 2-1, page 13) ☑: Patient ID is not required when entering a new patient in the archive. EchoPAC PC generates automatically an ID number. ☐: Patient ID is required when entering a new patient in the archive.
☐ Request acknowledge of End Exam action	**Request acknowledgement of End Exam:** ☑: The user is asked to confirm action when ending an examination.
☑ Go directly to scanning from search	**Go directly to scanning from search:** Not applicable in EchoPAC PC

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. obtain an IP address automatically   3. Save TCP/IP settings
2. Manually specify IP address and subnet mask

Figure 9-16: 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 9-17: The System settings setup sheet
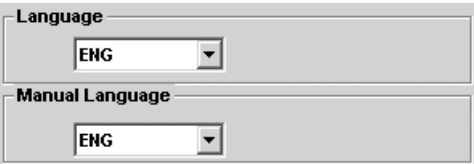
Location

Parameter	Description
Location Hospital GE Vingmed Ultrasound Department Development	**Location:** • **Hospital**: Enter the hospital name (up to 64 characters). This information is displayed on the *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 minute and second). • **Time Format**: select the desired format (24 or 12AM/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**: the four digits have to be typed when entering the year in the patient date of birth.

Languages

Parameter	Description
	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

Program configuration

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

Administration

The Admin. category is divided in six sheets:

- **Backup**: enables the backup procedures for local patient, image and report archives as well as EchoPAC PC configuration settings (see page 36).

- **Restore**: enables data retrieving of patient and report archives as well as EchoPAC PC configuration settings (see page 36).

- **Users**: deals with operators registration, operator's rights setting and registration of staff related to an examination (e.g. referral doctors, sonographers...etc.).

- **Logon**: deals with logon procedure.

- **System Administration**: keeps track of all the options implemented in the unit.

Users

The *Users sheet* deals with operators registration, operator's rights setting and registration of staff related to an examination (e.g. referring and interpreting physicians).

Figure 9-18: 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.

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 person ID (usually initials)
   - a password
   - The full name
3. Select the type of user/referring member in *Member of Group(s)*.

⚠
CAUTION

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 **Archive** 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
1. 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
1. Set the time span (from 10 min) for the system to automatically log off when not in use.

Logon

The *Log on sheet* deals with the on-logging procedure.

Figure 9-19: The Log on sheet

Remote Database Logon:

Give access to the network, refer to your network specifications.

Unlock all:

Unlock all lock patient records in the local database. Patient records are locked if an examination is not terminated properly or if it is opened.

View audit:

Displays a log file showing the operations performed on the unit.

Appendix

Contents

Regulatory information

The GE Vingmed 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 EchoPAC PC software is a Class I with measuring function device, according to the Medical Devices Directive 93/42EEC.

To fulfill the requirements of relevant EC directives and European Harmonized/International standards, the following documents/standards have been used:

Standard/Directive	Scope
93/42/EEC	Medical Devices Directive (MDD)

The EchoPAC PC software is installed and runs in a commercially available PC. According to applicable legislation, compliance to the following EC directives and European Harmonized/International standards are required for the PC in use:

$C\!\in_{0470}$
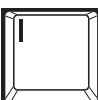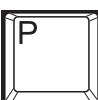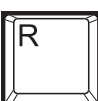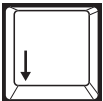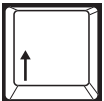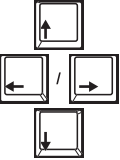
Standard/Directive	Scope
93/68/EEC	CE Marking Directive
89/336/EEC	Electromagnetic compatibility, EMC Directive
73/23/EEC	Low Voltage Directive
93/68/EEC	Amendment of 73/23/EEC.

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Standard/Directive	Scope
UL1950 (1996)	US and Canadian standard for information Technology Equipment.

Short-cuts
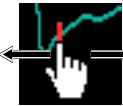
Keyboard short-cuts

Short-cut	Description
← / →	In Freeze, displays previous and next frame. Disabled when Direct report is activated.
Esc	Displays previous state (window).
Alt + A	Starts **Annotation** application
Alt + E	Ejects removable media
Alt + I	Store screen image to clipboard.
Alt + P	Print
Alt + R OR SPACE BAR	Run/stop cineloops. Space bar does not start/stop cineloop when Direct report is activated.
Alt + S	DICOM spooler

Short-cut	Description
Shift + F1 Shift + F2	• **SHIFT** + **F1**: In the *Analysis screen*, select previous image. • **SHIFT** + **F2**: In the *Analysis screen*, select the next image.
F1	Help: starts **On line user manual**.
F2	Starts EchoPAC PC configuration package.
F3 / F4	• Adjusts **Cine speed** when the selected cineloop is running (**F3** = decrease, **F4** = increase). • Enables **Frame scrolling** when the selected cineloop is frozen (**F3** = backward, **F4** = forward).
F3 / F4	Adjusts the **Baseline** when a Doppler window is selected (**F3** = up, **F4** = down).
F5 / F6	Adjust the **Horizontal sweep speed** when a Doppler window is selected (**F5** = decrease, **F6** = increase).
F7 / F8 OR ↓ / ↑	• **F8** or **ARROW UP**: **zoom in** • **F7** or **ARROW DOWN**: **zoom out** The Arrow keys do not control the Zoom function when Direct report is activated.
Shift + ↑ ← / → ↓	**Panning tool** when in Zoom mode Disabled when Direct report is activated.

Short-cut	Description
F9 / F10	Adjust **Compression** (**F9** = decrease, **F10** = increase).
F11 / F12	Adjust **Reject** (**F11** = decrease, **F12** = increase).

Mouse short-cuts

Short-cut	Description
	Zoom: select any point in a image and drag upward to zoom in, downward to zoom out.
Shift +	**Panning tool** in Zoom mode: press and hold down **SHIFT**, select any point in the image and drag around to display the different parts of the image.
	Color modes: select any point in the color bar and drag vertically to change the **Baseline** position.
	Select the **Start** or **End cineloop marker** and drag horizontally to adjust the position.
/	In freeze: select the frame marker on the ECG and drag horizontally, or select any point on the ECG to display another frame.
	Doppler: select the **Baseline** and drag vertically to change its position.

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Short-cut	Description
	Doppler: select any point in the Doppler spectrum (except for the baseline) and drag horizontally to adjust the **Horizontal sweep**.
	Anatomical M-Mode: select the **AMM cursor** and drag vertically to change the position.
	Anatomical M-Mode: select the **AMM angle cursor** arrow head and drag horizontally to change the angle.
	Tissue Tracking/Tissue Synchronization Imaging: select the **Start** or **End marker** and drag horizontally to change its position.

Product description

TruAccess

- EchoPAC PC workstation utilizes the TruScan architecture to provide patient archival and raw data image storage and is compatible with the Vivid 7 and Vivid 3 ultrasound units
- EchoPAC PC takes special advantage of TruAccess to the ultrasound raw data provided from the Vivid 7 and Vivid 3, enabling full image post-processing
- EchoPAC PC has also access to ultrasound data through DICOM Media Interchange offering the possibility to read and display DICOM images from removable media and DICOM storage to removable media (single or multiframe)
- EchoPAC PC captures scan data from basic ultrasound applications to multiple reporting packages for various applications such as adult and pediatric echocardiography, exercise and pharmacological stress echo, transesophageal and intra-operative imaging

TruData acquisition

- Digital raw data (single frames and cineloop of 2D, M-Mode, spectral and color Doppler modalities) at original resolution and frame rate from the Vivid 7 and Vivid 3 ultrasound units
- DICOM Media Read (Magneto-Optical Disk and CD-R)
- ECG, phono and three auxiliary traces recorded with raw data capture

Patient record and Image management

- Shared patient archive with Vivid 7 or Vivid 3
- Ultimate workflow with instant access data management.
- Utilize SQL open relational database for patient
- Fast search & recall of patient studies
- Patient browser screen for registration of demographic data and quick review of image clipboard contents
- Storage of single frame, multiframe and raw data images in raw data DICOM format
- DICOM media store (US and US-MF and secondary

capture)

- DICOM network storage to DICOM server
- Storage of reports and worksheets
- Export of reports as PDF, CHM, Excel and ASCII formats
- Export of cineloop as AVI
- Export of single frame images as JPEG

TruAccess Image review

- TruAccess allows for instant access/recall to digital raw data for uncompromised analysis and reporting
- Fast and efficient image recall
- Thumbnail image display for quick overview
- Flexible image layout: with multiple images allows for serial comparison of image data from different exam dates (up to 12 images - single frames and cineloops)

Image post-processing

- GE raw data enables full "scanner" post-processing functionality:
  - Anatomical M-Mode
  - Compress/Reject
  - Gain
  - Cine speed adjustment
  - Freeze/unfreeze
  - Frame-by-frame review of cineloop
  - Up/Down and Invert
  - Zoom and pan facility
  - Color map selection
  - DDP control
  - Color display on/off
  - Horizontal sweep adjustment
  - Baseline shift
  - Physiological traces control (gain and position)
  - Tissue priority
  - Variance

Image analysis

- Cardiac calculation package including extensive measurement and display of multiple repeated measurements
- Vascular measurement package
- Parameter annotation follows ASE standard
- User-configurable measurement protocol
- Measure and assign capability
- The measurements can be automatically exported to the report
- Doppler auto-trace function with automatic calculation
- Average calculation
- User-defined mathematical functions
- Metric and US units

Report

- ASE-recommended, report-structured text statements help create reports in minutes on your Vivid 7 or off-line on the EchoPAC PC
- Report function includes:
  - Patient information
  - Measurements
  - Calculations
  - Ultrasound images
  - Wall motion scoring
- Contains a set of pre-defined clinical report templates
- Printable on ink-jet printer
- Report can be exported as PDF, CHM, Excel and ASCII formats

EchoStress (option)

- Review of stress-echo studies acquired with the Vivid 7 or Vivid 3 ultrasound units
- User-configurable exam templates and labels including settings for pharmacological and exercise stress, single loop and continuous loop capture
- Continuous loop capture

- up to 14 levels
- up to 10 projection views
- User-definable groups
- Heart rate and ECG stored with each loop
- Parallel raw data acquisition of greyscale 2D and tissue velocity information for quantitative stress analysis
- Qualitative Wall motion scoring
- Quantitative TVI Stress analysis: provides three different analysis tools based on TVI data stored during stress acquisition:
    - Vpeak measurement: enables the display of a tissue velocity trace for a selected region of a previously scored segment through the entire heart cycle
    - Tissue Tracking: enables visualization of the heart contraction at peak level by color-coding the displacement in the myocardium
- Quantitative analysis: enables further quantitative analysis based on multiple tissue velocity traces
- M&A capability
- Report capability

EchoResearch (option)

- Quantitative TVI Analysis
    - Multiple time-motion trace display from selected points in the myocardium
    - Arbitrary straight Anatomical M-Mode
    - Arbitrary curved Anatomical M-Mode
    - Quantitative profiles: for TVI and Tissue Tracking can be derived
- Strain and Strain rate (option)
    - Multiple time-motion trace display from selected points in the myocardium
    - Arbitrary straight Anatomical M-Mode
    - Arbitrary curved Anatomical M-Mode
    - Quantitative profiles: for Strain and Strain rate
    - Dual focus increases sensitivity of signals
    - Cine compound for image loops and strain traces

- • Drift compensation
- Quantitative Contrast analysis: post processing on Contrast Harmonic images (2D and Angio data):
  - • Time-Intensity analysis: allows instant time-intensity calculation from up to eight regions of interest
  - • Curve-fitting analysis: for research studies of myocardial perfusion rates using contrast agents
  - • Arbitrary straight Anatomical M-Mode
  - • Arbitrary curved Anatomical M-Mode
  - • Caliper
  - • Area
  - • ECG triggering

DICOM

- • Ethernet network connection
- DICOM support:
  - • Storage: read/write images on DICOM format (US, US-MF and secondary capture)
  - • Verify

Hardware

- • Compaq DeskPro Workstation 300
- • Pentium 4, 1.4 GHz
- • 512 MB RAM
- • 36 GB Harddrive
- • CD-R
- • Modem 56 Kbit
- • 19" Monitor
- • 18" LCD Screen (option)
- • 9.1 GB 5.25 Magneto-Optical Disk
- • 1.3 GB 3.5 Magneto-Optical Disk (option)
- • 250 MB Zip drive (option)
- • HP Deskjet 990 CXI (option)

Software

- • Microsoft Windows based TruScan architecture

Safety

- Built to meet the requirements of:
  - EchoPAC software is CE Marked in accordance with 93/42/EEC Medical Device Directive
  - Computer hardware is CE Marked in accordance with 89/336/EEC Electromagnetic compatibility, EMC Directive
  - Computer hardware is CE Marked in accordance with 73/23/EEC Low Voltage Directive
  - UL 1950 (1996)

⚠
CAUTION

Not all features or products described in this document may be available or cleared for sale in all markets. Please contact your local GE Medical Systems representative to get the latest information.

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