GE Healthcare

Technical Publications

EchoPAC Software Only

Version 113

CE 0470

User Manual
EY092507 — English

Rev. 03

Operating Documentation

Regulatory requirement

This product complies with regulatory requirements of the following European Directive 93/42/EEC concerning medical devices.

CE 0470

This manual is a reference for EchoPAC Software Only and EchoPAC Turnkey. It applies to all versions of the 113 software for the EchoPAC Software Only and EchoPAC Turnkey.

GE Healthcare

Manual status:
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Manufacturer:
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Regulatory Requirements

Conformance Standards

The GE Healthcare product families are tested to meet all applicable requirements in relevant EU Directives and European/International standards. 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.

According to 93/42/EEC Medical Device Directive, this is Class IIa Medical Device.

CE 0470

EchoPAC Software Only 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:

Standard/Directive	Scope
93/68/EEC	CE Marking Directive
89/336/EEC	Electromagnetic compatibility, EMC Directive
73/23/EEC	Low Voltage Directive
2002/96/EC	Waste electrical and electronic equipment (WEEE Directive)
2002/95/EC	Restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS Directive).
UL60950: 2000	US and Canadian standard for information Technology Equipment
IEC60950: 2001	Safety for Information technology equipment

Country Specific Approvals

- JAPAN

MHLW Approved Number:

- CHINA

  SFDA:

  Product Standard Number:
- KOREA

  KFDA:

Importer Information

- TURKEY

İTHALATÇI	PENTA ELEKTRONİK MEDİKAL SİSTEMLER SAN. VE TİC. A.Ş. HOŞDERE CAD. FUAR SOK. 5 / 3 Y. AYRANCI / ANKARA

Certifications

- GE Vingmed Ultrasound is ISO 9001 and ISO 13485 certified.

Original Documentation

- The original document was written in English.

Software License Acknowledgements

- WindowBlinds™ OCX © Stardock ®

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Chapter 1

Introduction

EchoPAC Software Only is intended for diagnostic review and analysis of ultrasound images, patient record management and reporting. EchoPAC Software Only allows post-processing of raw data images from GE ultrasound scanner and DICOM ultrasound images..

Overview

Main functionality

EchoPAC Software Only 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

Attention

Read and understand all instructions in the User's Manual before attempting to use EchoPAC Software Only. Keep the manual with the equipment at all time. Periodically review the procedures for operation and safety precautions.

⚠ CAUTION

For USA only:

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

Indications for use

EchoPAC Software Only is indicated for diagnostic review and analysis of ultrasound images acquired via B, M, Color M modes, Color, Power, Pulsed and CW Doppler modes, Coded Pulse, Harmonic and Real time 3D. Clinical applications include: Fetal; Abdominal; Urology (including prostate); Pediatric; Small organs (breast, testes, thyroid); Neonatal and Adult Cephalic; Cardiac (adult and pediatric); Peripheral Vascular; Transesophageal (TEE); Musculo-skeletal Conventional;

Transrectal (TR); Transvaginal (TV); and Intraoperative (abdominal, thoracic and vascular).

Product range

The EchoPAC product range consists of:

- **EchoPAC Software Only**: the software to be installed on any PC that fulfills minimum requirements.
- **EchoPAC Turnkey**: a turnkey solution consisting of hardware and software in a complete package. EchoPAC Turnkey is only available as upgrade for existing Turnkey workstations.

CAUTION

EchoPAC Software Only must NOT be installed on computers, which control life-supporting or patient monitoring devices.

The EchoPAC Turnkey and EchoPAC Software Only have the same clinical functionality, except for the following differences:

EchoPAC Turnkey differs from EchoPAC Software Only as follows:

- EchoPAC Turnkey has no direct access to Windows other than with a service dongle.
- In the EchoPAC Turnkey the access to some Windows settings are available through Config (e.g monitor settings, keyboard, printer, video and TCP/IP).
- EchoPAC Turnkey can connect to the InSite Service platform.
- EchoPAC Turnkey allows connection to workgroup, but not to domains.
- EchoPAC Turnkey does not allow Export or Save as of images to the internal hard disk.
- The EchoPAC Turnkey program window cannot be minimized or closed.
- EchoPAC Turnkey status bar displays date and time.

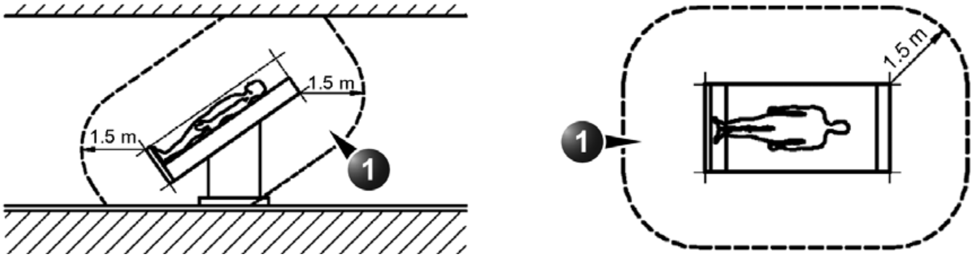
Important

CAUTION

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

CAUTION

Computer hardware running EchoPAC Software Only and accessories must not be placed inside the patient environment, unless it is in compliance with IEC60601-1-1 (2000).



1. Patient environment

Figure 1-1. Patient environment

Manual contents

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

Finding information

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

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

Index, provides an alphabetical and contextual list of topics.

Conventions used in this manual

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

Bold type: describes button name on the screen.

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

The following icons, highlight safety issues as follow:

DANGER

Indicates that a specific hazard exists that, given inappropriate conditions or actions, will cause:

- Severe or fatal personal injury
- Substantial property damage

WARNING

Indicates that a specific hazard exists that, given inappropriate conditions or actions, will cause:

- Severe personal injury
- Substantial property damage

CAUTION

Indicates that a potential hazard may exist that, given inappropriate conditions or actions, can cause:

- Minor injury
- Property damage

Contact Information

Contacting GE Healthcare Ultrasound

For additional information or assistance, please contact your local distributor or the appropriate support resource listed on the following pages:

INTERNET	http://www.gehealthcare.com http://www.gehealthcare.com/usen/ultrasound/products/probe_care.html
Clinical Questions	For information in the United States, Canada, Mexico and parts of the Caribbean, call the Customer Answer Center. TEL: (1) 800-682-5327 or (1) 262-524-5698 In other locations, contact your local Applications, Sales, or Service Representative.
Service Questions	For service in the United States, call GE CARES. TEL: (1) 800-437-1171 In other locations, contact your local Service Representative.
Information Requests	To request technical product information in the United States, call GE Healthcare. TEL: (1) 800-643-6439 In other locations, contact your local Applications, Sales, or Service Representative.
Placing an Order	To order accessories, supplies, or service parts in the United States, call the GE Healthcare Technologies Contact Center. TEL: (1) 800-558-5102 In other locations, contact your local Applications, Sales, or Service Representative.

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Chapter 2

Getting started

This chapter describes:

Launching EchoPAC Software Only

To start EchoPAC Software Only

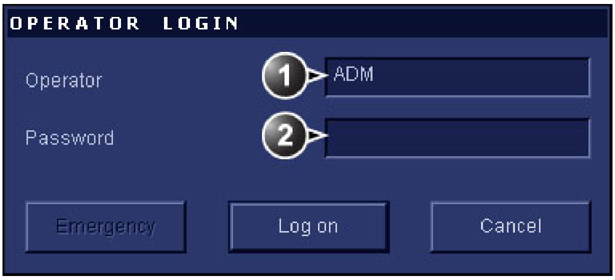
1. Double click on the EchoPAC Software Only icon on the computer's Desktop.

   The program undergoes an initialization sequence and the *Operator login dialogue box* is displayed (see Figure 2-1).

2. Enter the required information and press **Log on**.

   The *Archive* screen is displayed with the default dataflow selected (see Figure 3-1 *on page 3-4*).

1. Select the operator
2. Enter password



Operator: ADM

Figure 2-1. The Operator login windows

EchoPAC Software Only overview

EchoPAC Software Only is build on several main screens that can be entered by selecting the tabs on the top of the window.

Tab	Function
Archive	• Search patient • Create patient • Patient record management
Patient	• Patient info • Examination list • Medical info
Image Browser	• Displays a thumbnail overview of all images stored for the current patient record.
Review	• Displays all images of the selected examination
Protocol	• Review protocol based examinations
Analysis	• Image optimization • Measurements • Quantitative analysis
Worksheet	• Measurement listing
Report	• Summarizes data from an examination
Config	• EchoPAC Software Only configuration
Help	• Displays on-line user documentation
Exit	• Exit or Log off EchoPAC Software Only.

Chapter 3

Patient record management

This chapter describes:

'Server options' on page 3-48

'Configuration – System and presets' on page 3-53

'Configuration – Archiving' on page 3-58

Searching a Patient record

When the login procedure is completed, the *Search/Create patient* window is displayed (see Figure 3-1).

About dataflow

The connectivity on EchoPAC Software Only 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 3-62 about connectivity) that will automatically customize EchoPAC Software Only to work according to the services associated to the dataflow and search in the archive associated.

To find a patient record

NOTE: *EchoPAC Software Only can be configured to generate patient ID.*

1. Type the patient **Last Name**, and/or **ID** or another query that identifies a patient.

   When default configured, the system automatically searches to see if the patient is already in the archive. The result of this search is displayed in the *Patient list* field.
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 **Open Exam**).

   The *Examination List* window is displayed (see Figure 3-2).

CAUTION

In a network environment other than DICOM server, if the user tries to open a patient record or an examination that is already opened by another user, a dialog is displayed to let you open the exam as read only.

Category: Cardiac

8 records fetched

Last Name	First Name	Patient ID	Birthdate	Exam Date	Img	Str	Rep	Size	Code
2DStrain	QA	455667		22/04/2005					
4D d		12345		11/12/2006					
	LAD	78509	23/08/1933	21/11/2006					
dfg		dfgdfg		17/10/2007					
QTS	Mini	78120375621	01/02/1903	19/02/2007		✓			
Stressecho		STRES08_08008		13/12/2005		✓			
test		123		19/10/2007					

Dataflow: Local Archive - Int. HD

Operator: ADM

1. Press one of the headings to sort the list accordingly (ascending/descending).
2. Select archive and other pre-defined services.
3. Advanced search filters, the system can be configured to display the advanced search filters as default (see ‘Patient management presets’ on *page 3-59*).
4. Expand Patient record to display belonging examinations

The Search/Create patient window may be slightly different depending on the Dataflow selected

Figure 3-1. The Search/Create Patient window

OperId	Date	DiagCode	Tape	M&A	Report	Image	Disk
USR	13/07/2006			✓	✓	✓	Local HD:
ADM	13/07/2006						
ADM	19/02/2007					✓	Local HD:

1. The information displayed in the Patient list is configurable (see page 3-58).
2. Insert pre-defined text.
3. Edit Findings (see page 9-8).

Figure 3-2. The Examination list window

Advanced search

To restrain the search to a specific patient group, one or more filters may be applied to the search. The table below shows the filters applicable to a patient search.

Searching filter
Echolab
Diagnostic code
Born between
Examination date between
Current date
Images: patient records with examinations with images

Searching filter
Stress examinations: patient records with stress echo examinations
No Report: Patient record with examination(s) without stored reports
Category: displays only patient records for the selected category
Diagnosis Physician

NOTE: The list of searching filters may vary depending on the Dataflow selected

1. If not visible, press **More** in the *Search/Create Patient* window to display the advanced search filters.

   The unit can be configured to display the Advanced search options as default (see 'Patient management presets' on *page 3-59*)
2. Select the required searching filters.
3. Type the patient **Last Name**, and/or **ID** or another query that identifies a patient.

   The matching data is displayed in the *Patient list* when the automatic search function is turned on.

Printing patient list

1. Press **Print Patients**.

   A patient list with all patients matching the search criteria is printed.

Editing Referral Reasons, Comments and Diagnosis

CAUTION

The user is responsible for patient demographic data, diagnostic information or any other patient related information entered in the database.

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

Editing text

1. In the *Examination list* window (Figure 3-2), place the cursor in the required field.
2. Using the alphanumeric keyboard, edit the information.

Inserting pre-defined text input

1. In the *Examination list* window, press the **Insert Text** button over the field.

   The *Insert text* window is displayed (see Figure 3-3).

   The pre-defined text list is organized in a three level hierarchy. Selecting one item in the first column displays pre-defined text entries related to the selected text in the second and third columns.
2. Navigate through the pre-defined text list by selecting items in the columns and double-click on the desired pre-defined text to be inserted. If an entry in the third column is inserted, the selected text in the second column is also inserted.

   Press **More>>** to display the full text for the selected entry.

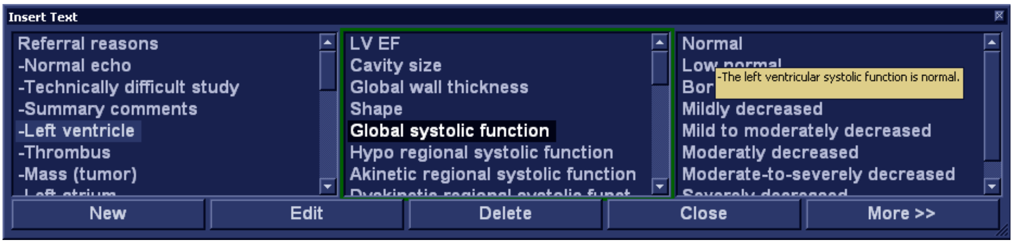


Figure 3-3. The Insert text window

Diagnosis code

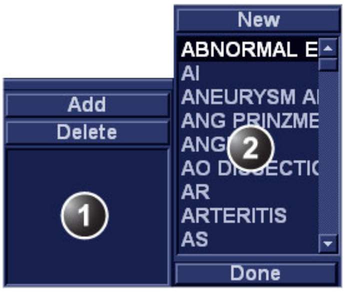
Adding a Diagnosis code

1. In the *Examination list* window, select **Code** (see Figure 3-2).

   The *Entered Code* window is displayed.
2. Select **Add**.

   The *Code list* window is displayed.
3. Double-click the code to enter.
4. Select **Done** to exit.

   The Code selected is displayed in the *Examination list* window.



1. The Entered code window
2. The Code list window

Figure 3-4. Entering Diagnosis codes

Deleting an entered Diagnosis code

1. In the *Examination list* window, select **Code** (see Figure 3-2).

The *Entered code* window is displayed.

2. In the *Entered code* window, select the code to delete and press **Delete**.

Creating a Diagnosis code

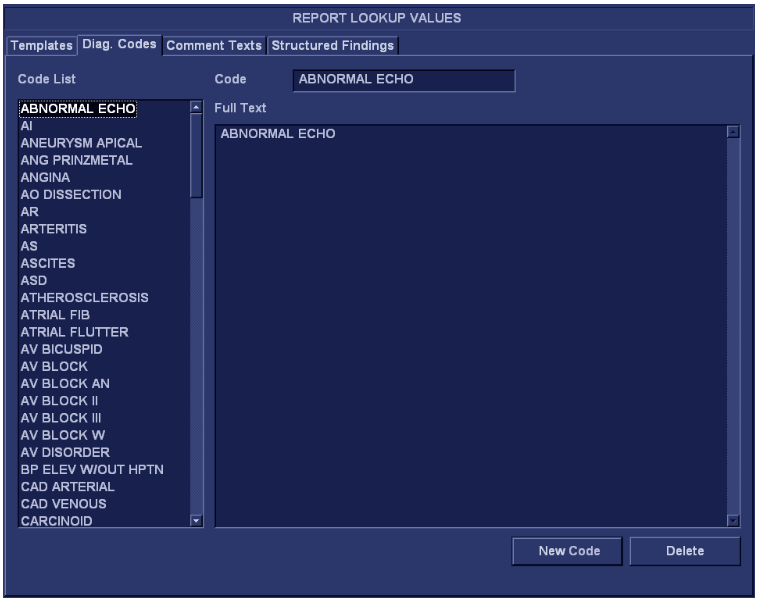
1. In the *Examination list* window, select **Code** (see Figure 3-2).

   The *Entered code* window is displayed.
2. Select **Add**.

   The *Code list* window is displayed.
3. Select **New**.
4. Enter the new code.
5. Select **Done** to exit.

Diagnostic codes can also be created and deleted from the configuration package:

1. Press **Config** (**F2**) to access the configuration package.
2. In the Configuration package, select the category **Report** and the Tab sheet **Diag. Codes**.



Code: ABNORMAL ECHO

Full Text: ABNORMAL ECHO

ABNORMAL ECHO
AI
ANEURYSM APICAL
ANG PRINZMETAL
ANGINA
AO DISSECTION
AR
ARTERITIS
AS
ASCITES
ASD
ATHEROSCLEROSIS
ATRIAL FIB
ATRIAL FLUTTER
AV BICUSPID
AV BLOCK
AV BLOCK AN
AV BLOCK II
AV BLOCK III
AV BLOCK W
AV DISORDER
BP ELEV W/OUT HPTN
CAD ARTERIAL
CAD VENOUS
CARCINOID

Figure 3-5. The Diagnostic codes sheet

To create a diagnostic code:

1. Select **New code**.
2. In the *Code* field, enter a name for the diagnostic code.

3. In the *Full text* field, enter the code text.

To delete a diagnostic code:

1. In the *Code list* field, select the diagnostic code to delete.
2. Select **Delete**.

Editing demographic data

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

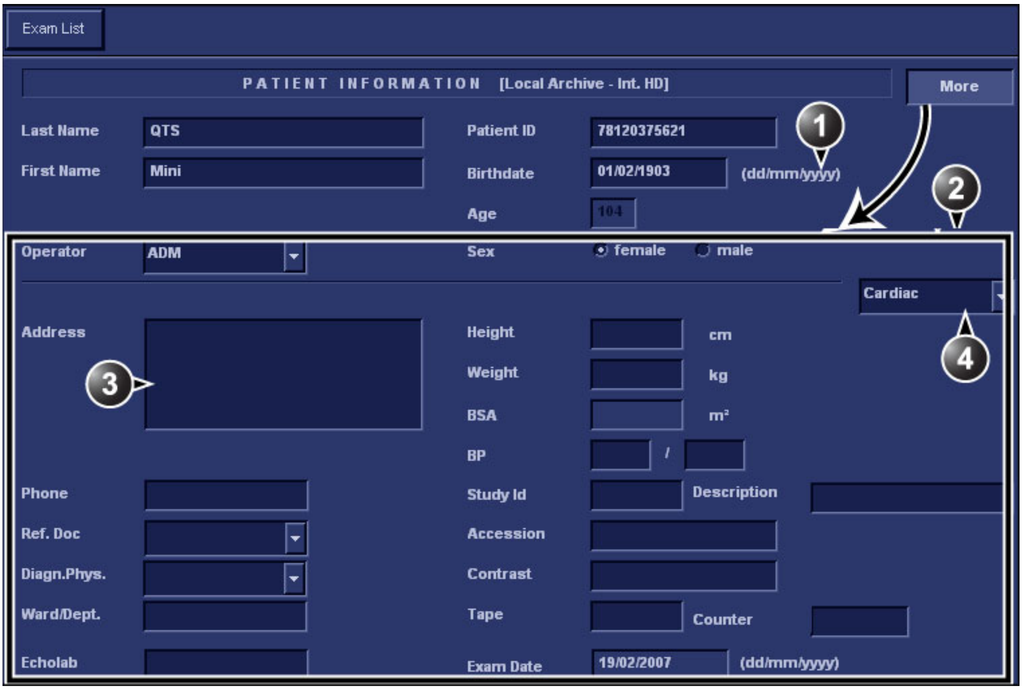
CAUTION

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 3-3) and press **Patient Info** in the *Examination List* window (see Figure 3-2).

   The *Patient information* window is displayed (see Figure 3-6).
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 3-6.).



Last Name QTS
First Name Mini
Patient ID 78120375621
Birthdate 01/02/1903 (dd/mm/yyyy)
Age 104
Operator ADM
Sex ● female ○ male
Cardiac
Exam Date 19/02/2007 (dd/mm/yyyy)

1. The date format is configurable (see page 3-53).
2. The window can be configured to display the expanded patient info as default (see page 3-58).
3. The Address field is configurable (see page 3-58).
4. Select patient information category.

Figure 3-6. The Patient information window

Creating a new Patient record

1. In the *Search/Create Patient* window (see Figure 3-1), enter patient **Last Name**, and/or **ID**.

NOTE: *EchoPAC Software Only can be configured to generate patient ID.*

2. Press **Create Patient**.

   The *Patient Information* window is displayed (see Figure 3-6).
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

To delete a patient record

1. Select the patient record to delete (see page 3-3).
2. In the *Search create Patient* window (Figure 3-1 *on page 3-4*), press **Delete**.

   A dialogue window is displayed asking for confirmation.
3. Press **OK** to delete the patient record.

To delete an examination

1. Select the examination to delete (see page 3-3).
2. In the *Examination list* window (see Figure 3-2), select **Del Exam**.

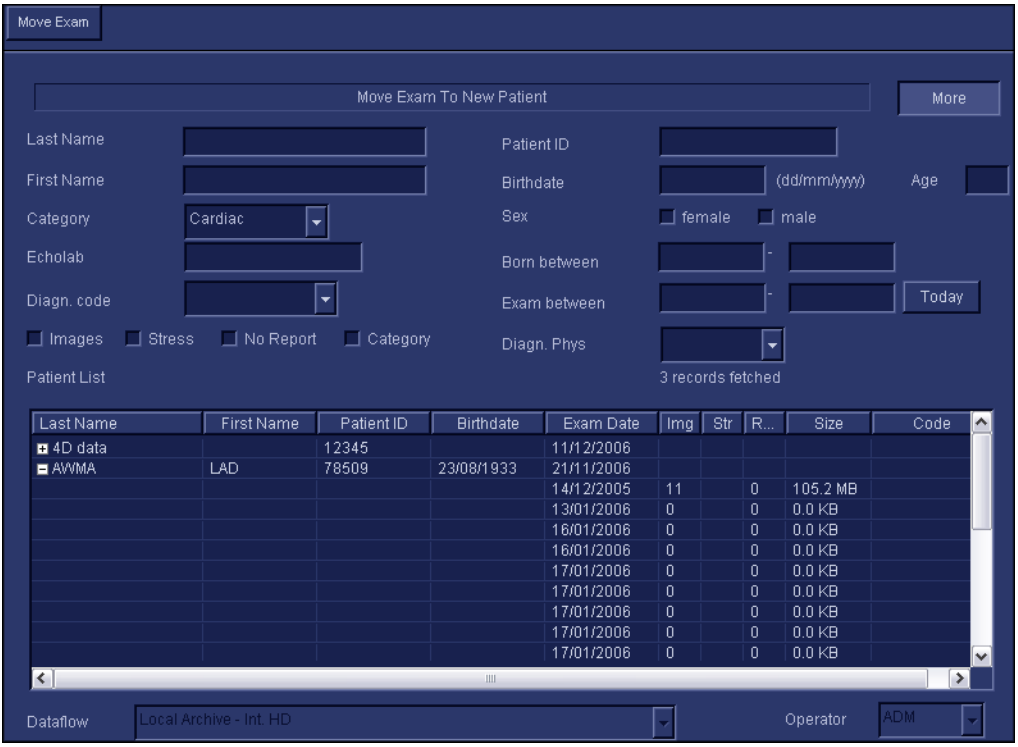
   A dialogue window is displayed asking for confirmation.
3. Press **OK** to delete the selected examination.

Moving examinations

An examination can be moved from one patient record to another. This feature should only be used if an examination was performed and stored to a wrong patient record.

1. In the *Search/Create Patient* window press **[+]** in front of the patient record containing the examination(s) to move (see Figure 3-1 *on page 3-4*).
2. Select the examination to move.
3. Press **Move Exam**.

   The *Move exam* window is displayed.



Category: Cardiac

3 records fetched

Last Name	First Name	Patient ID	Birthdate	Exam Date	Img	Str	R...	Size	Code
⊞ 4D data		12345		11/12/2006					
⊟ AWMA	LAD	78509	23/08/1933	21/11/2006					
				14/12/2005	11		0	105.2 MB	
				13/01/2006	0		0	0.0 KB	
				16/01/2006	0		0	0.0 KB	
				16/01/2006	0		0	0.0 KB	
				17/01/2006	0		0	0.0 KB	
				17/01/2006	0		0	0.0 KB	
				17/01/2006	0		0	0.0 KB	
				17/01/2006	0		0	0.0 KB	
				17/01/2006	0		0	0.0 KB	

Dataflow: Local Archive - Int. HD

Operator: ADM

Figure 3-7. 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.

6. Select **OK**.

   An information window is displayed to confirm the operation.

7. Select **OK**.

Removable media

Intended use

Removable media can be used for the following purposes:

- Long-term image storage: the final destination of the images, after they are moved out of the system harddisk by using the Disk Management feature (see page 3-33).
- Backup of patient database and system configuration presets (see page 3-41)
- Patient archive sneaker-net: copy a set of patient records between a scanner and EchoPAC Software Only using the Import/Export feature (see page 3-24) with a removable media.
- DICOM export to copy a set of patient records to a third party DICOM review station.
- MPEGVue export: review exported images on a Windows computer (see page 4-41).
- Excel export: exports demographics, measurements and reporting data from the unit to a third party reporting application using a removable media (see page 3-24).
- Copy of system configuration presets between to units using the Backup/Restore feature (see page 3-41).
- Save images as JPEG, MPEG or AVI for review on a regular computer.

Supported removable media

- CD-R
- DVD-R
- USB Flash card
- USB external desktop hard drive (Iomega Ultramax) (Option)
- 5 1/4” R/W Magneto Optical disk (MOD) (from Sony only, 1.2, 1.3, 2.3, 2.6, 5.2, 8.6 and 9.1 Gb) (Option)
- 3 1/2” Magneto Optical disk (from Sony only, 1.3 Gb), option
- Zip disk (250 Mb), option

CAUTION

USB Flash card:

- Use only shielded USB Flash cards that are verified for EMC performance according to EN55011/EN55022. The use of other USB Flash cards may cause interference on the system itself or on other electronic devices.

NOTE: EchoPAC Software Only: User without Windows administrator rights are normally prevented from using removable media with EchoPAC Software Only unless the Windows Policy setting "Devices: Allowed to format and eject removable media" is set to "Administrators and Interactive Users". If required, contact your network administrator to adjust the Windows local policy accordingly (Not applicable for Turnkey systems).

Media/Purposes compatibility

	USB HD	CD-R	DVD-R	USB Flash card
Long-term image storage	+[1]	+	+	
Backup of patient database and system configuration presets	+	+	+	+
Patient archive sneaker-net	+	+	+	+
DICOM export	+	+	+	+
MPEGVue export	+	+	+	+
Excel export	+	+	+	+
System configuration presets	+	+	+	+
Save images as JPEG, MPEG or AVI	+	+	+	+

[1] Recommended media

About removable media and long-term image storage

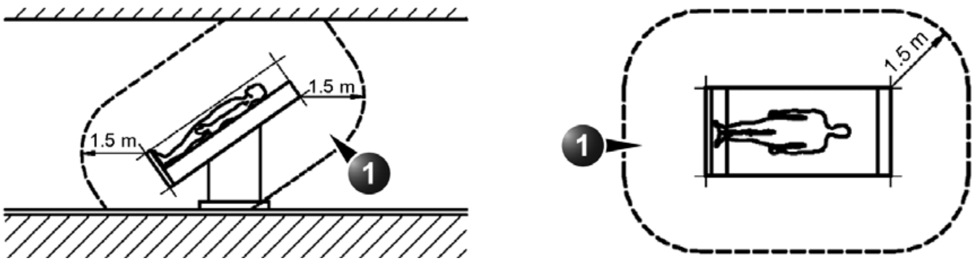
We recommend to run the Disk management feature with MOD media or USB desktop hard drive for long-term image storage, because of the longevity and reliability of these media. It is not recommended to use CD or DVD for long-term storage, because of weaker performance in general when it comes to longevity and reliability. However, Disk management does not prevent the use of CD/DVD for long-term image storage. If CD/DVD is used it is recommended to use Archival Grade or Medical Grade CD/DVD.

No matter which media is used, it is always highly recommended to take a backup of the media, which is the responsibility of the customer. The unit does not offer functionality for taking backup of images saved on long-term storage media.

USB desktop hard drive

NOTE: *Only connect one USB desktop hard drive to the EchoPAC Software Only at a time.*

⚠ CAUTION If connected to EchoPAC Software Only, the USB desktop hard drive must not be placed inside the patient environment (refer to local regulation and IEC60601-1-1 (2000)).



1. Patient environment

Figure 3-8. Patient environment

Iomega Ultramax desktop hard drive (option)

The Iomega Ultramax desktop hard drive is an external desktop hard drive that can be connected to EchoPAC Software Only via USB. It is configured as RAID 1, so the content is mirrored on two hard disk drives.

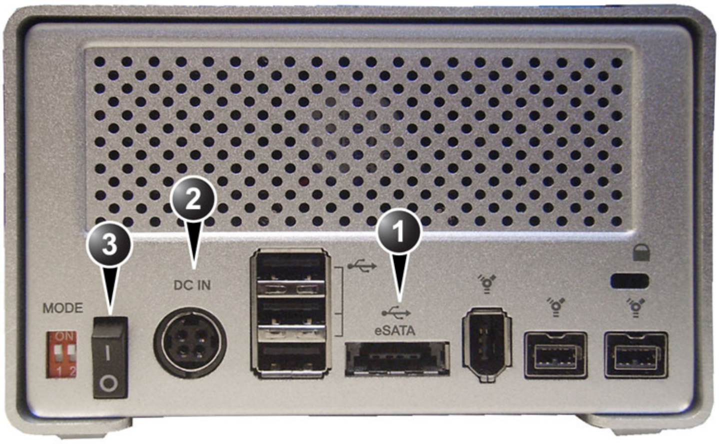
Iomega Ultramax unit connection

1. Connect the Iomega Ultramax unit to EchoPAC Software Only using the USB cable provided with the unit. The USB cable must be connected to the combined **USB/ eSATA** (Duolink) socket at the rear of the Iomega Ultramax unit (Figure 3-9).

NOTE: *Do not use any of the other USB sockets (USB hub) at the rear of the Iomega Ultramax unit.*

2. Connect the cable from the power supply to the **DC IN** connector on the rear of the Iomega Ultramax unit (Figure 3-9).

   Connect the power cord from the power supply to the mains AC outlet.



1. USB/eSATA (Duolink) connector
2. DC IN Power connector
3. On/Off switch

Figure 3-9. Iomega Ultramax unit, rear view

ICY BOX desktop hard drive (option)

The ICY BOX desktop hard drive is an external desktop hard drive that can be connected to EchoPAC Software Only via USB. It is configured as RAID 1, so the content is mirrored on two hard disk drives.

ICY BOX unit connection

1. Verify that the volume configuration is set to RAID 1 as shown below.

<table>
<tr><th></th><th>Mode</th><th>Switch 1</th><th>Switch 2</th></tr>
<tr><td rowspan="3"> </td><td>JBOD</td><td>OFF</td><td>OFF</td></tr>
<tr><td>RAID 0</td><td>ON</td><td>OFF</td></tr>
<tr><td><u>RAID 1</u></td><td><u>OFF</u></td><td><u>ON</u></td></tr>
<tr><td colspan="4">Note: if changing the RAID mode, push the button over the switches to confirm the new setting.</td></tr>
</table>

Figure 3-10. RAID 1 setup (rear side)

2. Connect the ICY BOX unit to EchoPAC Software Only using the USB cable provided with the unit. The USB cable must be connected to the **USB 3.0** socket at the rear of the ICY BOX unit (Figure 3-11).
3. Connect the cable from the power supply to the **DC** connector on the rear of the ICY BOX unit (Figure 3-11).

   Connect the power cord from the power supply to the mains AC outlet.

Figure 3-11. ICY BOX unit, rear view

Recommendation concerning CD and DVD handling

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

Formatting removable media

MOD, CD-R and DVD-R have to be formatted.

CAUTION

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

To format a removable media:

1. Insert the media in the drive.
2. Press **Config** (**F2**).

   The Configuration package is opened.
3. Select the category **Connectivity** and select the sheet **Tools** (Figure 3-12).

Media: CD/DVD Writable (E:\)

Label:

Capacity: 0.0 MB

Free space: 0.0 MB

Formatted: No

Database present: No

DICOMDIR present: No

Finalized (CD/DVD only): Yes

Write protected: Yes

Setting for remote path used for Save As, Export from Q-Analysis, and for exporting error logs with Alt-D

Remote Path: \\IDUNN\EXCHANGE\PC

The below configurable user and password is used for all remote paths configurable throughout the system as secondary log-in credential

User: -

Password: *

NOTE: User / Password should not be set here for server that is used as Remote Archive for the system

Figure 3-12. The Tools sheet

4. Select the removable media from the *Media* drop-down menu.
5. Enter a name for the removable media in the *Label* field.

NOTE: *Only the following characters and signs can be used when labelling a media: A - Z, a - z, 0 - 9, “_” and “-”. Do not use more than 11 characters or signs. Do not use space.*

6. Select **Format**.

   A confirmation window is displayed.
7. Select **OK** to continue.
8. Wait for the display of the *Information* window indicating that the formatting process is completed.
9. Select **OK**.
10. Eject the media as described below.

Ejecting removable media

1. Press **ALT+E** to eject the disk.

NOTE: *Do not eject CD/DVD using the button on the CD/DVD drive.*

The *Eject device* menu is displayed (Figure 3-13).

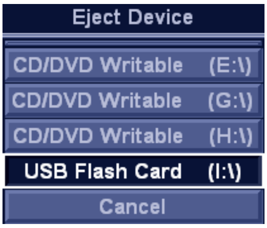


Figure 3-13. The Eject device menu

2. Select the relevant media.

   The selected media is ejected.

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

Export/Import patient records/ examinations

Patient records/examinations from the local archive on one system (EchoPAC Software Only) can be exported to the local archive on another system via a removable media. Patient records/examinations from the local archive can also be exported directly to a remote archive (an ImageVault server, a DICOM server or another EchoPAC Software Only). In addition patient records/examinations from a remote archive (an ImageVault server or another EchoPAC Software Only) can be exported to a removable media or to a DICOM server.

Similarly, patient records/examinations from the local archive on one system can be imported to the local archive on another system via a removable media. 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 (ImageVault server).

CAUTION

If an examination is opened, it must be closed before performing Export/Import of patient records/examinations.

Exporting patient records/examinations

1. If exporting to a removable media, Insert the media in the drive.
2. Press **Archive**.

   The *Search/Create Patient* window is displayed (see Figure 3-1 *on page 3-4*).
3. Select the source archive in the *Dataflow* field:
   - **LocalArchive-Int.HD**: exports data from the local archive.
   - **RemoteArch-RemoteHD**: exports data from the configured remote archive.

4. Press **Export**.

   The *Export dialogue* window is displayed.

To change source press cancel and change current dataflow

Figure 3-14. The Export Dialogue window

5. Select one of the following available destinations from the *Destination* drop-down menu:
   - **MOD Archive**: exports raw and DICOM data to a removable MOD.
   - **DICOM MOD**: export DICOM data only to a removable MOD.
   - **CD/DVD Archive**: exports raw and DICOM data to a CD/DVD.
   - **DICOM CD/DVD**: export DICOM data only to a CD/DVD-R/W.
   - **Remote Import/Export Archive**: exports raw and DICOM data to an ImageVault server or EchoPAC Software Only.
   - **Excel file**: exports demographics, measurements and reporting data to a spreadsheet. The export destination must be configured (see page 3-68).
   - **DICOM Print**: prints images to a DICOM printer via DICOM spooler.
   - **MPEGVue**: exports examinations to MPEGVue format readable from a regular computer. Ultrasound images are stored as MPEG, measurements as an Excel file and saved reports as CHM-files. The export destination must be configured (see page 3-68).
   - **USB Harddisk/Memstick Archive**: exports raw and DICOM data to an USB device. Only available when an USB device is mounted.
   - **UDO Archive**: exports raw and DICOM data to a removable UDO disk. Only available when an UDO disk is mounted.

- **DICOM UDO**: exports DICOM data only to a removable UDO. Only available when an UDO disk is mounted.
- **DICOM Storage**: export DICOM data only to a DICOM server via DICOM spooler

6. Press **OK**.

The following situations may occur:

- The system is checking that the removable media is inserted. If not, a dialogue window is displayed prompting the user to insert a media.

There is no media inside the tray.
Insert media.

Figure 3-15. Insert media window

Insert the media and select **Retry**.

- The system is checking if the destination media is empty and needs to be formatted. If yes an *Information* window is displayed asking the user whether or not to format the media.

Current media is not Formatted.
Do you wish to Format it?

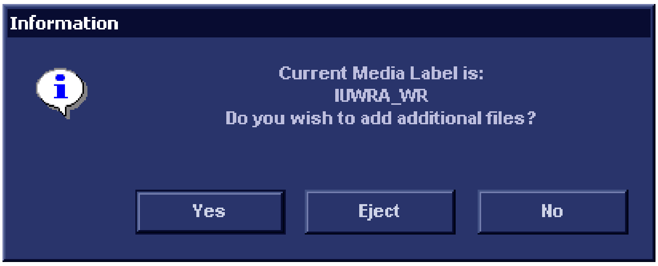
1910071113B

Figure 3-16. Media formatting window

Enter a new label and select **OK**.

NOTE: *Only the following characters and signs can be used when labelling a media: A - Z, a - z, 0 - 9, “_” and “-”. Do not use more than 11 characters or signs. Do not use space.*

- If the media is not empty, the *Add files* window is displayed.


Information

Current Media Label is:
IUWRA_WR
Do you wish to add additional files?

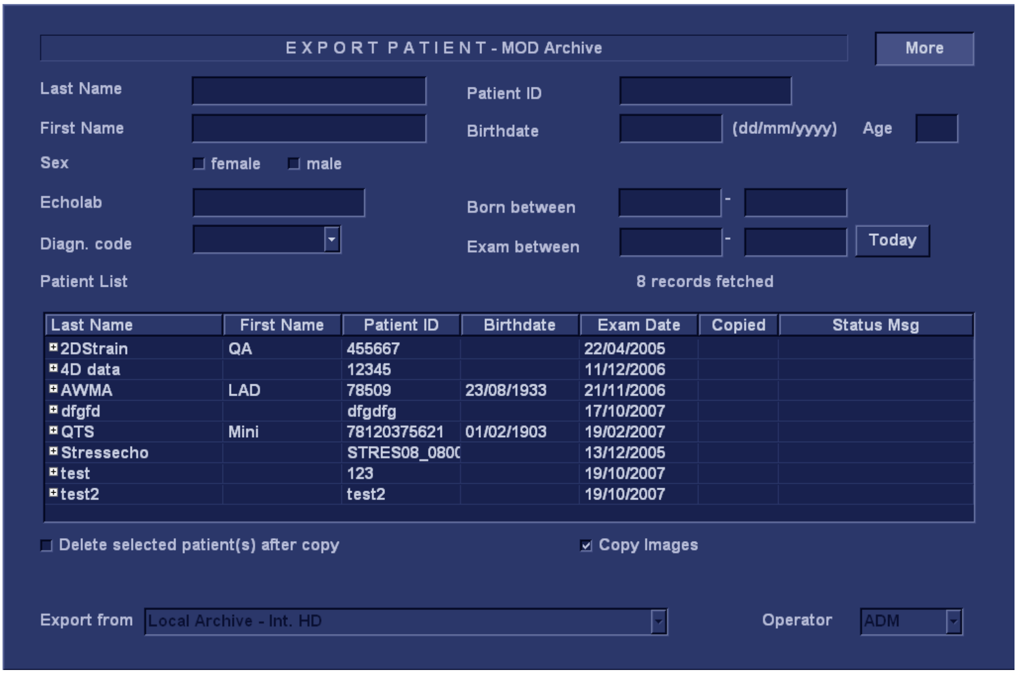
Figure 3-17. Add files windows

Select **Yes**.

The system is preparing the media to allow addition of new files.

NOTE: *If **Eject** is selected, the user is prompted to insert another media. If **No** is selected, the Export Dialogue window is displayed (Figure 3-14), where the user can select another destination.*

The *Export patient* window is displayed (see Figure 3-18).


EXPORT PATIENT - MOD Archive

8 records fetched

Last Name	First Name	Patient ID	Birthdate	Exam Date	Copied	Status Msg
⊞2DStrain	QA	455667		22/04/2005		
⊞4D data		12345		11/12/2006		
⊞AWMA	LAD	78509	23/08/1933	21/11/2006		
⊞dfgfd		dfgdfg		17/10/2007		
⊞QTS	Mini	78120375621	01/02/1903	19/02/2007		
⊞Stressecho		STRES08_080		13/12/2005		
⊞test		123		19/10/2007		
⊞test2		test2		19/10/2007		

☐ Delete selected patient(s) after copy

☑ Copy Images

Export from Local Archive - Int. HD

Operator ADM

Figure 3-18. The Export patient window

7. Search and select the patient records/examinations to export in the *Patient list*. All searching criteria can be used to find the patient records to export.

   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** to export all patient records.
   - Press **Today** in the *Export patient* window to display today's examinations and select the actual examinations.

NOTE: Select ***More*** *to display the extended Export patient window if necessary.*

   - Fill in the *Exam between* field to display the patient records done during a specific time period and select the actual records.
   - Fill in the *Born between* field to display the patient records of patients born during a specific time period and select the actual records.

8. Adjust the following settings (if available) as desired:
   - **Delete selected patient(s) after copy**
   - **Copy images**
9. Press **Copy**.

   If one or more patient examination is already present in the destination archive the *Export/Import conflict* window is displayed (see Figure 3-19). For each conflicting item, select:

   - **Keep**: to keep the existing examination in the destination archive.
   - **Replace**: to replace the existing examination with the corresponding item in the source archive.

Last name	First name	Pat. id	Exam Date	Keep	Replace
test2		test2	19/10/2007	●	○

Figure 3-19. The Export/Import conflict window

Press **OK** to resume export.

A progress indicator is displayed. When done a status window is displayed showing the number of patient records that have been successfully exported.

10. Press **OK**.

    A check mark is displayed in the *Copied* field in the *Export patient* window for each item exported.

    A status message is displayed for each item exported. Make sure that the operation was successful for each item exported.
11. Press **Done** to complete the process.
12. If exporting to a removable media, press **Alt** + **E** to eject the media.

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

The *Eject device* menu is displayed.

13. Select the relevant media.

    The selected removable media is ejected.

Importing patient records/examinations

1. Insert the removable media of the source archive in the corresponding drive.
2. Press **Archive**.

   The *Search/Create Patient* window is displayed (Figure 3-1 *on page 3-4*).
3. Select destination archive in the *Dataflow* field:
   - **LocalArchive-Int.HD**: imports data to the local archive.
   - **RemoteArch-RemoteHD**: imports data to an ImageVault server or an EchoPAC Software Only.
4. Press **Import**.

   The *Import dialogue* window is displayed (see Figure 3-20).

To change destination press cancel and change current dataflow

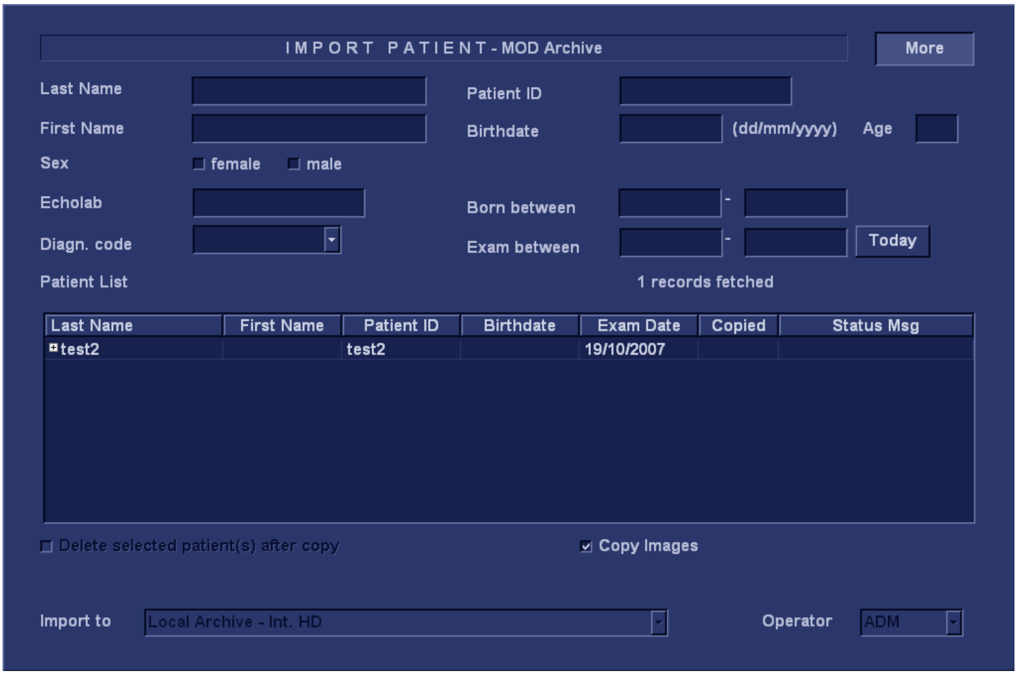
Figure 3-20. The Import Dialogue window

5. Select one of the following available source archive from the *Source* drop-down menu:
   - **MOD Archive**: imports raw and DICOM data from MOD.
   - **DICOM MOD**: imports DICOM data only from a MOD.
   - **CD/DVD Archive**: imports raw and DICOM data (if present) from a CD/DVD-R.
   - **DICOM CD/DVD**: imports DICOM data only from a CD/DVD-R.
   - **Remote Import/Export Archive**: imports raw and DICOM (if present) data from an ImageVault server or EchoPAC Software Only.
   - **Query retrieve**: imports data from a DICOM server.
   - **USB Harddisk/Memstick Archive**: imports raw and DICOM data from an USB device. Only available when an USB device is mounted.
   - **DICOM USB Harddisk/Memstick**: imports DICOM data only from an USB device. Only available when an USB device is mounted.

- **UDO Archive**: imports raw and DICOM data from an UDO disk. Only available when an UDO disk is mounted.
- **DICOM UDO**: imports DICOM data only from an UDO disk. Only available when an UDO disk is mounted.

6. Press **OK**.

   The *Import patient* window is displayed (see Figure 3-21).



IMPORT PATIENT - MOD Archive

☐ female ☐ male

1 records fetched

Last Name	First Name	Patient ID	Birthdate	Exam Date	Copied	Status Msg
test2		test2		19/10/2007		

☐ Delete selected patient(s) after copy

☑ Copy Images

Import to: Local Archive - Int. HD

Operator: ADM

Figure 3-21. The Import patient window

7. Search and select the patient records to import in the *Patient list*. All searching criteria can be used to find the patient records to import.

   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.

NOTE: *Select **More** to display the extended Import patient window if necessary.*

- 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. Press **Copy**.

   If one or more patient examination is already present in the destination archive the *Export/Import conflict* window is displayed (see Figure 3-19 *on page 3-28*). 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.

   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.
9. 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.
10. Press **Done** to complete the process.

Disk management

The Disk management function allows the user to manage hard disk space while maintaining the patient database on the system. The Disk management function can be used to move, copy or delete images and move or copy reports from the oldest patient records. The Disk management function has also an auto-purge feature that will automatically delete images and reports that have already been copied if the local hard disk is getting full.

Three different disk management scenarios are possible depending on the system configuration:

- Disk management is set to **move** files: the user runs the Disk management function on a regular basis to move images and reports from older patient records to removable media or to a network volume. Using this setting, moved images and reports are deleted from the local hard drive and copied to the specified destination. This scenario prevents the local disk to fill up and keeps images and reports from the most recent patient records on the local disk. Using this scenario, the user can control what should remain on the system while keeping the disk free space at an operational level.
- Disk management is set to **copy** files: the user runs the Disk management function on a regular basis to copy images and reports from older patient records to removable media or to a network volume. To prevent the local disk to fill up, the auto-purge function automatically deletes files that were previously copied when the disk free space has reached the minimum allowed limit. This scenario lets the system automatically manage the disk space on the system.

NOTE: *When using this setting, the images location displayed in the Examination list screen will be the selected destination for the copy operation, even if the images are still present on the local hard drive. When reviewing the exam, the original images will be retrieved from the local hard drive as long as they are available there. When the images are deleted from* *the local hard drive by the auto-purge function, the copied images will be retrieved.*

- Disk management is set to **delete** files: the user runs the Disk management function on a regular basis to delete images from older patient records.

NOTE: Ensure that you have established a data management protocol for your office/institution. The user MUST manage the removable media used when running Disk management by keeping a log and by creating a media filing system.

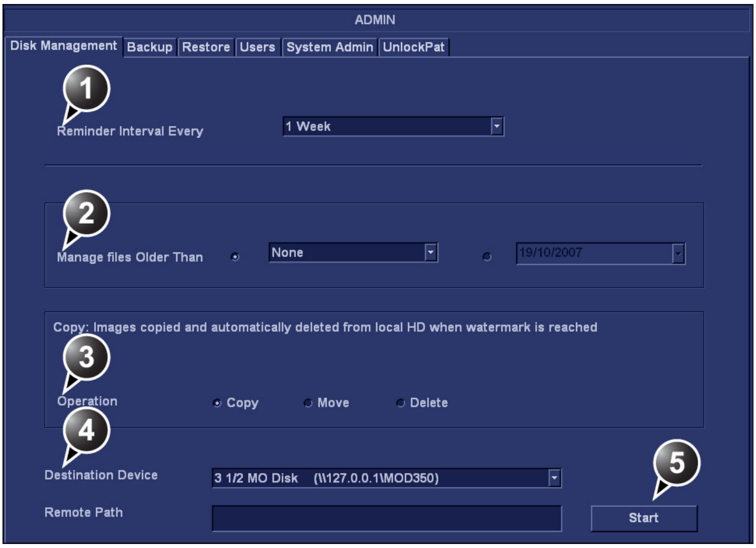
A person should be in charge of performing the process. The Disk management system can be set up so that a reminder is displayed at regular intervals.

Configuring the Disk management function

Configuration of the Disk management system can only be done by user with administration rights.

1. Press **Config** (**F2**).

   If required log on as administrator.
2. Select the category **Admin**.
3. In the *Admin* category, select the sheet **Disk management**.



Reminder Interval Every: 1 Week

Manage files Older Than: None 19/10/2007

Copy: Images copied and automatically deleted from local HD when watermark is reached

Operation: Copy Move Delete

Destination Device: 3 1/2 MO Disk (\\127.0.0.1\MOD350)

Remote Path:

1. Sets the reminder time interval for running Disk management.
2. Sets the files to be managed based on the examination dates.
3. Sets the Disk management to copy, move or delete images.
4. Sets the destination device.
5. Starts Disk management

Figure 3-22. The Disk management sheet

Disk management schedule setting

1. Next to **Reminder interval**, specify the number of days/ weeks you want the system to prompt you to perform disk management.

   This setting should be set based on the activity of your office/institution. If **None** is selected, no reminder will be displayed.

Data management settings

1. Select a number of days, weeks or months or a specific date next to **Manage files older than**. Only files older than the specified setting will be copied or moved.

   If **None** is selected, all files will be copied or moved.
2. Next to **Operation** check:

   - **Copy**: the images and reports from the examinations older than the specified setting defined in step 1 are copied to the specified destination. Using this setting, the files will exist in two locations, the local hard drive and the destination.

- **Move**: the images and reports from the examinations older than the specified setting defined in step 1 are copied to the specified destination, verified and then deleted from the local hard drive. Using this setting, the files will exist in one location, the destination media. They are removed from the local hard drive.
- **Delete**: the images from the examinations older than the specified setting defined in step 1 are deleted from the hard drive.

Destination device setting

1. Next to **Destination device**, select a removable media or a network share folder.

NOTE: *To be able to select a network share folder in the Destination device field, its path must have been entered in the Remote path field.*

CAUTION If using removable media, it is recommended to use dedicated media to the Disk management process. Removable media used for data backup must not be used when performing Disk management.

Do not use the same removable media on several systems.

Running the Disk management function

The Disk management function can be run at any time. In addition, the user may be prompted to run Disk management if the time since the last Disk management operation performed has reached the setting for the Reminder interval (see page 3-35), or if the local hard drive is about to be full.

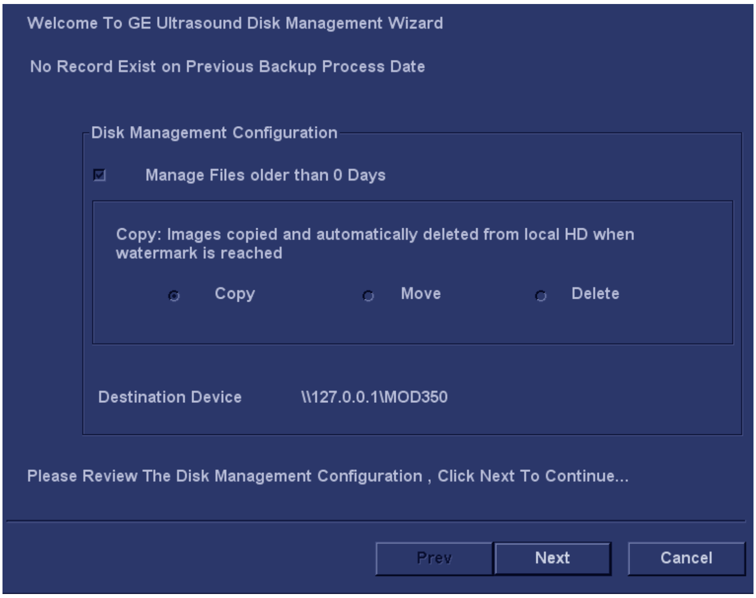
Disk management can be run from the *Search/Create patient* window (see below) or from **Config**/**Admin**/**Disk management** (Figure 3-22 *on page 3-35*).

Manual start of Disk management

1. Press **Patient**.

   The *Search/Create patient* window is displayed.
2. Press **Disk management**.

The *Disk management welcome* screen is displayed (Figure 3-23).



Welcome To GE Ultrasound Disk Management Wizard

No Record Exist on Previous Backup Process Date

Disk Management Configuration

☑ Manage Files older than 0 Days

Copy: Images copied and automatically deleted from local HD when watermark is reached

● Copy ○ Move ○ Delete

Destination Device \\127.0.0.1\MOD350

Please Review The Disk Management Configuration , Click Next To Continue...

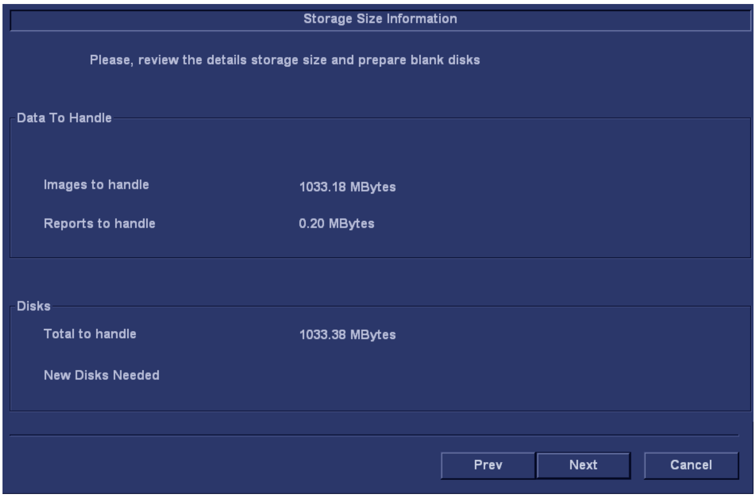
Figure 3-23. The Disk management welcome screen

The Disk management operation will either copy, remove or delete files from the local archives depending on the Disk management configuration (see page 3-34). Make sure that the correct configuration is set.

3. Press **Next**.

   The *Storage size information* window is displayed (Figure 3-24).

   Verify the information displayed. If using removable media, the operation may require several media as specified on the screen. Make sure that the specified number of disks are available.



Storage Size Information

Please, review the details storage size and prepare blank disks

Data To Handle

Images to handle 1033.18 MBytes

Reports to handle 0.20 MBytes

Disks

Total to handle 1033.38 MBytes

New Disks Needed

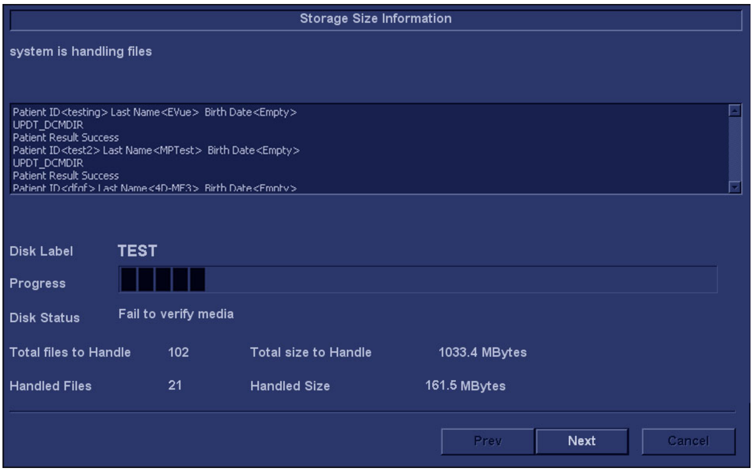
Figure 3-24. The Storage size information window

4. Insert a removable media in the specified drive.

   The disk does not need to be formatted.

5. Press **Next**.

   The *Copying files* window is displayed (Figure 3-25).



Storage Size Information

system is handling files

```
Patient ID<testing> Last Name<EVue>  Birth Date<Empty>
UPDT_DCMDIR
Patient Result Success
Patient ID<test2> Last Name<MPTest>  Birth Date<Empty>
UPDT_DCMDIR
Patient Result Success
Patient ID<dfof> Last Name<4D-MF3>  Birth Date<Empty>
```

Disk Label TEST

Progress

Disk Status Fail to verify media

Total files to Handle 102 Total size to Handle 1033.4 MBytes

Handled Files 21 Handled Size 161.5 MBytes

Figure 3-25. The Copying files window

The system automatically formats and labels new disks. If the media contains data from an export session, a warning window is displayed.

Select between:

- **Cancel**: the Disk management process is stopped.

- **Eject**: the media is ejected, a new media must be inserted to resume the Disk management process.
- **OK**: the data on the disk is deleted and the Disk management process is resumed.

The information displayed on the *Copying files* window is updated while the files are being copied.

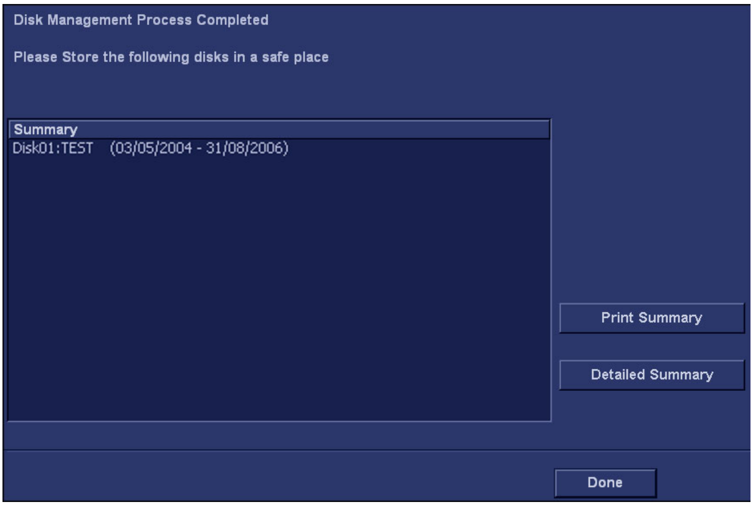
NOTE: If the media contains data from a backup session it is ejected and the user is asked to use another media.

6. If more than one media is necessary the filled media is ejected and a dialogue window is displayed asking the user to label the ejected disk and insert a new media.

   Press **OK** after the new media is inserted.

   The operation is resumed.

   When all the files are copied, the media is automatically ejected.
7. The *Summary* window is displayed (Figure 3-26), showing a list of the disks used.
   - Select **Print summary** to print the list for archiving purpose.
   - Select **Detailed summary** to display the list of the patient records copied.



Disk Management Process Completed

Please Store the following disks in a safe place

Summary

Disk01:TEST (03/05/2004 - 31/08/2006)

Figure 3-26. The Summary window

8. Make sure that all media are physically labelled according to the list displayed in the *Summary* window. The media label should also have an identification of the system the Disk management was run from.

9. Press **Done** to complete the Disk management operation and file the media.

Data Backup and restore

The Backup/Restore function enables the user to:

- Copy/Restore the patient archive.
- Copy/Restore the system configuration. The Copy/Restore system configuration feature enables the user to configure several units with identical presets, providing that the units have the same software version.

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

WARNING

GE Healthcare is not responsible for lost data if the suggested backup procedures are not followed and will not aid in the recovery of lost data.

There is no backup function for the images or reports (no creation of a safety copy). For long-term storage, images and reports should be moved to a USB HD or to a network shared folder using the Disk management procedure (see page 3-33).

CAUTION

DO NOT use the local harddrive for long-term image storage.

Only EchoPAC Software Only users with administration rights have access to the backup/Restore function.

NOTE: *EchoPAC Software Only: only users with Windows administrator rights have access to the restore function (Not applicable for Turnkey systems).*

Backup procedure

1. Press **Archive**.
2. In the *Search/Create patient* window, select the dataflow **Local Archive - Int. HD**.

Dataflow: Local Archive - Int. HD

Figure 3-27. Dataflow selection for backup

3. Press **Config** (**F2**).
4. Select the category **Admin**.
5. Select the **Backup** sheet.

Archive to backup	Result	Last successful backup
☑ Patient Archive		No record
☑ System Configuration		No record

Destination Device: CD/DVD Writable (\\127.0.0.1\CDRW)

Remote Path:

Figure 3-28. The Backup sheet

6. In the *Backup* sheet select as needed:
   - **Patient archive** to backup the patient records.
   - **System configuration** to copy system settings and user presets.
7. Select a removable media or a shared network folder as destination.

NOTE: *To be able to select a network share folder, the path (of type: \\server-name\share-name) must have been entered in the Remote path field.*

8. If the backup is done to a removable media, insert a dedicated media in the drive.
9. Select **Start backup**.

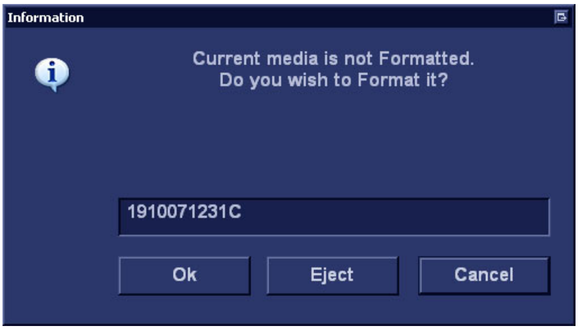
   The following situations may occur:
   - The system is checking that the removable media is inserted. If not, a dialogue window is displayed prompting the user to insert a media.

There is no media inside the tray.
Insert media.

Figure 3-29. The Insert media window

Insert the media and select **OK**.

- The system is checking if the media needs to be formatted. If yes, a dialogue window is displayed prompting the user to enter a media label.



Current media is not Formatted.
Do you wish to Format it?

1910071231C

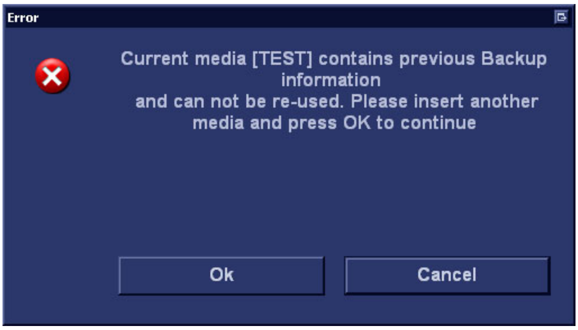
Figure 3-30. The Enter media label window

Type in a label for the media and select **OK**.

NOTE: *Only the following characters and signs can be used when labelling a media: A - Z, a - z, 0 - 9, “_” and “-”. Do not use more than 11 characters or signs. Do not use space.*

NOTE: *If you select **Eject** you can perform the backup using another removable media. If you select **Cancel** the backup operation is stopped.*

- The system is checking if there is already a backup or a Disk management copy on the media. If the following error message is displayed, the disk is ejected and the user is asked to use a new media that does not contain any backup or Disk management data.



Current media [TEST] contains previous Backup information
and can not be re-used. Please insert another media and press OK to continue

Figure 3-31. The Replace current media window

Insert a new media and select **OK**.

NOTE: *To reuse a Backup media when performing a new archive backup, the media has to be re-formatted first.*

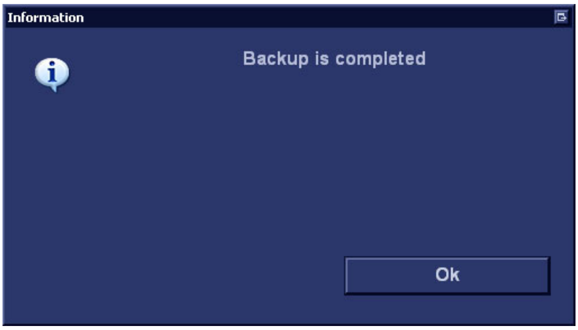
10. During backup, progress windows are displayed showing the current operation being performed.

Backing up system configuration

Backing up patient archive

Figure 3-32. The Backup progress windows

11. At the end of the process, the media is ejected and the *Backup completed* window is displayed.



Backup is completed

Figure 3-33. The Backup completed window

Select **OK**.

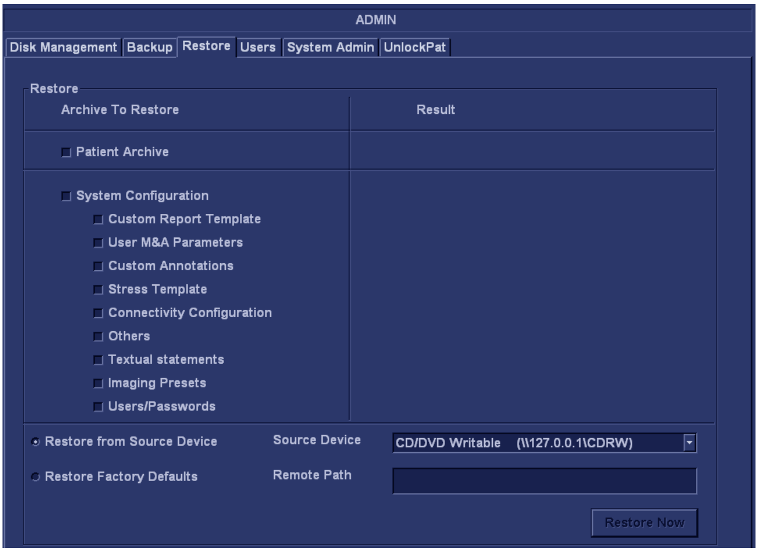
The Backup result is displayed on the *Backup* sheet.

12. Make sure to physically label the media. An identification of the system should also be noted on the media and a backup log should be kept.

    File the media in a safe place.

Restore procedure

1. Press **Config** (**F2**).
2. Select the category **Admin**.
3. Select the **Restore** sheet.



● Restore from Source Device

Source Device: CD/DVD Writable (\\127.0.0.1\CDRW)

Figure 3-34. The Restore sheet

4. In the *Restore* sheet select as needed:
   - **Patient archive** to restore the patient archive.
   - **System configuration** to restore all system settings and user presets.

     OR
   - One or several **system configuration items** to restore parts of the system settings and user presets (see Figure 3-34).
5. Make sure that **Restore from Source Device** is selected.
6. Select the appropriate **Source device**.

CAUTION

The Restore procedure will OVERWRITE the existing data on the local harddrive. Make sure to select the correct source device.

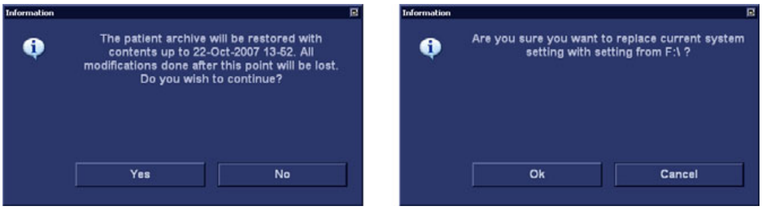
7. If restore is done from a backup on a removable media, insert the media in the drive.

CAUTION

The Restore procedure will OVERWRITE the existing data on the local harddrive. Make sure to insert the correct media.

8. Select **Restore now**.

   Depending on the selection, one or two restore confirmation windows are displayed:



The patient archive will be restored with contents up to 22-Oct-2007 13-52. All modifications done after this point will be lost. Do you wish to continue?

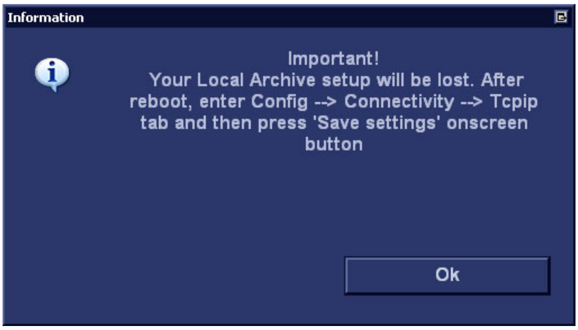
Are you sure you want to replace current system setting with setting from F:\ ?

Figure 3-35. The Restore confirmation window

9. Ensure that the correct source is selected an select **OK**.

   The selected items are copied to the systems.

10. If connectivity configuration settings are restored the following information window is displayed.

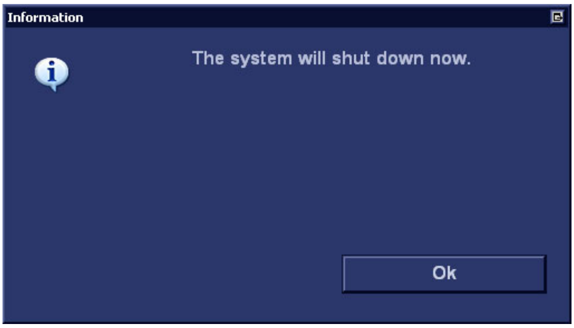


Important!
Your Local Archive setup will be lost. After reboot, enter Config --> Connectivity --> Tcpip tab and then press 'Save settings' onscreen button

Figure 3-36. Information window

11. Select **OK**.

    The *System shutdown* window is displayed.



The system will shut down now.

Figure 3-37. The System shutdown window

12. Select **OK** to shut down the system.
13. Restart the system.

    If connectivity configuration settings have been restored, make sure to save the TCP/IP settings: select **Config**/**Connectivity**/**TCPIP** and select **Save settings**. The system needs to be restarted again.

Server options

Two server options are available: EchoPAC Share and EchoPAC DICOM Share.

Server options activation

The server options activation requires Windows administrator rights.

1. Start EchoPAC Software Only and log on as administrator.
2. Press **Config** (**F2**).
3. Select the **Admin** category and **System Admin** subgroup.
4. In the *System Admin* sheet, press **New**.
5. Enter the server option key(s) and press **Save**.
6. Exit EchoPAC Software Only.

Port settings

Depending on the server options, the following ports need to be opened.

EchoPAC Share port settings

EchoPAC Software Only with EchoPAC Share installed

- 2638 (TCP)

Open either

- 139 (TCP), 137 (UDP), 138 (UDP) if NetBIOS is enabled.

or

- 445 (TCP) if NetBIOS is disabled.

Clients connecting to EchoPAC Software Only with EchoPAC Share installed

- 5050 (TCP) to 5060 (TCP)

EchoPAC DICOM Share port settings

EchoPAC Software Only with EchoPAC DICOM Share installed

- 3100 (TCP) (default port)

Clients connecting to EchoPAC Software Only with EchoPAC DICOM Share installed

- 104 (TCP) (default port)

Activation on Windows XP computers

1. Restart EchoPAC Software Only to enable the server option(s).

Activation on Windows 7 computers

The procedure described below is required only once after entering the option key(s).

1. Press the Windows **Start** button and enter **cmd** in the *Search* field.
2. Right-click **cmd.exe** and select **Run as Administrator**. Login as administrator if required.

   The *Command* window is opened.
3. Type **%TARGET_ROOT%\bin\EchoPACStarter.exe** in the *Command* window and press **Enter**.

   EchoPAC Software Only is started with enabled option(s).

EchoPAC Share

EchoPAC Share is an option that enables the EchoPAC Software Only to be used as a server for up to four different GE clients.

The following GE devices can be connected:

- Vivid 7 (v. 2.x or higher)
- Vivid 4 (v. 3.x or higher)
- Vivid 3 (v. 3.x or higher)
- Vivid i
- Vivid q
- EchoPAC Software Only (v. 4.x or higher)
- Vivid E9
- Vivid S5/S6

The GE clients connect directly via proprietary protocol to EchoPAC Software Only for both storage and retrieval of patient and image data. Without the option EchoPAC Share, only one single GE client can be connected to the workstation.

EchoPAC DICOM Share

EchoPAC DICOM Share is an option that enables non-GE ultrasound scanners to store images to EchoPAC Software Only over a network connection via DICOM protocol. I.e. EchoPAC Software Only acts as a DICOM server (DICOM Storage SCP). Up to two non-GE clients and one GE client can be connected simultaneously.

EchoPAC DICOM Share setup

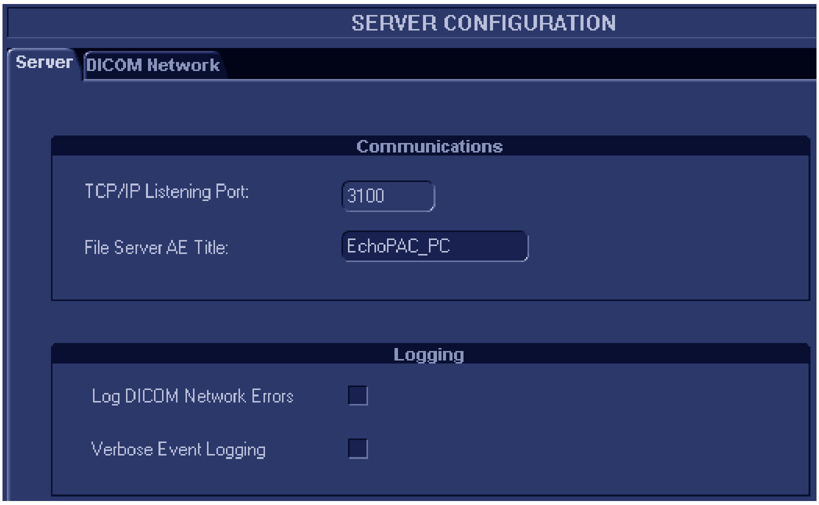
When the EchoPAC DICOM Share option is enabled a dedicated configuration sheet is available in Config. EchoPAC DICOM Share setup consists of:

- DICOM parameters setup for EchoPAC Software Only
- Non-GE clients registration

DICOM parameters settings

1. Press **Config** (**F2**).
2. Select **Server Config**.

   The *Server configuration* window is displayed.



TCP/IP Listening Port: 3100

File Server AE Title: EchoPAC_PC

Log DICOM Network Errors ☐

Verbose Event Logging ☐

Figure 3-38. Server configuration window

3. In the *Server* sheet, enter the **File server AE Title**. The default AE Title is **EchoPAC_PC**.

   The **TCP/IP listening port** is pre-configured (**3100**).

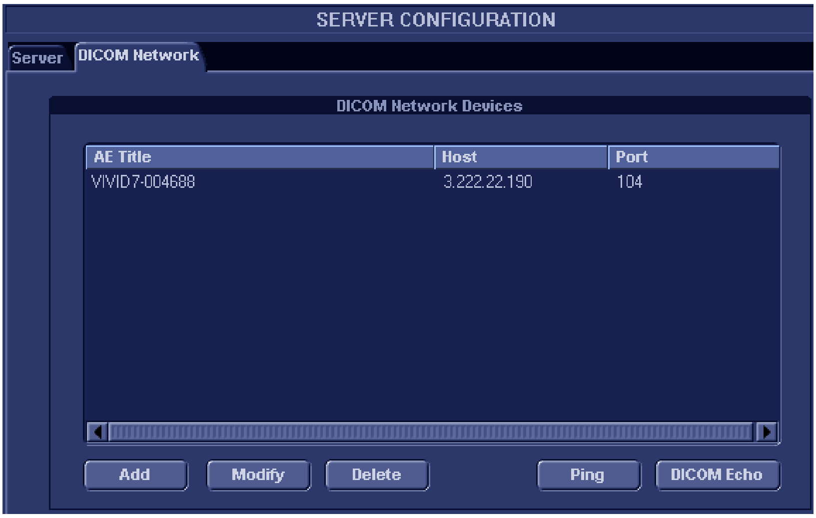
   If required activate the log functions.

*NOTE: If the **File server AE Title** is changed the user is prompted to restart the system. Select **OK** and restart he system.*

Client registration

1. In the *Server configuration* window, select the **DICOM network** tab.

   The *DICOM network* sheet is displayed.



AE Title	Host	Port
VIVID7-004688	3.222.22.190	104

Figure 3-39. DICOM network sheet

2. Select **Add**.

   The *Add/Modify DICOM device* window is displayed.

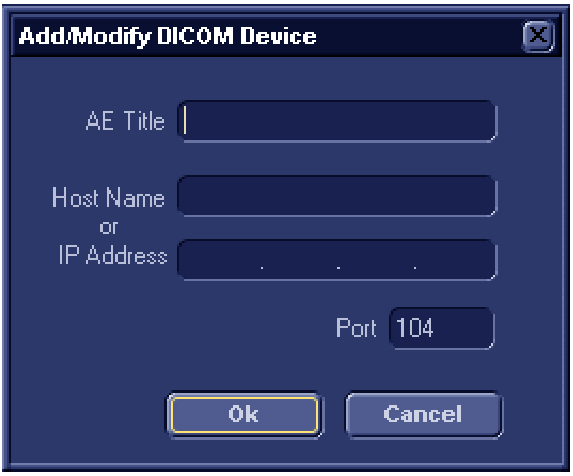


Figure 3-40. Add/Modify DICOM device window

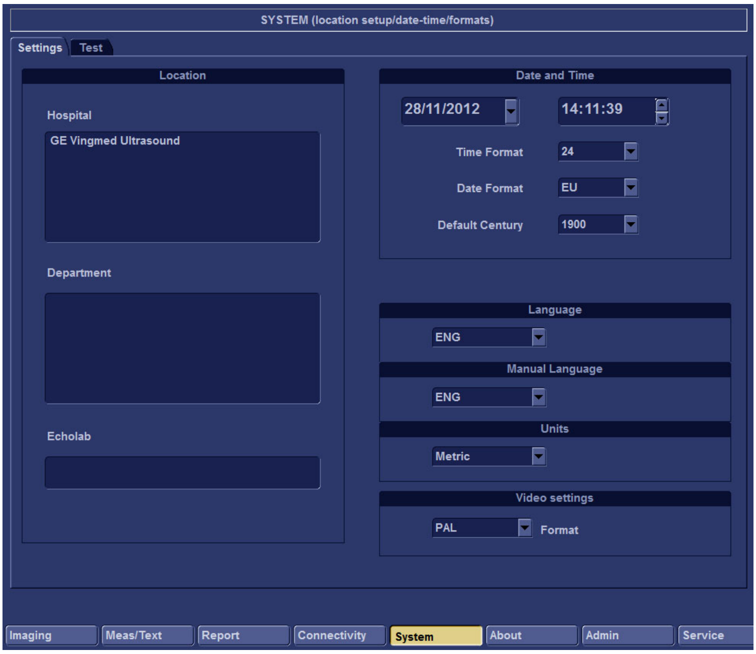
3. Enter the following information:
   - The client **AE Title**
   - The client **Host name** or **IP address**
   - The **Port number** (default is **104**)
4. Select **OK**.
5. Check the connection using **Ping** and **DICOM Echo**.
6. Press **Config** (**F2**) to exit Config and apply the changes.

Configuration – System and presets

General system settings

1. Press **Config** (**F2**) and log on as administrator if required.
2. Select the **System** category and **Settings** subgroup.

   The *Settings* sheet is displayed.



Hospital: GE Vingmed Ultrasound
Department:
Echolab:
28/11/2012
14:11:39
Time Format: 24
Date Format: EU
Default Century: 1900
Language: ENG
Manual Language: ENG
Units: Metric
PAL Format

Figure 3-41. The Settings sheet

Location

1. **Hospital**: enter the hospital name (up to 64 characters). This information is displayed on the scanning screen's *Title bar* (up to 24 characters) and on the image properties of all saved images.
2. **Department**: enter the department name (up to 64 characters). This information is displayed on the image properties of all saved images.

Date and time

Changes will be effective only after rebooting the system.

1. **Date**: select the correct date from the pop-up window.
2. **Time**: Press the arrow head buttons to set the time (hour minute and second).
3. **Time Format**: select the desired format (24 or 12 AM/PM) from the pop-up menu.
4. **Date Format**: select the desired format (EU or US) from the pop-up menu.
5. **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.

Language, units and video settings

Changes will be effective only after rebooting the system.

1. **Language**: select the desired language for the system from the pop-up menu.
2. **Manual Language**: select the desired language for the Online manual. If not available the English manual will be displayed as default.
3. **Units**: select the desired units (Metric or US) from the pop-up menu.
4. **Video settings**: select between PAL and NTSC from the pop-up menu.

System users

The system requires operator registration.

Users are divided in groups with different rights. There are two types of groups:

- **User groups**: members of these groups are allowed to login on the system when selected together with the group Operator. They have group specific rights (see tables below).
- **Referring groups**: members of these groups (Diagnosing physician and Referring doctors) 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	Delete	Diagnose	Preset admin	Print report	Store report	Admin	Service
Cardiologist	+	+			+	+		Activated with a Dongle
Physician	+				+			
Sonographer	+				+			
Fellow	+				+			
Sys Admin	+	+			+		+	
Hosp admin				+	+			
GE admin	+	+			+		+	
Diagnosing physician			+					
Referring doctor								

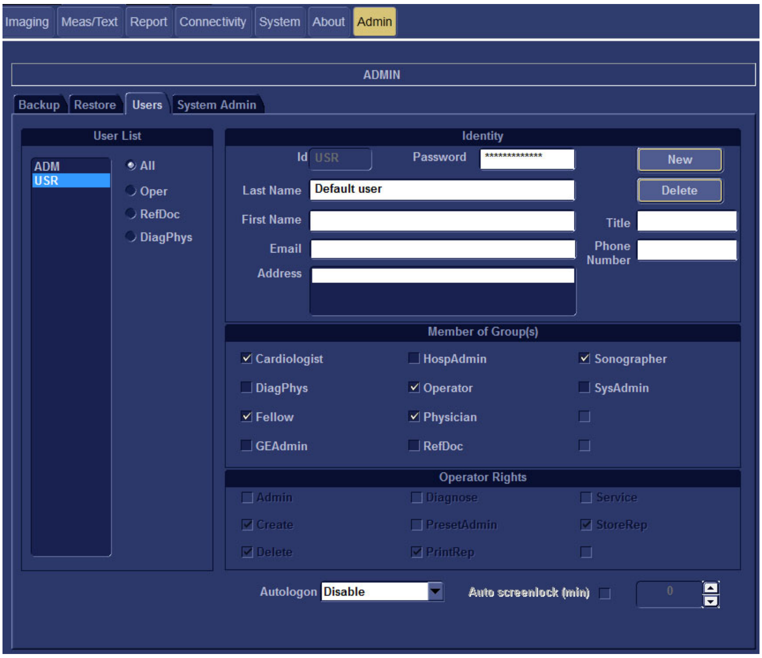
The rights associated to the user groups are:

Right	Definition
Create	Create and update patient record, examination, user and referring members. Import/Export patient records, examinations Move examinations.
Delete	Delete patient record, examination, user and referring members.

Right	Definition
Diagnose	Make the Diagnosing physician available in the *Patient info and exam* screen.
Preset admin	Make application presets protected. Delete protected application presets.
Print report	• Print a report
Store report	• Store reports, sign and unsign reports
Admin	• System administration
Service	• Access to the service platform

1. Press **Config** (**F2**) and log on as administrator if required.
2. Select the **Admin** category and **Users** subgroup.

   The *Users* sheet is displayed.



Id USR
Password *************
Last Name Default user

☑ Cardiologist ☐ HospAdmin ☑ Sonographer
☐ DiagPhys ☑ Operator ☐ SysAdmin
☑ Fellow ☑ Physician ☐
☐ GEAdmin ☐ RefDoc ☐

☐ Admin ☐ Diagnose ☐ Service
☑ Create ☐ PresetAdmin ☑ StoreRep
☑ Delete ☑ PrintRep ☐

Autologon Disable
Auto screenlock (min) ☐ 0

Figure 3-42. The Users sheet

Creating a user or a referring member

1. Press **New**.
2. Enter the user's information.
3. Select the type of user/referring member in *Member of Group(s)*.

CAUTION

To be able to login on the system, the group Operator MUST be selected.

Editing a user configuration

1. Select the actual user in the *User list*.
2. Make the desired changes.
3. Press **Config** (**F2**) 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 screen lock

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 screen lock

1. Set the time span (from 10 min.) for the system to automatically get locked when not in use. When the system is locked, the current user may either log on again or the system may be restarted by a different user.

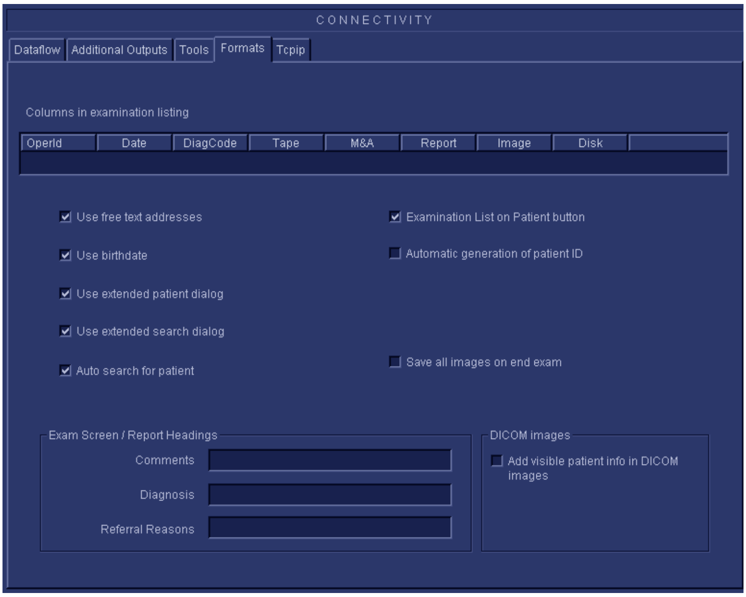
   Only available on Turnkey systems.

Configuration – Archiving

Archiving presets

1. Press **Config** (**F2**) and log on as administrator if required.
2. Select the **Connectivity** category and **Formats** subgroup.

   The *Format* sheet is displayed.



Columns in examination listing

OperId	Date	DiagCode	Tape	M&A	Report	Image	Disk	

☑ Use free text addresses

☑ Use birthdate

☑ Use extended patient dialog

☑ Use extended search dialog

☑ Auto search for patient

☑ Examination List on Patient button

☐ Automatic generation of patient ID

☐ Save all images on end exam

Exam Screen / Report Headings

Comments

Diagnosis

Referral Reasons

DICOM images

☐ Add visible patient info in DICOM images

Figure 3-43. The Formats sheet

Configuration of the Examination list window

1. In the *Formats* sheet, select the column to edit.

   A sub-menu is displayed.
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.

Patient management presets

The following settings related to patient management can be adjusted:

Setting	Description
Use free text addresses	In the *Patient information* window: ☑: 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	In the *Patient information* window, enter either the patient age or the birthdate: ☑: Enter age (Birthdate field not available) ☐: Enter birthdate, the age is calculated.
Use extended patient dialog	In the *Patient information* window: ☑: The entire patient information data is displayed. ☐: Patient information data displayed is restricted to a minimum (i.e. name and Patient ID). When unchecked, press **More** to display the entire patient information data.
Use extended search dialog	In the *Search/Create Patient* window (see Figure 3-1 *on page 3-4*) and *Patient information* window, ☑: 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.
Auto search for patient	In the *Search/Create Patient* window (see Figure 3-1 *on page 3-4*), ☑: The system searches automatically through the patient archive selected while entering patient information. ☐: The system searches through the patient archive after pressing **Enter** on the alphanumeric keyboard.
Examination list on Archive 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	In the *Search/Create Patient* window (see Figure 3-1 *on page 3-4*), ☑: Patient ID is not required when entering a new patient in the archive. The system generates automatically an ID number. ☐: Patient ID is required when entering a new patient in the archive.

Setting	Description
Save all images on end exam	☑: All images on the clipboard are automatically saved when ending an examination. ☐: A dialogue window is displayed when ending an exam where the user can select between: • Store all images • Select images to store • Store no images.
Exam screen/Report headings	Enter user-defined headings for Comments, Diagnosis and Referral reasons fields in the *Examination list* window and report.
DICOM images	☑: Displays patient information (name, date of birth and ID) on DICOM images.

TCP/IP configuration

To be able to use the network functions when connected to a hospital network, the scanner must have a proper network address. Typically source for this information is the network administrator.

NOTE: EchoPAC Software Only: only users with Windows administrator rights can perform TCP/IP configuration (Not applicable for Turnkey systems).

1. Press **Config** (**F2**) and log on as administrator.
2. Select the **Connectivity** category and **TCP/IP** subgroup.

   The *TCPIP subgroup* is displayed.

Computer Name XXXXXX

AE Title: XXXXXX

Port No: 104

☐ Detailed DICOM Log

Remote Archive IP-Addr 2 222 222 22

Remote Archive Name IMAGEVAULT-4ADV

1. Computer name: not editable
2. IP settings
3. Remote archive setup: remote archive IP address and name (EchoPAC Software Only, EchoServer, ImageVault)
4. Save TCP/IP settings. The changes will be effective after the system is rebooted.

Figure 3-44. TCP/IP setting

3. Select **Network settings** to configure:
   - The IP address for the system
   - The subnet mask for the system
   - The IP address for the Default Gateway
4. In the *Remote archive setup area* enter:
   - The IP address for the remote archive
   - The name of the remote archive
5. Press **Save settings** and reboot the system.

Dataflow

Communication between the EchoPAC Software Only and other information providers on the network takes the form of dataflows. Each dataflow defines the transfer of patient information and images from an input source to the unit, and from the unit to one or several output sources. Input/output devices cannot be added/removed to/from the pre-defined dataflows. However the settings for the devices can be adjusted.

Dataflows available

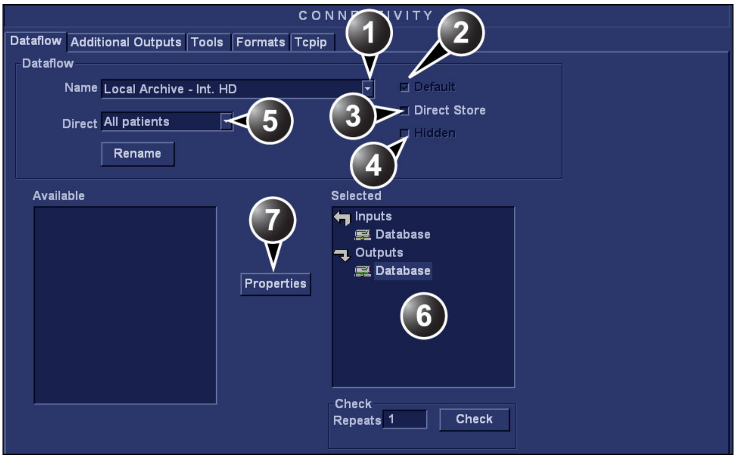
A set of pre-defined dataflows is available on the unit as listed in the table below.

Dataflow	Description
LocalArchive-Int.HD	The local database is used for patient archiving. Images are stored to internal harddrive. The stored image files will consist of raw data only, together with a single-frame DICOM preview image (no DICOM multi-frame is stored).
DICOM MOD 5.25	DICOM 5.25" Magneto Optical Disk Read DICOM Media from the 5.25" MO-drive. Some of the measurements are stored if DICOM SR is turned on.
DICOM MOD 3.5	DICOM 3.5" Magneto Optical Disk Read DICOM Media from the 3.5" MO-drive. Some of the measurements are stored if DICOM SR is turned on.
RemoteArch-RemoteHD	A remote database (either on EchoPAC Software Only or a server) is used for patient archiving. Images are stored to a network image volume (either internal HD on EchoPAC Software Only or a server).
DICOM CD/DVD read	Read DICOM Media from the CD/DVD-drive. Read only dataflow, no data can be stored.
EchoPAC Mac MOD read	Read MOD from EchoPAC (Macintosh). Read only dataflow, no data can be stored.
Query Retrieve	Retrieve images from a DICOM server
DICOM USB device read	Read DICOM data from an USB device. Read only dataflow, no data can be stored.
DICOM UDO read	Read DICOM media from an UDO drive. Read only dataflow, no data can be stored.
No Archive	Enables to perform an examination without storing the data to any archive.

Dataflow adjustments

1. Press **Config** (**F2**) and log on as administrator if required.
2. Select the **Connectivity** category and **Dataflow** subgroup.

   The *Dataflow* sheet is displayed.



Name: Local Archive - Int. HD
Direct: All patients
☑ Default
☐ Direct Store
☐ Hidden
Repeats: 1

1. Select a dataflow to configure.
2. Use selected dataflow as default (see page 3-67).
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. Input/output devices assigned to the current dataflow.
7. Adjust the settings for the selected assigned device.

Figure 3-45. The Dataflow sheet

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

General settings	Definition
File destination	Automatically selected according to the IP address
Removable	Check the entry is the media is removable.
MPPS	Modality Perform Procedure Step: send information (typically to a HIS) that a scheduled exam has been started, performed or interrupted.

Image settings	Definition
Allow raw data	☑: Save data in both raw and DICOM format. ☐: Save data in DICOM format only.
Raw Compression	Enables compression of raw data images upon storage and export. Raw compression is active only if the setting *Allow raw data* is checked.
Max Frame rate	Select 25, 30 or Full (original acquisition) from the pop-up menu.
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 retries, time interval between tentative and time-out.

DICOM settings	Definition
AE Title	The Application Entity Title is set during DICOM configuration. Refer to the network specifications.
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.

DICOM settings	Definition
DICOM SR settings	• **Allow SR**: enable DICOM SR. • **Allow SR private data**: send the current exam data in a private format. This option is by default unchecked and should only be used with DICOM storage devices that can handle private data format. • **Signed Doppler velocities**: send signed Doppler velocities. • **Use older SR version**: when checked a *Use older SR version* pull-down menu is displayed. The current exam data will be sent in the same format as the selected SR version. Details about format and content of the SR version can be found in the corresponding user manual of the selected version. See also 'DICOM SR' on *page 3-65*.

DICOM SR

DICOM Structured Reporting (SR) is a standardized format for medical results. EchoPAC Software Only supports the specialized form for Adult Echo Ultrasound ("TID 5200 Echocardiography Procedure Report") and Vascular Ultrasound ("TID 5100 Vascular Ultrasound Procedure Report") for M&A results.

With the DICOM SR support, M&A for an exam can be sent at the end of the exam or when exported from local archive. The destination can be either a server on the network (Storage SCP) or a removable media (DICOM Media) depending on the DICOM dataflow selected.

"TID 5200 Echocardiography Procedure Report" is sent if the exam contains M&A from category Cardiac or Pediatric (Heart). "TID 5100 Vascular Ultrasound Procedure Report" is sent if the exam contains M&A from category Vascular or Abdominal. If the exam contains M&A from both Cardiac/Pediatric (Heart) and Vascular/Abdominal categories, two SR documents are sent.

"TID 5200 Echocardiography Procedure Report" and "TID 5100 Vascular Ultrasound Procedure Report" do not support all M&A results from EchoPAC Software Only. They are limited to the following:

- No unassigned measurement.

  Refer to the EchoPAC Software Only Reference manual for a complete list of supported parameters.
- The following modes: 2D, M-mode, Color Flow, PW Doppler, CW Doppler, 3D and TDI.
- Not Modified Simpson method or Bullet methods.

Refer to the EchoPAC Software Only Reference manual for a complete list of supported methods.

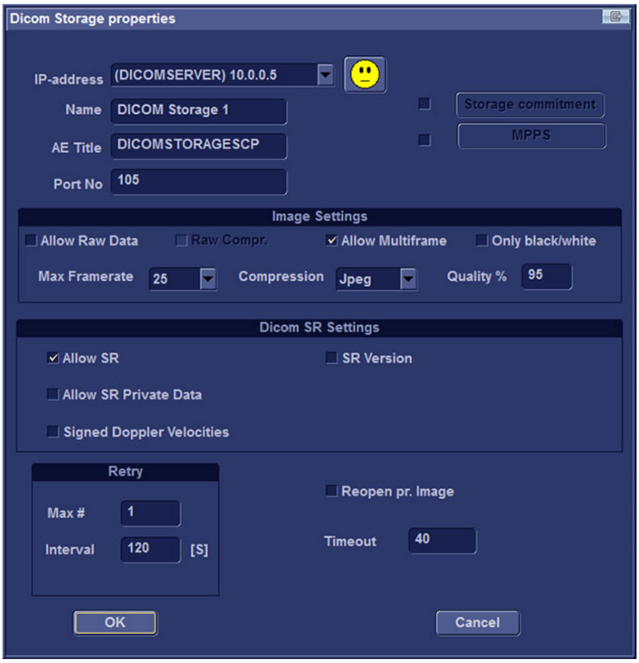
- Basic derivations (Average, Last, Min and Max), no references between the derived measurements and the ones they were made from.
- Wall Motion Scoring: individual segment scores only according to 16-segment model, no graded Hypokinesis (only Hypokinesis is used).

DICOM SR must be activated for each DICOM device.

1. Press **Config** (**F2**) and log on as administrator if required.
2. Select the **Connectivity** category and **Dataflow** subgroup.

   The *Dataflow* sheet is displayed.
3. Select the DICOM dataflow to configure in the *Name* pull-down menu.
4. Select a DICOM storage device in the *Selected devices pane* and press **Properties**.

   The *Properties* window for the selected DICOM storage device is displayed.



Dicom Storage properties

IP-address: (DICOMSERVER) 10.0.0.5

Name: DICOM Storage 1

AE Title: DICOMSTORAGESCP

Port No: 105

☐ Storage commitment

☐ MPPS

Image Settings

☐ Allow Raw Data ☐ Raw Compr. ☑ Allow Multiframe ☐ Only black/white

Max Framerate: 25

Compression: Jpeg

Quality %: 95

Dicom SR Settings

☑ Allow SR

☐ SR Version

☐ Allow SR Private Data

☐ Signed Doppler Velocities

Retry

Max #: 1

Interval: 120 [S]

☐ Reopen pr. Image

Timeout: 40

Figure 3-46. DICOM storage properties window

5. Check the option **Allow SR** to enable DICOM SR.

   The following additional options are available:

- **Allow SR private data**: send the current exam data in a private format. This option is by default unchecked and should only be used with DICOM storage devices that can handle private data format.
- **Signed Doppler velocities**: send signed Doppler velocities.
- **Use older SR version**: when checked a *Use older SR version* pull-down menu is displayed. The current exam data will be sent in the same format as the selected SR version. Details about format and content of the SR version can be found in the corresponding user manual of the selected version.

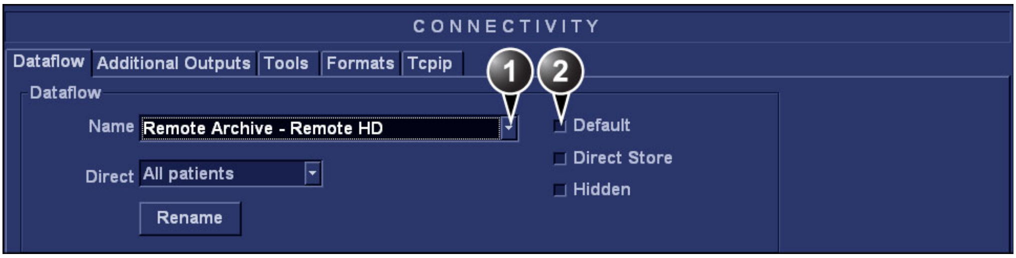
These settings apply to both “TID 5200 Echocardiography Procedure Report” and “TID 5100 Vascular Ultrasound Procedure Report”

6. Select **OK**.

Default dataflow selection

1. Press **Config** (**F2**) and log on as administrator if required.
2. Select the **Connectivity** category and **Dataflow** subgroup.

   The *Dataflow* sheet is displayed (see Figure 3-47).
3. Select the desired dataflow in the *Name* pull-down menu and check the option **Default**.
4. Press **Config** to exit the Configuration management package.



Name: Remote Archive - Remote HD

Direct: All patients

☐ Default

☐ Direct Store

☐ Hidden

1. Select a dataflow
2. Default option for the selected dataflow

Figure 3-47. Default dataflow setting

Remote path setting

The user can define a default remote path for a network shared folder (\\server-name\share-name). The remote path can then be selected as a destination archive for the following operations:

To define a remote path:

1. Press **Config** (**F2**) and log on as administrator if required.
2. Select the **Connectivity** category and **Tools** subgroup.

   The *Tool* sheet is displayed.

Media: CD/DVD Writable (E:\)
Label:
Capacity: 0.0 MB
Free space: 0.0 MB
Formatted: No
Database present: No
DICOMDIR present: No
Finalized (CD/DVD only): Yes
Write protected: Yes

Setting for remote path used for Save As, Export from Q-Analysis, and for exporting error logs with Alt-D

Remote Path: \\DUNN\EXCHANGE\PC

The below configurable user and password is used for all remote paths configurable throughout the system as secondary log-in credential

User: -
Password: *

NOTE: User / Password should not be set here for server that is used as Remote Archive for the system

Figure 3-48. The Tools sheet

3. Enter a remote path of a shared folder on the network.

   To check the connection, press **Check**.

Export configuration

The destination for Export of patient records to Excel and MPEG must be configured prior to use. See ‘Exporting patient records/ examinations’ on *page 3-24* for a description of the Export function.

To configure the Export function:

1. Press **Config** (**F2**) and log on as administrator.
2. Select the **Connectivity** category and **Dataflow** subgroup.

   The *Dataflow* sheet is displayed (Figure 3-49).

3. Select the dataflow **Misc. Export** in the *Name* pull-down menu.

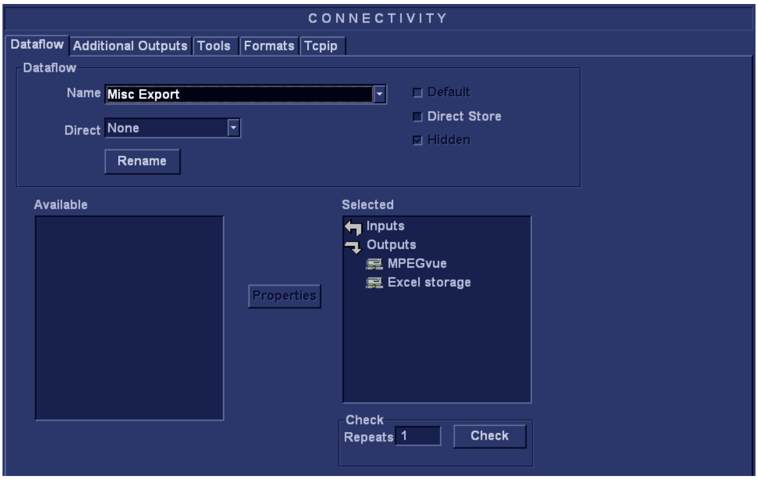


Figure 3-49. The Dataflow sheet

Export to Excel configuration

1. Select the **Excel storage** device in the *Selected devices pane* and press **Properties**.

   The *Excel properties* window is displayed.

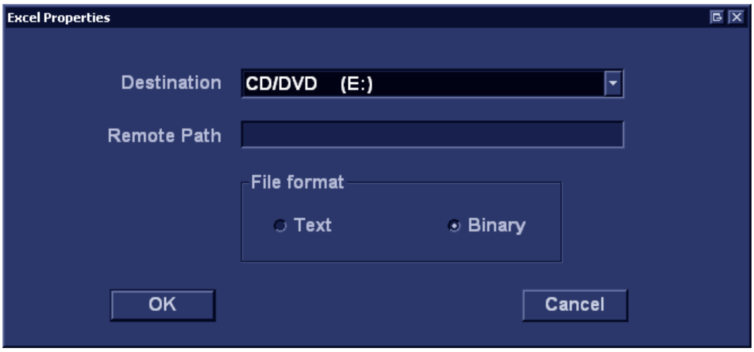


Figure 3-50. The Excel properties window

2. Select a removable media or a network volume remote path as the destination in the *Destination* pull-down menu.

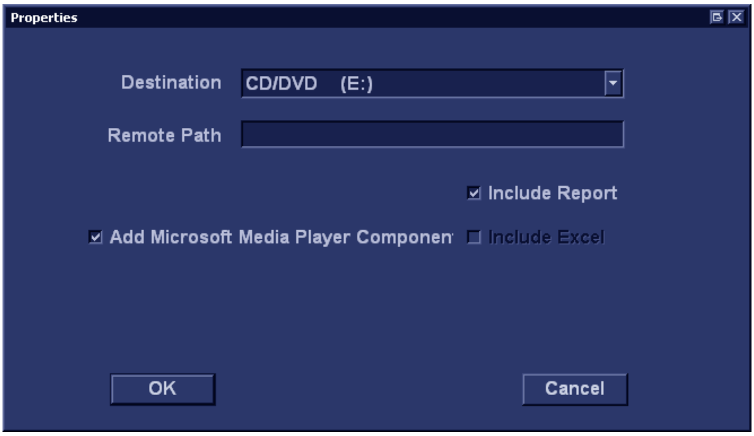
NOTE: *Remote paths of network volumes must be entered once in the Remote path field before they can be selected from the Destination pull-down menu.*

3. Select **OK** and press **Config**.

Export to MPEGVue configuration

1. Select the **eVue** device in the *Selected devices pane* and press **Properties**.

   The *eVue properties* window is displayed.



Destination: CD/DVD (E:)

Remote Path:

☑ Include Report

☑ Add Microsoft Media Player Componen

☐ Include Excel

Figure 3-51. The MPEGVue properties window

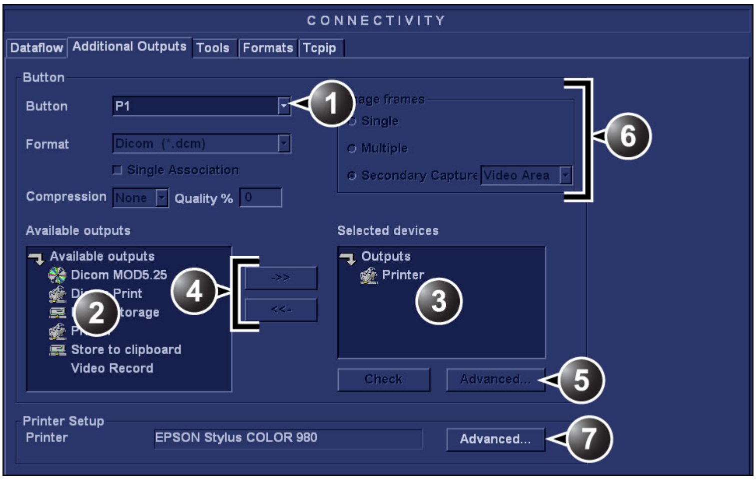
2. Select a removable media or a network volume remote path as the destination in the *Destination* pull-down menu.

NOTE: *Remote paths of network volumes must be entered once in the Remote path field before they can be selected from the Destination Pull-down menu.*

3. Check the options as required.
4. Select **OK** and press **Config**.

Additional outputs

The *Additional outputs* 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 the buttons (i.e. pressing **Alt. store 1** can result in printing to a printer and storage to a DICOM media).



Button: P1

Format: Dicom (*.dcm)

☐ Single Association

Compression: None

Quality %: 0

Printer: EPSON Stylus COLOR 980

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 of the selected assigned device.
6. Select the type of images to produce and adjust image settings.
7. Printer configuration

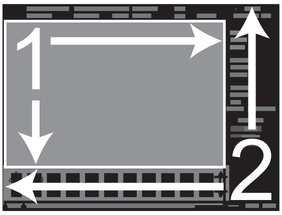
Figure 3-52. The Additional outputs sheet

Alt. store 1 / Alt. store 2 button configuration

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 device to the selected button.

   The *Properties* window for the selected device is displayed, if configurable.
3. Adjust the device specific parameters and select **OK**.
4. Adjust the image specific parameters (see table below).

Configuration parameter	
Format	Select between: • Raw DICOM • DICOM
Image compression	Select compression mode from the pop-up menu.
Quality	When JPEG compression is selected, adjust the picture quality between 1 and 100%. A low picture quality level allows high data compression, while a high picture quality restrains the compression.

Configuration parameter	
Image frames	Select between: • **Single**: stores single frame only • **Multiple**: stores cineloop • **Secondary Capture**: screen shot
Capture Area	Select between: • Video Area (1) • Whole Screen (2) 

To remove a device, select the device in the *Selected devices* field and press the **Left arrow** button.

Note regarding TomTec application

To be able to store secondary capture from the TomTec application to the EchoPAC Software Only clipboard, the **Alt. store 2** button must be configured as follows:

- Output device: Store to clipboard
- Image frames: Secondary Capture
- Capture area: Whole screen

Unlock patient record

If for any reason an examination is not properly finished, the patient record is locked and cannot be opened again unless it is unlocked.

Figure 3-53. The Unlock patient sheet

To unlock patient records:

1. Press **Config** (**F2**).
2. Select the category **Admin**.
3. In the *Admin* category, select the sheet **Unlock Patient**.
4. In the *Unlock Patient* sheet, select the patient record(s) to unlock.

   You can search for a specific patient record or a group of patient record using the searching filters.
5. Select **Unlock** to unlock the selected patient record(s) or select **Unlock all** to unlock all patient records.

   A *Confirmation* window is displayed.
6. Select **OK**.

Chapter 4

Image Management

This chapter describes:

Introduction

EchoPAC Software Only 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 Software Only image analysis package are:

- **Image optimization**: adjust image settings such as: Compress, Reject, Tissue priority, zooming, image rotation, cineloop replay adjustment...etc. 4D image optimization can perform Cropping, Slicing, Translation, Rotation... etc.
- **Measurement and Analysis**: perform either single measurement with post-assignment or protocol based pre-assigned measurements (see 'Measurements and analysis' on *page 5-1*).
- **Review and analyze protocol studies** such as Stress echo examinations including quantitative stress echo analysis (see 'Stress Echo' on *page 6-1*).
- **Quantitative analysis** of Tissue Velocity, Tissue Tracking and contrast imaging data (see 'Quantitative Analysis' on *page 7-1*).

CAUTION

The images and calculations provided by the system are intended for use by competent users, as a diagnostic tool. They are explicitly not to be regarded as the sole basis for clinical diagnosis. Users are expected to study the literature and reach their own professional conclusions regarding the clinical utility of the system

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

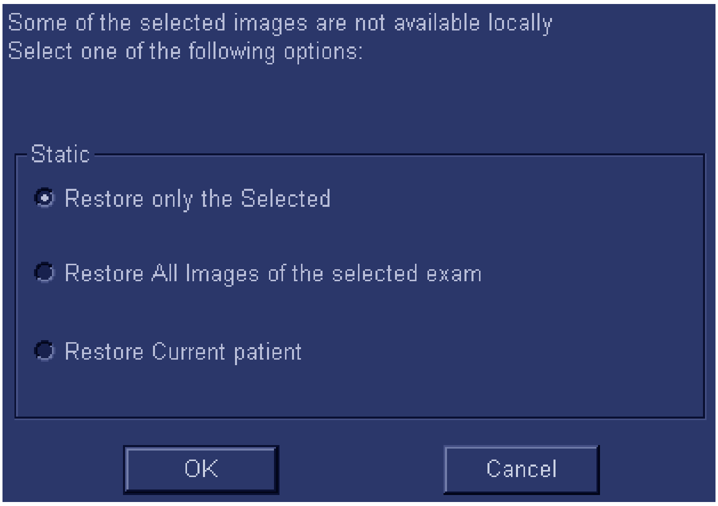
Review from the Image browser screen

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 browser** menu button.

   The *Image browser* screen is displayed (see Figure 4-3) showing thumbnails of stored images for the actual patient sorted by examination.

   If the images are stored on a removable media that is not mounted, the image thumbnail is replaced by a symbol.
2. Select the images to analyze 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.



Some of the selected images are not available locally
Select one of the following options:

Static

● Restore only the Selected

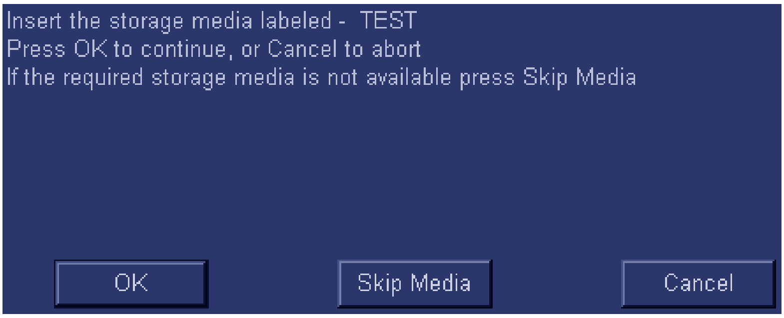
○ Restore All Images of the selected exam

○ Restore Current patient

Figure 4-1. The Restore images window

3. Select between:
   - **Restore only the selected images**: only selected images that are not available locally are restored.
   - **Restore all images of the selected exam**: all images that are not available locally in the exams where an image was selected are restored.
   - **Restore current patient**: restores all images in all examinations.
4. Press **OK**.

   The *Insert media* window is displayed.



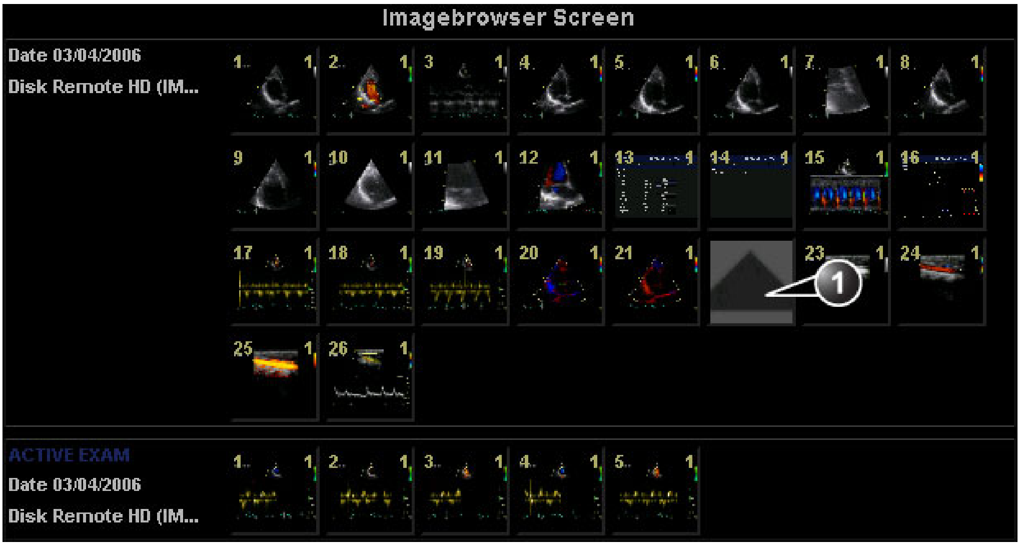
Insert the storage media labeled - TEST
Press OK to continue, or Cancel to abort
If the required storage media is not available press Skip Media

Figure 4-2. The Insert media window

5. Insert the required media.
6. Select between:
   - **OK**: the images on the mounted media are restored on the local hard drive. If not all the required images are on

the inserted media, the user is prompted to insert another media until all required images are restored on the hard drive.

- **Skip media**: the images stored on the inserted media 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.



1. Missing image

Figure 4-3. 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 4-4).

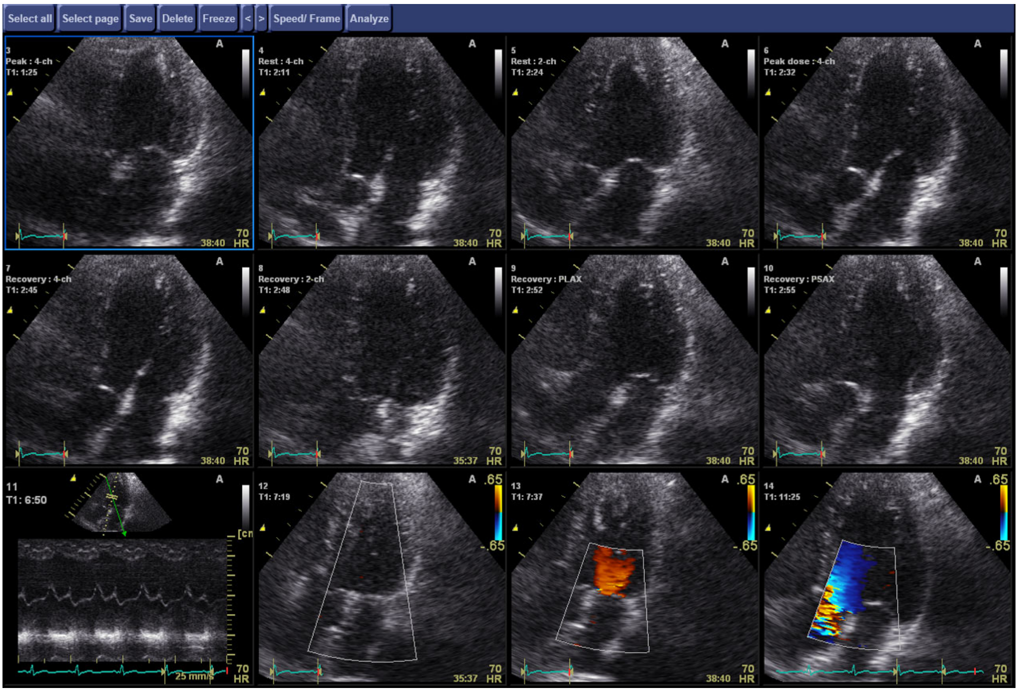


Figure 4-4. The Review screen

To delete an image

Images can be deleted from the *Review* screen or from the clipboard.

From the *Review* screen:

1. In the *Review* screen, select the images to delete.
2. Press **Delete**.

   A warning message is displayed asking the user to confirm the action to perform.
3. Select **Yes**.

From the clipboard:

1. Press the **Right mouse button** over the clipboard cell displaying the image to delete.
2. Select **Delete clipboard cell** from the context menu.

   A warning message is displayed asking the user to confirm the action to perform.
3. Select **Yes**.

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, the *Protocol* screen, or directly from the clipboard.

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

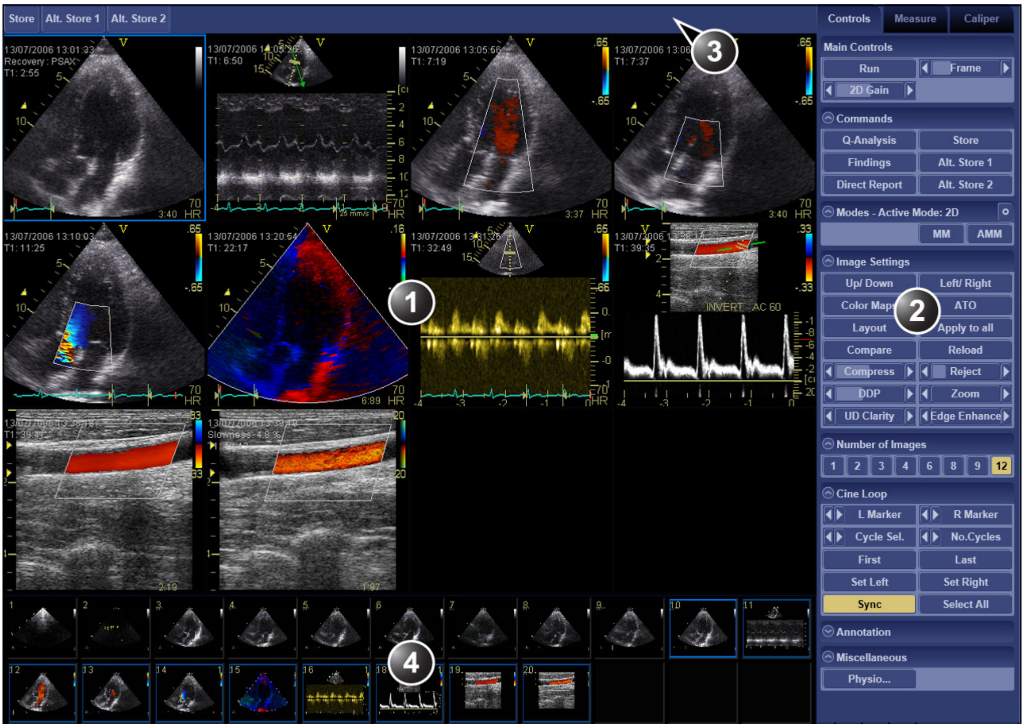
From the *Review* screen the user analyzes images from the currently selected examination.

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 4-5.
- a Control panel for image optimization and analysis. The control panel is mode-dependent.
- a top bar with often used controls (i.e image store)
- a clipboard giving access to all images from the current examination.



1. Display window
2. Control panel
3. Top bar
4. Clipboard

Figure 4-5. The Analysis screen

The Top bar

The following functions are available from the Top bar.

- **Store**: stores the currently active image to disk.
- **Alt. Store 1 and 2**: stores the image to an alternative media. This function is configurable.

The Control panel

The Control panel gives access to image optimization and analysis controls.

Using the three tabs the Control panel can be switched between:

- **Controls**: displays the image optimization and analysis controls (see below).
- **Measure**: activates the Measurement & Analysis (M&A) calculation program (protocol based pre-assigned measurements, see ‘Measurements and analysis’ on *page 5-1*).
- **Caliper**: activates the measurement tools (unassigned measurement, see ‘Measurements and analysis’ on *page 5-1*).

Image optimization Control panel

The controls available are mode dependent and grouped into functional groups. Each group can be collapsed or expanded to only display the controls of interest. Select the arrow in front of the functional group heading to expand or collapse the group.

Figure 4-6. The Control panel

Functional groups

Main controls	
Run/Stop	Starts/stops the cineloop.
Frame/Speed	• Frame: select the frame to display when in Freeze. • Speed: adjust cinespeed when the cineloop is running.
2D Gain	Adjust the amount of echo information displayed.
Gain	In combined mode, adjust the gain of the combined mode.

Commands	
Q Analysis	Starts Q Analysis (see page 7-1).
Findings	Starts Structured Findings (see page 9-8)
Direct Report	Starts Direct report (see page 4-36)
Store	Stores the currently active image to disk.
Alt Store 1 and 2	Stores the image to an alternative media. This function is configurable.

Modes	
	In combined mode, select the mode to display.

Image settings	
	Displays the mode specific image controls.
Up/Down	Flips the image 180 degrees.
Left/Right	Creates a mirror image of the original image. The left/right reference marker V moves to the other side of the image.
Color Maps	Selects mode specific color map from the pop-up menu.
Automatic Tissue Optimization (ATO)	ATO provides an automatic optimization of the 2D image by adjusting the gray scale curve.
Invert	Enables the color scheme assigned to positive and negative velocities to be inverted.
Invert (TSI)	Invert is available for TEE acquisitions. When applied, the time to peak negative velocity is calculated (instead of the time to peak positive velocity). Invert makes it possible to use TSI on TEE acquisitions where the image sector is inverted.
Variance	Controls the amount of variance data added to a color display. Variance enables computer-aided detection of turbulent flow (e.g. jets or regurgitation).

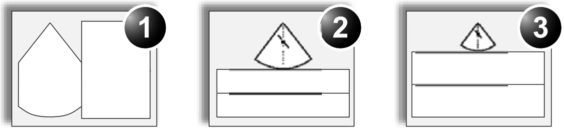
Image settings	
Baseline	• CF Adjusts the color map to emphasize flow either toward or away from the probe. • Doppler Enables the Doppler baseline to be shifted up and down. The default Doppler baseline is set at the center of the vertical aspect of the Doppler display, dividing evenly the flow toward and away from the probe. By adjusting the baseline a larger portion of the analysis is assigned to the flow direction present. • TVI Adjusts the color map to emphasize tissue motion either toward or away from the probe.
Simultaneous	Enables simultaneous display of 2D image and color image.
Apply to all	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	Restore all controls to original setting.
Compare	Displays a copy of the selected cineloop. Enables frame by frame comparison of the selected cineloop (independent scrolling).
Layout	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. 
TVI visible	Turns TVI display on/off.
Compress	Controls the amount of contrast.
DDP	Performs temporal processing which reduces random noise without affecting the motion of significant tissue structures.
Reject	Discards low levels echoes when increased.
Zoom	Magnifies the image display in both frozen and live (see ‘Zoom function’ on *page 4-16*).
UD Clarity	Enables the user to create a personalized appearance of the tissue. A decrease of UD Clarity creates a smoother image, though keeping boundaries sharp. An increase of UD Clarity creates a crisper image.
Edge Enhance	Controls image processing related to the extent of edge enhancement applied to an image.
Horizontal sweep	Controls the time scale in the time-motion display.
Tissue Priority	Emphasize either the color of the color mode or the greyscale tissue detail of the 2D image.
Angle Correct.	Enables stepwise angle correction (by 2 degrees) of the Doppler velocity scale.

Image settings	
Transparency	Controls the degree of transparency of the color display.
Threshold	Controls the level of greyscale intensity that is used as a threshold for color.
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	Controls the color cut-off value of max displacement displayed.
SI length	Determines the Strain/Strain rate sample volume size.
SRI reject **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 compound	Calculates and displays cineloops generated from a temporal averaging of multiple consecutive heart cycles.
SI scale **SRI scale**	Define the scale for the color coding for strain or strain rate.
TSI Cut-off	Controls the cut-off time: using this control it is possible to color all parts of the TSI image that have a time to peak less than a certain cut-off time.

Number of images	
1 to 12	Select the number of images to display.

Cineloop	
	Displays the cineloop controls (see ‘Cineloop’ on *page 4-17*).

Annotation	
	Enables the insertion/deletion of body marks, arrows and text in the selected image.

4D Controls	
Depth/Color maps	• Adjusts the volume rendering color from a color map menu. • Depth color maps: these color maps use colors to improve the perception of depth. Selecting the Depth bronze/blue color map will display structures that are close to the view plane with a bronze color. Structures that are farther behind will be colored with a gray color, while the structures that are farthest behind will be colored in blue. Very bright colors are almost white, independent of the depth.
	• Depth Illumination map: this color map creates shadows to improve the perception of depth. Adjust **Light source** on the Control panel to modify the light angle.

4D Controls	
Stereo Vision	Stereo Vision: 4D Stereo vision is a display technique that enhances the perception of depth in 3D renderings. This is achieved by mixing two different volume renderings with slightly separated viewing angles and presenting them separately to the user's left and right eyes. Two types of stereo visions are supported: anaglyph stereo vision and polarized stereo vision (see 'Stereo vision' on *page 4-24* for more information).
4D Home	Sets the cut-planes and crop planes to the default position.
Angle	Sets the cut-planes and crop planes to predefined positions.
Cine rotate	Displays the volume rendering of a cardiac cycle that rotates continuously back and forth.
Flexi-Slice	Toggles the display between Volume rendering and Slice mode.
Laser Lines	Enables the visualization of the 2D image locations in the volume rendering. The 2D image locations are shown as overlaying red or color coded lines following the surface in the volume rendering. The color of the laser lines (white or green) corresponds to the color coding used for the 2D images.
2-Click Crop	Crop mode where two parallel crop planes are applied in the volume rendering. The position and viewing direction are defined by clicking in two locations in the volume rendering. 2-click crop enables to quickly extract any views for visualization of 4D structures.
Crop tool	Enters the crop mode (see page 4-26).
View Crop	Crop mode where the view plane and the crop plane always coincide.
Parallel Crop	Crop mode where two parallel crop planes are applied (see page 4-26).
Flip Crop	Sets the crop plane so that the opposite volume is cropped and the viewing direction is flipped 180 degrees.
Multi Slice	Multi Slice enables simultaneous display of equidistant short axis views generated from a volume acquisition. Alternative displays are available by pressing **Layout** on the Control panel.
6 Slice	6 Slice enables simultaneous display of six equidistant short axis views and two long axis views generated from a 4D Color Flow acquisition.
4D Views	4D Views enables quick access to standard 2D and 4D views.
Dynamic	Dynamic is a tissue tracking tool. When Dynamic is on the cropping plane applied to the volume rendering is moving together with the tissue structure through the entire heart cycle. Available only for transthoracic acquisitions.
UD Clarity	Enables the user to create a personalized appearance of the tissue. A lower setting creates a smoother image, though keeping boundaries sharp. A higher setting creates a crisper image.
Volume optimize	One touch button that optimizes the volume rendering by adjusting several display controls simultaneously (e.g Shading, Smoothness... etc.).
Smoothness	Affects continuity of structures and image noise in the volume rendering. Too much smoothness will blur the image, too little will leave too much noise.

4D Controls	
Shading	Adjusts the shading effect on the volume rendering. Shading may improve three dimensional perception.
Gamma	Adjusts the brightness of midtone values. A higher gamma value produces an overall darker image, a lower gamma value a brighter image.
Up/Down	Flips the volume upside-down. Not available when alignment has been approved.

Image optimization

1. Select the image of interest.

   The control panel displays the mode specific controls.
2. If applicable, press **Stop** 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.
3. In dual mode, press **Layout** until the desired display is shown.
4. Adjust the mode specific image controls to optimize the display.
5. Press **Store** to save the changes.

Zoom function

1. Adjust the **Zoom** control on the Control panel.

   OR

   Press **Arrow up** key to zoom in and **Arrow down** key to zoom out

   OR

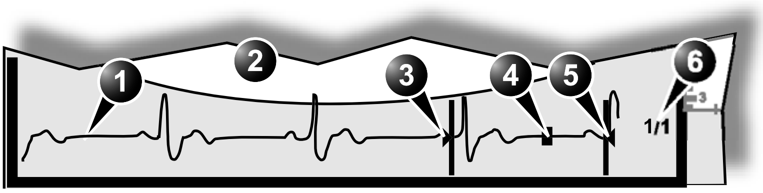
   Scroll mouse wheel up to zoom in and down to zoom out.

   A portion of the selected image is magnified and a situation picture is displayed showing the outlined zoom region.
2. Press and hold down **Shift** and use the **Arrow** keys to move the zoomed area.

   OR

   Press mouse wheel and drag.

Cineloop



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 4-7. Cineloop display

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.

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.
4. Using the **Cycle select** control, move from heart beat to heart beat to select the heart cycle of interest.

NOTE: 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 cineloops.

Generated Anatomical M-Mode

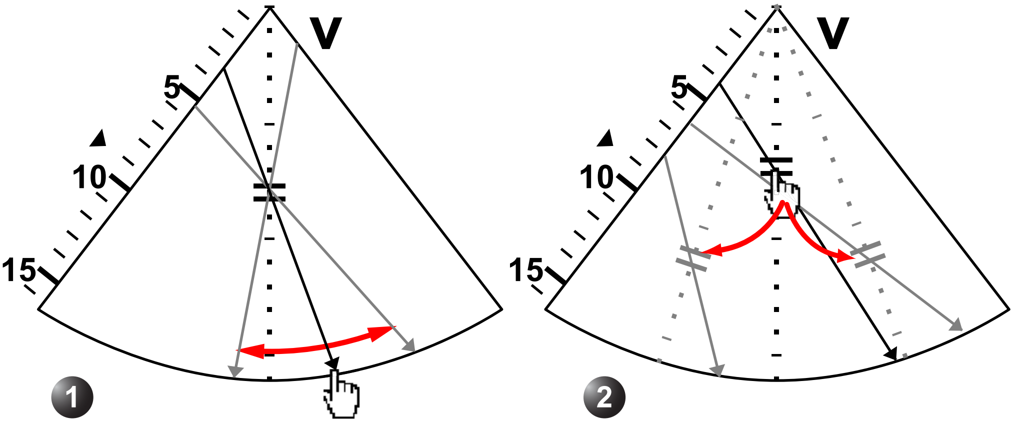
Anatomical M-Mode (AMM) displays can be generated from raw data 2D, 2D Color and TVI images.

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 4-8.

   All other controls are similar to conventional M-Mode (see page 4-9 and followings).



1. AMM cursor angle adjustment
2. AMM cursor position adjustment

Figure 4-8. Adjustment of the AMM cursor

Note regarding CTO

CTO (Continuous Tissue Optimization) optimizes the radial and lateral uniformity and brightness of the tissue continuously in real-time.

The mention “CTO” is displayed on the upper right corner of the image area if CTO has been used during acquisition.

NOTE: CTO may alter the local gain differently in separate (non-neighboring) regions of the image. CTO is only available in live scanning and cannot be turned off when the image is stored.

4D imaging optimization

Rotating/Translating the view plane or crop plane

Rotation and translation can be performed in either Volume rendering or Slice mode. Press **Flexi-Slice** to toggle between the two modes.

Volume rendering mode

In Volume rendering mode, rotation applies to the viewing direction onto the volume rendering. When **View Crop** on the Control panel is selected, the viewing direction and the crop plane rotate together. When **View crop** is deselected rotation applies only to the viewing direction.

Rotation:

1. Place the mouse cursor in the image area.
2. Press and hold down the **Left mouse button** and drag the mouse in any direction.
    - Rotation with **View crop** selected: viewing direction and crop plane always coincide.
    - Rotation with **View crop** deselected: the viewing direction rotates around the volume rendering. The crop plane is not rotated.

    To rotate around the Z axis, press and hold down **Alt** and drag the mouse to the left or right.

Translation:

1. Place the mouse cursor in the image area.
2. Press and hold down **Shift** and drag the mouse up or down to translate a crop plane into the volume.

    Alternatively, adjust **Translate** on the Control panel.

Slice mode

In Slice mode each cut-plane may be rotated or translated independently.

1. Press **Yellow**, **White** or **Green** on the Control panel to select the Reference plane.

    The volume rendering is updated accordingly.
2. Place the cursor at one of the extremities of a cut-plane intersection line in one of the cut-planes. The cursor is changed to ↻. Drag to rotate the cut-plane.

3. Place the cursor in the middle section of a cut-plane intersection line. The cursor is changed to ⤡. Drag to translate the cut-plane.
4. Place the cursor at the intersection between two cut-plane lines. the cursor is changed to ✥. Both cut-planes are translated simultaneously.
5. Click on a point in the volume rendering to move the intersection of the two other cut-planes to that location.
   - If **Depth Mode** is turned on: the reference plane is also moved inside the volume rendering to the corresponding selected depth.
   - If **Depth Mode** is turned off: the reference plane is kept at the current depth.
6. Place the cursor at the outer area of one of the cut-planes. The cursor is changed to ↻. Drag to rotate the cut-plane image. The cut-plane lines remain fixed.
7. Place the cursor in the inner area of one of the cut-planes. The cursor is changes to ✥. Drag to pan the cut-plane image. The cut-plane lines remain fixed.

Zoom

Zooming

1. Rotate the **Mouse wheel** to zoom in and out.

   OR

   Press **Arrow up** to zoom in, **arrow down** to zoom out.

   OR

   Adjust **Zoom** on the control panel.

Zoom panning

1. While in zoom mode, press and hold down the mouse wheel and drag the mouse.

   OR

   Press and hold down **shift** and press the **Arrow** keys.

4D Views

4D Views enables quick access to standard 2D and 4D views. 4D Views requires slice alignment before standard views can be selected.

1. Press **4D Views** on the Control panel.

   The *Slice alignment* screen is displayed.

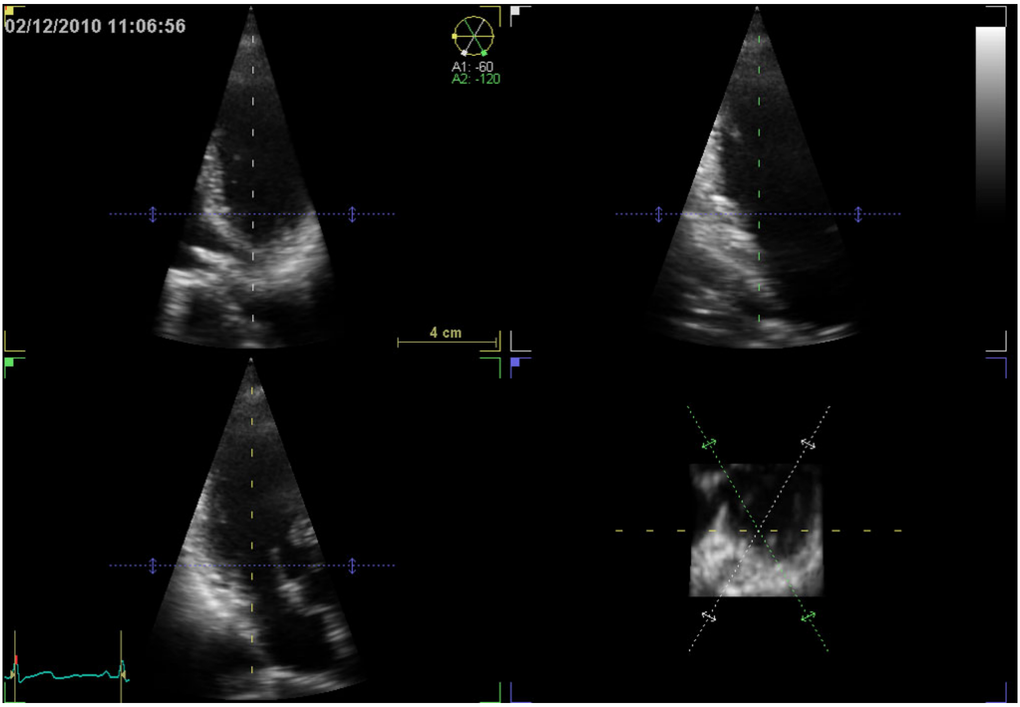


Figure 4-9. Slice alignment screen

Alignment – Transthoracic acquisition

1. Press **Auto Align** on the Control panel.

   The standard views are displayed with the left ventricle centered to the center axis.

   Further adjustment of the alignment can be done using the mouse.

   - Place the cursor outside one of the extremities of the slice intersection lines <u>in the Apical short axis view</u>. The cursor is changed to ↻.Drag to rotate all apical views around the main axis.
   - Place the cursor at one of the extremities of the Apical 2 chamber slice intersection line (white) <u>in the Apical short axis view</u>. The cursor is changes to ⤻.Drag to rotate the Apical 2 chamber slice around the main axis.
   - Place the cursor at one of the extremities of the Apical long axis slice intersection line (green) <u>in the Apical short axis view</u>. The cursor is changes to ⤻.Drag to rotate the Apical long axis slice around the main axis.
   - Place the cursor at one of the extremities of a slice intersection line <u>in one of the apical views</u>. The cursor is changed to ↻.Drag to tilt all slices around a perpendicular axis to the apical view.

- Place the cursor in the middle section of a slice intersection line in one of the apical views. The cursor is changed to ✥. Drag to pan all slices.
- Place the cursor on the blue intersection lines in one of the apical views. The cursor is changed to ↕. Drag to translate the short axis plane.

NOTE: *Press **4D Home** to remove the alignment and display the original probe position or a previously approved alignment.*

2. Press **Approve** when alignment is done.

NOTE: *Press **Delete** on the Control panel to remove any previously approved alignment and exit the Slice alignment function.*

3. Select the desired standard view on the Control panel.

Alignment – Transesophageal acquisition

1. Perform slice alignment using the mouse.
   - Place the cursor outside one of the extremities of the slice intersection lines in the short axis view. The cursor is changed to ↻.Drag to rotate all views around the main axis.
   - Place the cursor at one of the extremities of the 2 chamber slice intersection line (white) in the short axis view. The cursor is changes to ⟲.Drag to rotate the 2 chamber slice around the main axis.
   - Place the cursor at one of the extremities of the Mid-esophageal (ME) long axis slice intersection line (green) in the short axis view. The cursor is changes to ⟲.Drag to rotate the ME long axis slice around the main axis.
   - Place the cursor at one of the extremities of a slice intersection line in one of the long axis views. The cursor is changed to ↻.Drag to tilt all slices around a perpendicular axis to the view.
   - Place the cursor in the middle section of a slice intersection line in one of the long axis views. The cursor is changed to ✥. Drag to pan all slices.
   - Place the cursor on the blue intersection lines in one of the long axis views. The cursor is changed to ↕. Drag to translate the short axis plane.

NOTE: *Press **4D Home** to remove the alignment and display the original probe position or a previously approved alignment.*

2. Press **Approve** when alignment is done.

NOTE: *Press **Delete** on the Control panel to remove any previously approved alignment and exit the Slice alignment function.*

3. Select the desired standard view on the Control panel.

Stereo vision

4D Stereo Vision is a display technique that enhances the perception of depth in the 3D renderings. This is achieved by mixing two different volume renderings with slightly separated viewing angle and presenting them separately to the user's left and right eyes.

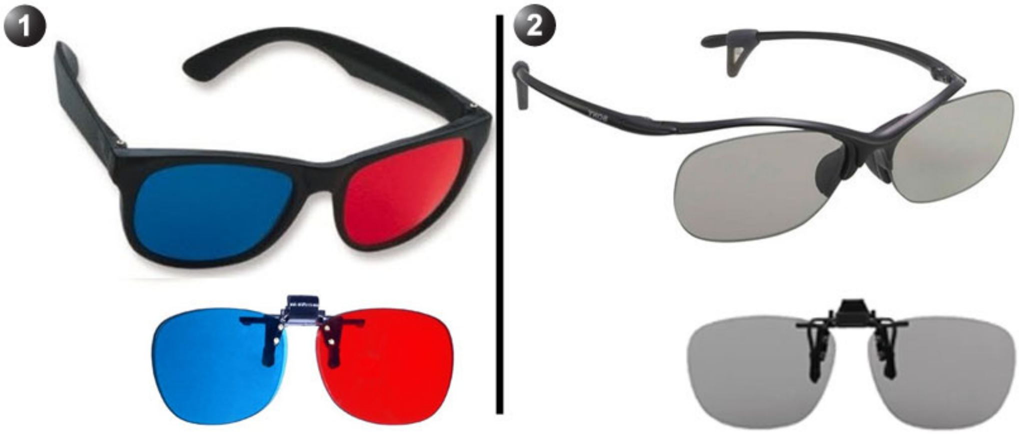
Two stereo display modes are supported.

- Anaglyph stereo vision: can be displayed on any monitor and requires anaglyph stereo glasses (glasses with one red and one cyan lens).
- Polarized stereo vision: can be displayed only on a monitor supporting this display (currently only Sony LMD-2451MT is supported). The monitor has to be connected to the digital video output of the computer. Polarized stereo vision requires polarized stereo glasses. The image will look only slightly blurred if viewed without glasses or on monitors not supporting polarized stereo vision.

Polarized stereo vision is available as an option. Anaglyph stereo vision is available as default on the system.

Stereo vision is started by pressing **Stereo vision** on the Control panel. Either anaglyph or polarized stereo vision is started depending on the configuration (see below).

Make sure to use the correct glasses.



1. 3D anaglyph glasses
2. Circular polarizer 3D glasses

Figure 4-10. 3D glasses

NOTE: *Not all users may be able to perceive depth using stereoscopic display techniques.*

Stereo vision configuration

Anaglyph stereo vision is the default stereo display mode and does not require further configuration. Polarized stereo vision must be enabled and the display options configured before it can be used.

Connecting the Sony LMD-2451MT monitor

CAUTION Read thoroughly the monitor’s user manual before attempting to use the monitor.

1. Connect the external monitor to the computer using a DVI cable.
2. Connect the external monitor to the mains as described in the monitor’s user manual.

To enable polarized stereo vision

1. Make sure the Sony LMD-2451MT monitor is connected to the system and turned on.
2. Press **Config** (**F2**) on the Control panel.
3. Select **Imaging**/**Global**.
4. Check the option **Enable Polarized stereo support**.
5. The stereo vision monitor should be set as primary monitor with native resolution of 1920x1200 px, 60 Hz and 32-bit color depth.

Dynamic

Dynamic is a tissue tracking tool. When Dynamic is on the cropping plane applied to the volume rendering is moving together with the tissue structure through the entire heart cycle. Only longitudinal displacements relative to the basal LV are detected. Dynamic tool may enable a better visualization of anatomical structures (e.g. MV annulus) through the entire heart cycle.

Dynamic is only available with transthoracic acquisitions.

⚠ CAUTION

Use Dynamic only on apical greyscale acquisitions.

Do not compare measurements performed on static and dynamic slices.

2-click cropping

2-click crop enables to quickly extract any views for visualization of 4D structures. Two crop planes are created by clicking twice in one of the 2D images or in the volume rendering.

1. Press **2-Click Crop** on the Control panel.
2. Place the cursor in one of the 2D views (or the volume rendering) and press the left mouse button to create the first crop plane.
3. Move the cursor to a new location. The volume rendering is updated simultaneously showing the cropped view.
4. Press the left mouse button to create the second crop plane.

NOTE: *If desired repeat the procedure to create a new cropped view.*

5. Press **2-Click Crop** to go back to the *Volume rendering* screen.

Parallel cropping

Parallel cropping applies two parallel crop planes in the volume rendering. This setting can be useful for valves and shunts renderings.

When using **Parallel Crop**, both crop planes move together, when translating and rotating. The thickness of the parallel crop is adjusted using the **Thickness** control.

Press **Dynamic** to display the structure dynamically through the entire heart cycle.

NOTE: *When Dynamic is on the icon is displayed on screen.*

To remove parallel cropping, press **Parallel Crop** again.

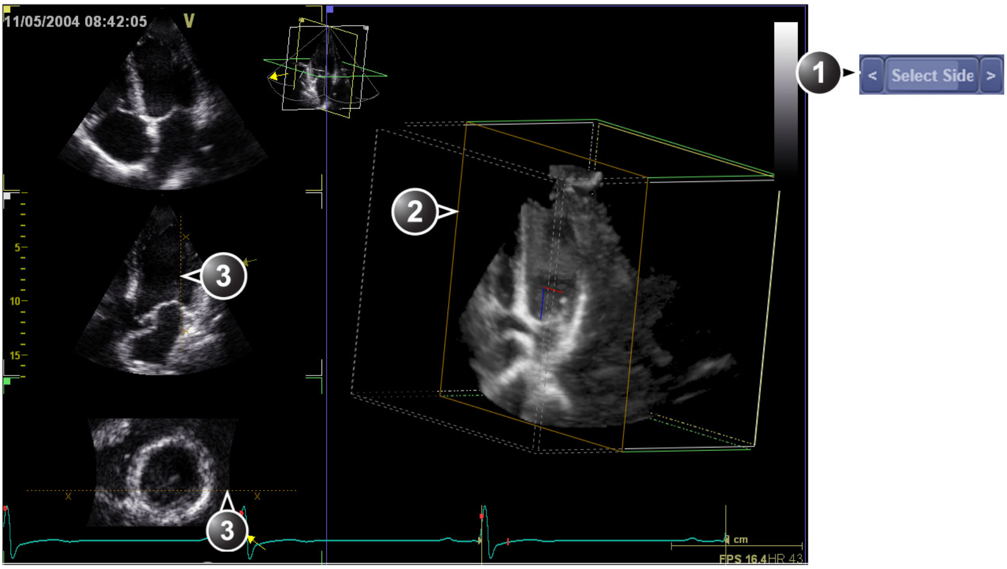
Cropping

The volume rendering can be cropped to only display the structure of interest.

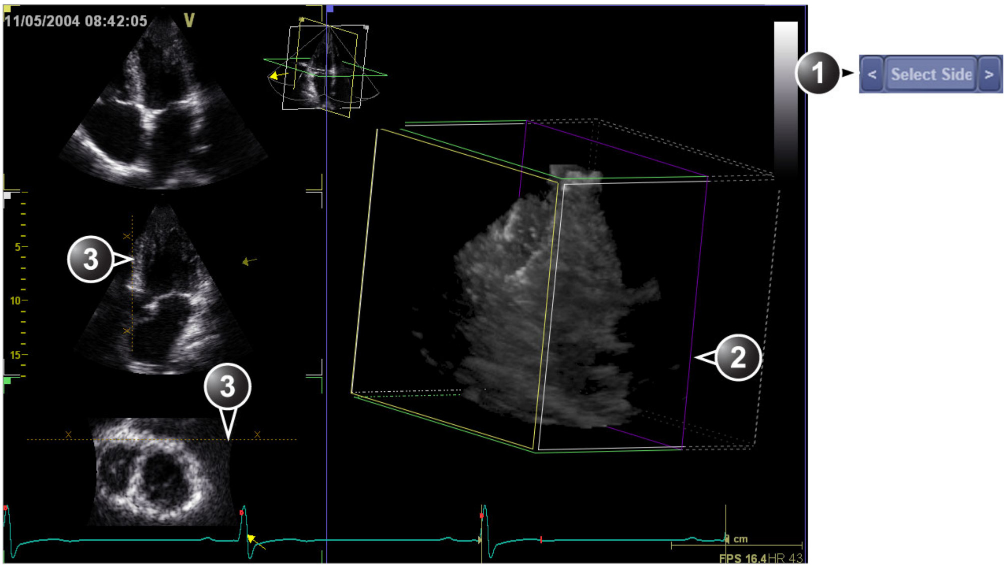
There are two crop planes that can be adjusted in each of the azimuth, elevation, and short axis planes.

Crop planes in the azimuth plane

Azimuth crop plane 1



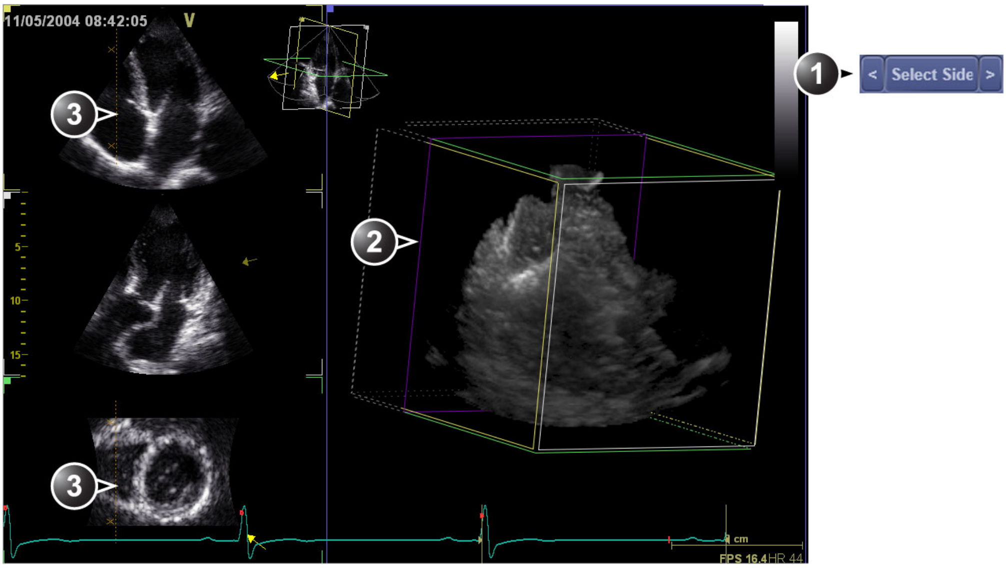
Azimuth crop plane 2



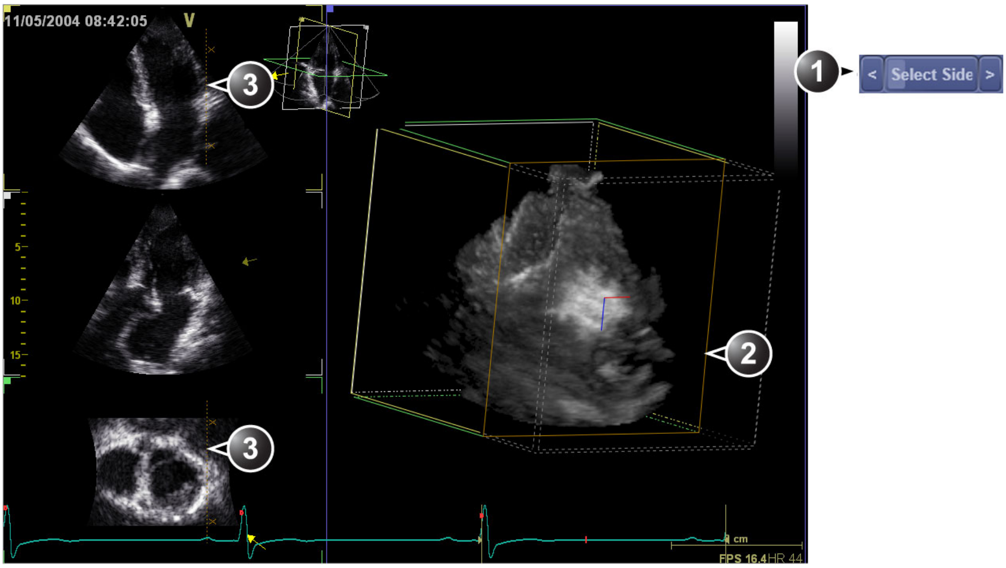
1. Cropping plane selection on the Control panel
2. Active crop plane in the volume rendering.
3. Crop plane intersection. The X symbols indicate the cropped side.

Crop planes in the elevation plane

Elevation crop plane 1



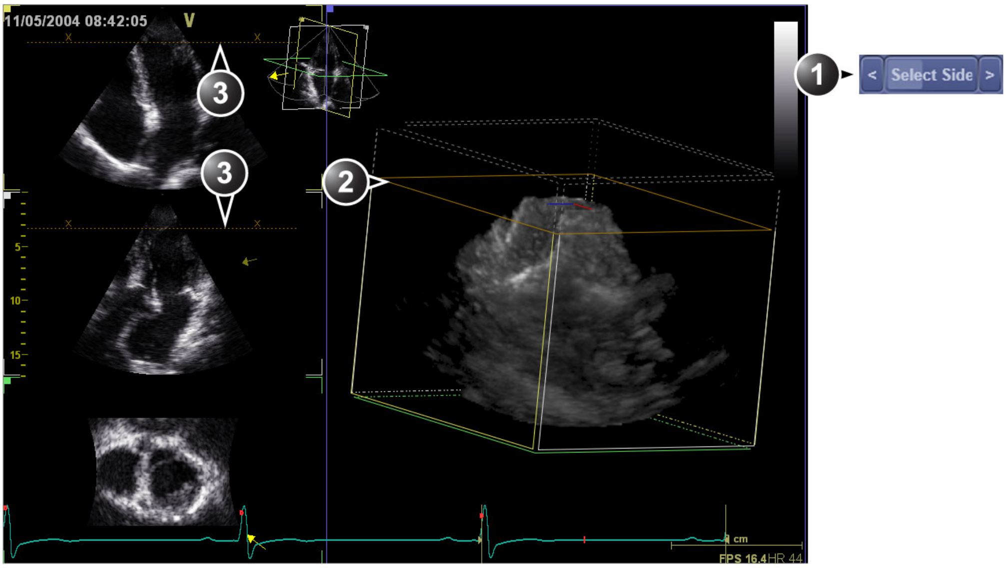
Elevation crop plane 2



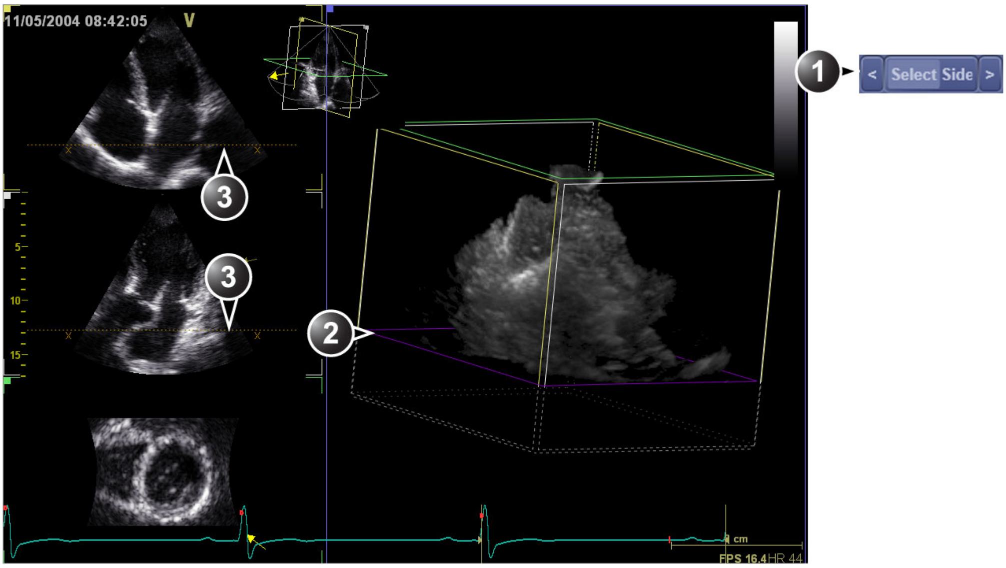
1. Cropping plane selection on the Control panel
2. Active crop plane in the volume rendering.
3. Crop plane intersection. The X symbols indicate the cropped side.

Crop planes in the short axis plane

Short axis crop plane 1



Short axis crop plane 2



1. Cropping plane selection on the Control panel
2. Active crop plane in the volume rendering.
3. Crop plane intersection. The X symbols indicate the cropped side.

1. Press **Crop tool** on the Control panel.
2. Press **Select side** on the Control panel to select the crop plane to adjust.
3. Press **Rotate Crop** to activate rotation of the crop plane using the mouse.
4. To rotate the crop plane: press and hold down the left mouse button and drag the mouse.

   To translate the crop plane: press and hold down **Shift**, press and hold down the left mouse button and drag the mouse up or down.

   Use the **Rotate red** and **Rotate blue** controls on the Control panel to fine tune the adjustment of the crop plane.

   The **Rotate Red** control rotates the crop plane about the red indicator in the center of the crop plane. Similarly, the **Rotate Blue** control rotates the crop plane about the blue indicator. The **Spin Red&Blue** control changes the orientation of the red and blue indicators, to facilitate cropping in oblique angles.
5. Other possible adjustments:
   - Press **Dynamic** to display the structure dynamically through the entire heart cycle. This applies to the last applied crop plane.

     NOTE: When Dynamic is on the icon is displayed on screen.

     NOTE: The display rate of Dynamic crop is dependent of the computer hardware (CPU and graphics card) and can be slower on low-end computers (Not applicable for Turnkey systems).
   - Press **Flip crop** to remove the data on the other side of the current crop plane. The viewing direction is flipped 180 degrees.
   - Press **Parallel crop** to add a crop plane parallel to the current crop plane. This setting can be useful for valves and shunts renderings.

     When using **Parallel Crop**, both crop planes move together, when translating and rotating. The thickness of the parallel crop is adjusted using the **Thickness** control.

     To remove parallel cropping, press **Parallel Crop** again.

   Press **Reset Active** to undo the adjustments made on the current active crop plane.

   Press **En face view** to display a straight forward view of the active crop plane.

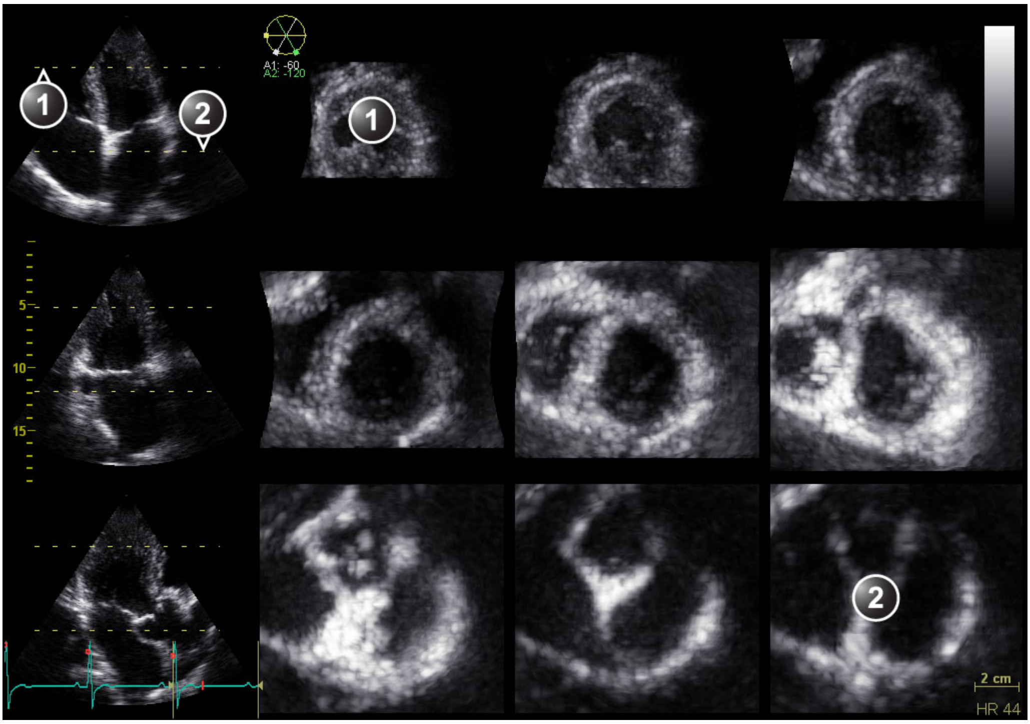
6. On the Control panel, press **Select side** to select another crop plane and make the required adjustments as described above.
7. Press **Crop tool** to exit the cropping mode.

Multi-Slice

Multi-Slice enables simultaneous display of equidistant short axis views generated from an Apical 4D acquisition.

1. Select an Apical 4D acquisition.
2. Press **Multi-Slice**.

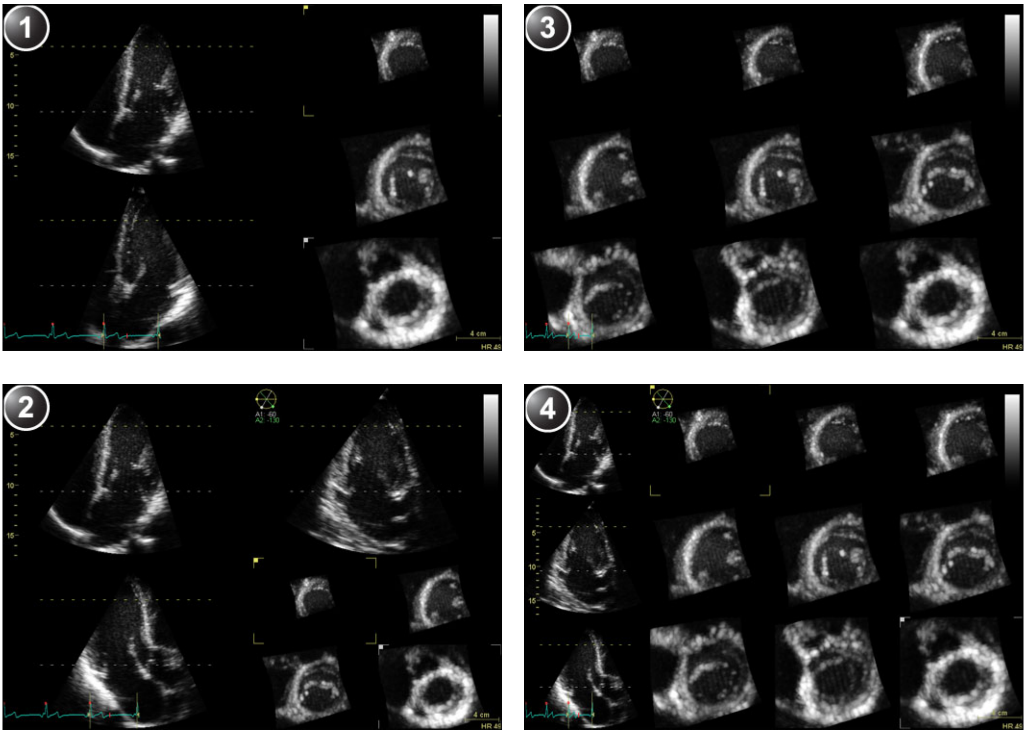
   The *Multi Slice* screen is displayed showing equidistant short axis views (Figure 4-11). The short axis views are evenly distributed and maximized in size for best assessment (e.g image quality, presence and visibility of all walls, stitching artifacts when using real time multi beat acquisition). Apical views are displayed on the left side for orientation purpose.



1. Upper slice
2. Lower slice

Figure 4-11. Multi Slice screen

*NOTE: Press **Layout** on the Control panel or use the dedicated buttons to get the following display alternatives.*



1. 5 Slice
2. 7 Slice
3. 9 Slice
4. 12 Slice

Figure 4-12. Multi Slice alternative displays

If required, apply zoom. All short axis views are zoomed in simultaneously.

3. The following adjustments can be done:
   - Place the cursor in the middle section of the top or bottom slice intersection line in one of the apical views. The cursor is changed to ↕. Drag to change the slicing area.

     Alternatively, adjust **Top** and **Bottom** controls on the Control panel.
   - Place the cursor at one of the extremities of the top or bottom slice intersection line in one of the apical views. The cursor is changed to ↻. Drag to rotate the slices backward/forward and sideways, to align the slices with the anatomical structure.

Alternatively, adjust the **Axis 1** and **Axis 2** controls on the control panel.

- Adjust **Translate** to move all slices up or down.

*NOTE: The default position can be displayed again by pressing **4D Home** on the Control panel.*

4. When imaging the left ventricle, press **Dynamic** on the Control panel. The nine slices display the structure dynamically through the entire heart cycle (only available with thoracic acquisitions).

NOTE: When Dynamic is on the icon is displayed on screen.

NOTE: EchoPAC Software Only: Dynamic Multi-Slice is only available on computer with nVidia graphics card with support for CUDA and with a driver supporting CUDA 2.3 (Not applicable for Turnkey systems).

5. Press **Store** to save.
6. Press **Done** to exit.

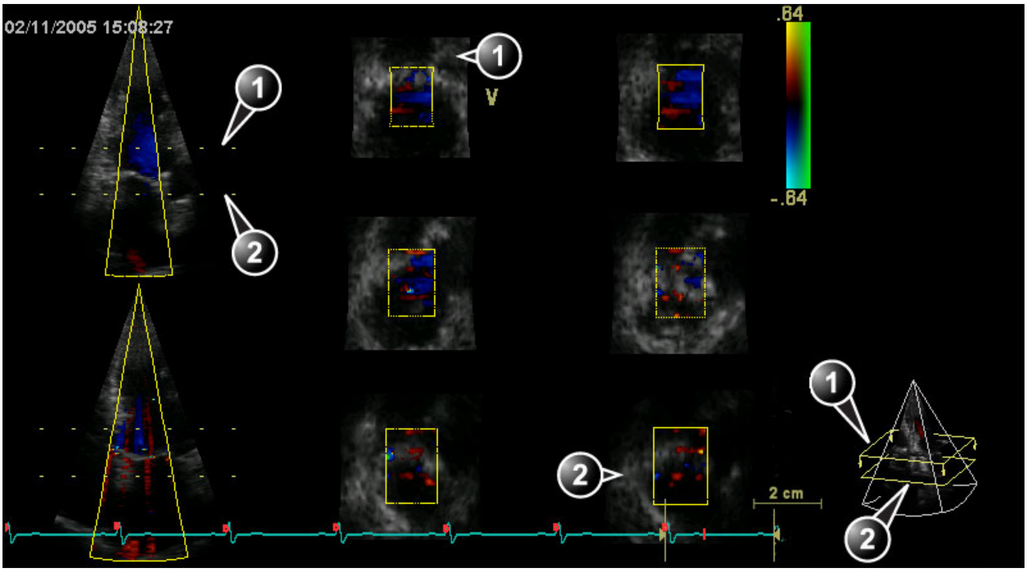
6 Slice

The 6 slice mode is used during live 4D color acquisition or during Freeze/Replay to assess image quality, and stitching artifacts.

6 Slice enables simultaneous display of six equidistant short axis views and two long axis views generated from a 4D Color Flow acquisition.

1. Select an Apical 4D Color Flow acquisition.
2. Press **6 Slice**.

   The *6 Slice screen* is displayed (Figure 4-13). The six slices are evenly distributed across the sector.



1. Upper slice
2. Lower slice

Figure 4-13. 6 Slice screen

If required, zoom in. All short axis views are zoomed in simultaneously.

3. The following adjustments can be done:
   - Place the cursor in the middle section of the upper or lower slice intersection line in one of the views. The cursor is changed to ⇕. Drag to change the slicing area.

     Alternatively adjust **Top** and **Bottom** controls on the Control panel.
   - Place the cursor at one of the extremities of the upper or lower slice intersection line in one of the views. The cursor is changed to ⟲. Drag to rotate the slices backward/forward and sideways, to align the slices with the anatomical structure.

     Alternatively when in Freeze, adjust the **Axis 1** and **Axis 2** controls on the control panel.
   - Adjust **Rotate Z** to rotate all six slices around the center axis.
   - Adjust **Translate** to move all six slices up or down.

*NOTE: The default position can be displayed again by pressing **Clear** on the Control panel.*

4. Press **Store** to save.

5. Press **Done** to exit.

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** in the *Commands* group.
2. In the *Direct report* screen, select the comment type.
3. Type your comments in the *Text* field.
4. To add a measurement in the comment, double-click a measurement in the *Measurement overview* field.

1. Select the type of information
2. Create/insert pre-defined text
3. Text field
4. List of measurements completed
5. Exits the Direct report

```
AVC 367 ms
G peak sys SL(APLAX) -14 %
G peak sys S      C) -11 %
G peak sys S      C) -11 %
G peak sys SL(Avg) -12 %
BS peak sys SL 6 %
```

Figure 4-14. 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 4-15).

Figure 4-15. The Insert text window

   The pre-defined text list is organized in a three level hierarchy. Selecting one item in the first column displays pre-defined text entries related to the selected text in the second and third column.

3. Navigate through the pre-defined text list by selecting items in the columns and double-click on the desired pre-defined text to be inserted. If an entry in the third column is inserted, the selected text in the second column is also inserted.

   Press **More>>** to display the full text for the selected entry.

Creating pre-defined text input

First level

1. Select the first level and press **New**.

   The *Enter new text* window is displayed.

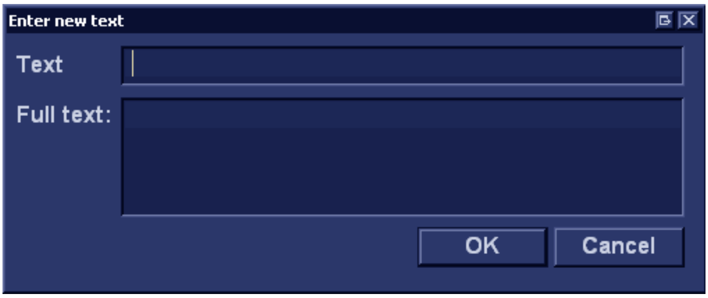


Figure 4-16. The Enter new text window

2. Enter a title in the *Text* field and a pre-defined text in the *Full text* field.
3. Select **OK**.

Second and third level

1. Select an item in the first column, then select either the second or third column and press **New**.

   The *Enter new text* window is displayed.

   The pre-defined text input to be created in the second and third column will be related to this selection only.
2. Enter a title in the *Text* field and a pre-defined text in the *Full text* field.
3. Press **OK**.

Editing a pre-defined text input

1. Select the term to edit in one of the columns.
2. Press **Edit**.

   The *Edit text* window is displayed.
3. Edit the text in both the *Text* and *Full text fields*.
4. Press **OK**.

Deleting a pre-defined text input

1. Select the item to delete in one of the columns.
2. Press **Delete**.

   A *Confirmation* window is displayed.
3. Press **Yes**.

   The selected text input is deleted including the belonging text inputs in the sub-levels.

Saving images and cineloops to a standard format

Images and cineloops can be saved to a removable media or a shared network folder in the following standard formats:

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

Images can also be stored as MPEG format on a CD-R using the Export function as described on page 4-41.

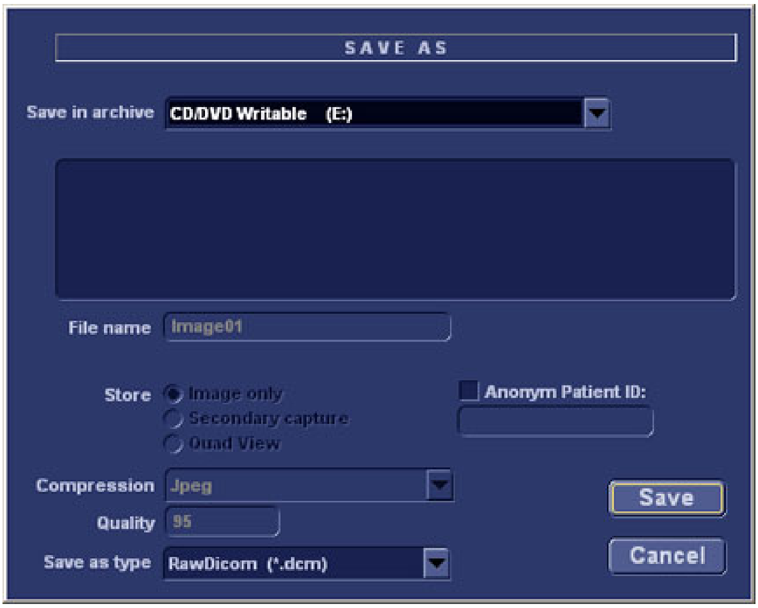
1. In the *Image analysis* screen, select the required image or loop.
2. Press the **Right mouse button**.

   The *System* menu is displayed.

Figure 4-17. The System menu

3. Select **Save as**.

   The *Save as* menu is displayed.



Save in archive: CD/DVD Writable (E:)

File name: Image01

Store: ● Image only ○ Secondary capture ○ Quad View

☐ Anonym Patient ID:

Compression: Jpeg

Quality: 95

Save as type: RawDicom (*.dcm)

Figure 4-18. The Save as menu

4. Select the desired destination 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 active image or cineloop only.
   - Store **Secondary capture**: creates a screen capture of the entire screen.
   - Store **Quad view**: saves all images or cineloop when in quad view.

NOTE: *Store Secondary capture and Quad view are not available when storing RawDICOM.*

7. Select the image compression type (JPEG or Rle) 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.
- **MPEG**: saves the still image or cineloop in MPEG format.
- **AVI**: saves the cineloop in AVI format.
- **HDF**: saves the image or cineloop in HDF (Hierarchical Data Format). HDF is a portable data format for exchange of scientific numerical and graphical data. More information about HDF format at: http://www.hdfgroup.org/.

  A tool for viewing HDF files can be downloaded from http://www.hdfgroup.org/hdf-java-html/hdfview/.

10. Press **Save**.

    A file is saved in the selected archive.

MPEGVue/eVue

MPEGVue/eVue enables the user to export or save an exam (images, measurements and reports) into MPEG format readable from a regular Windows computer together with a special MPEG viewer. The measurements performed during the exams are stored as an Excel file, the saved report as Compiled HTML format.

Creating a MPEGvue exam

1. Export the actual patient record as described on page 3-24.

   Make sure to select **MPEGvue** as export destination.

Reviewing a MPEG exported exam

A MPEG exam can be read from any computer with Windows 98/2000/XP/7, provided that DirectX 8.1 or later and Windows Media Player 7.1 or later are installed.

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* window displays an error.

From the DICOM spooler the user can also:

- **Delete** non-active jobs
- **Resend** a job that has failed or is in hold
- **Send** a job that has failed or is in hold, to a new destination
- **Hold** a job that is not active.

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

- **Pending**: the job is complete, waiting to be active.
- **Hold**: the job is complete, but suspended, waiting for an user action.
- **Append**: the job is incomplete, waiting for more images (Direct store function).
- **Active**: the job is complete and connected to the destination device.
- **Failed**: the job is complete but one or more images failed to transmit to the destination device.
- **Done**: the job is saved to the destination device. The jobs that are done are removed from the spooler after a few minutes.

Starting the DICOM spooler

1. Press **Alt** + **S** on the alphanumeric keyboard.

   The *DICOM spooler* window is displayed (see Figure 4-19).

   The *DICOM spooler* window is automatically updated. Press **Refresh** to update the information displayed at any time.

Figure 4-19. The DICOM job spooler window

Deleting a job

1. Select the job(s) to delete in the *DICOM job spooler* window.

NOTE: *Only non-active jobs can be deleted.*

2. Press **Delete**.

Resending a job

1. Select the job(s) to re-send in the *DICOM job spooler* window.

NOTE: *Only jobs that failed or are in hold can be resent.*

2. Press **Resend**.

Sending a job to a new destination

1. Select the job(s) to send in the *DICOM job spooler* window.

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

2. Press **Send to...**.

   A dialogue window is displayed.
3. Select the new destination from the *Destination* pull-down menu.
4. Press **Send**.

Holding a job

1. Select the job(s) to hold in the *DICOM job spooler* window.

NOTE: *Only inactive jobs can be set on hold.*

2. Press **Hold**.
3. To undo hold, press **Resend**.

4D LV volume and 4D RV volume

The 4D LV function and the 4D RV function may be analyzed on the EchoPAC Software Only using the TomTec 4D LV volume and 4D RV volume applications. These applications enable analysis of global and regional volume measurements. These applications are options to the EchoPAC Software Only.

Measurements from the 4D LV volume and 4D RV volume applications are available in the worksheet after completing the analysis.

In addition 4D tissue acquisitions can be stored on a removable media to a format compatible with the TomTec workstation, using the Save as function on the EchoPAC Software Only (File format: VolDicom (*.dcm)).

Starting the 4D LV volume and the 4D RV volume applications from EchoPAC Software Only

1. Open a 4D tissue acquisition.

   The *Volume rendering* screen is displayed.
2. Press **Measure**.
3. Select **Volume/4D LV volume (TomTec)** or **Volume/4D RV volume (TomTec)**.

   The corresponding application is started.

   Refer to the TomTec User manual for proper use of the application.

NOTE: *EchoPAC Software Only is not accessible while running these applications.*

4D MV-Assessment

The morphology and function of the mitral valve can be assessed in 4D transthoracic and transesophageal acquisitions using the TomTec 4D MV-Assessment application. This application is an option to the EchoPAC Software Only.

Measurements from the 4D MV-Assessment application are available in the worksheet after completing the analysis. The number of parameters displayed in the worksheet may vary depending on the steps that were completed during the 4D MV-Assessment analysis.

In addition, 4D tissue acquisitions can be stored on a removable media to a format compatible with the TomTec workstation, using the Save as function on the EchoPAC Software Only (File format: VolDicom (*.dcm)).

Starting the 4D MV-Assessment application

1. Open a 4D tissue acquisition.
2. Press **Measure**.
3. Select **Valve/4D MV-Assessment**.

   The 4D MV-Assessment application is started.

   Refer to the TomTec User manual for proper use of the application.

   Measurements will only be transferred to the worksheet if the option to save data is selected when ending the 4D MV-Assessment application.

NOTE: *EchoPAC Software Only is not accessible while running this application.*

Configuration – Imaging

Global imaging settings

1. Press **Config** (**F2**) and log on if required.
2. Select **Imaging/Global**.

Titlebar Line 1: Last, FirstName

Titlebar Line 2: Birth date

☐ Anonymous patient

☐ Enable Polarized Stereo Support

☐ When showing more than two images

☐ Show kHz scale

Figure 4-20. The Global sheet

Parameter	Description
Crop images	In the *Analysis screen*, removes top and bottom of the image when more than two images have been selected.
Doppler	• **Show KHz scale**: when selected, displays the KHz scale on the left side of the Doppler spectrum.

Parameter	Description
Patient Info	• **Title bar Line 1 & 2**: selects from the drop-down menu the patient information to display on the *Title bar*. • **Anonymous patient**: when checked, no patient information is displayed on the *Title bar*.
Stereo vision	☑ **Enable Polarized stereo support**: polarized stereo vision is enabled. ☐ **Enable Polarized stereo support**: anaglyph stereo vision is enabled. See ‘Stereo vision’ on *page 4-24* for more information.

Chapter 5

Measurements and analysis

This chapter describes:

Introduction

The ultrasound unit provides functionality for two measurement conventions:

- **Assign and Measure (Measure Protocols)**: the user selects a study consisting in a set of pre-labeled measurements related to the active scanning mode and clinical application. The user is prompted through the measurements in the order of the measurement labels. This convention is started from the **Measure** button on the control panel. A set of tools is implemented to make the measurement process as fast and easy as possible for the user:
    - The user is guided through the study: an auto-sequence functionality automatically selects the next measurement in a study.
    - The selected measurement is highlighted in the *Measurement* menu.
    - The performed measurement is indicated in the *Measurement* menu.

The studies and their parameters are user-configurable. The user can create its own studies containing the relevant measurements (see page 5-74).

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

CAUTION

Only assigned measurements are saved when ending the examination.

After doing measurements, the system automatically makes the calculations related to the measurements performed. Measurements and calculations are displayed in the *Measurements result* table (see page 5-94).

Assigned measurements and calculations are automatically gathered into a Worksheet and used to populate the patient report.

General recommendations about measurements

- When doing time-measurements in Doppler or M-Mode, it is recommended to freeze the 2D image during acquisition.
- Distance and area measurements should be done on greyscale 2D images or slice mode images if in 4D, not on color flow or TVI-based images. Similarly, in M-Mode, distance measurements should be done on greyscale M-mode images and not on color M-mode images. If doing Color M-Mode measurements of propagation of flow, please refer to your specific laboratory protocols.

Measurements on multi beat 4D acquisitions

Multi beat 4D acquisitions are based on ECG gated acquisition of at least two sub-volumes.

ECG gated acquisition may by nature contain artifacts, that may have impact on the measurements.

Artifacts may be caused by:

- Movements of the probe caused by the operator during acquisition.
- Movements of the patient during acquisition, including movements caused by respiration.
- Irregular heart rate during acquisition.

To validate the acquisition, press **Multi-Slice** and perform a visual inspection. Stitching artifacts are shown as visible transitions between the sub-volumes (Figure 5-1).

It is recommended to specify in the Comments for the examination that the measurements are performed on a Multi-beat 4D acquisition.

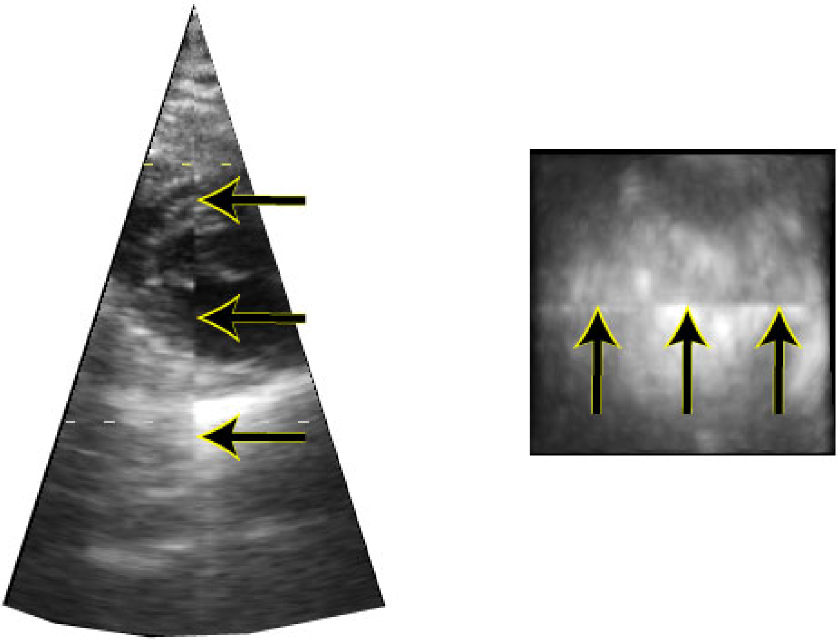


Figure 5-1. Stitching artifacts

About Measurement results display

Be aware of the following:

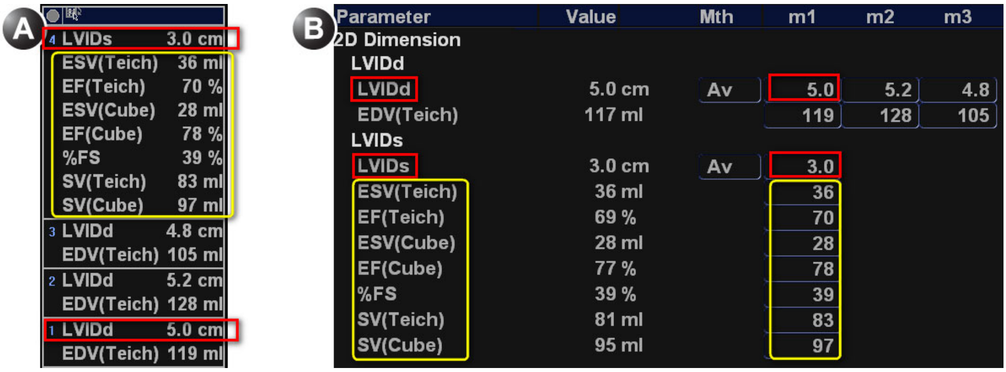
- Measurement results display

  By default the system always displays absolute values for parameters measured in Doppler. This means that values from above and below baseline will all be displayed as positive results.

  For Cardiac this behavior cannot be changed. For non-Cardiac the Absolute Value setting can be turned off in **Config** -> **Meas/Text** -> **Advanced**, by setting the attribute **Absolute Value** to Off.
- Calculated parameters

  For calculated parameters the system uses signed values in calculation formulas, and displays the absolute value of the result.
- When a parameter is measured several times the individual values for the parameter will be listed in the m1, m2... columns in the worksheet. The *Value* column in the worksheet will contain a derived value for the parameter, e.g. the average of the individual values (Figure 5-2).

When calculating formula derived parameters, the m1, m2... columns in the worksheet contain calculated values based on the individual input parameter values in the same column (Figure 5-2). The *Value* column contains calculated values based on the input parameter values in the *Value* column.



4	LVIDs	3.0 cm
	ESV(Teich)	36 ml
	EF(Teich)	70 %
	ESV(Cube)	28 ml
	EF(Cube)	78 %
	%FS	39 %
	SV(Teich)	83 ml
	SV(Cube)	97 ml
3	LVIDd	4.8 cm
	EDV(Teich)	105 ml
2	LVIDd	5.2 cm
	EDV(Teich)	128 ml
1	LVIDd	5.0 cm
	EDV(Teich)	119 ml

Parameter	Value	Mth	m1	m2	m3
2D Dimension					
LVIDd					
LVIDd	5.0 cm	Av	5.0	5.2	4.8
EDV(Teich)	117 ml		119	128	105
LVIDs					
LVIDs	3.0 cm	Av	3.0		
ESV(Teich)	36 ml		36		
EF(Teich)	69 %		70		
ESV(Cube)	28 ml		28		
EF(Cube)	77 %		78		
%FS	39 %		39		
SV(Teich)	81 ml		83		
SV(Cube)	95 ml		97		

Figure 5-2. Measurement result window (A) and Worksheet (B)

The *Measurement result* window always displays values from the m1, m2... columns.

It is therefore recommended to consult the worksheet (see page 8-1) to get an overview of measured and calculated parameters.

Assign and Measure modality

1. Measurement category for the current application
2. Study
3. Opened study
4. Performed measurement
5. Pre-selected measurement

Figure 5-3. Example of a measurement study

1. Press **Measure** on the control panel.

   The *Measurement* menu is displayed, showing the measurement category for the current application (Figure 5-3).

   The cursor is in the scanning window, ready for a caliper measurement.

To change Measurement category:

1. Select the heading in the *Measurement* menu and choose another category.

To perform measurements from a study:

1. Select a study (folder).

The study folder is opened and the first measurement is selected.

2. Perform the measurement. Follow the instructions displayed on screen.

   Make sure to follow the current medical practices when placing the specific points on the image.

   If the folder is configured with auto-sequence measurement (see page 5-75), the next measurement in the study is pre-selected. To skip a pre-selected measurement, select another measurement.

   Completed measurements are marked with a check mark.

Measure and Assign modality

1. Press **Caliper** on the Control panel and select the desired measurement tool.

   Or

   Press **Measure** and select the desired measurement tool in the *Generic* folder in *Measurement* menu.

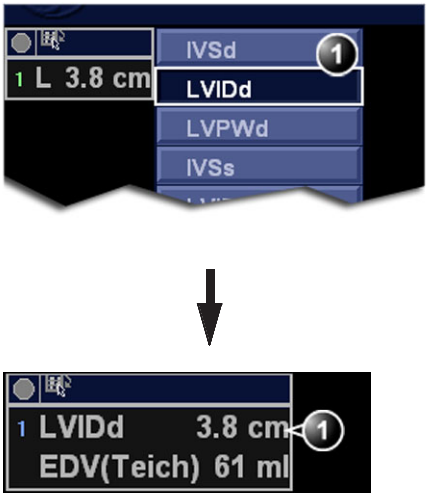
Figure 5-4. Measurement tools

2. Perform the measurement. Follow the instructions displayed on screen.

   Make sure to follow the current medical practices when placing the specific points on the image.

NOTE: The system supports up to 15 separate measurements per M&A session. When exceeding this limit the measurements are still correct but will no longer have unique labelling for the tool graphics and results.

3. To assign a label, select the measurement in the *Measurement result* table and select the required label.



1. Label menu

Assignment

1. Assigned measurement

Figure 5-5. Measurement assignment

Measurements on volume renderings

Distance and area measurements can be done on 4D volume renderings from a 4D acquisition.

1. Perform a distance or area measurement on a 4D acquisition by selecting either **Distance (Crop plane)** or **Area (Crop plane)** measurement tool.

CAUTION

When measuring on a volume rendering, the measurement is actually performed on the displayed crop plane and the depth information is NOT taken into account.

It is recommended to use parallel crop (see ‘Parallel cropping’ on *page 4-26*) with a short distance between the crop planes.

Be aware that the Gain adjustment (2D and 4D Gain) may impact the display of the anatomical structures to measure.

Measurements on protocol images

When performing measurements on images acquired in a protocol, the measurement results will be associated with the protocol level of the image. Average values will be calculated for each protocol level.

For example you may measure LVOT Diam for images acquired outside protocol and for images on each level of an Exercise 2x4 protocol, leading to the following results in worksheet:

Parameter	Value	Method	m1	m2
LVOT Diam	1.0 cm	Average	1.1	0.9
LVOT Diam, Rest	1.1 cm	Average	1.0	1.2
LVOT Diam, Peak	1.2 cm	Average	1.2	

⚠ CAUTION

Measurement results associated with a stress level will not be updated if the image is moved to another stress level at a later time. Images should be correctly placed in the protocol when performing measurements.

Advanced cardiac measurements and analysis

Event timing measurements

Event timing can be performed on a Doppler spectrum or an M-Mode acquisition showing the corresponding valves. The procedure is similar in both modes. In addition event timing can be done on traces in Q Analysis. The measurements are shown as dashed lines in the *Analysis* window and *Anatomical M-Mode* window in Q Analysis.

Event timing enables the time measurement for opening and closure of the Aortic and Mitral valves, as referred to the automatically detected QRS marker, which normally is on the rising slope of the R-wave.

1. Select the spectrum or M-Mode image to be measured.
2. Press **Measure** on the Control Panel.
3. Select **Event Timing** in the *Measurement* menu.

   The following event timing measurements are available (with the first measurement on the list selected):

   - **AVO**: Aortic Valve Opening
   - **AVC**: Aortic Valve Closure
   - **MVO**: Mitral Valve Opening
   - **MVC**: Mitral Valve Closure

4. Place the cursor to the corresponding point on the spectrum for the selected measurement.
5. Press the **Left mouse button** to anchor the point.

   The event timing measurement (ms) is displayed in the *Measurement result* table.

   When an event timing measurement is performed, the QRS markers are displayed on the ECG trace and correct QRS marker position should be verified before the Event Timing measurements are performed.

TSI Measurements

Each sample in the TSI image represents the time to the maximum velocity within the chosen TSI search interval from TSI Start to TSI End.

The TSI search interval may be adjusted as follows:

1. Press **Config** (**F2**) and select the category **Measure/Text**.
2. In the *Measure* category, select the sheet **Advanced**.
3. In the *Application specific parameters* section adjust TSI start and TSI end parameters by selecting a new value from the combo menu displayed upon selection.

There are two automatic TSI time to peak measurement tools:

- **Generic TSI Time to peak measurement**: displays the TSI value at the location point set by the user.
- **Segmental TSI Time to peak measurement**: measures the time to peak velocity in specific wall segments and gets automatically calculated TSI indexes based on these measurements. The measurements may be presented in a color coded Bull's eye diagram.

Alternatively, time to peak measurement can be done in Q Analysis by manually measuring the time between the QRS marker and the peak velocity on the velocity trace.

CAUTION

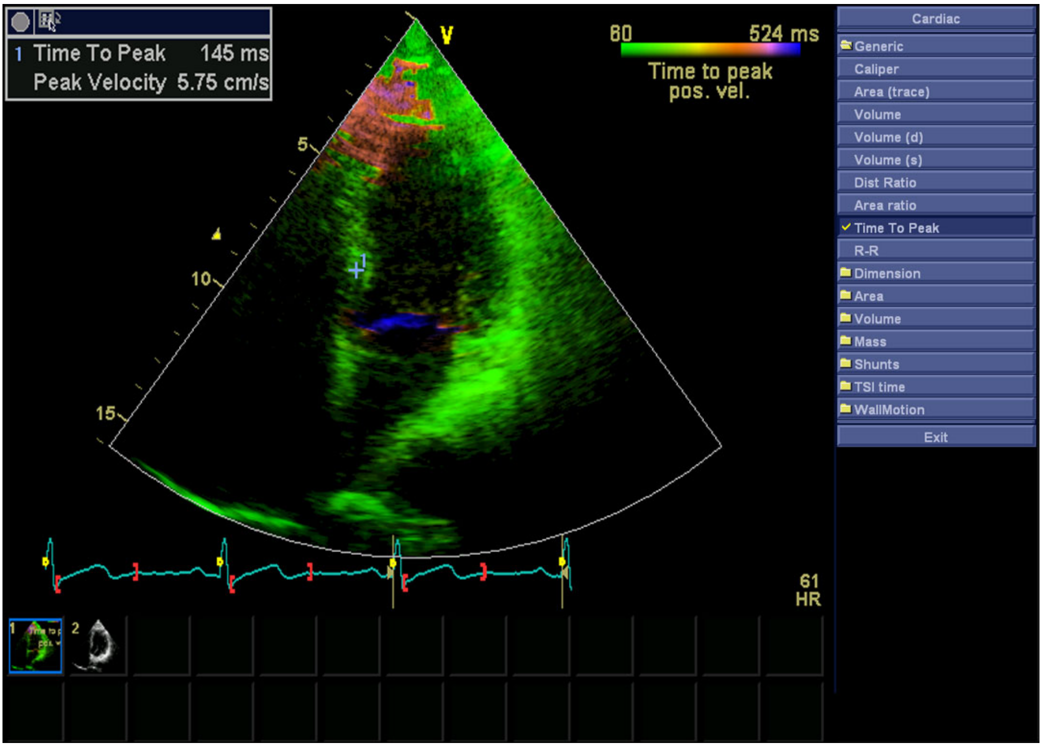
TSI is only recommended for adult cardiac images acquired with the following probes: M5Sc-D, M5S-D, 6T, 6Tc, 3V-D, 4V-D or 6VT-D. The measurement accuracies of the TSI time-to-peak values reported in the Reference manual are verified with these probes.

Generic Time to peak measurement

1. Open a TSI apical loop.
2. Press **Measure**.
3. In the *Measurement* menu, select **Generic** and **Time to peak** (see Figure 5-6).

   The TSI loop freezes at the TSI end frame.
4. Place a point in the middle of a basal or mid-level myocardial segment in the TSI image.
5. The Time to peak value for the segment is displayed in the *Measurement result* window.

NOTE: *To judge the quality of your data at the measuring point in the 2D image the TSI trace may be used (see 'TSI trace' on page 5-15). See also the Caution text on page 5-18.*



1 Time To Peak 145 ms
Peak Velocity 5.75 cm/s

Figure 5-6. TSI Generic Time to peak measurement screen

Segment Time to peak measurements

1. Open TSI loops from all three apical views.
2. Press **Measure** and select the **TSI time** study.

   The TSI loop freezes at the TSI end frame.

   The first measurement in the study is automatically selected (see Figure 5-7).
3. Place a point in the middle of the corresponding segment in the TSI image.

   The Time to peak and the Peak velocity for the segment are displayed in the *Measurement result* window.
4. Perform a measurement for all basal and mid-level segments in all three apical views.

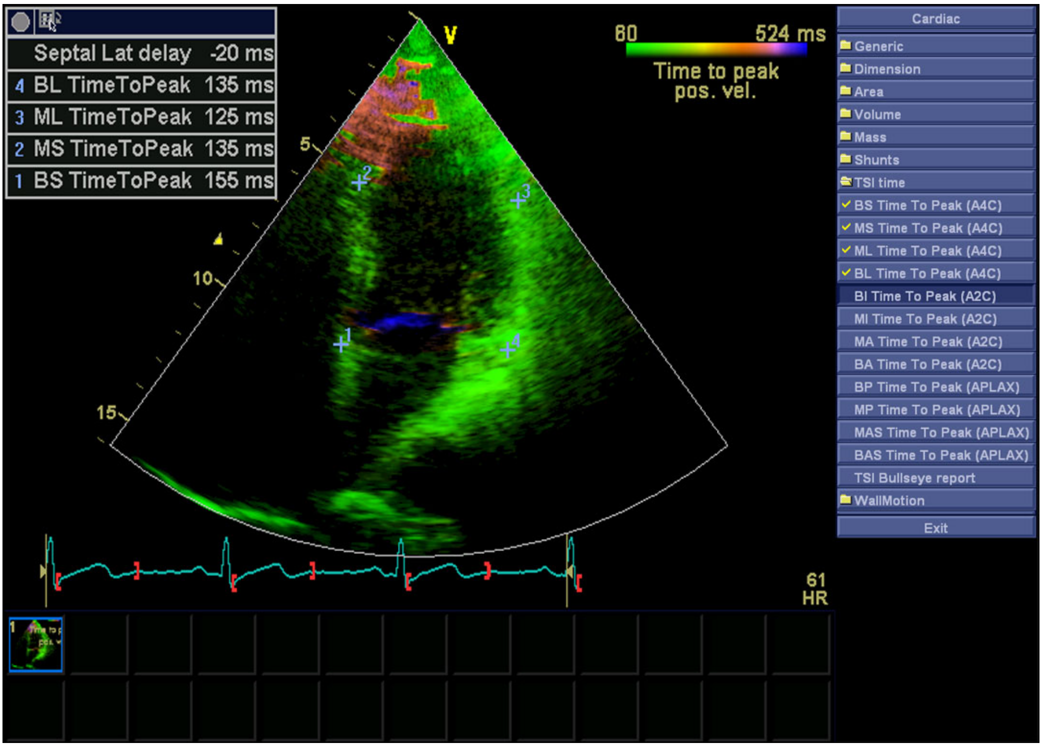
   In addition to the Time to peak and the Peak velocity for each segment, the following TSI indexes are calculated:

- *Septal lateral delay*: difference in Time to peak velocity in the basal lateral wall and basal septum.
- *Septal posterior delay*: difference in Time to peak velocity in the basal posterior wall and the basal antero-septum.
- *Basal seg. max diff.*: difference between the maximum and minimum time to peak measurements in the six basal segments. Requires at least four of the six basal segment measurements.
- *Basal standard deviation*: the standard deviation of the time to peak measurements in the six basal segments. Requires at least four of the six basal segment measurements.
- *All seg. max diff.*: difference between the maximum and minimum time to peak measurements in all the measured basal and mid level segments. Requires at least eight of the twelve segmental measurements.
- *All segments standard deviation*: the standard deviation of the time to peak measurements in all measured basal and mid level segments. Requires at least eight of the twelve segmental measurements.

The TSI indexes indicate degrees of asynchrony in time to peak velocity

5. Select **TSI Bull's eye report** in the *Measurement* menu.

   The measurements are displayed in a color coded bull's eye diagram together with a list of the calculated TSI indexes.



Septal Lat delay -20 ms
4 BL TimeToPeak 135 ms
3 ML TimeToPeak 125 ms
2 MS TimeToPeak 135 ms
1 BS TimeToPeak 155 ms

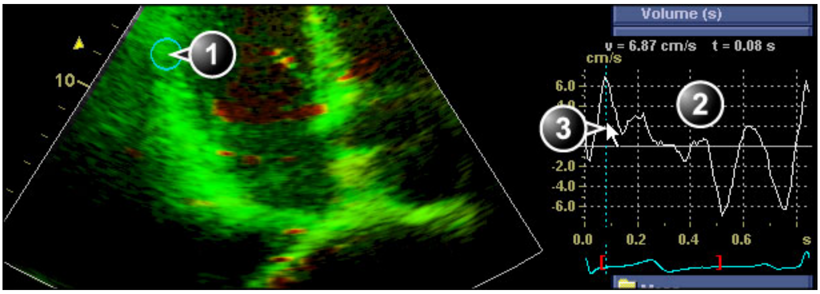
Figure 5-7. Segment Time to peak measurements screen

TSI trace

The TSI Time to peak measurement can be verified and eventually manually changed from the TSI trace.

1. Double click on the measurement point.

   The ROI and the corresponding TSI curve are displayed (see Figure 5-8).
2. Press the Left mouse button to anchor the ROI and trace.
3. If required, select a new peak location in the trace.
4. Click in the acquisition window to exit the TSI trace.



1. TSI ROI
2. TSI trace
3. TSI Time to peak marker

Figure 5-8. TSI trace

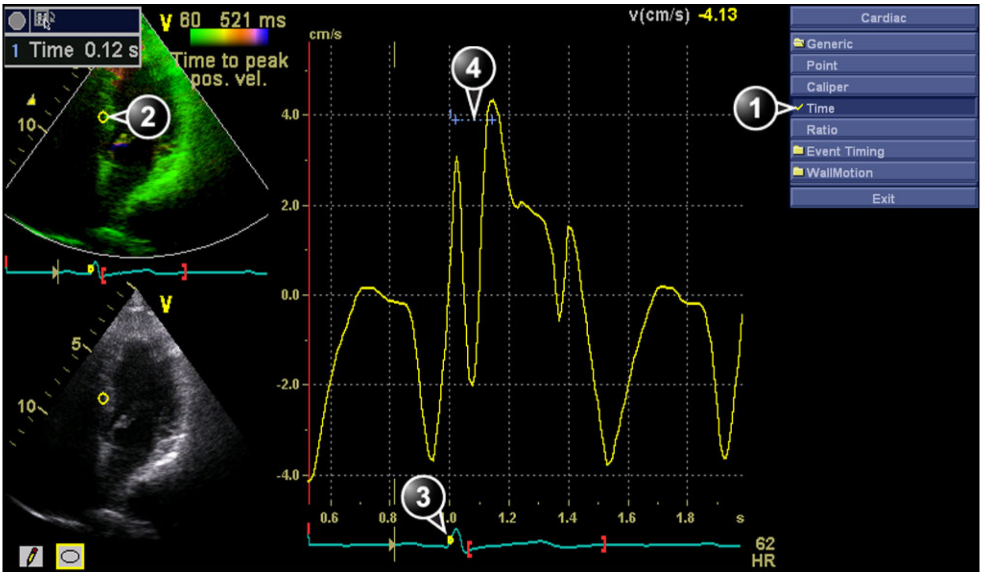
Time to peak measurement in Q Analysis

1. From a TSI apical loop, press **Q Analysis**.
2. Place a sample area in a myocardial segment.

   A velocity trace is displayed in the *Analysis* window (see Figure 5-9).
3. Press **Measure**.
4. In the *Measurement* menu, select **Generic** and **Time**.

NOTE: *If **Time** is not available in the Generic folder, Press **Active Mode** on the Control panel.*

5. In the *Analysis* window, measure the time from the yellow QRS marker to the peak velocity of the velocity trace.



1. Time measurement tool
2. Sample area
3. QRS marker
4. Time to peak measurement

Figure 5-9. Manual TSI Time to peak measurement in Q Analysis

NOTE: It is possible to do a Generic or a Segment Time to peak measurement from within Q Analysis and compare the result with a manual Time to peak measurement. To access the corresponding measurement tool in Q Analysis you may have to press ***Active mode*** *to display the relevant Measurement menu.*

CAUTION

The Time to peak measurement in Q Analysis may differ from the TSI Time to peak measurements due to the following considerations:

- The TSI Time to peak measurements find the maximum velocity only within the TSI search interval. If the desired peak on the velocity trace is outside the TSI search interval, the TSI Time to peak measurements will return a different result than the manual Time to peak measurement.
- If the maximum velocity is at one of the ends of the TSI search interval, the TSI time to peak measurements return the time of the end of the TSI search interval. In some cases the falling flank of an iso-volumic contraction peak at the time of TSI Start or the rising flank of a post-systolic contraction peak at the time of TSI End may be detected. In a manual measurement the time to a peak within the TSI search interval with a lower velocity than the velocity at the end of the interval may be measured instead. The color map *TSI Trace* may be used to identify regions in the image where the peak detection is near the ends of the TSI search interval. The TSI Trace tool should be used to verify TSI measurements in the identified regions.
- If there are two or more peaks of comparable velocity within the TSI search interval, or a poor signal quality, the TSI Time to peak measurements may return the time to a different peak than what a manual method would do. Typically in these situations, the TSI image will show a wide range of colors over a small spatial region.

Automated Function Imaging

Automated Function Imaging (AFI) is a decision support tool for regional assessment of the LV systolic function. AFI is a tool derived from 2D Strain, which calculates the myocardial tissue deformation based on feature tracking on 2D grey scale loops.

AFI is performed on apical views in the following order: apical long-axis, 4-chamber and 2-chamber view, following an on screen guided workflow (see also Figure 5-10). The apical views may be acquired sequentially in 2D mode, or simultaneously in Tri-plane mode.

AFI is also available for standard apical views acquired with a TEE probe.

The result is presented as a Bull's eye display showing color coded and numerical values for peak systolic longitudinal strain.

The result can also be presented as a Bull's eye with a score index (Auto scoring).

All values are stored to the worksheet. In addition, Global Strain for each view, Average Global Strain for the whole LV and the Aortic Valve Closure time used in the analysis are stored to the worksheet.

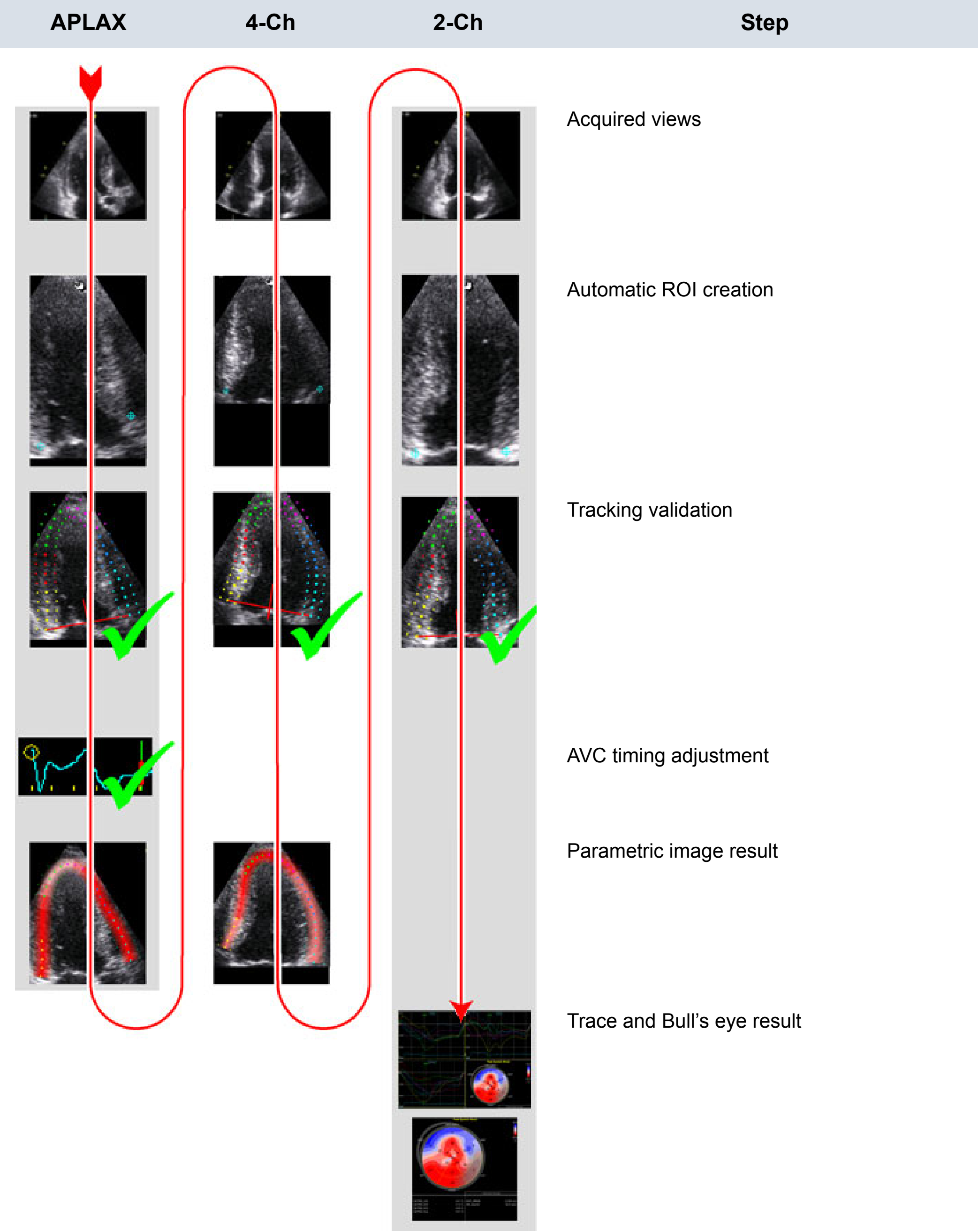


Figure 5-10. AFI workflow

Acquisition

CAUTION

AFI is only recommended for adult cardiac images acquired with the following probes: M5Sc-D, M5S-D, 6T, 6Tc, 3V-D, 4V-D or 6VT-D. The measurement accuracies of the longitudinal strain values reported in the Reference manual are verified with these probes.

Automated functional Imaging is performed on 2D grey scale cineloops of an Apical long axis (APLAX) view, an Apical 4 chamber view and an Apical 2 chamber view.

The views can be acquired either sequentially in 2D mode or simultaneously in Tri-plane mode.

For optimal result the acquisitions should conform to the following recommendations:

- All three apical views should be acquired sequentially in order to get similar heart rate in all views.
- The frame rate should be between 40 and 80 frames per second. A higher frame rate is recommended for high heart rate.
- The scanner should be configured to store 100 ms before and after each heart cycle.
- The entire myocardium should be visible.
- The acquisitions should have a depth range that cover the entire left ventricle.

Starting AFI

Starting AFI from sequential acquisition

1. Open an APLAX view and press **Measure**.
2. In the *Measurement* menu, select **AFI**.

   The *View selection* menu is displayed (see Figure 5-11).

Figure 5-11. Measurement and View selection menus

Starting AFI from simultaneous acquisition (Tri-plane acquisition)

1. Open a Tri-plane acquisition and press **Measure**.
2. In the *Measurement* menu, select **AFI**.

   The AFI application is started displaying the APLAX view.

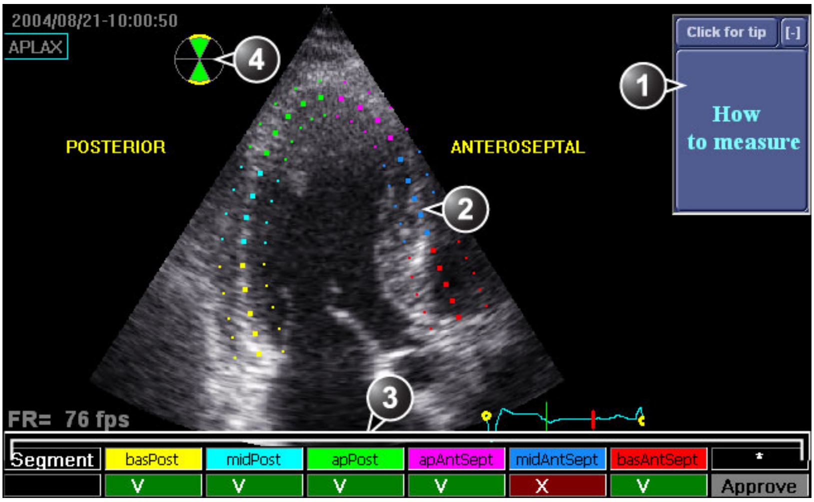
CAUTION

When performing AFI on all three apical views, the user is asked to start with the APLAX view. This allows manual adjustment of the Aortic Valve Closure (AVC) event timing that is used in the calculation of the longitudinal systolic strain in all apical views.

AFI on the APLAX view

1. Select **APLAX** in the *View selection* menu.

   A ROI following the endocardium is created and the *Tracking validation* screen is displayed.



Segment	basPost	midPost	apPost	apAntSept	midAntSept	basAntSept	*
	V	V	V	V	X	V	Approve

1. Display Quick Tips on tracking quality assessment
2. The ROI divided in segments
3. The Scoring table
   - ✓ : acceptable tracking
   - X : not acceptable tracking
4. Bull's eye icon:
   - Green sectors with yellow border: views being analyzed.
   - Green sectors: views already analyzed.
   - Black sectors: views not analyzed.

Figure 5-12. Tracking validation screen

2. Pay attention on the left/right orientation of the image: compare the LV wall names with a visual inspection of the image.

   If the image orientation is wrong create a new ROI manually as described in the section 'To create a new ROI' on *page 5-26*. Make sure to place the basal points correctly relative to the image landmarks when defining the ROI.

NOTE: *You may alternatively exit AFI, invert the image and start AFI again.*

The ROI is divided into segments. The tracking quality for each segment is automatically evaluated and summarized in the *Scoring* table (see Figure 5-12).

The tracking for each segment must be visually controlled and validated as described below.

Tracking validation

CAUTION

Poor tracking quality may lead to incorrect measurement results. The tracking for each segment must be visually controlled and validated.

The tracking for each segment must be visually controlled and validated. Poor tracking quality could result from a variety of causes. Select **Quick tips** (see Figure 5-12) to get tips on the most common causes for bad tracking. The common causes for bad tracking are:

- Erroneous placement of the basal points when defining the ROI. If the basal points are placed too far from the annular region, the ROI segments at the annular base will not move together with the underlying 2D image throughout the entire heart beat (see example cineloops in the Quick tips).
- Erroneous placement of the apex point when defining the ROI. The point should be placed so that the resulting ROI covers mainly the myocardium. If the apex point is placed too high, the ROI will mainly cover the epicardium resulting in poor tracking (see example cineloops in the Quick tips).
- Too narrow ROI width. Narrowing the ROI too much will result in poor tracking due to lack of tissue data in the ROI (see example cineloops in the Quick tips).
- Too much clutter. Images with too much static clutter will result in poor tracking (see example cineloops in the Quick tips).

1. Inspect each segment and make sure that the center line is moving together with the underlying 2D image.

   The tracking quality is automatically evaluated for each segment and displayed in the *Scoring* table.

   The tracking in each segment is scored as either Acceptable (✓) or Not acceptable (X).

   If the tracking needs to be improved for some segments, the user can modify the ROI or create a new ROI as described in ‘ROI adjustment’ on *page 5-25*.

   The user may override the tracking quality evaluation done by the system by clicking on the evaluation result in the *Scoring* table.

2. Once the tracking quality has been controlled for all segments, press **Approve** in the *Scoring* table.

   The user is asked to confirm or adjust the AVC timing setting (see ‘Timing validation’ on *page 5-30*).

ROI adjustment

If the automatic ROI is not optimal resulting in poor tracking, the user can either adjust the ROI or create a new ROI as described below.

To adjust the ROI

1. Press **Recalc**.
2. The following adjustments can be done to the existing ROI:
   - Adjust **ROI Width**.
   - Adjust the shape of the existing ROI: move the cursor over the inner ROI border, select an anchor point and move it to a new location. The shape of the ROI is updated accordingly.

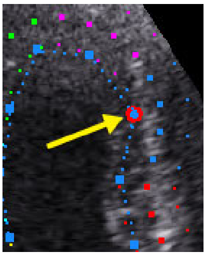
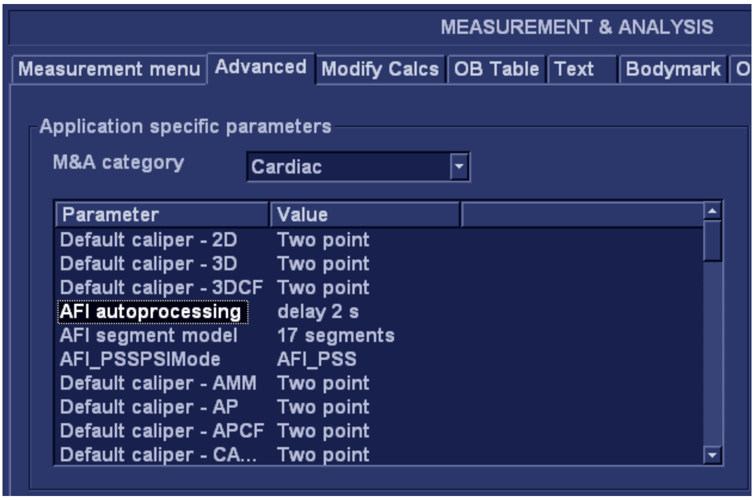


Figure 5-13. Selected anchor point on the inner ROI border

Data processing is started automatically if the cursor is not moved for a few seconds.

NOTE: *If the ROI needs to be adjusted make sure to make the changes immediately after the ROI is displayed.*

NOTE: *The auto processing function is configurable (from **Config/Meas-Text/Advanced/AFI auto processing**).*



Application specific parameters

M&A category: Cardiac

Parameter	Value
Default caliper - 2D	Two point
Default caliper - 3D	Two point
Default caliper - 3DCF	Two point
AFI autoprocessing	delay 2 s
AFI segment model	17 segments
AFI_PSSPSIMode	AFI_PSS
Default caliper - AMM	Two point
Default caliper - AP	Two point
Default caliper - APCF	Two point
Default caliper - CA...	Two point

Figure 5-14. AFI auto processing configuration

The *Tracking validation* screen is displayed.

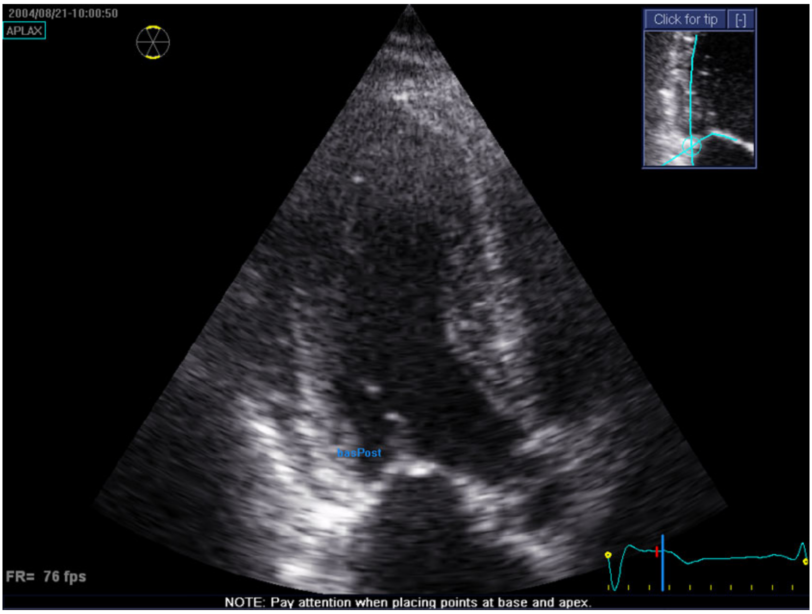
3. Perform Tracking validation (see ‘Tracking validation’ on *page 5-24*).

To create a new ROI

1. Press **Recalc**.
2. Press **New ROI** to re-define the ROI.

   The system automatically displays a frame where the endocardial border is usually clearly visible. To use another frame, adjust **Ref frame**.
3. To define a ROI, place three points at the endocardial border; two annular points and one at the apex (see Figure 5-15). Follow the indications displayed next to the pointer and on the *Status bar* when placing the three points.

NOTE: The Yo-yo function is turned on to help find correct location for the points.



NOTE: Pay attention when placing points at base and apex.

Figure 5-15. Defining a ROI

After placing the apex point the ROI is displayed.

NOTE: *Correct ROI definition is important for an accurate strain measurement. The system has an adaptive ROI function: using the endocardial three points as a guide, the system will analyze the image and automatically adapt the ROI to an optimal position.*

Data processing is started automatically if the cursor is not moved for a few seconds.

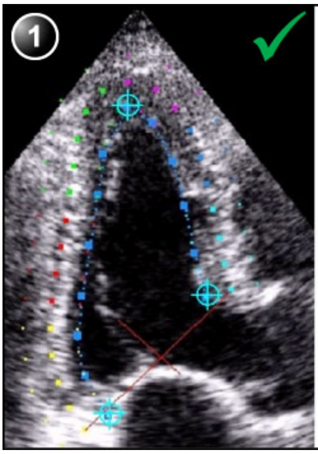
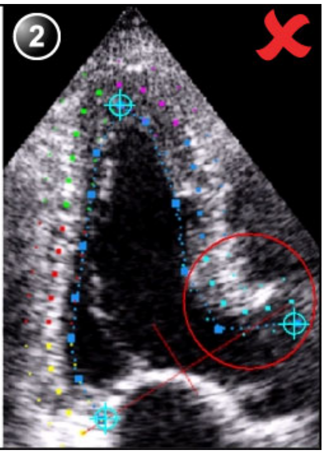
The *Tracking validation* screen is displayed.

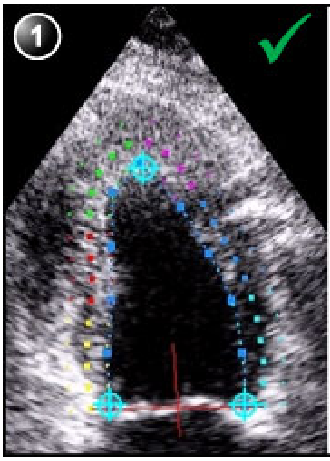
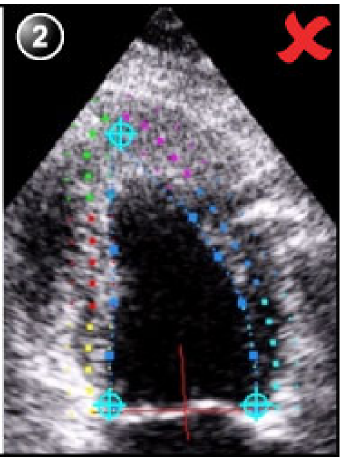
4. Perform Tracking validation (see 'Tracking validation' on *page 5-24*).

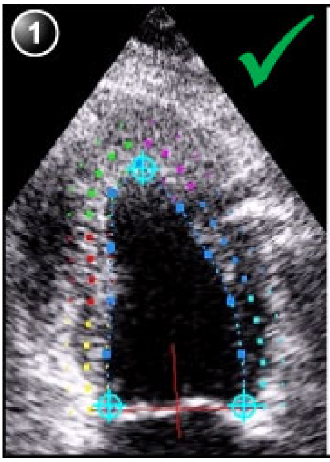
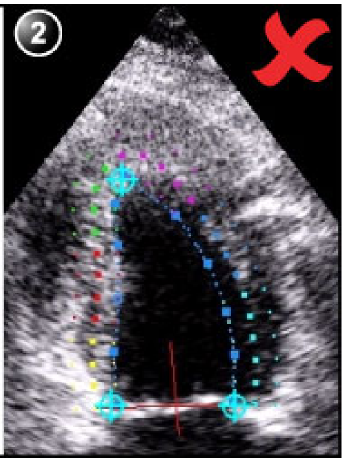
Quick tips when re-creating the ROI

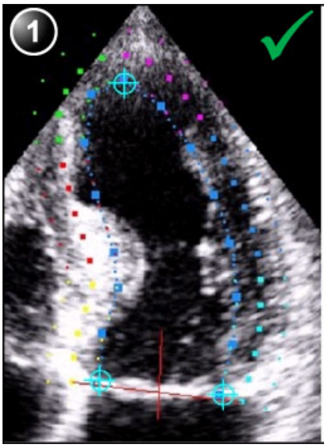
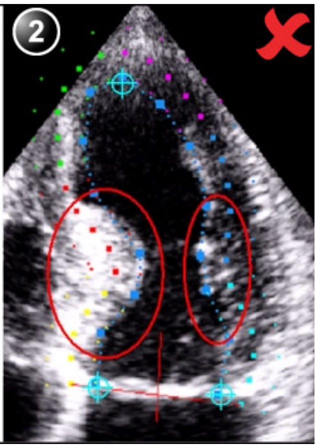
Correct ROI definition is crucial to get good tracking. Refer to the example displayed in the *Tip* window for correct point placements. To display additional guidelines, select **Click for**

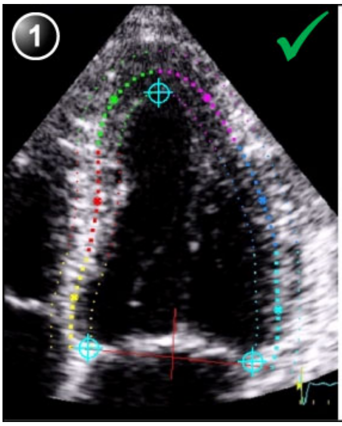
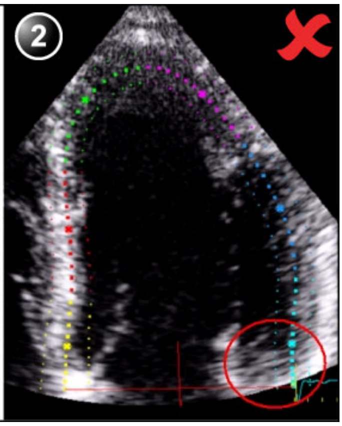
Tip. Make sure to follow the recommendations when placing the three points (see below).

Base	Correct	Wrong
1. Correct position of the base points. 2. The ROI extends into the aortic tract.		

Apex	Correct	Wrong
1. Correct position of the Apex point. 2. The apex point is placed too high. The ROI is extending beyond the epicardium.		

Apex	Correct	Wrong
1. Correct position of the Apex point. 2. The upper right border of the ROI is way too much into the chamber cavity.		

Bulges	Correct	Wrong
1. Correct ROI. 2. ROI should not be bulging or follow the papillary muscle. To edit the ROI, see 'ROI adjustment' on *page 5-25*.		

General	Correct	Wrong
The left ventricle must be visible through the entire cycle. 1. End systole frame: the entire left ventricle is displayed. 2. End diastole frame: the annulus is not displayed.		

Timing validation

Timing information may be crucial to accurate diagnosis. The most important event timing is the aortic valve closure (AVC), since it is part of the definition of the end systolic strain parameter.

Determination of the AVC timing by the system is as follows, depending on the situation:

- If AVC timing has been measured by the operator (through an event timing measurement, see page 5-11) prior to running AFI, the system is using this data.
- If event timing is not available, an automatic AVC estimate is used, determined by the temporal contraction of all LV segments (Strain curves).
- From the APLAX view, the user can adjust the estimated AVC timing. The adjusted AVC timing will then be used in the other apical views when running AFI on these views. This option is only available from the APLAX view.

AVC timing adjustment

This procedure is available in the APLAX view only.

1. After validation of the tracking quality, the frame for the current AVC setting (automatic or event timing measurement) is displayed and highlighted on the ECG.
2. To keep the current AVC setting, press the Left mouse button. To change the AVC setting, use the mouse to display another frame and press the Left mouse button.

   If the AVC setting was changed, a Confirmation window is displayed. Select one of the following options:

- **Manual** to accept the manual AVC setting.
- **Event timing** to discard the manual AVC setting (if for example the AVC setting was not possible to assess from the APLAX view). The AVC event timing measurement will then be used.

NOTE: *This choice is only visible if AVC event timing has been done.*

- **Auto** to discard the manual AVC setting and use the automatic AVC timing.

The *Parametric systolic strain APLAX view* is displayed (see Figure 5-16).

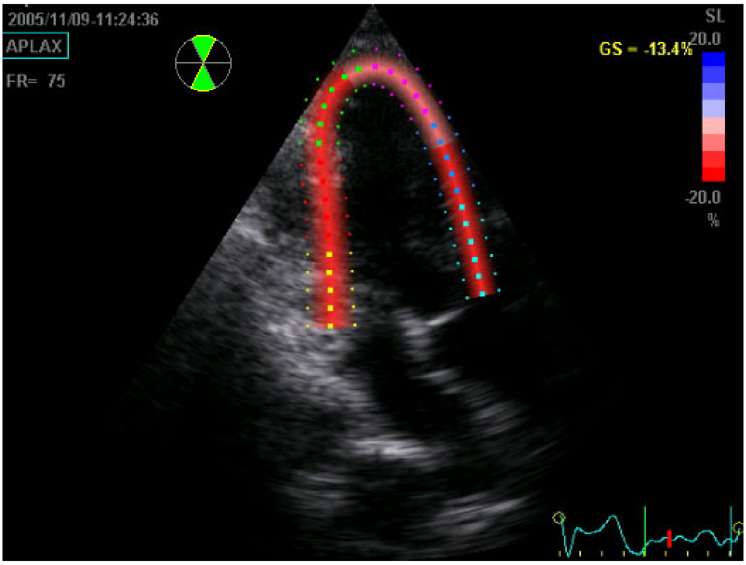


Figure 5-16. Parametric systolic strain APLAX view

NOTE: *The image will not be saved unless the user press* ***Store****.*

Press Quad screen to display a quad screen (see Figure 5-17) showing:

- 2D image with the ROI
- 2D image with Peak systolic strain parametric data
- Segmental curves with peak marker
- M-Mode image with strain parametric data

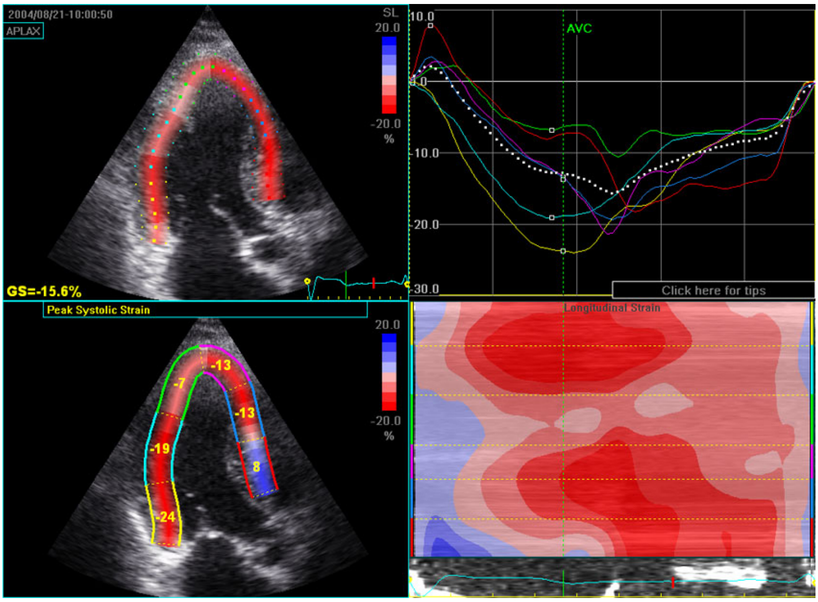


Figure 5-17. Quad screen for the APLAX view

*NOTE: The Quad screen will not be saved unless **Img. Store** is pressed.*

AFI on A4-Ch and A2-Ch views

The procedure for AFI on Apical 4-chamber and 2-chamber views is similar to the one used in the APLAX view.

For sequential acquisition

1. Open the apical view from the clipboard.
2. Select the corresponding view in the *View selection* menu (see Figure 5-11).
3. Validate tracking (see page 5-24).

For simultaneous acquisition (Tri-plane acquisition)

1. Press **Next view** on the Control panel to display the next Apical view.
2. Define a ROI (see page 5-26).
3. Validate tracking (see page 5-24).

NOTE: The AVC timing setting defined in the APLAX view is used by the system when running AFI on the other apical views.

Results

For the APLAX and apical 4-chamber views the following results are available:

- *Single* screen (see Figure 5-16) displaying a 2D image with strain parametric data.
- *Quad* screen (see Figure 5-17) displaying:
  - 2D image with the ROI
  - 2D image with Peak systolic strain parametric data
  - M-Mode image with strain data
  - Segmental curves

CAUTION

If auto-AVC is used as AVC timing calculation method when running AFI (see page 5-30), the strain values displayed in the *Quad* screen for the APLAX and 4 Chamber views may differ from the strain values obtained after the system has performed the final calculation from all three views. The reason for this is that the Auto-AVC calculation derived from all three views is most accurate and may be different from the intermediate AVC calculations used for each view. The strain values displayed in the *Quad* screen on APLAX and 4 Chamber views are therefor preliminary values (A warning text about this is displayed on the *Quad* screen). Only final strain values should be reported. Note: If you enter *Quad* screen again after all three loops have been processed, the strain values will be correct.

When performing AFI on all three apical views the following results are also available:

- *Bull's Eye and Traces* screen (Figure 5-18) displaying:
  - Segmental curves for each three Apical views
  - Bull's eye presentation with segmental Peak systolic strain color coding and segmental Peak systolic strain values.
- *Bull's Eye Only* screen (see Figure 5-19) displaying:
  - Bull's eye presentation with segmental Peak systolic strain color coding and segmental Peak systolic strain values

NOTE: *The Bull's eye can be configured to display either 18 or 17 segments (from Config/Meas-Text/Advanced/AFI Segment model).*

NOTE: *Press **BE Maps** to select another color map for the Bull's eye.*

NOTE: *The system can be configured so that the user can also choose to display Post systolic strain index (PSI) color coding and segmental PSI values in the Bull's eye (from Config/Meas-Text/Advanced/AFI).*

- Global Strain (GS) values for all three apical views.

  In a given view the Global Strain (GS), also called Global Longitudinal Peak Strain (GLPS), is defined as the percentage of maximal contraction over the whole cardiac cycle of the entire myocardial wall relative to its end diastolic length.
- Averaged Global Strain value from all three apical view data.
- AVC measurement (either automatic, event timing measurement or manual, see page 5-30)

Getting the results

When approving the tracking in the Apical 2-chamber the *Bull's Eye and Traces* screen with segmental curves and Bull's eye is displayed (Figure 5-18). Select **Bull's eye only** to display the *Bull's Eye Only* screen (Figure 5-19).

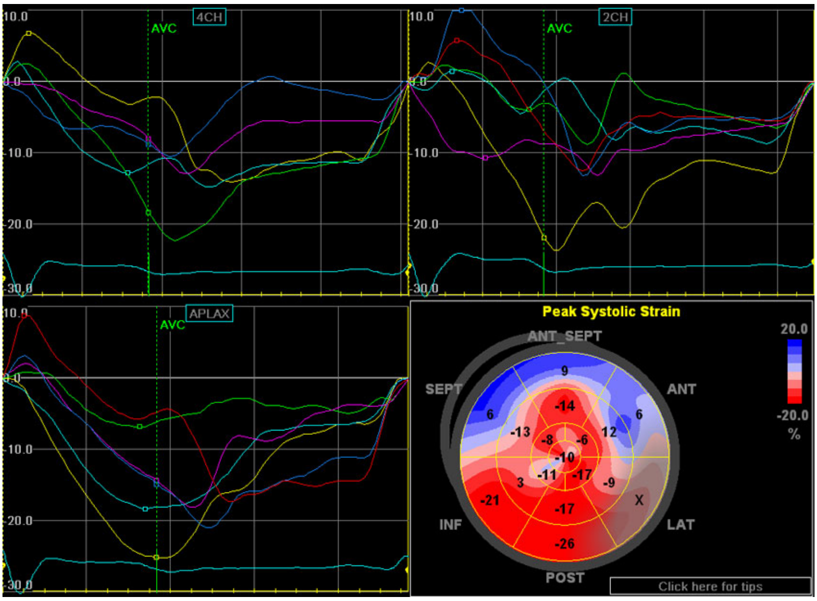
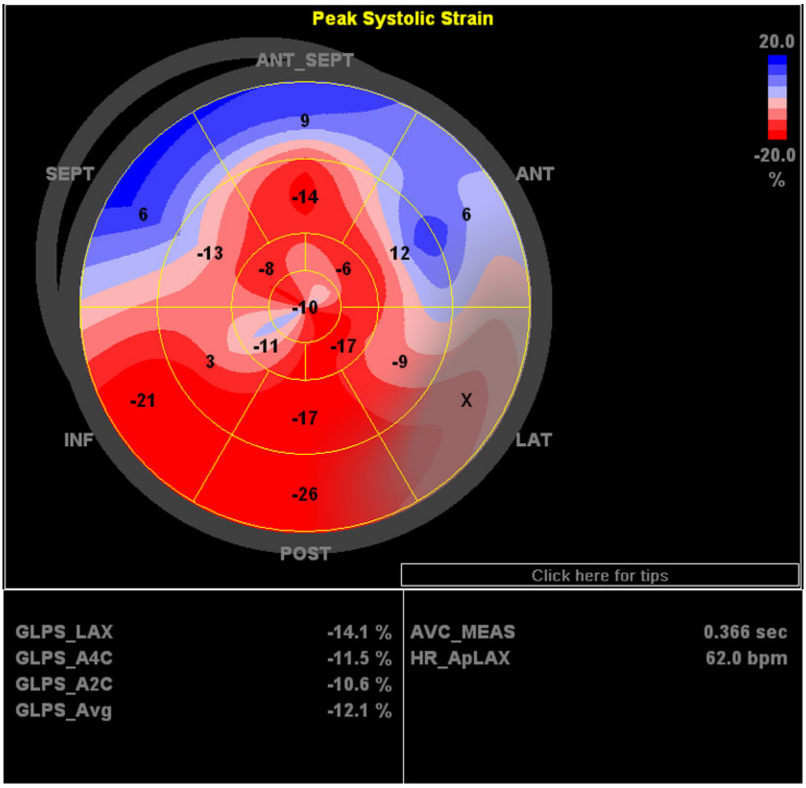


Figure 5-18. Quad screen

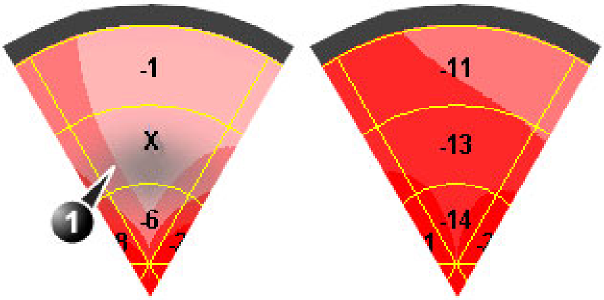


GLPS_LAX	-14.1 %	AVC_MEAS	0.366 sec
GLPS_A4C	-11.5 %	HR_ApLAX	62.0 bpm
GLPS_A2C	-10.6 %		
GLPS_Avg	-12.1 %		

Figure 5-19. Bull's Eye Only screen

To save the results, exit AFI and answer yes to the question “Do you want to store?”. Once the results are saved, the measurements are available in the Worksheet and can be used in the report.

If the tracking quality of a segment was scored as Not acceptable (X), the colorimetric display on the Bull's eye is greyed (see Figure 5-20).



1. Segment with tracking quality scored as Not acceptable (X).

Figure 5-20. Colorimetric display

Peak detection

The peak systolic strain detection for each segment can be verified and eventually manually changed.

To adjust the peak detection:

1. Press **BE+Traces**.

   The *Bull's Eye and Traces* screen is displayed (see Figure 5-18) showing:

   - Trace plots for all three loops
   - Bull's Eye with Peak systolic strain values

2. To change the peak marker position on a curve:

   - Select the peak marker (square point) on one of the curves and move it to a new position.

     OR

   - Place the cursor on a segment in the Bull's Eye. The corresponding curve is highlighted.

     Click on the segment to select the corresponding peak marker and move it to a new position.

About the results

Be aware of the following:

- Clinical assessments should be made based on both color and segmental Peak systolic strain values.
- The Save As function is intended for research purposes and should not be used to archive diagnostic data.
- To populate the worksheet and the report the *Bull's Eye Only* screen must be saved.
- All results shown (curves, colors and values) are based on drift compensated values. Any strain drifting is linearly compensated throughout the cycle. If the drift compensation in a given segment is too high, the tracking quality is automatically set to Not acceptable (**X**).
- If the tracking quality was scored as Not acceptable (**X**) in more than one segment, the Global Strain value is not calculated.

Reprocessing data

The data from one or several views from a saved AFI analysis may be reprocessed. When reprocessing an AFI analysis new result screens are created.

1. Double-click on the Bull's eye thumbnail.

   A quad screen is displayed showing the three apical views and the Bull's eye diagram.
2. Select the view to reprocess and perform the analysis as described on page 5-22.

AutoEF measurements

Automated Ejection Fraction (AutoEF) is a semi-automatic measurement tool used for measurement of the global EF (Ejection fraction). The AutoEF tool is used as an optional decision support tool.

The AutoEF tool is derived from 2D speckle tracking algorithm, which tracks and calculates the myocardial tissue deformation based on feature tracking on 2D grey scale loops.

AutoEF is performed on either one or both apical 4-chamber or 2-chamber views, in any order.

The result is presented as Ejection Fraction value for each view and average Ejection Fraction for the whole LV. All values are stored to the worksheet.

Acquisition

CAUTION

AutoEF is only recommended for adult cardiac images acquired with the following probes: M5Sc-D, M5S-D, 3V-D or 4V-D. The measurement accuracies of the 2D Auto EF measurement values reported in the Reference manual are verified with these probes.

AutoEF can be performed on 2D grey scale cineloops of Apical 4 chamber and/or Apical 2 chamber views.

For optimal result the acquisitions should conform to the following recommendations:

- The frame rate should be between 35 and 100 frames per second. A higher frame rate is recommended for high heart rate.
- The scanner should be configured to store at least 100 ms before and after each heart cycle.
- If the acquisition has more than one heart cycle, the analysis will be done on the second last heart cycle.
- The entire myocardium should be visible.
- A depth range that includes the entire left ventricle should be used.

Starting AutoEF

1. Open any one of the stored views and press **Measure**.
2. In the Measurement menu, select **AutoEF**.

The *View selection* menu is displayed (Figure 5-21).

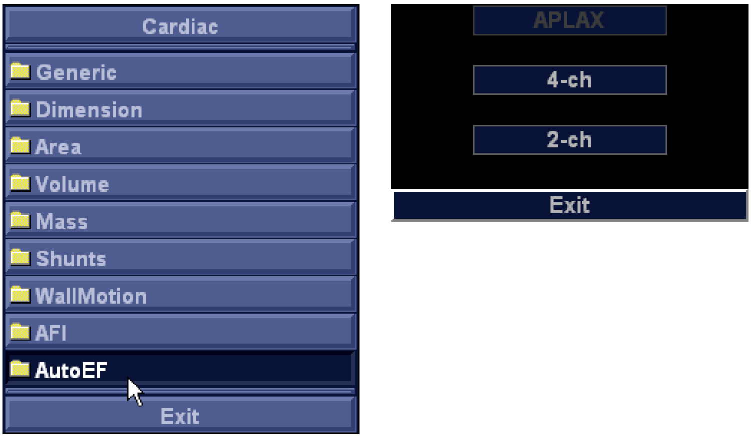


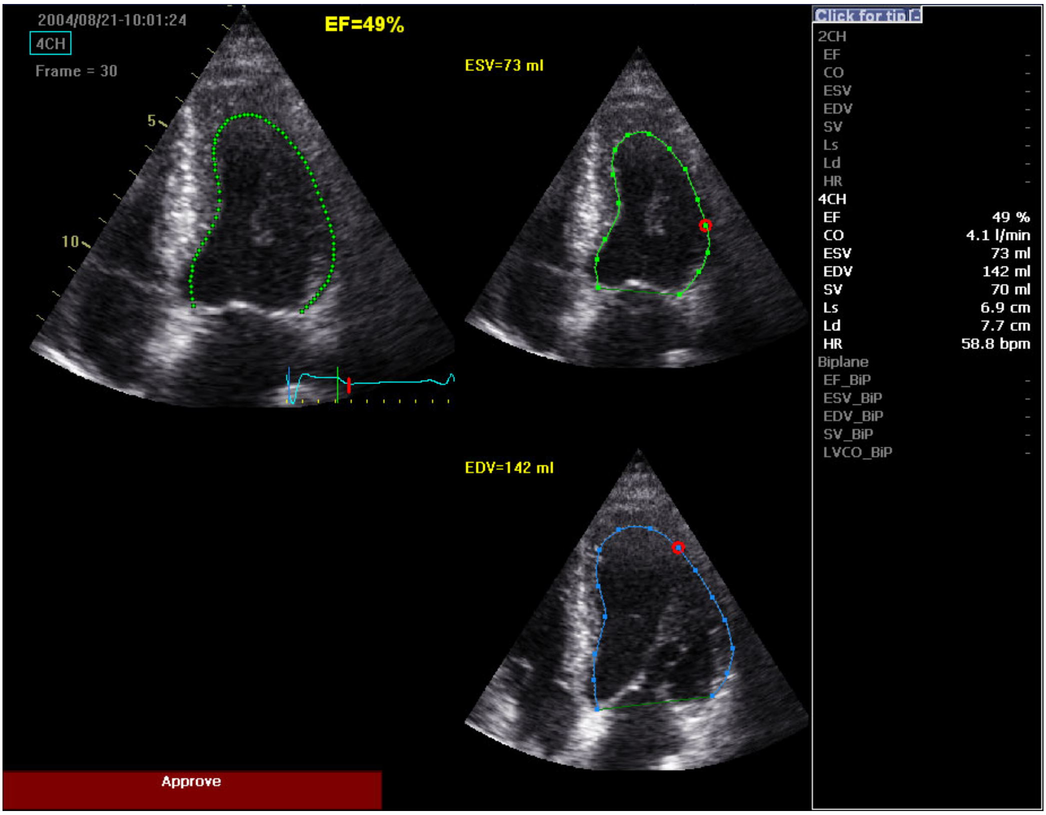
Figure 5-21. Measurement and View selection menus

3. Select the name of the current view: **4-ch** or **2-ch**.

   A trace following the endocardial border is created and the and the *EF result* screen is displayed (Figure 5-22).

   The tracking must be visually controlled and validated as described below.

EF results



2CH	
EF	-
CO	-
ESV	-
EDV	-
SV	-
Ls	-
Ld	-
HR	-
4CH	
EF	49 %
CO	4.1 l/min
ESV	73 ml
EDV	142 ml
SV	70 ml
Ls	6.9 cm
Ld	7.7 cm
HR	58.8 bpm
Biplane	
EF_BiP	-
ESV_BiP	-
EDV_BiP	-
SV_BiP	-
LVCO_BiP	-

Figure 5-22. The EF results screen

The running loop is shown on the left. A green dotted line marks the inner border of the chamber. In case of poor tracking, the system automatically displays parts of the border in red.

The frames with the maximal area (ED) and minimal area (ES) are displayed on the right side.

*NOTE: Press **EF Dual** to only display the ED and ES frames.*

The End Diastolic volume (EDV), the End Systolic Volume (ESV) and the resulting Ejection Fraction (EF) are displayed.

Results for each view are summarized in a table on the right side.

Tracking Validation

⚠ **CAUTION** Poor tracking quality may lead to incorrect measurement results. The tracking must be visually controlled and validated.

If the tracking results are visually correct press the red **Approve** button on screen. The calculated values are stored and available in the worksheet and can be used in a report.

The following can be done if tracking needs correction:

- Press **EF dual** to display ES and ED frames side-by-side.
- Adjust **ES frame** and **ED frame** controls if different frames need to be selected for ES and ED.
- Edit misaligned points on the endocardial border trace as described on 'Editing the endocardial border trace' on *page 5-41*.
- Create a new endocardial border trace (see 'Create a new trace' on *page 5-42*).

Possible causes of poor tracking

- Erroneous placement of the basal points when defining the border. If the basal points are placed too far from the annular region, the border segments at the annular base will not move together with the underlying 2D image throughout the entire heart beat.
- Erroneous placement of the apex point when defining the border. The point should be placed so that the resulting border trace covers mainly the endocardium. If the apex point is placed too high, the border trace will mainly cover the epicardium resulting in poor tracking.
- Too much clutter. Images with too much static clutter will result in poor tracking.

Trace adjustment of the endocardial border

If the automatic endocardial border detection is not optimal the user can either adjust the trace or create a new trace as described below.

Editing the endocardial border trace

1. Press **Recalc**.

   The initial endocardial border trace is displayed.
2. If required, use the **Left/Right Edge shift** controls to delineate separately the left or right portions of the endocardial border visually as best as possible. These

controls are not available if the endocardial border trace is adjusted.

3. You may adjust the trace by moving the cursor over the endocardial border trace, select an anchor point and drag it to a new location. The shape of the endocardial border trace is updated accordingly.

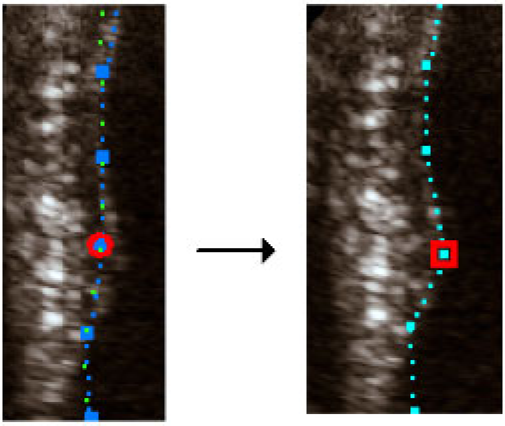


Figure 5-23. Moving an anchor on the trace

Create a new trace

1. Press **Recalc**.

   The initial endocardial border trace is displayed.

2. Press **New ROI**.

   The system automatically displays a frame where the endocardial border is usually clearly visible. To use another frame, adjust **Ref frame**.

3. To trace the endocardial border, place three points at the endocardial border; two annular points at the base and one at the apex. Follow the indications displayed on the screen when placing the three points.

   After placing the third point on the Apex an endocardial border is automatically traced (Figure 5-24).

NOTE: *Correct border tracing is important for an accurate EF measurement. The system has an adaptive border tracing function: using the endocardial three points as a guide, the system will analyze the image and automatically adapt the border tracing to an optimal position.*

NOTE: *The Yo-yo function is turned on to help finding correct location for the points.*

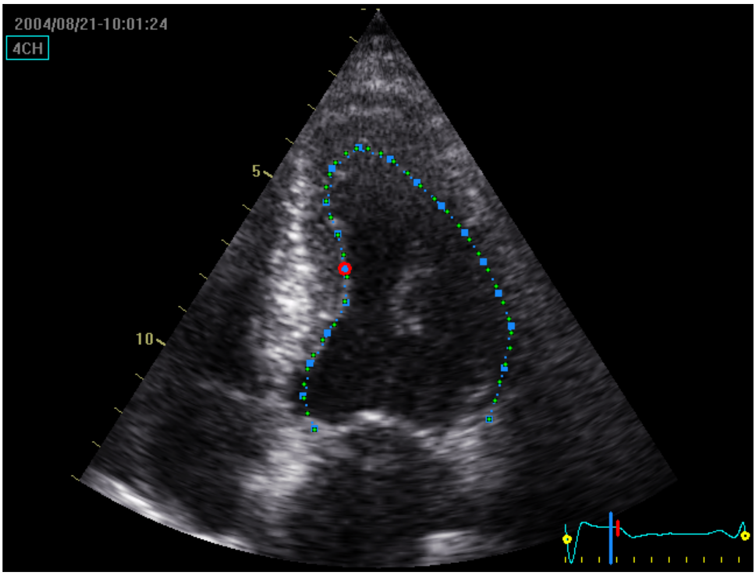


Figure 5-24. Tracing the endocardial border

4. Data processing is configured by default to start automatically if the cursor is not moved for a few seconds. If the trace needs to be adjusted make sure to make the changes immediately after the ROI is displayed. See 'Editing the endocardial border trace' on *page 5-41* for more information on how to edit the trace.

NOTE: *The auto processing function is configurable (from **Config/ Meas-Text/Advanced/AFI/AutoEF auto processing**).*

The data is processed and the *EF result* screen is displayed.

Exit AutoEF

1. Press **Exit** on the Control panel.

   A dialog is displayed asking the user about storage of the loop.

   - Press **Yes** to store the loop.
   - Press **No** to discard the loop.

Pediatric Z score measurement study

Calculated Z Scores are used to normalize pediatric heart measurements to the patient's body size. Z Score values are calculated based on **"Regression Equations for Calculation of Z Scores of Cardiac Structures in a Large Cohort of Healthy Infants, Children, and Adolescents: An**

Echocardiographic Study", M.D. Pettersen et.al. The parameters defined in this publication are calculated when present in the *Dimension* folder both for M-mode and 2D images.

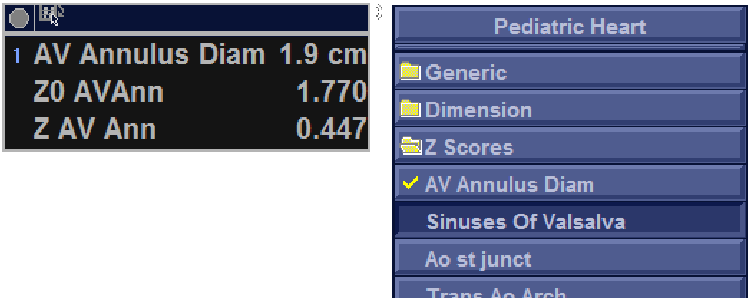
BSA value must be known. BSA is automatically calculated when entering the patient's height and weight in the *Patient information* window (see Figure 3-6 *on page 3-12*).

In addition, all Z Score values from the above publication are found in a separate *Z Scores* folder. By default this *Z scores* folder is hidden in the *Measurement* menu. To display the *Z scores* folder, see 'Configuration of the Measurement menu' on *page 5-76*. Please note that Z Score values from the *Z Scores* folder are not averaged together with the values in the *Dimension* folder.

1. Open a pediatric cardiac acquisition.

   Make sure the height and weight of the patient was entered in the *Patient information* window.
2. Press **Measure** and select the **Z Scores** folder (only available from the *Pediatric Heart* measurement category, if turned on).
3. In the *Z Scores* folder select the measurement to perform.
4. Make the measurement.

   The Z0 and Z values are displayed in the *Measurement result* table.



1	AV Annulus Diam	1.9 cm
	Z0 AVAnn	1.770
	Z AV Ann	0.447

Figure 5-25. Pediatric cardiac measurement with Z Score

4D/Multi-plane LV measurements and analysis

Introduction

Depending on the data set, the following 4D/multi-plane LV analysis tools are available on the EchoPAC Software Only:

	Data set		
Tool	**4D**	**Tri-plane**	**Tri-plane TSI**
4D Automated LV Quantification	page 5-45	-	-
Tri-plane LV Volume measurement	page 5-58	page 5-58	-
Bi-plane LV Volume measurement	-	page 5-61	-
TSI surface model	-	-	page 5-62

4D Automated Left Ventricular Quantification

The 4D Automated Left Ventricular Quantification tool enables the estimation of the left ventricular volumes and the ejection fraction in 4D data sets based on automatic border detection. The tool also enables estimation of left ventricular mass and strain (only with transthoracic 4D acquisitions). The automatic border detection is created after placing two points in an end-diastolic apical view, one at the center of the LV base and one at the apex.

Requirements

The 4D Automated Left Ventricular Quantification tool cannot be used on acquisition with volume rate equal or lower than 12 vps.

CAUTION

Do not use the 4D Automated Left Ventricular Quantification tool if:

- For volume measurements: The acquisition has a volume rate lower than 20% of the heart rate, e.g., 12 vps at 60 bpm, 20 vps at 100 bpm and 30 vps at 150 bpm.
- The image quality is poor.
- The acquisition has stitching artifacts. See 'Measurements on multi beat 4D acquisitions' on *page 5-3* for more information about stitching artifacts.
- The acquisition has significant reverberation artifacts.
- A significant part (more than 25%) of the left ventricular wall is outside the ultrasound sector.

The tool must not be used on other chambers than the human adult left ventricle.

Starting the 4D Automated Left Ventricular Quantification tool

1. Open a Full volume acquisition.
2. Press **Measure**.
3. Select **Volume/4D Auto LVQ** (Figure 5-26-A).

   The *Measurement* menu is displayed with the Alignment tool selected (Figure 5-26-B).

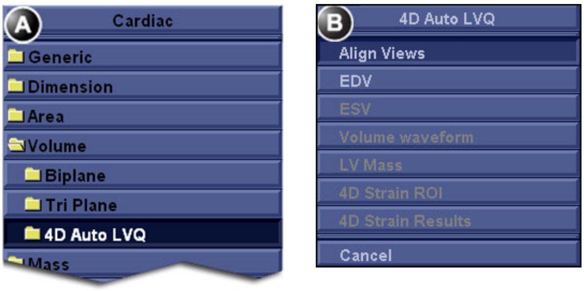


Figure 5-26. Measurement menu

The main screen displays three apical and a short axis views.

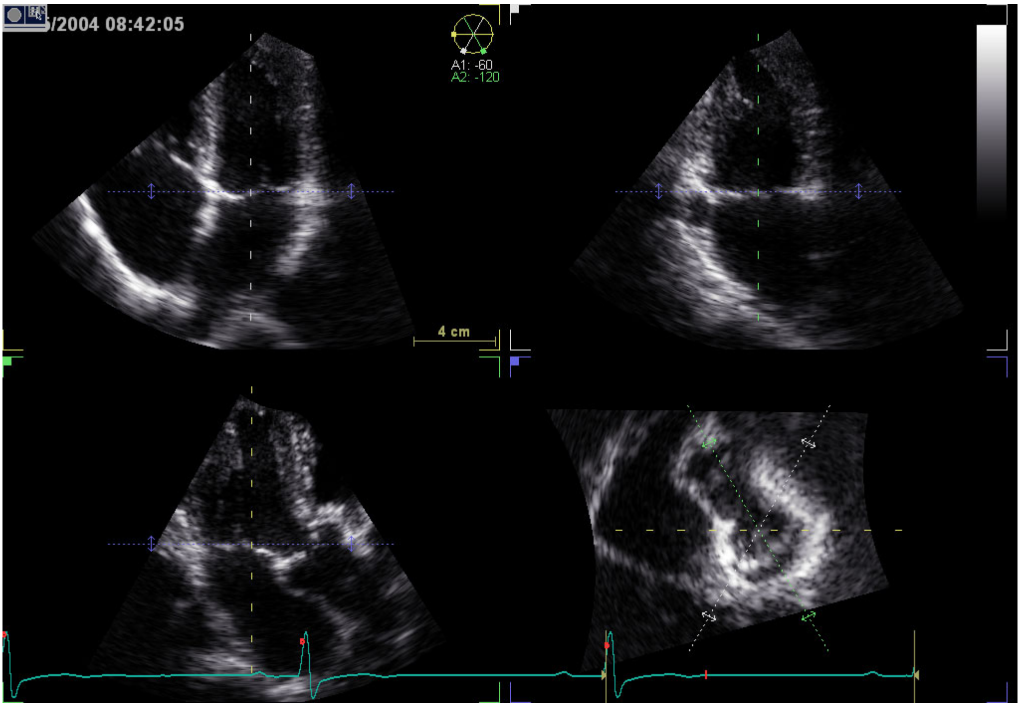


Figure 5-27. Slice alignment screen

Slice alignment

Slice alignment is used to identify the long axis of the left ventricle, the three standard apical views and the atrio-ventricular plane. Slice alignment performed and approved before running 4D Auto LVQ is used by default, otherwise the slice alignment is performed automatically. If necessary the auto alignment can be further adjusted as follows:

1. Tilt and/or translate the apical views using the controls on the Control panel or the mouse until the left ventricle is centered to the center axis.
2. Rotate the apical views using the controls on the Control panel or the mouse until the standard views are displayed.

NOTE: *Auto alignment is not available with transesophageal acquisitions, only manual alignment as described in 'Alignment – Transesophageal acquisition' on page 4-23.*

See page 4-21 for more information on Slice alignment.

End-diastolic volume contour detection

1. Select **EDV** (End-Diastolic Volume).

   The default screen displays three apical views, three short axis views and an interactive view (Figure 5-28).

   The system automatically displays the loops at the estimated end diastolic frame.
2. If the automatic end diastolic frame detection is not optimal, use the **Move ED** control to set the new end diastolic frame.
3. In one of the apical views, place two points: one at the center of the LV base and one at the apex.

*NOTE: Alternative methods for doing contour detection: press **Auto Init** on the Control panel to draw the contour automatically without placing any points, or press **Manual** and place two basal and one apical point in all three apical views.*

A contour is automatically drawn in all views (see Figure 5-28).

NOTE: Erroneous contour detection of the left ventricle may lead to incorrect measurement results. The contour detection should be visually checked and edited if required.

The contour detection should be checked in all slices.

*NOTE: press **Layout** several times on the Control panel to display the apical slices in large size one by one.*

The contour detection quality can be visualized by moving the cursor through the LV and observe the contour detection in the interactive view. The position of the interactive view updates according to the cursor position in the other views.

To lock the interactive view, press **Up** or **Down arrow** key on the keyboard. When the interactive view is locked the position can be controlled using the **Up** and **Down arrow** keys on the keyboard or the **Move view** control on the Control panel. Press **Enter** on the keyboard or **Unlock view** on the Control panel to unlock the view again.

Adjust **Contour visibility** to change the display intensity of the contour (or hide it).

To run the cineloop, press **Run** on the Control panel.

To stop the cineloop, press **Go To ED** on the Control panel. The end diastolic frame is displayed.

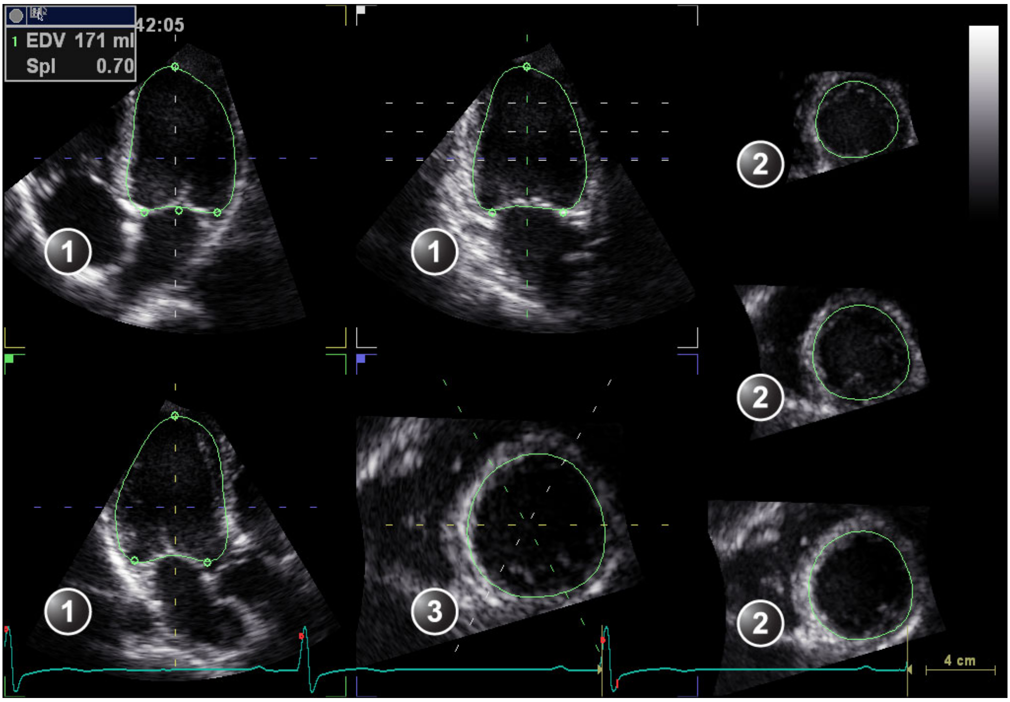
To edit the contours, see ‘Contour adjustment’ on *page 5-50*.

To reset the contours and start over, press **Reset**.

The following measurements are available:

- End diastolic volume
- Sphericity Index

NOTE: *You can press* ***Store*** *at any point during the procedure.*



1. Apical views
2. Short axis views
3. Interactive view

Figure 5-28. Left ventricle contour detection (end-diastole)

End-systolic Volume contour detection

1. Select **ESV** (End-Systolic Volume).

   The system automatically displays the loop at the estimated end systolic frame within the same heart cycle.
2. If the automatic end systolic frame detection is not optimal, use the **Move ES** control to set the new end systolic frame.
3. In one of the apical views, place two points: one at the center of the LV base and one at the apex.

   A contour is drawn in all views.

NOTE: *If the Auto or Manual contour detection method was used to define the EDV contour (see step 3 on page 5-48) the same method is used for the ESV contour detection.*

NOTE: *Erroneous contour detection of the left ventricle may lead to incorrect measurement results. The contour detection should be visually checked and edited if required.*

The contour detection should be checked in all slices.

NOTE: *press **Layout** several times on the Control panel to display the apical slices in large size one by one.*

The contour detection quality can be visualized by moving the cursor through the LV and observe the contour detection in the interactive view. The position of the interactive view updates according to the cursor position in the other views.

To lock the interactive view, press **Up** or **Down arrow** key on the keyboard. When the interactive view is locked the position can be controlled using the **Up** and **Down arrow** keys on the keyboard or the **Move view** control on the Control panel. Press **Enter** on the keyboard or **Unlock view** on the Control panel to unlock the view again.

Adjust **Contour visibility** to change the display intensity of the contour (or hide it).

To run the cineloop, press **Run** on the Control panel.

To stop the cineloop, press **Go To ES** on the Control panel. The end systolic frame is displayed.

To edit the contours, see ‘Contour adjustment’ on *page 5-50*.

To reset the contours and start over, press **Reset**.

The following measurements are available:

- End diastolic volume
- End systolic volume
- Ejection Fraction
- Sphericity Index
- Cardiac Output
- Stroke Volume
- Heart Rate

Contour adjustment

The contour detection should be checked. If the contour detection is not optimal, it can be adjusted by adding attracting points to the contour. An attracting point will pull the contour toward that point.

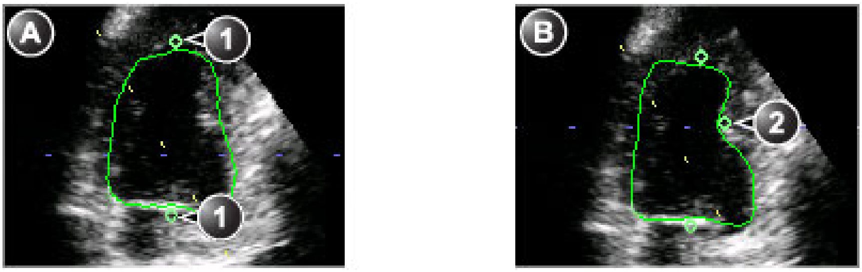
1. Place the cursor at the location where to add a point.

NOTE: *Attracting points can be added in any slice. Make sure to lock the interactive view if adding attractive points in the interactive view.*

2. Press the Left mouse button.

   A point is added and the contour is modified (Figure 5-29).

3. To delete an attracting point, double click on the point or press **Undo**.



a. Original contour

b. Modified contour

1. Original attracting points
2. Added attracting point

Figure 5-29. Contour adjustment

Volume waveform

Display and adjustment

1. Press **Volume waveform**.

   The data is processed and the *Result* screen is displayed (Figure 5-30) showing:

   - The four running views with dynamic contours
   - A volume waveform curve with end diastolic and end systolic markers
   - A dynamic LV surface model
   - The Measurement result table

NOTE: *Press **Layout** on the Control panel to display a large LV surface model.*

2. Press **Go to ED** on the Control panel to display the end diastolic frame.

   Press **Go to ES** on the Control panel to display the end systolic frame.

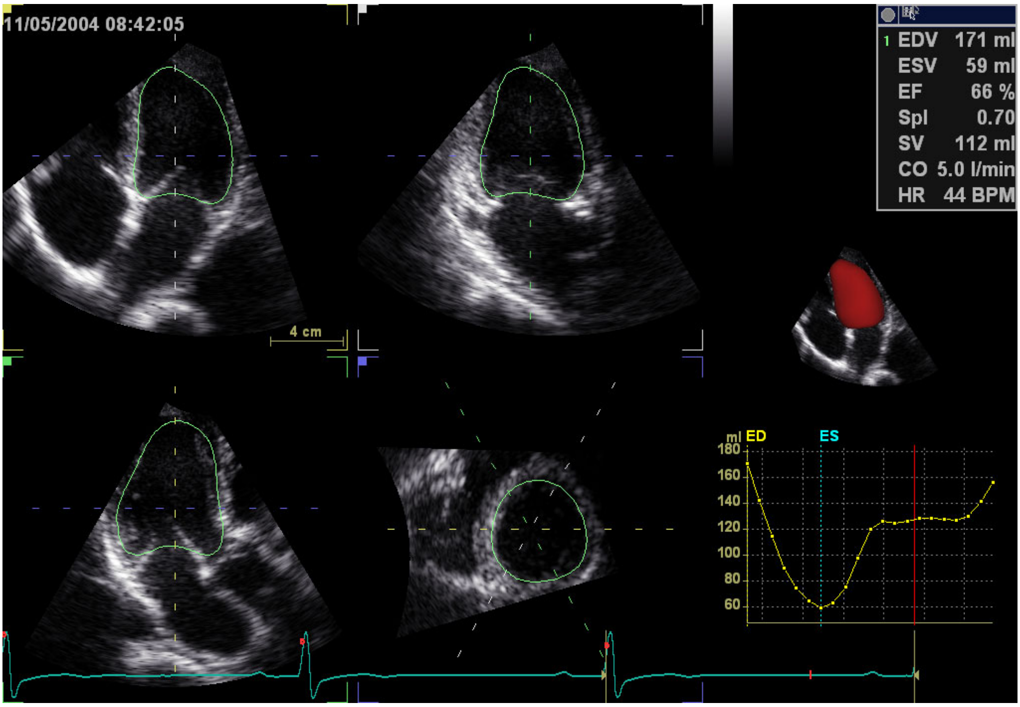
3. The contour detection may still be adjusted:

   - Press **Stop** or click on any view to stop the cineloops. Scroll to the correct frame.

- Add or remove attracting points to modify the contour as described in 'Contour adjustment' on *page 5-50*.
- Press **Volume waveform** to reprocess the data.

4. The end diastolic and end systolic markers on the volume waveform curve can be adjusted:
    - Adjust **Move ED** and **Move ES** controls to move the end diastolic and end systolic markers on the curve.

      The measurement results are updated.



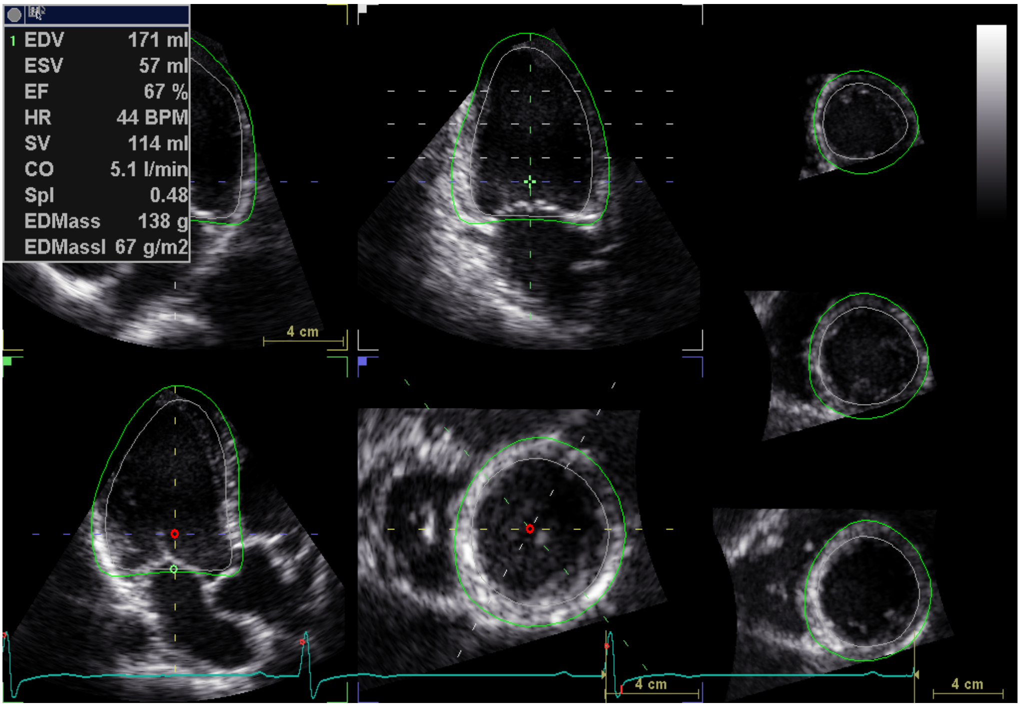
1 EDV 171 ml
ESV 59 ml
EF 66 %
Spl 0.70
SV 112 ml
CO 5.0 l/min
HR 44 BPM

Figure 5-30. The Volume waveform screen

LV mass

1. Press **LV Mass** (Left ventricular mass).

   The end diastolic frame is displayed and an epicardial contour is automatically drawn. The ED mass calculation is displayed in the *Measurement result* table.



1	EDV	171 ml
	ESV	57 ml
	EF	67 %
	HR	44 BPM
	SV	114 ml
	CO	5.1 l/min
	SpI	0.48
	EDMass	138 g
	EDMassI	67 g/m2

Figure 5-31. The ED mass screen

Adjust **Contour visibility** to change the display intensity of the contour (or hide it).

To run the cineloop, press **Run** on the Control panel.

To stop the cineloop, press **Go To ED** on the Control panel. The end diastolic frame is displayed.

2. The epicardial and endocardial contours may be adjusted by adding/removing attracting points as described in 'Contour adjustment' on *page 5-50*. Adjustment of the contours can only be done on the end diastolic frame.

NOTE: *Toggle between **Endo**, **Epi** and **Endo + Epi** on the Control panel to select the contour to adjust.*

The following measurements are available:

- End diastolic volume
- End systolic volume
- Ejection Fraction
- Sphericity Index
- Cardiac Output
- Stroke Volume
- Heart Rate
- End diastolic mass
- End diastolic mass index (if BSA is known)

4D Strain

4D Strain enables calculation of myocardial deformation parameters based on tissue tracking in 4D tissue data sets. Calculation is performed after defining a region of interest (ROI) that covers the left ventricular myocardium.

NOTE: *Poor tracking quality may lead to incorrect measurement results. The tracking for each segment must be visually controlled before approving the results.*

4D Strain ROI

1. Press **4D Strain ROI**.

   The end systolic frame is displayed and a ROI based on endocardial and epicardial contours is automatically created.

   To run the cineloop, press **Run** on the Control panel.

   To stop the cineloop, press **Go To ES** on the Control panel. The end systolic frame is displayed.
2. The epicardial and endocardial contours may be adjusted by adding/removing attracting points as described in ‘Contour adjustment’ on *page 5-50*. Adjustment of the contours can only be done on the end systolic frame.

NOTE: *Toggle between **Endo**, **Epi** and **Endo + Epi** on the Control panel to select the contour to adjust.*

The following measurements are available:

- End diastolic volume
- End systolic volume
- Ejection Fraction
- Sphericity Index
- Cardiac Output
- Stroke Volume
- Heart Rate
- End diastolic mass
- End diastolic mass index (if BSA is known)
- End systolic mass
- End systolic mass index (if BSA is known)

4D Strain results

1. Press **4D Strain results**.

   The *4D Strain result* screen is displayed (Figure 5-32) showing:

   - Apical and short axis views with segmented ROI.
   - Segmental and global curves showing a graphical display of the selected parameter as a function of time.
   - A 17-segments color coded Bull's eye representation with tracking quality indication when the loop is running and segmental values for the selected parameter at current frame when in Freeze.

   NOTE: Segments marked with an "X" are rejected.

   To stop the cineloop, press **Go To ES** on the Control panel. The end systolic frame is displayed.

   To run the cineloop, press **Run** on the Control panel.

2. The tracking for each segment must be visually controlled before approving the results. Inspect each segment and make sure that it is moving together with the underlying 2D image.

   *NOTE: press **Layout** several times on the Control panel to display the apical slices in large size one by one.*

   Press **Up** or **Down arrow** key on the keyboard or adjust the control **Segment** on the Control panel to highlight each segment individually and assess the tracking quality.

   A segment with poor tracking can be removed from the calculation of the global value for the selected parameter: press the **Enter** key on the keyboard or **Reject segment** on the Control panel to remove the highlighted segment. The curve of the rejected segment is removed and the rejected segment is marked with an “X” on the Bull’s eye representation. The global value for the selected parameter is not calculated if more than three segments are rejected.

NOTE: *To approve a segment previously rejected, highlight the rejected segment and press* ***Enter*** *on the keyboard or* ***Approve segment*** *on the Control panel.*

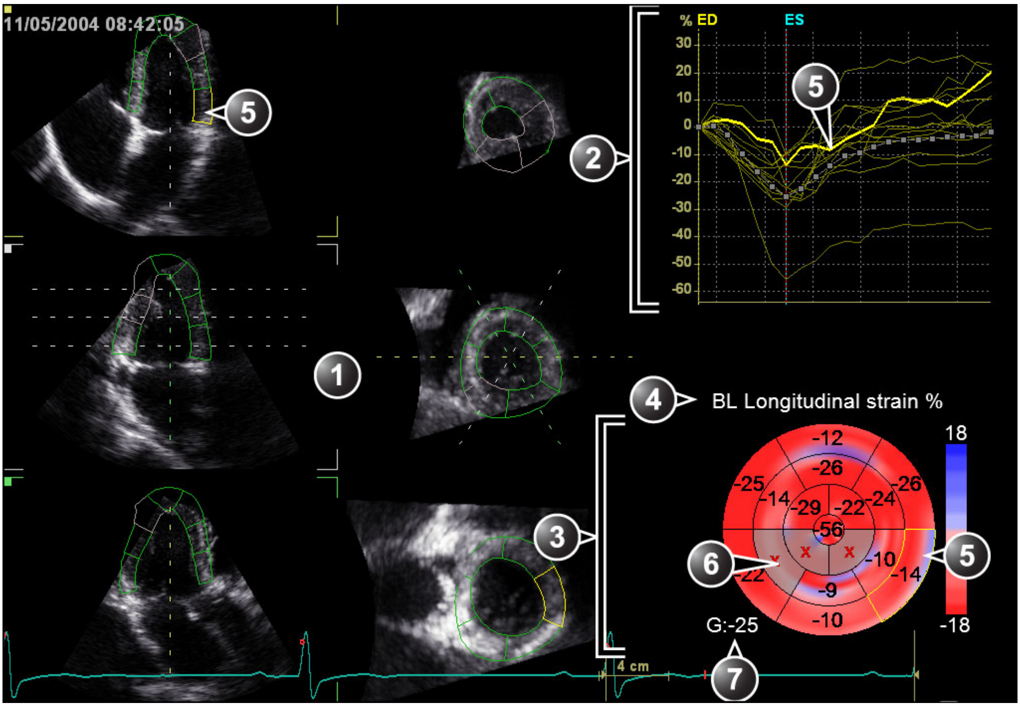
3. Press the **Parameter** button on the Control panel to display the results for other parameters.

   The following parameters are available:

   - Longitudinal Strain
   - Circumferential Strain
   - Area Strain
   - Radial Strain (assuming Volume Conservation)
   - Global Peak Longitudinal Strain (GPSL)

4. Press **Export results** to save the results in CSV format, readable in Microsoft Excel, or in HDF format, readable in HDF viewer. See page 4-41 for more information about HDF format. Both file types contain the segmental traces, but the HDF file in addition contains the midwall quadrilateral strain mesh.

NOTE: *Exported data is provided “as is”, without any guarantee of validity. It used at own risk, and should be manually cross-checked against the values shown on screen to ensure correctness. In case of discrepancy between exported values and values shown on screen, then the values on screen are the official valid ones that should be reported. The content and data format of the exported files are subject to change. GE Healthcare may change the definitions of the file format given in this document according to new development needs or by other circumstances.*



1. Apical and short axis views with segmented ROI.
2. Segmental and global curves
3. Bull's eye representation
4. Selected parameter
5. Selected segment (ROI, curve and Bull's eye)
6. Rejected segment
7. Global value for the selected parameter

Figure 5-32. The 4D Strain result screen

Approval

1. Press **Approve & Exit** to store the measurements shown in the *Measurement result* table.

   The measurements are transferred to the Worksheet.

   To exit without approving, press **Cancel**.

NOTE: *Measurements that are not approved will not be saved.*

CAUTION

The measurement should not be approved if a significant part (more than 25%) of the left ventricular wall or the detected contours are outside the ultrasound sector.

Calculation formula and measurement accuracy

Refer to the Reference manual for calculation formula and measurement accuracy information.

Manual left ventricular volume measurements

Tri-plane acquisition

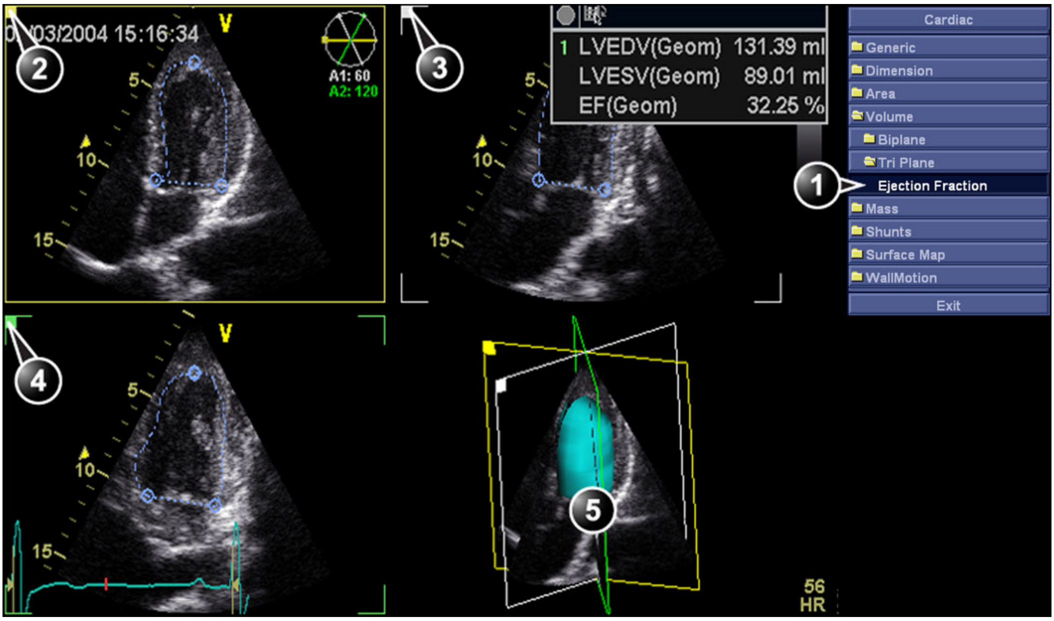
This procedure describes the calculation and reconstruction of the left ventricular volume from a Tri-plane acquisition. The Tri-plane acquisition should be a Tri-plane greyscale acquisition, not a Tri-plane color acquisition.

1. Open an Apical 4 chamber view acquired in Tri-plane mode.
2. Press **Stop**.
3. Press **Measure**.

   The *Measurement* menu is displayed.
4. In the *Measurement* menu select **Volume** and **Tri-plane**.

   The *Measurement* screen is displayed with the *Ejection fraction tool* selected (see Figure 5-33).

   The end diastolic frame of the current cardiac cycle is displayed and the cursor is moved to the reference scan plane.



```
1 LVEDV(Geom)  131.39 ml
  LVESV(Geom)   89.01 ml
  EF(Geom)      32.25 %
```

1. Ejection fraction tool for Tri-plane
2. Scan plane 1 (yellow): Apical 4 chamber view
3. Scan plane 2 (white): Apical 2 chamber view
4. Scan plane 3 (green): Apical long axis view
5. Volume reconstruction

Figure 5-33. The Tri-plane measurement screen

5. Place the cursor to the start point for the trace.
6. Press the **Left mouse button** and draw a contour of the left ventricle.

   To edit the contour while drawing:

   - Follow the contour backward to erase it and redraw.
   - Press **Undo** or **Backspace** to erase the contour stepwise and redraw.
   - Press **Delete** to remove the entire contour and redraw.

7. Press the **Left mouse button** to complete the contour.

   The cursor is automatically moved to the next scan plane.

   The crossing point of the trace done in the first scan plane is marked in the second scan plane.

8. Draw a contour of the left ventricle in scan plane 2 and 3 following the same procedure.

   When the last end-diastolic contour is drawn, an end-systolic frame is automatically displayed. Using the arrow keys, ensure that the correct end systolic frame is displayed.

9. Repeat steps 5 to 8 to draw a contour of the left ventricle at end-systole in all the scan planes.

   The measurement results, including end-diastolic and end-systolic volumes and the left ventricular ejection fraction, are displayed in the *Measurement result* table.

NOTE: *Other measurements may be displayed by configuring the Measurement menu, refer to the scanner's or workstation's User manual for more information about Measurement menu configuration.*

Multi beat 4D acquisition

This procedure describes the calculation and reconstruction of the left ventricular volume from a Multi beat 4D acquisition.

CAUTION ECG gated acquisition may by nature contain artifacts, that may have impact on the measurements.

See 'Measurements on multi beat 4D acquisitions' on *page 5-3* for more information about stitching artifacts.

1. Open an Apical 4 chamber view acquired in Multi-beat acquisition mode.
2. Press **Stop**.
3. Orientate the reference cut-plane to display an Apical 4 chamber.
4. Press **Measure**.

   The *Measurement* menu is displayed.
5. In the *Measurement* menu select **Volume** and **Tri-plane**.

   The *Measurement* screen is displayed with the *Ejection fraction tool* selected.
6. Follow the procedure described in 'Tri-plane acquisition' on *page 5-58* from step 5.

Rotation of the Volume reconstruction

The volume reconstruction displayed in the *Geometric model* can be rotated in any directions.

1. Place the pointer in the *Geometric model*.
2. Press and hold down **Left mouse button** and use the mouse to rotate the volume reconstruction.

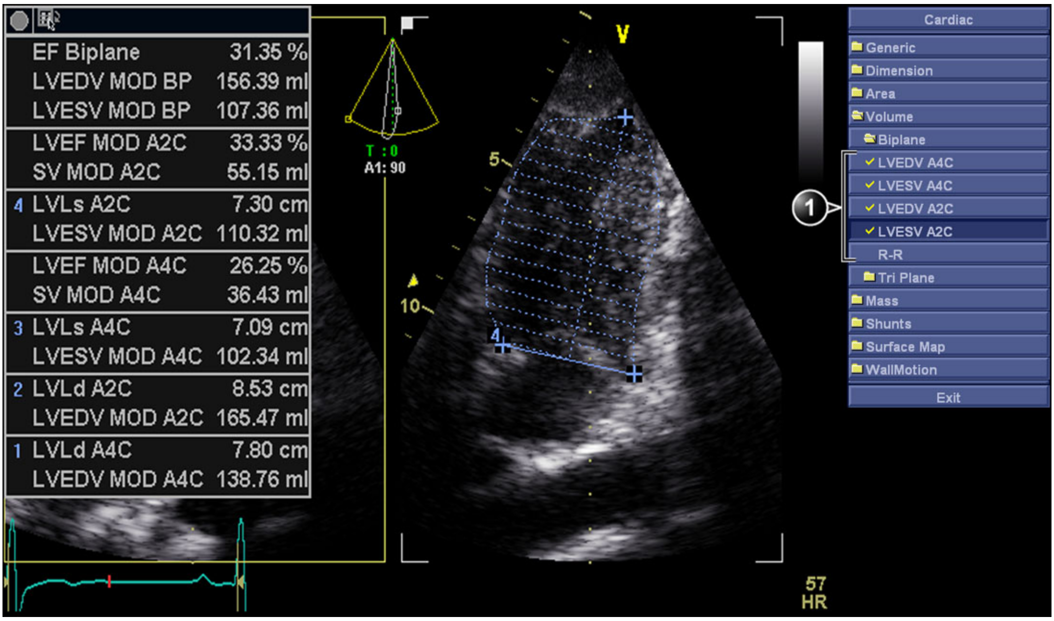
Bi-plane acquisition

This procedure describes the calculations of the left ventricular volume from a Bi-plane acquisition. The volume calculation is based on the Method of disk.

1. Open an Apical 4 chamber view acquired in Bi-plane mode.
2. If required, rotate scan plane 2 to display an Apical 2 chamber view.
3. Press **Stop**.
4. Scroll through the cineloop to display the end-diastolic frame.
5. Press **Measure**.

   The *Measurement* menu is displayed.
6. In the *Measurement* menu select **Volume** and **Bi-plane**.

   The *Trace tool* for the Left ventricular end-diastolic volume for the Apical 4 chamber view is selected (see Figure 5-34).



```
  EF Biplane          31.35 %
  LVEDV MOD BP       156.39 ml
  LVESV MOD BP       107.36 ml
  LVEF MOD A2C        33.33 %
  SV MOD A2C          55.15 ml
4 LVLs A2C             7.30 cm
  LVESV MOD A2C      110.32 ml
  LVEF MOD A4C        26.25 %
  SV MOD A4C          36.43 ml
3 LVLs A4C             7.09 cm
  LVESV MOD A4C      102.34 ml
2 LVLd A2C             8.53 cm
  LVEDV MOD A2C      165.47 ml
1 LVLd A4C             7.80 cm
  LVEDV MOD A4C      138.76 ml
```

1. Trace tools

Figure 5-34. The Volume measurement screen (Bi-plane)

7. In scan plane 1 (yellow), place the cursor to the start point for the trace.
8. Press the **Left mouse button** and draw a contour of the left ventricle.

9. Move the cursor to the apex and press the **Left mouse button** to measure the length.

   The trace tool for the Left ventricular end-diastolic volume for the Apical 2 chamber view is selected.
10. Repeat steps 8 and 9 in the scan plane 2 (measurement in the Apical 2 chamber view).

    The trace tool for the Left ventricular end-systolic volume for the Apical 4 chamber view is selected.
11. Scroll through the cineloop to display the end-systolic frame in the same heart cycle.
12. Repeat steps 7 to 10 to perform the end-systolic measurements in the Apical 4 chamber and 2 chamber views.

    The Ejection fraction (Bi-plane) and the end-diastolic and end-systolic left ventricular volumes are calculated.

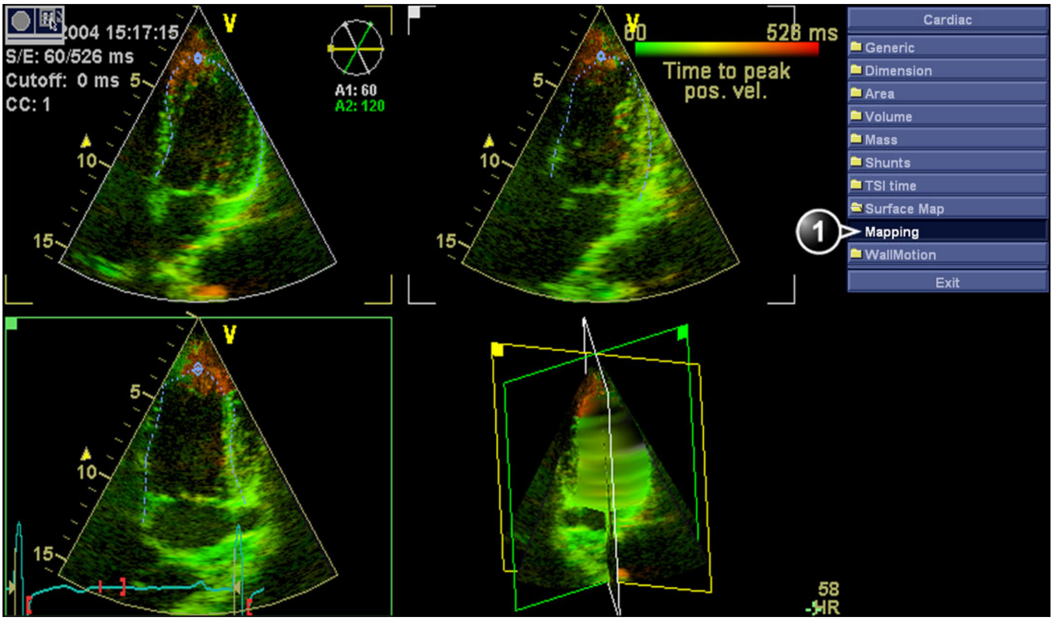
TSI surface model

A Surface model representation of the left ventricle with TSI color coding can be generated from a TSI Tri-plane acquisition by applying a sampling path in the myocardium. The sampling path is created by placing control points in the myocardium.

1. Open an Apical 4 chamber view acquired in Tri-plane TSI mode.
2. Press **Stop**.
3. Press **Measure**.

   The *Measurement* menu is displayed.
4. In the *Measurement* menu select **Surface Map**.

   The *Mapping tool* is selected (see Figure 5-35).



1. Mapping tool for Geometry model
2. TSI surface model

Figure 5-35. The Measurement screen (Geometry model)

5. In scan plane 1 (yellow), place the cursor to the start point for the sampling path starting in the myocardium.
6. Move the cursor following the myocardium and press the **Left mouse button** to place new points.

   By creating several control points the sampling path can be bent to follow the myocardium.
7. Double-click to end the sampling path.
8. Create a sampling path in scan plane 2 and 3.

   A TSI color coded surface model is displayed in the *Geometric model*.
9. To create a dynamic model, scroll to another frame in the same heart cycle and create a sampling path in each scan plane.
10. Press **Run** to run the model.

To edit the sampling path

1. Place the cursor over a control point.
2. Double-click and move the control point to a new position.
3. Press the **Left mouse button** to place the control point to its new position.

Advanced vascular measurements and analysis

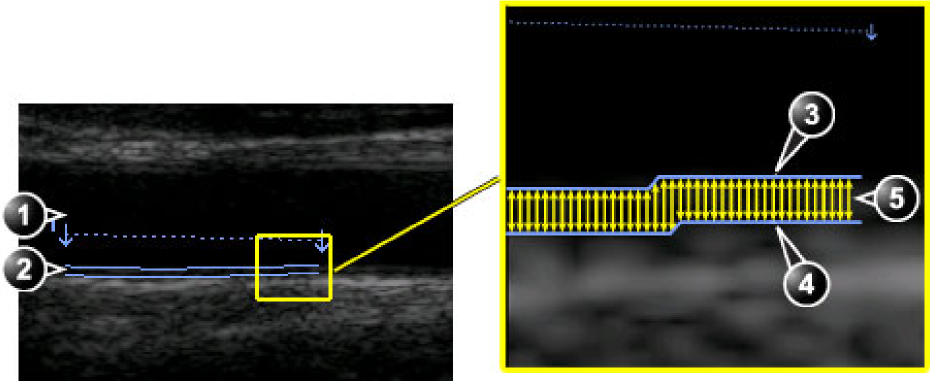
Intima-Media Thickness

The Intima-Media Thickness (IMT) is calculated based on automatic contour detection of the Intima and Media layers on a user-defined search region along the vessel wall. Multiple IMT measurements are made between pairs of intima and adventitia points along the wall (Figure 5-36). IMT can be measured both on the posterior and the anterior walls of the vessel. IMT should be done on 2D mode images, not on Color mode images.

NOTE: *Due to the physical properties of ultrasound imaging, the posterior IMT measurement is generally more accurate than the anterior IMT measurement.*

The following parameters are calculated:

- Average IMT
- Maximum IMT
- Minimum IMT
- Standard deviation of IMT measurements
- Number of successful IMT measurements



1. Vessel lumen
2. Vessel wall
3. Lumen-Intima boundary
4. Media-Adventitia boundary
5. Multiple IMT measurements

Figure 5-36. IMT measurement (Posterior wall)

IMT Measurement procedure

The following procedure describes the posterior IMT measurement.

1. Open a longitudinal scan of the carotid artery.
2. Select **Stop**.
3. Scroll to an end-diastolic frame where the intima layer is clearly visible.
4. Press **Measure**.
5. Select the appropriate IMT measurement. If measuring the IMT of the posterior wall of the right common carotid select **Rt** and **CCA IMT Post** (Figure 5-37).

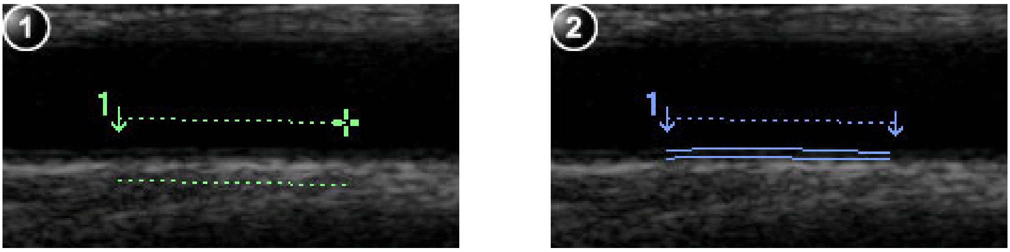
Figure 5-37. IMT Measurement menu (Right Common Carotid Posterior IMT measurement tool)

6. Place the cursor in the artery closer to the posterior wall and press the Left mouse button to anchor the start of the search region (Figure 5-38, left).
7. Move the cursor parallel to the artery to define the end point of the search region. Make sure the Intima and Media layers are within the search region (indicated by the lower dotted line in Figure 5-38, left).

   Press the Left mouse button to anchor the point. For the posterior wall the contour detector searches for the leading of the edges of the intima and adventitia layers. The detected contours are drawn in the image (Figure 5-38, right).

   The measurement calculations are displayed in the *Measurement result* table.

NOTE: *If the Intima and Media layers are not within the search region, the contour is not drawn. Select (double click) and move the anchored points closer to the Intima layer.*



1. Measurement segment
2. IMT trace

Figure 5-38. IMT Measurement segment and traces

8. If the contour is not optimal, adjust **Trace Fit** to modify the traces according to different threshold values.

   If the contour is still not optimal, try to perform the IMT measurement on another frame, preferably close to the end diastole.

IMT trace approval

NOTE: Erroneous contour detection of the Intima and Media layers may lead to incorrect measurement results. The contour detection should be visually checked and edited if required.

Since the IMT measurements are done semi-automatically, the operator has to approve the detection by visual inspection before storing the results in worksheet and report.

1. If the traces fit both layers of the posterior wall, approve the measurement by selecting **Transfer** in the *Measurement* menu.

   Once transferred, the calculations can be viewed in the worksheet and report.

NOTE: Measurements that are not approved will not be saved.

*NOTE: Any image adjustments (e.g Gain or zoom) on approved (transferred) measurements will unassign the measurements. Press **Transfer** to approve the measurements again.*

OB measurements

1. From an obstetric exam on a scan in Freeze, press **Measure**.
2. Select the desired study.
3. Perform the required measurements from the selected study.

   Follow the on-screen indications when performing measurements.

OB graphs

OB Graphs allow you to assess fetal growth compared to a normal growth curve. When a patient has completed two or more ultrasound exams, you can also use the graphs to look at fetal trending. For multi-gestational patients you can show curves for all fetuses and compare the growth on the graphs. The EchoPAC Software Only provides the following two basic types of graphs:

- **Fetal Growth Curve graphs** – show one measurement per graph. These graphs show the normal growth curve, positive and negative standard deviations or applicable percentiles, and ultrasound age of the fetus using the current measurement. For multi-gestational pregnancies, you can show curves for all fetuses. If previous exam data is available, the graph can show fetal trending.
- **Fetal Growth Bar graph** – shows the ultrasound age and the gestational age based on patient data. Plots all measurements on one graph.

CAUTION

The system provides calculations (e.g. estimated foetal weight) and charts based on published scientific literature. The selection of the appropriate chart and clinical interpretation of calculations and charts are the sole responsibility of the user. The user must consider contraindications for the use of a calculation or chart as described in the scientific literature. The diagnosis, decision for further examinations and medical treatment must be performed by qualified personnel following good clinical practice.

To view OB graphs

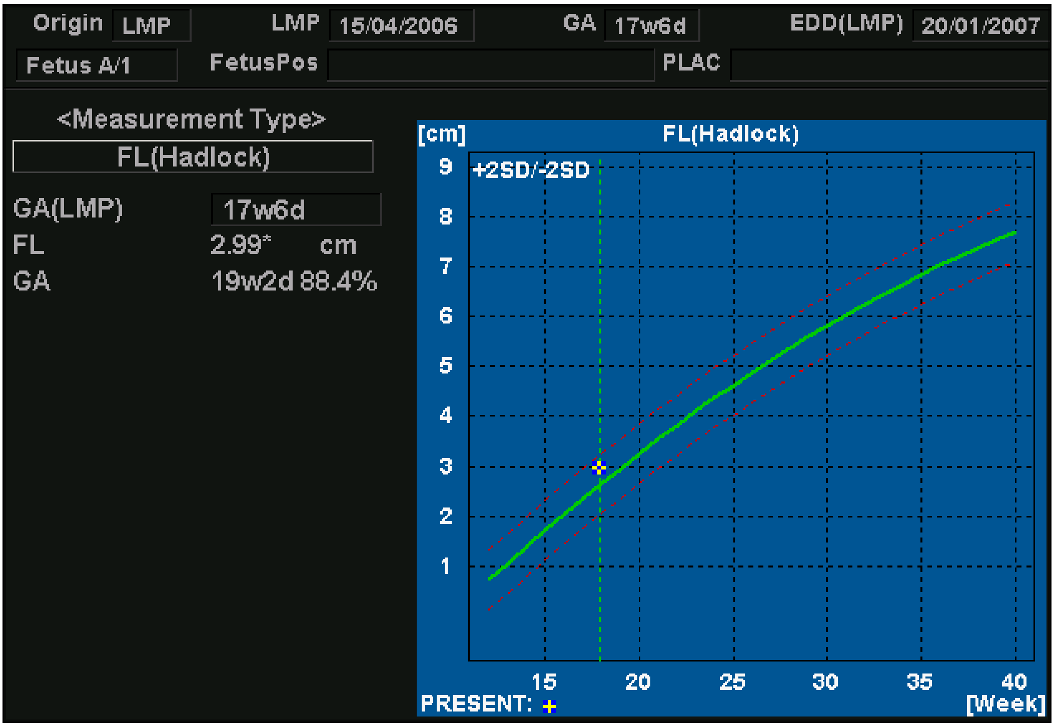
1. Press **Worksheet**.
2. Press **Graph**.

   The Fetal growth curve graph is displayed (Figure 5-39). The horizontal axis shows the fetal age in weeks. The system determines this age from the data entered in the *Patient information* window. Depending on the measurement selected the vertical axis displays measurements (mm or cm), ratios (%) or fetal weight (g).

   The Fetal growth curve graph shows the following information for the selected measurement:

   - The normal growth curve
   - The standard deviations or relevant percentiles
   - The gestational age of the fetus, using patient data (vertical dotted line)
   - Using the current ultrasound measurement data, where the fetus is on the growth curve

From the OB graphs screen, the user can enter relevant information in the *Fetus position* and *Placenta* fields.



Origin LMP
LMP 15/04/2006
GA 17w6d
EDD(LMP) 20/01/2007
Fetus A/1
FetusPos
PLAC

<Measurement Type>
FL(Hadlock)

GA(LMP)	17w6d
FL	2.99* cm
GA	19w2d 88.4%

Figure 5-39. Fetal growth curve graph

To select the measurement

1. Select the measurement in the *Measurement type* field.

   A list of available measurements is displayed.
2. Select the measurement to display.

   To scroll through all Fetal growth curve graphs, adjust **Graph change**.

To edit the Gestational age (GA)

1. Select the **GA (LMP)** value.

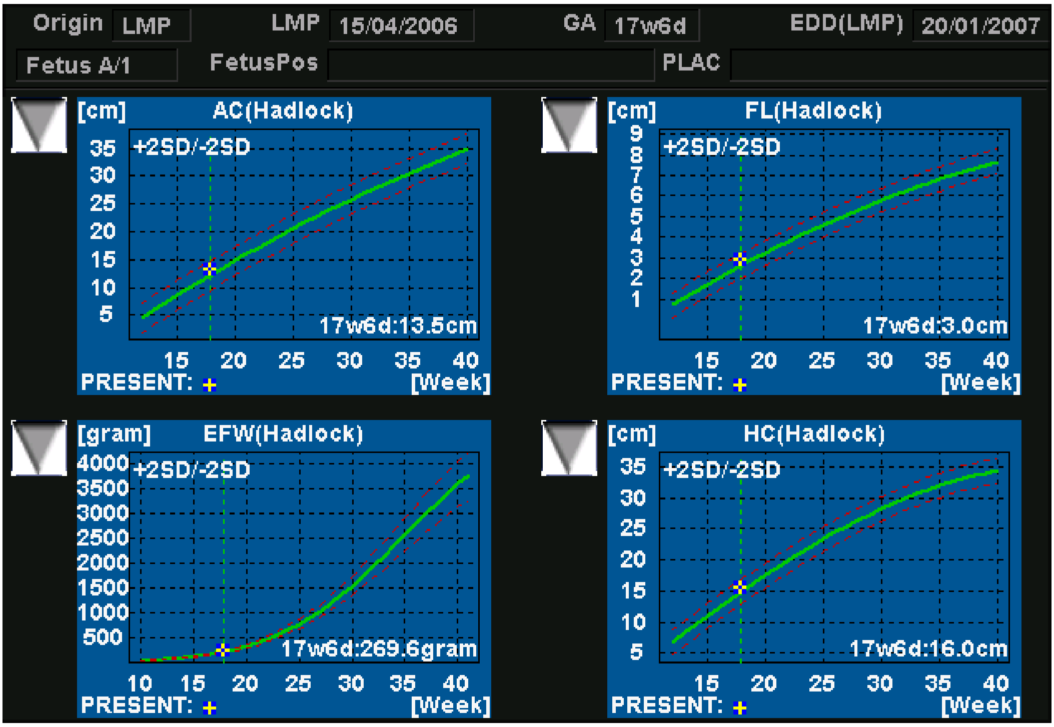
   An editing window is displayed.
2. Enter a new value and select **OK**.

   The GA (LMP) label is changed to GA(GA) showing the new value entered. This information is also updated in the *Patient information* window. In addition the EDD (LMP) is updated to EDD (GA) with new calculated value.

To view single or quad screen

1. Press **Quad** to display four graphs simultaneously.

2. To select the measurements to display in the quad screen, select the drop-down button on the left of each graph and select the desired measurement.
3. Press **Single** to display single graph screen again.



Origin LMP
LMP 15/04/2006
GA 17w6d
EDD(LMP) 20/01/2007
Fetus A/1
FetusPos
PLAC

Figure 5-40. Fetal growth curve graph: quad screen

Fetal trending

When you have ultrasound data for more than one exam for a patient, you can use the data to look at fetal trending on the Fetal growth curve graphs. Fetal trending requires that a LMP value is entered in the *Patient information* screen.

1. Press **Worksheet**.
2. Press **Graphs** and select the desired measurement to display.
3. Press **Plot Both**.

   The system automatically finds the data from previous ultrasound exams, and displays it on the graph with the present data.

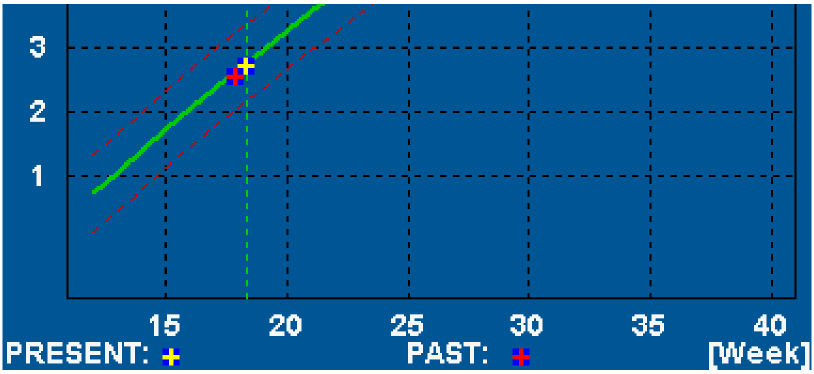


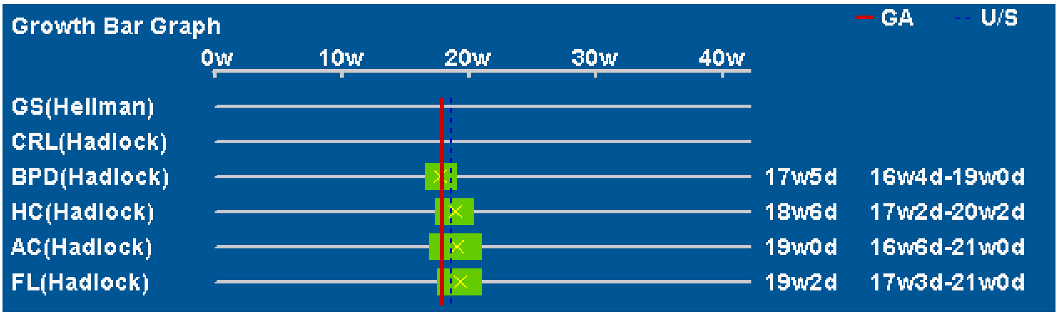
Figure 5-41. Fetal trending graph

Fetal growth bar graph

The fetal growth bar graph shows current exam measurements and the normal growth range based on the gestational age. It shows all measurements on one graph.

1. Press **Worksheet**.
2. Press **Graph**.
3. Press **Bar**.

   The fetal growth bar graph is displayed.



GS(Hellman)		
CRL(Hadlock)		
BPD(Hadlock)	17w5d	16w4d-19w0d
HC(Hadlock)	18w6d	17w2d-20w2d
AC(Hadlock)	19w0d	16w6d-21w0d
FL(Hadlock)	19w2d	17w3d-21w0d

Figure 5-42. Fetal growth bar graph

- The horizontal axis shows the gestational weeks.
- The red vertical line shows the gestational age using the patient data.
- The blue dotted vertical line shows the ultrasound age using the current measurements.

- The yellow x shows the ultrasound age for each measurement.
- The green rectangle shows the normal age range for the measurement.

Measurement package configuration

There are many more measurements and parameters in the measurement package than shown in the default *Measurement* menu. Use the configuration system to set up the measurements that should be available in the *Measurement* menu and which parameters should be calculated.

A list of all cardiac calculations with needed measurements and location in the Measurement package can be found in the Reference manual.

Basic operations

Opening the Measurement configuration package

1. Press **Config** (**F2**) and select the category **Measure/Text**.

   The *Measurement menu* sheet is displayed (see Figure 5-43).

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.
2. Check the categories to be displayed.

   Uncheck the categories to hide.

To select a Measurement category in the *Measurement* menu:

1. Select the heading of the *Measurement* menu.

   The measurement categories are displayed in a sub-menu.
2. Select the Measurement category to display.

Moving an item in the Measurement menu

1. Select an entry in 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 deleted.

1. Select an 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.

Auto-sequence of measurements within a folder

1. In the *Measurement menu* sheet, select a folder in the *Measurement* menu.
2. Check **Auto sequence**.

   When performing the first measurement in the folder, the next measurement is automatically selected.

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. Enter the folder name in the *Name text* field.

Measurement package configuration - example

The following example based on calculation of AV CO (Cardiac Output by Aortic Flow) describes how to configure the measurement package so that necessary measurements and the resulting calculations are displayed on screen.

Calculation of Cardiac Output by Aortic Flow requires the measurement of:

- AV diameter located in the folder *Dimension* (2D mode)
- AV VTI located in the folder *Aortic* (Doppler AV Trace).
- Heart rate

If a calculated parameter (e.g. AV CO in AV Trace measurement) requires another parameter to be calculated (e.g. AV Diam) the user must first measure the required parameter (e.g. AV Diam) before the dependent parameter (e.g AV CO in AV Trace) gets calculated.

Configuration of the Measurement menu

If the AV diameter measurement is not present in the folder *Dimension* in the *Measurement* menu, follow the following procedure:

1. Press **Config** (**F2**) and select the category **Measure/Text**.

   The *Measurement menu* sheet is displayed (see Figure 5-43).
2. AV Diam is a 2D measurement, make sure that **2D** is checked in the *Measurement* sheet.
3. Select folder **Dimension** in the *Measurement* menu.

   A list of all available measurements for the selected folder is displayed in the *Measurement menu* sheet.
4. Check the box in front of **AV Diam**.

   The AV Diam measurement is displayed in the folder *Dimension* in the *Measurement* menu.
5. For the AV VTI measurement, check **Doppler** in the *Measurement menu* sheet and select the folder **Aortic** in the *Measurement* menu.
6. Check the box in front of **AV Trace**.

   The AV Trace measurement is displayed in the folder *Aortic* in the *Measurement* menu.

Name: Dimension

☑ Auto sequence

- ☐ LVd
- ☐ LVs
- ☑ IVSd
- ☑ LVIDd
- ☑ LVPWd
- ☑ IVSs
- ☑ LVIDs
- ☑ LVPWs
- ☑ LVOT Diam
- ☐ LA/Ao
- ☐ LA Diam
- ☐ Ao Diam
- ☐ Ao asc
- ☐ Ao Desc Diam
- ☐ junct
- ☐ Arch Diam
- ☐ AV Cusp
- ☐ AV Diam
- ☐ Ao Isthmus
- ☐ MV Ann Diam
- ☐ LV Major
- ☐ LV Minor
- ☐ LA Major
- ☐ LA Minor
- ☐ TV Ann Diam
- ☑ RVOT Diam
- ☐ PV Ann Diam
- ☐ RVIDs
- ☐ RVAWs
- ☐ RVIDd
- ☐ RVAWd
- ☐ MPA
- ☐ RPA
- ☐ LPA
- ☑ PEd
- ☐ PEs
- ☐ RA Major
- ☐ RA Minor
- ☐ RV Major
- ☐ RV Minor
- ☐ PDA Diam
- ☐ ASD Diam
- ☐ VSD Diam
- ☐ PFO Diam
- ☐ Pre Ductal
- ☐ Post Ductal
- ☑ EPSS
- ☐ MVL Thck
- ☐ LCA
- ☐ RCA
- ☐ LCX
- ☐ IVC
- ☑ R-R
- ☐ RA Diam

1. Select the scanning mode for the measurement to add to the Measurement menu.
2. Select the folder for the measurement to add.
3. Select the measurement to add.

Figure 5-43. Configuration of the Measurement menu

Configuration of the Measurement result table

If AV CO calculation is not displayed in the *Measurement result* table, follow the following procedure:

1. Press **Config** (**F2**) and select the Config category **Measure/ Text**.

   The *Measurement menu* sheet is displayed.

2. The AV CO calculation is based on Doppler AV Trace measurement in the folder *Aortic*, check **Doppler** in the *Measurement menu* sheet and select the folder **Aortic**.

   A list of all available measurements and calculations for the selected folder is displayed in the *Measurement menu* sheet.

NOTE: *Entries in green are calculated measurements.*

3. In the *Measurement menu* sheet, double-click on the **AV Trace** measurement.

   A list of all available output parameters for the AV Trace measurement is displayed in the *Measurement menu* sheet.

4. Check the box in front of **AV CO**.

   The AV CO calculation will be displayed in the *Measurement result* table.

User-defined formulas

User-defined formulas can be created using existing measurements or by defining new measurements. The following example describes the creation of a formula based on existing measurements.

CAUTION

GE Healthcare does not take any responsibility for the correctness of the user-defined studies, parameters or functions.

User-defined formula - example

The workflow for user-defined formula is:

- If the user-defined formula is based on several measurements of different types, create a user-defined folder in the *Measurement* menu so that all measurements and the formula are grouped together. If the formula is based on a single measurement you may select an existing appropriate folder.
- Add the measurement(s) needed for the formula to the user-defined (or existing) folder.
- Create the formula based on the added measurements.

The following procedure describes the creation of user-defined LIMP formula as follows: My LIMP = (MCO-AV ET)/AV ET.

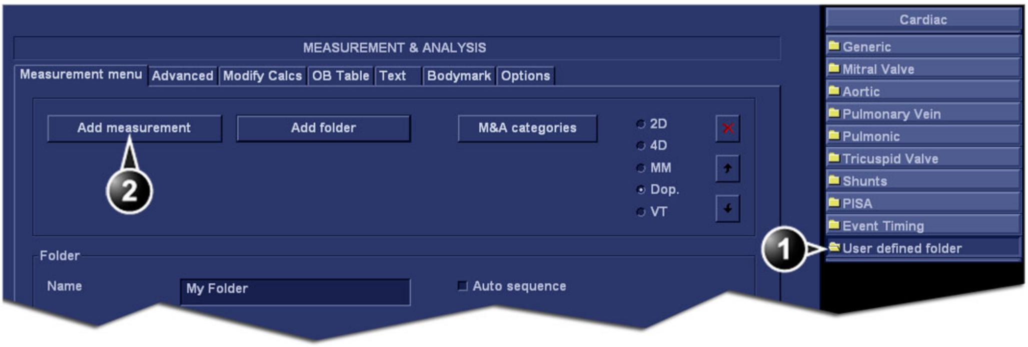
Creation of a user-defined folder

1. Select the appropriate scanning mode.
2. Create a folder in the Measurement menu.

Figure 5-44. The Measurement menu sheet

1. Press **Config** (**F2**) and select the category **Measure**.
2. MCO and AV ET are Doppler measurements, select **Doppler** in the *Measurement menu* sheet.
3. Select **Add folder**.
4. Give the folder a name (e.g. “My Folder”).

Adding measurements



1. Select the user-defined folder.
2. Press Add measurement.

Figure 5-45. The Measurement menu sheet

1. Select the user-defined folder (e.g. “My Folder”) in the *Measurement* menu.
2. Press **Add Measurement** in the *Measurement menu* sheet.

   The *Add measure* window is displayed.

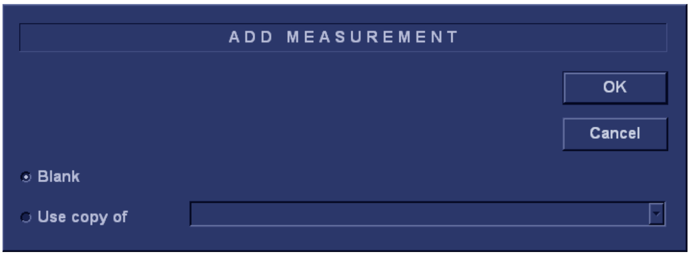
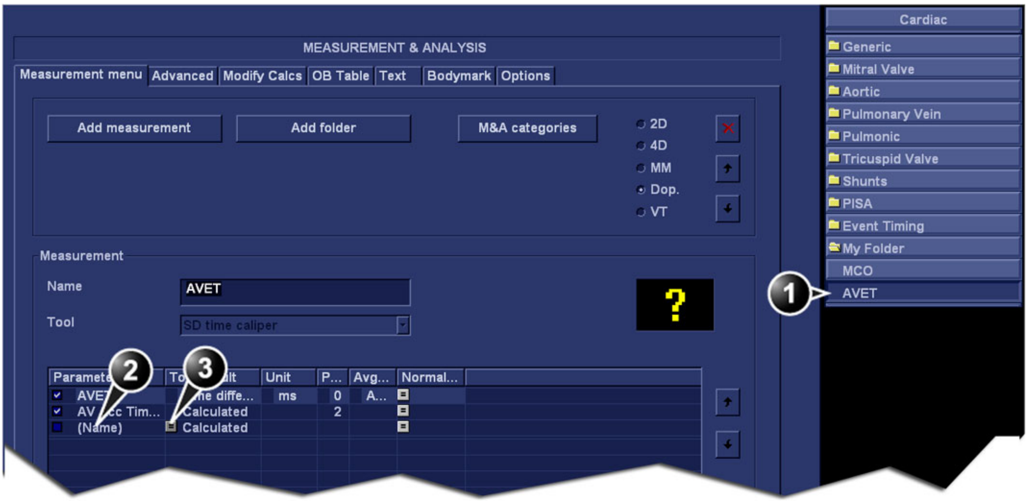


Figure 5-46. The Add measure window

3. MCO and AV ET are measurements that already exist on the system, check **Use copy of** and select **MCO** from the drop down menu.
4. Select **OK** to add the MCO measurement.
5. Repeat steps 2 to 4 to add the AV ET measurement.

Creation of the formula



Name: AVET

Tool: SD time caliper

Paramet...	To...	...lt	Unit	P...	Avg...	Normal...
☑ AVE...		...ne diffe...	ms	0	A...	▤
☑ AV ...c Tim...		Calculated		2		▤
■ (Name)	▤	Calculated				▤

1. Select the last measurement.
2. Double click and enter the formula name.
3. Select “=” to create the formula.

Figure 5-47. The Measurement menu sheet

The formula for this example is as follows:
My LIMP = (MCO-AV ET)/AV ET

1. In the user-defined folder (e.g.”My folder”), select the last measurement created (e.g. AV ET).
2. Double-click **(Name)** in the last line in the *Parameter list* in the *Measurement menu* sheet.

3. Enter the name for the formula (e.g. My LIMP).
4. Select =.

   The *Edit formula* window is displayed.

Name: My Limp

Figure 5-48. The Edit formula window

5. Select “**(**“from the *Operators* drop-down menu.
6. In the *Doppler* drop-down list, select **MCO [My Folder, MCO]**.

   Make sure to select the measurement located in the user defined folder (e.g. “My Folder”).
7. Select “**-**“ from the *Operators* drop-down menu.
8. In the *Doppler* drop-down list, select **AV ET [My Folder, AVET]**.
9. Select “**)**“ from the *Operators* drop-down menu.
10. Select “**/**“ from the *Operators* drop-down menu.

NOTE: Operators may also be entered using the alphanumeric keyboard.

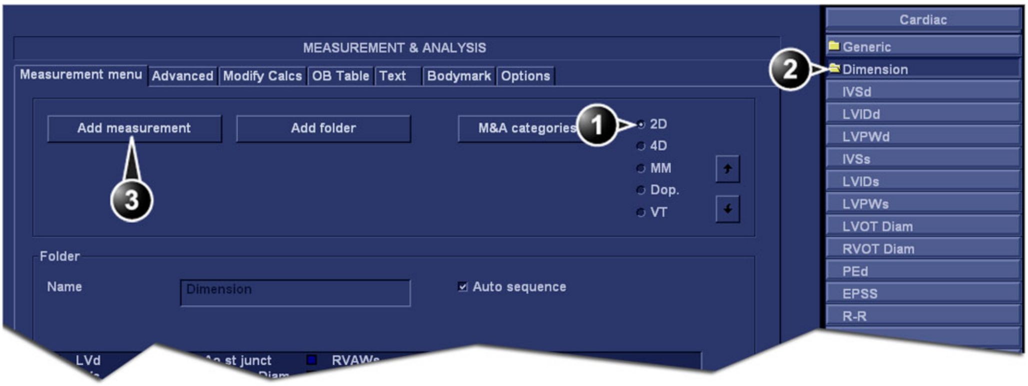
11. In the *Doppler* drop-down list, select **AV ET [My Folder, AVET]**.

    The Formula line should display: *({MCO}-{AVET})/{AVET}*.

    No units are necessary since the formula is a ratio (see also ‘About units’ on *page 5-83*).
12. Press **Check** to make sure that the syntax for the formula is correct.

User-defined measurements

Some user-defined formula may require measurements that do not exist on the system. The following example based on a generic distance measurement illustrates how to create user-defined measurements.



1. Select the appropriate scanning mode.
2. Select the appropriate folder.
3. Press Add measurement.

Figure 5-49. The Measurement menu sheet

1. Press **Config** (**F2**) and select the category **Measure**.
2. In the *Measurement menu* sheet, select the appropriate scanning mode for the measurement to be created (e.g. 2D).
3. Select the appropriate folder in the *Measurement menu* (e.g. Dimension).
4. Press **Add Measurement** in the *Measurement menu* sheet.

   The *Add measure* window is displayed.

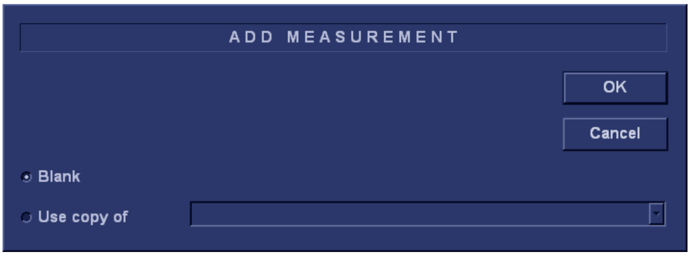
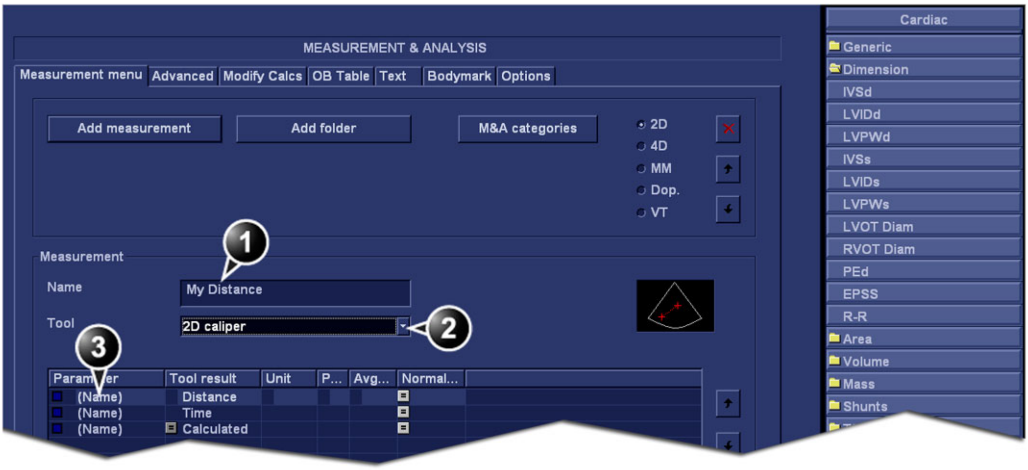


Figure 5-50. The Add measure window

5. Check **Blank** and press **OK**.

   The *Measurement menu* sheet is updated.



Name: My Distance

Tool: 2D caliper

Param er	Tool result	Unit	P...	Avg...	Normal...
(Name)	Distance			⊟	
(Name)	Time			⊟	
(Name)	⊟ Calculated			⊟	

1. Enter a name for the measurement.
2. Select the appropriate measurement tool.
3. Double click and enter the formula name.

Figure 5-51. The Measurement menu sheet

6. In the *Measurement menu* sheet, enter the name for the measurement (e.g. My Distance).
7. Select the appropriate measurement tool in the drop-down menu, next to **Tool** (e.g. 2D Caliper).
8. Double-click **(Name)** in the appropriate parameter (e.g Distance) and enter a name for the parameter (e.g. My Length).

   If desired change the unit and the number of decimals for the measurement by double clicking the values under *Unit* and *Precision* (see also ‘About units’ on *page 5-83*).

About units

Be aware of the following:

- All formulas are calculated in SI units (see table below).
- If no unit is specified in the *Edit formula* window when defining a formula, the displayed value will be in SI unit.

To define a different unit

1. When creating a formula, enter the unit to use when displaying the formula output. E.g. if Y in the formula Y=f(x) is to be displayed in cm, enter cm in the *Unit* field (see Figure 5-48 *on page 5-81*).

The *Unit* field is case sensitive, make sure to enter the exact unit as shown in the table below (Alternative unit column).

2. The output of a formula must always be in an SI unit (see table below). Conversion to the specified display unit is then done automatically.

   Example: an user wants to add a regression formula for estimating a length **B** from a measured length **A**, both in cm.

   The formula is: B = 2.4 + 1.1*A.

   - As **A** is a measurement value the system will enter the formula in the SI unit for length (m). The formula expects A in cm, and to get that, **A** must be multiplied by 100:

     B = 2.4 + 1.1*A***100**

   - The formula now gives **B** in cm. Converting the output from cm to the SI unit (m), is done by dividing by 100:

     B = (2.4 + 1.1*A*100)**/100**

   The output is now in m, and by entering this formula into the system the user gets the expected result. Measuring an **A** of 2 cm gives: B = (2.4 + 1.1*0.02*100)/100 = 0.046 m.

   Before display of the value it is converted according to the specified display unit (cm), and the system displays 4.6 cm. If the selected display unit was set to mm the formula would give the exact same output, 0.046 m, but the automatic unit conversion would now instead give a displayed value of 46 mm.

Calculation	SI	Alternative unit
Time	s	ms - msec - min - h
Ratio	%	
Frequency	bpm	
Angle	rad	deg - grad
Distance	m	cm - dm - cm - mm - inch - feet- pixels
Velocity	m/s	dm/s - cm/s - mm/s - inch/s
Acceleration	m/s^2	dm/s2 - cm/s2 - mm/s2 - inch/s2
Area	m^2	dm2 - cm2 - cm^2 - mm2 - inch2
Volume	m^3	dm3 - cm3 - l - dl - cl - ml - gallon - quart

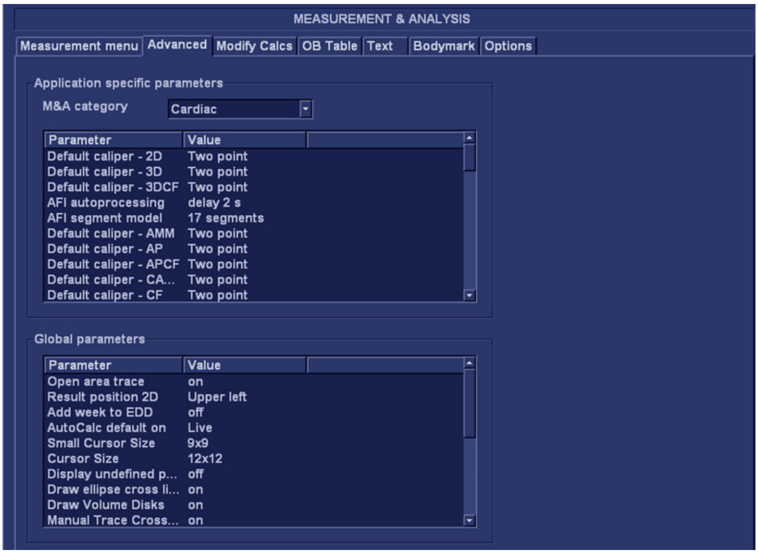
Calculation	SI	Alternative unit
Volume flow	m^3/s	dm3/s - cm3/s - l/s dl/s - cl/s - ml/s - m3/min dm3/min - cm3/min - l/min - L/min - dl/min cl/min - ml/min - ml/m2
Pressure	mm Hg*	Pa - kPa - bar - torr - atm - psi
Pressure/time	mm Hg/s	mmHg/s
Mass	kg	g - ounce - pound
Other		mmHG - Date - WeekDay - Day - NoUnit l/minm2 - g/m2 - cm/m2

* The correct SI unit for pressure is Pa, but here mm Hg was used as base unit as it is a standard pressure unit to use in medicine.

Advanced settings

The Advanced sheet

The *Advanced* sheet enables further configuration of the Measurement function. The settings are divided into application specific parameters and global parameters.



M&A category: Cardiac

Parameter	Value
Default caliper - 2D	Two point
Default caliper - 3D	Two point
Default caliper - 3DCF	Two point
AFI autoprocessing	delay 2 s
AFI segment model	17 segments
Default caliper - AMM	Two point
Default caliper - AP	Two point
Default caliper - APCF	Two point
Default caliper - CA...	Two point
Default caliper - CF	Two point

Parameter	Value
Open area trace	on
Result position 2D	Upper left
Add week to EDD	off
AutoCalc default on	Live
Small Cursor Size	9x9
Cursor Size	12x12
Display undefined p...	off
Draw ellipse cross li...	on
Draw Volume Disks	on
Manual Trace Cross...	on

Figure 5-52. The Advanced sheet

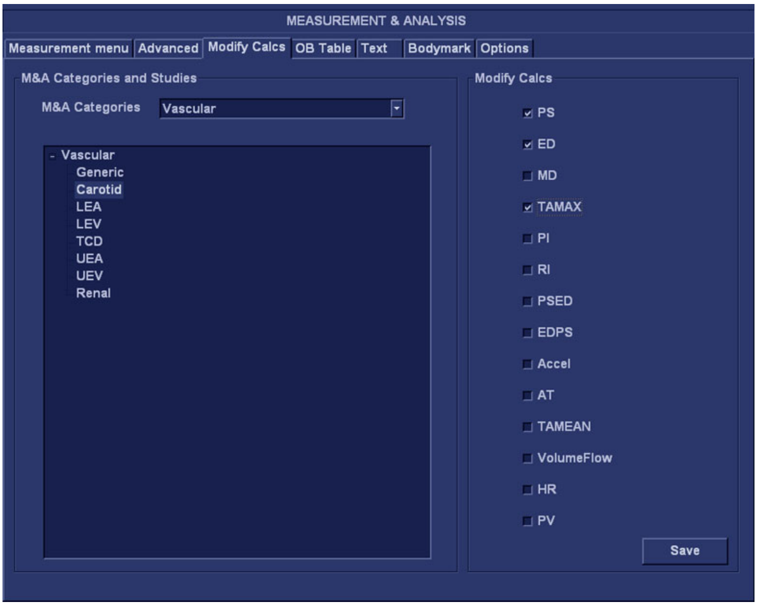
1. If configuring application specific parameters, select an application from the *M&A category* pull-down menu.

2. Select the configuration value next to the parameter to configure.

   A pull-down menu is displayed.
3. Select a new value from the pull-down menu.

The Modify calculations sheet

The *Modify calculation* sheet is used to configure the calculations to be performed when doing a Doppler vascular measurements.



M&A Categories: Vascular

☑ PS
☑ ED
☐ MD
☑ TAMAX
☐ PI
☐ RI
☐ PSED
☐ EDPS
☐ Accel
☐ AT
☐ TAMEAN
☐ VolumeFlow
☐ HR
☐ PV

Figure 5-53. The Modify calculations sheet

The following example describes how to configure the Carotid Doppler calculations.

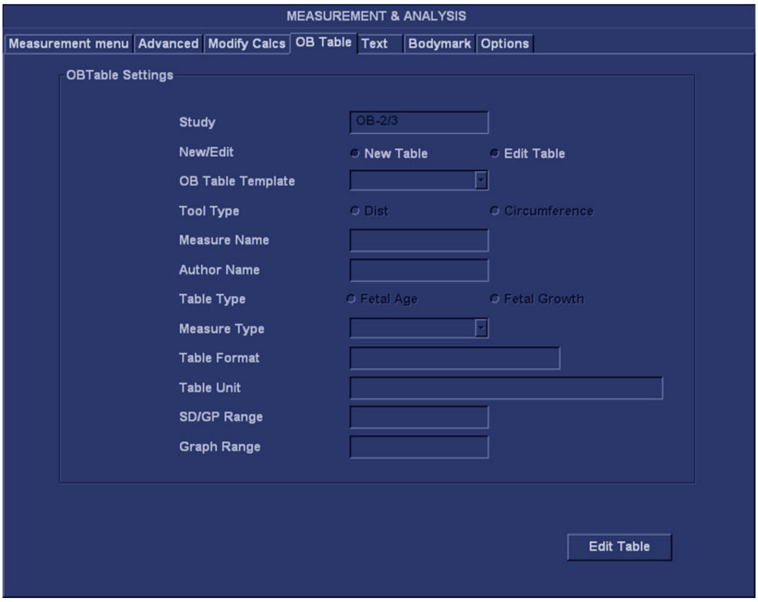
1. In the *Modify calculations* sheet, select **Vascular** next to *M&A Categories*.

   The *Vascular measurement category* is displayed.
2. Select **Carotid**.

   The available calculations are displayed.
3. Check the desired calculations to be performed.
4. Select **Save**.

The OB table sheet

The OB table sheet enables the creation and edition of user-defined OB tables.



Study: OB-2/3

Figure 5-54. The OB table sheet

The following example describes how to create a fetal age OB-2/3 table based on Bi Parietal Diameter measurements.

1. In the *Measure/Text category*, select the **Measurement menu**.
2. In the *Measurement menu* sheet, select **2D** mode.
3. Select the **OB table** sheet.
4. In the *Measurement* menu, select the category **Obstetrics** and the **OB-2/3** measurement study.
5. In the *OB table* sheet, check **New table.**
6. Enter or select the following:
    - **OB Table Template**: when creating a new OB table, select Template (1 - 7) which you want to use as the basis of the user programmable OB Table (see page 5-89).

      When editing an existing user OB table, select the desired OB table to edit.
    - **Tool type**: Select the type of measurement (e.g. Distance)

- **Measure Name**: type the name of measurement that will display in the *Measurement* menu (e.g. My BPD Measure).
- **Author Name**: Type the author's name (e.g. My Name).
- **Table Type**: If necessary, select the table type (e.g. Fetal Age).
- **Measure type**: select the desired measurement (e.g. BPD).

7. Select **Edit table**.

   The OB Table spreadsheet is displayed, showing the table template selected.
8. Enter the Min, Max and Interval values in the *Parameters* field.

   The system automatically fills in the *MEAS column*.
9. Enter the input values for the *MEAN* and *SD columns*.
10. Select **Exit to save**.

The OB table templates

Template 1 (based on Hadlock)				
Fetal age	format:	MEAS	MEAN	SD
	Unit:	mm	week	week
	Table range:	1 SD		
	Graph range:	1 SD		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	Min:	[#w#d]		
	Max:	[#w#d]		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	week	mm	week
	Others are same as above			

Template 2 (based on Tokyo)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	day	day
	Table range:	1 SD		
	Graph range:	1 SD		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	SD:	[day (+/-)]		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	day	mm	day
	Others are same as above			

Template 3 (based on Osaka)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	day	mm
	Table range:	1 SD		
	Graph range:	1 SD		

Template 3 (based on Osaka)				
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	SD:	[(mv-pv)/sd]		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	day	mm	day
	Others are same as above			

Template 4 (based on several European tables)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	weekday	mm
	Table range:	5%–95%		
	Graph range:	5%–95%		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	weekday	mm	day
	Others are same as above			

Template 5 (based on several European tables)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	weekday	mm
	Table range:	1 SD		
	Graph range:	5%–95%		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	weekday	mm	day
	Others are same as above			

Template 6 (based on several European tables)					
Fetal age	Format:	MEAS	MIN	MEAN	SD
	Unit:	mm	weekday	weekday	weekday
	Table range:	10%–90%			
	Graph range:	10%–90%			
Measurement result	Value:	[cm]			
	GA:	[#w#d]			
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.			
Fetal growth	Format:	AGE	MIN	MEAN	SD
	Unit:	weekday	mm	mm	mm
	Others are same as above				

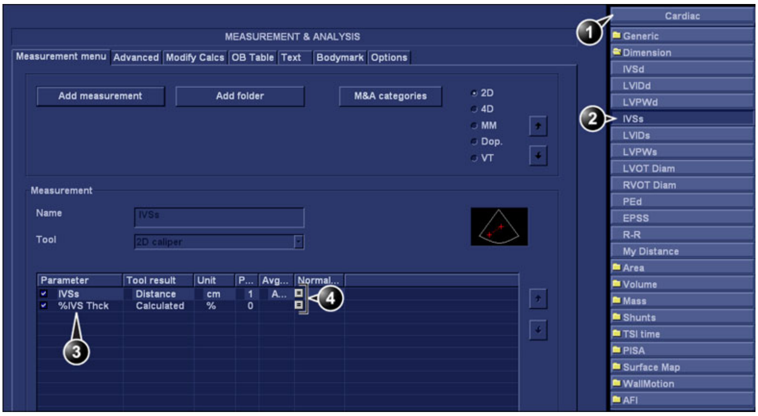
Template 7 (based on several European tables)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	weekday	mm
	Table range:	1 SD		
	Graph range:	10%–90%		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	weekday	mm	mm
	Others are same as above			

Normal values

Normal values can be defined by the user for all parameters. A Normal value can be either a range or a threshold. Normal values entered are grouped by measurement category (e.g. Cardiac, Pediatrics...etc).

Normal values are displayed in the report if the report template used is configured to display normal values (see page 9-30).

To define a Normal value



Name IVSs

Tool 2D caliper

	Parameter	Tool result	Unit	P...	Avg...	Normal...
☑	IVSs	Distance	cm	1	A...	⊟
☑	%IVS Thck	Calculated	%	0		⊟

1. Measurement category
2. Selected measurement
3. Parameters
4. Press to define Normal value

Figure 5-55. Adding Normal value

1. Press **Config** (**F2**) and select the Config category **Measure/Text**.

   The *Measurement menu* sheet is displayed (Figure 5-55).

2. In the *Measurement* menu, browse to the measurement of interest.

   The parameters for the selected measurements are displayed in the *Measurement menu* sheet.

*NOTE: To change Measurement category, press the **Heading** in the Measurement menu and select another Measurement category.*

3. Select ⊟ in the *Normal value column*.

   The *Normal value* window is displayed.

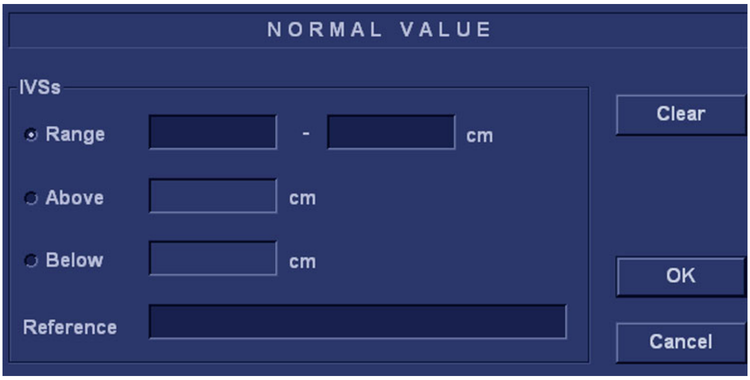


Figure 5-56. The Normal value window

4. In the *Normal value* window:
   - Select the Normal value type (Range, Above or Below).
   - Type in the Normal value.
   - Optionally enter a reference for the Normal value.
5. Select **OK**.

   The Normal value is displayed in the *Measurement menu* sheet.

To display Normal values and references in the Report, the Report template must be configured to show Normal values (see ‘Normal values’ on *page 5-91*). Measurements outside the Normal value are highlighted with an “!” in the report.

Measurement result table

The display of the *Measurement result* table can be minimized and moved to prevent the table obscuring parts of the ultrasound image.

Minimizing the Measurement result table

1. Select ● on the heading of the *Measurement result* table.

   The *Measurement result* table is minimized to the heading bar.

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

Moving the Measurement result table

1. Select ✥ on the heading of the *Measurement result* table.
2. Move the table.
3. Press the Left mouse button to anchor the table.

NOTE: *Alternative: adjust* ***Move Result Win*** *on the Control panel to move the Measurement result table around the screen.*

Deleting measurements

1. Select the measurement to delete in the *Measurement result* table.
2. Select **Delete measurement** in the context menu.

Chapter 6

Stress Echo

This chapter describes:

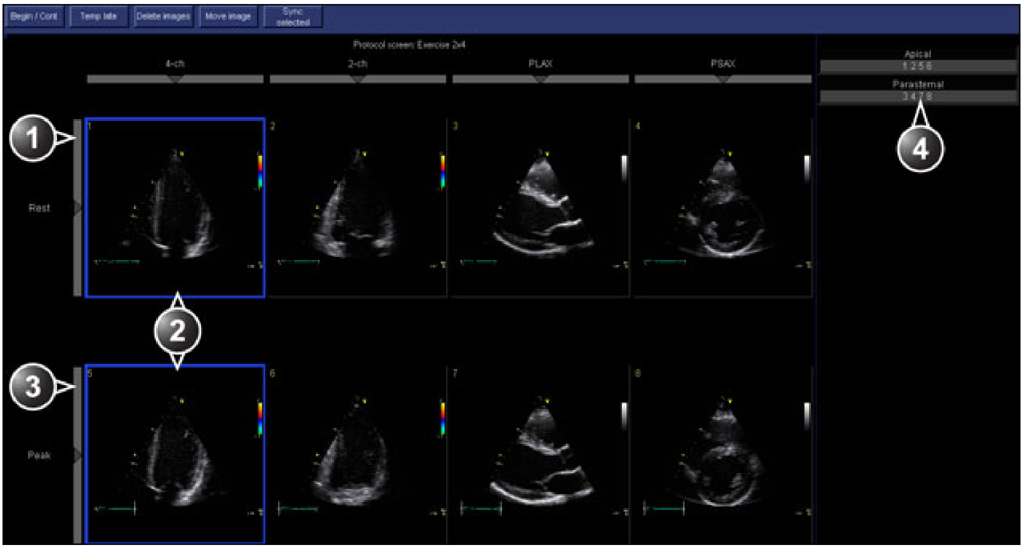
Introduction

The EchoPAC Software Only 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 user’s 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.



1. Level selection
2. Selected loops
3. Projection selection
4. Group of views

Figure 6-1. The Protocol screen

Image selection for analysis

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

Selection of images from a group

If groups of images have been defined in the protocol template (see page 6-24), the user can select a group of images for analysis and sequentially analyze all images from all groups from within the *Analysis* screen (see Figure 6-3 *on page 6-7*).

1. Move the Mouse cursor over a group in the *Group* list.

   The frame of the images belonging to the group are highlighted.
2. Press the Left mouse button to open the images in the *Analyze* screen (see page 6-7).

1. **Select a Projection**
2. Select an image
3. Select and open an Image group

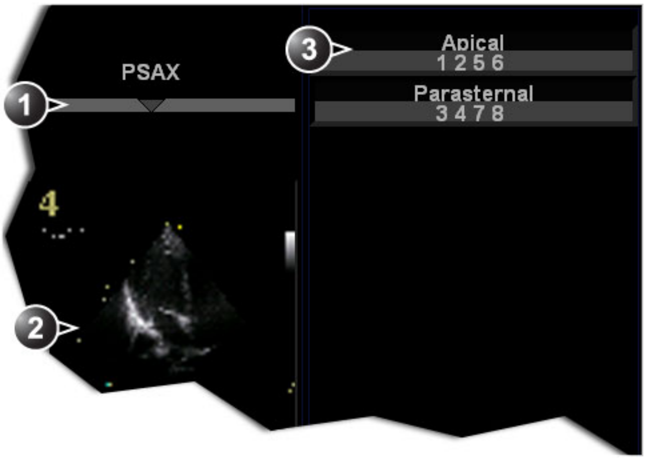


Figure 6-2. Image selection from the Protocol screen

Manual selection of images in the Analysis screen

1. When currently in protocol analysis in the *Stress analysis quad* screen (Figure 6-3), hold down **Shift** while selecting the images on the clipboard on the stress template matrix.
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 **Shift**.

Manual selection of images in the Protocol screen

1. In the *Protocol* screen, click once on the images of interest.
2. Press **Analyze** to open images in the *Analyze* screen (see page 6-7).

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

Loop synchronization

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 scores to each cardiac segment, in order to quantify the function of the muscle, or wall motion.

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

Wall motion scoring is used to evaluate wall motion in each cardiac segment. The left ventricle myocardium is divided into a number of segments (e.g. 16 or 18), and each segment is assigned a score based on visual evaluation/”eye-balling”. The wall motion scoring results are linked to the stress level of the image being evaluated. This means that for instance when scoring a short axis projection and a long axis projection from the same stress level, then common segments with the same scoring value will be shown in the respective scoring diagrams.

CAUTION The wall motion scoring result is assigned to the stress level of the image, but will not be updated if the image is moved to another stress level in the protocol at a later time. Images should be correctly placed in the protocol when performing wall motion scoring.

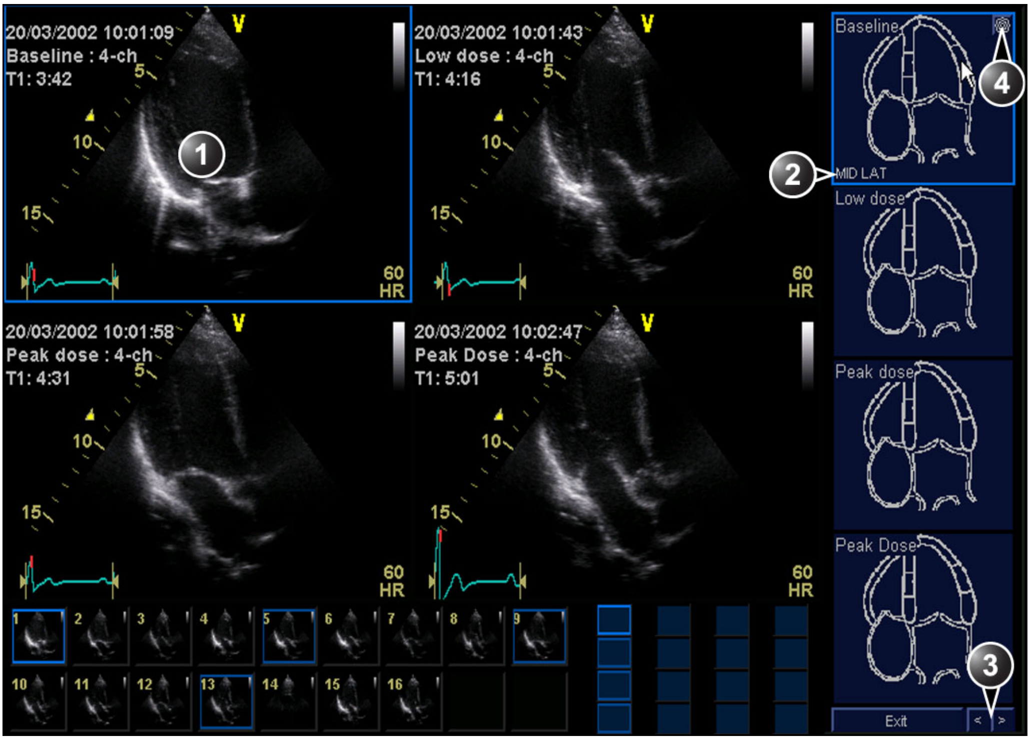
NOTE: *The number of segments (WMS segment model), the range of scoring values (WMS scoring legend) and the initial scoring value (WMS initial scoring) may be configured in Config/Meas Text/Advanced under the Cardiac M&A category.*

Conventional Stress Echo acquisition

Starting analysis

1. From The *Protocol* screen (see Figure 6-1 *on page 6-3*), select the first image group.

   The *Stress Echo analysis* screen is displayed (see Figure 6-3) showing the first four images and the corresponding scoring diagrams.



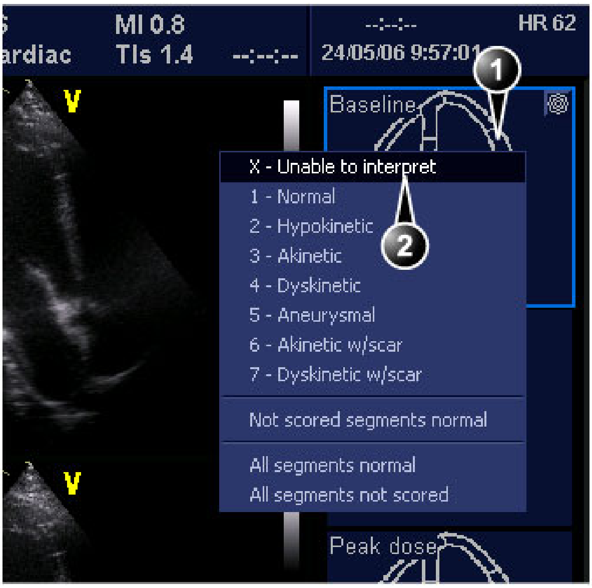
1. Selected loop (highlighted frame)
2. Highlighted segment name (see pointer)
3. Change page or enter next image group
4. Display Bull's eye diagram

Figure 6-3. The stress echo analysis screen (Quad screen)

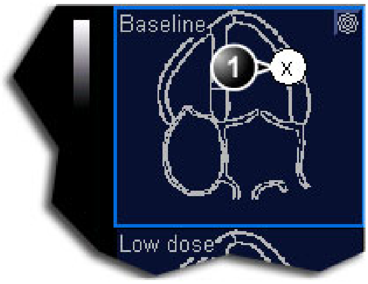
Wall motion scoring

1. Click on a **segment** in one of the scoring diagrams.

   The *Score pop-up list* is displayed (see Figure 6-4).
2. Select the **score** from the *Score* popup list. The score is displayed in the relevant segment area in the diagram.
3. Repeat the operation 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 6-4. 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 Control panel is displayed.
2. Select a loop.
3. If necessary, press **Stop** to freeze the image and scroll through the cineloop using the **Frame slider** to display the desired image.
4. Adjust the image controls to optimize the display.
5. Check **Apply to all** if global adjustment is desired.

Zoom function

The image can be magnified as described in 'Zoom function' on *page 4-16*.

Multi-plane Stress Echo analysis

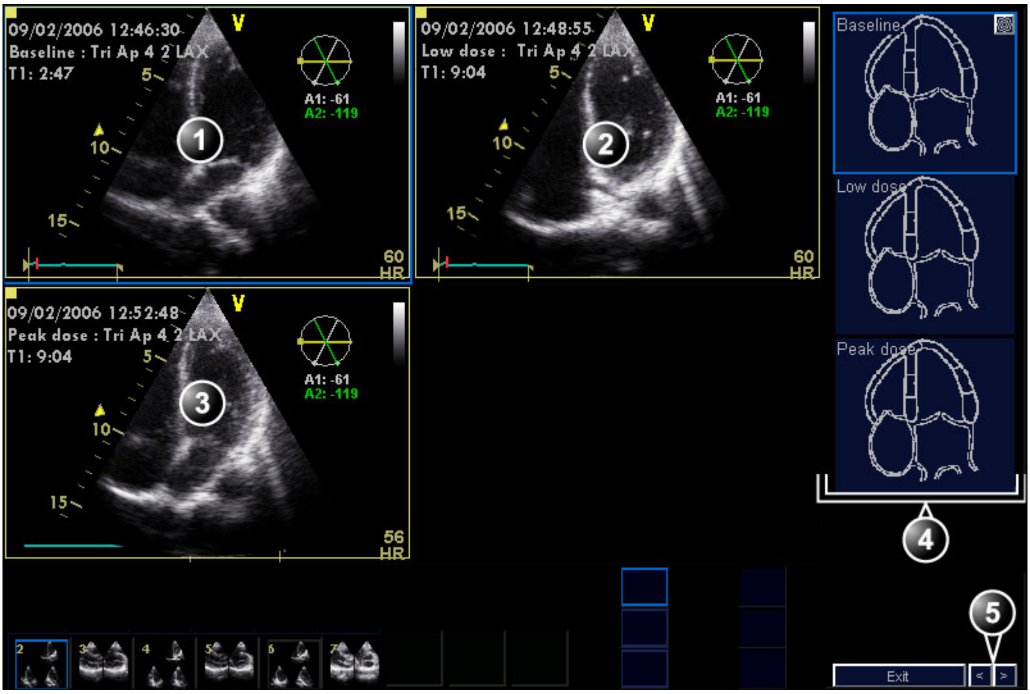
This section describes the basic procedure for image analysis of Multi-plane Stress Echo acquisition. In a Multiplane Stress Echo acquisition each cell in the template contains simultaneous acquisitions of several projection planes.

The example below is based on the following Pharm. 4x2 Multiplane factory template. This template consists of:

- Four levels: Baseline, Low dose, Peak dose and Recovery
- Two columns:

  - A Tri-plane mode column with simultaneous acquisition of Apical 4 chamber, Apical 2 chamber and Apical long axis views.

  - A Bi-plane mode column with simultaneous acquisition of Parasternal long axis and Parasternal short axis views.



1. Scan plane 1 (yellow): Apical 4 chamber, Baseline
2. Scan plane 1 (yellow): Apical 4 chamber, Low dose
3. Scan plane 1 (yellow): Apical 4 chamber, Peak dose
4. Corresponding Wall segment diagrams
5. Previous next images/group

Figure 6-5. Multi-plane Stress Echo analysis screen (Apical group, 4 chamber acquisition)

1. When starting analysis, the *Stress echo analysis* screen is displayed, showing the first scan plane from the images in the first group (Apical 4 chamber for all levels, acquired in scan plane 1 (yellow) in Tri-plane mode) and the corresponding wall segment diagrams.
2. Perform segment scoring.
3. Select the **Right arrow** in the lower right corner of the screen to display the next scan planes from the images in the first group (Apical 2 chamber for all three levels, acquired in scan plane 2 (white) in Tri-plane mode).
4. Perform segment scoring.
5. Select the **Right arrow** in the lower right corner of the screen to display the next scan planes from the images in the first group (Apical long axis for all three levels, acquired in scan plane 3 (green) in Tri-plane mode).
6. Perform segment scoring.

7. Select the **Right arrow** in the lower right corner of the screen to display the first scan plane from the images in the second group (Parasternal long axis for all three levels, acquired in scan plane 1 (yellow) in Bi-plane mode).
8. Perform segment scoring.
9. Select the **Right arrow** in the lower right corner of the screen to display the next scan planes from the images in the second group (Parasternal short axis for all three levels, acquired in scan plane 2 (white) in Bi-plane mode).
10. Perform segment scoring.
11. Press **Patient** and select **End Exam**.

    The examination is stored.

4D Stress Echo analysis

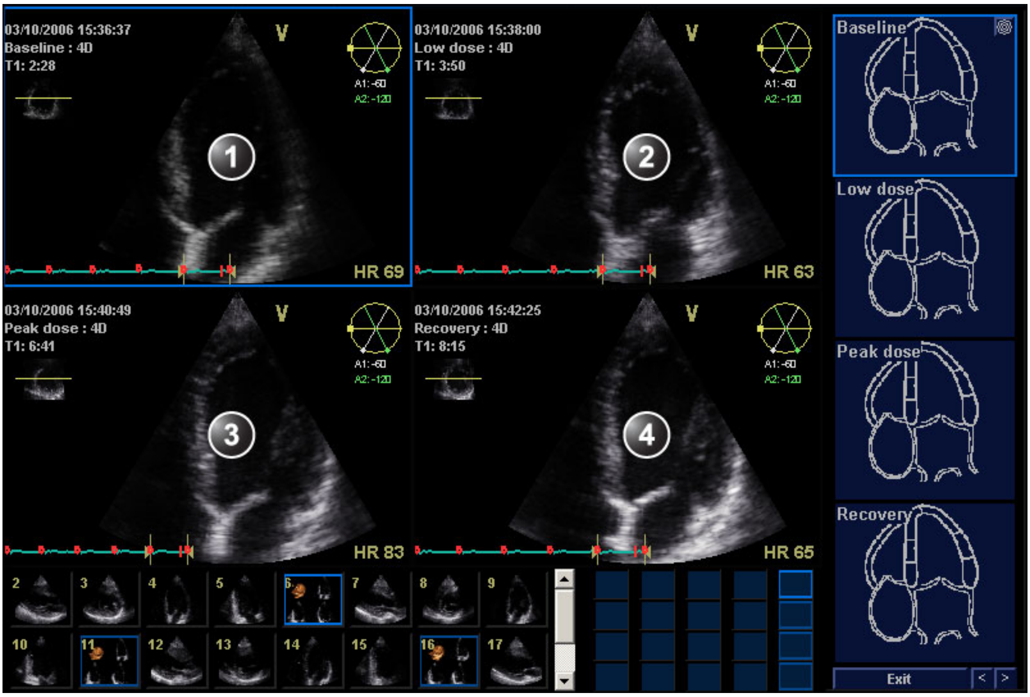
This section describes the basic procedure for image analysis of 4D Stress Echo acquisition based on the Pharm. 4x1 4D factory template. This template consists of:

- Four levels with 4D acquisition: Baseline, Low dose, Peak dose and Recovery
- One column (projection) with 4D acquisition.

The 4D Stress analysis consists of:

- Apical views analysis: segment scoring from 4 chamber, 2 chamber and Apical long axis views for all stress levels
- Short axis views analysis: segment scoring from apex, mid and basal Short axis views for all stress levels.

4D Stress Apical analysis



1. Baseline Apical 4 chamber view
2. Low dose Apical 4 chamber view
3. Peak dose Apical 4 chamber view
4. Recovery Apical 4 chamber view

Figure 6-6. 4D Stress Echo analysis screen (Apical 4 chamber view)

1. When starting analysis, the *Stress echo analysis* screen is displayed, showing the Apical 4 chamber for all stress levels and the corresponding wall segment diagrams.
2. If required, adjust **Rotation** to rotate the scan plan to get an optimal Apical 4 chamber view. The rotation is applied simultaneously in all views.
3. Perform segment scoring.
4. Select the **Right arrow** in the lower right corner of the screen or **Review page** to display the Apical 2 chamber for all stress levels. The segment diagrams are updated accordingly.
5. If required rotate the scan planes and perform scoring.
6. Select the **Right arrow** in the lower right corner of the screen or **Review page** to display the Apical long axis for all

stress levels. The segment diagrams are updated accordingly.

7. If required rotate the scan planes and perform scoring.
8. Select the **Right arrow** in the lower right corner of the screen or **Review page**, the Short axis apex view and corresponding segment diagram for all stress levels are displayed.

4D Stress Short axis analysis

1. Baseline short axis apex view
2. Low dose short axis apex view
3. Peak dose short axis apex view
4. Recovery short axis apex view
5. Indicator window, the green bar indicates the position of the current short axis view. Can be translated simultaneously in all views.
6. Indicator window, the yellow bars indicate upper and lower slices. Can be adjusted individually in each stress level view.

Figure 6-7. 4D Stress Echo analysis screen (Short axis apex view)

1. The default position for the short axis apex view is at 17% from the upper slice toward the lower slice. Adjust **Translate** to translate the short axis apex view up or down. The translation is applied in all stress level views simultaneously.

NOTE: *If the upper slice is placed at the top of the apex and the lower slice is placed at the bottom of the basal segments, then the position at 17% from the upper slice will show the center of the apical segment.*

The upper and lower slices may be adjusted individually in each stress level view. Adjust the corresponding **Top** and **Bottom** controls to set the upper and lower slices.

The positions of the upper and lower slices and the current view can be visualized in the *Indicator* window.

2. Perform segment scoring.
3. Select the **Right arrow** in the lower right corner of the screen or **Review page** to display the short axis mid view for all stress levels.

   The default position for the short axis mid view is at 50% from the upper slice toward the lower slice. Adjust the short axis mid view and top/bottom slices as described in step 1 above.
4. Perform segment scoring.
5. Select the **Right arrow** in the lower right corner of the screen or **Review page** to display the short axis basal view for all stress levels.

   The default position for the short axis basal view is at 83% from the upper slice toward the lower slice. Adjust the short axis basal view and top/bottom slices as described in step 1 above.
6. Perform segment scoring.
7. Press **Archive** and select **End Exam**.

   The examination is stored.

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.

The ultrasound unit 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.

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 6-20). 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 note).

NOTE: Velocity measurements in mid and basal segments of the myocardium will contain contributions from the apical region of the myocardium. E.g. if measured value in a mid segment is below the cutoff value for this segment then this might relate to a reduced function in the mid or apical region.

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 6-20).

Three different analysis tools based on TVI data are available:

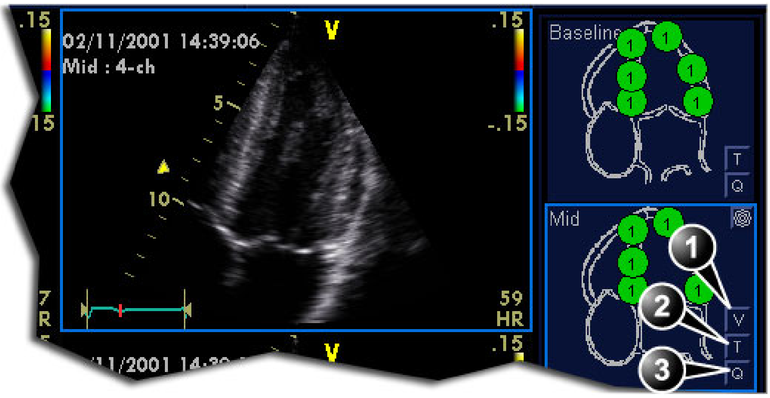
- **'Vpeak measurement' on *page 6-17***, enables the display of a tissue velocity trace for a selected region of a previously scored segment through the entire heart cycle. In addition Vpeak is color-coded on the 2D image. From the velocity trace, the user can estimate the peak systolic velocity (see reference 1 on page 6-20).

  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 6-20***, enables visualization of the systolic contraction of the heart by color-coding the myocardial displacement through the systole.
- **'Quantitative analysis' on *page 6-20***, enables further quantitative analysis based on multiple tissue velocity traces.

  The quantitative analysis is described in Chapter 'Quantitative Analysis' on *page 7-1*.

Accessing QTVI Stress analysis tools

The three QTVI Stress analysis tools are entered by pressing a dedicated button on the scoring diagram (see Figure 6-8) 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 6-8. QTVI 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 6-20) 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 currently highlighted segment* for the current level and projection view.

To display a Vpeak measurement

1. Perform segment scoring as described on page 6-7.

   When performing scoring in 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 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 6-9).
- Color-coded velocity in tissue. The color-coding convention is as follow:

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

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

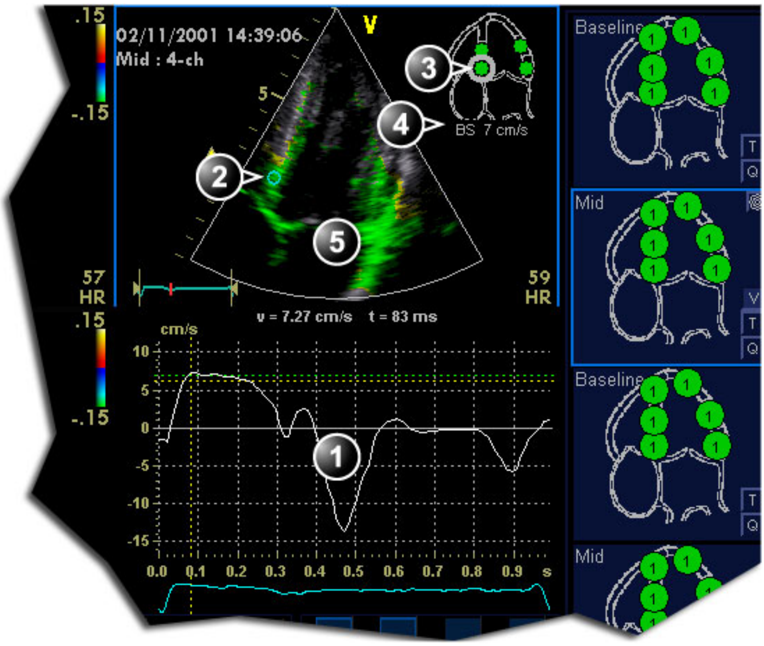
  - **White**: Velocities below threshold value - 5%
- A result window to display tissue velocity profile, shown when moving the sampling area in the view.

3. In the 2D sector, place 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 6-9).
4. Use **Segment Select** to analyze the other segments in the peak view,

   Or

   Select another scoring bullet in the diagram in one of the peak views.



1. Tissue velocity profile
2. Sampling point
3. Current segment
4. Vpeak threshold for current segment
5. Color-coded tissue velocity:

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 6-9. Vpeak QTVI Stress display

Turn-off the Vpeak measurement tool

1. Select the **V** button in the peak view scoring diagrams.

V-peak measurement interpretation

The systolic Vpeak in the tissue velocity profile is automatically detected and highlighted by a vertical bar (see Figure 6-9). The automatically detected Vpeak should be visually verified by the user. In addition Vpeak thresholds are displayed as color-coded horizontal lines (see Figure 6-9). 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 6-20). 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 6-9).

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 at peak levels.

To display Tissue Tracking

1. Press **T** in one of the *Wall segment diagram* field (usually an apical view at peak level).

   The Tissue Tracking color overlay is displayed in the *Acquisition* window.

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 ‘Quantitative Analysis’ on *page 7-1*.

To start quantitative analysis

1. Press **Q** in one of the *Wall segment diagram* field (usually an apical view at peak level) to launch the Quantitative analysis package (see page 7-1).

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 Stress Echo protocol 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.

Multi-plane Stress Echo requires specially designed template, see page 6-25 for more information.

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

- Adding/deleting levels and projections, page 6-22
- Assigning new labels to levels and projections, page 6-23
- Defining level options, page 6-23
- Defining new groups, page 6-24

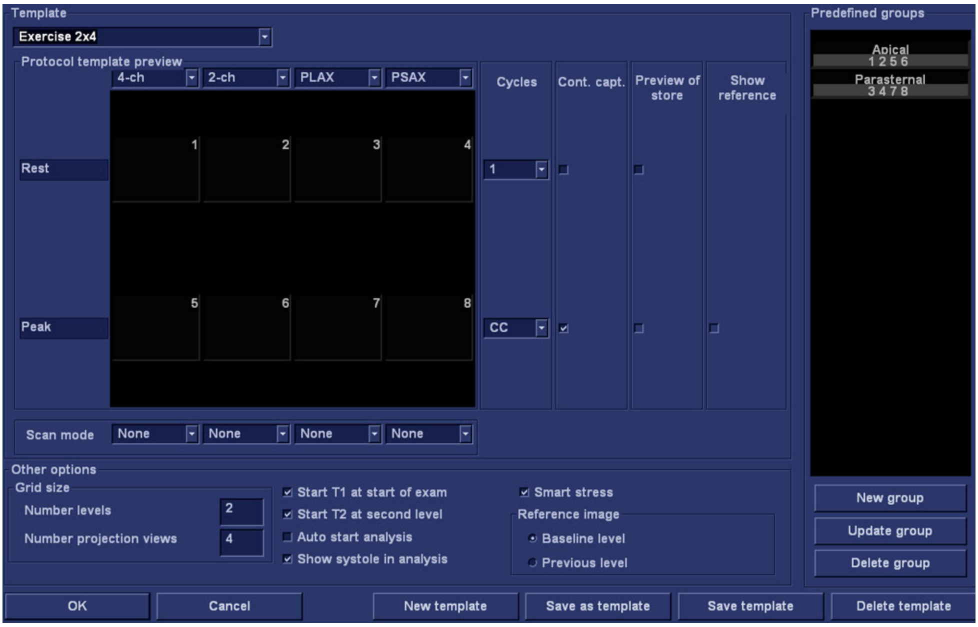
Templates are edited/created from the *Template editor* screen.

Entering the Template editor screen

1. Press **Protocol** to enter the stress echo mode.
2. Press **Template**.

   The *Template* menu is displayed.
3. Select **Template Editor**.

   The *Template editor* screen is displayed (see Figure 6-10).



Template: Exercise 2x4

Rest: Cycles 1, ☐ Cont. capt., ☐ Preview of store

Peak: Cycles CC, ☑ Cont. capt., ☐ Preview of store, ☐ Show reference

Scan mode: None, None, None, None

Number levels 2

Number projection views 4

☑ Start T1 at start of exam

☑ Start T2 at second level

☐ Auto start analysis

☑ Show systole in analysis

☑ Smart stress

Reference image

● Baseline level

○ Previous level

Figure 6-10. The Template editor screen

Editing/Creating a template

Selecting a base template to edit

1. From the *Template* drop-down menu on the upper left corner of the *Template editor* screen select a base template to edit.

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

The selected template is displayed in the *Protocol template preview* field, showing the levels and projections and their labels.

Adding/deleting levels and projections

1. Enter the number of levels and projections in the *Grid size* field (see Figure 6-10).

   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.

NOTE: Factory templates cannot be changed.

Scan mode selection

1. From the **Scan mode** drop-down menu, select a scan mode (e.g. 4D real time or gated, color... etc.) to be associated to the actual column (projection).

Display timer(s)

1. Check the box(es) to display timer(s) as specified (see Figure 6-10).

Start analysis automatically

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

Smart stress

Check **Smart stress** to store a subset of the image acquisition settings (e.g. geometry, 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.

Assigning new labels to levels and projections

1. Select a label from the *Label* drop-down menu or type a new label.

Configuring levels

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

1. In the *Pre-defined group* field, select the group to edit.
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

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.

Multi-plane Stress Echo Template setup

The following example describes the creation of a Multi-plane Stress Echo pharmacological protocol template consisting of:

- Three levels:
  - Baseline
  - Low dose
  - Peak dose
- Two columns:
  - A Tri-plane mode column with simultaneous acquisition of Apical 4 chamber, Apical 2 chamber and Apical long axis views.
  - A Bi-plane mode column with simultaneous acquisition of Parasternal long axis and Parasternal short axis views.

1. In the *Grid size* field, adjust the **Number of levels** to three and the **Number of projection views** (columns) to two.
2. From the *Label* drop-down menu of the first column select the label **Tri Ap 4 2 LAX**.

   With this setting the system will automatically launch the Tri-plane mode enabling simultaneous acquisition of Apical 4 chamber, 2 chamber and Long axis views in all levels in the first column.
3. From the *Label* drop-down menu of the second column select the label **Bi PLAX SAX-PM**.

   With this setting the system will automatically launch the Bi-plane mode enabling simultaneous acquisition of Parasternal long axis and short axis views in all levels in the second column.
4. Enter the labels for the three levels.
5. Make sure that **Smart stress** is checked. This will ensure that all acquisition settings defined at Baseline will be preserved in the next levels, including rotation and tilt angle settings.
6. Delete any existing predefined groups (in case the template is based on an existing template with groups already defined).
7. Select all the views from the first column and select **New group**.

   The *Group name* window is displayed.

NOTE: *You should not mix bi-plane and tri-plane recordings in the same analysis group.*

8. Give the group a name (e.g. Apical) and press **OK**.
9. Likewise create a group for all the views from the second column (e.g. Parasternal).
10. Adjust the other settings as required (see ‘Editing/Creating a template’ on *page 6-22* for additional information.
11. Select **Save as template** and give the template a name (e.g Pharm. 3x2 Multiplane).
12. Select **OK** in the *Template editor* screen.

    The new template is selected and the *Protocol* screen is displayed.

Chapter 7

Quantitative Analysis

This chapter describes:

Introduction

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

CAUTION

Q Analysis is only recommended for adult cardiac images acquired with the following probes: M5Sc-D, M5S-D, 6T, 6Tc, 3V-D, 4V-D or 6VT-D. The measurement accuracies of the quantitative values reported in the Reference manual are verified with these probes.

The main features of these options are:

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

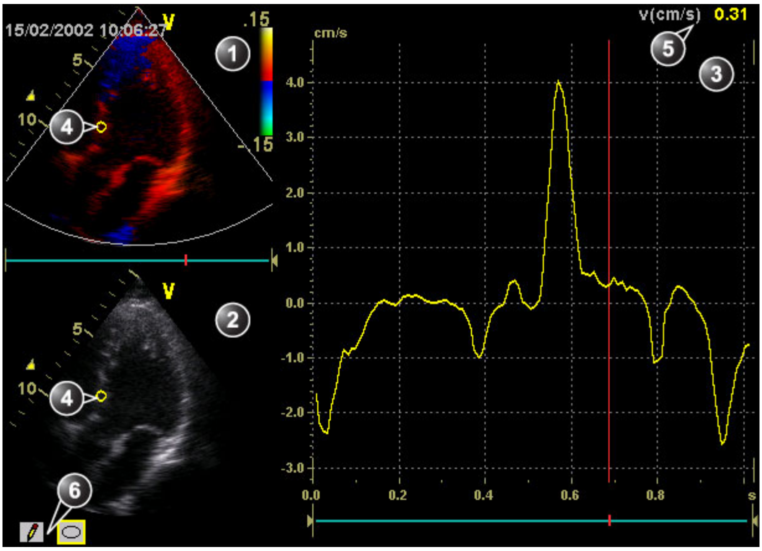
Starting Q Analysis

1. Open an examination and select a TVI or a contrast loop.
2. Press **Q Analysis**.

   The *Quantitative Analysis* screen is displayed (see Figure 7-1).

Q Analysis overview

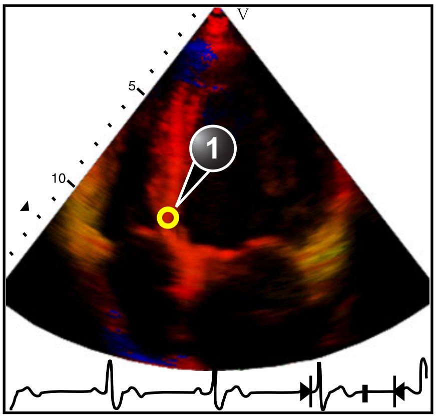
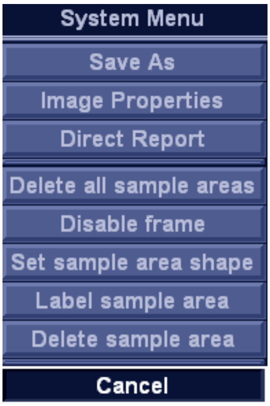
Q Analysis screen



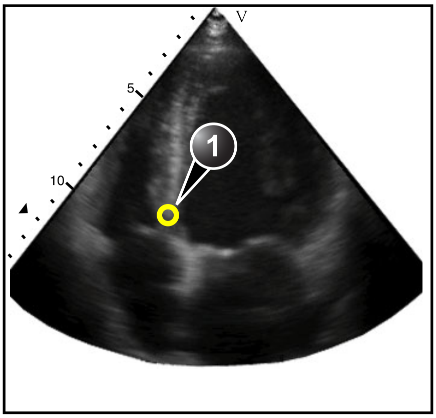
1. Color cineloop window
2. Tissue cineloop window
3. Analysis window
4. Sample area
5. Time and velocity at cursor position
6. Sample area tools

Figure 7-1. Quantitative analysis window (here with TVI data)

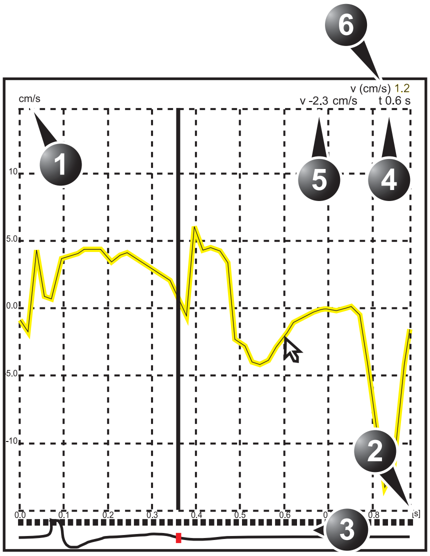
The Color cineloop window

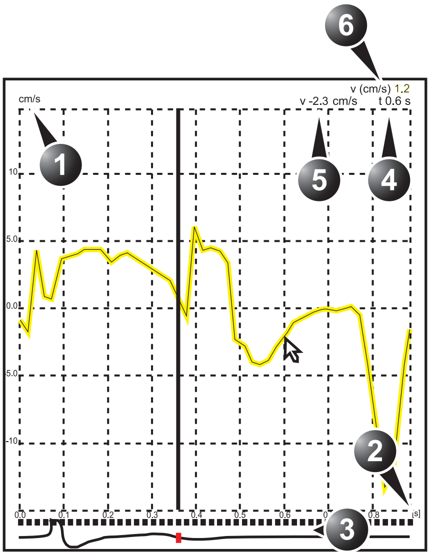
	Displays TVI, Tissue Tracking, Strain, Strain rate or Angio color-coded data. **Sample area (1):** Indicates sampling position of the velocity (TVI), displacement (Tissue Tracking), percent deformation (Strain), deformation rate (Strain rate) or intensity (Contrast) trace. The sample area is color-coded: the first sample area is yellow, the second blue...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 displayed by pressing the right mouse button when the cursor is in the 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 mouse 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 Sample area**[c]: delete the selected sample area. • **Delete anchor**[c]: remove anchoring from a dynamic sample area (see also page 7-8 and page 7-9). • **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 blue...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 7-12)

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)

[a] With contrast data only.

[b] Shown only in zoom mode.

The analysis window *System* menu:
This menu is displayed by pressing the right mouse button when the cursor is in the *Analysis* window.

- **Delete all Sample areas**: removes all traces at once.
- **Analysis signal**: toggles trace display between velocity, displacement, strain rate, stain or greyscale intensity curves.
- **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)
- **Vertical auto-scaling**: selects between full unit range or a range according to the maximum and minimum values of the displayed trace(s).
- **Vertical unit**[a]: toggles between logarithmic (dB) and linear acoustical units (AU).
- **Line style**: selects between solid line only or solid line with square markers at each data point.
- **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.
- **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.

Using Q Analysis

Generation of a trace

Up to eight traces can be generated.

About the sample area

The sample area can be in three different states:

- **Free sample area**: freely moving sample area (QA cursor) before anchoring.

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

- **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 shape of the pre-defined sample area is configurable (see page 7-12).

1. If necessary, select the sample area **Shape button** ⬭.
2. Place the cursor in one of the *Cineloop* windows.

   The cursor is changed to a sample area (white circle).

   A preview of the trace is displayed in the *Analysis* window.
3. Press the **Left mouse button** to anchor the sample area.

   In this frame the sample area 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.

NOTE: *The trace and sample area are color-coded. First generated trace is yellow, second blue...etc.*

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. Place the cursor in one of the *Cineloop* windows.

   The 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)

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

1. Freeze the image and place a sample area over a region of interest.

   Note the anatomical location of the sample area.
2. 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.

   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.

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

5. Scroll through the cineloop and control that the sample area follows the moving anatomical structure.
6. Add anchored sample areas in several frames to obtain a more accurate displacement of the sample area.

To move a dynamic anchored sample area

1. Freeze the image.
2. Scroll through the cineloop to display one of the frames where the sample area was anchored.

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

3. Select the sample area to move, in one of the *Cineloop* windows.

   The sample area is unanchored.
4. Drag the sample area to a new location.
5. 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 sample areas**.

To delete one specific trace

1. Place the mouse cursor on the sample area to delete.
2. Press the **Right mouse button**.

   The *System* menu is displayed.
3. Select **Delete sample area**.

Frame disabling

Frame disabling excludes the actual frame from the cineloop display. Frame disabling is available only with contrast data.

Disabling frames

1. Select the **Frame marker** beneath the *Analysis* window (see Figure 7-2).

   The frame marker turns red (disabled frame).

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

Disabling successive frames at a time

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).

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

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 7-2).

   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.

Re-enabling all frames

1. Press the **Right mouse button** over the *Frame marker axis*.
2. Select **Enable all frames**.

   All previously disabled frames are re-enabled.

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

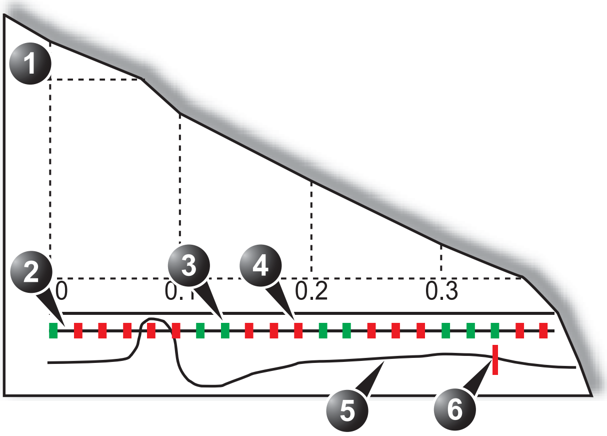


Figure 7-2. Frame disabling

Optimization

Optimizing the sample area

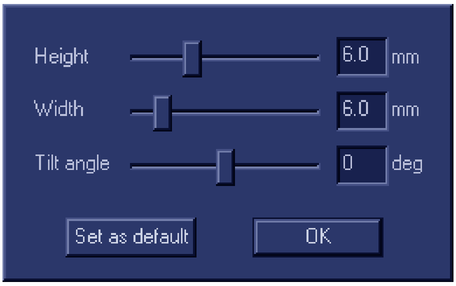
The sample area can be reshaped and labelled.

Reshaping a sample area

1. Place the cursor on the sample area to reshape.
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 7-3).



Height 6.0 mm

Width 6.0 mm

Tilt angle 0 deg

Figure 7-3. 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* window 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 cursor on the sample area to label.
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 (see Figure 7-4).
4. Type a name for the sample area.
5. Press **OK** to return to the *Quantitative analysis* screen.

Figure 7-4. The sample area labelling window

Trace display

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).

1. Press the **Right mouse button** in the *Analysis* window.

   The *System* menu is displayed.
2. Select **Vertical auto-scaling**.

   The *Vertical auto-scaling* menu is displayed.

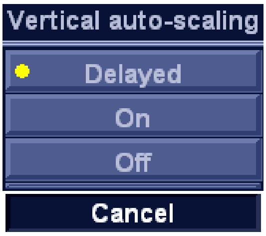


Figure 7-5. The Vertical Auto-scaling menu

3. Select the desired option:
    - **Delayed**: auto-scaling takes place after anchoring the sample area.
    - **On**: auto-scaling while moving the sample area.
    - **Off**: displays full scale.

Vertical units

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.

1. Press the **Right mouse button** in the *Analysis* window.

   The *Vertical unit* menu is displayed.

Figure 7-6. The Vertical unit menu

2. 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.

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.

Cine compound

Cine compound calculates and displays cineloops generated from a temporal averaging of multiple consecutive heart cycles. The number of averaged cycles is displayed on the top left corner.

To apply cine compound:

1. Adjust **Cine compound** to set the number of heart cycles to average.

   The traces are updated showing averaged data. The number of heart cycles averaged is displayed on the top left corner.
2. Press **CC Zoom** to display the last recorded heart cycle.
3. Press **CC Zoom** again to unzoom.

Switching modes or traces

The user can toggle between TVI, Tissue Tracking, Strain rate or Strain modes to access to the mode specific controls 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 from the Control panel.

To switch trace

- Press the **Right mouse button** in the *Analysis* window.

  The *System* menu is displayed.
- Select **Analysis signal**.

  The *Analysis signal* menu is displayed.

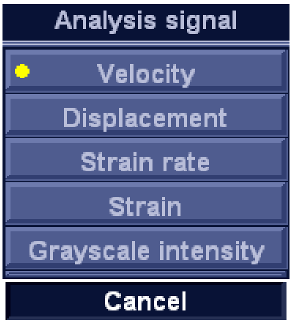


Figure 7-7. The Analysis signal menu

- 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.

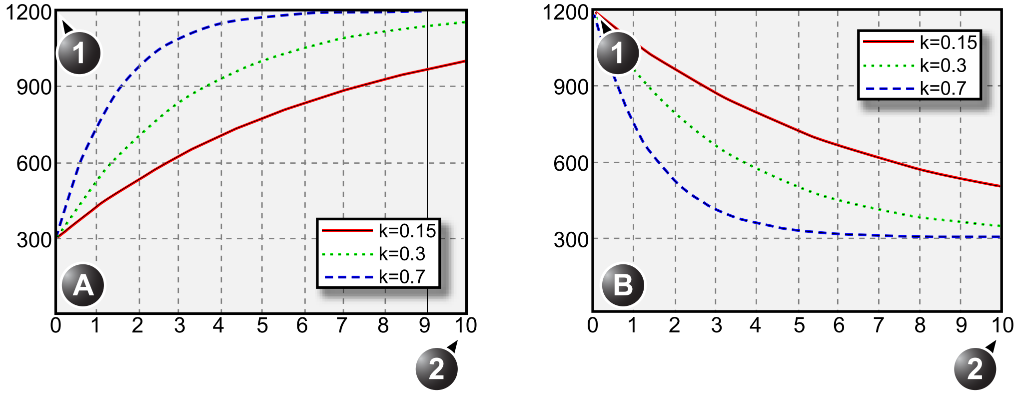
    Note that A+B = contrast + tissue = plateau level.
  - **k** (1/s) is a time constant.
- **Wash-out curve fitting**: find and estimate the wash-out rate of contrast agent locally (e.g. LV or myocardium).

  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.

    Note that A+B is the initial intensity level.
  - **k** (1/s) is a time constant.



1. Intensity (AU)
2. Time (s)

Figure 7-8. 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 CPI 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 7-11.

2. Place the sample area over the myocardium in one of the *Cineloop* windows.

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

3. If desired, reshape the sample area as described on page 7-12.
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.

NOTE: Refer to 'Manual tracking of the sample area (dynamic anchored sample area)' on page 7-9 for further details

5. Browse through the cineloop to ensure that the sample area is in the same anatomical position in all frames.
6. Adjust **Horizontal sweep** and scroll through the cineloop to visualize a specific part of the data, typically the region immediately after Flash.
7. Adjust **Left marker** and **Right marker** 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.

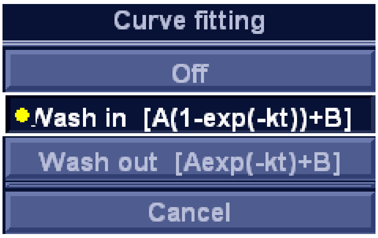
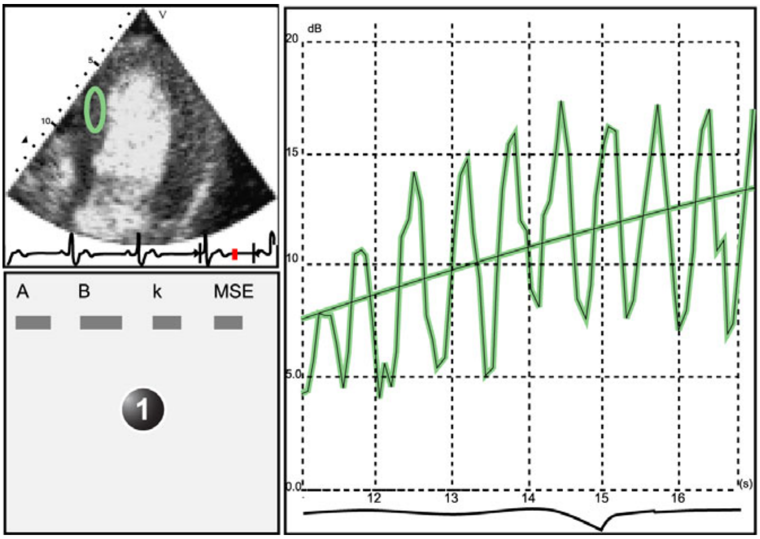


Figure 7-9. The Curve fitting menu

10. Select **Wash-in**.

    The Wash-in curve is displayed in the *Analysis* window (see Figure 7-10).



1. Parameter window

Figure 7-10. Wash-in curve fitting

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. Curve fitting will be performed using all enabled frames.

NOTE: *The frame disabling procedure is explained on page 7-11.*

2. Place the sample area over the myocardium in one of the *Cineloop* windows.
3. Repeat step 2 if other sample areas are desired.

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

4. If desired, reshape the sample area as described on page 7-12.
5. Perform **manual tracking** of the sample areas on all frames to ensure that the sample area is inside the myocardium.

NOTE: *See page 7-9 for more information on sample area manual tracking.*

6. Press the **Right mouse button** in the *Analysis* window.

   The *System* menu is displayed.
7. Select **Horizontal scale**.

The *Horizontal scale* menu is displayed.

8. Select **dT scaling**.

   The X-axis in the *Analysis* window is updated accordingly.

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

   The *System* menu is displayed.

10. Select **Curve fitting**.

    The *Curve fitting* menu is displayed.

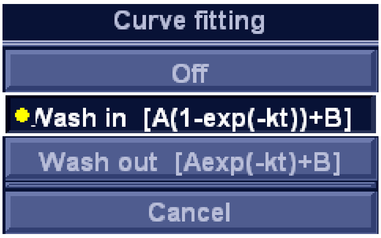
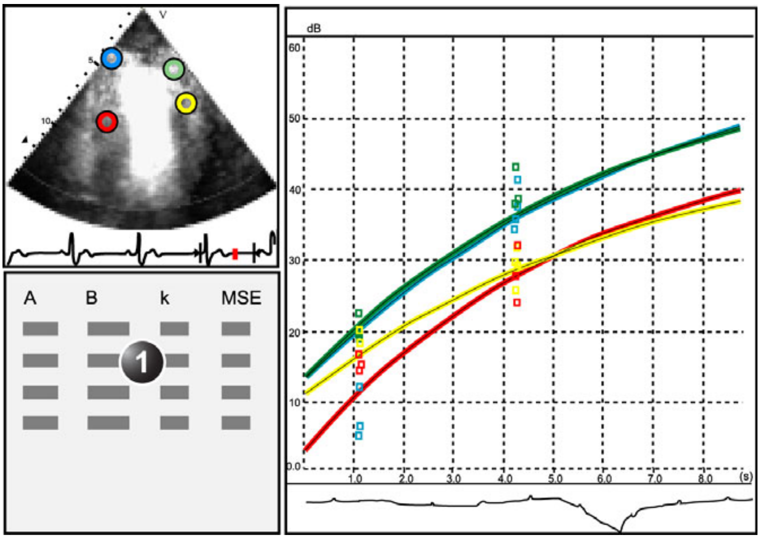


Figure 7-11.   The Curve fitting menu

11. Select **Wash-in**.

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



1. Parameter window

Figure 7-12.   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:

1. Disable frames that are significantly different (i.e. because of respiration or probe movements), see page 7-11.
2. Place the sample area over the myocardium in one of the *Cineloop* windows.

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

3. If desired, reshape the sample area as described on page 7-12.
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).

NOTE: Refer to 'Manual tracking of the sample area (dynamic anchored sample area)' on page 7-9 for further details.

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. Browse through the cineloop to ensure that the sample area is in the same anatomical position in all frames.
6. Adjust **Horizontal sweep** and scroll through the cineloop to visualize a specific part of the data.
7. Adjust **Left marker** and **Right marker** 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.

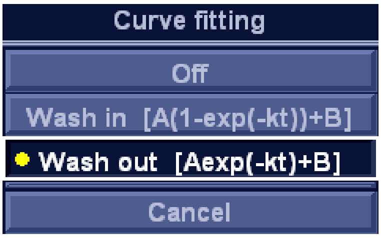


Figure 7-13. The Curve fitting menu

10. Select **Wash-out**.

    The Wash-out curve is displayed in the *Analysis* window (see Figure 7-14).

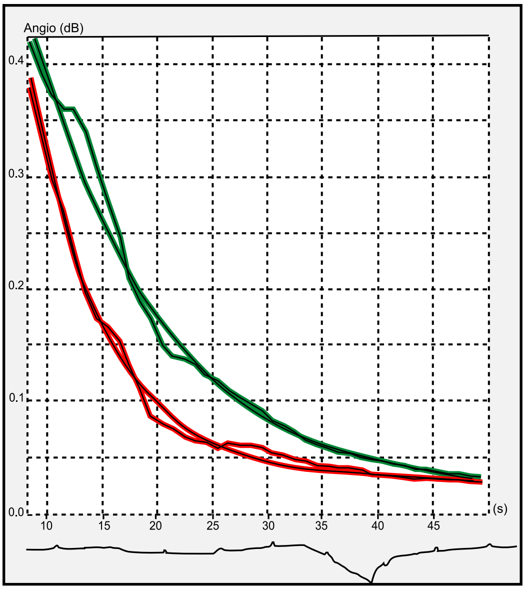


Figure 7-14. Wash-out curve fit of two sample regions in an in-vitro experiment

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. Press **Curved AMM**.
2. In one of the *Cineloop* windows, place the first point of the path.
3. Move the cursor to the location for the next anchoring point of the path and press the **Left mouse button**.

   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.

NOTE: *To edit a path under construction, move the cursor backward and retrace the path.*

4. Double click the **Left mouse button** to end the trace.

   The color-coded display of the corresponding data calculated along the path is shown in the *Analysis* window.

NOTE: *Rotate **Horiz. Sweep** and scroll through the cineloop to optimize the display to the portion of interest.*

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 8

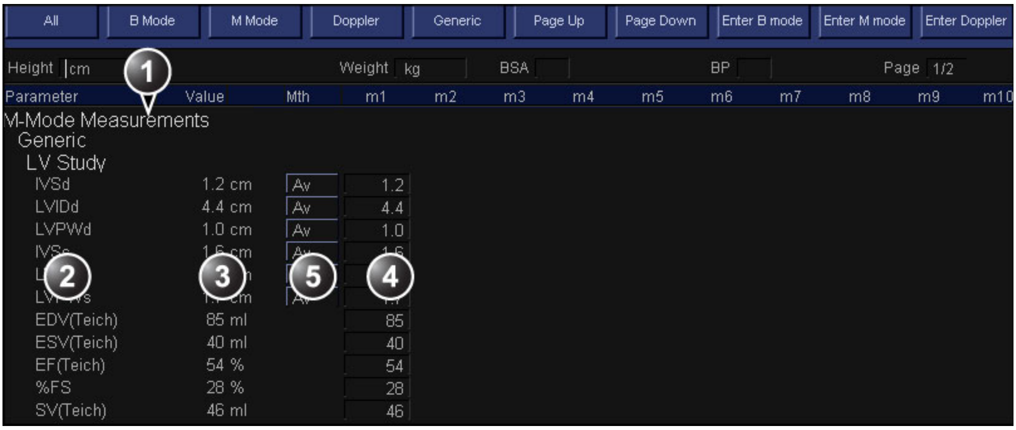
Worksheet

This chapter describes:

Introduction

The worksheet function enables the user to review, edit, delete or print data independently of a report. All measurements and calculations taken during the examination can be viewed at any time using the worksheet.

Overview



Height cm Weight kg BSA BP Page 1/2

Parameter	Value	Mth	m1	m2	m3	m4	m5	m6	m7	m8	m9	m10
M-Mode Measurements												
Generic												
LV Study												
IVSd	1.2 cm	Av	1.2									
LVIDd	4.4 cm	Av	4.4									
LVPWd	1.0 cm	Av	1.0									
IVSs	1.6 cm	Av	1.6									
[illegible]	[illegible]	[illegible]	[illegible]									
[illegible]	[illegible]	Av	[illegible]									
EDV(Teich)	85 ml		85									
ESV(Teich)	40 ml		40									
EF(Teich)	54 %		54									
%FS	28 %		28									
SV(Teich)	46 ml		46									

1. Measurement type
2. Measurement parameter
3. Value calculated according to the value type selected.
4. Measured / calculated values
5. Value type: Averaging, Max, Min or Last

Figure 8-1. Worksheet screen

Using the Worksheet

1. Press **Worksheet**.
2. Select the Measurement type.
3. To browse through the measurements, select **Page Up** or **Page Down**.

To select a type of value

1. Select the relevant cell in the *Method* column.

   A pop-up menu is displayed showing the different options available.

1. Average of the measurements taken
2. Maximum measurement
3. Minimum measurement
4. Last measurement that was taken

Figure 8-2. Value options

2. Select the required option.

   The value is updated accordingly.

To exclude or include measurements

One or more measurement values from a set of measurements for a parameter can be excluded when doing average calculation.

1. Place the cursor over the measurement to exclude.
2. Press the **Right mouse button** and select **Exclude value/ Include value** in the displayed menu.

To delete measurements

1. Place the cursor over the measurement to delete.
2. Press the **Right mouse button**.
3. Select:
    - **Delete value** to delete the current value
    - **Delete set** to delete the current set of values
    - **Delete all** to delete all values from the Worksheet.

To change a measurement value

1. Select the measurement to change.
2. Enter a new value.

NOTE: Changed measurements are marked with an asterisk (*).

Chapter 9

Report

This chapter describes:

Introduction

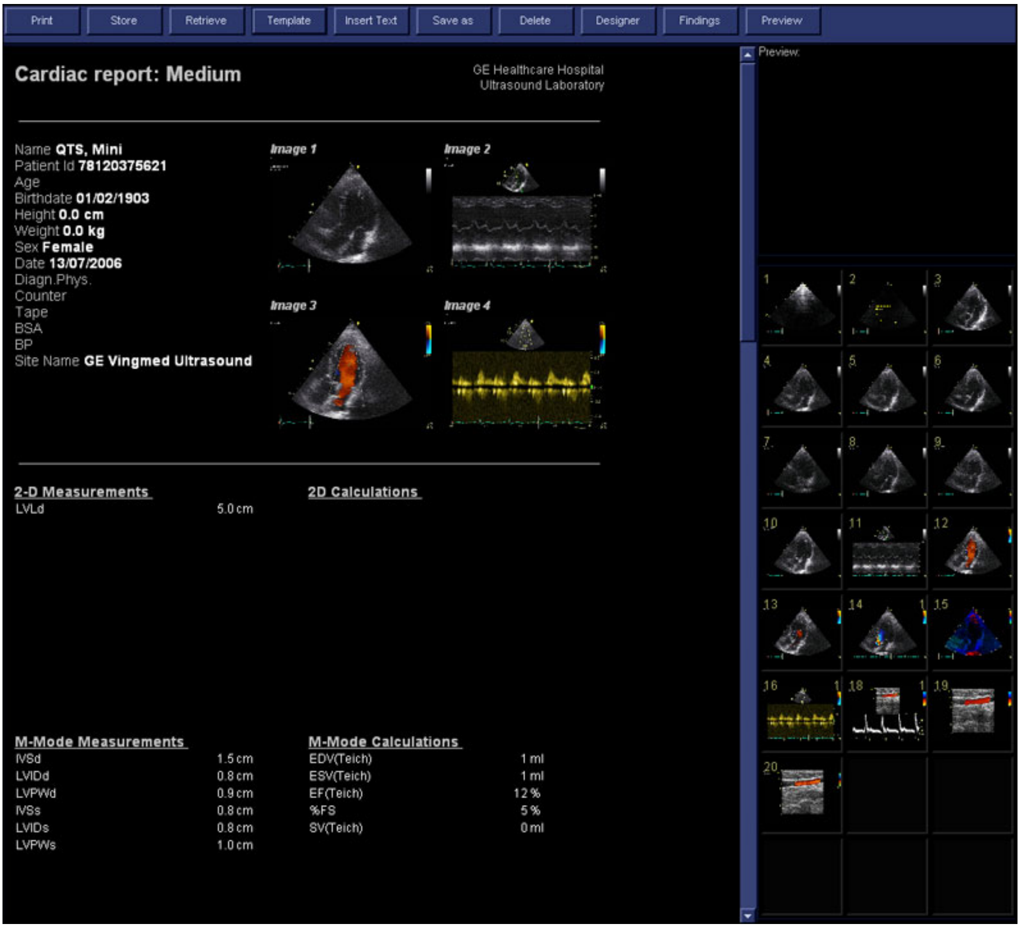
The system enables the creation of patient and examination reports containing measurements, images and analysis that were made during the examination. The layout of the reports is defined by generic templates delivered with the system. Custom templates can also be made.

Saved reports are *read-only*. Therefore it is recommended that the data is carefully reviewed before the report is saved. Use the worksheet (see page 8-1) to facilitate the review and adjustment of data before generating a report. The final report can be printed on a regular printer.

Working with the report function

1. Select **Report**.

   The default template for the current examination is displayed (see Figure 9-1). The information entered during the examination is automatically filled in (e.g. demographic, Diagnosis, Comments...etc.).



Cardiac report: Medium

GE Healthcare Hospital
Ultrasound Laboratory

Name **QTS, Mini**
Patient Id **78120375621**
Age
Birthdate **01/02/1903**
Height **0.0 cm**
Weight **0.0 kg**
Sex **Female**
Date **13/07/2006**
Diagn.Phys.
Counter
Tape
BSA
BP
Site Name **GE Vingmed Ultrasound**

2-D Measurements		**2D Calculations**	
LVLd	5.0 cm		

M-Mode Measurements		**M-Mode Calculations**	
IVSd	1.5 cm	EDV(Teich)	1 ml
LVIDd	0.8 cm	ESV(Teich)	1 ml
LVPWd	0.9 cm	EF(Teich)	12 %
IVSs	0.8 cm	%FS	5 %
LVIDs	0.8 cm	SV(Teich)	0 ml
LVPWs	1.0 cm		

Figure 9-1. The Report screen

To choose another report template

1. Press **Template**.

   The *Template selection* menu is displayed showing the available report templates organized by application.

NOTE: The Template selection menu can be configured to display only the templates of interest (see page 9-37).

2. Do one of the following:
   - Select a template from the current application template list.
   - Select another application and select the desired template from the sub-menu displayed.

   The selected template is displayed on the screen.

To change patient information

1. Select the heading of the information to change.

   The *Patient information* screen is displayed.
2. Change the information as required.
3. Press **Report** when completed.

   The user is asked to confirm the changes.
4. Select **OK** to confirm or **Cancel** to abort.

Images in the report

1. To add an image to the report, double-click on an image in the clipboard.

   The image is inserted into the first free image container in the report.
2. To move an image in the report, select and drag the image to move it to a new image container.
3. To replace an image in the report, select and drag an image from the clipboard over the image to replace in the report.
4. To remove an image from the report, select and drag the image to remove outside the report page.

To print a report

Only members of the user group “Cardiologist” are allowed to print a report (see ‘System users’ on *page 3-55*).

1. Press **Print**.

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

To store a report

Only members of the user group “Cardiologist” are allowed to store a report (see ‘System users’ on *page 3-55*).

1. Press **Store**.

   The report is stored in the Report archive.

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.
- **Text (.TXT) files**: only text data is saved; readable with a text editor.

1. Press **Save as**.

   The *Save as dialogue* window is displayed.
2. Select the destination folder from the *Save in archive* pull down menu.

NOTE: To configure the default remote path, see ‘Remote path setting’ on page 3-68.

3. Select **PDF**, **CHM** or **TXT** format.
4. Press **Save**.

Report sign-off

Report sign-off is used to save a report as read-only. A signed report cannot be changed unless it is first unsigned.

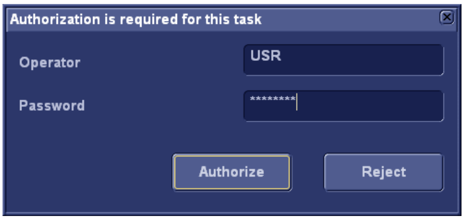
When signing a report, the examination becomes read-only: the patient demographic data in the *Patient information* window and the diagnostic information in the *Examination list* window for the current examination cannot be changed unless the report is first unsigned.

The signing and unsigning operations require an authorization (operator name and password). Only members belonging to both “Cardiologist” and “DiagPhys” user groups are allowed to sign off or unsign a report.

To sign off a report

1. Press **Sign-off**.

   The *Authorization* window is displayed.



Authorization is required for this task

Operator: USR

Password: ********

Figure 9-2. The Authorization window

2. Enter the operator name and password.
3. Select **Authorize**.

NOTE: *If the operator is not authorized to sign off, an Error message is displayed. Press **Retry** to go back to the Authorization window or **Cancel** to quit sign-off.*

Signed reports display a heading confirming sign-off with the operator name and the date of signature. In addition the diagnostic physician name is applied at the end of the report.

NOTE: *The sign-off header is not printed. To get the sign-off signature inside the report, the report template must contain the assigned field "Diag.Phys. signoff" (see 'Inserting archive information' on page 9-28).*

To unsign a report

1. Press **Unsign**.

   The *Authorization* window is displayed (see Figure 9-2).
2. Enter the operator name and password.
3. Select **Authorize**.

Retrieving an archived report

1. Press **Retrieve**.

   A list of the available reports for the actual examination is displayed.

   The default name for a report is of type:
   <template type>_<store date>_<store time>.
2. Select the report to retrieve.

*NOTE: To display the current report, select **Show active exam**.*

Deleting an archived report

Only members of the user group “Cardiologist” are allowed to delete a report (see ‘System users’ on *page 3-55*).

1. Press **Delete**.

   A list of the available reports for the actual examination is displayed.

   The default name for a report is of type:
   <template type>_<store date>_<store time>.
2. Select the report to delete.

Structured Findings

Structured Findings is a feature that enables the user to insert pre-configured structured diagnostic statements and codes (e.g Billing, Accreditation) in the patient report and create a conclusion based on the inserted statements.

Prerequisite

To be able to insert structured diagnostic statements and create a conclusion in a patient record, the report template used must have assigned fields for the structured findings, the codes and the conclusion.

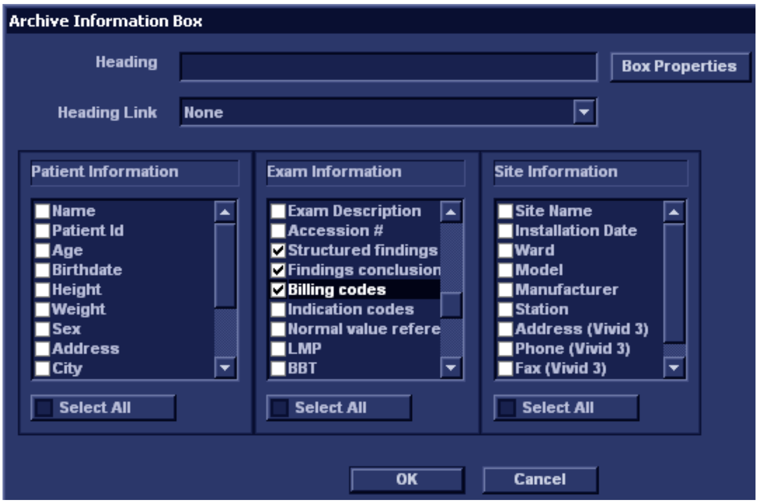
NOTE: Factory templates have Findings and Conclusion fields.

To create the assigned fields in a user-defined report template:

1. Select **Report**.
2. Press **Template** and select the desired report template.
3. Press **Designer**.

   The *Report designer* screen is displayed.
4. Select the location in the report template where to insert the Structured findings fields.
5. Select **Insert** and **Archive Information**.

   The *Archive information* box is displayed (Figure 9-3).
6. Double-click on **Select All** under all three parameter fields in the *Archive information* box to deselect all parameters.
7. Select **Structured findings**, **Findings conclusion Indication codes** and **Billing codes** in the *Exam Information* field (Figure 9-3).
8. Select **OK**.
9. Save the Report template and exit the Report designer.



Heading:

Heading Link: None

Patient Information

☐ Name
☐ Patient Id
☐ Age
☐ Birthdate
☐ Height
☐ Weight
☐ Sex
☐ Address
☐ City

Exam Information

☐ Exam Description
☐ Accession #
☑ Structured findings
☑ Findings conclusion
☑ Billing codes
☐ Indication codes
☐ Normal value refere
☐ LMP
☐ BBT

Site Information

☐ Site Name
☐ Installation Date
☐ Ward
☐ Model
☐ Manufacturer
☐ Station
☐ Address (Vivid 3)
☐ Phone (Vivid 3)
☐ Fax (Vivid 3)

Figure 9-3. The Archive information box

Starting Structured Findings

Structured Findings can be started from within the Report function or during Image Analysis.

1. Press **Report**.

   Make sure the current template has a Structured Findings field and a Conclusion field defined or select another template if necessary.

2. Press **Findings** or select the header of the Findings box in the report.

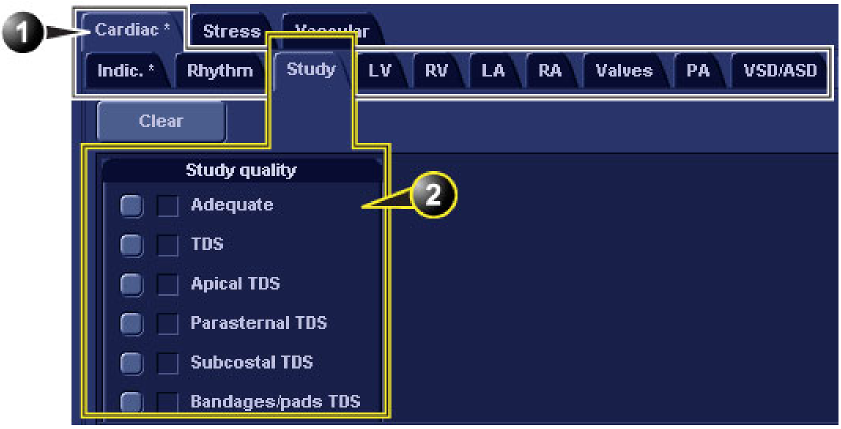
   The *Structured Findings* window is displayed (Figure 9-6).

NOTE: *If the workstation has a dual screen, the Report screen and the Structured Findings window are displayed. From the Image Analysis screen the Structured Findings window is displayed side by side with the images. A preview of the report is also displayed if the workstation has a dual screen.*

Structured Findings structure

The diagnostic statements are organized in tab folders (see Figure 9-4). Each tab folder may contain:

- Underlying tab folders that contain Tab sheets.
- Tab sheets that contain diagnostic statements.

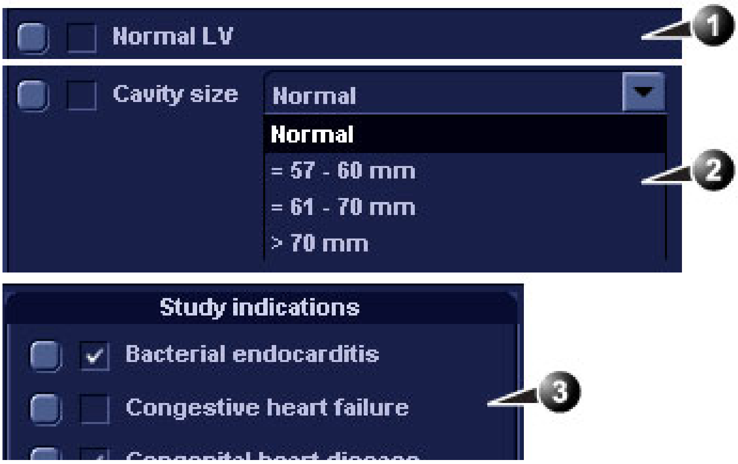


1. Tab folder with underlying tab sheets
2. Tab sheet

Figure 9-4. Structured findings structure

There are three types of diagnostic statements (see Figure 9-5):

- Check box statement: when selected the statement is included in the report.
- Combo box statement: create a statement by selecting one alternative text among several choices.
- Statement group: create several statements by selecting multiple check box statements.



1. Check box statement
2. Combo box statement
3. Statement group

Figure 9-5. Diagnostic statement types

Using Structured Findings

1. Start Structured Findings (see page 9-9).
2. Browse to the tab sheet containing the statements of interest.
3. To insert a statement in the report (Findings field):
   - Check box statement: select the statement.
   - Combo box statement: select an alternative text in the combo box next to the statement.
   - Statement group: select the statements of interest within the group.

   A preview of the selected statement(s) is displayed in the *Findings preview* field (see Figure 9-6). The statement text in the preview field can be edited. This will apply only for the current report.

   Once a statement is selected an asterisk is displayed on the tab of the current sheet and folder.

   *NOTE: Select **Normal** to select only normal statements from the current tab sheet (see page 9-16 for more information on how to define normal statements).*

   *NOTE: Select **Clear** to deselect all statements from the current tab sheet.*

   To insert a conclusion statement in the report:

   - Press the Conclusion button in front of the statement of interest.

   A preview of the selected conclusion statement is displayed in the *Conclusion preview* field (see Figure 9-6). Conclusion statements are displayed in a numbered list.

   The list can be reordered: triple-click on the conclusion statement to move in the *Conclusion preview* field and use the **Arrow up** or **Arrow down** key to move the statement up or down.

   The conclusion text in the preview field can be edited. This will apply only for the current report.

   To display the changes in the report, select **Refresh report**.

   NOTE: Pressing the Conclusion button in front of a statement that was not previously selected results in simultaneously inserting the finding statement and create the conclusion.

4. Press **Close**.

   The report for the current patient is displayed with the selected findings, conclusion statement(s) and associated codes (if any).

NOTE: *Some diagnostic statements have measurements values in the body text referred by a tag (e.g the {EF} tag refers to EF measurement). These statements require that the actual measurement is done to display correctly in the report.*

☑ Cavity size: Normal
☑ ness: Normal
☐ LV Glo unction: Mild Hypokinesis
☐ LV EF: >70
☐ Asymmetric hypertrophy: Sigmoid septum
☐ Eccentric hyperthrophy: Absent
☐ SAM gradient: Mild SAM
☐ Abnormal septal motion: RV overload
☐ Diastolic filling: Normal
☐ Grossly Normal
☐ False Tendon
☐ Statement
☐ Statement (2)

Left Ventricle

LV size, wall thickness and systolic function are normal, with an EF of 60%. Left ventricular wall thickness is normal.

Conclusion

1. LV size, wall thickness and systolic function are normal, with an EF of 60%.

1. Statement inserted in the Conclusion and Findings field.
2. Statement inserted in the Findings field only.
3. Findings preview field
4. Conclusion preview field
5. Remove all selections.
6. Insert normal findings for the current tab sheet.
7. Create and add a statement. The statement will be available only for the current examination.

Figure 9-6. Structured Findings window

Global selection of normal statements

It is possible to select all normal statements from all tab sheets belonging to the current top tab sheet.

1. Place the cursor in the *Statement* field, press the Right mouse button and select **Normal**.

All statements defined as normal are selected from all the tab sheets. An asterisk is displayed on the tab of all the tab sheets that contain normal statements.

NOTE: *This operation will remove any other "non-normal" previously selected statements.*

2. To remove all statements at once, place the cursor in the *Statement* field, press the Right mouse button and select **Clear**.

Structured Findings configuration

Structured Findings configuration is used to:

- Create, edit or delete finding statements, conclusion statements and codes.
- Organize the diagnostic statements in the *Structured Findings* screen.
- Define the normal diagnostic statements.

Accessing the Structured Findings configuration screen

1. Press **Config** (**F2**) and select the **Report** category.
2. Select the **Structured Findings** tab.

   The *Structured Findings* configuration screen is displayed (Figure 9-7).

Or from within Structured Findings:

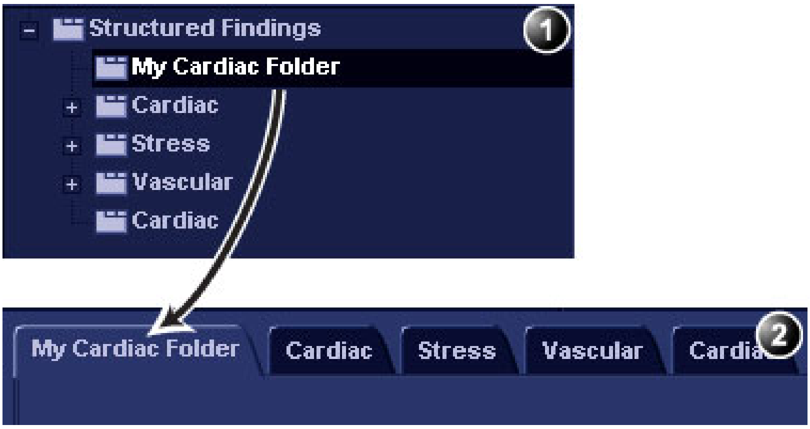
1. place the cursor in the *Statement* field, press the Right mouse button and select **Config**.

1. Structured Findings structure tree:
    - Tab folder
    - Tab sheet
    - Check box statement
    - Combo box statement
    - Statement group
2. Tab or statement label
3. Findings text
4. Conclusion text
5. Codes for the selected statement
6. Create, move, copy or delete statement
7. Create folder, Combo box or statement groups
8. Enter a variable in statement or conclusion text
9. Hide selected tab or statement from the Structured Finding window
10. Set the selected statement as normal
11. Rest factory default findings
12. Export/import findings.

Figure 9-7. Structured Findings configuration screen

Creation of a tab folder

The following procedure describes how to create a new top level tab folder.



1. Configuration window
2. Structured findings window

Figure 9-8. New tab folder

1. In the *Structured Findings* configuration window (Figure 9-7), select the Structured Findings tab folder.
2. Select **Add**.

   A new entry is created in the Structured Findings tab folder. The new entry is by default a tab sheet (🗀).
3. Select **Enable one more tab level** to change the new entry to a tab folder (🗂).

   A warning message is displayed. Select **OK**.
4. With the new entry selected, follow the following steps:
   - Enter a name in the *Label* field (tab name).
   - Enter a description in the *Findings text* field. The description will be displayed in the report as a heading when selecting a statement from the underlying tab sheets. The system is always using the Findings text from the highest item in the structure as a heading for the selected underlying statements.
   - Enter the appropriate codes.

NOTE: *To enter several codes separate each code by a space.*

5. Press **Up** or **Down** to move the tab in the structure tree (or do drag and drop).

Creation of a tab sheet

The following procedure described how to create a tab sheet in a tab folder.

1. Configuration window
2. Structured findings window

Figure 9-9. New tab sheet

1. Make sure that the tab folder is selected and press **Add**.

   A new entry is created in the tab folder. The new entry is by default a tab sheet (🗀).
2. With the new entry selected, follow the following steps:
   - Enter a name in the *Label* field (tab name).
   - Enter a description in the *Findings text* field.

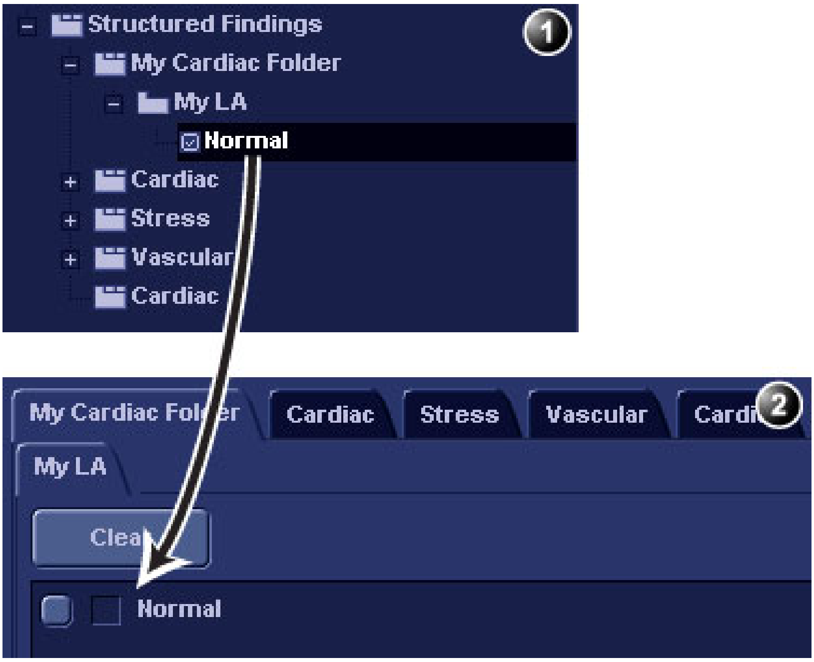
   If required:
   - Enter the appropriate codes.

NOTE: *To enter several codes separate each code by a space.*

Adding statements in the tab sheet

Check box statement

The following procedure describes how to create a check box statement.



1. Configuration window
2. Structured findings window

Figure 9-10. New check box statement

1. Make sure that the tab sheet is selected and press **Add**.

   A new entry is created in the tab sheet. The new entry is by default a check box statement (☑).
2. With the new entry selected, follow the following steps:
   - Enter a name in the *Label* field (statement name).
   - Enter the full statement in the *Findings text* field.
   - Enter a conclusion in the *Conclusion text* field (optional).

NOTE: *If the Conclusion text field is left empty, the statement text will be used as conclusion when selected.*

If required:

- Enter the appropriate codes.

NOTE: *To enter several codes separate each code by a space.*

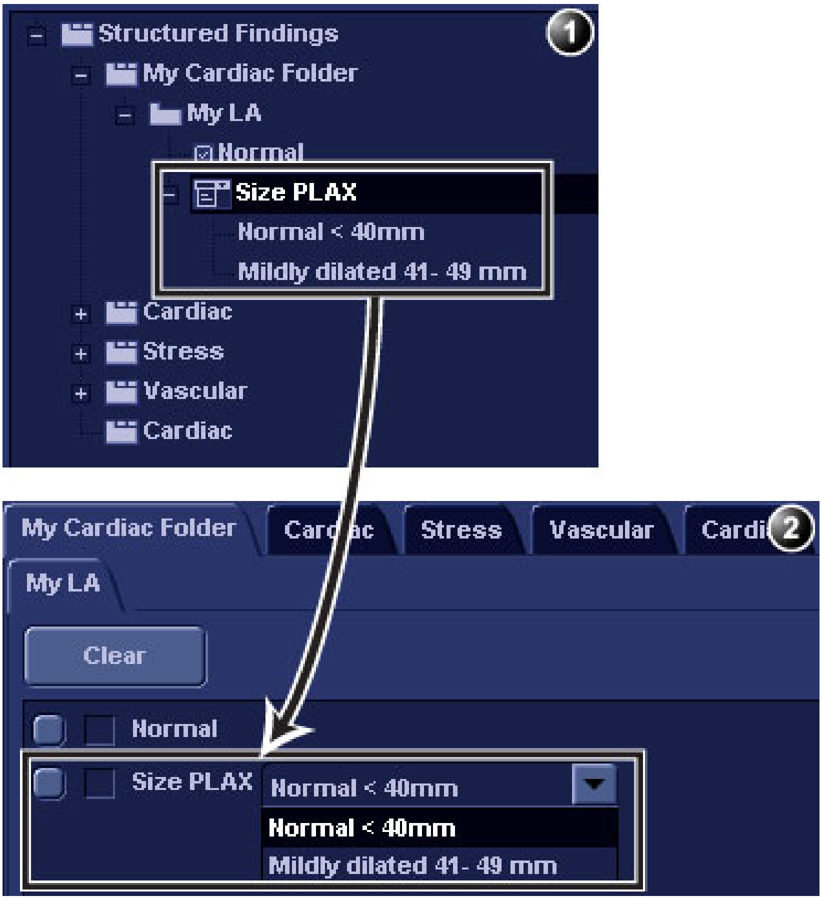
- Check **Include findings in normal report** to define the statement as normal.

  All statements within the selected tab sheet that have this option checked will be included in the report when

Normal is selected in the *Structured Findings* window (see ‘Using Structured Findings’ on *page 9-11*).

Combo box statement

The following procedure describes how to create a combo box statement.



1. Configuration window
2. Structured findings window

Figure 9-11. New combo box statement

1. Create a new statement as described above. A check box statement is created by default.
2. With the new statement selected, press **Add**.

   A new underlying entry is created and the parent statement is changed to a Combo box statement (▤).
3. With the new underlying entry selected, follow the following steps:

- Enter a name in the *Label* field.
- Enter a text in the *Findings text* field.
- Enter a conclusion in the *Conclusion text* field (optional).

4. Repeat the procedure from step 2 to create as many underlying statements as necessary. Each underlying statement will be a selectable entry in the combo box.

Statement group

Statement groups are created by changing a combo statement to a statement group.

1. Create a combo box statement as described above.
2. Make sure the combo box statement is selected and deselect the option **Enable pull-downs**.

   The combo box statement is changed to a statement group (■). Each underlaying entries are changed to check box statements.

Editing a statement

Tab label, statements and statement alternative texts can be edited.

1. In the *Structured Findings* configuration window (Figure 9-7), select the item to edit.
2. Make the required changes.

Inserting variable parameters in a statement

Variable parameters such as patient name, institution name, measurement values...etc can be inserted in a statement as tagged information.

To insert variable parameters in a statement:

1. Place the cursor at the required position in the *Findings text* field (or *Conclusion text* field).
2. Press **Insert parameter**.

   The *Insert parameter* window is displayed (see Figure 9-12).

Figure 9-12. Insert parameter window

3. Browse and select the actual parameter to insert.

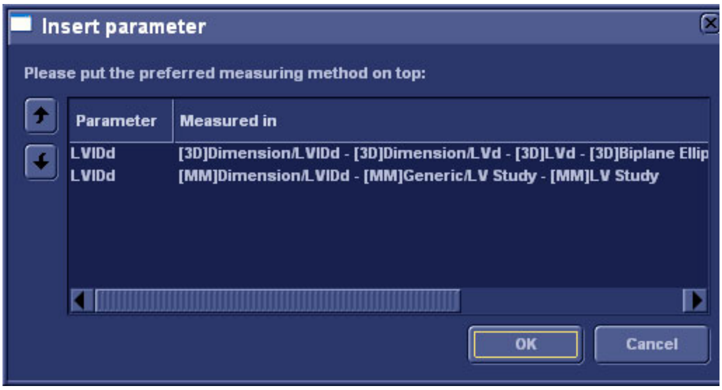
NOTE: *For measurement values, select first the scanning mode.*

4. Press **OK**.

NOTE: *To display correctly in the report, the actual parameter value must exist, e.g. if a measurement value is included in a statement as a variable parameter, a measurement value must exist for the current patient, otherwise the parameter name is displayed.*

5. If the selected parameter can be measured/calculated by different methods, the user is asked to select the preferred parameter to insert (Figure 9-13). Move the preferred parameter as first item in the list displayed and select **OK**.

   The selected parameter is inserted in the statement as a tag (e.g the {EF} tag refers to EF measurement)



Please put the preferred measuring method on top:

Parameter	Measured in
LVIDd	[3D]Dimension/LVIDd - [3D]Dimension/LVd - [3D]LVd - [3D]Biplane Ellip
LVIDd	[MM]Dimension/LVIDd - [MM]Generic/LV Study - [MM]LV Study

Figure 9-13. The parameter list

Copy of a statement

Tab folders, tab sheets and statements can be copied from one location to another. The word “Copied” is added to the copied item name.

1. In the *Structured Findings* configuration window (Figure 9-7), select the item to copy.
2. Select **Copy**.
3. Select the item to contain the copy.
4. Select **Paste**.

NOTE: If the item to copy cannot be copied in the selected location, the operation is ignored.

*NOTE: Copy can be done by drag-and-drop, while holding **Ctrl** depressed.*

Deletion of a statement

Tab folders, tab sheets and statements can be deleted.

CAUTION Deletion cannot be undone.

1. In the *Structured Findings* configuration window (Figure 9-7), select the item to delete.
2. Select **Delete**.

   The selected item is deleted.

Factory reset

All statements can be reset back to the factory default.

CAUTION

Factory reset cannot be undone.

1. Select **Reset**.

   The *Reset statements* window is displayed.
2. Select:
   - **Yes** to reset all statement to the factory default (No undo).
   - **No** to cancel the operation.

Exporting/Importing statements

Diagnostic statements can be exported from one system and imported on another system.

Exporting statements

1. In the *Structured Findings* configuration window (Figure 9-7), select **Export**.

   A browsing window is displayed.
2. Browse to a destination and select **Save**.

Importing statements

1. In the *Structured Findings* configuration window (Figure 9-7), select **Import**.

   A browsing window is displayed.
2. Browse to a destination and select **Open**.
3. Select one of the following options
   - **Insert**: the statements are imported in a new top tab sheet, keeping the current statements in place.
   - **Replace**: the imported statements replace the existing ones.
   - **Cancel**: cancel the import.

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

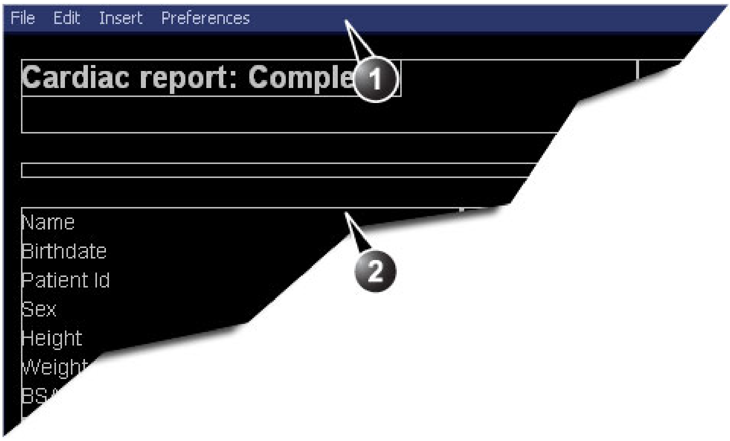
1. Press **Report**.

   The *Report* screen is displayed.
2. Press **Designer**.

   The *Report designer* screen is displayed with the selected template in the *Report template design area* (see Figure 9-14).

Report designer overview

The Report designer screen



1. Menu bar
2. Report template design area

Figure 9-14. The Report designer screen

The menu bar

Menu	Description
File	• **New**: start working on an new template. • **Save**: save the template using the same name. Factory report templates cannot be overwritten. • **Save as**: save the template using a new name. • **Page setup**: define printing orientation and header/footer for the printed report. • **Print Preview**: display a print preview of the report template. • **Exit**: exit the Report designer and returns to the report function. The user can choose whether to save the updates or restore the original template.

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

Menu	Description
Insert	• **Page Break**: insert a new page in the report template. • **Table**: configure and insert a table in the report template. • **Logo**: select and insert a logo to the report template. • **Archive info**: select and insert data from the following categories: Patient information Exam information Site information • **Anatomical graphics**: select and insert an 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). • **OB/GYN**: insert OB graph. • **Measurements**: insert a container for the display of measurements and calculations. When creating a measurement container, the user is prompted through a configuration procedure enabling the selection of mode specific measurements and/or calculations. • **Text field**: insert a container where the user can write in the report. • **Fixed text**: insert a container with static text. The text typed during the creation of the container will be displayed in the report.

Menu	Description
Preferences	• **Page Color**: sets the default background color for the template page.

Designing a report template

Starting template designing

1. Start the Report designer (see page 9-23).
2. Press **File** and select **New** to display a blank page or use the current report template as basis template.

Setting the layout preferences

Adjusting the report page color background

1. Press **Preferences** and select **Page Color**.

   The *Color selection* window is displayed.
2. Select the desired color.
3. Press **OK**.

Header and footer in the printed report

This function is described on page 9-35.

Inserting an information container in the report template body

The different types of information to be included in a report are grouped in information containers. Designing a report template consists in inserting and configuring the different information containers in the template page in an ordered manner.

Information containers can be inserted either:

- Directly into the report template body: this procedure does not allow side-by-side insertion, the information container will normally cover the width of the report template page.
- Within a table: this procedure allows side-by-side insertion of several information containers.

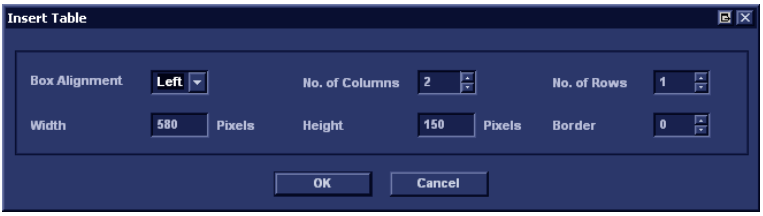
Inserting a table

1. Place the cursor at the desired insertion point in the *Report template design area*.
2. Press **Insert** and select **Table**.

   The *Container properties* window is displayed (see Figure 9-15).
3. Adjust the parameters as desired.
4. Press **OK**.

   The table is displayed in the template.

NOTE: *To modify an inserted table, double-click in an empty area in the table. A selection menu is displayed where the user can add, delete a row or a column or open the Table properties window.*



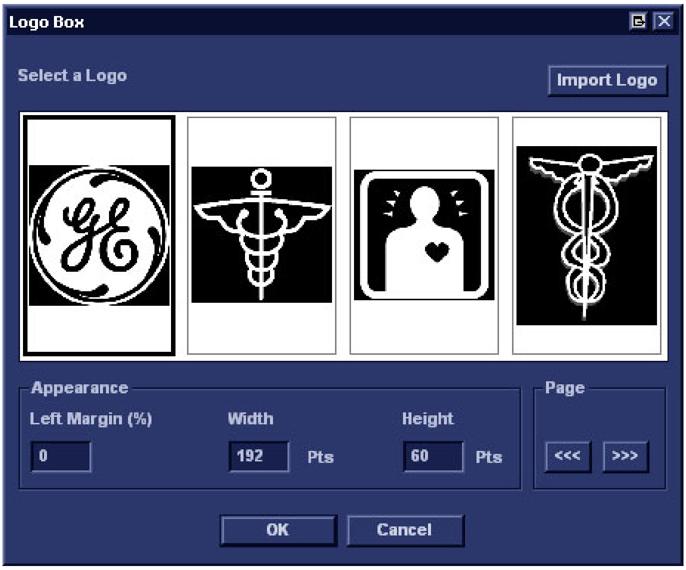
Box Alignment: Left
No. of Columns: 2
No. of Rows: 1
Width: 580 Pixels
Height: 150 Pixels
Border: 0

Figure 9-15. The Table properties window

Inserting a logo

1. Provide the hospital logo in JPEG or Bitmap format onto a removable media.
2. Select the location where to insert the logo (a table cell or directly in the report template).
3. Select **Insert** and **Logo**.

   The *Logo* box is displayed.



Left Margin (%): 0
Width: 192 Pts
Height: 60 Pts

Figure 9-16. The logo box

4. Select a logo, or if not available, select **Import logo**.

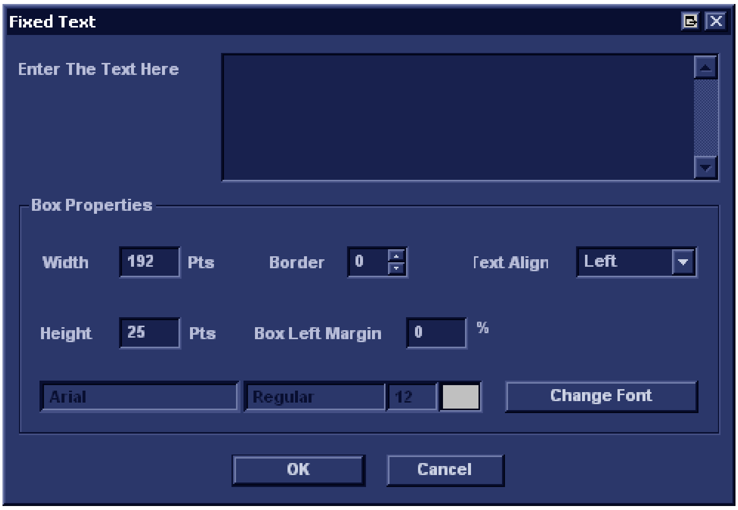
   Browse and select the logo and select **OK**.
5. Specify the appearance.
6. Select **OK**.

Inserting fixed text

Fixed text is an entry that cannot be changed in the report (e.g. hospital information).

1. Select the location where to insert the fixed text (a table cell or directly in the report template).
2. Select **Insert** and **Fixed text**.

   The *Fixed text* box is displayed.



Width 192 Pts
Border 0
Text Align Left
Height 25 Pts
Box Left Margin 0 %
Arial Regular 12

Figure 9-17. The Fixed text box

3. Enter the text and specify the appearance.
4. Select **OK**.

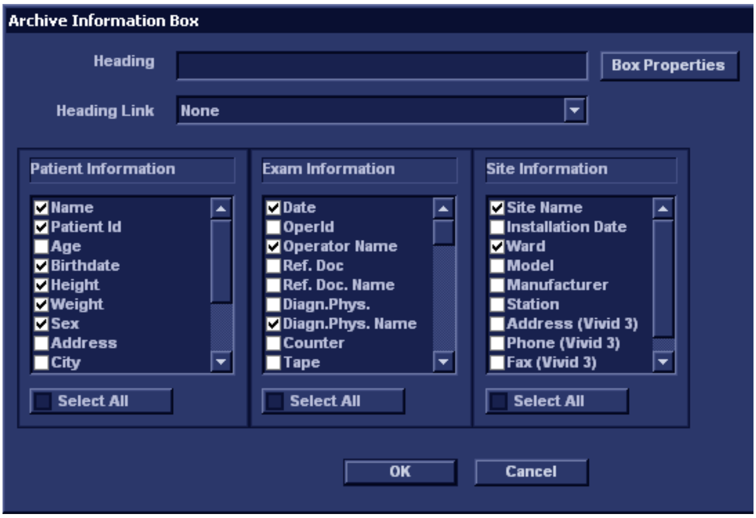
Inserting archive information

Archive information contains all the objects of the different information menus (Patient, Exam, Study and Site Information).

You may display the archive information over two columns using a table container as described below.

1. Insert a table for the archive information to the desired location (a table cell or directly in the report template).
2. Select the first table cell.
3. Select **Insert** and **Archive information**.

   The *Archive information* box is displayed.



Heading Link: None

Patient Information:
☑ Name
☑ Patient Id
☐ Age
☑ Birthdate
☑ Height
☑ Weight
☑ Sex
☐ Address
☐ City

Exam Information:
☑ Date
☐ OperId
☑ Operator Name
☐ Ref. Doc
☐ Ref. Doc. Name
☐ Diagn.Phys.
☑ Diagn.Phys. Name
☐ Counter
☐ Tape

Site Information:
☑ Site Name
☐ Installation Date
☑ Ward
☐ Model
☐ Manufacturer
☐ Station
☐ Address (Vivid 3)
☐ Phone (Vivid 3)
☐ Fax (Vivid 3)

Figure 9-18. The Archive information box

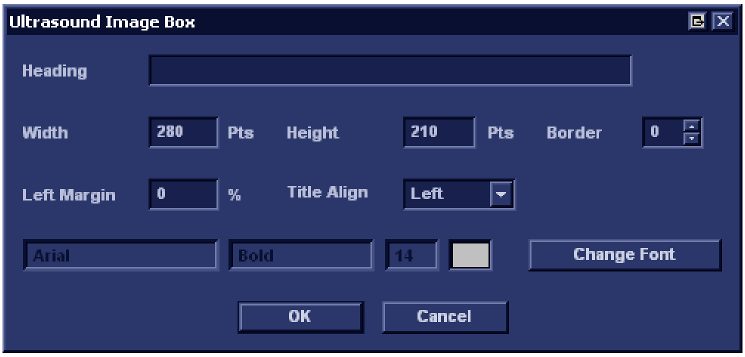
4. If desired, enter a heading and select a heading link from the pull-down menu.
5. Select the Information parameters to be displayed in the first cell.

   Select **Box properties** to change the font, alignment, appearance, etc.
6. Select **OK**.
7. Select the next table cell and repeat steps 3 to 6 to enter the remaining archive information.

Inserting an Image container

- Select the location where to insert the fixed text (a table cell or directly in the report template).
- Select **Insert** and **Image**.

  The *Ultrasound image* box is displayed.



Heading

Width 280 Pts Height 210 Pts Border 0

Left Margin 0 % Title Align Left

Arial Bold 14

Figure 9-19. The Ultrasound image box

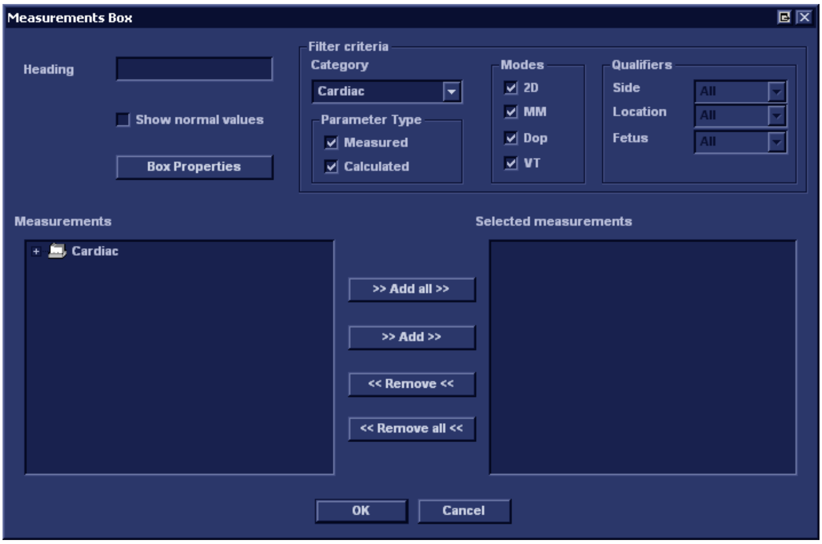
- If desired, enter a heading, set the container size and specify the text appearance.
- Select **OK**.

Inserting a measurement container

You may display the measurements over several columns using a table container as described below.

1. Insert a table for the measurements to the desired location.
2. Select the first table cell.
3. Select **Insert** and **Measurements**.

   The *Measurements* box is displayed.



Heading

☐ Show normal values

Filter criteria

Category: Cardiac

Parameter Type: ☑ Measured ☑ Calculated

Modes: ☑ 2D ☑ MM ☑ Dop ☑ VT

Qualifiers: Side All, Location All, Fetus All

Measurements: + Cardiac

Selected measurements

Figure 9-20. The Measurements box

4. Enter a heading (e.g. 2D).
5. Using the *Filter criteria*, define the type of measurements to be displayed (e.g. Cardiac, 2D, measured and calculated).

   Select **Show normal value** to display user-defined Normal value next to the measurements in the Report (see ‘Normal values’ on *page 5-91* for more information).

NOTE: *References for the normal values can be displayed in the report by checking **Normal value references** from **Insert** -> **Archive Info** (see page 9-28).*

   The *Measurement* list on the left side is updated.

6. From the measurement list, select the measurement to insert and press **Add**. Both single measurements or a folder may be added.
7. The list of the inserted measurements is displayed in the *Selected measurement* list on the right side.
8. Press **OK**.
9. Select the next table cell and repeat steps 3 to 8 to insert several measurements.

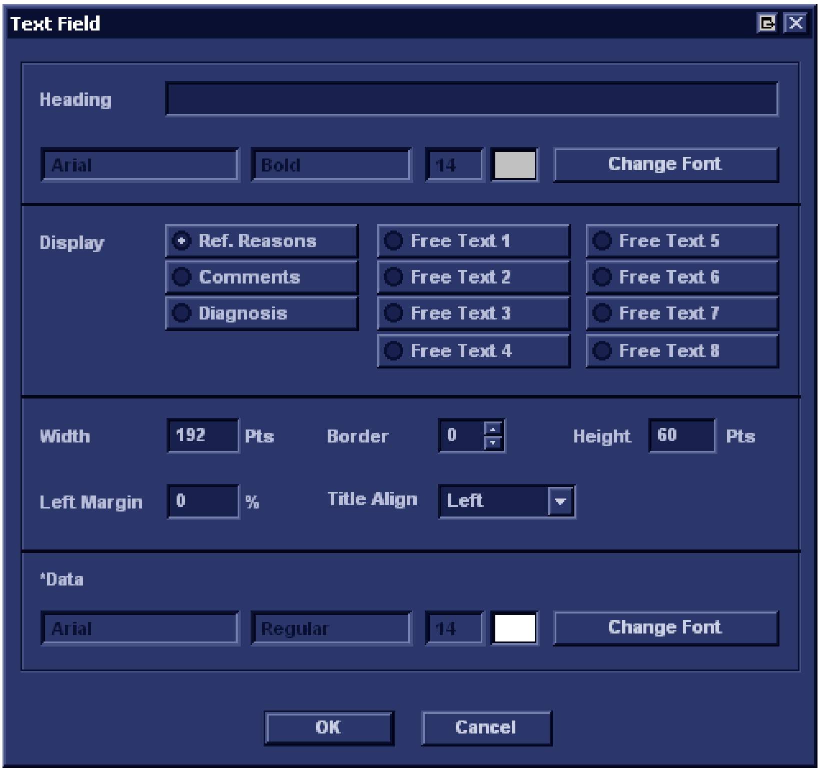
Inserting Text fields

Text fields are:

- Containers for Referral reasons, Comments and Diagnosis information.
- Containers for free text, where the user can type information in the report.

1. Select the location where to insert the text field container (a table cell or directly in the report template).
2. Select **Insert** and **Text field**.

   The *Text field* box is displayed.



Text Field

Heading

Arial Bold 14

Display
- ● Ref. Reasons
- ○ Comments
- ○ Diagnosis
- ○ Free Text 1
- ○ Free Text 2
- ○ Free Text 3
- ○ Free Text 4
- ○ Free Text 5
- ○ Free Text 6
- ○ Free Text 7
- ○ Free Text 8

Width 192 Pts

Border 0

Height 60 Pts

Left Margin 0 %

Title Align Left

*Data

Arial Regular 14

Figure 9-21. The Text field box

3. Enter a heading.
4. From the *Display* field, select between:
    - **Referral reasons**: displays the information entered in the Direct report (see page 4-36) or in the *Examination list* window.
    - **Comments**: displays the information entered in the Direct report (see page 4-36) or in the *Examination list* window.
    - **Diagnosis**: displays the information entered in the Direct report (see page 4-36) or in the *Examination list* window.
    - **Free text 1-8**: creates an empty free text container.
5. If desired, adjust the font settings for the header and data.

Inserting Wall motion scoring analysis containers

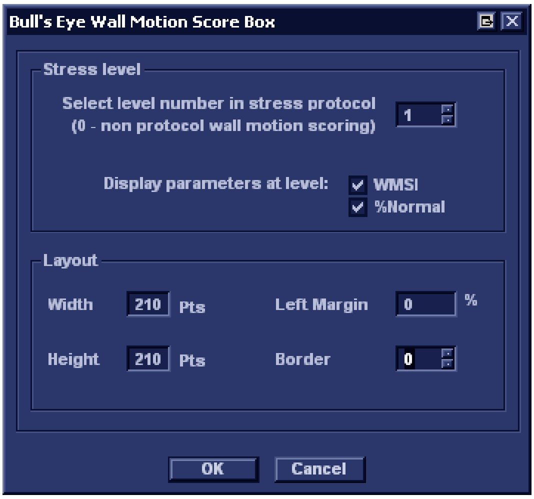
Two different containers must be inserted for the Wall motion scoring analysis:

- A Wall motion scoring diagrams container (Cut planes or Bull's eyes)
- A Wall motion scoring table

Inserting Wall motion scoring diagrams container

1. Select the location where to insert the free text container (a table cell or directly in the report template).
2. Select **Insert**, **Wall motion analysis** and select between **Cut planes** and **Bull's eye**.

   The corresponding *Wall motion scoring* box is displayed.



Select level number in stress protocol (0 - non protocol wall motion scoring): 1

Display parameters at level: ☑ WMSI ☑ %Normal

Width: 210 Pts

Left Margin: 0 %

Height: 210 Pts

Border: 0

Figure 9-22. The Wall motion scoring box (Cut planes)

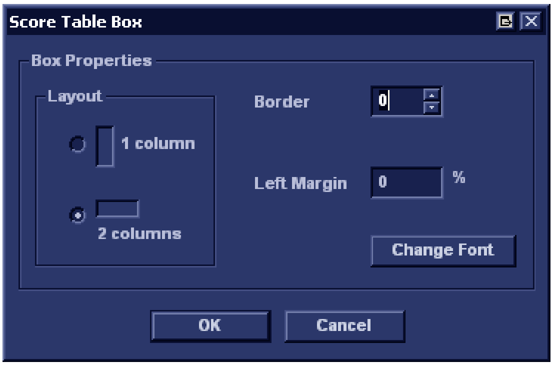
3. Adjust the parameters and select **OK**:

   The scoring diagrams are inserted in the report template

Inserting Wall motion scoring table container

1. Place the cursor right below the *Wall motion scoring diagrams* container.
2. Select **Insert**, **Wall motion analysis** and select **Score table** box.

   The *Score table* box is displayed.



Border 0

Left Margin 0 %

Figure 9-23. The Score table box

3. Adjust the layout parameters in the *Score table* box and select **OK**.

   The Score table is inserted in the report template.

Editing the information container

Resizing the information container

1. Move the cursor over the border of the container to resize.

   The mouse cursor is changed to a cross ✛.
2. Press **Select**.

   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

1. Double-click in the container to edit and select **Properties**.

   The *Properties* window is displayed.
2. Adjust the parameters specific to the selected container.

*NOTE: Some information containers have additional parameters that may be adjusted by selecting **Box properties**.*

Inserting a new page

1. Place the cursor at the desired insertion point in the *Report template design area*.
2. Press **Insert** and select **Page Break**.

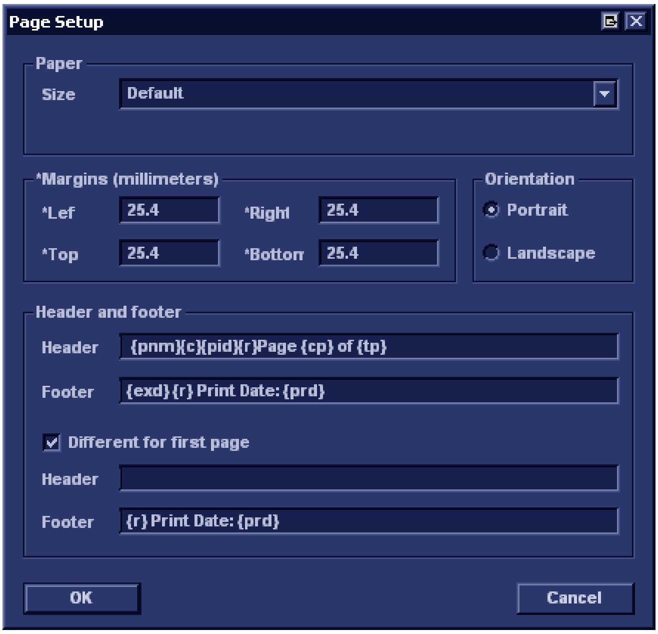
Inserting header and footer

Header and footer may be defined to be displayed in the printed report. The header and footer are not visible in the on screen report.

To insert header and footer in the printed report:

1. Select **File** and **Page setup**.

   The Page setup box is displayed.



*Lef 25.4
*Right 25.4
*Top 25.4
*Botton 25.4

Header {pnm}{c}{pid}{r}Page {cp} of {tp}
Footer {exd}{r} Print Date: {prd}

Header
Footer {r} Print Date: {prd}

Figure 9-24. The Page setup box

2. Adjust the printing orientation.
3. Define the header and footer for the printed report, by typing text and entering the required variables listed in the table below.

   Check **Different on first page** and create a specific header/ footer for the first page.
4. Select **OK**.

   To check the display of the header and footer, select **File** and **Print preview**.

Variable	Description
{pid}	Patient ID
{pnm}	Patient name

Variable	Description
{pdb}	Patient date of birth
{exd}	Examination date
{prd}	Current date (printing date)
{prt}	Current time (printing time)
{cp}	Current page
{tp}	Page count
{c}	Subsequent entries are centered
{r}	Subsequent entries are right aligned

Report templates management

This section describes:

- Configuration of the *Template selection* menu.
- Deletion of user-defined report templates.
- Export/import of user-defined report templates.

The report templates management is done from the *Report templates* sheet in the system configuration package.

To access to the *Report templates* sheet:

1. Press **Config** (**F2**) and select the **Report** category.

   The *Report category* sheet is displayed.

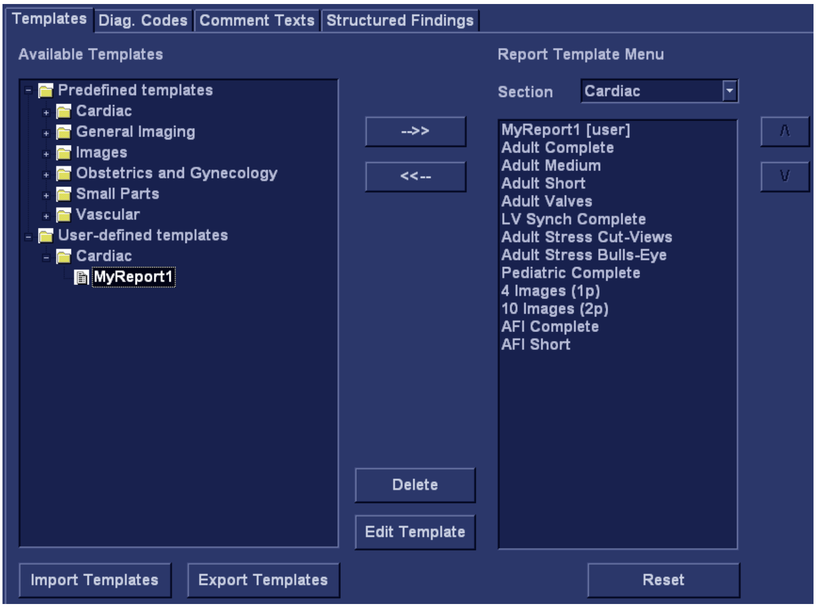


Figure 9-25. The Report templates sheet

Configuration of the Template selection menu

The *Template* selection menu displays the application specific report templates that can be selected when creating a report.

The *Template* selection menu can be configured to display only the templates of interest.

Inserting a template in the Template selection menu

1. Press **Config** (**F2**) and select **Report**.

   The *Report templates* sheet is displayed (Figure 9-25)
2. In the *Available templates* field (left field), select the template to insert in the *Template* selection menu.
3. Next to *Section*, select the appropriate application.
4. Press the **Right arrow button** -».

   The selected template is inserted in the *Template* selection menu.

NOTE: *Double-clicking on a template in the Available template field will also insert the template in the Template menu.*

Removing a template from the Template selection menu

1. In the *Report template menu* field (right field), select the template to remove.
2. Press the **Left arrow button** «-.

   The selected template is removed from the *Template* selection menu.

NOTE: *Double-clicking on a template in the Report template menu field will also remove the template from the Template menu.*

Sorting the templates in the Template selection menu

1. In the *Report template menu* field, select the template to move.
2. Press the **Up** or **Down arrow buttons** ∧ ∨.

   The selected template is moved accordingly in the *Template* selection menu.

Deleting a report template from the system

Only user-defined report templates can be deleted from the system.

1. In the *Available templates* field (left field), select the report to delete (Figure 9-25).
2. Press **Delete**.

   A Confirmation window is displayed.

3. Select **Yes** to delete the report template.

Export/Import of Report templates

User-defined report templates can be exported to a removable media and imported from the removable media into another system.

Export of Report templates

1. Insert a removable media in the in the drive.
2. Press **Config** (**F2**) and select **Report**.

   The *Report templates* sheet is displayed (Figure 9-25 *on page 9-37*).
3. Select **Export Templates**.

   The available user-defined templates are displayed in the *Export templates* window.

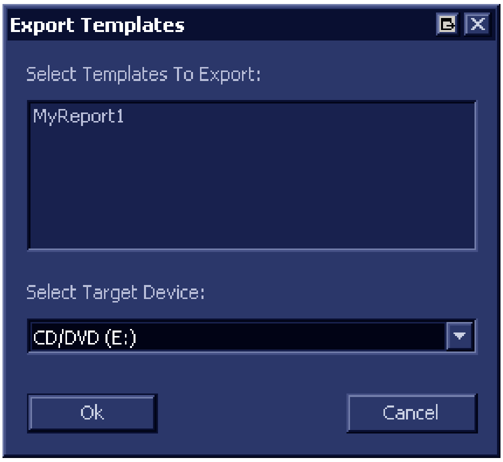


Figure 9-26. The Export templates window

4. Select the template(s) to export. Multiple selection can be done using the **Shift** or **Ctrl** key.
5. Select the desired removable media under *Select target device*.

NOTE: *To export to a shared folder on a network, a remote path must be defined (see 'Remote path setting' on page 3-68).*

6. Press **OK**.

   A Confirmation window is displayed.
7. Press **OK**.

The selected template(s) are exported to the removable media.

8. Press **Alt** + **E** and select the media to eject.

Import of Report templates

1. Insert the removable media with the report template(s) to import.
2. Press **Config** (**F2**) and select **Report**.

   The *Report templates* sheet is displayed (Figure 9-25 *on page 9-37*).
3. Select **Import Templates**.

   The *Import templates* window is displayed.

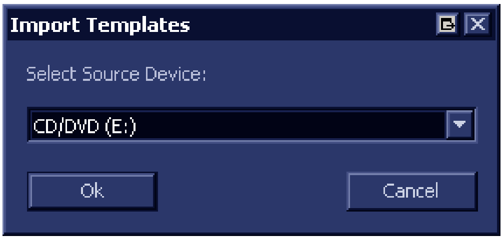


Figure 9-27. The Import template window

4. Select the source device from the pull-down menu.
5. Press **OK**.

   A Confirmation window is displayed.
6. Press **OK**.

   The templates are imported into the system.
7. Press **Alt** + **E** and select the media to eject.

Chapter 10

2D Strain

This chapter describes:

Introduction

2D Strain is an advanced research option on EchoPAC Software Only allowing global and regional quantitative evaluation of the myocardial function. 2D Strain enables calculation of myocardial tissue velocity and deformation parameters based on tissue tracking from 2D grey scale and/or 2D tissue Doppler (TVI) images.

Acquisition

CAUTION

2D Strain is only recommended for adult cardiac images acquired with the following probes: M5Sc-D, M5S-D, 6T, 6Tc, 3V-D, 4V-D or 6VT-D. The layer strain component of 2D Strain is only recommended for adult cardiac images acquired with the M5Sc-D or M5S-D probe. The measurement accuracies of the strain values reported in the Reference manual are verified with these probes.

2D Strain can be applied to 2D grey scale or TVI acquisitions. In both cases, the 2D grey scale frame rate should be between 40 and 80 frames per second.

NOTE: *In TVI images the system reports TVI frame rate. It is the 2D grey scale frame rate that must be between 40 and 80 frames per second. A higher frame rate is recommended for high heart rate.*

Use only images of good quality where the entire myocardium is visible.

1. Select a TVI or 2D acquisition.

   The image quality should be reasonably good, all myocardial segments to be analyzed should be clearly visible on each frame.
2. If the acquisition has more than one heart cycle, select Cineloop and select a single heart cycle (see also page 4-17).

   The scanner should be configured to store heart cycles with 100 milliseconds before and after the R-wave (in Config/ Global).

Starting 2D Strain

1. In the Advanced control panel, select **Q Analysis**.

   The *Quantitative analysis* screen is displayed.
2. Select **2D Strain** to start the application.

   The *Choose view* window is displayed.

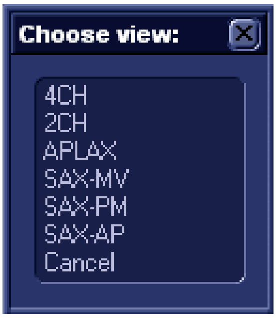


Figure 10-1. The Choose view window

3. Select the correct view type.

   It is recommended to start with the APLAX view. This will allow the user to adjust the Aortic Valve Closure (AVC) to define end of systole. The AVC setting will then be used in the other views.

Defining a ROI

Once the view type has been selected, a Region of Interest (ROI) must be created. The ROI is created either by manual outlining of the endocardial border or by placing three points at the endocardial corners: two basal points and one apical point (Auto ROI, only for full apical views, not for short axis views and single wall). When using manual outlining, the user may trace the entire myocardial or a single wall.

The system automatically displays a frame at end-systole and the mouse arrow cursor is changed to a pencil cursor ✍.

1. If required, adjust **Ref. Frame** to display another frame at end-systole.

Manual outlining

1. Place the cursor at the starting point (as indicated next to the pointer) and press the Left mouse button.
2. Move the cursor following the endocardial border and press the Left mouse button to place a new point. By creating several points the outlining trace can be bent to follow the endocardial border (see 'Guidelines for the ROI definition' on *page 10-6* for additional information).

   The **Yo-yo** runs back and forth display around the reference frame. This may help finding the endocardial border.
3. When placing the last point, double-click the Left mouse button to end the trace.

   A ROI following the endocardial border is displayed.

   Data processing is started automatically if the cursor is not moved for a few seconds.

NOTE: *The auto processing function is configurable (from Config/ Meas-Text/Advanced/AFI auto processing.)*

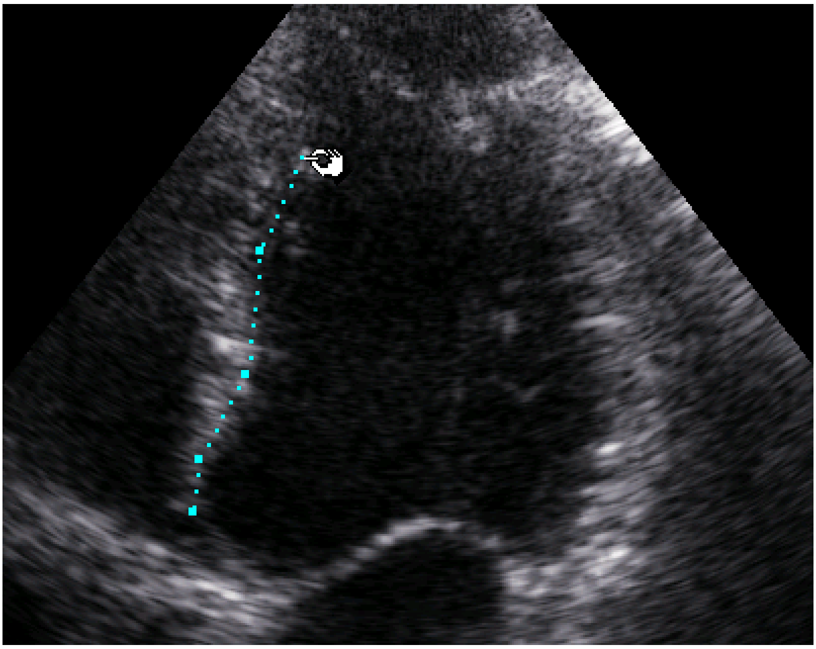


Figure 10-2. Tracing the Region of Interest (ROI)

NOTE: *In a SAX view the trace should be closed.*

Auto ROI

1. Place the cursor at the first basal point (as indicated next to the pointer) and press the Left mouse button.
2. Place the cursor at the Apex and press the Left mouse button.
3. Place the cursor at the other basal point and double-click on the Left mouse button.

   A ROI following the endocardial border is displayed.

   Data processing is started automatically if the cursor is not moved for a few seconds.

NOTE: The auto processing function is configurable (from Config/ Meas-Text/Advanced/AFI auto processing.)

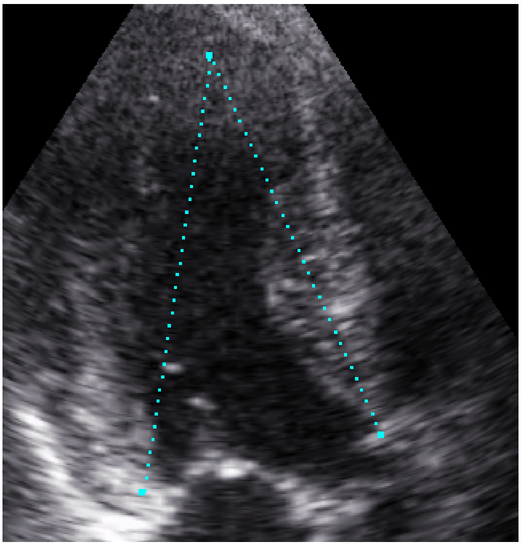
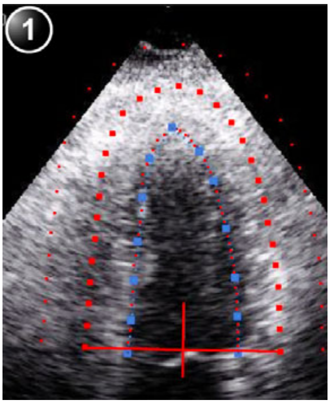
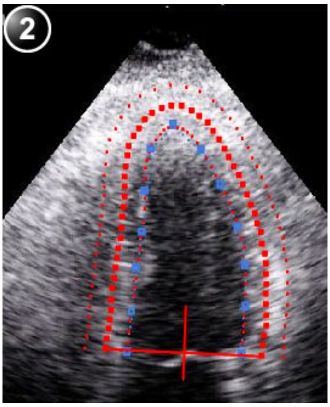
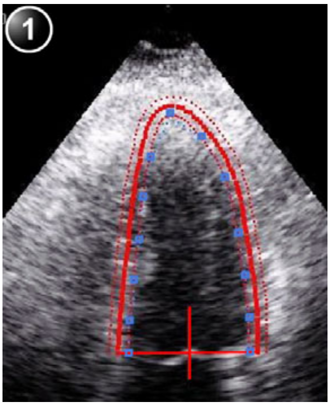
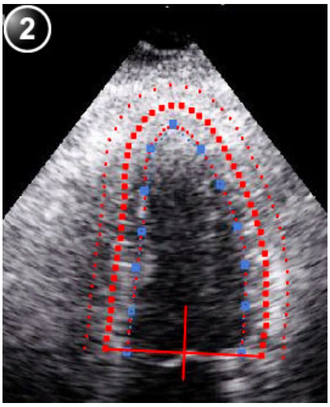
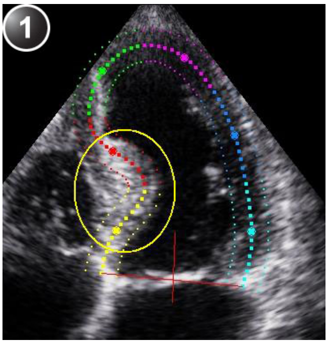
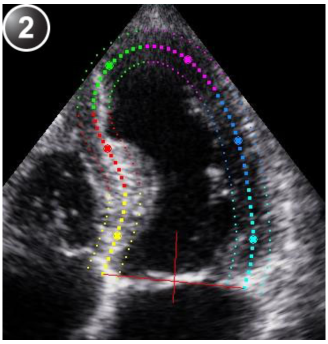


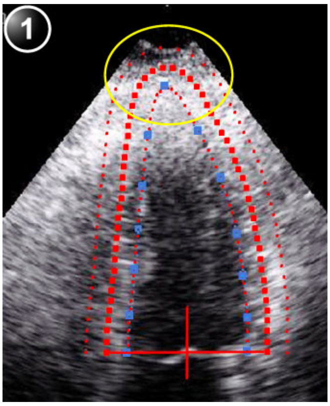
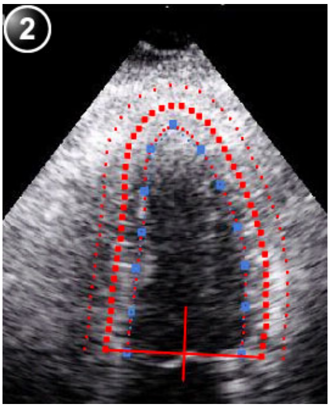
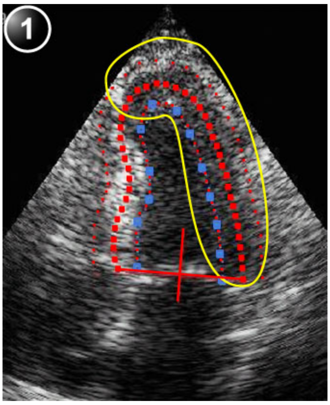
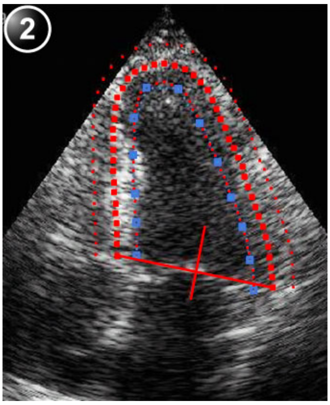
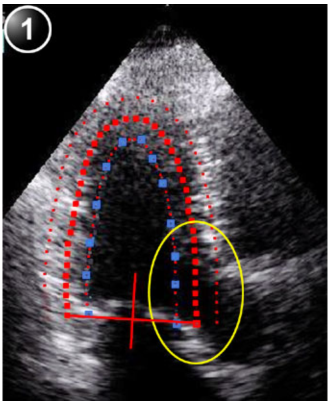
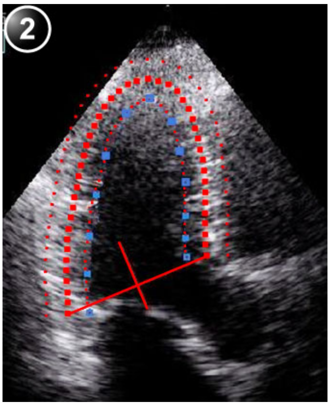
Figure 10-3. Auto ROI creation

Guidelines for the ROI definition

- When tracing the myocardial border, the first and last point should be placed at the connection between the mitral ring and the wall ("hinge point"), except in the long axis view where the anteroseptal end point should be set at the border between the anteroseptal wall and the outflow tract.
- The ROI should be defined as a smooth curve, avoid to warped curves. Make sure the pericardium is not inside the ROI. Some amount of blood area within the ROI may be OK.

The following examples illustrate typical errors that should be avoided when defining the ROI.

Wrong	Correct	Comment
		1. The ROI is too wide and extends beyond the epicardial borders 2. Correct ROI definition
		1. The ROI is too narrow, and does not contain enough information for tracking. 2. Correct ROI definition
		1. The ROI should not follow the bulging, as this results in the ROI central line not being in the direction of myocardial contraction. 2. Correct ROI definition

Wrong	Correct	Comment
		1. The apical point is too high, extending beyond the epicardium. 2. Correct ROI definition
		1. The right border of the ROI is way too much into the chamber cavity. 2. Correct ROI definition
		1. The ROI should not extend into the aortic cavity. 2. Correct ROI definition

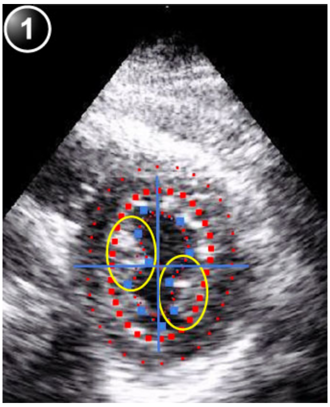
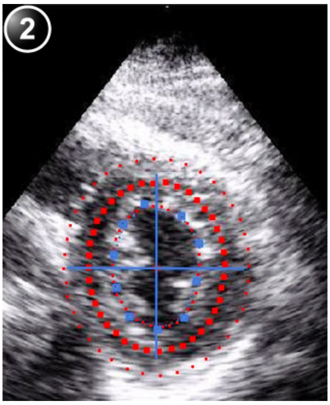
Wrong	Correct	Comment
		1. The ROI should not be traced through the papillary muscles. 2. Correct ROI definition

Figure 10-4. ROI definition guidelines

Adjusting a ROI

The following adjustments can be done to modify the ROI:

- Each point on the inner trace can be moved to modify the ROI shape keeping the ROI width unchanged.
- The width of the ROI can be adjusted globally using the **ROI width** control.
- Each point on the outer trace can be moved along a perpendicular line to adjust the ROI width locally.

To adjust the ROI

1. Press **Recalc**.

ROI shape adjustment

1. Place the mouse cursor over a point to move in the inner trace. The point is highlighted.
2. Press the Left mouse button and move the point.

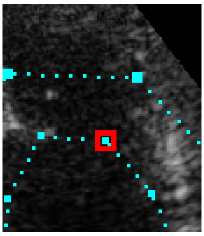


Figure 10-5. Highlighted point on the inner trace

3. Press the Left mouse button to place the point in the new location.

   The shape of the ROI is updated accordingly. The width of the ROI is kept unchanged.
4. Data processing is started automatically if the cursor is not moved for a few seconds.

NOTE: The auto processing function is configurable (from Config/Meas-Text/Advanced/AFI auto processing.)

ROI width adjustment

1. Use the control **ROI width** to adjust the width of the entire ROI. Make sure the ROI covers the region to be analyzed.

NOTE: In order to optimize the tracking try to avoid too wide or too narrow ROI in comparison with the analyzed myocardial wall.

Local ROI width adjustment:

1. Place the mouse cursor over a point to move in the outer trace. The point is highlighted.
2. Press the Left mouse button and move the point along the perpendicular yellow line to change the ROI width locally.

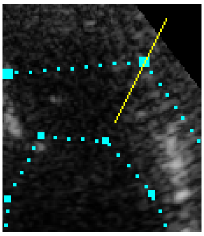


Figure 10-6. Highlighted point on the outer trace

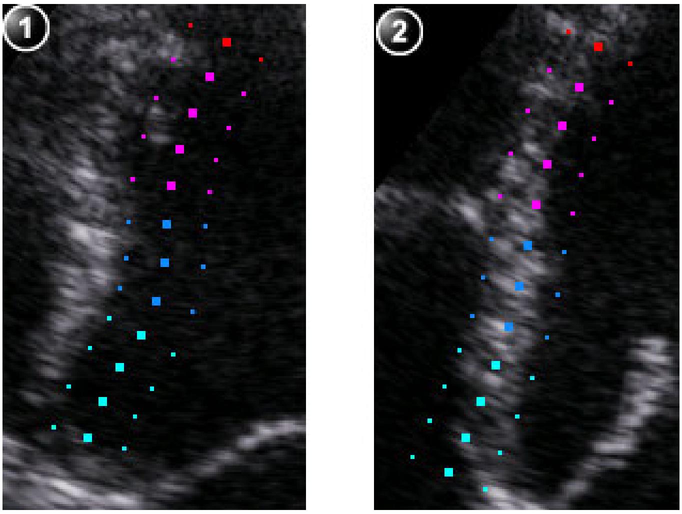
3. Press the Left mouse button to place the point in the new location.

   The width of the ROI is updated accordingly.
4. Data processing is started automatically if the cursor is not moved for a few seconds.

Single wall ROI adjustment

When tracing a ROI for a single wall, the generated ROI may have to be adjusted relatively to the myocardial border.

1. Press **ROI side** to move the ROI to the correct side of the myocardial border (Figure 10-7).



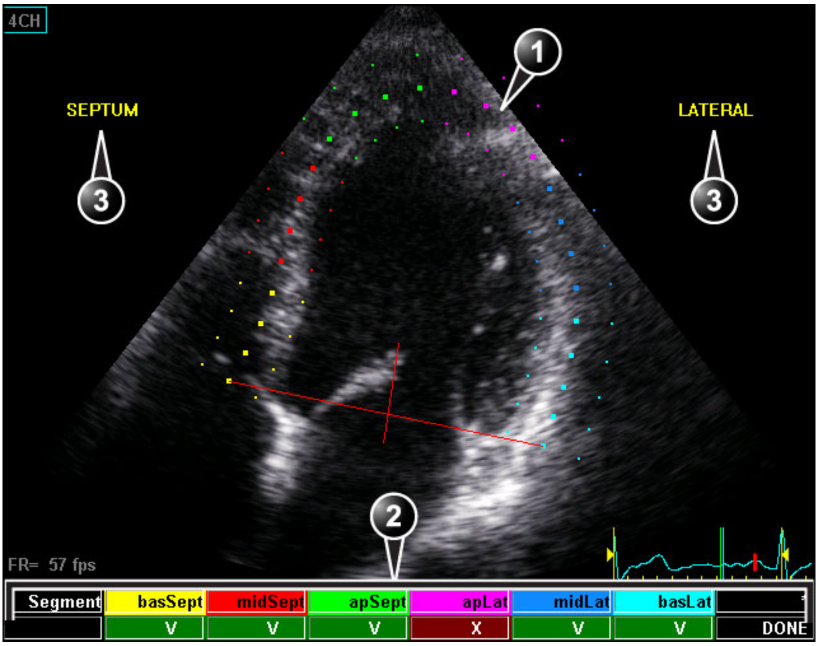
1. Generated ROI on the wrong side of the myocardial border
2. Adjusted ROI

Figure 10-7. Single wall ROI adjustment

2D Strain processing

2D Strain processing divides the ROI into segments and evaluates the tracking quality for each segment. The user has to review and validate the tracking evaluation for each segment.

1. The *Processing* screen is displayed showing the ROI divided into segments. The tracking quality for each segment is automatically evaluated and summarized in the *Tracking* table (see Figure 10-8).



Segment	basSept	midSept	apSept	apLat	midLat	basLat	
	V	V	V	X	V	V	DONE

1. The ROI divided in segment
2. The Tracking table
    - V: valid tracking
    - X: not acceptable tracking
3. Segmental labels

Figure 10-8. The Processing screen

NOTE: *Post-scan gain adjustment does not affect the 2D Strain processing. Live gain adjustment during acquisition will affect* *the 2D Strain processing, and should be adjusted for optimal imaging of the myocardium.*

Tracking validation

The tracking for each segment must be visually controlled and validated.

1. Inspect each segment and make sure that the center line is moving together with the underlying 2D image. To get a better visualization you may adjust the control **Bullets** to add or remove bullets.

   The tracking quality is automatically evaluated for each segment and displayed in the *Scoring* table. The user may override the tracking quality evaluation done by the system by clicking on the evaluation result in the Tracking table.

   If the tracking quality needs to be improved, select **Recalc**, re-adjust the ROI as described on page 10-9.
2. Once the tracking quality has been controlled for all segments, press **Approve** in the *Tracking* table.

   If running 2D Strain on an APLAX view, you may adjust the AVC timing as described below.

   If running 2D Strain on another view than the APLAX view, the *Trace analysis screen* is displayed (see page 10-15).

Timing

Timing information may be crucial for accurate diagnosis. The most important timing is the aortic valve closure (AVC), since it is part of the definition of important parameters such as peak systolic strain or peak systolic strain rate.

Determination of the AVC timing by the system is as follow, depending on the situation:

- If AVC timing has been measured by the operator (through an event timing measurement) the system is using this data.
- If event timing is not available, an automatic AVC estimate is used, determined by the temporal contraction of all LV segments (Strain curves).
- From the APLAX view, the user can adjust the estimated AVC timing. The adjusted AVC timing will then be used in the other apical views. This option is only available from the APLAX view.

AVC timing adjustment

The following procedure is available in the APLAX view.

1. After validation of the tracking quality. the frame for the current AVC setting (automatic or event timing measurement) is displayed and highlighted on the ECG.
2. To keep the current AVC setting, press the Left mouse button. To change the AVC setting, use the mouse to display another frame and press the Left mouse button.

   If the AVC setting was changed, a *Confirmation* window is displayed. Select one of the following options:

   - **Manual** to accept the manual AVC setting.
   - **Event timing** to discard the manual AVC setting (if for example the AVC setting was not possible to assess from the APLAX view). The AVC event timing measurement will then be used.
   - **Auto** to discard the manual AVC setting and use the automatic AVC timing.

NOTE: *In non-APLAX view the AVC adjustment is possible after processing by dragging the AVC green bar on the ECG.*

2D Strain quantitative analysis

2D Strain quantitative analysis enables full data analysis in both numerical, parametric color coding and graphical forms for any point within the ROI in any frame in the cineloop.

The 2D Strain quantitative analysis is available through:

- The *Trace analysis* screen: provides a local graphical display of various selectable parameters as a function of time (curves) and color coded parametric display in the 2D and M-Mode windows (page 10-17).
- The *Single analysis* screen: provides a display of various selectable parameters as a color coded large size 2D cineloop (page 10-20).
- The *Quad analysis* screen: provides a segmental graphical display of various selectable parameters as a function of time (curves) and color coded parametric display in the 2D and M-Mode windows (page 10-20).
- The *Layers* screen: provides color-coded still images, segmental traces and color M-Mode for both endocardial, mid and epicardial Strain results (page 10-21).
- The *Result analysis* screen: provides both numerical and graphical display of the results (page 10-24).
- The *Bull's eye* screen and *Bull's eye with traces* screen: provide parametric imaging (both numerical and graphical) of entire LV of the various selectable parameters. These screens are available only when APLAX, 4-chamber and 2-chamber views have been processed (page 10-22).
- The *Bull's eye with layers* screen: provides endocardial, mid and epicardial parametric imaging (both numerical and graphical) of entire LV of Strain parameter. This screen is available only when APLAX, 4-chamber and 2-chamber views have been processed (page 10-22).
- The *Torsion* screen: provides a graphical display of the global apical and basal rotations and Torsion. From this screen, the user may also display global apical and basal rotation rates and torsion rate. This screen is available only when apical short axis (SAX-AP) and mitral valve short axis (SAX-MV) views have been processed (page 10-25).

These screens are available only when all segment tracking scores have been approved (see page 10-13).

About the results

Be aware of the following:

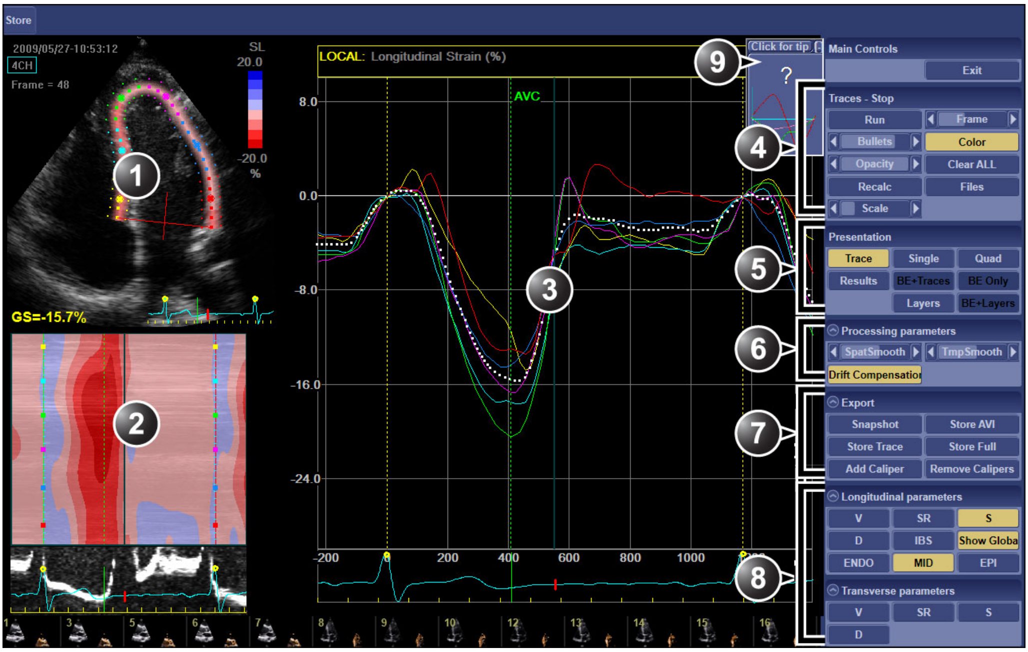
- Assessments should be made based on both color and segmental Peak systolic strain values.
- The Save As function is intended for research purposes and should not be used to archive diagnostic data.
- Any strain drifting is linearly compensated throughout the cycle. If the drift compensation in a given segment is too high, the tracking quality is automatically set to Not acceptable (**X**).

Trace analysis

To start the Trace analysis:

1. The *Trace analysis* screen is automatically displayed after validating the tracking.

   The *Trace analysis* screen displays the traces for the selected parameter for the marked point at the center of each segment and color coded parametric overlay in the 2D and M-Mode windows.



1. 2D Cineloop with parametric color coding
2. M-mode with parametric color coding
3. Trace display for the selected parameter
4. Display adjustment controls
5. Screen selection controls
6. Processing parameters
7. Export controls and time caliper
8. Parameter selection panel
9. On line Help

Figure 10-9. The Trace analysis screen

2. In the control panel, select a parameter to display the corresponding traces for all segments (see also page 10-19).
3. The following adjustments may be done:

- Move the mouse cursor to any point in the ROI in the 2D or M-Mode window to display numerical parameter value and temporal trace for the highlighted point.
- Adjust the **Scale** in the Trace window.
- Adjust the **Opacity** of the color coded parametric display in the 2D and M-Mode window.

To perform a time measurement on the trace:

1. Press **Time Caliper** on the Control panel.
2. Place the cursor on the starting point of the measurement and press the left mouse button.
3. Move the cursor to the end point of the measurement and press the left mouse button.

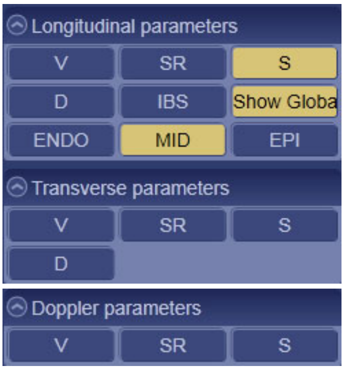
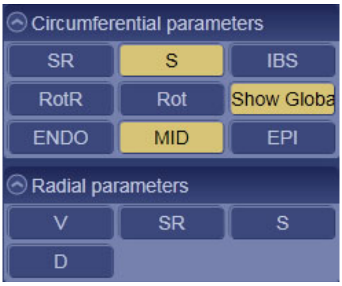
   The measurement result is displayed on screen.

NOTE: Repeat the operation to make multiple measurements.

4. Make a screen snapshot (see page 10-29) to store the measurement(s).
5. To remove the time measurement(s), press **Remove calipers** on the Control panel.

Parameters

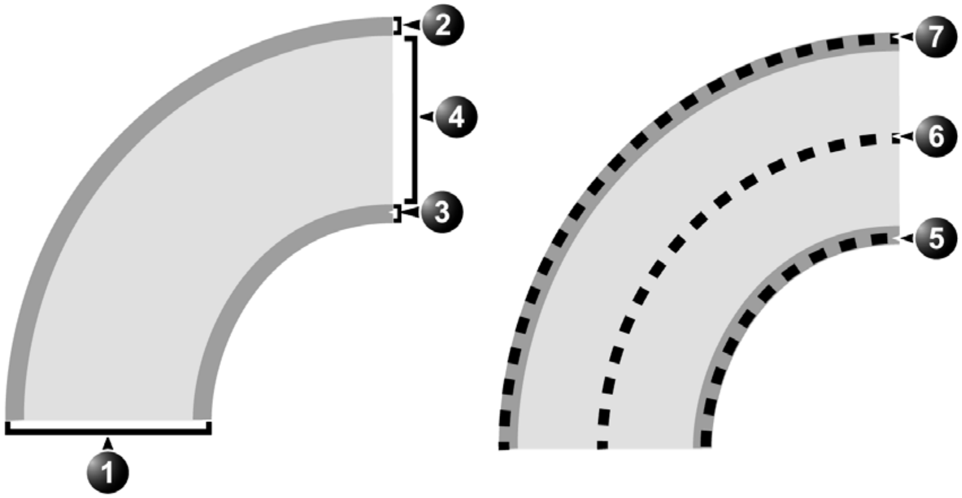
The following calculation parameters are available:

Apical parameters  Short axis parameters  	• **V**: Velocity • **SR**: Strain rate • **S**: Strain • **D**: Displacement • **IBS**: Integrated back scatter • **RotR**: Rotation rate (short axis only) • **Rot**: Rotation (short axis only) • **ENDO/MID/EPI**: display either endocardial, mid or epicardial Strain information. The parameters in the Doppler section are based on Doppler only (available only if TVI data is present).

Note regarding ENDO, MID and EPI parameters

Speckle tracking is performed for the entire myocardial wall thickness outlined by the tracked ROI borders. The MID (center line) of the ROI represents the average values for the full wall thickness (see Figure 10-10 *on page 10-20*).

The exact thickness of the endocardial and the epicardial layers are not measured and used for the analysis. The measurement presented for the endocardial layer (ENDO) and epicardial layer (EPI) are the values at the inner and outer tracked ROI lines (see Figure 10-10 *on page 10-20*).



1. Heart wall
2. Epicardial layer
3. Endocardial layer
4. Myocardium
5. ENDO: inner tracked ROI line (endocardial measurement)
6. MID: full heart wall thickness average (mid myocardial measurement)
7. EPI: Outer tracked ROI line (epicardial measurement)

Figure 10-10. Schematic representation of myocardial layers, ROI, and position of the calculated ENDO, MID and EPI measurements

Display options

Single screen

1. Select **Single**.

   The cineloop is displayed in a single screen with color coded parametric information.
2. Use the Display adjustment controls (see Figure 10-9) to optimize image quality.

Quad screen

1. Select **Quad**.

   A Quad screen is displayed showing the cine loop in the upper left quadrant, color coded parametric still image in the bottom left quadrant, color M-Mode window in bottom right quadrant and segmental traces in the upper right quadrant.
2. To display a color coded parametric image for another parameter, select the heading of the color coded parametric image and choose another parameter.

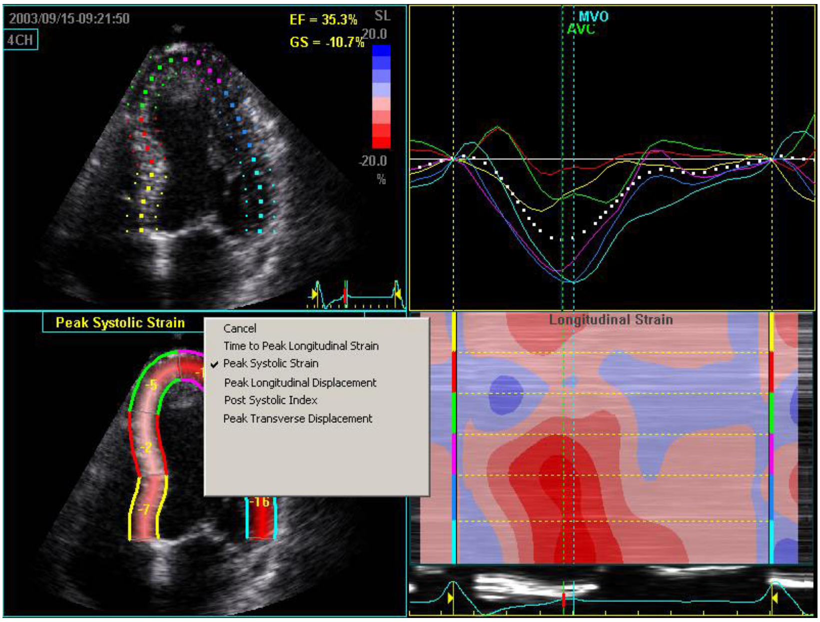


Figure 10-11. The Quad screen

Layers screen

1. Select **Layers**.

   The color-coded still images, segmental traces and color M-Mode for both endocardial, mid and epicardial Strain results are displayed. See ‘Note regarding ENDO, MID and EPI parameters’ on *page 10-19* for more information.

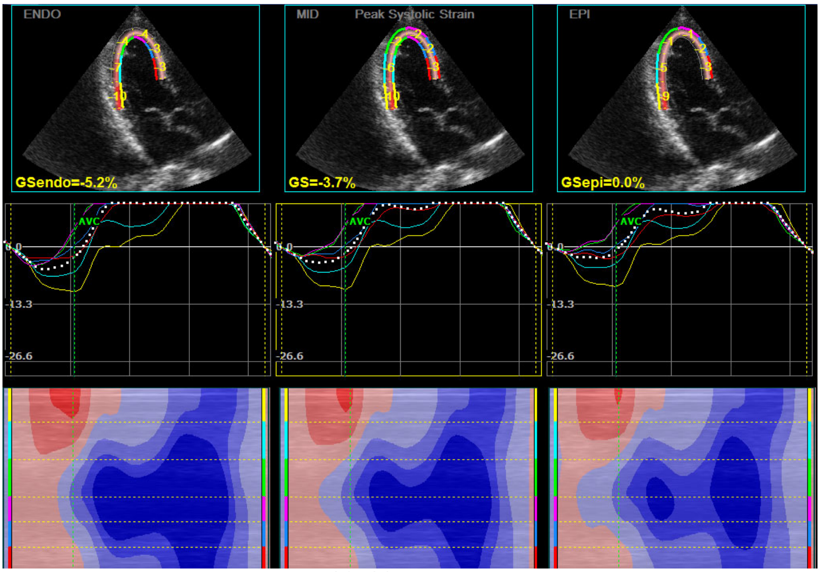


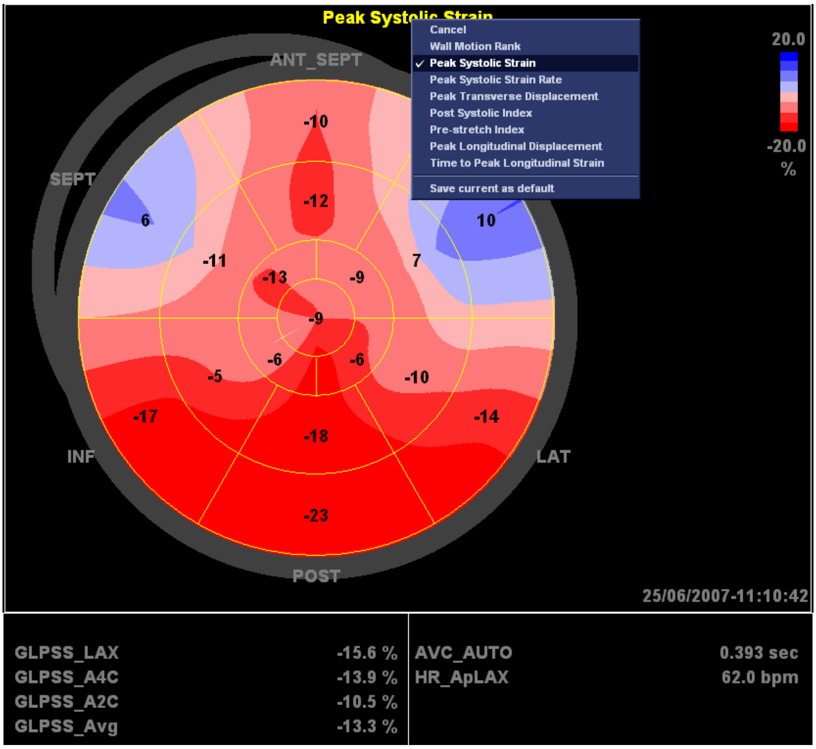
Figure 10-12. The Layer screen

Bull’s eye, Bull’s eye with traces and Bull’s eye with layers screens

1. When APLAX, 4-chamber and 2-chamber views have been processed, the Bull’s eye buttons become active.

   Select **BE Only**.

   A *Bull's Eye* screen is displayed showing the color-coded parametric image in Bull's Eye schematic form.
2. To display a color-coded parametric image for another parameter, select the heading of the color coded parametric image and choose another parameter.



GLPSS_LAX -15.6 %
GLPSS_A4C -13.9 %
GLPSS_A2C -10.5 %
GLPSS_Avg -13.3 %

AVC_AUTO 0.393 sec
HR_ApLAX 62.0 bpm

Figure 10-13. The Bull’s eye screen

3. To display segmental traces and Bull’s eye, select **BE+Traces**.

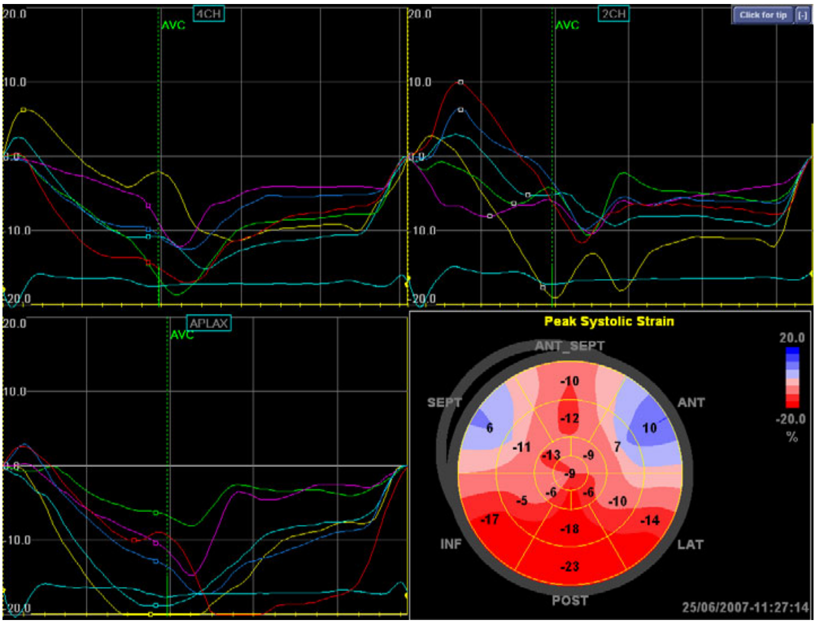
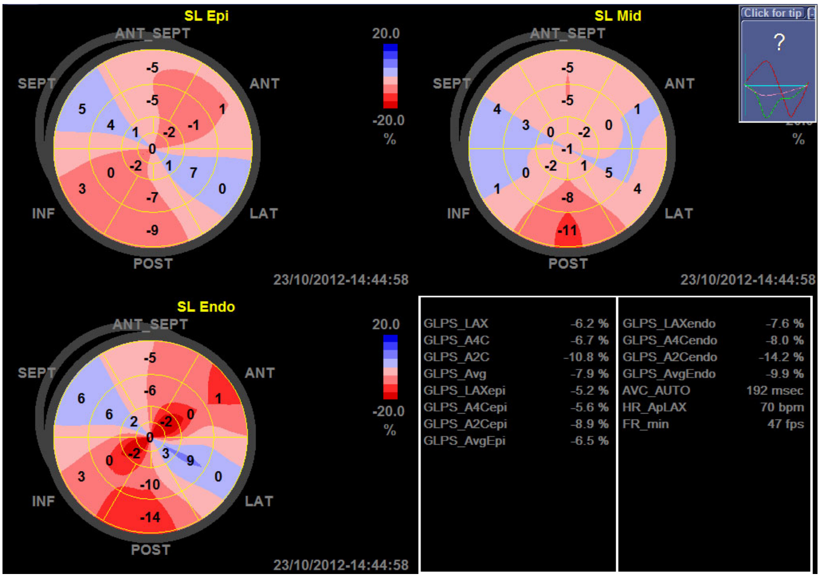


Figure 10-14. The Bull’s eye with traces screen

4. To display Bull’s eyes for endocardial, mid and epicardial Strain results, select **BE+Layers**.



GLPS_LAX	-6.2 %
GLPS_A4C	-6.7 %
GLPS_A2C	-10.8 %
GLPS_Avg	-7.9 %
GLPS_LAXepi	-5.2 %
GLPS_A4Cepi	-5.6 %
GLPS_A2Cepi	-8.9 %
GLPS_AvgEpi	-6.5 %

GLPS_LAXendo	-7.6 %
GLPS_A4Cendo	-8.0 %
GLPS_A2Cendo	-14.2 %
GLPS_AvgEndo	-9.9 %
AVC_AUTO	192 msec
HR_ApLAX	70 bpm
FR_min	47 fps

Figure 10-15. The Bull’s eye with layers screen

Result analysis

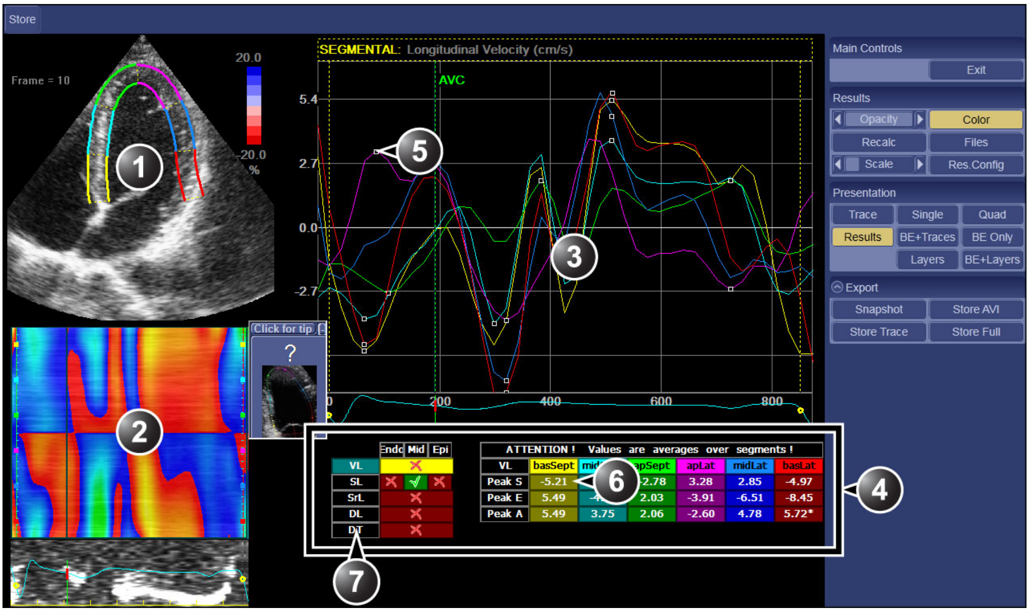
The *Result quantitative analysis* screen displays the average traces for a selected parameter for each segment (averaged on all points in the segment) and corresponding peak values (Peak S, Peak E and Peak A). The peak positions in the curves must be assessed and approved.

All approved peak values and time positions will be exported into the Excel Report.

Peak adjustment

1. Press **Result**.

   The *Result analysis* screen is displayed.



	Endo	Mid	Epi
VL	✗		
SL	✗	✓	✗
SrL	✗		
DL	✗		
DT	✗		

ATTENTION ! Values are averages over segments !

VL	basSept	mid	apSept	apLat	midLat	basLat
Peak S	-5.21	[illegible]	2.78	3.28	2.85	-4.97
Peak E	5.49	-4	2.03	-3.91	-6.51	-8.45
Peak A	5.49	3.75	2.06	-2.60	4.78	5.72*

1. 2D image with segmented ROI
2. M-mode with parametric color coding
3. Trace display for the selected parameter
4. Peak result table
5. Peak marker
6. Peak value
7. Select a parameter
   - Green V: approved parameter result
   - Red X: not approved parameter result

   Yellow: selected parameter

Figure 10-16. The Result analysis screen

2. Select a Peak marker (white square point) on one of the traces.

   The corresponding peak value is highlighted in the *Peak result* table.

OR

Select a Peak value in the *Peak result* table.

The corresponding Peak marker is selected.

3. Move the Peak marker to the correct position.
4. Press the Left mouse button.

   The corresponding Peak value is updated in the *Peak result* table.
5. Repeat the procedure for all Peak markers in all segments for the selected parameter.

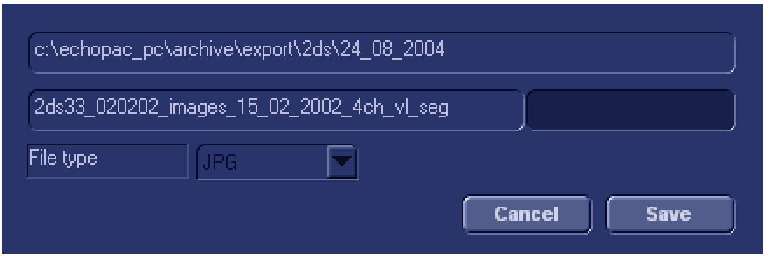
Peak validation

Once all peak positions in all segments for the selected parameter are controlled, the results can be approved.

1. Select **Approve** in the *Peak result* table next to the selected parameter.

   A window is displayed prompting the user to save a snapshot.

   You may enter a text to be added to the file name in the text field.



c:\echopac_pc\archive\export\2ds\24_08_2004

2ds33_020202_images_15_02_2002_4ch_vl_seg

File type: JPG

Figure 10-17. The store window

2. Select **Save**.

   A snapshot of the screen is saved to the local hard disk.

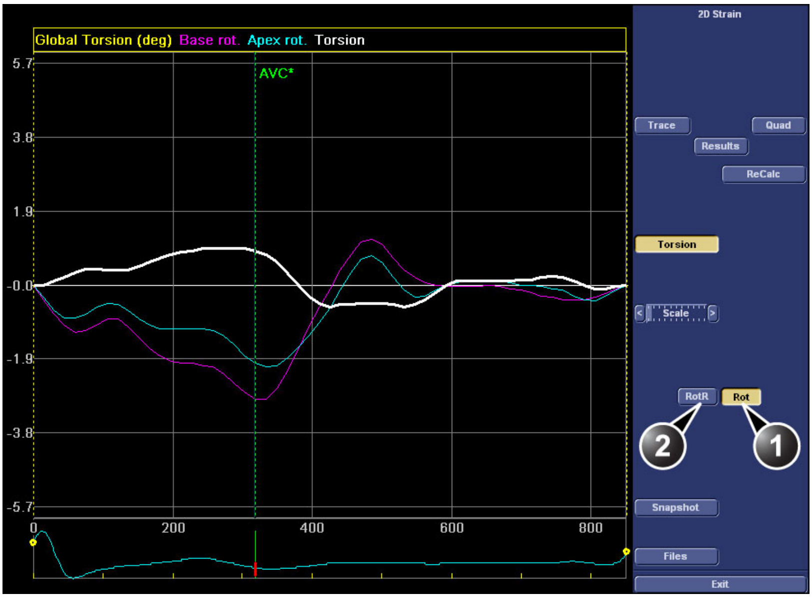
   To retrieve snapshots, see page 10-28.
3. Select the next parameter in the *Peak result* table and repeat the Peak adjustment and validation procedures.

Torsion analysis

The *Torsion* screen displays the global apical rotation, global basal rotation and global Torsion traces. The Torsion parameter is calculated as the difference between the apical and basal rotations.

The *Torsion* screen is available only when apical short axis (SAX-AP) and mitral valve short axis (SAX-MV) views have been processed.

From this screen, the user can also display the global apical rate, basal rotation rate and torsion rate traces.



1. Display global apical and basal rotations and global Torsion.
2. Display global apical and basal rotation rates and global Torsion rate.

Figure 10-18. The Torsion screen

When processing the SAX-AP and SAX-MV views, make sure that:

- The acquisitions should have only one heart cycle.
- Both acquisitions should have similar heart rate and frame rate.
- The cineloop markers should be placed in the same position in both acquisitions.

To display the *Torsion* screen:

1. Process the SAX-AP and SAX-MV views. The Torsion button is displayed.
2. Press **Torsion**.

   The *Torsion* screen is displayed (see Figure 10-18) showing the global apical and basal rotation curves and global Torsion curve.

3. Press **RotR** to display the global apical and basal rotation rate curves and global Torsion rate curve.
4. Press **Snapshot** to save a screen shot of the curves.

Data management

The 2D Strain result file

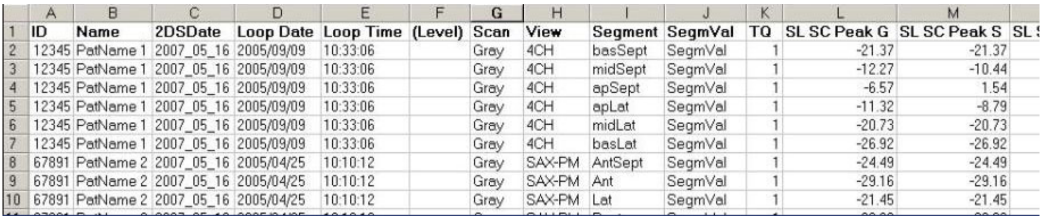
2D Strain generates a single result file (spreadsheet) for each day, regardless of how many examinations that have been performed that day. The file can be exported to a removable media or a shared network folder as described in 'File management' on *page 10-29*.

Description of the 2D Strain result file

The 2D Strain result file is a spreadsheet consisting of:

- A worksheet for the global values (one row per view and per patient, see Figure 10-19)
- A worksheet for segmental values
- A worksheet for segmental timings.

NOTE: The parameters listed in the worksheets are described in the Reference manual.



	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	**ID**	**Name**	**2DSDate**	**Loop Date**	**Loop Time**	**(Level)**	**Scan**	**View**	**Segment**	**SegmVal**	**TQ**	**SL SC Peak G**	**SL SC Peak S**	**SL**
2	12345	PatName 1	2007_05_16	2005/09/09	10:33:06		Gray	4CH	basSept	SegmVal	1	-21.37	-21.37	
3	12345	PatName 1	2007_05_16	2005/09/09	10:33:06		Gray	4CH	midSept	SegmVal	1	-12.27	-10.44	
4	12345	PatName 1	2007_05_16	2005/09/09	10:33:06		Gray	4CH	apSept	SegmVal	1	-6.57	1.54	
5	12345	PatName 1	2007_05_16	2005/09/09	10:33:06		Gray	4CH	apLat	SegmVal	1	-11.32	-8.79	
6	12345	PatName 1	2007_05_16	2005/09/09	10:33:06		Gray	4CH	midLat	SegmVal	1	-20.73	-20.73	
7	12345	PatName 1	2007_05_16	2005/09/09	10:33:06		Gray	4CH	basLat	SegmVal	1	-26.92	-26.92	
8	67891	PatName 2	2007_05_16	2005/04/25	10:10:12		Gray	SAX-PM	AntSept	SegmVal	1	-24.49	-24.49	
9	67891	PatName 2	2007_05_16	2005/04/25	10:10:12		Gray	SAX-PM	Ant	SegmVal	1	-29.16	-29.16	
10	67891	PatName 2	2007_05_16	2005/04/25	10:10:12		Gray	SAX-PM	Lat	SegmVal	1	-21.45	-21.45	

Figure 10-19. 2D Strain result file (example)

Other files

The user may store:

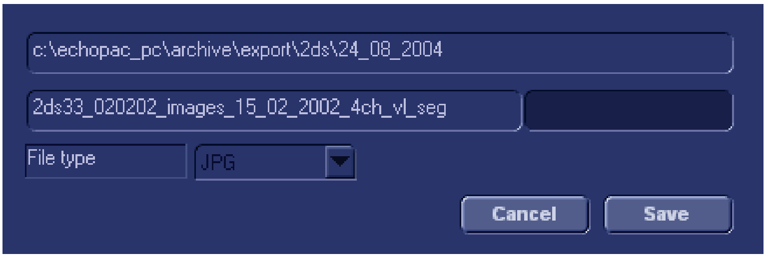
- Snapshot (JPEG format) of the *Trace analysis* screen or *Result analysis* screen (**Snapshot** button).
- AVI file with running cineloop in the *Trace analysis* screen or *Result analysis* screen (**Store AVI** button).
- Trace data for the current screen (**Store trace** button).
- Trace data at all nodal points along the ROI, available from the *Result analysis* screen (**Store full** button).

To store data:

1. Select one of the storing options.

   The *Store* window is displayed.

   The location, name and type of the stored file are shown in upper, mid and bottom strings in the Store window. You may enter a text to be added to the file name in the text field.



c:\echopac_pc\archive\export\2ds\24_08_2004

2ds33_020202_images_15_02_2002_4ch_vl_seg

File type: JPG

Figure 10-20. The Store window

2. Select **Save**.

   A file is saved to the local hard disk.

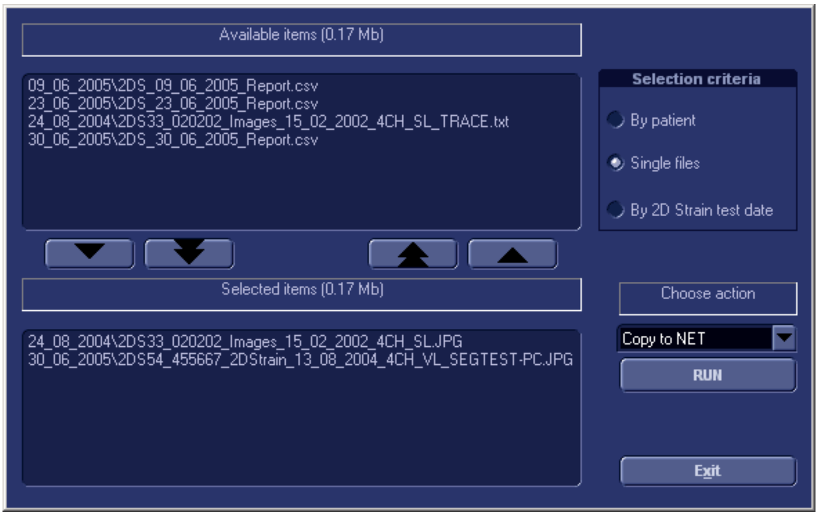
File management

The 2D Strain result file and other stored files can be exported from the local hard drive to a removable media or a shared network folder.

If a shared network folder is used, the path (of type: \\SERVER-NAME\SHARED-FOLDER) must be entered in the *Remote path* field in **Config/Connectivity/Tools**.

1. In the *Trace analysis* screen or in the *Result analysis* screen, select **Files**.

   The *File management* window is displayed showing the available files in the *Available items* field.



Available items (0.17 Mb)

09_06_2005\2DS_09_06_2005_Report.csv
23_06_2005\2DS_23_06_2005_Report.csv
24_08_2004\2DS33_020202_Images_15_02_2002_4CH_SL_TRACE.txt
30_06_2005\2DS_30_06_2005_Report.csv

Selection criteria

- ○ By patient
- ● Single files
- ○ By 2D Strain test date

Selected items (0.17 Mb)

24_08_2004\2DS33_020202_Images_15_02_2002_4CH_SL.JPG
30_06_2005\2DS54_455667_2DStrain_13_08_2004_4CH_VL_SEGTEST-PC.JPG

Choose action: Copy to NET

Figure 10-21. The File management window

2. Check the desired selection criteria and select one or several files in the *Available items* field.
3. Select the **Down arrow** button to move them over to the *Selected items* field (right side).
4. Under **Choose action**, select:
   - Copy to CD/USB Flash card
   - Copy to Net
5. Select **Run**.
6. The selected files are copied to the selected device.
7. The copied files can be opened from a regular PC.

2D Strain – Frequently asked questions

1. **Q:** What system settings should be used for acquiring best data for 2D Strain analysis?

   A: The 2D grey scale frame rate should be between 40 and 80 frames per second. Use only images of good quality where the entire myocardium is visible (not only the endocardial border). Slightly more than one cardiac cycle should be stored to allow adjustment of the QRS markers: configure the scanner such that when you save the loop, margins of 100 msec are saved at both ends of the heart cycle.
2. **Q:** Are there different criteria for TVI images than for 2D images?

   A: The same criteria apply (see Question 1). Note that the TVI and 2D grey scale images may have different frame rates. It is the 2D grey scale frame rate that should be between 40 and 80 frames per second.
3. **Q:** Is the peak of the R wave the starting point for the loop used for 2D strain analysis?

   A: Yes, the reference for the strain measurements is the end-diastolic state.
4. **Q:** How do I define the start and end points of the heart cycle?

   A: In most cases, when the ECG signal is good, you do not have to do anything, the software will do it automatically for you by analyzing the QRS complex. Sometimes the ECG signal is poor. In order to be able to handle these situations we recommend to manually shift the markers that define the heart cycle either prior to entering 2D Strain or within the 2D Strain package.
5. **Q:** Is “Right Twist” shown by red color and clockwise?

   A: Yes, clockwise rotation is measured as negative degrees and is colored red.
6. **Q:** How is the combination of greyscale and TVI information performed?

A: If the data set contains TVI, the velocities within the ROI are first angle corrected to the actual motion direction found by 2D Strain processing. Next, the quality of the TVI and the 2D Strain data is estimated for each point within the ROI from the spatial variation around the point. The data type with the lowest variance is used for further processing.

7. **Q:** How is the result affected if the ROI covers both myocardium and blood?

   A: The processing uses a special filtering which ensures that the blood samples have minimal effect on the estimated strain values.

8. **Q:** How do we calculate rotation (twist)?

   A: The rotation (twist) is calculated as an angular displacement of each point of myocardium around the "center of gravity". The start angle is zero at the beginning of heart cycle The rotation rate is the temporal derivative of the rotation. The Global Rotation is the averaged rotation along the ROI.

9. **Q:** What are the "global" values, and how are they found?

   A: The global values are calculated from the whole ROI as a single segment. Note that this is similar, but not necessarily identical, to averaging the values of all the segments.

10. **Q:** How is the Time to peak strain parametric image derived, and what do the quantitative values represent?

    A: The Time to peak strain parametric image color codes the time from start systole to the peak negative longitudinal strain. The quantitative values are in milliseconds.

11. **Q:** What are the start and end search times for the Time to peak strain parametric image, and can the user control these times?

    A: The start search time is start systole (start QRS), and can be controlled by adjusting the AVC marker. The end search time is the QRS of the next beat, and is not adjustable. It is possible to adjust Peak marker position manually (using Drag-and-drop) in the *Result analysis* screen.

12. **Q:** What are the consequences if the warnings for low frame rate etc. are ignored and analysis is performed anyway?

    A: Up to a certain limit, probably none. For images with a good image quality the tracking is good even for frames rates as low as 30 fps. The message will appear for frame rates below 40 fps.

13. **Q:** How can I use another heart beat than the second in a loop?

    A: The desired beat should be selected prior to entering the 2D Strain application.

14. **Q:** I am assuming that 90 fps is acceptable? With the higher frame rate acquisition this would give us a better temporal resolution when performing the 2D strain analysis.

    A: A too high frame rate tends to come in the expense of a reduced line density. This has a detrimental effect on tracking quality.

15. **Q:** Horizontal timing intervals are set at 15 msec. Can these be smaller?

    A: Timing interval is given by the acquisition frame rate.

16. **Q:** What is the strain length at longitudinal and transverse strain?

    A: We do not measure distances between selected points, rather we calculate strain based on interpolated positions of all points inside the ROI.

17. **Q:** What is the difference between Lagrangian strain and natural strain?

    A: There are several definitions for one-dimensional strain. One of them is the so-called Lagrangian strain, a.k.a. engineering strain, which is defined as *epsilon = (L-L0)/L0*. Another is the natural strain, a.k.a. logarithmic strain, which is defined as *epsilon_n = ln(L/L0)*, where *ln* means the natural logarithm. (The name “natural strain” comes from the use of the natural logarithm.) There is a direct mathematical relation between these two strain measures: epsilon_n = ln(epsilon + 1) or correspondingly epsilon = exp(epsilon_n) - 1, where “exp” is the exponential function. Using two different measures for the same property can be compared to presenting a temperature either in Fahrenheit or in Celsius. If you know the natural strain, you can easily convert it to the Lagrangian/ engineering strain and vice versa.

Chapter 11

Appendix

This chapter describes:

Short-cuts

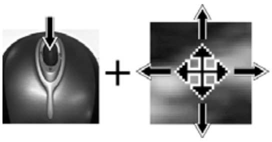
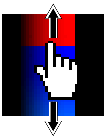
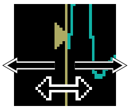
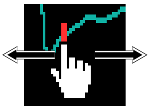
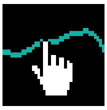
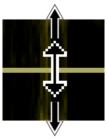
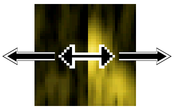
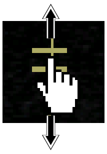
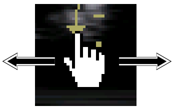
Keyboard short-cuts

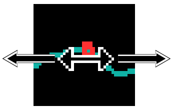
Short-cut	Description
← / →	In Freeze, displays previous and next frame. Disabled when Direct report is activated.
Esc	Displays previous state (window).
Alt + 1	Performs **Alt. store 1**.
Alt + 2	Performs **Alt. store 2**.
Alt + A	Starts **Annotation** application.
Alt + E	Ejects removable media
Alt + F	Starts Structured findings application.
Alt + I	Store screen image to clipboard.

Short-cut	Description
Alt + Q	Displays the monitor test image (Turnkey system only).
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
Alt + T	Starts Direct report.
Alt + W	Starts Q Analysis.
Alt + Z	Image store
Shift ⇧ + F1 Shift ⇧ + F2	• **Shift** + **F1**: In the *Analysis* screen, select previous image. • **Shift** + **F2**: In the *Analysis* screen, select the next image.
Ctrl + ← / →	In duplex mode, scrolls through a cineloop.

Short-cut	Description
F1	Help: starts the **On line user manual**.
F2	Starts EchoPAC Software Only 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.
F9 / F10	Adjust **Compression** (**F9** = decrease, **F10** = increase).
F11 / F12	Adjust **Reject** (**F11** = decrease, **F12** = increase).

Mouse short-cuts

Short-cut	Description
	**Zoom**: scroll the mouse wheel to zoom in/out.
	**Panning tool** in Zoom mode: press and hold down **the mouse wheel**, 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.
	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.

Short-cut	Description
	Tissue Tracking/Strain: select the **Start** or **End marker** and drag horizontally to change its position.

System self-test

The ultrasound unit is designed for reliable operation and consistent, high-quality performance. Automatic self-testing facilities are provided to monitor system operation and to detect malfunction as soon as possible, thereby eliminating unnecessary downtime. The detection of any serious malfunction may result in immediate interruption of the unit operation.

System malfunction

In the event of error or system malfunction the user may save locally or export a log file to a removable media as described below and contact authorized service personnel.

In addition, system malfunctions can be bookmarked, enabling creation of a log file specific to that event.

Bookmarking a system malfunction

1. If a system malfunction is observed, press **Alt** - **B**.

   A bookmark will be created when creating a log file.

Generating a log file

1. Press **Alt** - **D** on the alphanumeric keyboard.

   The *Problem description dialogue* window is displayed (see Figure 11-1).
2. Type in a description of the problem. If applicable, try to describe the button or key pushing sequence that immediately preceded the problem.

   Check the mention *System lockup* if applicable.
3. Select the destination where to save or export the log file.

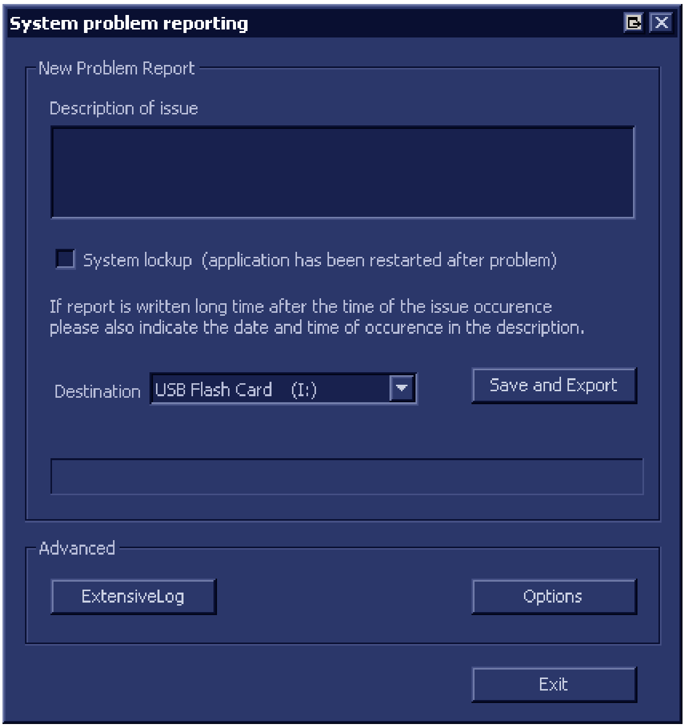
   If **Store locally** is selected, the log file is saved to the local hard disk.

   If a removable media is selected, the current and previously saved log files are exported to the selected media.

NOTE: To export to a shared folder on a network, a remote path must be defined (see 'Remote path setting' on page 3-68).

4. Press **Save and Export**.

   A Zip file (named "logfile_<date>_<time>.zip") is created.



☐ System lockup (application has been restarted after problem)

If report is written long time after the time of the issue occurence please also indicate the date and time of occurence in the description.

Destination: USB Flash Card (I:)

Figure 11-1. The Problem description dialogue window

Advanced log options

Extensive Log

Extensive Log enables the creation of a log file containing additional information for the selected functionality.

Options

Options enables creation of a log file based on a selected bookmark or for a user configurable time frame. Different type of information can be selected to be part of the log file.

Software upgrade

Software upgrade for the unit may become available for download and installation through the GE Service platform. When a software upgrade is available a message icon ✉ is displayed on the status bar.

Users must have administrator rights to perform the software download. If a user is not logged in as ADM (administrator) he/ she will not be prompted for initiating SW Download.

CAUTION

Please backup up presets and database before installation of the software (see ‘Data Backup and restore’ on *page 3-41*).

Remote software download should not change user presets or affect customer database; however, it is always best practice to ensure patient data and preset are backed up before proceeding with any software installation.

NOTE: Please allow approximately one hour for complete software download and installation. (Times may vary due to network connection speed).

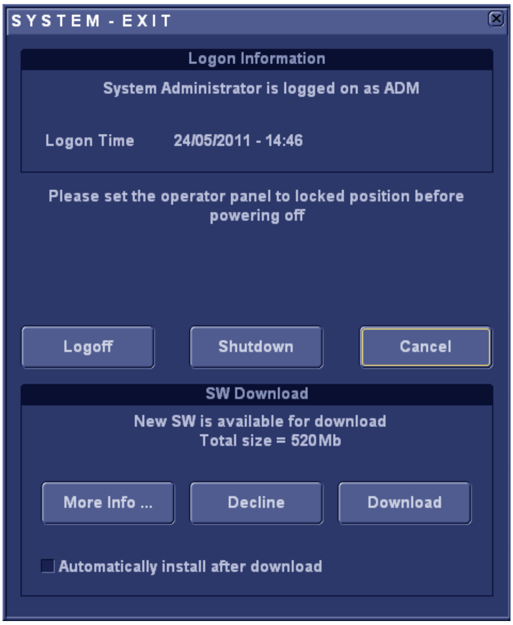
NOTE: Software upgrade through the GE service platform may not be available in all markets.

To ensure TCP/IP settings are retained after software upgrade, save the TCP/IP settings as described in section ‘Save TCP/IP settings’ on *page 11-14* prior to downloading the software.

Software download and installation

1. Press the **Exit** tab.

   The *Exit dialogue* window with software download is displayed.



System Administrator is logged on as ADM

Logon Time 24/05/2011 - 14:46

Please set the operator panel to locked position before powering off

New SW is available for download
Total size = 520Mb

☐ Automatically install after download

Note: the *SW Download* section (lower part of the window) may take a few seconds to be displayed.

- ☑ **Automatically install after download**: it is recommended that the user checks this option. This selection allows the software to start loading automatically after the software has been downloaded. If not selected the user will be given the opportunity after download to install the software.
- **More Info**: displays a window with information about the software to download.
- **Decline**: the software is not downloaded, no upgrade will be performed.
  Note: If you choose **Decline**, you will not be prompted to install this software update again unless you contact GE Service.
- **Download**: starts software download.

Figure 11-2. The Exit dialogue window

2. Press **Download**.

   The download process is started. The progression of the download process is displayed.

NOTE: *A typical software update of about 600 Mb may take up to 60 minutes to download.*

Please allow the software to fully download and only stop or suspend in case of emergency.

SW download in progress
50 % of 520Mb completed

☐ Automatically install after download

- **Stop**: the download process is stopped, no software upgrade is performed.
- **Suspend/Resume**: the download process is paused, press **Resume** to continue download.

Figure 11-3. Software download in progress

3. If the user did not check the option **Automatically install after download** in step 1 the following message is displayed.

SW is ready to be installed

- **Decline**: the downloaded software will not be installed; software upgrade will not be performed.

  Note: If you choose **Decline**, you will not be prompted to install this software update again unless you contact GE Service.
- **Install**: the downloaded software will begin installation.

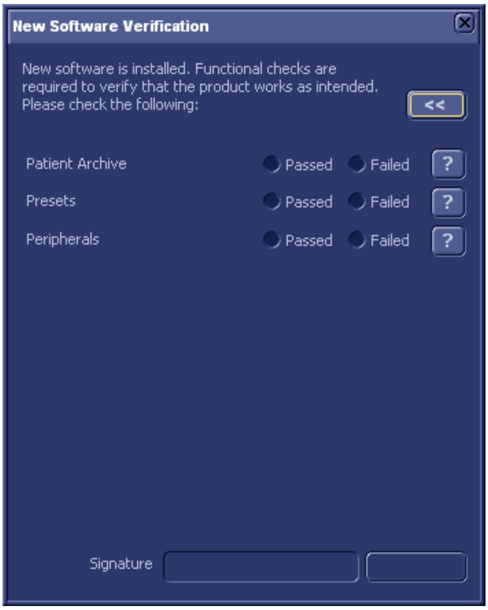
Figure 11-4. Software ready to be installed

4. Press **Install**.

   The system will reboot automatically and the installation process will begin <u>Do not power off the system</u> during the software installation. The system will reboot during installation. <u>Please allow the system to completely install the software</u>.

NOTE: A typical installation may take up to 20 minutes.

when installation is complete, reboot the system. Perform TCP/IP Save Settings (see page 11-14) and reboot. After a few minutes the *New software verification* window is displayed (see Figure 11-5).



New Software Verification

New software is installed. Functional checks are required to verify that the product works as intended. Please check the following:

Figure 11-5. Software verification

5. Perform a check for all features listed. Press ? to get information on how to check each feature.

NOTE: *You can press << to minimize the Software verification window and move it out of the way when testing.*

Select **Passed** or **Failed** for each feature. If all features are “Passed” the signature field is enabled.

⚠ CAUTION

If for any reason the user fails a test the system will roll back to the original software version. Please call your local service immediately.

Figure 11-6. Signature field enabled

6. Enter your signature (minimum three characters) and press **OK**.
7. Create an Insite permanent user as described in the next section.

Create an Insite permanent user

An Insite permanent user is required for automatic system error reporting to the GE digital service network.

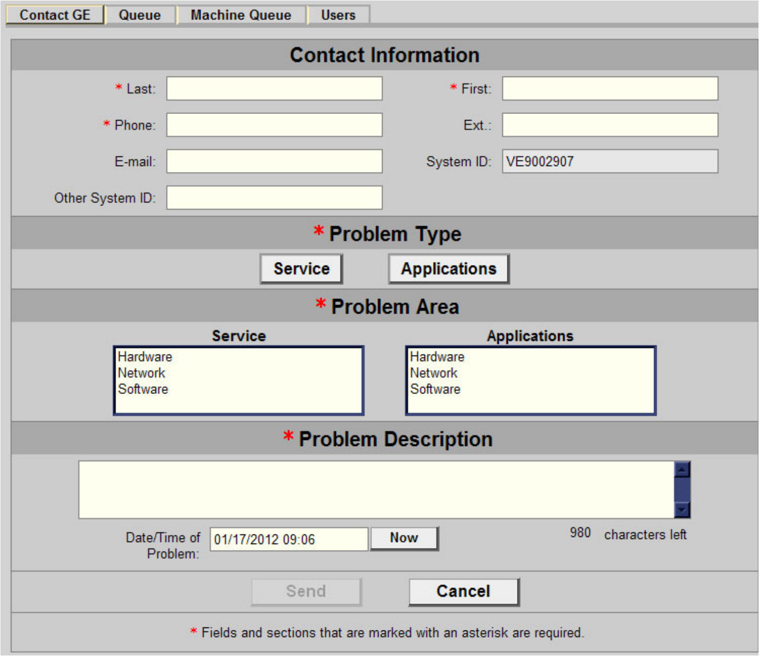
1. Select the **Contact GE** icon ☎ on the status bar.

   The *Insite service* menu is displayed.

Figure 11-7. The Insite service menu

2. Select **Request for service**.

   The *Contact GE* screen is displayed.



Contact Information

* Last:
* First:
* Phone:
Ext.:
E-mail:
System ID: VE9002907
Other System ID:

* Problem Type

* Problem Area

Service: Hardware, Network, Software

Applications: Hardware, Network, Software

* Problem Description

Date/Time of Problem: 01/17/2012 09:06

980 characters left

* Fields and sections that are marked with an asterisk are required.

Figure 11-8. The Contact GE screen

3. Select **Users** on the top menu.

   The *Permanent users* screen is displayed.
4. Press **Add user** (see arrow in Figure 11-9).

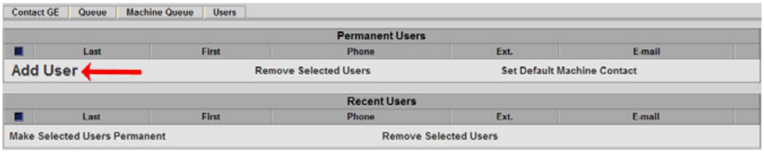
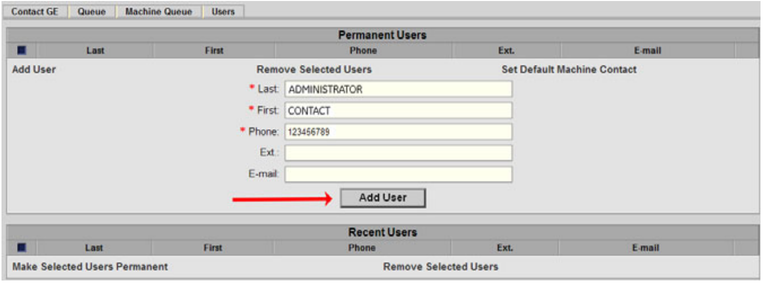


Figure 11-9. The Permanent users screen

5. Fill in the required information and press the **Add user** button (see arrow in Figure 11-10).



* Last: ADMINISTRATOR
* First: CONTACT
* Phone: 123456789
Ext.:
E-mail:

Figure 11-10. The Permanent users screen

The permanent user is created.

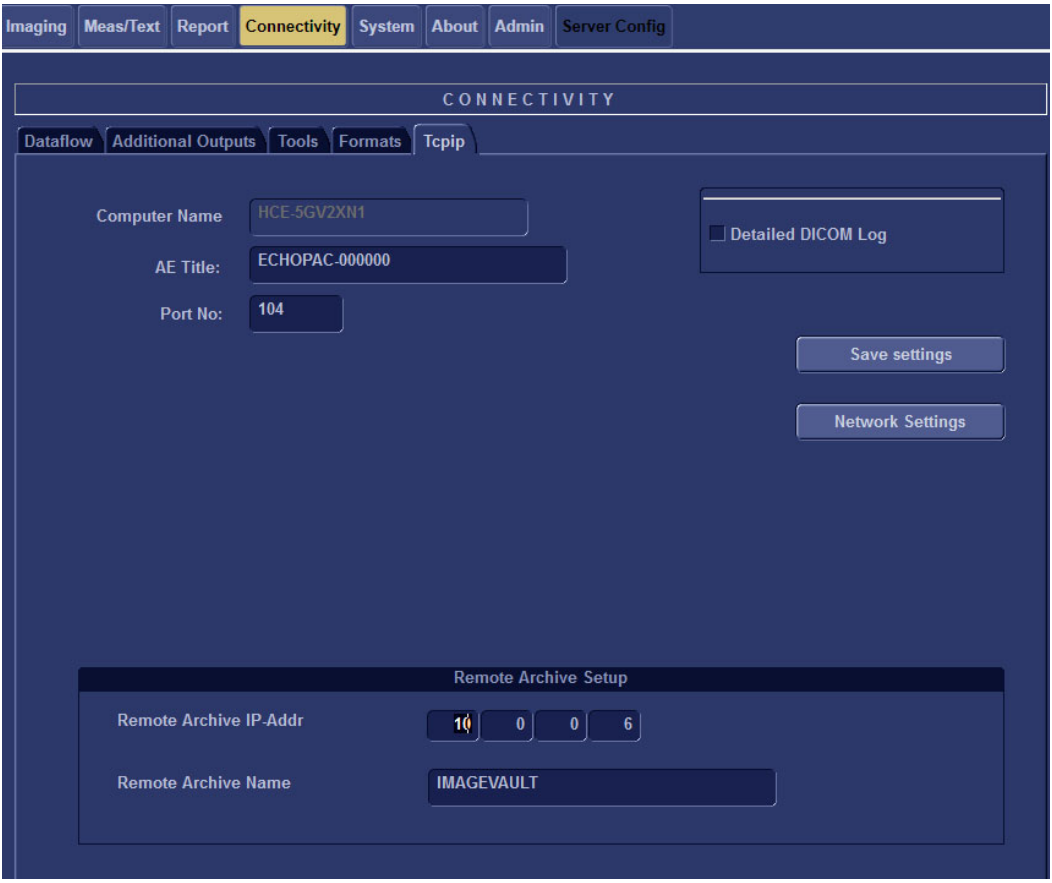
6. Close the window.

Save TCP/IP settings

The TCP/IP settings of the system need to be saved after a software upgrade.

1. Press **Config** (**F2**).
2. Select the **Connectivity** category and **TCP/IP** subgroup.

   The *TCP/IP settings* window is displayed (Figure 11-11).



Computer Name: HCE-5GV2XN1

AE Title: ECHOPAC-000000

Port No: 104

☐ Detailed DICOM Log

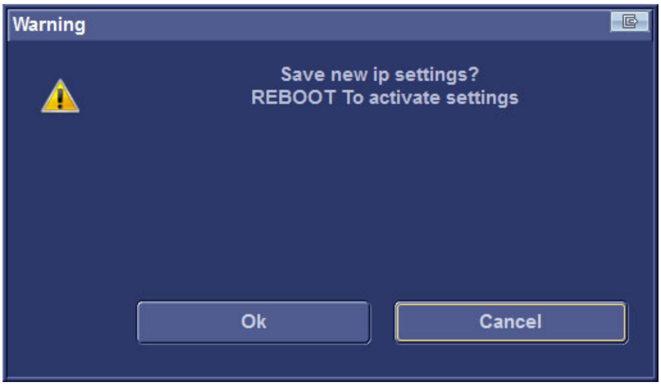
Remote Archive IP-Addr: 10 0 0 6

Remote Archive Name: IMAGEVAULT

Figure 11-11. TCP/IP settings

3. Press **Save settings**.

   A *Confirmation* window is displayed.



Save new ip settings?
REBOOT To activate settings

Figure 11-12. Confirmation window

4. Press **OK** and reboot the system.

5. The software upgrade is complete. If you have any questions or concerns, please call your GE service organization.

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GE Healthcare