SIEMENS

ACUSON X600
ACUSON X700
Diagnostic Ultrasound System
Features and Applications Reference

US

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Siemens Medical Solutions USA, Inc.

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ACUSON X700, Product Version 2.0

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Siemens reserves the right to change system specifications at any time.

CE Declaration

This product is provided with a CE marking in accordance with the regulations stated in Council Directive 93/42/EEC of June 14, 1993 concerning Medical Devices. The CE marking only applies to medical devices that have been put on the market according to the above referenced Council Directive.

Unauthorized changes to this product are not covered by the CE marking and the related Declaration of Conformity.

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Chapter B2 **Application-Specific Measurements and Calculations**

Description of the measurements and calculations specific to the following exams: Gynecology, Orthopedic, Fetal Echo, TCD (Transcranial Doppler), Thyroid.

Note: All general measurements and calculations are available for the Abdominal, Musculoskeletal, Breast, Testicle, Renal, Pediatric, and Small Parts exam types.

Chapter B3 **Obstetrical Measurements and Calculations**

Description of the measurements and calculations specific to the Obstetrical package, including fetal cardiac measurements.

Chapter B4 **Urology Measurements and Calculations**

Description of the measurements and calculations specific to the Urology exam.

Chapter B5 **Vascular Measurements and Calculations**

Description of the measurements and calculations specific to the Vascular exams: Cerebrovascular, Peripheral Vascular, Venous.

Chapter B6 **Cardiac Measurements and Calculations**

Description of the measurements and calculations specific to the Cardiac exam.

Chapter B7 **Emergency Medicine Measurements and Calculations**

Description of the measurements and calculations specific to the EM (Emergency Medicine) exam, including information for each report type.

Chapter C1 **Patient Data Management**

Explanation of the integrated workstation, including storage and management of studies on the system and external storage media.

Chapter D1 ***syngo* Auto Left Heart**

Explanation of the *syngo* Auto Left Heart (Auto LH) module.

Chapter D2 ***syngo* Velocity Vector Imaging**

Explanation of the *syngo* Velocity Vector Imaging module.

Chapter D3 **Axius Edge-Assisted Ejection Fraction**

Explanation of the Axius Edge-Assisted Ejection Fraction feature and measurements.

Chapter D4 ***syngo* Arterial Health Package**

Explanation of the *syngo* Arterial Health Package.

Chapter D5 ***syngo four*Sight TEE View**

Explanation of the *syngo four*Sight TEE View module.

Chapter D6 ***syngo* Mitral Valve Analysis (MVA)**

Explanation of the *syngo* Mitral Valve Analysis (MVA) module.

Note: Not all features and options described in this publication are available to all users. Please check with your Siemens representative to determine the current availability of features and options.

About the User and Reference Manuals

The user and reference manuals contain descriptions for the following ultrasound systems:

- ACUSON X600 diagnostic ultrasound system
- ACUSON X700 diagnostic ultrasound system

Features and options unique to an ultrasound system are identified in Chapter 1 and Appendix A of the Instructions for Use.

The user and reference manuals consist of the following publications.

Publication	**Includes**
Instructions for Use	▪ Intended Audience ▪ Technical description of the ultrasound system ▪ Safety and care information for the system and compatible transducers ▪ Descriptions of all system controls ▪ Procedures for system setup, examination fundamentals, and the biopsy function ▪ Acoustic output data
*Features and Applications Reference**	▪ Descriptions of image acquisition and optimization, including optional imaging features ▪ General and exam-specific measurements and calculations ▪ Data management ▪ Explanation of the clinical software programs for use on the ultrasound system
*System Reference**	▪ Description of customizable system settings ▪ Information about DICOM connectivity, network capabilities, and external devices ▪ Clinical references
*Electromagnetic Emissions and Immunity: Guidance and Manufacturer's Declaration**	▪ Information regarding the electromagnetic compatibility (EMC) testing of this system

*Languages supported by the user interface include a translation of this publication.

Conventions

Take a moment to familiarize yourself with these conventions.

Warnings, Cautions, and Notes	⚠ **WARNING:** Warnings are intended to alert you to the importance of following the correct operating procedures where risk of injury to the patient or system user exists. ⚠ **Caution:** Cautions are intended to alert you to the importance of following correct operating procedures to prevent the risk of damage to the system. **Note:** Notes contain information concerning the proper use of the system and/or correct execution of a procedure.
Cross-References	**Examples:** **See also:** Biohazards, Safety and Care, Chapter 2, Instructions for Use **See also:** Documentation Devices, Chapter 2, System Reference **See also:** Alphanumeric Keyboard, p. 26
Customizable System Settings	System settings available for customization are depicted as shown. **Example:** **Default Settings > Automatic Freeze Response**
Keys and Controls	Keys and controls located on the control panel are identified by uppercase, boldface type. **Example:** Rotate the **2D** control. Keys located on the keyboard are identified by boldface type. **Example:** Press the **Exam** key.
On-screen Objects	On-screen objects such as menu selections, soft key selections, and buttons are identified by boldface type. **Example:** The system displays the **Patient Registration** form.
Selection of On-screen Objects	The **SET** key on the control panel functions as a point-and-select device (similar to a computer mouse) when used with the trackball. "Select" or "click" describes this action: Roll the trackball to position the pointer (cursor) on an on-screen object and then press the **SET** key. "Double-click" describes this action: Roll the trackball to position the pointer (cursor) on an on-screen object and then press the **SET** key twice. "Drag" describes this action: Roll the trackball to position the pointer (cursor) on an on-screen object and then press and hold the **SET** key. Roll the trackball to reposition the object and then release the **SET** key.

Intended Audience

The intended audience for the user and reference manuals includes the following users.

User	Interaction with Ultrasound Equipment	Expected Experience and Other Characteristics
Sonographer	▪ Acquires diagnostic views of anatomy, blood flow, and related pathology ▪ Performs measurements and analysis of the acquired images ▪ Prepares exam data for review and interpretation by a qualified physician	▪ Ranges from novices (for example, students) to advanced practitioners with certification in multiple subspecialties ▪ Educated in anatomy, physiology, patient care, and identification of pathology in ultrasound images ▪ Many sonographers have a Bachelor's degree; some have advanced degrees in related health care subjects
Cardiologist	▪ Performs invasive and non-invasive ultrasound exams ▪ Interprets exam data, including echocardiography exam data ▪ Writes and assembles exam findings in a report	▪ Medical doctor ▪ Expert in diagnostic imaging, including computed tomography (CT), magnetic resonance imaging (MRI), X-ray, ultrasound, and nuclear medicine ▪ Advanced training in imaging physics with typically four to six years of post-doctoral training in the field of cardiology
Maternal-fetal Medicine Obstetrician/ Perinatologist	▪ Performs ultrasound exams ▪ Interprets exam data ▪ Writes and assembles exam findings in a report	▪ Medical doctor ▪ Manages high-risk obstetrical patients for the safe and successful delivery of the fetus ▪ Skilled in interpreting ultrasound exam data
Radiologist and Internist	▪ Performs ultrasound exams ▪ Interprets exam data ▪ Writes and assembles exam findings in a report	▪ Medical doctors ▪ Expert in diagnostic imaging, including CT, MRI, X-ray, ultrasound, and nuclear medicine ▪ Advanced training in imaging physics with typically two to six years of post-doctoral training in the field of radiology
System Administrator and Customer Service Engineer	▪ Configures the ultrasound system for use in a networked environment	▪ A System Administrator is an individual within your organization who is designated to set up system parameters to connect the ultrasound system or workstation to a picture archiving and communication system (PACS). ▪ Customer Service Engineers are Siemens representatives who configure the ultrasound system or workstation during software installation and support troubleshooting activities.

A1 Imaging Functions

Annotations and Pictograms

You can use any of these methods to annotate an image:

- Direct text entry using the keyboard
- Predefined labels for positions and anatomical structures
- Arrow keys
- Pictograms of anatomical structures

You can program the system to automatically delete on-screen annotations each time you unfreeze the image. Use the system presets to specify whether all text or all pictograms are deleted at unfreeze.

General 2 > Common Mode > Delete Pictogram on Unfreeze

General 2 > Common Mode > Delete Text on Unfreeze

Adding Annotations

Note: You can also insert text without activating the annotation function.

Use the system presets to display a list of annotations when you activate the annotation feature, to customize the text libraries, to select a library for initial display, and to specify the size of annotation text.

General 1 > Annotation Type > Default Type

General 2 > Common Mode > Default Annotation Library

General 2 > Common Mode > Font Size

Use the system presets to display tab indicators for annotations and to enable or disable the automatic display of predefined labels when entering the text with the keyboard.

Text Annotation > Tab Order

Text Annotation > Auto-Complete

To	Do This
Activate the annotation function	▪ Press **TEXT**. The system displays the **General**, **Anatomy**, **Position**, and **User Def** tab indicators. The highlighted tab corresponds to the displayed soft key selections.
Define the default position for the annotation cursor	1. Roll the trackball to position the annotation cursor at the required location on the image screen. 2. Press **Home Set** on the keyboard. Or, press the toggle key for **Home Set**.
Return to the defined default position during imaging	▪ Press **Home** on the keyboard. Or, press the toggle key for **Home**.

To	Do This
Enter annotation text	1. Activate the annotation function. The system places the text cursor on the image screen. 2. To reposition the text cursor, roll the trackball. 3. Use the keyboard to enter text. When you begin typing annotation text, the system displays a predefined label that matches the first characters entered. 4. To confirm the predefined text, press **Tab** on the keyboard. Or, press **SET** twice. **Note:** If you move the trackball or press **SET** once before confirming the predefined label, the text displayed to the right of the cursor is deleted. **Note:** The predefined label is confirmed when the image is stored to a disk.
Insert a predefined annotation label	**Note:** Each exam type has annotation labels for anatomical structures, imaging views, and body positions. 1. Activate the annotation function. 2. Press **PAGE** to highlight the **General** tab indicator. 3. To reposition the text cursor, roll the trackball. 4. Press the toggle key for **Library**. The system displays the list of annotations for the active exam type as soft key selections. **Note:** To access another page of annotations, rotate **PAGE**. 5. Press **PAGE** to select a tab indicator for a category of annotation labels. 6. Press the toggle key for the required label.
Insert a user-defined annotation label	1. Press **PAGE** to highlight the **User Def** tab indicator. 2. Select the displayed soft key selections to insert user-defined labels.
Reposition an annotation	1. Roll the trackball to position the cursor on the annotation and then press **SET**. 2. Roll the trackball to the new location and then press **SET** to confirm the change. The system places the cursor at the end of the annotation with a space.
Edit an annotation	1. Roll the trackball to position the cursor on the annotation. Or, position the cursor on the annotation and press **SET** twice. 2. Use the keyboard to edit the annotation.
Cycle through confirmed annotations	▪ Press **UPDATE**. Or, press **Tab** on the keyboard.
Temporarily hide annotations	1. During the annotation function, press the toggle key for **Hide Text**. 2. To redisplay annotations, press the toggle key for **Show Text**.
Exit the annotation function	▪ Press **TEXT**.
Exit the annotation function and delete all text	▪ Press **ESCAPE**.

Inserting User-Defined Text

You can insert user-defined text on the image screen with the Text A and Text B keys on the keyboard or the user-defined keys on the control panel.

Use the system presets to create the user-defined text and assign the text to the Text A or Text B keys. You can also assign the Text A and Text B function to the user-defined keys on the control panel,

Text Annotation > Set Text A / Text B

Customize Keys > Key Function > User-Defined 1 Key

Customize Keys > Key Function > User-Defined 2 Key

Customize Keys > Key Function > User-Defined 3 Key

To	Do This
Insert user-defined text using the keyboard	▪ Press **Text A** or **Text B**. The system cycles through the user-defined text
Insert user-defined text using user-defined keys	▪ Press the assigned user-defined keys on the control panel. The system cycles through the user-defined text.

Inserting Directional Arrows

Use the system presets to select the type and the size of the arrow. You can place multiple types of arrows on the image screen.

General 2 > Arrow Size

To	Do This
Place an arrow on the image screen	▪ Press **Arrow** on the keyboard. Or, press the toggle key for **Arrow** during the annotation function. The system displays an arrow on the image screen.
Place multiple arrows on the image screen	1. Roll the trackball to position an arrow. 2. Press the toggle key for **New**. The system confirms the activated arrow and displays a new arrow on the screen.
Reposition the selected arrow	▪ Roll the trackball to the new location.
Change the direction of the arrow	▪ Rotate **SELECT**.
Change the direction of the arrow by a defined angle	▪ Press the toggle key for **Rotate 30°** or **Rotate 90°**.
Change the size of the active arrow	▪ Press the toggle key for **Arrow Size**.
Confirm the position and direction of the selected arrow	▪ Press **SELECT**. Or press **SET**.
Activate a confirmed arrow	▪ Position the cursor on the arrow and then press **SET**.
Cycle through arrows on the image screen	▪ Press **UPDATE**. Or, press the toggle key for **Select**.
Cancel placement of the selected arrow	▪ Press **Arrow** on the keyboard.

Inserting Pictograms

Pictograms are graphics that display on-screen to indicate the anatomical structure under evaluation and to indicate the orientation of the transducer to the structure. One pictogram can display on an image. In Dual-mode and 4B-mode, you can display one pictogram for each image.

Use the system presets to customize the pictograms assigned to an exam type, to change the location of the pictogram on the image, and to delete the pictogram when the image is unfrozen. Use the system presets to automatically display pictograms when you freeze the image.

Pictogram List

General 2 > Common Mode > Pictogram Location

General 2 > Common Mode > Delete Pictogram on Unfreeze

To	Do This
Activate the pictogram function	▪ Press **PICTOGRAM**. The system displays the first available pictogram for the selected exam type. The pictogram includes a transducer orientation indicator. **Note:** The system displays the pictogram in white and the transducer marker in green.
Position the transducer orientation indicator	▪ Before confirming the pictogram, roll the trackball to move the indicator to the required position.
Rotate the transducer orientation indicator	▪ Rotate **SELECT**.
Display the previous or next pictogram	▪ Press the toggle key for **Pictogram Select**. Or, press **UPDATE**.
Confirm the displayed pictogram and exit the pictogram function	▪ Press **PICTOGRAM**. Or, press **SELECT**. Or, press **SET**.

Deleting Annotations, Arrows, and Pictograms

Use the system presets to automatically delete all text, arrows, and/or all pictograms when you unfreeze the image.

General 2 > Delete Text on Unfreeze

General 2 > Delete Pictogram on Unfreeze

To	Do This
Delete all annotations, arrows, and pictograms	▪ During the annotation function, press the toggle key for **Clear Screen**. Or, press **Clear Screen** on the keyboard. **Note:** To delete annotations and arrows during the annotation function without removing the pictogram from the screen, press **ESCAPE**.
Delete a single annotation	1. During the annotation function, position the cursor on the annotation and then press **SET**. 2. Press **PAGE** to highlight the **General** tab indicator. 3. Press the toggle key for **Delete Word**. Or, press the **Delete Word** on the keyboard.
Delete a line of annotations	1. During the annotation function, roll the trackball to position the cursor at any position. 2. Press the toggle key for **Delete Line** to delete the annotations located on the same line as the cursor.
Delete an arrow	▪ Press the toggle key for **Delete** to delete the activated arrow. ▪ To delete all arrows, press the toggle key for **Delete all**.
Delete a pictogram	▪ Press the toggle key for **Delete Pictogram**.

QuickSet Feature

The QuickSet feature allows you to capture an optimized configuration of imaging parameter settings for a specific transducer and exam. When a QuickSet is selected as the current exam type, the system activates the associated transducer and resets all imaging functions according to the stored configuration. A QuickSet can be saved for a particular physician or user.

You can have a maximum of 128 QuickSets on the system at one time. If you attempt to create a new QuickSet or load a saved QuickSet from disk after the maximum is reached, the system requires you to delete one or more existing QuickSets before you can add new ones.

Working with QuickSets

To	Do This
Create a QuickSet	1. Adjust the image parameter settings as required. 2. Press **Exam/QuickSet** on the keyboard. Or, press **EXAM** on the control panel and then click **QuickSet>>**. 3. Enter up to 10 characters in the **QuickSet Name** field for the name of the QuickSet. 4. To add a comment for the new QuickSet, enter up to 30 characters in the **Description** field. 5. To use the QuickSet when the transducer is selected, select **Yes** next to **Active QuickSet when transducer is selected**. The system automatically activates the QuickSet in the Exam/QuickSet list when you select the associated transducer. 6. Click **New**. The system adds the new name to the list of the QuickSets. 7. Click **Close**. The system displays the image screen and activates the QuickSet you created.
Overwrite an existing QuickSet with the current image parameter settings	1. Adjust the image parameter settings as required. 2. Press **Exam/QuickSet** on the keyboard. Or, press **EXAM** on the control panel and then click **QuickSet>>**. 3. Enter the name of the QuickSet and then click **Overwrite**. The system displays a message to confirm overwriting the QuickSet. 4. To assign the new QuickSet configuration to the existing name, click **OK**. 5. To display the image screen, click **Close**.

To	Do This
Rename an existing QuickSet with the current image parameter settings	1. Adjust the image parameter settings as required. 2. Press **Exam/QuickSet** on the keyboard. Or, press **Exam/QuickSet** on the keyboard and then click **<<Exam**. 3. Select an existing QuickSet. 4. Enter a new name in the **QuickSet Name** field. 5. To add a comment, enter text in the **Description** field. 6. Click **Rename**. 7. Click **Close**. The system displays the image screen with the renamed QuickSet activated.
Delete an existing QuickSet	**Note:** QuickSets currently in use cannot be deleted. 1. Press **EXAM** on the control panel and then click **QuickSet>>**. 2. Select an existing QuickSet and then click **Delete**. The system removes the highlighted name from the list of QuickSets. 3. Click **Close**.
Activate a QuickSet	1. Press **EXAM** on the control panel. The system displays the list of exams and QuickSets. 2. Click the required QuickSet.
Display all QuickSets	1. Press **Exam/QuickSet** on the keyboard. Or, press **EXAM** on the control panel. 2. Click **All QuickSets**. **Note:** Click the name of the connected transducer to display the list of exams and QuickSets associated with the transducer.

Specifying the Default Exam Type or QuickSet for a Transducer

Note: To display the specified default exam type or QuickSet during patient registration, re-select the related transducer from the **Transducer** drop-down list.

To specify the default exam type or QuickSet for a connected transducer:

1. Press **Exam/QuickSet** on the keyboard. Or, press **EXAM** on the control panel and then click **QuickSet>>**
2. Click the required transducer button.

   The system displays the exams supported by the selected transducer.
3. Select the required exam type or QuickSet.
4. Click **Set as Default**.

   The system displays an asterisk next to the exam type or QuickSet.
5. To activate an exam or a QuickSet, click **<<Exam** and then click the required exam type or QuickSet.
6. To close the dialog box without changing the active exam or QuickSet, click **Close**.

Information Stored in QuickSets

QuickSets contain all settings controlled by the control panel, including pictograms and annotations, the current setting (on or off) for Tissue Harmonic Imaging (THI), and the following mode-specific parameters.

Mode QuickSets

2D-mode	M-mode	Color Flow	Power Mode	Doppler
Gain	Transmit Frequency	Color Map	Transmit Frequency	Transmit Frequency
Persistence	Sweep Speed	Baseline	Gain	Gate Size
Gray Map	Dynamic Range	Scale	Scale	Baseline
Dynamic Range	Edge Enhancement	Transmit Frequency	Filter	Scale
Edge Enhancement	Map	Persistence	Persistence	Tint
Tint	Gain	Resolution/Speed	Power map	Sweep Speed
2D Size	Transmit Power	Smooth	Smooth	Doppler Gain
Transmit Power	Tint	Gain	Color Priority	Map
Depth		Filter	Resolution/Speed	Angle
Focal Zones		Color Priority	Flow State	Update Rate
Transmit Frequency		Invert	Directional Power	Filter
Flip (U/D)		Flow State		Volume
Flip (L/R)		Color DTI		Gain
Resolution/Speed		Color DTE		Dynamic Range
THI				Time/Frequency Resolution
Sector Display Format				Spectral DTI
SieClear/Advanced SieClear				Auto Stat
LVO Contrast				Sensitivity
Clarify VE				
TGO Gain				
DTO				
Offset				
DTCE				
CAI[1]				
Image Presets				

[1] QuickSets for contrast agent imaging include settings for on/off, capture duration, balance, frame rate control, and burst duration.

A2 2D and M-Mode Imaging Functions

2D-Mode Formats

You can display 2D-mode images in different formats: 4B, Split and Dual. Imaging capability in 2D-mode, M-mode, and mixed modes is available.

The following mixed mode formats are available:

- 2D/M-mode
- 2D/Doppler
- 2D-mode with color
- 2D-mode with power
- 2D/M-mode with color
- 2D/Doppler with color
- 2D/Doppler with power

Activating 2D-Mode

2D-mode is the default imaging mode for the ultrasound system. 2D indicates two-dimensional (2D) grayscale imaging. When you first power on the system, 2D-mode is active.

To access 2D-mode from another imaging mode:

- Press the **2D** control on the control panel.

  The system displays in 2D-mode (full screen).

Note: When operating in mixed modes (for example, 2D-mode with M-mode, 2D-mode with Doppler, or 2D-mode with color), pressing the **2D** control deactivates M-mode, Doppler, or color and displays full-screen 2D-mode imaging.

Active Image

In Dual and 4B modes, while more than one 2D-mode image displays on the monitor, you can adjust the imaging parameters for one image at a time. This image is the ***active*** image. The system indicates the active image with the active image indicator.

On-screen icon to indicate image orientation and to identify the active image.

Activating Split Mode

Split mode creates side-by-side images from one 2D-mode image. The two images are simultaneously frozen or real-time. Split mode is available with all imaging transducers.

When you first initiate Split mode, the image parameter settings from the previous mode are applied to both images.

Certain imaging parameters (such as Tint and Gray Map) can be changed in the right image, allowing comparison of the effects of different image settings on an anatomical structure.

Use the system presets to display the two images with no separation between the images.

Exam Configuration > Seamless Dual

To activate Split mode:

1. Press the toggle key for **Split** to select **On**.

   The left image is the reference image.
2. To simultaneously freeze both images, press the **FREEZE** key on the control panel.
3. To exit Split mode, press the toggle key for **Split** to select **Off** or press the **2D** control.

Activating Dual-Mode

In Seamless Dual-format, two acquired images display side-by-side on the Image screen with no separation between them. Both images are obtained separately, and only one image displays in real-time.

When you first activate Dual or Seamless Dual format, the imaging settings from the imaging mode are applied to the first image. The second image retains the same settings as the first image. After acquiring both images, you can set imaging parameters independently for each image.

Use the system presets to display the two images with no separation between the images.

Exam Configuration > Seamless Dual

You can activate Dual-mode only during imaging in 2D-mode or 2D-mode with Color or Power.

Note: You cannot activate M-mode or Doppler while Dual-mode is active.

Note: If Advanced SieClear is activated in Dual-mode, you cannot activate Color or Power.

To activate Dual-mode:

1. Press **DUAL** on the control panel to display an image on the left side of the screen.
2. To generate a second image, press **DUAL** or **FREEZE** on the control panel.

   The system freezes the active image and activates a second image.

   Only one image can be active at a time. The active image is indicated by the active image indicator.
3. To inactivate the current image and activate the other image in a side-by-side display, press **DUAL**.

   The system shifts the active image indicator to the selected image.
4. To exit Dual-mode, press the **2D** control on the control panel.

Activating a 4B Display

In 4B-mode, four separately acquired 2D-mode images display on the Image screen. Only one image can display in real-time.

Subsequent images retain the same settings as the previous image.

To activate 4B-mode:

1. Press the toggle key for **4B**.

   The first image displays in the upper left quadrant of the screen. This is the active image, as identified by the brightened active image indicator.
2. Press the **FREEZE** key. Or, press the toggle key for **4B**.

   The image is frozen in position and a second image displays in the next available quadrant.
3. To continue to acquire images, repeat step 2.
4. To exit 4B-mode, press the **2D** control.

To activate the particular image when all four images are displayed:

1. Press the **FREEZE** key and then press the toggle key for **4B** until the active marker in the required image is highlighted.
2. Press the **FREEZE** key again to unfreeze the image.

Activating M-Mode

Use the system presets to select your preference of a 2D/M-mode imaging format. The available formats include:

- 1/2 2D, 1/2 trace
- 1/3 2D, 2/3 trace
- 2/3 2D, 1/3 trace
- Side by side

Exam Configuration > 2D/M & 2D/Doppler Display Format

Display > Doppler/M-Mode > Bypass M/D Cursor Display

Curved array, linear array, and phased array transducers allow a 2D-mode image and an M-mode sweep to display simultaneously in real-time.

To activate M-mode or 2D/M-mode:

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

   Note: If the cursor bypass is selected in the system presets, the system activates 2D/M-mode immediately; proceed to step 4. If the cursor bypass is not selected, the system initially displays an M cursor on the 2D-mode image.

2. Roll the trackball to position the M cursor.
3. To activate 2D/M-mode, press the **M** control a second time.

   The system displays a 2D-mode image and an M-mode sweep in the format selected in the system presets. Use the trackball to reposition the M-mode cursor on the 2D-mode image.

4. To exit 2D/M-mode, press the **2D** control on the control panel.
5. To activate full screen M-mode, press the toggle key for **Full M** to select **On**.

   Note: During M-mode with Color, you must optimize the color image before activating a full screen display format.

   The system displays a full-screen M-mode sweep.

6. To exit full-screen M-mode, press the toggle key for **Full M** to select **Off** or press the **2D** control.

Scrolling Speed

You can adjust the scrolling speed of the M-mode sweep.

The current setting displays in the Imaging Parameters on the upper left of the screen.

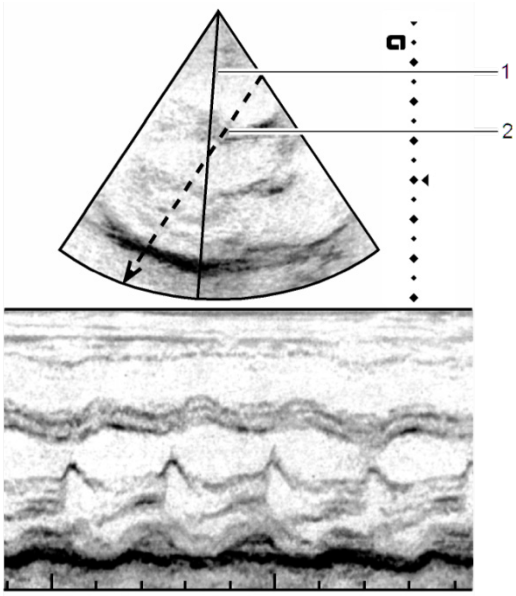
To adjust the scrolling speed of the M-mode sweep:

- Press the toggle key for **Sweep**.

Activating Anatomical M-Mode

Use Anatomical M-mode (AMM) in cardiac applications to analyze 2D-mode images and display motion over time. You can manipulate the Anatomical M-mode cursor at different angles and positions based on the patient's anatomy.

You can generate an Anatomical M-Mode display during live imaging or system freeze.



Example of cursors during Anatomical M-mode.

1 M-mode cursor
2 Anatomical M-mode cursor

Note: Anatomical M-mode is not available during HD zoom.

Note: In Anatomical M-mode, do not bypass the display of the M cursor. Use the system presets to disable the "bypass cursor" function.

Display > Doppler/M-Mode > Bypass M/D Cursor Display

To	Do This
Activate Anatomical M-mode in live M-mode	1. Press **M**. 2. Rotate **ANGLE** until 2D/M-mode displays on the image screen. Or, press the **AMM** soft key. The system displays the AMM cursor as a dotted line with an arrow pointing to the deeper part of the image. The M-mode cursor displays in the middle of the 2D region of interest (ROI).
Activate Anatomical M-mode in freeze	▪ Press **M**. The system reads the CINE buffer and then activates Anatomical M-mode.
Position and rotate the M-mode cursor and the Anatomical M-mode cursor	▪ Roll the trackball to move both cursor lines to the required position. The two cursor lines act together in reference to a pivot point.
Rotate the Anatomical M-mode cursor	▪ Rotate **ANGLE**.
Reset the angle of the Anatomical M-mode cursor	▪ Press **ANGLE**.
Change the pivot point of the M-mode cursor and AMM cursor	1. Press **UPDATE**. 2. Roll the trackball to move the cursors up or down. 3. Press **UPDATE** to set the new pivot point.
Adjust the overall gain	▪ Rotate **2D**.
Activate or exit CINE for the Anatomical M-mode display	▪ Press **ESCAPE**.
Exit Anatomical M-mode	**Note:** When ECG data is displayed on the AMM image screen, the system does not retain the adjusted position in AMM when you exit the function and activate 2D-mode. ▪ Press **M** or **2D**.

In Anatomical M-mode, you can adjust the scrolling speed of the sweep, magnify images, select gray maps or color maps, change the dynamic range, perform measurement functions, and annotate images. These functions operate in the same way and use the same controls as M-mode.

Available clip capture durations are 1, 2, 3, 4, and 8 seconds. The maximum clip length is 8 seconds. If the duration is configured to more than 8 seconds, the system only stores up to 8 seconds.

Imaging Parameters

Use the ultrasound system controls and soft key selections to change the settings for imaging parameters. When the system displays multiple images, changing the imaging parameters may affect all images or only the active image.

Note: Frequency, steering, and scan width are transducer-dependent. Also, full-screen M-mode does not support the functions that apply only to 2D-mode images.

Control Panel-Related Imaging Parameters

		Dual-mode		2D/M-mode		
	2D-mode	**Active**	**Both**	**2D**	**M**	**AMM**
2D Gain	✓	✓		✓		✓
HD Zoom	✓	✓				
Depth/Zoom	✓	✓		✓	✓	Depth function only
Depth Gain Compensation	✓	✓		✓	✓	✓
Focus	✓	✓		✓		✓
M Gain					✓	
Steer	✓	✓		✓		
Angle						✓
Transducer	✓	✓	✓			
Dual	✓	✓				
TGO	✓	✓		✓	✓	✓

2D-Mode Soft Key Selections for Imaging Parameters

		Dual-mode		2D/M-mode		
Parameter	**2D-mode**	**Active**	**Both**	**2D**	**M**	**AMM**
Tint (Color)	✓	✓		✓	✓	✓
Dynamic Range	✓	✓		✓	✓	✓
Edge Enhance	✓	✓		✓	✓	✓
Map (Gray Map)	✓	✓		✓	✓	✓
Persistence	✓	✓		✓		✓
2D Size	✓	✓		✓		
R/S (Res/Speed)	✓	✓		✓		
THI	✓	✓		✓	✓	✓
Image Presets	✓	✓		✓	✓	
MultiHertz	✓	✓		✓	✓	✓
Full Size	✓	✓		✓		
P (Transmit Power)	✓	✓		✓	✓	✓
U/D Flip	✓	✓		✓		✓
L/R Flip	✓	✓		✓		✓
Sector	✓	✓		✓		
Split	✓					
4B	✓					
Clarify VE	✓	✓				
SieClear/ Adv. SieClear	✓	SieClear function only		SieClear function only		SieClear function only
DTO	✓	✓		✓		
LVO Contrast	✓	✓				
Dynamic TCE	✓	✓				
CAI (Contrast agent imaging)	✓	✓				

Note: You must activate **DTCE** before entering Dual-mode.

M-Mode Soft Key Selections for Imaging Parameters

The following M-mode soft key selections influence only the M-mode sweep during 2D/M-mode:

- Dynamic Range
- Tint (Color)
- Edge Enhance
- Sweep
- Map
- Full M

Changing the Imaging Depth

Maximum and minimum depth selections are dependent upon the frequency of the transducer you are currently using.

In Split-mode, rotating the **DEPTH/ZOOM** control changes the depth for both 2D-mode images. In Dual-mode, rotating the **DEPTH/ZOOM** control changes the depth for the active image.

The imaging depth displays at the bottom right of the Image screen.

Use the system presets to assign the direction of rotation to the **DEPTH/ZOOM** control for increasing the depth.

Customize Keys > Depth

Customize Keys > Zoom

To change the imaging depth:

- Rotate the **DEPTH/ZOOM** control on the control panel to adjust the depth.

Adjusting the Overall System Receiver Gain

Adjust the echo amplification and brightness of a 2D-mode image by rotating the **2D** control. For the M-mode sweep, make this adjustment by rotating the **M** control. This functions as the overall system receiver gain.

When you are viewing Dual-mode with more than one image, the value displays only for the active image. In 2D/M-mode, separate gain values display for the 2D-mode image and the M-mode sweep.

The gain value for the priority mode displays in Imaging Parameters on the upper left of the screen.

To adjust the overall gain for 2D-mode:

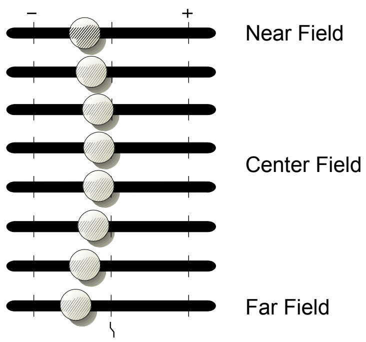
- Rotate the **2D** control on the control panel clockwise to increase the gain or counterclockwise to decrease the gain.

To adjust the overall gain for M-mode:

- Rotate the **M** control on the control panel clockwise to increase the gain or counterclockwise to decrease the gain.

Adjusting the Depth Gain Compensation (DGC)

To compensate for weak signals or over-bright signals at various depths, you can adjust Depth Gain Compensation (DGC) using the DGC slide controls. The **2D** control adjusts the overall receiver gain and compensates for the brightness of the image.



DGC Slide Controls.

Use the system presets to turn on the display of the DGC curve. The curve provides an on-screen representation of the DGC settings.

Display > DGC Curve Display

Display > DGC Control

Display > DGC Invert with Image Invert

In 2D/M-mode, DGC adjustments affect both the 2D-mode image and the M-mode sweep.

The DGC slide controls have no effect during CINE.

To adjust the DGC slide controls:

- Move a slide control to the right to increase a setting or to the left to decrease a setting.

Dynamic Tissue Optimization (DTO)

Dynamic Tissue Optimization (DTO) technology detects and optimizes hyperechoic signals in real-time to prevent over saturation.

To adjust DTO:

- Press the toggle key for **DTO** on the 2D-mode soft key selections to change the setting.

LVO Contrast

⚠ **WARNING:** At the time of publication, the United States Food and Drug Administration has cleared ultrasound contrast agents only for use in LVO (left ventricular opacification). Check the current regulation for the country in which you are using this system for contrast agent clearance.

⚠ **WARNING:** Carefully follow manufacturers' instructions for use, including indications and contraindications, when administering ultrasound contrast agents.

LVO Contrast is a low power harmonic imaging technology intended for use with injectable ultrasound contrast agents to improve visualization of the endocardial border of the left ventricle.

You can adjust LVO Contrast imaging parameters to optimize performance for different ultrasound contrast agents and user preferences. You can then store the settings in a QuickSet.

To adjust LVO Contrast:

- During 2D imaging, press the toggle key for **LVO Contrast** to select **On**.

  The system displays **MIF** (Mechanical Index at Focus) below the image, which provides additional mechanical index (MI) information for minimizing the destruction of contrast bubbles.

Changing the Dynamic Range

Dynamic Range controls the overall contrast resolution of the 2D-mode image or the M-mode sweep.

In Dual mode, the value displays only for the active image. In 2D/M-mode, separate dynamic range values display for the 2D-mode image and the M-mode sweep.

The current setting for the priority mode displays in the Imaging Parameters on the upper left of the screen.

To change the dynamic range for 2D-mode or M-mode:

- Press the toggle key for **DR**.

Selecting Focal Zones

Curved array, linear array, and phased array transducers support multiple transmit focus zones, which you can select in 2D-mode images. Focal zone markers display on the right side of the Image screen.

During M-mode, Doppler, or Color, only one focal zone is available.

To select the number of focal zones:

- Press the **FOCUS** control to cycle through the selections.

Positioning Focal Zone Markers

You can change the location of the focal zone markers for curved array and linear array and phased array transducers.

Use the system presets to assign the direction of rotation to the **FOCUS** control for decreasing the depth of the focal zone marker (to the near field).

Customize Keys

To position the focal zone:

- Rotate the **FOCUS** control to adjust the focal zone depth.

Single Focal Zone

When you select one (1) focal zone, you can position the focal zone marker, regardless of scan depth.

Multiple Focal Zones

When you select two or more focal zone markers, the spacing between the focal zones adjusts automatically. You can adjust the relative position of the focal zone markers within the field of view.

Available positioning depends upon your selected depth.

Using multiple focal zones causes a reduction in the frame rate. The amount of frame rate reduction depends on the depth of view and transducer.

Maximizing Resolution (Line Density) and Speed

You can increase or decrease the number of acoustic scan lines per frame for 2D images. Increasing the line density improves image detail and decreases the frame rate. Frame rate is also dependent on the scan angle or image width and the imaging depth.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To change the Res/Speed:

- Press the toggle key for **R/S**.

Changing the Persistence

Persistence provides a visible smoothing effect to the 2D-mode image by persisting lines of image data for each frame of imaging.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To change persistence:

- Press the toggle key for **Persist**.

Changing the Edge Enhancement

Edge enhancement helps you distinguish the contours of a structure during real-time imaging.

In Dual mode, the value displays only for the active image. In Split mode the value applies to both images.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To change edge enhance:

- Press the toggle key for **Edge**.

Selecting a Gray Map

The Map parameter is used to select a processing curve that assigns echo amplitudes to gray levels. Map can be activated during real-time imaging or when the system is in freeze.

The active gray map is depicted by a gray bar, which displays on the right side of the image screen. The gray bar represents the range of gray shades available for the selected map.

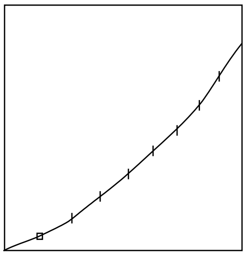
The current setting displays in the Imaging Parameters on the upper left of the screen.

To select a Gray Map:

- Press the toggle key for **Map**.

Modifying a Gray Map

You can redistribute the range of echo amplitudes assigned to the range of available gray shades for selected gray maps during real-time imaging or when the system is in freeze. You can reposition the inflection points within a specific range. The system automatically recalculates the curve and updates the image.



Inflection points display on the processing curve.

To modify the map:

1. Press the toggle key for **Modify Map**.
   The system overlays the modify map box on the image screen.
2. Select the number of inflection points from the drop-down box.
   The system displays inflection points on the processing curve.
3. Roll the trackball to position the cursor on the inflection points.
   The cursor changes to a pointer.

   Link Select icon.

4. To reposition an inflection point, use one of the following methods:
   a. Press the **SET** key and roll the trackball simultaneously to reposition the selected inflection point.
   b. Press the **SET** key and then press the up arrow or down arrow key on the keyboard.
5. To select another inflection point, roll the trackball to position the pointer on the inflection points and then follow one of the two methods:
   a. Press the **SET** key and roll the trackball simultaneously.
   b. Press the left arrow or right arrow key on the keyboard.
6. To remove recent changes, select the **Undo** button.
7. To recover the former settings, select the **Redo** button.
8. To display the coordinates of the inflection points on the left side of the screen, select the **XY** check box.

To save the map settings:

1. Select the **Save** button.

   The system displays the **User Map** box.
2. Select a destination from the drop-down list.

   These selections will display in the soft key selections for **Map**.
3. Select the **Save** button.

   The system saves the modifications and removes the **User Map** box.
4. To cancel saving the map settings, select the **Cancel** button.

To exit the map settings:

- Select the **Exit** button to remove the modify map box from the image screen. Alternatively, press the **ESCAPE** key.

Selecting a Color Map (Tint)

You can individually colorize the grayscale 2D-mode image and M-mode sweep by applying a color map during real-time imaging or when the system is in freeze.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To adjust a tint:

- Press the toggle key for **Tint**.

Adjusting the Field of View

You can optimize the ***field of view*** (FOV) during real-time imaging.

- For curved and phased array transducers, adjust the sector angle and position of the image.
- For linear array transducers, adjust the image width and steer the image through the left, center, and right positions.

  Note: You can adjust the sector angle and position the image with a linear transducer that supports a sector display format.

The actual angle of the field of view is determined by the geometry of the transducer.

To select the sector display format for linear array transducers:

- Press the toggle key for **Sector**.

Changing the Sector Angle

You can change the sector angle for transducers displaying with a sector format. Adjusting the sector angle enhances the area of interest under examination.

To change the sector angle:

- Press the toggle key for **2D Size**.
- Press the toggle key for **Full Size** to achieve the maximum sector angle.

Positioning the Image

You can position the image for curved and phased array transducers. You can steer the image for linear array transducers.

To position the image for curved and phased array transducers:

1. Press the **SET** key on the control panel to display the field of view outline.
2. Roll the trackball to reposition the image.
3. To remove the field of view outline, press the **SET** key again.

To steer the image for linear transducers:

Note: The sector display format must be disabled to steer the image.

- Press the **STEER** control on the control panel.

Offsetting the Image

To	Do This
Scroll the 2D image vertically and/or horizontally	1. Press the toggle key for **Offset** to select **On**. 2. Roll the trackball to scroll the image vertically and/or horizontally. The amount of offset available depends on the selected transducer. 3. Press **SET** to confirm the position of the image. The offset displays on the image screen. Offset values display only for the active image in a dual display. 4. To exit the Offset function, press the toggle key for the **Offset** to select **Off**. The system cancels the offset value and restores the normal image display.

Changing the Image Orientation

You can horizontally or vertically flip a 2D-mode image. The image orientation is indicated by the location of the active image indicator.

On-screen icon to indicate image orientation and to identify the active image.

On-screen icon to indicate image orientation and to identify the inactive image.

Horizontal Orientation

Mode	Effect of L/R Flip
Split mode	Simultaneously reverses both images
Dual-mode	Reverses the active image only

To change the horizontal orientation of an image:

- Press the toggle key for **L/R Flip**.

Vertical Orientation

Use the system presets to determine if the DGC curve inverts when you change the vertical orientation of the image.

Display > DGC Invert with Image Invert

Mode	Effect of U/D Flip
Split mode	Simultaneously rotates both images
Dual-mode	Rotates the active image

To change the vertical orientation of an image:

- Press the toggle key for **U/D Flip**.

Rotating the Image

Use the system presets to display the soft key selection for rotation.

Customize Keys > Key Functions

To rotate the image:

- Press the **Rotate** soft key up to rotate the image 90° clockwise or down to rotate the image 90° counterclockwise.

  In split mode, the system rotates both images. In dual-mode, the system rotates the active image.

Magnifying the Image

You can magnify 2D-mode and M-mode images, including split, dual, and 2D/M-mode images, in real-time or freeze.

Use the system presets to assign the direction of rotation to the **DEPTH/ZOOM** control to increase magnification.

Customize Keys > Key Direction

To	Perform this action
Activate the zoom window	1. Press **DEPTH/ZOOM**. The system displays the zoom window on the image. On a split image, the system displays the zoom window on the left reference image. On a dual image, the system displays the zoom window on the active image. 2. To position the zoom window over the region of interest, roll the trackball. **Note:** For 2D/M-mode images, position the zoom window on the 2D image.
Magnify the image (portion that displays in the zoom window)	▪ Press **DEPTH/ZOOM**. The system displays a "**Z**" next to the depth indicator on the image screen. On a split image, the system magnifies the right image in the area indicated by the zoom window. On a dual image, the system magnifies the active image. To magnify the second image, press **UPDATE** to make the image active and then press **DEPTH/ZOOM**. On 2D/M-mode images, the system magnifies both the 2D image and the M-mode sweep.
Adjust the size of the zoom window	▪ Rotate **DEPTH/ZOOM**.
Exit the zoom function and remove the zoom window from the active image	**Note:** If you adjust the zoom window before pressing **DEPTH/ZOOM** to exit, the system reactivates the zoom function. ▪ Press **DEPTH/ZOOM** again or press the **2D** control.

High-Density (HD) Zoom

Use the **HD ZOOM** key on the control panel to displays a high-density zoom image on the screen.

To	Perform this action
Activate the HD zoom window	▪ Press **HD ZOOM**. The system displays the zoom window on the image.
Adjust the position of the zoom window	▪ Roll the trackball.
Adjust the size of the zoom window	▪ Rotate **DEPTH/ZOOM**.
Magnify the image (portion that displays in the zoom window)	▪ Press **HD ZOOM** or **DEPTH/ZOOM**. When the image is magnified, the system displays a "**HD Z**" next to the depth indicator on the image screen.
Exit the zoom function and remove the zoom window from the active image	▪ Press **HD ZOOM**, **DEPTH/ZOOM** or **2D**.

Tissue Harmonic Imaging

Tissue Harmonic Imaging (THI) is a system feature that can enhance contrast resolution with fine tissue differentiation, benefiting difficult-to-image patients. THI creates images from received signals using the harmonics of the transmitted frequency. For certain applications, Filtered THI can be used to optimize temporal resolution. The frame rate of Filtered THI is higher than THI when similar imaging depth, field of view, and focus conditions are used.

Use the system presets to display the soft key selection for THI function.

Customize Keys > Key Functions

To activate THI:

1. Press the toggle key for **THI**.

   The system displays **THI** next to the frequency value.
2. To change the THI frequency, press the toggle key for **MultiHertz**.

   If you adjust the frequency to the range where Filtered THI is applied, the system displays **THI F** next to the frequency value.
3. To exit THI, press **THI**.

Tissue Grayscale Optimization

The TGO (Tissue Grayscale Optimization) technology optional feature optimizes the image's contrast resolution and brightness uniformity by shifting low-level amplitude signals to the grayscale range optimal for viewing.

Example of TGO symbol.

When you activate TGO, the system immediately optimizes the image's contrast resolution and brightness uniformity and displays the "TGO" symbol to indicate that TGO is active. TGO remains active for the current examination until you exit TGO, end the current examination, or select another exam type or transducer.

You can also select a TGO gain for preferred image brightness with TGO during the current examination (for the current exam type and transducer). The selected value represents the increments of gain adjustment to be added to or subtracted from the default optimized gain.

If you activate a 2D-mode imaging feature that supports TGO (such as THI), then the system automatically updates the optimization for that imaging feature. When you exit TGO, the system removes the "TGO" symbol from the screen to indicate that TGO is no longer active.

Use the system presets to assign the refresh function for TGO to the User Defined 2 key.

Customize Keys > User Defined 2 Key

To optimize the image with TGO:

1. To activate TGO, choose a method:
   - Press **TGO** on the control panel.
   - Press **TGO/UD 2** on the control panel.
2. To refresh or update TGO, press **TGO** again. Or, press **TGO/UD 2**.
3. To exit TGO, press **TGO** on the control panel twice.

Saving TGO Gain Offsets for Later Patient Examinations

The TGO gain offset represents the increments of gain adjustment to be added to or subtracted from the automatically optimized gain. You can save one or more TGO gain offsets as a QuickSet for use in later studies or examinations. You can designate either the default overall gain or an adjusted overall gain for use when 2D-mode imaging is active but TGO is not active.

Note: A QuickSet retains all TGO gain offsets. For example, after you save a TGO gain offset for general 2D-mode imaging and another TGO gain offset for Tissue Harmonic Imaging (THI), create a user-defined exam type. The next time you retrieve this exam type (and activate TGO and the applicable 2D-mode imaging feature), the system applies the relevant TGO gain offset.

To create a QuickSet containing TGO gain offset(s):

1. Press the **TGO Gain** soft key to adjust the gain.
2. While TGO is not active, create (save) the QuickSet.

SieClear Multi-View Spatial Compounding

SieClear multi-view spatial compounding is a feature that can decrease speckle in a 2D-mode image, resulting in a clear view of image structures. Reduced speckle allows low contrast lesions to stand out and boundaries to appear more continuous.

SieClear multi-view spatial compounding involves the acquisition of echoes at a given point in an image, using multiple different apertures, to decrease speckle. These echoes are then combined by averaging or by using a nonlinear process such as choosing the maximum intensity. The speckle from the different apertures are uncorrelated, so the compounded image has less variance in the speckle brightness than the uncompounded image.

The range of settings is **2** (lowest) when SieClear is enabled and **3**, **5**, **7** (highest) when Advanced SieClear is enabled. Higher settings use more compounding (more smoothing).

The SieClear option is compatible with linear and curved array transducers supporting all exam types.

To activate SieClear or Advanced SieClear:

- Press the toggle key for **SieClear** or **Adv.SieClear** and select the required setting.

To exit SieClear or Advanced SieClear:

- To exit SieClear or Advanced SieClear, press the toggle key for **SieClear** to display **Off**.

Clarify VE

Clarify vascular enhancement technology (Clarify VE) is an optional feature that can decrease artifacts in the 2D-mode image, resulting in an improved view of anatomical structures. Decreased artifacts can enhance definition of both tissue and vessel walls by increasing contrast resolution and improving boundary detection. Clarify VE uses flow information to eliminate noise and reverberation from vessels.

When Clarify VE is active, you can reposition and resize the Clarify VE ROI (region of interest) to designate the area for the system to add flow information. You can also select the level of flow information added to the image. Higher settings for the Clarify VE level increase the blood flow information added to the image.

To activate Clarify VE and reposition/resize the Clarify VE ROI:

1. Press the toggle key for **ClarifyVE**.

   The system enables Clarify VE and places the Clarify VE ROI, outlined in solid green, on the image.
2. To reposition the ROI, roll the trackball.
3. To resize the ROI, press the **SET** key and roll the trackball.

   The system outlines the ROI with a dotted green line with solid corners.
4. For linear array transducers, to steer the ROI, push the **STEER** control left or right.

   The system outlines the ROI with a dotted green line.

To change the Clarify VE level:

1. Activate Clarify VE.
2. Press the toggle key for **ClarifyVE Levels**.
3. To exit Clarify VE, choose one of the following methods:
   a. Press the toggle key for **ClarifyVE** to display **Off**.
   b. Press the **2D** control on the control panel.

Dynamic Tissue Contrast Enhancement (DTCE)

Note: The system deactivates Dynamic Tissue Contrast Enhancement (DTCE) when you activate any of the following functions: Stress Echo, SieScape, *four*Sight TEE, or Anatomic M-Mode.

Dynamic TCE is a multi-scale adaptive image filter that relies on edge diffusion and pyramidal processing to simultaneously achieve speckle reduction and contrast enhancement, improving the coherence of anatomical structures.

Dynamic TCE provides:

- Enhanced, realistic tissue presentation
- Patient-specific processing which adapts to differences in tissue

Note: During Dynamic TCE, soft key selections, such as Offset and Clarify VE, are disabled.

Note: The acquisition rate for the clip capture setting defaults to **normal**. Use the system presets to change the default frame rate of the acquisition.

To change the value for Dynamic TCE:

- Press the **DTCE** soft key.

A3 Color Flow Imaging

Activating Color Flow Imaging

During Color Flow imaging, the system applies color to a defined ***region of interest*** (ROI) within the 2D image. The system measures and assigns specific color to the velocities of blood flow within the ROI. You can adjust the depth, location, and size of the ROI, as well as the parameters that affect color imaging performance. Color Flow imaging is supported by all imaging transducers.

Note: If the Advanced SieClear is activated during Dual-mode, you cannot activate Color or Power.

To activate Color Flow:

1. Press the **C** control on the control panel.
   The system places the ROI, outlined in solid green, on the image.
2. To reposition the ROI, roll the trackball.
3. To resize the ROI, press the **SET** key and roll the trackball.
   The system outlines the ROI with a dotted green line with solid corners.
4. Press the **SET** key to set the size.
   The ROI is outlined in solid green and is available for repositioning with the trackball.
5. To exit Color Flow imaging, press the **C** control.

Color Flow Imaging and Power Mode Combinations

These combinations are available:

- 2D-mode with Color or Power
- Zoomed 2D-mode with Color or Power
- Split 2D-mode with Color or Power
- Color or Power Dual or Seamless Dual (Color or Power in both images on the screen)
- 4B display with Color or Power
- 2D/Doppler with Color or Power
- Zoomed 2D/Doppler with Color or Power
- M-mode with Color
- 2D-mode with color/M-mode with color
- 2D-mode with color and zoom/M-mode with color

Update Function

The update function displays a frozen 2D-mode with color image with a real-time Doppler spectrum. Use the **UPDATE** key to toggle the two update formats. One format presents a real-time 2D-mode with color image and a frozen spectrum. The other format presents a frozen 2D-mode with color image and a real-time spectrum.

Simultaneous (Triplex) Format

Synchronize the Doppler spectrum and a 2D-mode image with Color or a 2D-mode image with Power to display simultaneously in real-time.

Use the system presets to select the default refresh interval for 2D/Doppler.

Display > Doppler/M-mode > Default Doppler Update Style

In simultaneous format, the images refresh at the same time.

To enable a simultaneous format:

1. Press the **TRIPLEX** key on the control panel.
2. To disable the simultaneous format, press the **TRIPLEX** key again or press the **UPDATE** key on the control panel.

   The 2D-mode image updates according to the refresh interval.

Update with 2D-Image Refresh

Use the update function to pause the Doppler spectrum and refresh (update) the 2D-mode image. During the update function, you can adjust the refresh interval.

Use the system presets to select the default refresh interval for 2D/Doppler.

Display > Doppler/M-mode

To enable the refresh format or change the refresh interval:

Note: If Simultaneous format is enabled, then you must disable Simultaneous format before enabling the refresh format or changing the refresh interval.

1. To modify the refresh interval, press the toggle key for **Update Rate**.
2. To freeze the Doppler spectrum and update the 2D-mode image in real-time, press the **UPDATE** key again.

   Note: You cannot change the refresh interval when the Doppler spectrum is frozen and the 2D-mode image displays in real-time.

3. To display the Doppler spectrum in real-time, and update the 2D-mode image according to the refresh interval, press the **UPDATE** key again.

Activating Color DTI

The Color DTI (Doppler tissue imaging) capability illustrates myocardial motion by using color to emphasize velocity differences in myocardial layers.

To activate Color DTI:

1. Activate Color Flow or a mixed imaging mode with Color.
2. Press the toggle key for **DTI** to select **On**.
3. Use the trackball and **SET** key to adjust the position and size of the Color ROI.
4. To exit DTI, press the toggle key for **DTI** to select **Off**.
5. To exit Color mode, press the **C** control.

Activating Doppler Tissue Energy (DTE)

Doppler Tissue Energy (DTE) applies color to the Doppler signal energy returning from the tissue.

To activate Doppler Tissue Energy:

- Press the toggle key for **DTE**.

Note: DTE and DTI cannot be activated at the same time.

Color Flow Imaging Parameters

Use the ultrasound system controls and soft key selections to change the settings for imaging parameters. The system increases the lighting intensity of the control or key associated with the active function.

Positioning, Sizing, and Steering the ROI

When a 2D-mode image is displayed and the **C** control or **POWER** key is pressed, the color window, or ROI, displays on the image. The initial location and shape of the window depend on the active transducer and default imaging depth.

Note: You can press the **SET** key to toggle the size and position options for the ROI. The trackball status at the lower right of the screen indicates the active option.

When the size or position of the ROI is changed, the color information momentarily disappears. The ROI is outlined with a solid green line that denotes that the position of the ROI can be changed. A dotted green line with solid corners indicates that the sizing function is active.

Note: Changes to the ROI size, shape, and position can change the frame rate.

To change the size and position of the Color ROI:

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

   The system places the ROI, outlined in solid green, on the image.
2. To reposition the ROI, roll the trackball.
3. To resize the ROI, press the **SET** key and roll the trackball.

   The system outlines the ROI with a dotted green line with solid corners.
4. Press the **SET** key to set the size.

   The ROI is outlined in solid green and is available for repositioning with the trackball.
5. To exit Color Flow imaging, press the **C** control.

Steering the Color Window

Steer the color window by using the **STEER** control to improve color sensitivity. The amount of steering available is transducer-dependent and available only with linear array transducers.

Note: Changes to the ROI size, shape, and position can change the frame rate.

Use the system presets to automatically convert the color velocity scale when you steer the ROI from left to right or from right to left. This preset is exam-dependent.

To steer the color window:

1. Push the **STEER** control on the control panel.

   Note: The default position of the window depends on the transducer and exam type.

2. Push the **STEER** control to the left to move the ROI to the left. Push the **STEER** control to the right to move the ROI to the right.

   The Doppler cursor is linked to the color window and tracks each steering direction.

Exam Configuration > Auto Invert of Color and Spectrum

Exam Configuration > Linear Steer Color Invert

Linear Array Transducers

With linear array transducers, the color ROI is displayed as a parallelogram.

Steer the color ROI to improve color sensitivity.

The amount of steering available is transducer-dependent and available only with linear array transducers.

Curved Array and Phased Array Transducers

Note: This section also applies to linear array transducers with the sector display format activated.

With curved array and phased array transducers, rather than steer the color ROI, you can position the sector color ROI throughout the field of view. The curved color ROI follows the radial pattern of the image scan lines.

Adjusting the Color Gain

Rotate the **C** control on the control panel to adjust the receive gain for Color without affecting the 2D-mode image gain.

For optimal results, adjust the color gain before adjusting other Color Flow controls. Set the gain level so that random pixels of color appear outside of the vessel of interest, then reduce the gain until random noise disappears.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To adjust the gain for Color Flow imaging or Power mode:

- Rotate the **C** control clockwise to increase the gain; rotate the control counterclockwise to decrease the gain.

Adjusting the Wall Filter

Filter selects a level of motion discrimination during real-time imaging. Higher settings suppress flash (motion artifacts) and reduce system sensitivity to detect low velocity flow. Lower settings provide better sensitivity to lower velocities and small vessel detection, and increase the probability of displaying flash.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To adjust the filter:

- Press the toggle key for **Filter**.

Adjusting the Color Baseline

Baseline adjusts aliasing in the flow direction under evaluation. Shifting the Baseline adjusts the range of displayed flow velocities without changing the Color PRF. If adjusting the baseline does not compensate for very high velocities and aliasing, increase the Color PRF to increase the velocity range.

As the baseline is changed, the system updates the values displayed at both ends of the velocity color scale.

To shift the baseline:

- Press the toggle key for **Baseline**.

Adjusting Persistence

Color Persistence determines how long Color data remain in the ROI. Persisted color data remain on the screen until the persistence time has expired or the system detects a higher flow velocity.

Power Persistence adjusts the time over which power data are processed in calculating the power amplitude display. When power persistence is increased, a longer duration for calculations displays a smoother power image. When power persistence is decreased, a shorter duration for calculations displays a more pulsatile flow.

Increase persistence to increase the time a peak velocity is held. Decrease persistence to decrease the time a peak velocity is held.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To change persistence:

- Press the toggle key for **Persist**.

Adjusting the PRF (Velocity Range)

Pulsed Repetition Frequency (PRF) adjusts the color velocity range or the power frequency range. You can also adjust the color velocity range using the color baseline. The velocity range is determined by the depth of the ROI and by the transmit frequency of the transducer. When the transmit frequency is downshifted, the velocity range increases.

You can adjust the PRF independently for each operating mode during mixed mode imaging. For example, the velocity range can be different for Color Flow imaging than for Doppler.

The color velocity scale is displayed as a bar graph along the right side of the image screen. The scale displays a total of 128 shades of color, 64 above and 64 below the center baseline. Values in centimeters per second (cm/s) are displayed at each end of the color bar to indicate the color Nyquist limit in both directions.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To change the PRF:

- Press the toggle key for **Scale**.

Using Peak Hold

Peak hold occurs when the ultrasound system accumulates and displays the peak color velocities associated with blood flow for a selected period of time.

The peak hold setting designates the period of time that peak color velocities of blood flow are collected. When peak hold is active, the system performs peak hold each time an image is acquired.

Peak hold cannot be initiated from a frozen image. In 2D-mode with color/Doppler, you can perform peak hold during Update when the 2D-mode with color image is real-time and the sweep or spectrum is frozen.

To specify the duration of peak hold:

- Press the toggle key for **Peak**.

Changing the Line Density (Resolution/Speed)

Line Density increases or decreases the number of acoustic scan lines passing through the ROI. Increasing the line density increases resolution and decreases frame rate.

The current setting displays on the on-screen menu at the lower left of the screen.

To change the Line Density setting:

- Press the toggle key for **R/S**.

Smoothing the Flow Pattern (Spatial Averaging)

Smoothing the flow pattern adjusts the level of spatial averaging (both axial and lateral) used to smooth the flow pattern display. As spatial averaging is increased, the flow sensitivity increases, but spatial resolution decreases.

The system reduces the random noise level by looking at adjacent pixels to determine if a value is real or the result of noise. Higher number settings yield greater color smoothing.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To smooth the flow pattern:

- Press the toggle key for **Smooth**.

Selecting a Color Map

A ***Map*** is the range of colors assigned to the Color or Power ROI. It is based on blood velocity for Color Flow imaging and flow amplitude for Power mode.

0.22

0.22
cm/s

Example of a Color Bar: displays the velocity range in centimeters/second (cm/s).

The active map is depicted by the Color bar, which displays on the right side of the image screen. The bar represents the range of color shades available for the selected map.

For Color Flow imaging, changes in hue represent changes in velocity. Darker hues indicate lower velocities, and lighter hues indicate higher velocities. These maps also indicate flow direction by using shades of red and blue. Color Flow velocity and variance maps indicate blood flow turbulence by using shades of green.

The current setting displays in the Imaging Parameters on the upper left of the screen.

Note: Color maps can be applied to images in real-time or freeze.

To select a map:

- Press the toggle key for **Map**.

Using a Velocity Tag

You can designate or tag a specific blood flow velocity or a range of blood flow velocities in a real-time or frozen Color mode image or during CINE review.

To position a velocity tag at a single point:

1. Press the toggle key for **VelTag** to select **Sngl**.

   A green velocity tag marker displays on the color bar.

2. Roll the trackball to position the velocity tag marker at the required point in the color bar and then press the **SET** key to select the value.

   The value for the selected velocity displays to the left of the color bar.

3. To deactivate the velocity tag, press the toggle key for **VelTag** to select **Off**.

To select a velocity tag range:

1. Press the toggle key for **VelTag** to select **Rng**.

   A green velocity tag marker displays on the color bar. The size and position of the marker in the color bar indicates the range of velocities for display in the Color Flow image. Increase or decrease the size of the marker by rolling the trackball.

2. Define the maximum and minimum velocities of the range.

   The system displays the maximum and minimum velocity values to the left of the color bar.

   a. Roll the trackball to position the maximum end of the tag marker at the required velocity range and then press the **SET** key.

      Rolling the trackball upward extends the range upward.

   b. Roll the trackball to position the minimum end of the tag marker at the required velocity range and then press the **SET** key.

3. Roll the trackball to position the range of velocities anywhere along the color bar above or below the baseline and then press the **SET** key.

   The system updates the maximum and minimum velocity values.

4. To deactivate the velocity tag, press the toggle key for **VelTag** to select **Off**.

Inverting the Color Scale

Invert the color scale to quickly adjust the color flow to the type of hemodynamics in the image.

To invert the color scale in 2D-mode with color/Doppler, press the **UPDATE** key to freeze the Doppler spectrum and activate a real-time 2D-mode with color image, then proceed to invert the color scale.

To invert the color scale:

1. Press the **INVERT** key on the control panel.

   The system inverts the colors depicting forward and reverse flow in the Color ROI and in the color bar.

2. To deactivate the function, press the **INVERT** key again.

   The system reverts to the original color assignment.

Deactivating the Display

Display activates or deactivates the Color or Power display. The default setting is to display Color or Power. Use this parameter to show 2D anatomy in the ROI for real-time and frozen images.

To activate or deactivate the display:

- Press the toggle key for **Display** to select **On** or **Off**.

Selecting a Priority Level

Color Priority adjusts the threshold for choosing whether to display Color or 2D-mode data for any pixel. An increase in color priority results in more color pixel information overlaying the 2D image.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To adjust the priority level:

- Press the toggle key for **Priority**.

Selecting a Flow State

Flow State optimizes the system for hemodynamic flow conditions. The system automatically adjusts the parameters for wall filter and pulse repetition frequency (PRF) for the selected Flow State.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To select a flow state:

- Press the toggle key for **Flow**.

Activating Power Mode

Power mode detects and assigns color to the energy generated by the reflections of blood flow. It is independent of the Doppler flow angle. Power mode has a full range of color imaging parameters for optimizing the energy image. You can use Power mode with any transducer that supports Color Flow imaging.

See also: Inverting the Color Scale, p. A3-12

See also: Technical Description, Appendix A, Instructions for Use

To activate Power mode:

- Press **POWER**.

  The system activates Power mode and displays the available soft key selections.

Positioning, Sizing, and Steering the ROI

When you display a 2D-mode image and then activate Power mode, the power window, or ROI, displays on the image. The initial location and shape of the window depend on the active transducer and default imaging depth.

The ROI is outlined with a solid green line, which indicates that the position of the ROI can be changed. A dotted green line with solid corners indicates that the size of the ROI can be changed. If you change the size or position of the ROI, the 2D information remains on the image screen.

Note: Changes to the ROI size, shape, and position can change the frame rate.

To change the size and position of the Power ROI:

1. Press the **POWER** key on the control panel.

   The system places the ROI, outlined in solid green, on the image.

2. To reposition the ROI, roll the trackball.
3. To resize the ROI, press the **SET** key and roll the trackball.

   The system outlines the ROI with a dotted green line with solid corners.

4. Press the **SET** key to set the size.

   The ROI is outlined in solid green and is available for repositioning with the trackball.

5. To exit Power mode, press the **POWER** key.

Adjusting the Power Gain

Rotate the **C** control on the control panel to adjust the receive gain for Color or Power without affecting the 2D-mode image gain.

For optimal results, adjust the color gain before adjusting other Color Flow controls. Set the gain level so that random pixels of color appear outside of the vessel of interest, then reduce the gain until random noise disappears.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To adjust the gain for Color Flow imaging or Power mode:

- Rotate the **C** control clockwise to increase the gain; rotate the control counterclockwise to decrease the gain.

Selecting a Power Map

A ***Map*** is the range of colors assigned to the Color or Power ROI. It is based on blood velocity for Color Flow imaging and flow amplitude for Power mode.

The active map is depicted by the Power bar, which displays on the right side of the image screen. The bar represents the range of color shades available for the selected map.

Example of a Power Bar: displays the velocity range in centimeters/second (cm/s).

Power maps indicate stronger signals in brighter colors and weaker signals in dimmer colors, according to flow amplitude.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To select a map:

- Press the toggle key for **Map**.

Specifying Directional Power

You can determine power flow relative to the transducer. Forward flow (flow towards the transducer) is always represented by the color in the upper half of the power bar; backward flow (flow away from the transducer) is always represented by the color in the lower half of the power bar.

To activate directional power flow:

- Press the toggle key for **Dir Power** to select **On**.

Selecting a Priority Level

Power Priority adjusts the threshold for the amplitude of the Power display. An increase in power priority results in more power information, since the range of signal amplitudes increases, including the weaker signals. A decrease in power priority decreases the weaker amplitude signals, and less power is displayed.

The current setting displays in the Imaging Parameters on the upper left of the screen.

To adjust the priority level:

- Press the toggle key for **Priority**.

Power Background Display

Background activates a background enhancement of solid color. The solid background color changes, depending on the power map selected. As Power **Priority** is decreased, the background color fills in the areas where the weaker power signals previously existed.

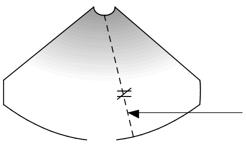
To activate or deactivate the background display:

- Press the toggle key for **Background**.

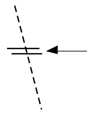
A4 Doppler Functions

Activating Pulsed Doppler

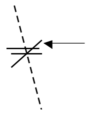
When you activate Doppler from 2D-mode, the ***Doppler cursor*** is displayed on the 2D image. This cursor is a graphical representation of the acoustic line along which the sample volume or the ***Doppler gate*** is placed for gathering Doppler information.



Doppler cursor



Doppler gate



Flow angle indicator

Use the system presets to activate Doppler Search Mode to audibly interrogate vessels with Doppler in 2D-mode before displaying the Doppler spectrum.

Display > Doppler/M-Mode > Doppler Search Mode

Display > Doppler/M-Mode > Bypass M/D Cursor Display

To activate pulsed Doppler:

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

   If the cursor bypass is selected in the system presets, the system activates 2D-mode/Doppler immediately. If the cursor bypass is not selected, the system initially displays a Doppler cursor on the 2D-mode image.
2. Roll the trackball to position the Doppler gate on the area of interest.
3. To change the size of the Doppler gate, press the toggle key for **Gate**.

   The system applies the selection and displays the current setting in the Imaging Parameters on the upper left of the screen.

   The range of the Doppler gate size is dependent on the transducer.
4. If the cursor bypass is not selected, press the **D** control again.

   The system displays the 2D-mode image and the Doppler spectrum using the image format and refresh interval selected in the system presets.

To	Perform this action after activating pulsed Doppler
Activate or deactivate a full-screen Doppler spectrum	Press the toggle key for **Full D**.
Change the interval for refreshing the 2D image during Update	Press the toggle key for **Update Rate**.
Freeze the spectrum	Press the **FREEZE** key.
Activate another mode	Press the required mode key.

5. To exit, press the **2D** control on the control panel.

Activating Doppler Search Mode

Use Doppler ***Search Mode*** to audibly interrogate vessels with Doppler in 2D-mode before displaying the Doppler spectrum.

Use the system presets to configure the system to initiate Doppler Search mode whenever the **D** control is first pressed.

Display > Doppler/M-Mode > Doppler Search Mode

Note: Activating this function reduces the frame rate.

Activating DTI

The Doppler tissue imaging (DTI) capability illustrates movement of tissue by emphasizing low myocardial velocities.

DTI measurements can facilitate quantification of tissue movement. For example, you can measure the velocity of local myocardial movement without the need to compensate for movement of the entire heart.

When you activate DTI, the system adjusts the velocity scale to emphasize low myocardial velocities and adjusts the Pulsed Repetition Frequency (PRF) setting and the Doppler gate size setting according to the default value or to the last value you set during DTI.

Note: High PRF (HPRF) is disabled during DTI.

Note: DTI is disabled during CW and SCW.

To activate DTI:

1. Activate pulsed Doppler or a mixed imaging mode including pulsed Doppler.
2. Roll the trackball to position the Doppler gate on the tissue of interest.
3. Press the toggle key for **DTI** to display **On**.
4. To exit DTI, press the toggle key for **DTI** to display **Off**.

Activating Auxiliary Continuous Wave Doppler

Auxiliary continuous wave Doppler is possible with the use of CW transducers or ***pencil*** transducers. The frequency of a pencil transducer cannot be changed.

Note: Operating continuous wave in close proximity to sources of strong radiated electromagnetic fields, such as radio transmission stations or similar installations, may lead to interference visible on the monitor screen.

See also: Connecting and Disconnecting Transducers, System Setup, Chapter 3, Instructions for Use

To activate auxiliary continuous wave Doppler:

- Activate the connected continuous wave transducer.

  The name of the active transducer displays on the upper left of the screen.

  – If a CW transducer is not active and only two transducers are connected to the system, press the user-defined key assigned to the transducer function.

  – If a CW transducer is not active and three or more transducers are connected to the system, press the user-defined key assigned to the transducer function. Then press the toggle key for the required transducer.

  The system activates continuous wave Doppler, scrolling the Doppler spectrum across the image screen.

Activating Steerable Continuous Wave Doppler

Steerable continuous wave Doppler is possible with a phased array transducer. The following two procedures outline SCW Doppler operation with and without cursor bypass.

Use the system presets to check or change the cursor bypass setting.

Display > Doppler Search Mode

Display > Bypass M/D Cursor Display

To activate steerable continuous wave Doppler with cursor bypass activated:

1. Press the **CW** key on the control panel.

   The system displays a 2D image and a Doppler spectrum. A ***circle*** displays on the Doppler cursor in the 2D image; it represents the focal point for SCW Doppler.

2. Roll the trackball to position the Doppler cursor on the area of interest.

   The soft key selections list Doppler selections, and the system displays 2D-mode/Doppler using the image format selected in the system presets.

3. To exit, press the **2D** control or the **CW** key on the control panel.

To activate steerable continuous wave Doppler with cursor bypass deactivated:

1. Press the **CW** key on the control panel.

   The system displays the pulsed Doppler cursor in a full-screen 2D image. A ***circle*** displays on the Doppler cursor; it represents the focal point for SCW Doppler.

2. Roll the trackball to position the Doppler cursor on the area of interest.
3. Press the **CW** key again.

   The soft key selections list Doppler selections, and the system displays 2D-mode/Doppler using the image format selected in the system presets.

4. To exit, press the **2D** control or the **CW** key on the control panel.

Update Function

During 2D/Doppler, you can use the **UPDATE** key to toggle a real-time 2D image and a frozen spectrum with a frozen 2D image and real-time spectrum.

Update with 2D-Image Refresh Interval

Use the update function to pause the Doppler spectrum and refresh (update) the 2D-mode image. You can also change the refresh interval.

Use the system presets to select the default refresh interval for 2D/Doppler.

Exam Configuration > Default Doppler Update Style

To enable the refresh format or change the refresh interval:

Note: If Simultaneous format is enabled, then you must disable Simultaneous format before enabling the refresh format or changing the refresh interval.

1. To modify the refresh interval, press the toggle key for **Update Rate**.
2. To freeze the Doppler spectrum and update the 2D-mode image in real-time, press the **UPDATE** key on the control panel.

   Note: You cannot change the refresh interval when the Doppler spectrum is frozen and the 2D-mode image displays in real-time.

3. To display the Doppler spectrum in real-time, and update the 2D-mode image according to the refresh interval, press the **UPDATE** key again.

Simultaneous Format

You can synchronize the Doppler spectrum and 2D-mode image to display simultaneously in real-time.

Note: Phased Inversion THI and SCW Doppler are not available with the simultaneous format.

To enable a simultaneous format:

1. Press the **TRIPLEX** key on the control panel.

   The 2D-mode image updates according to the refresh interval.
2. To disable a simultaneous format, press the **TRIPLEX** key again or press the **UPDATE** key on the control panel.

Doppler Imaging Parameters

You can modify the Doppler spectrum using controls and keys on the control panel and soft key selections on the on-screen imaging menu.

As with most controls for imaging in 2D-mode and M-mode, the system increases the lighting intensity of the control or key associated with the active function.

Selecting Frequency or Velocity

You can select the type of scale for the Doppler spectrum.

Use the system presets to select a frequency or velocity scale.

Display > Doppler Frequency/Velocity

Effect of Other Imaging Parameters

When you downshift the transmit frequency, change the baseline, or change the PRF, the scale adjusts accordingly (after a temporary pause in the spectrum).

Positioning and Steering the Doppler Cursor

You can position and ***steer*** the Doppler cursor in relation to the vessel or pathology of interest to obtain the required angle of incidence. Positioning and steering are transducer-dependent.

Phased and Curved Array Transducers

Use the trackball to position the Doppler cursor throughout the field of view. Steering is not available with phased and curved array transducers.

Note: You can use the trackball to position the Doppler cursor for a linear transducer that supports a sector display format.

Linear Array Transducers

You can steer and position the Doppler cursor with linear array transducers.

To steer the Doppler cursor:

- Push the **STEER** control left or right.

  Pushing the **STEER** control to the left or right cycles through positions available in the respective direction. The default position of the Doppler cursor is in the center.

To position the Doppler cursor:

- Roll the trackball to position the Doppler cursor throughout the field of view. You can position the Doppler cursor before or after steering.

Positioning the Doppler Gate

The ***Doppler gate*** displays on the Doppler cursor in the 2D image. Roll the trackball up or down to position the gate on the cursor. Roll the trackball right or left to position the cursor in the image. When the Doppler spectrum displays, the depth of the gate displays on the left, above the spectrum.

Sizing the Doppler Gate

For pulsed Doppler, you can adjust the size of the Doppler gate to gather signals suitable for the size of the required vessel. The amount of adjustment available is dependent on the transducer and the depth.

To change the size of the Doppler gate:

- Press the toggle key for **Gate**.

Angle Correction

The ***flow angle indicator*** depicts the degree of angle correction for the Doppler spectrum.

When you first activate Doppler, the display of the flow angle indicator to the Doppler cursor is exam-dependent.

Accurate Doppler shifts can be calculated for angles of 64° or less.

The system also displays the values of angles greater than 1° on the screen. When the angle is 65° or greater, the system highlights the value of the angle in green.

To correct the flow angle:

- Press **ANGLE** to adjust the flow angle from 0° to 60° to 0°. Or, rotate **ANGLE** to adjust the flow angle by 1° increments.

Adjusting Time/Frequency Resolution

You can provide finer detail in either the time data or the frequency data by adjusting the Time/Frequency Resolution.

To adjust the time/frequency resolution:

- Press the toggle key for **T/F Res**.

Adjusting the Baseline

Baseline shifts the absolute perspective (zero velocity) for Doppler mode. When the baseline position has been changed, the scrolling spectrum restarts at the new position. On-screen frequency and velocity scales also update.

To shift the baseline:

- Press the toggle key for **Baseline**.

Adjusting Doppler Gain

Adjust Doppler gain by rotating the **D** control. The Doppler gain controls the overall gain for pulsed Doppler.

To adjust gain for Doppler imaging:

- Rotate the **D** control clockwise to increase gain and counterclockwise to decrease gain.

Adjusting the Wall Filter

Wall Filter allows you to reject low frequency signals generally caused by tissue clutter. You can only change the wall filter during a real-time spectral sweep. The change affects the audio signal. Wall filter settings are dependent on the active transducer and exam type.

To change the wall filter:

- Press the toggle key for **Filter**.

Adjusting the PRF

The PRF (Pulse Repetition Frequency) is dependent on the transmit frequency and the depth of the Doppler gate.

During simultaneous or Triplex display (the 2D-mode image or the 2D-mode with color image and Doppler spectrum are active), curved and linear array transducers use up to half the available PRF. In Update, the full PRF range is available for all Doppler-compatible transducers.

To adjust the PRF:

- Press the toggle key for **Scale**.

Activating High PRF

High PRF detects and depicts higher velocity flows using the maximum scale. An example of high velocity is the abnormal flow due to high-grade stenosis. Without High PRF, the signal aliases, and quantifiable analysis is difficult. Using High PRF, the system places additional Doppler gates in the 2D-mode image and expands the velocity scale of the Doppler spectrum.

The system automatically activates High PRF when the Doppler gate reaches specific depths in the image and when the signal exceeds the upper level of the active scale.

High PRF is available only in Update; it is not available in a simultaneous display.

To activate High PRF:

- Press the toggle key for **Scale** to increase the PRF until the system displays additional sample gates in the 2D image.

Selecting a Gray Map

The Map parameter is used to select a processing curve that assigns echo amplitudes to gray levels. Map can be activated during real-time imaging or when the system is in freeze.

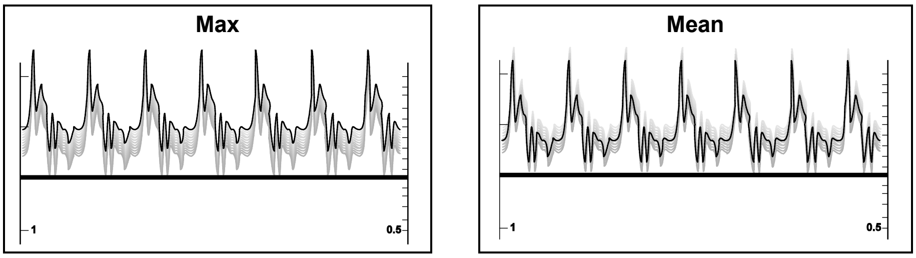
The active gray map is depicted by a gray bar, which displays on the right side of the image screen. The gray bar represents the range of gray shades available for the selected map.

To select a gray map:

- Press the toggle key for **Map**.

Tracing the Doppler Spectrum

You can display a graphical trace that tracks mean and maximum velocities or frequencies. You can display up to two of the four available selections on a real-time or frozen spectrum. On-screen labels identify the selected trace(s).



Trace options.

Auto Stats

The Auto Stats (statistics) function automatically traces the spectral Doppler waveform and records several measurements depending on the selected transducer. You can use the Auto Stats function on a real-time pulsed wave Doppler spectrum.

To activate the Auto Stats function:

1. Press **D** to activate 2D-mode with Doppler.
2. Press the toggle key for **Auto Stat**.

   The system displays a graphical trace to indicate mean (yellow) and maximum (blue) velocities or frequencies.

   – **Blw** to display trace below the baseline
   – **Abv** to display trace above the baseline
   – **Both** to display trace both above and below the baseline
   – **Off** to remove the trace

   The system also displays the values of **PI**, **RI**, **SD**, **PS**, **ED**, **TAmx**, and **TAmn**.
3. Press the **FREEZE** key to display the latest measurement values.

Note: The system saves values measured by the Auto Stats function unless you press the toggle key for **PI Manual** or **PI Auto** on the measurements screen.

To	Do This
Adjust the sensitivity of the automatically traced Doppler spectrum	1. Press the toggle key for **Auto Stat** to select **On**. 2. Press the toggle key for **Sensitivity**.

Manual Trace

A manual (**PI Manual**) trace method is only available for use during the measurement function with the Pulsatility Index calculation.

See also: Calculating the Pulsatility Index, Measurements and Calculations, Chapter B1, Features and Applications Reference

Adjusting the Sweep Speed

The Sweep parameter allows you to adjust the scrolling speed of the Doppler spectrum.

The system applies the selection and displays the current setting in the on-screen menu.

To adjust the scrolling speed of the M-mode or Doppler sweep:

- Press the toggle key for **Sweep**.

Inverting the Spectrum

Invert flips the spectral information vertically on the spectral baseline. The system inverts the scale and displays the word **Invert** on the upper left of the spectrum. When the Doppler spectrum flips vertically, Doppler audio also inverts.

To invert the spectrum:

- Press the **INVERT** key on the control panel.

Changing the Dynamic Range

Dynamic Range controls the overall contrast resolution of the Doppler spectrum.

To change the dynamic range for Doppler:

- Press the toggle key for **DR**.

Adjusting Doppler Volume

Speakers located inside the monitor housing emit audio during Doppler. Separate audio signals indicate forward or reversed flow direction. Typically, flow moving toward the transducer displays above the Doppler baseline and delivers audio from the right speaker. Flow moving away from the transducer displays below the baseline and emits audio from the left speaker.

To adjust the Doppler volume:

- Rotate the **VOLUME** control on the upper right side of the control panel.

Colorizing the Doppler Spectrum

You can colorize the Doppler spectrum independent of the gray scale image or sweep by applying a tint during real-time imaging or when the system is in freeze.

To apply color to a Doppler spectrum:

- Press the toggle key for **Tint**.

A5 CINE

CINE

The CINE function is available in all imaging modes except 4B-mode. During real-time imaging, the system places the most recently acquired images as well as the image currently on screen into a CINE memory buffer. You can view images stored in CINE memory using a review method.

- **Frame Review** – The Frame function is the system default. Use the trackball to cycle through the frames of data, one at a time, either forward or backward. You can also use the Frame function to select individual frames for printing or for storing on a disk.
- **Motion Review** – The Motion function provides a continuous display of stored data, in either a forward or backward direction. Data can be played back at the same frame rate at which the data was acquired, or the playback speed can be adjusted. All of the available frames can be viewed, or a segment can be selected using the Edit Start and Edit End options.

CINE Memory Buffer — First In, First Out

You can review any or all of the image data in the CINE memory buffer. When the CINE memory buffer is filled, the first data acquired is the first to be replaced. This process of overwriting data is continuous. Unfreezing the system erases the data from the CINE memory buffer and restarts the acquisition of CINE data.

Memory Buffer Capacity

The amount of storage available in the CINE memory buffer depends on the image complexity (setting for **R/S**), mode combinations, and the active exam type.

M-mode and Doppler

The maximum CINE memory capacity for M-mode and Doppler depends on the sweep speed. The capacities are the same for NTSC and PAL systems.

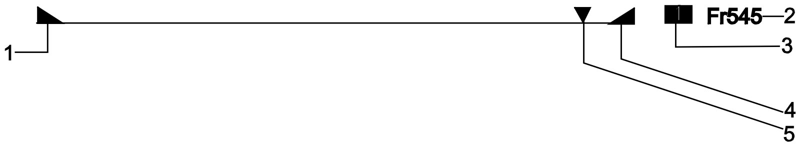
Partially Filled Memory Buffer

If the acquired frames of CINE data do not fill the CINE memory buffer for 2D-mode, then the system displays a marker to indicate how much of the CINE memory buffer is available for review.

Note: If the memory buffer has been cleared and the system is not filled to capacity with CINE frames, only the newly-acquired frames are present.

CINE Graphics

During CINE playback, a ***CINE bar*** displays on-screen below the image. This CINE bar represents the status of the CINE memory buffer and contains the following elements:



Example of a CINE bar.

1 **Left CINE marker** – Indicates the beginning of the CINE data. This marker can be repositioned to edit the length of the CINE data.

2 **Frame Counter** – Indicates the number of the active frame.

3 **Rate Indicator** – Indicates the rate of CINE playback. It can be set to 1, 2, 4, 1/8, 1/4, 1/3, 1/2, 2/3.

4 **Right CINE marker** – Indicates the end of the CINE data. This marker can be repositioned to edit the length of the CINE data.

5 **Frame Indicator** – Indicates the location of the frame within the loop of CINE data. It also indicates the direction the CINE data is moving for backward and forward review, and can be scrolled one frame at a time or continuously.

In Dual-mode, a CINE bar displays below each image.

Note: During M-mode and Doppler, only the Frame indicator and Rate indicator display on the CINE bar. The Frame Counter does not display.

Activating CINE Review

The CINE memory buffer continuously accumulates data during real-time imaging. When CINE is activated, the accumulation process stops, and the data in the memory buffer is available for replay, printing, or storage to a disk medium.

Use the system presets to assign the **FREEZE** key to activate CINE.

Exam Configuration > Automatic Freeze Response

Note: If you use system presets to assign the **FREEZE** key to a function other than CINE, then the system activates the function and also displays the CINE bar. CINE Review is activated when you exit from the active function.

To activate CINE Review:

- If the automatic freeze response is set to CINE in the system presets, press the **FREEZE** key on the control panel to activate the CINE Review function.

To exit CINE Review:

- Press the **FREEZE** key to exit the CINE Review function and resume real-time imaging.

Viewing CINE with Motion Modes

During 2D-mode imaging with motion data active (for example, a Doppler spectrum or an M-mode sweep), the CINE buffer stores Doppler and M-mode data separately from the 2D-mode image or 2D-mode with color or power image. You can view data for both modes.

Resetting CINE Memory

The following actions reset CINE memory; the CINE memory buffer empties and the system begins acquiring new data:

- Unfreezing an image
- Changing or re-selecting an imaging mode
- Changing or re-selecting the exam type or a QuickSet
- Changing the transducer or transducer frequency
- Powering off the system
- Beginning a new patient exam

CINE memory also resets in response to certain commands or functional changes performed during real-time imaging.

Frame Review

The Frame Review method provides access to any frame in the loop of data. You can edit the beginning and ending positions of the loop.

To review CINE data using the Frame method:

1. Activate CINE.
2. Roll the trackball to the left or right to review individual frames.

   The CINE indicator identifies the location of the current frame within the CINE data.

   Note: For M-mode and Doppler, one frame of motion data is displayed at a time. No frame numbers are displayed.

3. To exit and clear the memory, press the **FREEZE** key.

   The system activates real-time imaging.

Motion Review

The CINE feature provides continuous playback of the loop of CINE data in a forward or backward direction.

To play back CINE data in a continuous loop:

1. Activate CINE.
2. Roll the trackball quickly to the right to replay the CINE data in a forward direction; roll the trackball quickly to the left to replay data in a backward direction.

   The frame indicator scrolls continuously, indicating the direction of review and the location of the active frame. The Frame Counter updates with the number of the active frame.

3. To stop playback, roll the trackball in the opposite direction.
4. To exit and clear the memory, press the **FREEZE** key.

   The system activates real-time imaging.

Adjusting the Review Speed

During Motion Review, you can increase or decrease the review speed.

The review speed displays in the rate indicator by the CINE bar.

The available settings are: 1, 2, 4, 1/8, 1/4, 1/3, 1/2, and 2/3.

Note: The signal of a Doppler spectrum is not audible when the playback rate has been adjusted.

To adjust the playback rate:

- Press the toggle key for **Rate**.

Editing the Loop

You can change the beginning and ending CINE review positions within a loop of data. This edit function allows you to exclude frames from review of a specific segment. Exiting the CINE function will reset both points.

See also: Activating CINE Review, p. A5-5

Note: You cannot position the ending point of the CINE data ahead of the starting point.

To	Do This
Edit a loop with the trackball and soft key selections	1. Activate CINE. 2. To designate the starting point of the loop, roll the trackball to position the Frame Indicator on the CINE bar and then press the toggle key for **Edit Start**. The system places the left CINE marker at the position of the Frame Indicator. 3. To designate the ending point of the loop, roll the trackball to position the Frame Indicator on the CINE bar and then press the toggle key for **Edit End**. The system places the right CINE marker at the position of the Frame Indicator. 4. To view the edited loop, roll the trackball. 5. To reset the CINE markers, press the toggle key for **Edit Reset**.
Edit a loop with the trackball and **SET** key	1. Activate CINE. 2. Press **SET** to highlight the start mark and then roll the trackball to position the marker on the designated point. The system displays **Start Mark** on the trackball status bar. 3. Press **SET** to confirm the start mark. The system highlights the end mark and displays **End Mark** on the trackball status bar. 4. Roll the trackball to position the marker on the designated point and then press **SET**.

Dual CINE

While operating in 2D Dual-mode, the system divides the CINE memory buffer into two equal parts to provide image recording. During 2D Dual-mode, you can acquire two independent single 2D-mode images. The loops display simultaneously side-by-side. Each loop is also available for individual replay.

To	Do This
Activate the CINE buffer for the other dual image	▪ Press **DUAL**.
Activate identical CINE buffers for dual images	1. Press **FREEZE** to acquire a frozen 2D image. 2. Press **DUAL**. The system displays two identical images with the same CINE data.

Saving a CINE Image to File

Color and black and white CINE images can be saved and reviewed in the patient browser. You can save images in both AVI and TIFF formats and store images on external media or on the network (DICOM). Images stored on external media or the network are duplicated on the hard disk for data safety.

To save a CINE image to file:

- Press the documentation control (**PRINT/STORE1**, **PRINT/STORE2**, or **CLIP STORE**) on the control panel configured for saving files.

  The image is transferred to the Patient Browser for review and is stored in the location selected in system presets.

Printing a CINE Image

You can transfer a CINE image to a print device that is selected in system presets.

To print an image:

- Press the documentation control (**PRINT/STORE1**, **PRINT/STORE2**, or **CLIP STORE**) on the control panel configured for the print function.

  The system transfers the image to the print device.

Interacting with Other Functions

ECG Display and Trigger

During CINE review, a marker above an ECG trace indicates the segment of the heart cycle that corresponds to the currently displayed image.

To display the ECG Trigger with CINE Review:

1. Place the ECG trigger along the ECG trace on the real-time image.
2. After acquiring images, press the **FREEZE** key and then activate CINE Review by rolling the trackball.

   When the CINE memory is filled, the system freezes the image and the data is available for CINE Review. The system displays the CINE indicator.

CINE Review Post-Processing

You can apply the following post-processing functions to CINE data in either frame playback or motion playback. Post-processing is not available for images in temporary CINE storage.

Imaging Mode	Post-Processing Options
2D	Zoom
	Dynamic range
	Gray map
	Tint
	Flip U/D
	Flip L/R
	Measurements
	Annotations
	Pictograms
	DTCE (available only if DTCE is enabled before you activate CINE review)
Color	Zoom
	Color map
	Color invert
	Color display on/off
	Invert
	Velocity Tag
	Priority
	Measurements
	Annotations
	Pictograms
Doppler	Baseline shift
	Spectral dynamic range
	T/F Res
	Sweep
	Gray map
	Tint
	Angle correct
	Spectral invert
	Measurements
	Annotations
	Pictograms
M-Mode	Dynamic range
	Gray map
	Tint
	Sweep speed
	Measurements
	Annotations
	Pictograms

To apply post-processing to a CINE frame:

1. Activate CINE.
2. Press the toggle key for the post-processing function.

   Note: Selecting Full M or Full Doppler will clear the CINE buffer.
3. To exit CINE, press the **FREEZE** key on the control panel.

Image Magnification

Use the **DEPTH/ZOOM** control to magnify a single frame of data. You can also display images in CINE playback that were acquired while using the Zoom function, but the magnification cannot be reduced on those images.

A6 SieScape Imaging

SieScape Imaging

⚠ **WARNING:** To avoid technique-related artifacts and measurement inaccuracies, read this entire chapter before using the SieScape feature.

The SieScape Panoramic Imaging feature is a system option that allows the acquisition of two-dimensional ultrasound images with a composite, extended field of view.

Image creation begins with a standard field of view, which extends during steady, forward motion scanning. You can confine the created image within a single scan plane (for example, a transverse scan of the abdomen) or not confine the image to a single plane (for example, when following the path of a tortuous vessel).

Intended Use

SieScape imaging is intended for the following uses:

- Imaging any structure where a field of view larger than standard real-time imaging is required; for example, large organs, masses, and long lengths of a vessel.
- Depicting anatomic relationships over a larger area than that provided by standard 2D-mode imaging.

Transducer Compatibility

Any system-supported curved array or linear array transducer is compatible with SieScape imaging.

- Linear (preferred)
- Curved (not intended for performing tightly curved SieScape scans)

Supported Study Types

All study types on the ultrasound system are compatible with SieScape imaging.

SieScape Imaging — Process Overview

SieScape imaging includes three processes:

- **Setup.** Allows you to set the scanning parameters for the image you intend to capture.
- **Acquire.** Builds the composite image as you move the transducer.
- **Review.** Presents the frozen composite image for your review.

Creating a SieScape Image

This section describes how to create a SieScape image, using the processes for **Setup** and **Acquire**.

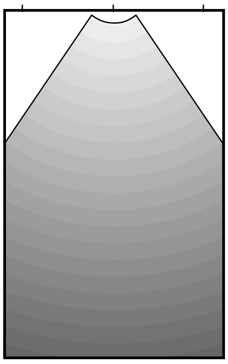
To enter Setup:

1. Press the **APPLICATIONS** key.
2. Press the toggle key for **SieScape** to activate the SieScape imaging feature.

   A ***bounding box*** displays on the 2D-mode image. This indicates the portion of the scanned image used to create the composite image.

   The system activates one focal zone and sets the persistence 2D-mode parameter selection to zero. You can adjust the position of the focal zone marker, however, you cannot adjust the number of focal zones or persistence setting during SieScape imaging.

   Note: Although you can adjust the position of the focal zone marker, the marker itself does not display on the SieScape image. It is recommended that you optimize the image prior to entering the SieScape Setup process.



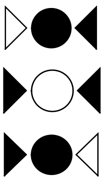
With curved array transducers, the bounding box is rectangular. With linear transducers, the bounding box should not exceed the lateral boundaries of the image. If necessary, decrease the image depth to increase the image size so the image fills the bounding box.

Image Acquisition

During the **Acquire** process, the system builds the composite image and indicates the status of your scan with a speed indicator and reference indicator.

Speed Indicator

The system displays the speed indicator during SieScape image acquisition. Optimal scanning speed is indicated when the circle is white. The two-stage shading of the indicator guides you toward optimal scanning speed.



Below optimum scan rate – increase scan speed slightly

Optimum scan rate

Above optimum scan rate, nearing "tear" speed – decrease scan speed slightly

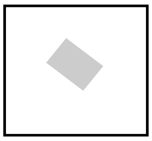
The **Speed Indicator** *shows, by shading, the speed of scanning. To capture a SieScape image, use a steady speed.*

Scanning too slow can create unwanted compounding effects from patient breathing or erratic hand motion.

Scanning too fast can cause the image to ***tear***, leaving small blank gaps in the image or jagged edges at the skin line and might cause the image to bend. Moving the transducer too fast can also distort the image geometry.

Reference Indicator

The ***reference indicator*** provides a "snapshot" of the entire SieScape image. Data displays in the reference indicator only during the SieScape **Acquire** process.

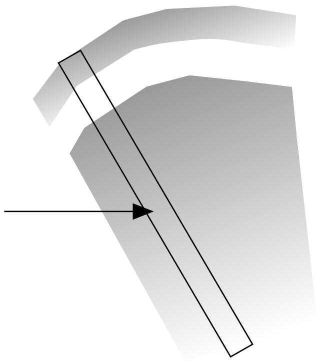


Example of a reference indicator.

To enter Acquire:

1. After entering SieScape **Setup**, press the **SET** key and then slowly and steadily scan in the desired direction.

   The system builds the composite image and indicates your scan speed with the speed indicator.

   To help guide the alignment of the scan, the system displays a graphic **ROI** *to indicate the boundary between the composite image and the real-time image.*

2. To stop image acquisition, press the **FREEZE** key.

   Note: When the memory buffer for the SieScape image is full, the system automatically stops image acquisition and freezes the image.

   The system enters SieScape **Review**.

3. To reactivate **Acquire**, press the **FREEZE** key.

Reviewing a SieScape Image

Use SieScape **Review** after completing the **Setup** and **Acquire** process.

During **Review**, the system displays a flexible ruler along the length of acquisition and lateral margins of the acquired image in 1 cm increments with a larger marker every 5 cm.

Use the system presets to enable the default display of the flexible ruler.

To enter Review:

1. After activating SieScape **Setup** and **Acquire**, press the **FREEZE** key.

   The system freezes the image and automatically scales the image according to the selection, such as **Best Fit** or **Full**, in the system presets.
2. Use the following procedures to size, rotate or "pan" a SieScape image.
3. To unfreeze the image and reactivate SieScape **Setup**, press the **FREEZE** key.

   Note: During **Review**, you can also press the toggle key for **Setup** to display the setup screen.
4. To activate standard 2D-mode imaging, press the **2D** control located on the control panel. Alternatively, press the **APPLICATIONS** key.

Sizing an Image

Use the SieScape selections **Best Fit** and **Full** to resize the image.

- **Best Fit** automatically scales the image to fit the image area.
- **Full** scales the image to its full acquisition size.

You can also incrementally scale the image between **Best Fit** and **Full**. The resize increments are not fixed values but are evenly spaced values based on the **Best Fit** size at the time. The **Best Fit** size is dictated by the selected rotation.

During image sizing, the system displays a status indicator at the bottom of the image screen. The status indicator represents the range of scale from **Best Fit** to **Full** and the currently selected image size.

To size an image:

- To restore a scaled image to the original display of the frozen image, press the toggle key for **Full**.
- To scale the image to fit the image area, press the toggle key for **Best Fit**.
- To incrementally decrease or increase the scale of an image, rotate the **DEPTH/ZOOM** control on the control panel.
- To toggle **Full** with **Best Fit**, press the **DEPTH/ZOOM** control.

Rotating an Image

Rotation is possible on frozen SieScape images but not on SieScape images in CINE.

To rotate an image:

Note: If **Best Fit** is selected, rotating the image causes the system to automatically change the SieScape image's size to fit the image area.

- Rotate the **ANGLE** control on the control panel to turn the image in a clockwise or counterclockwise direction.

Panning an Image

Use the trackball to "move" or "pan" an image that is larger than the display area of the screen. You cannot "pan" an image when **Best Fit** is selected.

To pan an image:

- Roll the trackball to move the image in a left/right and up/down direction. Alternatively, rotate the **DEPTH/ZOOM** key.

Reviewing CINE Images

A SieScape image is composed of hundreds of single frames. You can use the CINE function to recall single frames for review.

As with 2D-mode CINE, there is a finite CINE memory capacity. When a large SieScape image is acquired, the CINE frames may not be viewable from the beginning of the scan.

To review SieScape images during CINE:

1. During SieScape Review, press the toggle key for **Cine**.
2. Roll the trackball left or right to display a "thumbnail" of the selected frame from the composite image on the right side of the image screen with a standard 2D-mode frame on the left side.

   The center of the reference box on the composite image indicates the position of the displayed single frame from the composite image.
3. Press the toggle key for **Redisplay** to redisplay the image in the size and rotation selected prior to entering CINE.

Measuring a SieScape Image

⚠ **WARNING:** To ensure accuracy, measurements should only be made on SieScape images that are acquired in a single scan plane.

You can make general 2D-mode measurements on a frozen, full-sized or best fit, composite image.

See also: Measurements and Calculations, Chapter B1, Features and Applications Reference

To ensure accurate results, measurements should not be made:

- On images that do not follow a single plane (for example, when tracking a tortuous vessel). An out-of-plane image shows the contour pattern of the skin line and the appearance of internal structures.
- Across a large shadow in a SieScape image
- Across gaps in an image, such as those encountered with a tightly curved scan
- Across those areas of the image where the flexible ruler along the skin line is jagged as this indicates that the image in this area has disrupted, which causes inaccurate measurements
- On an image with a swirl at the bottom

Note: If the structure to be measured is contained within the boundary of a single, standard 2D-mode frame, measurements should be made on the corresponding frame retrieved from CINE and not on the SieScape image.

To activate the measurement function during SieScape imaging:

Note: The system presets option to automatically activate the measurement function with the **FREEZE** key is not available during SieScape imaging.

- When a SieScape image is frozen, press the **CALIPER** key on the control panel.

  The system activates the measurement function.

SieScape Imaging — Technique Hints

This section includes information on how to obtain optimum SieScape images.

Adequate Gel

Apply a generous amount of coupling agent (gel) along the entire area to be scanned to avoid disrupting the scan sweep. Insufficient gel causes the transducer to drag on the skin.

Preview Sweep

Before acquiring a SieScape image, perform preview sweep of the scan plane in standard 2D-mode.

The maximum length of the composite image that can be acquired depends on the depth selected. That is, you can acquire approximately 8-10 times the selected depth for length (for example, for a linear SieScape scan).

Focus

Note: Prior to activating SieScape imaging, adjust the position of the focal zone marker.

To minimize possible bending artifacts, position the single focal zone in the optimum position as follows:

- Linear arrays – lower half of image
- Curved arrays – upper half of image

Gain

While in **Setup**, ensure the gain is balanced throughout the image. Low gain in the far field decreases the amount of data needed to ensure a geometrically correct SieScape image and can create a bending artifact.

When in **Acquire**, the image acquisition parameters cannot be changed with the exception of DGC controls. These controls can be used as with standard 2D-mode scanning to increase or decrease the gain in the image as you scan across structures of different densities.

Transducer

To avoid excessive bending and to ensure a constant elevation position, hold the transducer so that your little finger is in contact with the skin alongside the transducer face. This acts as a guide to ensure that the transducer is parallel to and in full contact (perpendicular) with the skin surface.

Plane

To ensure that you are staying in plane or correctly following a vessel, watch the trailing edge of the real-time portion of the image, which is located in the ROI. The remainder of the real-time image should be used as a guide to correct your rotation, as necessary, while scanning forward.

Scan Area

Scanning over a long length of superficial bone (for example, in the lower leg), which occupies the full width of a single frame, creates shadowing. Therefore, there is not enough data in the lower half of the image, which can cause excessive bending of the SieScape image.

Speed and Depth

Optimum scanning speed depends on depth. The Speed Indicator is related to the depth setting and indicates the optimum scanning speed for the specific exam type and transducer.

An optimum scan is indicated when the gray outline of the SieScape image in the Reference Indicator is solid gray. If this bar appears broken, you may have scanned too fast.

Note: To obtain the optimum SieScape images, scan slowly. If you move off plane or off the required path, you can stop your forward scan motion and correct your orientation in the real-time portion of the image before continuing.

SieScape Imaging — Avoiding Technique-Related Artifacts

⚠ **WARNING:** Technique-related artifacts unique to SieScape imaging can occur. Before using the SieScape imaging feature, be sure to read and understand the following information.

Plane Change Indications

A single plane image has a relatively smooth skin line contour. If the scan is "off plane," or off the required path, stop the forward scan motion and correct the scan orientation in the real-time image before continuing.

The following appearances in the image indicate a change in the plane:

- The skin line contour has the appearance of a "waving flag" and appears to have folds or shows a jagged broken skin line.
- Abrupt changes in boundaries (for example, boundaries that do not align) generally indicate that the plane has changed.

  Note: As you scan, ensure that anatomy and structures display as contiguous on the image screen.

- A structure, which is visible in the real-time portion of the image, abruptly disappears at the composite boundary.

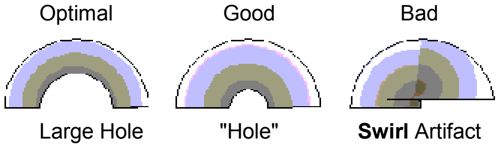
Artificial Compounding

Use a forward scanning motion to avoid an unwanted image-compounding effect, which appears as a brighter, distorted section of the SieScape image.

Swirl Artifact

Optimum SieScape imaging occurs when the scanned surface is flat or gently curved. If a tightly curved scan is performed, a ***swirl*** compounding artifact occurs where the image overlaps in depth. Therefore, when performing a tightly curved scan (for example, transverse slice through the calf), set the depth as shallow as possible.

The depth should be less than the radius of the target area being scanned. This leaves a blank "hole" in the image. If the depth is too deep, the bottom of the image appears swirled. Never use an image with a swirl at the bottom for measurements.



Example of curved SieScape images.

A7 *four*Sight 4D Imaging and 3-Scape Imaging

*four*Sight 4D Imaging and 3-Scape Imaging Overview

⚠ **WARNING:** To avoid technique-related artifacts, you must be thoroughly familiar with the techniques of 3D and 4D imaging. Read this entire chapter before using the 3-Scape real-time 3D imaging or *four*Sight 4D ultrasound imaging technology.

The 3-Scape imaging feature allows the acquisition of three-dimensional ultrasound images. The *four*Sight 4D imaging feature allows the acquisition and simultaneous viewing of three-dimensional ultrasound images in real-time. MultiPlanar Rendering (MPR) provides a view of each plane of the volume (acquisition, elevation, and coronal) as an arbitrary slice.

Ultrasound data based on three-dimensional imaging methods can facilitate the diagnostic process. Volumes can be viewed and the display can be manipulated to help differentiate anatomic structures (for example, by selecting an arbitrary slice, modifying volume rendering, or rotating and magnifying localized areas of interest).

3-Scape imaging is useful for maximizing resolution when you assess structure. *four*Sight 4D imaging is useful for assessing motion, such as fetal movement.

You can activate *four*Sight 4D imaging or 3-Scape imaging for study types or exam types if the active transducer supports the feature.

See also: Technical Description, Appendix A, Instructions for Use

Compatible Operating Modes

The *four*Sight 4D imaging and 3-Scape imaging features can be used with the following operating modes:

- 2D-mode
- 2D-mode with THI

*four*Sight 4D Imaging

Perform the following steps to complete and review a 4D imaging examination.

Setup

During setup, optimize the image and select settings for the volume acquisition.

- Prepare for volume acquisition by scanning and optimizing the image in 2D-mode. You can adjust the imaging parameters for the current transducer and exam type.
- After activating 4D imaging, you can define a 4D imaging region of interest (ROI) to limit acquisition to the data contained within the ROI. The system displays a volume of interest (VOI) with the ROI.
- Adjust the steering angle within the transducer's array with the following transducers:
  - EV9F3

Acquisition and View

During acquisition, the system simultaneously processes the volume data and displays a high-resolution volume, providing a real-time view of the three-dimensional image.

- You can view a single slice from a volume. The system simultaneously displays the orthogonal slices.
- To enhance visualization, you can use controls to emphasize or remove data within the volume data.

Review Stored Volumes

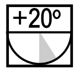
At any time during acquisition and viewing, you can pause volume acquisition to review the data sets stored in the CINE buffer.

Activating 4D Imaging Setup

To	Do This
Activate 4D imaging setup	1. Press **4D**. The system activates 4D setup. 2. To change from 4D setup to 3D setup, press the **3D/4D** soft key or press **3D** on the control panel.
Exit 4D imaging setup	▪ Press **4D**. Or, press **2D**.

Preparing for 4D Imaging Volume Acquisition

Optimize the 2D-mode image before beginning 4D imaging acquisition. Only the activated imaging parameters displayed as soft key selections are available during 4D acquisition.

To	Do This	Icon
Activate the display of the 4D imaging ROI	1. Press the toggle key for **ROI**. 2. Size and position the ROI.	---
Configure the sweep parameters	1. Press the toggle key for **Angle** to select the required angle. 2. Press the toggle key for **Quality** to select the required quality setting.	---
Adjust the steering angle of the EV9F3 transducer, if required	▪ Press the toggle key for **Steering Angle** to select the required steering angle. The system displays a symbol to indicate the steering angle (for non-zero values).	 *(Example)*

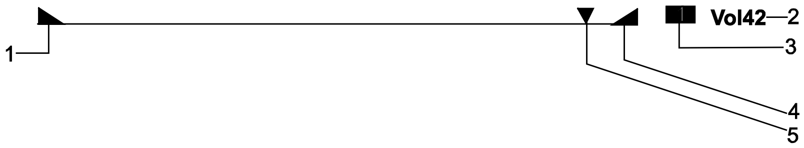
Acquiring Volumes

Each acquisition results in a rendered volume. The system displays one volume at a time and displays the acquisition rate in volumes per second (vps).

To	Do This
Begin acquisition	**Note:** Hold the transducer steady during acquisition. ▪ Press **UPDATE**. An audible tone indicates that volume acquisition has begun.
Temporarily pause and resume volume acquisition	▪ Press **FREEZE**.
End 4D acquisition	▪ Press **4D**.

Reviewing Volumes Stored in the CINE Buffer

When 4D imaging volume acquisition is paused, you can review the volumes stored in the CINE buffer. The system displays a 4D CINE bar at the bottom of the screen when acquisition is paused.



Example of 4D CINE bar.

1 ***Left CINE marker*** — Indicates the beginning of the CINE data.
2 ***Volume Counter*** — Indicates the number of the displayed volume.
3 ***Rate Indicator*** — Indicates the rate of CINE playback.
4 ***Right CINE marker*** — Indicates the end of the CINE data.
5 ***Volume Indicator*** — Indicates the location of the volume within the CINE data and the direction of review (backward or forward).

To	Do This
Display the CINE soft key selections	▪ Press **FREEZE**. **Note:** Press the toggle key for **4D Cine** if the CINE soft keys are not displayed.
Change the beginning or ending position on the 4D CINE bar (exclude volumes from review)	1. Position the CINE marker on the starting point or the ending point. 2. Press the toggle key for **Edit Start** or **Edit End**. 3. To reset the CINE markers, press the toggle key for **Edit Reset**.
Adjust the playback rate	▪ Press the toggle key for **Rate**.
Review volumes in the CINE buffer	▪ Rotate **SELECT**.
Play the CINE buffer when CINE soft key selections are not displayed	▪ Press the toggle key for **Play/Stop**.

3-Scape Imaging

Perform the following steps to complete and review a 3-Scape (3D) imaging examination.

Setup

During setup, optimize the image and select settings for the volume acquisition.

- Prepare for volume acquisition by scanning and optimizing the image in 2D-mode. You can adjust the imaging parameters for the current transducer and exam type.
- After activating 3D imaging, you can define a 3D imaging region of interest (ROI) to render the data within the volume of interest (VOI). The system displays the volume of interest (VOI) with the ROI.
- Select a method for the scan. You can obtain images using one of the following methods, depending on the selected transducer and exam type:
  - **Linear**: A horizontal or vertical sweep of the transducer.
  - **Rocked**: An angular scanning motion, during which the transducer face is used as a pivot (does not slide).
  - **Auto Sweep**: A mechanically-driven single-sweep acquisition across the area of interest. (available for 4D transducers)
- Configure the scan method. The system estimates the duration for the volume acquisition based on your selections and then displays a time gauge to help you maintain a steady scan speed.
- Adjust the steering angle within the transducer's array with the following transducers:
  - EV9F3

Acquisition

During acquisition, you scan while the system acquires volume data. When acquisition is complete, the system automatically processes the volume data and displays a high-resolution volume and MPRs.

- During freehand acquisition, scan in a single, continuous sweep, using careful scanning technique. The time gauge indicates the progress of the volume acquisition.
- You can choose the auto sweep method for automatic scanning motion generated by a compatible transducer.

View

After acquisition, you can view and manipulate the displayed volume and MPRs. For example, you can rotate or reposition the volume or MPRs, or emphasize or remove data within the volume and MPRs. You can also view a single slice from a volume; the system simultaneously displays the orthogonal slices.

Activating 3D Imaging Setup

To	Do This
Activate 3D imaging setup	1. Press **3D**. The system activates 3D setup. 2. To change from 3D setup to 4D setup, press the **3D/4D** soft key or press **4D** on the control panel.
Exit 3D imaging setup	▪ Press **3D**. Or, press **2D**.

Preparing for 3D Imaging Volume Acquisition

Optimize the 2D-mode image before beginning 3D imaging acquisition. Only the activated imaging parameters displayed as soft key selections are available during 3D/4D acquisition.

To	Do This	Icon
Activate the display of a 3D imaging ROI	1. Press **3D**. 2. Size and position the ROI. The system outlines the active ROI in green. The system also displays the VOI.	---
Configure the scan method	**Note:** The scan methods available depend on the current transducer. 1. Select the required scan method. 2. Select the required scan length or angle. 3. For the **Rocked** or **Linear** scan methods, select the required scan speed. 4. For the **Auto Sweep** method, select the required angle and quality setting. The system computes scan duration based on the selected scan length or angle, acquisition speed, and the current frame rate.	---
Adjust the steering angle of the EV9F3 transducer	▪ Select the required steering angle on the image menu. The system displays a symbol to indicate the steering angle (for non-zero values).	 *(Example)*

Acquiring a Volume

During 3D volume acquisition, the system updates the incremental data set or slice (acquired image) and the elapsed time on the time gauge. The incremental slice is the mid-plane perpendicular to the 2D scan plane. Use the incremental slice to assess imaging artifacts and the position within the selected scan angle. Use the time gauge to estimate an optimal scanning speed.

Note: During acquisition, the time gauge depicts the elapsed time, the scan length or angle, and the scan duration. (For the auto sweep method, only the angle is displayed.)

To	Do This
Begin acquisition	**Note:** When using the auto sweep scan method, hold the transducer in a fixed position while the transducer automatically scans the area of interest. For a rocked scan, use the transducer face as a pivot. ▪ Press **UPDATE**. An audible tone indicates that volume acquisition has begun. A second audible tone indicates that volume acquisition is complete.
Cancel the acquisition (for example, for an image artifact)	▪ Press **UPDATE**.
Complete acquisition before the scan duration on the time gauge elapses	▪ Press **FREEZE**. The system processes the acquired information into one or more data sets for the 3D imaging volume and then displays the volume.
Begin another volume acquisition without saving the displayed volume	1. Press **FREEZE**. 2. Press **UPDATE**.

Viewing Volumes and MPRs

The system automatically displays the volume and MPRs during 4D imaging volume acquisition, after 3D volume acquisition, or during review of retrieved volumes.

Note: Quadrant D contains the volume; Quadrants A, B, and C contain MPRs of the volume. Quadrant A is the acquisition plane, Quadrant B is the elevation plane, and Quadrant C is the coronal plane.

Note: Volumes per second (vps) is displayed only during 4D imaging acquisition.

The MPRs are oriented to the center of the volume; each slice is orthogonal to the other two slices. The reference point, represented by a dot within each quadrant, indicates the point of intersection of the MPRs.

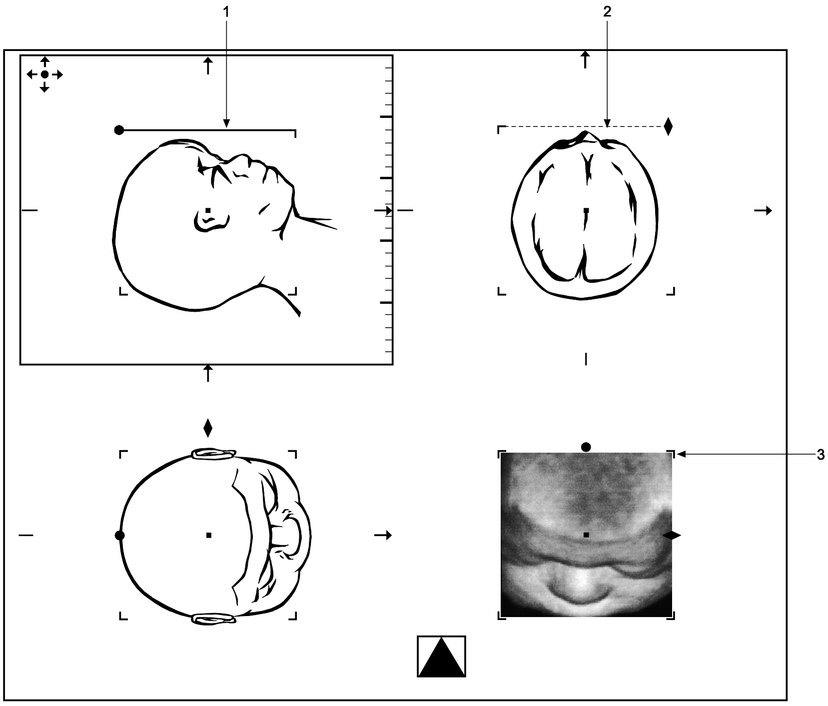
Changing the Quadrant Display

To	Do This
Select a quadrant	1. If necessary, press **SET** to assign trackball control to the pointer. 2. Position the pointer on the required quadrant and then press **SET**.
Cycle through quadrants	▪ Press the toggle key for **Quadrant**.
Display or hide the volume quadrant	▪ Press the toggle key for **Render** to display **MPR Only**.
Change the display format for the volume and MPRs (for example, 1:1 or 4:1)	Press the toggle key for **Format**. Or, press **UD 1**, **HD ZOOM**, or **DUAL**.
Magnify the volume and MPRs	1. Press **DEPTH/ZOOM** to activate the zoom function. 2. Rotate **DEPTH/ZOOM** to adjust the zoom factor. The system magnifies all MPRs and the volume to the same size.
Display or hide the wireframe, which indicates the boundaries of the volume	(Available only when the volume of interest is not displayed) ▪ Press the toggle key for **Wireframe**.

Defining Volume of Interest and View Planes

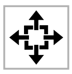
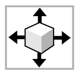
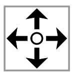
You can define the data to be displayed in the volume quadrant by enabling the VOI (volume of interest) and then resizing and repositioning the VOI in relation to the acquired volume data.

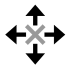
The system displays the VOI in the volume and the related view plane in each orthogonal MPR. The view plane is the side of the VOI represented by a solid or dotted line.



1 View plane for the selected quadrant
2 View plane for an unselected quadrant
3 VOI

Example of the VOI and view planes.

To	Do This	Icon
Display or hide the VOI	▪ Press the toggle key for **VOI**.	---
Change the size of the VOI	1. Select a quadrant. 2. If necessary, press **ESCAPE** to display the VOI icon. 3. Roll the trackball to adjust the VOI size.	
Reposition the image within the VOI	1. Select any quadrant. 2. If necessary, press **ESCAPE** to select the required panning icon (volume or MPR). The system displays the panning icon on the quadrant. 3. Roll the trackball to pan the image.	 **Pan** (volume)  **Pan** (MPR)

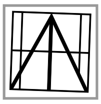
To	Do This	Icon
Curve the rendering view line of the VOI to exclude extraneous information	(Available only when an MPR is selected) 1. Press the toggle key for **VOI** to select **Curved**. 2. Roll the trackball to change the contours of the curve. 3. Press **ESCAPE** to select **Pan**. **Note:** To return to the flattened viewing line, press **ESCAPE** until the Curved VOI icon displays. Roll the trackball to flatten the view plane and then press **SET**.	 **Curved VOI**
Change the render direction of the VOI	1. Press the toggle key for **RenderDir**. 2. Select the required direction to start the rendering: – **Up/Down** — from the top – **Down/Up** — from the bottom – **Front/Back** — from the front – **Back/Front** — from the back – **Left/Right** — from the left – **Right/Left** — from the right	---

Changing the Appearance of Rendered Volumes

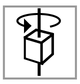
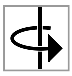
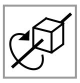
To	Do This
Adjust 2D-mode settings	1. Select the volume to change the settings for the volume. Or, select an MPR to change the settings for the MPRs. 2. Adjust the imaging settings.
Select a rendering method	▪ Press the toggle key for **Render**.

Changing the Orientation of Volumes and MPRs

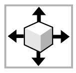
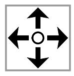
Rotating a volume or MPR along any of the three axes can help you visualize an anatomic structure. You can rotate a volume manually or automatically.



The reference orientation indicator at the lower-left of the volume quadrant uses color to indicate the relative location of the data acquired first (the blue portion) and the data acquired last (the red portion). The top (apex) of the pyramid represents the transducer. The base of the pyramid represents the data at the greatest depth.

Axis of rotation	Volume rotation icon	MPR rotation icon
X axis		
Y axis		
Z axis		

Note: The system displays a reverse symbol ("R") on the MPR quadrants that have a reversed orientation in relation to the original acquisition.

To	Do This	Control
Manually rotate the volume or an MPR using the trackball	1. Select a quadrant. 2. If necessary, press **ESCAPE** to display the **Pan** icon. 3. Press **UPDATE** to select the axis of rotation. 4. Roll the trackball to rotate the volume or MPR. The system displays the icon for the axis of rotation on the selected MPR or volume. When an MPR is selected, the system also displays a line indicating the axis of rotation on two of the corresponding MPRs.	---
Manually rotate the volume or an MPR using the control panel	▪ Rotate the required control: – **X** to rotate along the x axis – **Y** to rotate along the y axis – **Z** to rotate along the z axis The system displays the icon for the axis of rotation on the selected MPR. The system also displays a line indicating the axis of rotation on two of the corresponding MPRs.	---
Pan the volume or MPR	1. Select the required quadrant. 2. Roll the trackball to pan the volume or MPR. If VOI is enabled, the system pans the image. If VOI is disabled, the system pans the reference point.	 **Pan** (volume)  **Pan** (MPR)
Rotate the volume in 90° increments	▪ Press the toggle key for **Rotate**.	---
Enable automatic rotation of the volume	**Note:** You can change the automatic rotation settings while the volume is rotating. 1. Press the toggle key for **Animation**. 2. To change the rotation settings, press the toggle key for **Speed**, **Angle**, or **Axis**.	---
Restore the orientation from the original acquisition for all quadrants	1. Press the toggle key for **Reset**. 2. Press the toggle key for **Reset Ori.**	---
Restore the orientation and all imaging parameters from the original acquisition	1. Press the toggle key for **Reset**. 2. Select the toggle key for **Reset All**.	---
Reverse the render direction	1. Press the toggle key for **Reset**. 2. Press the toggle key for **Flip**.	---
Align the volume with the selected MPR	1. Select an MPR. 2. Press the toggle key for **Reset**. 3. Press the toggle key for **Sync**.	---

Changing the Plane Display in a Volume

The cut plane function helps you visualize the anatomy of interest, such as a lesion, that is not visible on the surface of a volume by controlling the amount of data displayed in the volume.

For example, if anatomy is visible in an MPR but is not visible in the volume, you can use the cut plane function to reveal the anatomy of interest in the volume.

Note: For an optimal view of the cut plane, you can rotate the volume or align the orientation of the volume with that of the selected MPR.

To control the plane display in the volume:

Note: You must disable **VOI** to control the plane display in the volume.

1. Press the toggle key for **CutPlane** to adjust the setting:
   - Select **A** to display the data in front of the cut plane.
   - Select **B** to display the data behind the cut plane.

   The system removes all mode-specific volume data beyond the cut plane. A line on the reference orientation indicator indicates the location of the cut plane.
2. To activate the slicing function, roll the trackball.

Displaying Parallel Slices with MultiSlice

You can view multiple parallel slices of a plane (A, B, or C) at the same time. MultiSlice enables you to view anatomy of interest in sequential order, similar to a CT or MRI scan. You can also use MultiSlice to view a 4D CINE sequence.

To	Do This
Activate or deactivate MultiSlice	1. Press **PAGE** to select the **Advanced** tab indicator. 2. Press the toggle key for **MultiSlice**.
Slice the volume vertically or horizontally in the selected MPR	▪ Press the toggle key for **Vertical** or **Horizontal** to select the axis. The volume quadrant displays a page of the slices. An asterisk indicates the center slice of the acquired volume.
View a slice in full screen format	▪ Press **SELECT**.
Display the next slice of the image	▪ Press the toggle key for **Next Image**.
Display the previous slice of the image	▪ Press the toggle key for **Prev Image**.
Display the next page of slices	▪ Press the toggle key for **Next Page**.
Display the previous page of slices	▪ Press the toggle key for **Prev Page**.
Change the division between pages	1. Select the quadrant. 2. Roll the trackball to scroll the images.
Adjust the distance between slices	▪ Press the toggle key for **Slice Spacing** to adjust the slice spacing setting.
Change the number of slices displayed on each page	▪ Press the toggle key for **Layout**.
Change the reference MPR (slice quadrant)	▪ Press the toggle key for **A**, **B**, or **C** to select the plane.

Improving Contrast with Thick Slice Imaging (TSI)

Thick Slice Imaging (TSI) allows you to adjust the thickness of an individual slice to improve contrast resolution in the following views:

- A thick slice image of the coronal plane (C plane) is displayed with the 2D acquisition plane (A plane) as the reference plane (**A/C** option).
- A thick slice image of the acquisition plane (A plane) is displayed with the 2D acquisition plane (A plane) as the reference plane (**A/A** option).

To	Do This
Activate or deactivate TSI	1. Press **PAGE** to select the **Advanced** tab indicator. 2. Press the toggle key for **TSI**.
Display a thick slice image of the C plane (with A plane as reference)	▪ Press the toggle key for **View** to select **A/C**.
Display a thick slice image of the A plane (with A plane as reference)	▪ Press the toggle key for **View** to select **A/A**.
Change the thickness of the TSI image	▪ Press the toggle key for **Slice Thickness** to adjust the slice thickness setting.
Rotate the reference line on the reference plane (A plane) around the z axis	**Note:** Not available for the **A/A** option. 1. Select the MPR quadrant. 2. Press **UPDATE** to activate the rotation function. 3. Roll the trackball to the required position. The TSI image in the volume quadrant corresponds to the location of the reference line.
Pan the reference line on the reference plane (A plane)	1. Select the MPR quadrant. 2. Press **UPDATE** to activate the panning function. 3. Roll the trackball to the required position and then press **SELECT**. The TSI image in the volume quadrant corresponds to the location of the reference line.
Zoom the reference plane (A plane)	1. Select the MPR quadrant. 2. Press **DEPTH/ZOOM** to activate the zoom function. 3. Rotate **DEPTH/ZOOM** to adjust the zoom factor.
Zoom the TSI image	1. Select the volume quadrant. 2. Press **DEPTH/ZOOM** to activate the zoom function. 3. Rotate **DEPTH/ZOOM** to adjust the zoom factor.

Straightening Curved Anatomy with Curved MPR

You can use curved MPR to straighten curved anatomy (such as a fetal spine) to facilitate evaluation.

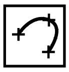
Curved MPR generates cross-sections along a centerline to show details of a curved structure and displays the result with the orthogonal reference image of the displayed volume.

Note: Take care in drawing and interpreting the curved MPR result. Structures outside the path may be distorted because the final image is straightened.

To activate Curved MPR:

1. Optimize the orientation and display the required portion of the curved anatomy in quadrant A.
2. Press **PAGE** to select the **Advanced** tab indicator.
3. Press the toggle key for **CurvedMPR**.
4. Press the toggle key to select the method for drawing the curve.

 **Line**

 **Spline**

 **Trace**

5. Select the displayed quadrant to activate the Curved MPR.

Note: To avoid misrepresenting and distorting anatomical structures and their relationships, ensure that the path you draw does not cross the same object more than once.

To	Do This
Define a line curve	1. Select the starting point and then position the cursor on the ending point. 2. Press **SET** to anchor the point and complete the line curve.
Define a spline or a trace curve	1. Select the starting point. 2. To set individual points along the curve, roll the trackball and then press **UPDATE** at intervals. 3. Press **SET** to anchor the last point and complete the curve. The volume quadrant displays the curved anatomy as straightened. The arrows indicate the direction that the curve was drawn. A red dot indicates the center of the drawn line.
Reposition the drawn MPR curve to another location on the image	1. To display the repositioning pointer, position the cursor over the center segment of the line. The system displays a hand cursor. 2. Drag the line to the required location. Or, press the arrow keys to reposition the line to the required location.

To	Do This
Rotate the MPR curve around the center point of the image	1. To display the rotation pointer, position the cursor over either endpoint of the line. 2. Drag the endpoint in the direction of the required rotation.
Magnify the curved MPR image	1. Select the curved MPR image. 2. Press **DEPTH/ZOOM** to activate the zoom function. 3. Rotate **DEPTH/ZOOM** to adjust the zoom factor.
Rotate the curved MPR image around the z axis	1. Select the curved MPR image. 2. Rotate **Z**. Or, press **UPDATE** and then roll the trackball.
Exit Curved MPR	▪ Press the toggle key for **Back**.

Removing Data from a Volume

You can remove data from a volume to clarify anatomical structures.

Note: Rotating the volume can help to determine the type of edit required.

To	Do This
Display the editing tools	▪ Press the toggle key for **Editing**.
Remove data from inside or outside a polygon	**Note:** You can perform multiple polygon edits. 1. Press the toggle key for **Polygon**. The system constrains the cursor to the selected quadrant. 2. Position the cursor at the starting point and then press **SET** to anchor the first point. Or, press **UPDATE**. 3. For each segment of the polygon trace, position the cursor at the end point and then press **UPDATE** to anchor the end point. The system uses the end point of the segment as the starting point for the next segment. 4. Press **SET** to complete the polygon trace. Or, position the current segment over an existing segment and press **UPDATE** to complete the trace. 5. Position the cursor where data will be removed (inside or outside the polygon) and then press **SET**.
Remove data between parallel planes	**Note:** This edit is not available when **VOI** is enabled. **Note:** You can simultaneously perform multiple parallel cut edits. 1. Press the toggle key for **Parallel Cut**. The system displays the wireframe and highlights the active plane. 2. For each plane to be used in the edit, position the plane and then press **UPDATE** to anchor the plane position and select the next plane. 3. Press **SET** to complete the edit.

To	Do This
Remove data inside a niche (cube shape)	**Note:** This edit is not available when **VOI** is enabled. **Note:** You can perform one niche edit at a time. 1. Rotate the volume until the area that requires editing is in front. 2. Press the toggle key for **Niche**. The system displays a cube outlined in green at the front corner of the volume. The cube represents the niche edit. 3. To simultaneously adjust the size of all planes of the cube, roll the trackball. 4. To resize one plane of the cube, press **UPDATE**. 5. Press **SET** to complete the edit.
Remove data inside or outside a trace	**Note:** You can perform multiple trace edits. 1. Press the toggle key for **Trace**. The system constrains the cursor to the selected quadrant. 2. Position the cursor at the starting point, and then press **SET** or **UPDATE** to anchor the first point. 3. Roll the trackball to trace the area of interest. 4. Press **SET** to anchor the end point and complete the trace. 5. Position the cursor where data will be removed (inside or outside the traced shape) and then press **SET**.
Erase data in a volume or slice	**Note:** When you complete the edit, the system updates the other quadrants. 1. Press the toggle key for **Small Eraser** or **Large Eraser**. The system displays a circle-shaped cursor on the most recently selected quadrant. 2. Position the cursor at the starting point for the edit and then press **SET** to begin the edit. Or, press **UPDATE**. 3. Roll the trackball to erase data. 4. Press **SET** to complete the edit.
Complete the current edit	Choose a method: ▪ Select a different quadrant. ▪ Magnify the selected quadrant. ▪ Change the orientation of the selected quadrant.
Cancel the most recent segment of the current edit (such as an eraser edit)	▪ Press the toggle key for **Undo Last Edit**.
Cancel all completed edits	**Note:** VOI edits cannot be canceled. ▪ Press the toggle key for **Undo All Edits**.

Creating SubPresets

User-defined SubPresets are an optimized configuration of imaging parameters for use during 3D or 4D imaging.

To	Do This
Create a SubPreset	1. Adjust the settings to apply to the SubPreset. 2. Press **PAGE** to select the **SubPreset** tab indicator. 3. Press the toggle key for **Define**. The system displays a SubPresets dialog box. 4. Select **New**. 5. Enter a SubPreset name. 6. To enable the new SubPreset as the default exam type for subsequent patient studies, select the check box for **Set as default**. The system displays an asterisk next to the SubPreset name. 7. Click **OK**.
Save a SubPreset	▪ Click **Apply**. The system displays the name of the SubPreset as a soft key selection.
Define a SubPreset as a default	1. Press the toggle key for **Define**. 2. Select a SubPreset. 3. Click **Default**. The system displays an asterisk next to the SubPreset name.
Rename a SubPreset	1. Press the toggle key for **Define**. 2. Click **Rename**. 3. Enter a new name for the SubPreset and then click **OK**.
Overwrite a SubPreset	1. Press the toggle key for **Define**. 2. Select a SubPreset and then click **Overwrite**. The system displays a confirmation dialog box. 3. Click **OK**.
Delete a SubPreset	1. Press the toggle key for **Define**. 2. Select a SubPreset and then click **Delete**. **Note:** You cannot delete system-defined SubPresets.

Making Measurements

Note: Measuring in free hand 3D is not available.

Note: Siemens recommends not measuring across MPR quadrants. Instead, perform each measurement in an individual MPR quadrant.

To make a measurement on a quadrant:

1. While viewing the acquired volume, make any necessary changes to the MPR orientation and imaging parameters to optimize the area of interest.
2. Press **CALIPER**.

   The system displays basic measurement tools.
3. Select the required measurement tool and make the measurement.
4. To save a record of the measurement, press the key assigned to the store function.
5. To exit the measurement function, press **ESCAPE** or **2D**.

Storing and Printing Volumes and Images

Images are stored as single-frame images in screen capture format on the system's hard disk. The images are stored within the series object that contains the volume. Series objects are accessible from the patient browser.

Note: An image of the volume can be printed. The volume itself (all of its multiple frames) cannot be printed.

Use the patient browser to transfer volumes (and their representative images) to connected devices that support multi-frame images. Volumes are multi-frame images.

To	Do This
Store a volume	1. For a 4D imaging volume, press **FREEZE.** 2. Press the key assigned to the clip store function. The system displays a dialog box. 3. For 4D imaging volumes, select **4D Single volume**. 4. Click **OK**.
Store a sequence of 4D imaging volumes	**Note:** A sequence of volumes consists of all 4D imaging volumes in the CINE buffer and the beginning and ending CINE markers. 1. Press **FREEZE** to pause acquisition. 2. Press the key assigned to the clip store function. The system displays a dialog box. 3. Select **4D Cine**. 4. Click **OK**.
Store or print an image	**Note:** The volume is not automatically stored when you store or print an image. If you plan to retrieve the volume after the examination ends, store the volume. 1. For a 4D imaging volume, roll the trackball to display the volume. 2. Press the key assigned to the store or print function.

Storing Volumes as Clips

You can convert a volume to a DICOM multi-frame clip (.avi) and store clips of the currently displayed volume(s) during continuous review of acquired volumes or during automatic rotation.

To	Do This
Store volumes in the CINE buffer	1. Press **FREEZE** to pause acquisition. 2. Press the toggle key for **Play/Stop** or roll the trackball quickly to continuously review the volumes. 3. Press **CLIP STORE**.
Store a 3D imaging clip of the volume during automatic rotation	1. Press the toggle key for **Animation**. 2. Select the animation settings. 3. Press the toggle key for **Animation** to select **On**. 4. Press **CLIP STORE**.

Retrieving Stored Volumes

When you load the study (or series object) containing the volume(s) from previous examination(s), the system initially displays all images. You can then select an image that is associated with a stored volume to retrieve and view the volume. Images associated with volumes contain a cube graphic.

Note: The patient browser includes a representative image (stored as a bookmark) for each stored volume.

To	Do This
Load images from a previous examination	1. Press **Patient Browser** or **REVIEW**. 2. Select the study folder (or series object) that contains the volume(s). 3. Select **Image Screen**. The system displays the review screen with images stored in the selected study folder or series object.
Retrieve volume(s) associated with an image in the review screen	1. Select a single image with a cube graphic from the review screen. **Note:** If the image selected was a bookmark, the system displays the volume(s) using the settings (except edits) that were applied when the bookmark was stored. 2. Click the cube graphic.

Saving Settings for Later Patient Examinations

You can save 3D imaging and 4D imaging settings for display of acquired volumes and retrieve them for later studies or examinations. To save these settings, create a SubPreset. The SubPreset saves the following information:

- Rendering method
- The active quadrant
- The display format (such as **1:1**)
- Animation settings
- The following settings, as applied to the volume:

2D-mode Parameters
Cut Plane
Map
Tint
DR
Low Th
Opacity
Brightness
Contrast

*four*Sight 4D Imaging and 3-Scape Imaging Techniques

Adequate Gel

Apply a generous amount of coupling agent (gel) along the entire area to be scanned to avoid disrupting the scan sweep. Insufficient gel causes the transducer to drag on the skin during a linear scan.

Preview Sweep

Before volume acquisition, perform a preview scan of the anatomy in standard 2D-mode. To be sure you acquire a complete structure of interest, include some of the surroundings in the 2D-mode image.

Scan Speed (for 3D imaging methods other than Auto Sweep)

Scan at a constant rate. An irregular movement pattern may result in motion artifacts or distortions of the 3D image.

Transducer (Linear and Rocked Scan Methods)

To ensure a constant elevation position during a linear scan, hold the transducer so that your little finger is in contact with the skin alongside the transducer face. This acts as a guide to ensure that the transducer is parallel to and in full contact (perpendicular) with the skin surface.

For a rocked scan, ensure a steady, even scan motion.

A8 Reserved for Future Use

A9 Stress Echo

About the Stress Echo Feature

Note: Siemens recommends that you become familiar with stress echo examinations before attempting to acquire stress echo loops. Refer to the American Society of Echocardiography (ASE) protocol in the following publication: Schiller NB, Shah PM, Crawford M, et al. "Recommendations for Quantification of the Left Ventricle by Two-Dimensional Echocardiography." *Journal of the American Society of Echocardiography* 2(5):364, 1989.

Use the Stress Echo feature to capture and review cardiac loops for multiple-phase (multiple-stage) stress echo protocols. This feature provides tools for ECG-triggered acquisition, display, selection, comparison, evaluation, and archiving of multiple cardiac loops during various stages of the stress echo patient examination.

Capturing Stress Echo Data

You can capture either the systolic segment of the heart cycle or the full heart cycle (systolic and diastolic segments). A loop is a clip that displays motion from beginning systole to end systole (end diastole to end systole) or R-wave to R-wave, as indicated by the R-wave of the ECG trace and determined by the configuration settings for stress echo.

Note: To acquire stress echo loops that are based on the systolic cycle, enable ECG in the exam presets. If ECG is not enabled, the system acquires one-second clips. If ECG is not enabled for continuous stages, the system defaults to time capture.

The loops in a protocol are acquired by stages (phases), according to the stage configuration (continuous or non-continuous). You can acquire both non-continuous and continuous loops during the stress echo exam. When you complete acquistion for each stage, the system advances to the next stage. The system retains depth and gain settings across stages. The system also retains the region of interest (ROI) position across non-continuous stages. 2D settings, such as DR, Tint, and ROI position, are retained for each view in all stages.

Use the Stress Echo configuration dialog box to set up each stage in a protocol.

Stress Echo

Stress Echo Stages	Description
Non-continuous	Stages are limited to a maximum number of loops-per-view. You must assign a view label before acquiring the loops. Acquisition can be retrospective (you complete the capture and the system saves the previously acquired images) or prospective (you initiate the capture and the system starts saving newly acquired images). When you complete acquisition for a stage, the system displays the views for the stage. If automatic review is configured for a non-continuous stage, the system automatically transitions to review after acquiring clips for the current view. You can accept or reject the acquired clips and then resume acquiring clips.
Continuous	Stages are limited by time and acquisition is always prospective. You can acquire views in any sequence and length within the two-minute maximum. You assign view labels to the loops after acquisition is complete. **Note:** For continuous stage loops, you must assign view labels to the loops to use the wall motion scoring and left ventricle measurement functions. The system has default protocols containing continuous stages (continuous capture phases).

Activating and Exiting Stress Echo

Note: Stress Echo is available only with Cardiac and Ped Echo exams.

To	Do This
Activate Stress Echo	1. Press **APPLICATIONS**. 2. Press the toggle key for **Stress Echo**.
Exit Stress Echo	▪ Click **Exit**. The system prompts you to save changes to the stress echo exam. The system removes the display of the stress echo screen, but the patient examination remains active.
Exit Stress Echo without saving clips	▪ Click the "X" on the screen and then click **No** when prompted to save changes.

Acquiring a Loop

To	Do This
Begin a stress echo examination and select a protocol	Use the Stress Echo **Maintenance** dialog box to select the size of the region of interest (ROI) to use during the exam. **Stress Echo > Acquire Mode** 1. Activate Stress Echo. The system displays the **Select Protocol to load** dialog box. 2. Select a protocol and then click **OK**. 3. If the ROI is **Fixed ROI**, press **CLIP STORE** to begin image acquisition. 4. If the ROI is **Manual ROI**: a. Press **SET** and then roll the trackball to size and position the ROI. b. Press **CLIP STORE**.
Begin acquiring images for the selected continuous stage	▪ Press **CLIP STORE**. The system displays the percentage of allocated memory used for the selected stage. All views for the stage must be acquired within the allocated memory.
Adjust the ROI position during acquisition when **Manual ROI** is selected for non-continuous stages **Note:** You cannot adjust the ROI size during acquisition.	1. Press **SELECT** and then roll the trackball to place the ROI in the required position. 2. Press **SELECT**.

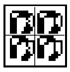
To	Do This
Adjust image settings during acquisition	▪ Press the toggle keys for the required soft keys, such as **DR**. The system applies the settings for each view in all stages.
To cancel and restart acquisition for the selected view in a non-continuous stage	1. Select a view. 2. Press **CLIP STORE**.
Select a specific view for image acquisition or reacquisition in a non-continuous stage **Note:** You can reacquire views until their stage is complete.	▪ Rotate **SELECT** to highlight a selection and then press **SET**.
Select another stage	▪ Rotate **SELECT** to highlight a selection and then press **SET**. ▪ Select the stage from the image menu.
Select another view in the current continuous stage	(Available only when **Show View control** is enabled in the Stress Echo **Maintenance** dialog box) **Stress Echo > Show View control** 1. Rotate **SELECT** to highlight a view and then press **SET**. 2. Press **CLIP STORE**. The system begins acquiring clips for the selected view. The system does not overwrite previously acquired clips.
Select another continuous stage	▪ Select the stage from the on-screen menu.
Suspend stress echo acquisition for use of another application	1. Click **Pause** on the on-screen menu. **Note:** For continuous stages, you can only pause between stages. The system displays a pause icon on the review image screen.  *Stress Echo pause icon* 2. To suspend stress acquisition during review, click **Pause** on the review screen. 3. To use another application, press the required control. 4. To reactivate the suspended stress echo acquisition, click the pause icon on the review image. Or, press the toggle key for **Stress Echo**.

<table>
<tr><th>To</th><th>Do This</th></tr>
<tr><td>Temporarily suspend stress echo acquisition to use another imaging mode</td><td>1. Press the required control (such as 2D or D).
Note: You can access only limited functions while Stress Echo is temporarily suspended. Disabled soft key selections are dimmed. The following control panel and keyboard keys are also disabled when Stress Echo is suspended.
<table>
<tr><th>Keyboard keys</th><th>Control Panel keys</th></tr>
<tr><td>▪ Patient Data</td><td>▪ NEW PATIENT</td></tr>
<tr><td>▪ Patient Browser</td><td>▪ REVIEW</td></tr>
<tr><td>▪ Presets</td><td>▪ DUAL</td></tr>
<tr><td>▪ Biopsy</td><td>▪ 3D/4D</td></tr>
<tr><td>▪ Exam/QuickSet</td><td>▪ User-defined key</td></tr>
<tr><td>▪ NEW</td><td></td></tr>
</table>
2. To reactivate the suspended Stress Echo acquisition, press APPLICATIONS.</td></tr>
<tr><td>Review loops before ending acquisition</td><td>1. Press REVIEW.
During acquistion of a continuous stage, the system stops the image acquistion and saves the acquired images in a buffer (indicated by the percentage displayed below the selected stage) and then displays the Stress Echo review screen.
2. Review the loops.
3. To continue acquisition, press REVIEW. Or, click Acquire Mode.</td></tr>
<tr><td>End acquisition and review the acquired images</td><td>▪ Select STOP.
The system displays the Stress Echo review screen.</td></tr>
<tr><td>Save acquired images for the selected view in a non-continuous stage</td><td>▪ Press CLIP STORE.</td></tr>
<tr><td>Pause continuous acquisition</td><td>▪ Press CLIP STORE.
The system replaces the percentage indicator with a continuous label.
▪ To resume continuous capture, press CLIP STORE again.</td></tr>
</table>

Reviewing Stress Echo Data

Stress echo data includes stress echo loops, wall motion scores, and left ventricle (LV) volume measurements, and patient information pertaining to the stress echo examination.

To	Do This	Button	Tool Tip
Activate review during acquisition	**Note:** Reviewing stress echo data during continuous acquisition stops the acquisition. 1. Press **REVIEW**. The system displays the review screen with **Select Mode** enabled. For non-continuous stages, the system displays the default loop selection for each view. 2. To resume acquisition, press **REVIEW**. Or, click **Acquire Mode** on the toolbar.	 	**Review Mode** **Acquire Mode**
Complete acquisition and review stress echo data during the patient examination	▪ Select **STOP**. The system displays the stress echo screen with **Select Mode** enabled.	---	---

To	Do This	Button	Tool Tip
Review loops automatically after completing non-continuous acquisition for a view	**Note:** Automatic review must be enabled for the stage in the **Protocol Editor** dialog box. 1. Complete acquisition for the current view. The system automatically displays the acquired loops on the stress echo review screen. 2. To accept the selected loop as the preferred loop, choose a method: – Press **CLIP STORE**. – Press **SELECT**. – Click **Accept**. **Note:** To accept a different loop as the preferred loop, click the loop and then use one of the methods listed. The system activates acquisition for the next view in the stage. 3. To reject the loop, click **Reject**. Or, press the toggle key for **Reject**. The system reactivates acquisition for the current view.	---	---
Review previously saved stress echo data	**Note:** Saved stress echo data cannot be retrieved directly from external media. To review the data, copy the study to the system's hard disk. 1. Access the review screen: a. If the exam is still active, press **REVIEW**. b. If the exam is not active, select the study from the Patient Browser and load images to the review screen. The stress echo exam displays as a single image with a stress echo icon located on the image. 2. To select the stress echo exam, click the stress echo icon on the review image screen. The system enables review and displays the previously selected preferred loop for each view. For non-continuous stages, if you did not select a preferred loop for a view, the system displays the default loop selection. For continuous stages, the system does not designate default loop selections.	 *Stress Echo icon*	---

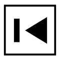
Selecting Preferred Stress Echo Loops

In Select Mode, you can select the representative loop (preferred loop) for each view. If you activate review without first selecting preferred loops, the system uses the default loop selection to represent each view (for non-continuous stages). The default loop selection is the loop acquired immediately before the last loop. For example, if four loops are acquired for every view, then the default loop selection is the third loop.

Loops for views in non-continuous stages are labeled with the view name at acquisition. Loops for views in continuous stages are labeled with the view name when you select the preferred loop. Each loop is identified by sequence identifier number (loop ID) to indicate the sequence of loop acquisition within the view.

Use the stress echo presets to enable the display of sequence identifier numbers.

Stress Echo > Overlay

To	Do This	Button	Tool Tip
Activate Select Mode from the stress echo screen	▪ Click **Select Mode** on the toolbar. The system displays the acquired loops for the first view in the protocol (for non-continuous stages). If the first stage is continuous, then the system displays the first set of acquired loops for that stage.		**Select Mode**
Display another loop in the current view	▪ Rotate **SELECT** and then press **SET**. Or, click the required button: **Home** — Displays the first loop. **To Left** — Displays the previous loop. **To Right** — Displays the next loop. **End** — Displays the last loop. **Note:** For a continuous stage, **Home**, **To Left**, **To Right**, and **End** display loops saved for the stage (not the view).	   	**Home** **To Left** **To Right** **End**
Display another stage and the corresponding views	▪ Click **Scroll Up** or **Scroll Down** to displays loops in the next or previous view for non-continuous stages. **Note:** For a continuous stage, click these buttons to display the preferred loop for the view. If you have not designated a preferred loop, then the buttons do not have any effect.	 	**Scroll Up** **Scroll Down**
Designate preferred loops	1. Roll the trackball to the loop and then press **SET**. The system highlights the preferred loop. 2. To select a secondary preferred loop, select another loop. The system highlights the loop in a darker color. 3. Continue designating the preferred loop for each displayed view until all views are completed.	---	---

Displaying and Comparing Loops During Stress Echo Review and Wall Motion Scoring

To	Do This	Button	Tool Tip
Display views for comparison	▪ Activate **Review** or **Wall Motion Scoring**.	 	**Review Mode** **Wall Motion Scoring**
Select a stage or view	▪ Select the gray check box next to each required stage or view.	---	---
Exclude a stage or view	▪ Select the blue check box next to each required stage or view.	---	---
Display selected stages and selected views side-by-side	1. Select the stages and views. 2. Click **Display Selected Loops**.		**Display Selected Loops**
Display all the views for a stage or display all the stages for a view	1. Click **Shuffle Mode**. 2. Select the label of the stage or view (for example, **Rest** or **PLAX**). The system displays all loops that represent the selected stage or view. If fewer than four phases exist, then the system also displays phases for the next view. 3. To exit Shuffle Mode, click **Select Mode**.		**Shuffle Mode**
Display a loop in full-screen format	▪ Select the loop and then press **SELECT**.	---	---
Restore a full-screen loop to the default size	▪ Select the loop and then press **SELECT**.	---	---
Cycle through acquired loops in forward or reverse sequence	▪ Click the upper-right of the page forward/backward icon in the image area to cycle forward through the acquired loops. Click the lower-left of the page forward/backward icon to cycle back through the loops. Or, rotate **SELECT**. The system displays the current loop ID and the total number of acquired loops below the icon.		---

Playing Back Loops

To	Do This	Button	Tool Tip
Play back displayed loops in the forward direction from beginning systole to end systole	▪ Click **Toggle Play** on the toolbar. When the last frame is played, the system restarts playback from the first frame.		**Toggle Play**
Play back the displayed loops in both directions	▪ Click **Sweeping play** on the toolbar. The system plays the displayed loops in the forward direction, from beginning systole to end systole. When the last frame is played, the system reverses the playback direction, from end systole to beginning systole.		**Sweeping play**
Change the playback speed	▪ Click **Decrease Speed** or **Increase Speed** on the toolbar.		**Decrease Speed** **Increase Speed**
Display a specific frame	▪ Click the required button on the toolbar: – **Start of sequence** — Displays the first frame of each loop. – **Step backward** — Displays the previous frame of each loop. – **Step forward** — Displays the next frame of each loop. – **End of sequence** — Displays the last frame of each loop.		**Start of sequence** **Step backward** **Step forward** **End of sequence**
Stop playback	▪ Click **Toggle Play** on the toolbar.		**Toggle Play**

Enabling Loop Overlays

Use the stress echo maintenance dialog box to configure identifying information.

Stress Echo > Overlay

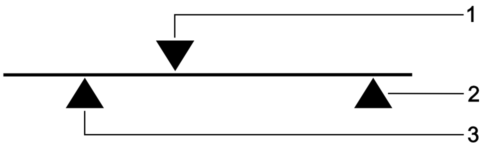
To	Do This	Button	Tool Tip
Enable loop overlays	▪ Click **Labels on/off**. The system overlays the displayed loops with identifying information, such as the related stage and view.		**Labels on/off**
To disable label display	▪ Click **Labels on/off** again.	---	---

Excluding Frames from Review

You can exclude frames from review by selecting loop segments for display or by repositioning the review markers on the clip bar. You can reposition review markers for one loop or for all loops.

Use the system presets or the Stress Echo **Maintenance** dialog box to display the frame slider.

Stress Echo > Frame Slider

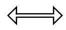


Example of frame slider.

1 **Frame indicator** — Indicates the location of the displayed frame within the loop.

2 **Right review marker** — Indicates the ending of the loop.

3 **Left review marker** — Indicates the beginning of the loop.

To	Do This	Cursor
Select a loop segment for display	▪ Select the required segment from the loop segment drop-down list.	---
Reposition a review marker for a single loop	**Note:** The frame slider must be displayed for this procedure. 1. Select **User-defined** from the loop segment drop-down list. 2. Select a loop. 3. Position the cursor on the review marker until it changes to the marker selection pointer and then press **SET**. 4. When the repositioning pointer displays, roll the trackball to position the selected marker and then press **SET**.	 *Marker selection pointer*  *Repositioning pointer*
Reposition the review markers for all loops	1. Select **Fixed range** from the loop segment drop-down list. The system displays a set of buttons (**–** and **+**) and a counter with the frame number for each review marker. 2. To reposition the left review marker, click the left-most **–** or **+**. 3. To reposition the right review marker, click the right-most **–** or **+**.	---

Saving Stress Echo Data

To	Do This	Button	Tool Tip
Save all acquired loops	▪ Click **Save Examination**.		**Save Examination**
Save only preferred loops	**Note:** You must select preferred loops for the continuous stages before using this save method. ▪ Click **Save Examination (only selected loops)**. For non-continuous loops, the system saves the selected preferred loops. If you have not selected any loops, the system saves all loops for that view. For continuous loops, the system saves only the selected preferred loops.		**Save Examination (only selected loops)**

Data Quantification and Reports

The Stress Echo feature has the following reports:

- The **WMS-Report** lists user-assigned wall motion scores and associated data.
- The **LV-Report** displays user-created traces and associated calculations for the left ventricle volume.

Entering Indications or Comments for the Reports

To	Do This	Button	Tool Tip
Enter an indication	1. Click **Indication**. 2. If required, enter the reviewer's name in the **Interpreter** text box or select a name from the **Interpreter** drop-down list. 3. To enter a predefined term: a. Click **Insert text** to display the **Select text to insert** dialog box. b. Select a predefined term from the list. c. If required, change the settings (such as position and placement on a separate line). d. Click **OK** to close the **Select text to insert** dialog box. 4. To enter text directly into the **Indication** dialog box, type the text and then click **OK**.		**Indication**
Enter a comment for inclusion in the WMS-Report or LV-Report	1. Click **Wall Motion Scoring Mode** or **LV Mode** on the toolbar. 2. Click **Edit WMS Comment** and then enter the required text. 3. Enter the text for the comment and then click **OK**.	  	**Wall Motion Scoring** **LV Mode** **Edit Comment**

Modifying Lists of Predefined Terms

The system maintains a list of predefined terms for the following items:

- Indications
- WMS (wall motion scoring) comments
- LV (left ventricle) comments

To	Do This
Display a list of predefined terms	▪ For indications, click **Indication** and then click **Insert text**. The system displays the **Select text to insert** dialog box.
Edit a term	1. Select the predefined term in the **Select text to insert** dialog box. 2. Click **Edit**. 3. Modify the term as required and then click **OK**.
Enter a new term	1. Click **New** in the **Select text to insert** dialog box. 2. Enter the new predefined term and then click **OK**.
Delete a term	1. Select the required term in the **Select text to insert** dialog box. 2. Click **Delete** and then confirm the deletion.
Remove all user-defined modifications and restore all terms to the factory default list	▪ Click **Defaults** and then click **OK**.

Assigning Wall Motion Scores

Note: Wall Motion Scoring selections are not available for views with user-defined names.

You can assign wall motion scores (WMS) to specific segments within each view (representative loop). You can also assign a normal wall motion score to the currently selected view or to all displayed views.

To	Do This	Button	Tool Tip
Activate Wall Motion Scoring	▪ Click **Wall Motion Scoring Mode**.		**Wall Motion Scoring**
Assign individual scores to each wall motion segment	1. Select a number. 2. Select the required portion of the WMS graphic that corresponds to the selected loop.	---	---
Assign a normal wall motion score to all currently displayed loops	▪ Click **All Visible Loops Normal**.		**All Visible Loops Normal**
Assign a normal wall motion score to all currently selected loops	▪ Click **Selected Loop Normal**.		**Selected Loop Normal**

Measuring LV Volume

You can create a trace to measure the volume of the left ventricle (LV) when the stress echo exam includes the A4C and the A2C views.

To	Do This	Button	Tool Tip
Activate LV mode	▪ Click **LV Mode**. The system displays the **Diastole** and **Systole** from the first views of the first stage.		**LV Mode**
Measure LV volume	1. Select the required stage and view. 2. For each frame, create a trace of the structure: a. Roll the trackball to position the measurement marker on the required segment (for example, the basal inferior segment for the **2Ch** view) and then press **SET**. b. Roll the trackball to create a trace of the structure. c. To anchor the marker as an end point for the current segment of the trace, press **SET**. d. To complete the trace, double-click **SET**. e. Roll the trackball to position the center line of the trace and then press **SET**. The system updates the values for the current volume, diameter, and length for the selected frame (**Diastole** or **Systole**) and shades the segment of the frame that represents the volume. **Note:** The system calculates biplane measurements when you measure LV volume for both 4-chamber and 2-chamber views and the length difference does not exceed 20 percent.	---	---
Adjust a segment of an LV volume trace	1. Roll the trackball to position the marker on a segment of the trace. The system highlights selected segment in yellow. 2. Press **SET** to activate the trace segment or point. 3. Roll the trackball to adjust the trace segment or point and then press **SET**.	---	---
Adjust the center line measurement of an LV volume trace	1. Roll the trackball to the line representing the center line. 2. Press **SET** to activate the center line. 3. Roll the trackball to adjust the center line and then press **SET**.	---	---
Edit a contour or LV length	▪ Drag the contour or trace to the required location.	---	---
Delete a contour	▪ Click **Delete Contour**.		**Delete Contour**
Undo all traces	▪ Double-click **Delete Contour**.	---	---

LV and WMS Reports

In addition to the standard information included in reports, you can designate data to include or exclude for a specific stage.

To include or exclude data for a specific stage:

1. Activate **Wall Motion Scoring Mode** for the **WMS-Report** or **LV Mode** for the **LV-Report**.
2. To include the data for a stage, click the printer icon (highlighted) for that stage on the image menu.
3. To exclude the data for a stage from the report, click the printer icon again (not highlighted).

	Information Included in Reports	
Report Type	**Standard Information**	**When the Printer Icon is Highlighted**
LV-Report	▪ Patient name ▪ Patient ID ▪ Birth date ▪ Sex (gender) ▪ Date of stress echo examination ▪ Any user-entered indication or report-specific comment ▪ Patient height ▪ Patient weight ▪ Patient BSA	▪ User-generated traces ▪ Measurement data ▪ Calculations
WMS-Report	▪ Patient name ▪ Patient ID ▪ Birthdate ▪ Sex (gender) ▪ Date of stress echo examination ▪ Any user-entered indication or report-specific comment ▪ Wall motion scores for each segment ▪ Sum and average for each stage	▪ WMS graphics for each view, indicating each segment's wall-motion scores by color or degree of shading

Previewing and Printing Reports

Note: To preview or print reports, a printer driver must be installed and a laser printer connected to the X700 system.

To	Do This	Button	Tool Tip
Preview the report for the currently selected mode	▪ Click **Report Preview**.		**Report Preview**
Print the report for the currently selected mode	▪ Click **Print**.		**Print**
Enable report printing in color (for WMS graphics) **Note:** Requires a color printer.	1. Select the **Maintenance** toolbar button on the stress echo screen. 2. Select **Print colored** in the **WMS Type** section of the dialog box.		**Maintenance**

Configuring Stress Echo Options

To	Do This	Button	Tool Tip
Display the **Maintenance** dialog box	▪ From the Stress Echo application, click **Maintenance**. Or, press **Presets** and then select **Stress Echo**.		**Maintenance**
Display the **Protocol Editor** dialog box	1. Access the **Maintenance** dialog box. 2. Click **Protocol Editor**.	---	---

Configuring Acquisition Settings

To	Do This
Select the acquisition method	▪ In the **Protocol Editor** dialog box, select the required method from the **Clip Capture** drop-down list: – **Prospective** – **Retrospective** – **Continuous**
Enable or disable the audible tone when acquisition is complete	▪ In the **Maintenance** dialog box, select (enable) or clear (disable) the **Beep during acquisition** check box.
Enable or disable the View control during continuous acquisition	**Note:** You cannot change this setting during acquisition. ▪ In the **Maintenance** dialog box, select (enable) or clear (disable) the **Show View Control** check box.

Configuring Loop Display and Compression

To	Do This
Designate the level of image compression	▪ Select the required **Image Compression** option and then click **Save**.
Configure the overlays (labels) that display on the loops	▪ Select the check box for each **Overlay** option required for display and then click **Save**.

Customizing the Display During Wall Motion Scoring Mode

Note: Wall Motion Scoring selections are not available for views with user-defined names.

To	Do This	Button	Tool Tip
Alternate between placement of views and placement of WMS graphics	▪ During Wall Motion Scoring, click **Toggle Display**.		**Toggle Display**
Configure the available wall motion scores	**Note:** You can select one method for wall motion scoring per report. 1. In the **Maintenance** dialog box, select the required **WMS Type** option and then click **Save**. 2. Click **Quit**.		**Maintenance**

Changing the LV Trace Line Method

To	Do This
Select a solid or dotted line for LV traces	1. Click **Maintenance**. 2. Select the required **LV Trace Line** option (solid or dotted line) and then click **Save**. 3. Click **Quit**.

Customizing Systolic Duration Lengths

To	Do This
Add a heart rate and referring systolic duration to the **QT-Time Table**	▪ In the **Maintenance** dialog box, enter the required values in the **Heart Rate** and **Syst. Duration** boxes and then click **Update**.
Delete a heart rate and referring systolic duration from the **QT-Time Table**	▪ Select the required heart rate and systolic duration pair and then click **Delete**.
Restore factory defaults	▪ Click **Factory Settings**.

Changing the Stress Echo Protocols

You can create, edit, and delete stress echo protocols. Your changes take effect the next time you activate the stress echo feature. You cannot edit protocols during acquisition.

When you create or edit a protocol, you can choose the number of stages (phases), the number of loops acquired for each view in the stage, and the standard views to include. You can designate the type of stage: continuous or non-continuous. You can also name the protocol, protocol stages, and views.

Note: The system restricts the maximum size of a stress echo exam to the number of loops displayed in the stress echo configuration dialog box.

Protocol Element	Maximum Allowed Per Protocol	Default Value	Standard Options
Stage (Phase)	12	---	---
View	6	---	▪ PLAX ▪ SAB ▪ PSAX ▪ SAA ▪ A4C ▪ A2C ▪ ALAX
Loops (set by stage) **Note:** This selection is not available for continuous stage loops.	20	4	---

To	Do This
Create a stress echo protocol	1. Click **New**. 2. Enter the protocol name in the **Protocol Name** box. 3. Select the required heart cycle segments from the **Trigger** drop-down list: **R-R Systolic** or **R-R Full**. 4. For each option in the protocol: a. Click **<new>** in the **Stage** list. b. Enter a name in the **Description** box. c. Select the required option from the **Clip Capture** drop-down list (for continuous stages): **Retrospective**, **Prospective**, or **Continuous** d. Select the number of loops to acquire (per view in the selected stages) in the **Loops** list (for non-continuous stages). e. To enable automatic review non-continuous acquisition stages, select the **Review** check box. 5. For each view (all views display for each stage): a. Click **<new>** in the **View** list. b. Enter a name for the view or select a standard view from the **Standard View** list.

To	Do This
Display the phases and views for a saved stress echo protocol	1. Click **Load** to display the **Select Protocol to load** window. 2. Select the protocol and then click **OK**.
Change the name of the protocol	▪ Enter the required name in the **Protocol Name** box.
Change the name of a stage	▪ Select the stage and then enter the required name in the **Description** box.
Change the name of a view	▪ Select the view and then enter the required name in the **Standard View** text box or select a standard view from the **Standard View** list.
Change the type of stage (continuous or non-continuous)	▪ Select the required option from the **Clip Capture** drop-down list.
Change the number of loops acquired for each view in a stage	▪ Select the phase and then select the required number from the **Loops** list (for non-continuous stages).
Change the heart cycle segment(s) captured by the protocol	▪ Select an option from the **Trigger** drop-down list.
Delete a phase or view	▪ Select the stage or view and then click the **X** button.
Delete the protocol	▪ Select the protocol or one of its component phases or views and then click **Delete**.
Save changes and close the **Protocol Editor** dialog box	▪ Click **Save** and then click **Quit**.

Configuring Export Options

To	Do This
Configure DICOM export settings	1. Access the **Maintenance** dialog box. 2. Click **Export options**. 3. Select the required options from the **Overlay** list.

A10 Contrast Agent Imaging

Contrast Agent Imaging

⚠ **WARNING:** At the time of publication, the United States Food and Drug Administration has cleared ultrasound contrast agents only for use in LVO (left ventricular opacification). Check the current regulation for the country in which you are using this system for contrast agent clearance.

⚠ **WARNING:** Carefully follow manufacturers' instructions for use, including indications and contraindications, when administering ultrasound contrast agents.

- Contrast Agent Imaging (CAI) is designed for use with contrast agents.
- CAI is a low mechanical index (MI), continuous real-time imaging detection technique that provides contrast-to-tissue specificity using phase inversion technology in 2D-mode.
- Burst is a high mechanical index (MI) technique designed to rapidly destroy the injected contrast agent bubbles for a view of re-perfusion immediately afterwards.

  Use the Burst process to assess re-perfusion by observing the time required for the contrast agent bubbles to refill the burst area.

Compatibility

Transducer	Imaging Techniques	Study Types/Exam Types
4C1	CAI	Abdomen
CH5-2	CAI	Abdomen

Operating Modes

CAI is available in the following operating modes:

- 2D live and dual mode

Using Contrast Agent Imaging

For the combination of study type and transducer that is supported for use with CAI, preconfigured factory settings for system parameters are coordinated with Siemens patented data sequencing techniques to provide optimal viewing of blood flow when the contrast agent is injected.

You can adjust general imaging parameters, such as the transmit frequency, focal zones, and dynamic range.

Use the system presets to activate the CAI function and define the duration of clip capture during contrast agent imaging.

CAI

To activate contrast agent imaging:

1. Press **PAGE** to highlight the **CAI** tab indicator and display the soft key selections.
2. Press the toggle key for **CAI**.

   The system activates CAI and displays the mechanical index on the lower left of the screen. The maximum of the mechanical indices (**MIF**) is measured at the active focal zone.

To	Do This
Adjust transmit power	▪ Press the toggle key for **P** in 2D-mode.
Adjust the gain	▪ Rotate **2D**.
Capture and accumulate images	1. Press the toggle key for **CAI Dur** to adjust the duration of the capture, if necessary. 2. Press the toggle key for **CAI Capture**. When the capture is complete, the system freezes the image and displays the CINE bar. **Note:** To stop and exit the capture function before the capture is complete, press the toggle key for **CAI Capture** again. 3. To review the accumulated images, roll the trackball. 4. To resume imaging, press **FREEZE**.
Start the timer	(Available only during live imaging) 1. Press the toggle key for **Timer**. The system displays the elapsed time since the timer was started. When the image is frozen, the system also displays the time when freeze occurred. 2. To stop the timer, press the toggle key for **Timer**.

To	Do This
Capture a clip	▪ Press **CLIP STORE**.
Capture an extended clip	1. Press the toggle key for **Extended Clip**. The **CLIP STORE** control flashes to indicate clip capture is in progress. The status bar displays the storage status. The system continues to capture the extended clip until the process is terminated. 2. To terminate the clip capture, press the toggle key for **Extended Clip** or press **CLIP STORE**. **Note:** You cannot perform measurements on a stored extended clip if the full screen 2D image was changed during extended clip capture. Changes include adjusting the depth, zooming the image, or activating a dual mode or mixed mode for 2D imaging.
Emphasize either the tissue or the contrast agent	▪ Press the toggle key for **Balance** to view either the reference 2D image using the low mechanical index imaging technique (**2D**) or the image with the contrast agent (**CA**).
Adjust the frame rate	▪ Press the toggle key for **FR Control** to adjust the number of frames per second (fps) to acquire.
Use the Burst technique	1. Press the toggle key for **Burst Dur** to select the duration of the Burst process. 2. Press the toggle key for **Start Burst**. The system acquires the Burst frames, concludes the Burst sequence, and returns to the low-MI imaging technique.
Display the recorded time during CINE	▪ Rotate the trackball. The system displays the recorded time in 1/100 seconds next to the timer.
Exit contrast agent imaging	▪ Press the toggle key for **CAI**.

B1 Measurements and Calculations

Measurement Function — Overview

The measurement function contains the measurements and calculations available for each exam type and imaging mode. You can use the measurement function during a patient examination or on images stored in CINE Review. You can also make measurements on stored images.

Note: You must have a transducer connected to the ultrasound system to perform measurements during DIMAQ Review.

When the measurement function is active:

- The soft key selections list measurement methods for the active exam type and imaging mode.
- The trackball controls the placement of measurement markers (calipers) and selection of measurement labels.
- The Measurement Menu displays selectable labels along the left side of the image screen. When available, a report uses these labels to identify measurement values.
- The system performs calculations when you complete the required measurements and assigns calculation labels to the results.
- Results of measurements and calculations display on the image screen, patient report, Results panel, and Summary.

See also: Patient Data Management, Chapter C1, Features and Applications Reference

Activating the Measurement Function

Use the system presets to automatically activate the measurement function each time you press the **FREEZE** key. If this default has not been set, press the **CALIPER** key to enter the measurement function while an image is frozen for M-mode and Doppler. You can perform measurements on a real-time or frozen 2D-mode image.

Use the system presets to assign the position of the trackball pointer (caliper) when you activate the measurement function:

- Place the first measurement marker in the center of the image screen.
- Highlight the Measurement Menu.
- Display the first measurement marker with a dotted line, representing the depth from the skin line and indicating the Depth in the Measured Results.

Exam Configuration > Automatic Freeze Response

M & R Configuration > Measurement and Report Preset > General Configuration

Measurement Calipers

Each caliper set includes one or more pairs of measurement markers for indicating the beginning and ending points of a measurement. Some caliper sets require multiple measurements to calculate one value; all related markers are identified with the same caliper set number.

Maximum On-Screen Calipers

Depending on the measurement, up to eight caliper sets can display on an image at one time. If you attempt to add more caliper sets, the system prompts you to press the **ESCAPE** key and then press the **CALIPER** key to enable eight more caliper sets.

Use the system presets to select the shape and size of a caliper measurement marker.

M & R Configuration > Measurement and Report Preset > General Configuration

Caliper Type	Description	Mode
+ + x x	Indicate beginning and ending points for each pair of markers.	**2D-mode:** Depth, Distance, Area, Circumference, and Volume
	Delineates beginning and ending positions for marking horizontal position of an interval.	**M-mode:** Time, Heart Rate **Doppler:** Time, Heart Rate, Pulsatility Index, Point Values (single), Average Values, Flow Volume
	Indicates both a vertical and a horizontal position.	**Doppler:** Velocity, Frequency, Resistive Index, Acceleration - Deceleration, and Slope **M-mode:** Distance, Slope

Caliper Sets and Measurement Data

A number displays next to the first marker of each marker pair. This number identifies the caliper set and the corresponding measurement data that displays in the Measured Results. The number may be repeated if multiple measurements are required in the same image.

See also: Measured Results, p. B1-8

Positioning and Anchoring Calipers

Position a measurement marker by rolling the trackball. An active marker is green. Anchor a marker by pressing the **SET** key. An anchored marker is yellow. A second measurement marker in a caliper set displays near the first marker. Position the second marker by rolling the trackball; the system automatically updates the value of the measurement in the Measured Results. Anchor the second marker by pressing the **SET** key.

Measurement Menu

Activating the measurement function causes the system to display a Measurement Menu on the left side of the image screen. The Measurement Menu contains system and any user-defined labels for the active exam type and imaging mode.

If the menu has additional pages, click the page direction (< or >) to display the previous or next page.

Accessing Measurement Labels for All Exam Types

The Measurement Menu provides access to measurement labels for all exam types.

To display measurement labels for another exam type:

1. Select the current exam name and then select an exam type from the list.

   The Measurement Menu displays the measurement labels for the selected exam type.
2. If the required measurement label does not display on the first page, select another page of the Measurement Menu.
3. To redisplay the previous exam list, select the current exam name on the Measurement Menu.

Measure then Label, Label then Measure

To include a measured value in a patient report, you must assign a label to the value. You can either perform a measurement and then assign the measured value to a label – *Measure then Label* – or select a label and then use the default measurement method for the selected label to perform the measurement – *Label then Measure*.

Some measurements require the use of specific measurement methods. When you highlight a label in the Measurement Menu, the system automatically displays the required measurement method on the lower right of the image screen.

Example:  **BDistance**

When a label has been assigned a measured result, the system displays the value next to the label in the Measured Results section of the screen. To view the labeled values in an exam with a patient report, press the **Report** key on the keyboard at any time during the exam or select **Report** in the Measurement Menu during the measurement function.

The following exams contain specific labels that are assignable to a value for display in a report: **Abdomen**, **Breast**, **Cardiac**, **Cerebrovascular**, **Early Obstetrics**, **Emergency Medicine**, **Fetal Echo**, **Gynecology**, **Obstetrics**, **Orthopedic**, **Pediatric Echo**, **Pelvic Floor**, **Penile**, **Peripheral Vascular**, **Renal**, **TEE**, **Testicle**, **Thyroid**, and **Urology**.

Measure then Label

Use the system presets to customize the system to display a measurement marker on the image when you activate the measurement function.

M & R Configuration > Measurement and Report Preset > General Configuration

To measure then label:

1. During an exam, acquire and freeze the image, sweep, or spectrum.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays any measurement labels available for this exam type.
3. Press the toggle key that corresponds to the soft key selection. Select the method required by the measurement label.

   The system places a measurement marker in the image. The system displays measurement data in the Measured Results, such as (**D**) for distance, (**C**) for circumference, and (**A**) for area. The system also displays the corresponding measurement units, such as **mm** for distance and circumference, and **cm^2** for area.
4. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
5. Roll the trackball to position the next measurement marker and then press the **SET** key.

   The system automatically updates the measurement data in the Measured Results.
6. Rotate the **SELECT** control to highlight a measurement label and then press either the **SET** key or the **SELECT** control.

   The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.
7. If the selected label requires additional measurement data, the system activates a new measurement marker in the image area. Continue making measurements until all items called for in the Measured Results have been completed. The system then assigns the Measured Results to the measurement label.

   Note: Raw and labeled measurement data displays while a measurement is in progress. Raw (unlabeled) measurement data will not be retained when you exit the measurement function. The Measured Results do not redisplay labeled measurement data when the measurement function is reactivated.

Label then Measure

Use the system presets to assign the trackball to the Measurement Menu when you activate the measurement function.

M & R Configuration > Measurement and Report Preset > General Configuration

To label then measure:

Note: If the trackball is not assigned to the Measurement Menu after activating the measurement function, press the **CALIPER** key to place the trackball pointer in the Measurement Menu. The system activates the default measurement method for the active exam type and imaging mode.

1. During an exam, acquire and freeze the image, sweep, or spectrum.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays any measurement labels available for this exam.
3. Rotate the **SELECT** control to highlight a measurement label and then press either the **SET** key or the **SELECT** control.

   The system displays the soft key selections for the selected label and places a measurement marker on the image. The system also displays measurement data in the Measured Results.
4. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
5. Roll the trackball to position the next measurement marker and then press the **SET** key to complete the measurement. Measurement data updates in the Measured Results as each measurement is made.
6. To continue measurements, repeat steps 3 through 5 as required.

   When all required measurements are complete, the system displays the measurement label and corresponding value in the Measured Results and assigns the value to the label in the worksheet and the patient report.

Default Measurement Methods by Imaging Mode

Use the system presets to change the default measurement method.

M & R Configuration > Measurement and Report Preset > Measurement Method

Measured Results

Note: Measured results for OB, EOB, and Fetal Echo exams display below the measurement label on the Measurement Menu.

Values from measurements and calculations display in the Measured Results on the image screen for the current exam. If you exit and then reactivate the measurement function, the system does not redisplay labeled measurements in the Measured Results.

Measured Results display as raw measurement data until all steps required by the selected measurement method have been completed. If available in the Measurement Menu, a label can then be assigned; the completed Measured Results are labeled accordingly. If a label is not available or if a measurement method is used that is not compatible with any label, the completed Measured Results are not labeled and retain the display format used when they were still raw measurement data.

All raw measurement data and unlabeled Measured Results are deleted when the measurement function is deactivated.

General Measurements — Abbreviations of Measured Results

2D-mode Measurement	Unit	Abbreviation
Distance, diameter, trace, circumference	millimeters	mm
Area	centimeters^2	cm^2
Angle	degrees	°
Volume, one or two-plane	cubic centimeters	cm^3
Volume, residual urine, prostate	milliliter	mL
Flow volume, area or diameter*	liters per minute	L/min
%Stenosis	percent	%

**Also requires Doppler measurement.*

M-mode Measurement	Unit	Abbreviation
Distance	millimeters	mm
Heart rate	beats per minute	bpm
Time	milliseconds	ms
Slope	millimeters per second	mm/s

Doppler Measurement	Unit	Abbreviation
Velocity or frequency	centimeters per second or kilohertz	cm/s or kHz
Heart rate	beats per minute	bpm
Time	milliseconds	ms
Acceleration	meters per second^2	m/s^2
Systole, peak	centimeters per second or kilohertz	cm/s or kHz
Diastole, end	centimeters per second or kilohertz	cm/s or kHz
Time average velocity	centimeters per second or kilohertz	cm/s or kHz
Flow volume, diameter*	liters per minute	L/min
Pressure, mean or peak	millimeters mercury	mmHg
Velocity time integral	centimeters	cm

**Also requires 2D-mode measurements.*

Repositioning the Measured Results

You can reposition the Measured Results on the screen.

To reposition the Measured Results:

1. Activate the measurement function.
2. Press the toggle key for **MDA Position** to cycle through the available positions.

Editing Measured Results

You can edit Measured Results that have been completed during the current session of the measurement function.

Note: You can also edit Measured Results values in a Worksheet. Worksheets are available with the OB, Early OB, Cardiac, Ped Echo, and Gynecology exams. For exams without a worksheet, for example, the vascular exams, edit Measured Results in the report.

To activate Measured Results editing of measurement data:

1. Press the **UPDATE** key on the control panel after completing all the required measurement data and prior to exiting the measurement function.

   Measurement data displays in the Measured Results with the most recently acquired data highlighted. The system activates the most recently used marker.

   Note: Pressing the **UPDATE** key during the editing of measured results cycles through the markers for the selected measurement.

2. Press the toggle key for **Select Next** to select the previous measured result for editing.
3. Roll the trackball to reposition the selected marker and then press the **SET** key to anchor the marker.

   The system updates the Measured Results.

Exiting the Measurement Function

Raw measurement data, completed Measured Results, and the Measurement Menu are erased from the image screen when you exit the measurement function by unfreezing the image or by pressing the **ESCAPE** key on the control panel. The system discards raw measurement data but retains all Measurement Label assignments and completed Measured Results for the exam. The system discards Measurement Label assignments and completed Measured Results if a new patient is selected or if the power is cycled.

Measurement Formulas

The following formulas are used to calculate the general measurement labels.

2D-Mode (2D)

Measurements		Formula
Ellipse Circumference	---	$C = \pi\{1/2(D1^2+D2^2)\}^{1/2}$
Area	**Ellipse**	$A = \pi / 4 \times D1 \times D2 \times 100$
%Stenosis	**Diameter %Stenosis**	%Steno = (D1-D2) / D1 x 100
	Area %Stenosis	%Steno = (A1-A2) / A1 x 100
Volume	**1 Dist**	$V = \pi \times L^3 / 6$
	2 Dist	$V = \pi \times L \times D^2 / 6$
	3 Dist	$V = \pi \times L \times D \times W / 6$
	Thyroid	V = 0.479 x W x H x L
	1 Ellipse + 1 Dist	$V = \pi \times D1 \times D2 \times D3 / 6$
	1 Ellipse	$V = (8 \times A^2) / (3 \times \pi \times L)$

M-Mode (M)

Measurements		Formula
Slope	---	S = D/T

Doppler Mode (D)

Measurements		Formula
RI	---	RI = I(PS-ED)/PSI
PI	---	PI = I(PS-ED)/TAmxI
Acceleration	---	(V1-V2)/T
Flow Volume	**D-Flow Vol**	FV = TAmn x A x 60 / 1000
		$(A = \pi / 4 \times D^2 / 100)$
	A-Flow Vol	FV = TAmn x A x 60 / 1000
		$(A = \pi / 4 \times D1 \times D2 / 100)$

General 2D-Mode Measurements and Calculations

General 2D-mode measurements include depth, distance, and circumference and calculations for area, volume, and ratios.

General Caliper Performance in 2D-Mode

Note: The currently selected measurement remains active until you press **ESCAPE** or **CALIPER**.

To:	Perform this action:
Anchor a marker	Press the **SET** key on the control panel.
Complete a measurement	Press the **SET** key, **PRINT/STORE 1** or **PRINT/STORE 2** key when the last measurement marker is active.
Exit the measurement function	Press the **ESCAPE** key or the **FREEZE** key on the control panel to unfreeze the image.

Measuring Depth

If selected as an option in the system presets, depth is automatically measured when the first measurement marker displays on the image. The distance from a point on the transducer–skin interface to the marker is displayed in the Measured Results until the first marker is anchored.

M & R Configuration > Measurement and Report Preset > General Configuration

Measuring Straight-Line Distance

The distance measurement calculates the length of a straight line between two markers.

To make a distance measurement:

1. Activate the measurement function.
2. Press the toggle key for **Distance**.
3. Roll the trackball to position the first measurement marker and then press the **SET** key.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second measurement marker and then press the **SET** key to complete the measurement.

   The system automatically updates the distance (**D**) measurement in the Measured Results.

Measuring Trace Distance

Measure distance for non-straight lines by using the Trace Length 2D-mode measurement:

To make a trace distance measurement:

1. Activate the measurement function.
2. Press the toggle key for **Trace Length**.
3. Roll the trackball to position the first measurement marker and then press the **SET** key.
4. Roll the trackball to trace a distance with a second measurement marker.

   The system automatically updates the distance (**D**) measurement in the Measured Results.
5. To untrace, rotate the **SELECT** control on the control panel counterclockwise. Or, press the toggle key for **Undo**.
6. To complete the measurement, press the **SET** key.

   The measured distance (**D**) displays in the Measured Results.

Making an Area Measurement

Use the system presets to select the default measurement method, Ellipse or Trace, to use for calculating an Area.

M & R Configuration > Measurement and Report Preset > Measurement Method

Making the Ellipse Measurement

The Ellipse measurement method is used to determine the circumference and area by positioning a graphical ellipse over the structure of interest.

Ellipse Circumference Measurement Accuracy

The formula used for computing the circumference is most accurate when the two diameters used in the measurement, D_1 and D_2, are close to being equal.

Note: Common formulas for the calculation of the Ellipse circumference are approximations. The formula used by the system will provide an accurate result (< 2% error) as long as one diameter does not become more than twice the other.

If a circumference measurement is required for image areas where the ratio of the diameters is more than 2-to-1, the Trace method is recommended to ensure adequate measurement accuracy.

To make an ellipse measurement:

1. Activate the measurement function.
2. Press the toggle key for **Area** and then press the toggle key for **Ellipse**.
3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker, displays an ellipse, and displays two diameters (**D1**, **D2**), the circumference (**C**), and the area (**A**) in the Measured Results.
4. Roll the trackball to rotate the first axis and adjust the size of the ellipse and then press the **SET** key.

   The system updates the measurement data in the Measured Results.
5. Roll the trackball to adjust the shape of the ellipse along the second axis and then press the **SET** key.

   The system updates the measurement data in the Measured Results.

Making a Trace Area Measurement

The Trace method is used to manually determine the circumference of a structure. The system calculates the area inside the trace.

To perform a trace measurement:

1. Activate the measurement function.
2. Press the toggle key for **Area** and then press the toggle key for **Trace**.
3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.

4. Roll the trackball to create a trace of the structure.

   Note: You can rotate the **SELECT** control on the control panel counterclockwise to delete the trace before completing the circumference.

5. To complete the trace, press the **SET** key.

   The system displays the circumference (**C**) and area (**A**) of the traced structure in the Measured Results.

Measuring an Angle

The Angle measurement requires the placement of two lines to determine an angle. The lines must intersect or connect. The system calculates and displays both angles formed by the two lines.

To measure an angle:

1. Activate the measurement function.
2. Press the toggle key for **Angle**.
3. Roll the trackball to position the first marker and then press the **SET** key.

   The system anchors the marker and displays a second marker.

4. To define the reference line, roll the trackball to position the second marker and then press **SET** key.
5. To create the line for the alpha (α) and beta (β) angle:
   a. Roll the trackball to position the first marker and then press the **SET** key.

      The system anchors the marker and displays a second marker.

   b. To draw the angle line, roll the trackball to position the second marker and then press **SET** key.

      The system anchors the angle line, labels the α angle and the β angle, and displays the angle values in the Measured Results.

Making a Volume Calculation

Volume measurements can be made on single or dual 2D-mode images. Press the toggle key for **Volume** to display the soft key selections for calculating volume.

- **1 Distance**
- **2 Distances**
- **3 Distances**
- **Thyroid**
- **1 Ellipse**
- **1 Ellipse + 1 Distance**
- **Disk**

Note: To make a 1 Ellipse + 1 Distance measurement, make an ellipse measurement and then make a distance measurement for length in a different plane.

To change image planes while making measurements:

1. Activate the measurement function.
2. Make the required measurements in the first plane.

   The system displays values in the Measured Results for the measurements made in the first plane.
3. Press the **FREEZE** key to unfreeze the image.
4. Acquire the required view in the second plane.
5. Press the **FREEZE** key to freeze the image and make the required measurements in the second plane.

   The system displays values in the Measured Results for measurements made in both planes, and the calculated volume.

1 Dist Method

The system uses a single distance measurement to calculate a volume. The system uses the following formula to calculate the volume:

$$\text{Volume} = \frac{(\pi \times L^3)}{6}$$

To obtain a volume using the 1 Dist method:

1. Activate the measurement function.
2. Press the toggle key for **Volume** and then press the toggle key for **1 Dist**.

   The system displays one distance (**D**) and a volume (**V**) in the Measured Results.
3. Roll the trackball to position the first measurement marker for the length and then press the **SET** key on the control panel.

   The system anchors the marker, updates the distance value (**D**), and displays a second marker.
4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system anchors the marker and displays the length (**D**) and the calculated volume (**V**) in the Measured Results.

2 Dist Method

The system uses two distance measurements to calculate a volume. The system uses the following formula to calculate the volume, based on length and diameter:

$$\text{Volume} = \frac{\left(\pi \times L \times D^2\right)}{6}$$

To obtain a volume using the 2 Dist method:

1. Activate the measurement function.
2. Press the toggle key for **Volume** and then press the toggle key for **2 Dist**.

   The system displays two distances (**D1**, **D2**) and a volume (**V**) in the Measured Results.
3. Roll the trackball to position the first measurement marker for the length and then press the **SET** key on the control panel.

   The system anchors the marker, updates the distance value (**D1**), and displays a second marker.
4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system anchors the marker and displays the length (**D1**) in the Measured Results. The system also displays the first marker in the second set of measurement markers on the image screen.
5. Roll the trackball to position the first measurement marker for the depth measurement and then press the **SET** key.

   The system anchors the marker, updates the distance (**D2**), and displays a second marker.
6. Roll the trackball to position the second measurement marker for the depth measurement and then press the **SET** key.

   The system displays the two distances (**D1**, **D2**) and calculated volume (**V**) in the Measured Results.

3 Dist Method

To use this method, obtain three distance measurements: length and depth in one plane, and width in another plane. The system uses the following formula to calculate the volume:

$$\text{Volume} = \frac{(\pi \times L \times D \times W)}{6}$$

The system assumes you will perform the measurements in the sequence length, depth, and width. If you are using two single 2D-mode images, you must perform two measurements in the first plane.

To obtain a volume using the 3 Dist method:

Note: The procedure below assumes you have acquired images in Dual-mode. If single 2D-mode images are used, perform the first six steps below on one image. Unfreeze the system. If you press the **ESCAPE** key on the control panel, the system erases the measurements. Acquire and freeze the second image. Press the **CALIPER** key on the control panel and then perform steps 7 and 8. The system displays the saved values from the first image and combines them with the measured values from the second image to produce the volume measurement.

1. Activate the measurement function.
2. Press the toggle key for **Volume** and then press the toggle key for **3 Dist**.

   The system displays three distances (**D1**, **D2**, **D3**) and a volume (**V**) in the Measured Results.
3. Roll the trackball to position the first measurement marker for the length and then press the **SET** key on the control panel.

   The system anchors the marker, updates the distance value (**D1**), and displays a second marker.
4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system anchors the marker and displays the length (**D1**) in the Measured Results. The system also displays the first marker in the second set of measurement markers on the image screen.
5. Roll the trackball to position the first measurement marker for the depth measurement and then press the **SET** key.

   The system anchors the marker, updates the distance (**D2**), and displays a second marker.
6. Roll the trackball to position the second measurement marker for the depth measurement and then press the **SET** key.
7. On the second image, roll the trackball to position the first measurement marker for the width measurement and then press the **SET** key.

   The system anchors the marker, displays a second marker and updates the distance (**D3**) and volume (**V**).
8. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system displays the length (**D1**), depth (**D2**), width (**D3**), and calculated volume (**V**) in the Measured Results.

Thyroid Method

You can perform Thyroid volume measurements on either two or three images in Dual mode or on two separate 2D-mode images. Thyroid volume requires two image planes and three distance measurements: width, height, and length. The system uses the following formula to calculate the thyroid volume:

VT = WxHxLx0.479

To perform the thyroid volume measurement:

1. Activate the measurement function.
2. Press the toggle key for **Volume** and then press the toggle key for **Thyroid**.

   The system displays a width (**D1**), height (**D2**), length (**D3**), and thyroid volume (**V**) in the Measured Results.
3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker and displays the second marker.
4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system anchors the marker, displays the width (**D1**) in the Measured Results, and displays the next measurement marker.
5. Repeat steps 3 and 4 to measure the height (**D2**) of the structure.

   If you are in Dual- or Split mode, roll the trackball to another frozen image. Otherwise, press the **FREEZE** key on the control panel, scan to obtain another image, and press the **FREEZE** key again. Press the **CALIPER** key on the control panel.
6. Roll the trackball to position the marker for the length (**D3**) and then press the **SET** key.

   The system anchors the marker and displays the second marker.
7. Roll the trackball to position the second marker and then press the **SET** key.

   The system displays the width (**D1**), height (**D2**), and length (**D3**) above the calculated thyroid volume (**V**) in the Measured Results.

Ellipse Method

To calculate a volume using the Ellipse method, perform an area measurement and identify the axis common to both planes. The system uses the following formula to calculate the volume:

$$\text{Volume} = \frac{\left(8 \times A^2\right)}{3\pi \times L},$$

where L is the axis common to both planes.

To obtain a volume measurement using an ellipse:

1. Activate the measurement function.
2. Press the toggle key for **Volume** and then press the toggle key for **1 Ellipse**.
3. Roll the trackball to position the first measurement marker on the axis that is common to both planes and then press the **SET** key.

   The system anchors the marker, displays an ellipse, and updates diameters (**D1**, **D2**), area (**A**), circumference (**C**), and volume (**V**) in the Measured Results. The dotted line of the ellipse represents the axis common to both planes.
4. Roll the trackball to adjust the axis that is common to both planes, diameter **D1**, and then press the **SET** key.
5. To adjust the shape of the ellipse along diameter **D2**, roll the trackball and then press the **SET** key.
6. Roll the trackball to position the ellipse on the image and then press the **SET** key.

   The system displays diameters (**D1**, **D2**), area (**A**), circumference (**C**), and volume (**V**) in the Measured Results.

Disk Method

To calculate a volume using the Disk method, use the trackball to trace a structure and then position an axis line along which the disks will be calculated.

To obtain a volume using a disk measurement:

1. Activate the measurement function.
2. Press the toggle key for **Volume** and then press the toggle key for **Disk**.
3. Roll the trackball to position the first measurement marker and then press the **SET** key.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to create a trace of the structure with the second marker.
5. To complete the trace, press the **SET** key.

   The system draws a line across the structure, signifying the axis along which the disks will be calculated.
6. Roll the trackball to position the axis line and then press the **SET** key.

   The system displays the volume (**V**).

Determining an Area Percent Stenosis

The Area Percent Stenosis calculation compares cross-sectional areas of the same vessel. The system automatically performs the calculation using the following formula after you position two ellipses over the same vessel.

$$\text{Area \% Stenosis} = \left(\frac{A1 - A2}{A1} \right) \times 100 \text{ ,}$$

where A1 = the larger area, A2 = the smaller area.

To determine an area percent stenosis:

1. Activate the measurement function.
2. Press the toggle key for **%Stenosis** and then press the toggle key for **A-%Stenosis**.
3. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker, displays an ellipse, displays the area (**A1**, **A2**), and the area percent stenosis (**%Steno**) in the Measured Results.
4. Roll the trackball to rotate the first axis and size the ellipse and then press the **SET** key.
5. Roll the trackball to adjust the shape of the ellipse along the second axis and then press the **SET** key.

   The system displays the area of the ellipse in the Measured Results.
6. Roll the trackball to position the ellipse on the image and then press the **SET** key.
7. Unfreeze the image, and acquire and freeze a second image. Reactivate the measurement function. If you press the **ESCAPE** key, the system erases the measurements.

   The system automatically reselects **A-%Stenosis**.
8. For the second ellipse, repeat steps 3 through 6.

   The system displays the areas for the two ellipses (**A1**, **A2**), and the calculated area percent stenosis (**%Steno**) in the Measured Results.

Determining a Diameter Percent Stenosis

The Diameter Percent Stenosis calculation compares diameters of the same vessel. The system automatically determines the calculation using the following formula after you obtain two diameters of the same vessel.

$$\text{Diameter \% Stenosis} = \left(\frac{D1 - D2}{D1} \right) \times 100 \ ,$$

where D1 = larger diameter, D2 = smaller diameter.

To determine a diameter percent Stenosis:

1. Activate the measurement function.
2. Press the toggle key for **%Stenosis** and then press the toggle key for **D-%Stenosis**.
3. Roll the trackball to position the first measurement marker and press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system anchors the marker and displays the first diameter (**D1**) in the Measured Results.
5. Unfreeze the image, and acquire and freeze a second image. Reactivate the measurement function. If you press the **ESCAPE** key, the system erases the measurements.
6. Repeat steps 3 and 4 for the second diameter (**D2**).

   The system anchors the measurement marker and displays the diameters (**D1**, **D2**) and calculated diameter percent stenosis (**%Steno**) in the Measured Results.

General M-Mode Measurements and Calculations

The M-mode measurement function includes distance, heart rate, slope, and time measurements.

General Caliper Performance in M-Mode

Note: Press the **FREEZE** key on the control panel before performing a measurement on an M-mode sweep.

Note: The currently selected measurement remains active until you press **ESCAPE** or **CALIPER**.

To:	Perform this action:
Anchor a marker	Press the **SET** key on the control panel.
Complete a measurement	Press the **SET** key, **PRINT/STORE 1** or **PRINT/STORE 2** key when the last measurement marker is active.
Exit the measurement function	Press the **ESCAPE** key or the **FREEZE** key on the control panel to unfreeze the image.

Making a Distance Measurement

The distance measurement calculates the length of a straight line between two markers.

To make a distance measurement:

1. Activate the measurement function.
2. Press the toggle key for **Distance**.
3. Roll the trackball to position the first (vertical) measurement marker and then press the **SET** key.

   The system anchors the marker.
4. Roll the trackball to position the second (horizontal) measurement marker and then press the **SET** key to complete the measurement.

   The system automatically updates the distance (**D**) measurement in the Measured Results.

Making a Heart Rate Measurement

Determine the heart rate by delineating one heart cycle with the measurement markers that display as vertical lines.

To make a heart rate measurement:

1. Activate the measurement function.
2. Press the toggle key for **HR**.

   The system displays the first measurement marker.
3. Roll the trackball to position the marker at the beginning of the cardiac cycle and then press the **SET** key.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second measurement marker at the end of the cardiac cycle and then press the **SET** key.

   As the marker is moved, the system updates the heart rate (**HR**) and time (**T**) in the Measured Results.

Making a Time Measurement

The time method measures the change in time between two points. Time is calculated on the horizontal axis. The measurement markers display as vertical lines.

To make a time measurement:

1. Activate the measurement function.
2. Press the toggle key for **Time**.
3. Roll the trackball to position the first measurement marker in the image and then press the **SET** key.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   As the marker is moved, the system updates Time (**T**) in the Measured Results.

Making a Slope Measurement

Slope measures the change in distance over time, as determined by two distance measurement markers.

To make a slope measurement:

1. Activate the measurement function.
2. Press the toggle key for **Slope**.
3. Roll the trackball to position the first (vertical) measurement marker and then press the **SET** key.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second (horizontal) measurement marker to the right or the left of the first marker and then press the **SET** key.

   The system displays an oblique line and updates the distance (**D**), time (**T**), and slope (**S**) in the Measured Results.

General Doppler Measurements and Calculations

The measurement function on the system includes velocity or frequency, heart rate, and time measurements and calculations for volume, values, and ratios.

See also: Doppler Functions, Chapter A4, Features and Applications Reference

See also: Editing Measured Results, p. B1-10

General Caliper Performance in Doppler

Note: Press the **FREEZE** key on the control panel before performing a measurement on a Doppler spectrum.

Note: The currently selected measurement remains active until you press **ESCAPE** or **CALIPER.**

To:	Perform this action:
Anchor a marker	Press the **SET** key on the control panel.
Complete a measurement	Press the **SET** key, **PRINT/STORE 1** or **PRINT/STORE 2** key when the last measurement marker is active.
Exit the measurement function	Press the **ESCAPE** key or the **FREEZE** key on the control panel to unfreeze the image.

Making a Velocity and/or Frequency Measurement

This measurement is for calculating a velocity.

To measure velocity or frequency:

1. Activate the measurement function.
2. Press the toggle key for **Velocity**.
3. Roll the trackball to position the measurement marker at the required position and then press the **SET** key.

   The system displays the velocity (**V**), frequency (**Freq**), and pressure gradient (**PG**) in the Measured Results.

Making a Heart Rate Measurement

Determine the heart rate by delineating one heart cycle with the vertical measurement markers.

To measure heart rate:

1. Activate the measurement function.
2. Press the toggle key for **HR**.
3. Roll the trackball to position the first measurement marker on the spectrum at the beginning of the cardiac cycle and then press the **SET** key.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second measurement marker at the end of the cardiac cycle and then press the **SET** key.

   The system updates the time (**T**) and heart rate (**HR**) in the Measured Results.

Making a Time Measurement

The Time method measures intervals between two vertical measurement markers. The system calculates time on the horizontal axis.

To make a time measurement:

1. Activate the measurement function.
2. Press the toggle key for **Time**.
3. Roll the trackball to position the first measurement marker on the spectrum and then press the **SET** key.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second measurement marker on the spectrum.

   The system displays an updating time value (**T**) in the Measured Results.

Making a Slope Measurement

Slope measures acceleration or deceleration over time, as determined by two measurement markers: one distance marker and one velocity marker.

To make a slope measurement:

1. Activate the measurement function.
2. Press the toggle key for **Acceleration**.
3. Roll the trackball to position the first measurement marker at the beginning of the slope and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second measurement marker to the right or the left of the first marker, and then press the **SET** key.

   The system displays a slope and updates the slope (**Accel**), time (**T**), and peak velocity (**Vmx**) measurements in the Measured Results.

Calculating the Resistive Index

This measurement is for calculating the resistive index.

To calculate the resistive index:

1. Activate the measurement function.
2. Press the toggle key for **RI**.
3. Roll the trackball to position the first measurement marker on peak systole and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second measurement marker on end diastole and then press the **SET** key.

   The system displays the values for the resistive index (**RI**), peak systole (**PS**), end diastole (**ED**), and systole/diastole (**S/D**) in the Measured Results.

Calculating the Pulsatility Index

You can determine the pulsatility index using the following methods:

- **PI Auto Trace** – a system-generated (automatic) tracing of the spectrum, or
- **PI Manual Trace** – a user-generated (manual) tracing of the spectrum.

To calculate a pulsatility index using the automatic spectrum tracing:

1. Activate the measurement function.
2. Press the toggle key for **PI Auto**.

   The system displays the first vertical measurement marker on the spectrum.
3. Roll the trackball to position the marker and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second marker.
4. Roll the trackball to position the second measurement marker and then press the **SET** key.

   The system displays a graphical trace on the spectrum for automatically tracking maximum velocities. The system displays the peak systole (**PS**) in the measured results and activates a measurement marker for the end diastole (**ED**).
5. Roll the trackball to select end diastole (**ED**) and press the **SET** key on the control panel.

   The system displays the resistive index (**RI**), pulsatility index (**PI**), peak systole (**PS**), end diastole (**ED**), and systole/diastole (**S/D**) in the Measured Results. A time-averaged velocity (**TAmx**, **TAmn**) value displays according to the traced interval or segment.

   The system activates the measurement marker for peak systole (**PS**) to allow editing.
6. Reposition the marker for peak systole (**PS**) as required and then press the **SET** key.

   The system displays the updated measured results.

   Note: To edit **PS** or **ED**, press the **UPDATE** key to select the measurement marker and then roll the track ball to reposition the marker. Press the **SET** key to anchor the measurement marker and exit the editing function.

To calculate a pulsatility index using the manual spectrum tracing:

Note: You can rotate the **SELECT** control on the control panel counterclockwise to delete the trace before completion.

1. Activate the measurement function.
2. Press the toggle key for **PI Manual**.

   The system displays the first measurement marker on the spectrum.
3. Roll the trackball to position the marker at peak systole on the Doppler spectrum and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second measurement marker.
4. Roll the trackball to trace one cycle on the waveform and then press the **SET** key.

   The system automatically displays the peak systole (**PS**) in the Measured Results and a marker for **ED** is activated.
5. Roll the trackball to select end diastole (**ED**) and press the **SET** key on the control panel.

   Note: To edit **PS** or **ED**, press the **UPDATE** key to select the measurement marker and then roll the track ball to reposition the marker. Press the **SET** key to anchor the measurement marker and exit the editing function.

Performing a Velocity Ratio

The system provides ratio calculations for two velocity measurements.

To perform a ratio of velocities:

1. Acquire and freeze a Doppler image and then activate the measurement function.
2. Press the toggle key for **Velocity Ratio**.

   The system displays labels for two velocities (**V1**, **V2**), two frequencies (**Freq1**, **Freq2**), two simple ratios (**V1/V2**, **V2/V1**), and a calculation ((**V2-V1**)/**V2**) or ((**V1-V2**)/**V1**) in the Measured Results.
3. Roll the trackball to position the measurement marker for the first velocity and then press the **SET** key.

   The system anchors the marker, displays a second marker, and displays values for the first velocity (**V1**) and frequency (**Freq1**) in the Measured Results.
4. Roll the trackball to position the measurement marker for the second velocity and then press the **SET** key.

   The system anchors the marker and displays results for the second velocity (**V2**) and frequency (**Freq2**) and for all the ratio calculations.

Making an Area Flow Volume Measurement

Area flow volume is an estimate of the blood flow volume calculated from the area. Area flow volume requires an area measurement in 2D-mode and a spectral Doppler trace.

Note: Perform the Doppler measurement from peak systole to the next peak systole or from the beginning of the cardiac cycle to the next end diastole.

To perform an area flow volume measurement:

1. Acquire and freeze a 2D-mode/Doppler- or 2D-mode with color/Doppler image and then activate the measurement function.

   The system displays a measurement marker in the spectral Doppler waveform.
2. Press the toggle key for **Flow Volume**.
3. Press the toggle key for **A-Flow Vol**.
4. Roll the trackball to position the measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker and displays the second marker.
5. Roll the trackball to position the second measurement marker to the right of the first marker, including as many cardiac cycles as possible and then press the **SET** key.

   The system displays the time-averaged mean velocity (**TAmn**) and the first measurement marker of the second caliper set. Use this caliper set to outline the inner lumen of the cross-sectional vessel in the 2D-mode image.
6. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors the marker and displays an ellipse.
7. Roll the trackball to rotate the first axis and size the ellipse and then press the **SET** key.
8. Roll the trackball to adjust the shape of the ellipse along the second axis and then press the **SET** key.

   The system displays the circumference and area of the ellipse in the Measured Results.
9. Roll the trackball to position the ellipse on the image and then press the **SET** key.

   The system displays measurements for circumference (**C**), area (**A**), two distances (**D1**, **D2**), time-averaged mean velocity (**TAmn**), and flow volume (**FV**) in the Measured Results.

Making a Diameter Flow Volume Measurement

Diameter flow volume is an estimate of blood flow volume using the diameter of the vessel. Diameter flow volume requires a vessel diameter measurement in 2D-mode and a Doppler velocity trace.

2D-Mode Vessel Diameter and Doppler Velocity Trace

You can perform measurements in any sequence.

To perform a diameter flow volume measurement in 2D-mode:

Note: When acquiring the Doppler spectrum, extend the range of the Doppler gate so that it fits just within the vessel of interest. Rotate the **ANGLE** control on the control panel to adjust the Doppler angle to be parallel to the blood flow.

Note: You can perform the Doppler measurement from peak systole to the next peak systole or from the beginning of the cardiac cycle to the next end diastole.

1. Acquire and freeze a 2D-mode/Doppler or 2D-mode with color/Doppler image and then activate the measurement function.

   The system displays a Doppler measurement marker in the spectral Doppler waveform.
2. Press the toggle key for **Flow Volume** and then press the toggle key for **D-Flow Vol**.
3. Roll the trackball to position the measurement marker and then press the **SET** key on the control panel.

   The system anchors the marker and displays the second marker.
4. Roll the trackball to position the second measurement marker to the right of the first marker, including as many cycles as possible and then press the **SET** key.

   The system displays the time-averaged mean velocity (**TAmn**) and the first measurement marker of the second caliper set. Use this caliper set to determine the diameter of the vessel wall in the 2D-mode image.
5. Roll the trackball to position the first measurement marker on a vessel wall and then press the **SET** key.

   The system anchors the marker and displays a second marker.
6. Roll the trackball to position the second marker on the opposite wall and then press the **SET** key.

   The system displays measured values for the diameter (**D**), area (**A**), time-averaged mean velocity (**TAmn**), and flow volume (**FV**) in the Measured Results.

Measuring a VTI (Continuity Equation)

The system calculates a velocity-time integral, maximum and mean velocities, and maximum and mean pressure gradients from a trace of the Doppler spectrum.

Note: You can rotate the **SELECT** control on the control panel counterclockwise to delete the trace before completion.

To calculate a continuity equation:

1. Activate the measurement function.
2. Press the toggle key for **VTI**.

   The system displays the first measurement marker on the spectrum.
3. Roll the trackball to position the marker on the Doppler spectrum and then press the **SET** key on the control panel.

   The system anchors the marker and displays a second measurement marker.
4. Roll the trackball to trace one cycle on the waveform and then press the **SET** key.

   The system calculates and displays the values for **VTI**, **Vmax**, **Vmean**, **PGmax**, **PGmean**, **AT**, and **ET** in the Measured Results.

Report Features

The system transfers labeled measurements and calculations from a Measurement Menu on the image screen to a report.

The system also transfers information from the patient data form into the report. You can annotate the report and edit system-supplied data. You can edit measurements and calculations only if the report includes a worksheet.

See also: Report Tab, System Presets, Chapter 1, System Reference

To access a patient report:

1. Press the **Report** key on the keyboard at any time during an exam with a report or roll the trackball to highlight **Report** at the bottom of the Measurement Menu and then press the **SET** key.

   The system displays the patient report.
2. If the patient report has more than one page, roll the trackball to **Prev** or **Next** at the bottom of the report and then press the **SET** key.
3. To redisplay the image screen, press the **ESCAPE** key on the control panel.

To use a drop-down box:

1. Roll the trackball to position the pointer in the drop-down box and then press the **SET** key.
2. Roll the trackball to highlight the selection and then press the **SET** key.

To use a text entry field:

1. Roll the trackball to the text entry field and then press the **SET** key.
2. Use the keyboard to enter data.

Annotating a Report

There are two methods for entering text into the **Comments** section of a patient report. You can enter text from the keyboard or insert comments that you have pre-defined in the system presets. You can edit comments after placing them in the report.

Use the system presets to pre-define comments for each exam type.

M & R Configuration > Measurement and Report Preset > Comments Library for Report

Note: If the report has more than one page, you must access the page containing the **Comments** field before the system will display the comments.

To enter text:

1. When a patient report is displayed, roll the trackball to place the text cursor at the required position in the **Comments** field of the report and then press the **SET** key.
2. Enter text using the keyboard.

   Note: Enter your comments as a single paragraph. Do not use the **Enter** key on the keyboard to separate lines of comments.

To insert pre-defined comments:

1. When a patient report is displayed, roll the trackball to the **Comments** button and then press the **SET** key.

   A list of available phrases displays on the screen.
2. Roll the trackball to the appropriate phrase and then press the **SET** key.
3. To cancel the insertion, roll the trackball to the **Cancel** button and then press the **SET** key.
4. Roll the trackball to the **OK** button and then press the **SET** key.

   The system places the phrase in the **Comments** field of the report.

Report Drawing Function

Use the Report Drawing function to indicate structures of interest on pictograms in the patient report.

Note: The Report Drawing function is available for the following exam types: Urology, Fetal Echo, C-Vas.

To indicate a structure of interest in the displayed report:

1. Select **Draw** on the right side of the report and then press the **SET** key on the control panel.

   A pencil-shaped cursor displays in the pictogram on the report.
2. Roll the trackball to place the cursor where you want to begin tracing and then press the **SET** key.
3. Roll the trackball to create a trace.
4. When you have completed the drawing, press the **SET** key.

   The system joins beginning and ending cursor positions and marks the area created by the trace.
5. Repeat steps 1 through 4 for each structure of interest.

To remove a trace drawing from the displayed report:

1. Select **Delete** on the right side of the report and then press the **SET** key on the control panel.

   The system displays an eraser in the pictogram area.
2. Roll the trackball to position the eraser on the trace drawing and then press the **SET** key.

   The system deletes the trace drawing.
3. Repeat steps 1 and 2 as required for each trace drawing.

Printing a Report

Use the system presets to indicate the printer that is to receive the on-screen information when the **PRINT/STORE1** or **PRINT/STORE2** key is pressed.

Customize Keys

To print the report:

- Press the **PRINT/STORE1** or **PRINT/STORE2** key. Or, select the **Send Report** button on the report.

Summary

You can create summaries for all exam types.

Summaries can include the following optional items: Letter Header, Patient Data, Exam Specific Data, Results, Images, Summary, Recommendations, and Signature. For OB or Early OB exam types, graphs from the report page can be automatically inserted into the **Graph** section of the summary.

Cardiac exam types display reference values for each label in a bracket next to the measured label.

While working with a summary, you can do one or more of the following:

- View the summary on the screen
- Export the summary as a PDF or RTF file to the USB-compatible device
- Export the summary as a PDF or RTF file using the network export function
- Print the summary

Use the system presets or the summary screen to customize the display of the summary items.

Summary

Displaying the Summary

You can display a summary any time you are performing measurements in a supported exam type.

To display a summary:

1. Activate the measurement function.
2. Perform the required measurements.
3. Roll the trackball to highlight **Summary** on the Measurement Menu and then press the **SET** key.

   The system displays the summary.
4. To exit the summary, press the toggle key for **Exit**.

   The system returns to the measurement screen.

Modifying the Summary

The patient name, patient ID, study date, and exam-specific data entered in the patient data form display in the header of all summary pages. Changes to the patient data form are automatically updated in the summary.

Item	Description	How to Modify
Letter Header	header image	Import a GIF, JPG, or BMP image, such as a logo, from a USB-compatible device. Recommended image size: 25 x 250 pixels. Use the system presets to modify the letter header. You can customize the type, size, and emphasis of the font. **Summary > Site Information**
Images	display images	**See also:** Adding Images, p. B1-36
Graph	For OB and Early OB exam types; display graphs	Automatically inserted from Report pages.
Summary	displays comments from the Report	Automatically inserted from Report pages.
Recommendations	display personal recommendations for the patient	Type recommendations using the keyboard. (Maximum length: 300 characters.)
Signature	reserve a place in the printed summary for your signature	Print the summary. Write your signature in the signature field.

Selecting Summary Items to Display

Only sections within the summary populated with data are available for display.

To select summary items to display:

- Roll the trackball to the arrow displayed to the right of the item title and then press the **SET** key.

  The system hides or displays the item.

Adding Images

You can display images in the summary.

To insert images into the summary:

1. Select an image display format from the list box.
2. Select a static image from the thumbnail panel using the trackball and the **SET** key.

   The system highlights the border of the selected image.

   Note: If you select a clip, the system will display the first frame of the clip in the summary.

3. Roll the trackball to the image section where you need to position the image and then press the **SET** key.
4. The system copies the selected image into the selected section in the summary.

Adding Recommendations

Enter your recommendations using the keyboard in the **Summary** text box.

To insert or edit predefined recommendations:

1. Click **Recommendations**.

   The system displays a dialog box with the predefined recommendations.

2. To insert a predefined recommendation into the summary, double-click the recommendation. Or, select a recommendation and click **OK**.
3. To insert more than one recommendation, repeat steps 1 and 2.
4. To edit the inserted recommendations or add new text, enter your new text in the **Summary** text box.

Exporting the Summary

To export a summary to a USB-compatible device:

- Press the toggle key for **Export to USB**.

  The system saves the summary as a PDF file and an RTF file and exports the files to a USB-compatible device connected to the system.

Printing the Summary

To print a summary:

- Press the toggle key for **Print**.

  The system sends the data to the printer connected to the system.

B2 Application-Specific Measurements and Calculations

Measurements and Calculations for All Exam Types

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for all exam types.

See also: Measurements and Calculations, Chapter B1, Features and Applications Reference

Use the system presets to customize each of the exam types.

- Specify the shape, size, and default position for the caliper
- Specify whether the background for the Measured Results section of the screen has a different color than the image background
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Select the measurement methods that display as soft key selections for each mode and the order in which they display
- Customize display options and enable operator and referring physician information for the patient report
- Define the Comments library for the patient report
- Define Recommendations for the summary
- Define anatomy assessments for the patient report

M & R Configuration > Measurement and Report Preset

Abdominal, Aorta, Venous, Musculoskeletal, Superficial Musculoskeletal, Breast, Testicle, Pelvic Floor, Pediatric, Neonatal Head, and Small Parts Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available.

Use the system presets to customize each of these exam types.

- Specify user-defined labels

M & R Configuration > Measurement and Report Preset

Use the system presets to configure the volume labels available in 2D-mode for the following exams: abdomen, breast, testicle, pelvic floor.

M & R Configuration > Measurement and Report Preset > Measurement Order

Gynecology Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for use with the Gynecology exam type. In addition, the system has measurement labels in 2D-mode and Doppler for specific use with the Gynecology exam.

Use the system presets to customize the Gynecological exam.

- Select the measurement method for follicle evaluation
- Establish user-defined labels for 2D-mode and Doppler
- Customize the display of tabs on the patient report

M & R Configuration > Measurement and Report Preset

2D-Mode Measurement Labels

Measurement Label	Description	Measurement Method
Uterus **Length** **Depth** **Width**	Measurements of the uterus. The system automatically calculates the volume when all three distance measurements have been performed. The volume displays in the patient report and in the Measured Results.	Distance
Endometrium	Thickness of the endometrium.	Distance
Cervix	Length of the cervix.	Distance
Lt Ovary **Length** **Depth** **Width**	Measurements of the left ovary. The system automatically calculates the volume when all three distance measurements have been performed. The volume displays in the patient report and in the Measured Results.	Distance
Rt Ovary **Length** **Depth** **Width**	Measurements of the right ovary. The system automatically calculates the volume when all three distance measurements have been performed. The volume displays in the patient report and in the Measured Results.	Distance
Lt Follicle #1-15	Measurements of the left ovarian follicle. The system transfers labeled values for follicle measurements into the patient report.	Method selected in the system presets.
Rt Follicle #1-15	Measurements of the right ovarian follicle. The system transfers labeled values for follicle measurements into the patient report.	Method selected in the system presets.
CRL	Crown Rump Length.	Distance
MSD	Mean Gestational Sac Diameter.	Distance
YolkSac	Yolk Sac Diameter.	Distance
GS	Gestational Sac. Maximum Length.	Distance
xxxx	A user-defined label. You can define 2D-mode measurement labels to correspond to a measurement method. Four measurement methods are available: distance, area, circumference, and volume.	The 2D-mode measurement method assigned in the system presets.

Follicle Measurements

The system uses one of the following measurement methods selected in the system presets for evaluating follicles. Measured results display in millimeters (mm).

- **Distance**
- **2Dist & Avg** (two distances and the average of the two distances)
- **3Dist & Avg** (three distances and the average of the three distances)
- **2Dist Avg** (the average of the two distances)
- **3Dist Avg** (the average of the three distances)
- **Area**
- **Circumference**
- **Volume**

The system transfers labeled values for follicle measurements into the patient report.

To perform a follicle measurement:

1. Activate the measurement function.
2. If necessary, access the page in the Measurement Menu containing the **Lt Follicle** or **Rt Follicle** measurements.
3. Roll the trackball to select the appropriate **Lt** or **Rt Follicle #** in the Measurement Menu and then press the **SET** key.

   The system activates the follicle measurement method selected in the system presets and displays the first measurement marker in the image area.
4. Roll the trackball to position the first measurement marker to the beginning point and then press the **SET** key.
5. Perform the measurement according to the activated method.

   The system assigns the measurement value to the selected follicle number and transfers the values to the patient report.
6. Repeat steps 3 through 5 for each follicle.

Evaluating Follicles with *syngo* Auto Follicle Measurements

You can use *syngo* Auto Follicle measurements during a gynecology exam to determine the size (diameter and area) of multiple ovarian follicles.

Use the system presets to select a measurement method for follicle evaluation.

M & R Configuration > Measurement and Report Preset > Measurement Order

To	Do This
Perform a follicle measurement using *syngo* Auto Follicle measurements	1. During a gynecology exam, acquire and freeze a 2D-mode image. 2. Activate the measurement function. 3. Press the toggle key for **Auto Follicle** to select **On**. 4. Roll the trackball to position the measurement marker for each follicle and then press the **SET** key. The system traces the borders of the follicle and indicates one or two axes of the follicle depending on the Auto Follicle measurement method.  *Example of follicle measurement marker.* **Note:** The system displays a message if a follicle cannot be detected. You can reposition the measurement marker and repeat this step. 5. Press the **SET** key to confirm the measurement. The system updates the Measured Results for the measured follicle and activates a measurement marker for another follicle. 6. Repeat steps 4 and 5 for each follicle.
Edit a follicle measurement	**Note:** Before editing, press the **ESCAPE** key if the marker is active. 1. Press the **UPDATE** key and then press the toggle key for **Select Next** to activate the required follicle measurement for editing. 2. Position and then anchor the measurement marker for the selected follicle. The system displays the updated values in the Measured Results.
Deactivate follicle measurements	▪ Press the toggle key for **Auto Follicle** to select **Off**.

Doppler Measurement Labels

Measurement Label	Description	Measurement Method
Uterine A	Uterine Artery	PI Auto, PI Manual
Lt Uterine A	Left Uterine Artery	PI Auto, PI Manual
Rt Uterine A	Right Uterine Artery	PI Auto, PI Manual
Lt Ovarian A	Left Ovarian Artery	PI Auto, PI Manual
Rt Ovarian A	Right Ovarian Artery	PI Auto, PI Manual
xxxx	A user-defined measurement label.	The system assigns the default measurement method set in system presets to each label.

Gynecology Patient Report

The Gynecology exam has a one-page patient report. The system transfers labeled measurements from the Gynecology Measurement Menu on the image screen to the patient report. The system also loads information from the patient data form into the report. You can annotate the report.

Use the system presets to customize the display of tabs on the patient report.

M & R Configuration > Measurement and Report Preset > Report Tab

Gynecology Data Tab

The first tab of the Gynecology patient report contains information entered on the patient data form for the GYN exam type. The Data tab may contain measurement details for 2D-mode and Doppler if abbreviated display of results has not been selected in the system presets.

M & R Configuration > Measurement and Report Preset > Display Item

Gynecology Description Tab

The second tab of the Gynecology patient report contains drop-down boxes with descriptive data. Selections are shown below:

Report Item	Selections	Report Item	Selections
Uterus	**WNL** **Fibroid** **Atrophic** **Septated** **Bicornuate** (blank)	**Uterine Mass**	**Calcification(s)** **Solid** **Complex** **Cystic** **Yes** (blank)
Right Adnexa	**WNL** **Absent** **Mass** (blank)	**Right Ovary**	**WNL** **Absent** **Not Seen** (blank)
Left Adnexa	**WNL** **Absent** **Mass** (blank)	**Left Ovary**	**WNL** **Absent** **Not Seen** (blank)
Cul de Sac	**WNL** **Fluid Seen** **No Fluid Seen** (blank)		

Using the Gynecology Worksheet

The values for a measurement type display in the same worksheet even if the measurements are taken in different imaging modes.

You can edit values directly in the worksheet. When you edit one of the measurements required for a calculation, the system updates the calculated value.

To access the Gynecology Worksheet:

1. During a Gynecology exam, roll the trackball or rotate the **SELECT** control to select **Worksheet** in the Measurement Menu.

   The system displays the Gynecology Worksheet.
2. To view a different page of the worksheet, select the **Prev** or **Next** buttons.
3. To access the patient report, select the **Report** button.
4. To return to the image screen, press the **ESCAPE** key or select the **Return** button on the bottom of the screen.

Editing Worksheets

Edit a worksheet to change the values that display in the patient report and the Measured Results. To change calculated results, edit the measurements that are components of the calculation.

The system displays an asterisk (*) next to an edited value. If an edited value is used in data averaging, an asterisk displays next to the calculated average.

Note: You cannot edit the results of follicle measurements on the gynecology worksheet.

To edit a value in the worksheet:

1. Display the worksheet.
2. Roll the trackball to position the pointer in the cell that you want to edit and then press the **SET** key.
3. Use the keyboard to edit the value.
4. Roll the trackball to position the pointer outside of the cell and then press the **SET** key.

   The system displays an asterisk next to the value. If data averaging is used, the system also displays an asterisk next to the new average value.

   Note: If the value just edited is used in a calculation, the system displays an asterisk (*) next to the newly calculated value.

To delete one value for a measurement:

1. Roll the trackball to highlight a value in the worksheet and then press the **SET** key.
2. Select the **Delete Cell** button.

   The system clears the selected cell in the worksheet. If data averaging is used, the system updates the averaged value based on the remaining measurements.

To delete all values for a measurement:

1. Roll the trackball to highlight a value in the worksheet and then press the **SET** key.
2. Select the **Delete Line** button.

   The system removes all values for that measurement from the worksheet.

   Note: If the value just deleted is used in a calculation, the system removes the calculated value from the worksheet and the Measured Results.

To delete all values for a measurement type:

- Select the **Delete All** button.

  The system removes all values for all measurements from the individual page of the worksheet, and clears the column in the report for that measurement type. If you do not make any more measurements for that measurement type, the system removes the column from the patient report.

Orthopedic Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for use with the Orthopedic exam type. In addition, the Orthopedic exam has a calculation for **Hip Angle**. Hip Angle is an angle calculation designed for examination of infant hips. The Orthopedic exam also has specific 2D-mode measurement labels and a Sonographic Infant Hip Classification patient report.

Use the system presets to customize the Orthopedic exam.

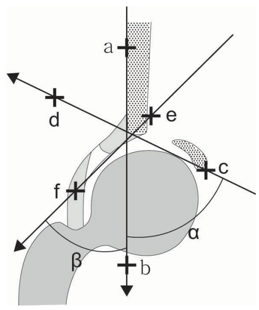
M & R Configuration > Measurement and Report Preset

2D-Mode Measurement Labels

Measurement Label	Description	Measurement Method
R Hip Angle	Right hip angle	Hip Angle
L Hip Angle	Left hip angle	Hip Angle
R Flexed FHC	Right Flexed Femoral Head Coverage	Distance
L Flexed FHC	Left Flexed Femoral Head Coverage	Distance
R Stressed FHC	Right Stressed Femoral Head Coverage	Distance
L Stressed FHC	Left Stressed Femoral Head Coverage	Distance

Measuring a Hip Angle

The Hip Angle measurement requires the placement of three intersecting lines to determine two angles. The first line is called the ***reference line***. The second line establishes the alpha angle (α), and the third line establishes the beta angle (β). The system calculates and displays angles α and β.



Points a and b define the reference line. Points c and d establish the line used for the α angle, and points e and f establish the line used for the β angle.

To measure a hip angle:

1. Activate the measurement function.
2. Roll the trackball to **R Hip Angle** in the Measurement Menu and then press the **SET** key on the control panel.
3. Roll the trackball to position the first marker at point a and then press the **SET** key.

   The system anchors the marker and displays a second marker.
4. To define the direction of the reference line, roll the trackball to position the second marker so that the line intersects point b and then press the **SET** key.

   The system anchors the reference line and displays a new marker.
5. To create the line for the alpha (α) angle:
   a. Roll the trackball to position the marker at point c and then press the **SET** key.

      The system anchors the marker and displays a new marker.

   b. To draw the alpha (α) angle line, roll the trackball so that the line intersects point d and then press the **SET** key.

      The system anchors the line and displays a new marker.
6. To create the line for the beta (β) angle:
   a. Roll the trackball to position the marker at point e and then press the **SET** key.

      The system anchors the marker and displays a new marker.

   b. To draw the beta (β) angle line, roll the trackball so that the line intersects point f and then press the **SET** key.

      The system anchors the line and displays the α angle and β angle in the Measured Results and the Graf sonometer.
7. Roll the trackball to **L Hip Angle** in the Measurement Menu and then press the **SET** key. Repeat steps 3 through 6.

Orthopedic Report

The Orthopedic exam has a one-page report for the Sonographic Infant Hip Classification.

Descriptive Data

The patient report contains drop-down boxes with descriptive data. Selections are shown below:

Report Item	Selections (right)	Selections (left)
Osseous Profile	(Blank)	(Blank)
	I : Good	**I : Good**
	II : Deficient	**II : Deficient**
	D : Deficient	**D : Deficient**
	III : Poor	**III : Poor**
	IV : Poor	**IV : Poor**
Osseous Acetabulum	(Blank)	(Blank)
	I : Sharp	**I : Sharp**
	II : Round	**II : Round**
	D : Round/Flat	**D : Round/Flat**
	III : Flat	**III : Flat**
	IV : Flat	**IV : Flat**
Cartilaginous Acetabulum	(Blank)	(Blank)
	I : Narrow	**I : Narrow**
	II : Wide/Overlapped	**II : Wide/Overlapped**
	D : Everted	**D : Everted**
	III : Everted Echo Free	**III : Everted Echo Free**
	III : Everted Echo Poor	**III : Everted Echo Poor**
	IV : Everted	**IV : Everted**
Type	(Blank)	(Blank)
	Ia	**Ia**
	Ib	**Ib**
	IIa	**IIa**
	IIb	**IIb**
	IIc	**IIc**
	D	**D**
	IIIa	**IIIa**
	IIIb	**IIIb**

Orthopedic References

Hip Angle

Graf R. "Sonographic Diagnosis of Hip Dysplasia and Hip Dislocation." Revised by R. Graf from reprint. Schuler P. Graf R. 1986. "Sonographie in de Orthopädie in Braun — Günther — Schwerk." Ultraschalldiagnostick 4. Erg. Lig 7, 1986. Ecomed Verlag.

Fetal Echo Measurements and Calculations

The Fetal Echo exam supports system-defined measurement labels which display in the Measurement Menu for the active imaging mode. The exam also supports calculation labels.

Use the system presets to select specific measurement methods and the measurement order for use with the Fetal Echo exam.

M & R Configuration > Measurement and Report Preset > Measurement Method

M & R Configuration > Measurement and Report Preset > Measurement Order

2D-Mode Measurement Labels

Measurement Menu Label	Description	Measurement Method
CTAR	Cardiothoracic Area Ratio: Fetal Heart Area/Fetal Thoracic Cross-Sectional Area	Area Ratio
TCD	Total Cardiac Dimension	Distance
Cardiac Axis	Cardiac Axis	Angle
LVIDd	Left Ventricular Internal Dimension at end-diastole	Distance
LVIDs	Left Ventricular Internal Dimension at end-systole	Distance
AoD Arch	Aortic Arch Diameter	Distance
Asc AoD	Ascending Aorta Diameter	Distance
Desc AoD	Descending Aorta Diameter	Distance
IVSd	Interventricular Septal dimension at end-diastole	Distance
IVSs	Interventricular Septal dimension at end-systole	Distance
LVPWd	Left Ventricular Posterior Wall dimension at end-diastole	Distance
LVPWs	Left Ventricular Posterior Wall dimension at end-systole	Distance
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
PA	Pulmonary Artery	Distance
RVDd	Right Ventricular Dimension at end-diastole	Distance
RVOT diam	Right Ventricular Outflow Tract diameter	Distance

M-Mode Measurement Labels

Measurement Menu Label	Description	Measurement Method
LVIDd	Left ventricular internal dimension at end-diastole	Distance
LVIDs	Left ventricular internal dimension at end-systole	Distance
FHR	Fetal Heart Rate	HR (Heart Rate)
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
AoD Arch	Aortic Arch Diameter	Distance
Asc AoD	Ascending Aorta Diameter	Distance
Desc AoD	Descending Aorta Diameter	Distance
RVOT diam	Right Ventricular Outflow Tract diameter	Distance
PA	Pulmonary Artery	Distance
RVDd	Right Ventricular Dimension at end-diastole	Distance
IVSd	Interventricular Septal dimension at end-diastole	Distance
IVSs	Interventricular Septal dimension at end-systole	Distance
LVPWd	Left Ventricular Posterior Wall dimension at end-diastole	Distance
LVPWs	Left Ventricular Posterior Wall dimension at end-systole	Distance

Doppler Measurement Labels

Measurement Menu Label	Description	Measurement Method
PLI	Preload Index: Comparison of two velocity values of the inferior vena cava of a fetus: retrograde flow during atrial contraction (A) / systole (S)	Velocity Ratio
FHR	Fetal Heart Rate	HR (Heart Rate)
LVOT Vmax	Left Ventricular Outflow Tract Velocity maximum	Velocity
LVIMP	Left Ventricular Index of Myocardial Performance	---
lvet	Left Ventricular Ejection Time	Time
LV C-O dur	Left Ventricular Close-Open duration	Time
Asc Ao vmax	Ascending Aorta Velocity maximum	Velocity
Ao Arch vmax	Aortic Arch Velocity maximum	Velocity
Desc Ao vmax	Descending Aorta Velocity maximum	Velocity
da vmax	Ductus Arteriosus Velocity maximum	Velocity
rvot max	Right Ventricular Outflow Tract Velocity maximum	Velocity
RVIMP	Right Ventricular Index of Myocardial Performance	---
rvet	Right Ventricular Ejection Time	Time
RV C-O dur	Right Ventricular Close-Open duration	Time
pa	Pulmonary Artery	Velocity

2D-Mode and M-Mode Calculation Labels

Use the system presets to select the author's formula to use for calculation of the **EDV** and **ESV**.

Calculation Label	Description	Required Measurements	Units
EDV and **ESV**	Left Ventricular End-Systolic Volume and Left Ventricular End-Diastolic Volume estimates volume from the left ventricular internal diameter (LVID) using the distance measurement. Teichholz Volume Method: EDV = 7(LVIDd^3/1000)/(2.4 + LVIDd/10) ESV = 7(LVIDs^3/1000)/(2.4 + LVIDs/10) Cubed: EDV = LVIDd^3/1000 ESV = LVIDs^3/1000 Gibson: EDV = 0.52(0.98*LVIDd/10 + 5.90)* LVIDd^2/100 ESV = 0.52(1.14*LVIDs/10 + 4.18)* LVIDs^2/100	LVIDd LVIDs	mL
EF	***Ejection Fraction*** is the ratio of the stroke volume to the end-diastolic volume: EF = SV/EDV *100	EDV ESV	%
FS	***Fractional Shortening*** is the percentage of shortening of the Left Ventricular dimension: FS = [(LVIDd - LVIDs) ÷ LVIDd] * 100	LVIDd LVIDs	%
SV	***Stroke Volume*** is the volume of blood ejected from a ventricle during one cardiac cycle or phase of ventricular systole: SV = EDV-ESV	EDV ESV	mL

Fetal Echo Report

You can view the Fetal Echo exam report.

Transcranial Doppler (TCD) Measurements and Calculations

All general measurements and calculations in 2D-mode and Doppler are available for use with the TCD exam type. In addition, the system has measurement labels in 2D-mode and Doppler for specific use with the TCD.

Use the system presets to customize the TCD patient report and the TCD exam.

M & R Configuration > Measurement and Report Preset

2D-Mode and Doppler Measurement Labels

Measurement Label	Description	2D-Mode Measurement Method Options	Doppler Measurement Method
MCA	Middle Cerebral Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume
ICA-Siphon	Internal Carotid Artery-Siphon	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume
ACA-A1	The A-1 section of the Anterior Cerebral Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume
ACA-A2	The A-2 section of the Anterior Cerebral Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume
ACoA	Anterior Communicating Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume

Measurement Label	Description	2D-Mode Measurement Method Options	Doppler Measurement Method
PCA-P1	The P1 section of the Posterior Cerebral Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume
PCA-P2	The P2 section of the Posterior Cerebral Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume
PCoA	Posterior Communicating Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume
PCA	Posterior Cerebral Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume
Basilar A	Basilar Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume
Vert A	Vertebral Artery	Distance Stenosis Flow Volume	Velocity PI Auto PI Manual RI Acceleration Flow Volume

Calculation Labels

The system calculates the following ratios when the required labeled measurements have been made. The ratios display only in the patient report.

Calculation Label	Description	Required Measurements
R MCA/R ICA-Siphon	Ratio of the right Middle Cerebral Artery to the right Internal Carotid Artery-Siphon	MCA ICA-Siphon (Right side)
L MCA/L ICA-Siphon	Ratio of the left Middle Cerebral Artery to the left Internal Carotid Artery-Siphon	MCA ICA-Siphon (Left side)

TCD Report

The TCD exam has a report. The system transfers labeled measurements from the TCD Measurement Menu on the image screen to the patient report. The system also loads information from the patient data form into the report. You can annotate the report.

Penile Measurements and Calculations

All general measurements and calculations in 2D-mode and Doppler are available for use with the Penile exam type. In addition, the system has measurement labels in 2D-mode and Doppler for specific use with the Penile exam.

2D-Mode Measurement Labels

These labels display in the Measurement Menu and in the patient report with the measured result, when assigned. The labels are the same for both the **Right** and **Left** imaging selections.

Measurement Label	Description	Measurement Method Options
Copr Cav	Corpus Cavernosom	Distance Stenosis
Corp Spong	Corpus Spongiosum	Distance Stenosis
Cav A	Cavernosal Artery	Distance Stenosis
Pre-Inj Cav A	Pre-Injection Cavernosal Artery	Distance Stenosis
Post-Inj Cav A	Post-Injection Cavernosal Artery	Distance Stenosis
Urethra	Urethra	Distance Stenosis

Doppler Measurement Labels

The following describes measurement labels for Doppler measurements when the Penile exam is active. These labels display in the Measurement Menu.

Measurement Label	Description	2D-Mode Measurement Method	Default Doppler Measurement Method
Iliac A	Iliac Artery	Flow volume	Velocity
Dorsal A	Dorsal Artery	Flow volume	Velocity
Urethral A	Urethral Artery	Flow volume	Velocity
Bulbar A	Bulbar Artery	Flow volume	Velocity
Brach A	Brachial Artery	Flow volume	Velocity
Cav A	Cavernosal Artery	Distance Stenosis Flow volume	Velocity
Pre-Inj Cav A	Pre-Injection Cavernosal Artery	Distance Stenosis Flow volume	Velocity
Post-Inj Cav A	Post-Injection Cavernosal Artery	Distance Stenosis Flow volume	Velocity
Sup Dorsal V	Superficial Dorsal Vein	Flow volume	Velocity
Dp Penile V	Deep Penile Vein	Flow volume	Velocity

Penile Calculation Labels

The system calculates the following ratios when the required labeled measurements have been made. The ratios display only in the patient report.

Calculation Label	Description	Required Measurements
LC / LBI	Ratio of the Left Cavernosal Artery to the Left Brachial Artery	**Cav A** (left side) **Brach A** (left side)
RC / LBI	Ratio of the Right Cavernosal Artery to the Left Brachial Artery	**Cav A** (right side) **Brach A** (left side)
LC / RBI	Ratio of the Left Cavernosal Artery to the Right Brachial Artery	**Cav A** (left side) **Brach A** (right side)
RC / RBI	Ratio of the Right Cavernosal Artery to the Right Brachial Artery	**Cav A** (right side) **Brach A** (right side)

Use the system presets to select the method used for calculating results.

M & R Configuration > Measurement and Report Preset > Measurement Method

Penile Report

The Penile exam has a report. The system transfers labeled measurements from the Penile Measurement Menu on the image screen to the patient report. The system also loads information from the patient data form into the report. You can annotate the report.

Thyroid Measurements and Calculations

All general measurements and calculations are available for use with the Thyroid exam type. In addition, the system has measurement labels in 2D-mode for specific use with the Thyroid exam.

The system displays the calculated volume for each lobe and node in the Measured Results.

See also: Report Features, Measurements and Calculations, Chapter B1, Features and Applications Reference

Use the system presets to customize the Thyroid report and the Thyroid exam.

M & R Configuration > Measurement and Report Preset

2D-Mode Measurement Labels

Measurement Label	Description	Measurement Method
Isthmus	Isthmus	---
AP	Anteroposterior	Distance
Lt Lobe	Left Lobe	---
TRV	Transverse	Distance
AP	Anteroposterior	Distance
SAG	Sagittal	Distance
Rt Lobe	Right Lobe	---
TRV	Transverse	Distance
AP	Anteroposterior	Distance
SAG	Sagittal	Distance
NOD 1 - NOD 15	Nodule	---
TRV	Transverse	Distance
AP	Anteroposterior	Distance
SAG	Sagittal	Distance

Thyroid Report

The Thyroid exam has a report. The system transfers labeled measurements from the Thyroid Measurement Menu on the image screen to the patient report. The system also loads information from the patient data form into the report. You can annotate the report.

Using the Thyroid Worksheet

The values for a measurement type display in the same worksheet even if the measurements are taken in different imaging modes.

You can edit values directly in the worksheet. When you edit one of the measurements required for a calculation, the system updates the calculated value.

B3 Obstetrical Measurements and Calculations

Obstetrical Measurements and Calculations

The ultrasound system has two exam types for the Obstetrical (OB) application, the Early OB exam and the Standard OB exam. Both exams use formulas for estimating menstrual age, estimating fetal weight, and determining growth ratios. Parameter labels are assigned to measured results used as parameters in these formulas. Each exam also supports multiple gestation studies.

- The Early OB exam is intended for **first trimester studies** and has measurement and parameter labels for use in 2D-mode.
- The Standard OB exam is intended for **second and third trimester studies** and has measurement and parameter labels for use in 2D-mode, including a label for the **Amniotic Fluid Index**.

The OB exams also have the capability for generating **Growth Analysis Graphs** for each OB exam. Growth Analysis compares actual fetal growth to predicted growth patterns. Graphs can display measured results from a single exam, or from data acquired over a series of exams and combined using the **Link Files** function.

See also: Growth Analysis Graphs, p. B3-30

See also: Linking Patient Data Files, p. B3-33

All general measurements and calculations are available for the Obstetric exam type. The results of the measurements and calculations can be used to determine an estimated menstrual age and/or estimated fetal weight. These estimations are based upon ***standard*** or ***user-defined*** tables or formulas. Standard tables or formulas are system-defined, while a user-defined table or formula contains data that you have entered using the system presets.

See also: Measurements and Calculations, Chapter B1, Features and Applications Reference

Customizing Obstetrical Measurements and Reports

Use the system presets to customize the following.

- Specify the shape, size, and default position for the caliper.
- Specify whether the background for the Measured Results section of the screen has a different color than the image background.
- Select the default measurement method for each mode.
- Select the default method for each type of measurement.
- Select the measurement methods that display as soft key selections for each mode and the order in which they display.

M & R Configuration > Measurement and Report Preset

Use the system presets to customize the OB exam.

- Specify which labels display in the Measurement Menu and the order in which they display.
- Select the default references for tables and formulas provided by the system.
- Designate a method, direct or average, for determining parameter values.
- Customize the content of the patient report.
- Create user-defined labels for 2D-mode and Doppler measurements.
- Define up to twenty tables and/or formulas to estimate menstrual age.
- Define up to five formulas to estimate fetal weight.
- Define up to twenty tables and/or formulas for growth analysis.
- Define up to five formulas for ratios of parameters.
- Define anatomy assessments for the patient report.

M & R Configuration > Measurement and Report Preset

Tables, Formulas, and Calculations to Estimate Fetal Weight and Menstrual Age

Use the system presets to select references for the tables and formulas used by the ultrasound system to calculate an estimated menstrual age and estimated fetal weight. You can also change a reference in the OB worksheet.

Estimated Fetal Weight Formulas

Use the system presets or the worksheet to designate the references (authors) for the formulas that the system uses in determining estimated fetal weights (**EFW1** and **EFW2**). You can also use the system presets to create up to five user-defined formulas for **EFW**.

M & R Configuration > Measurement and Report Preset > Item & Reference Selection > EFW/USMA

M & R Configuration > Measurement and Report Preset > User-Defined EFW Formula

Note: The calculation and display of an estimated fetal weight is dependent on the valid ranges specified by the author of an equation. Calculated values above or below the valid range display a value of xxx, such as EFW1 xxxg. If all the measurements required by the author have not been made, the system displays blanks next to the EFW label.

EFW1 and **EFW2** display in the worksheet and the patient report. **EFW** also displays in the Measured Results after the measurements required by the designated author are made.

Menstrual Age Tables and Formulas

You can designate the reference (author) for the table or formula that the system uses in determining an estimated menstrual age. Tables are available for the following parameters: **BPD**, **OFD**, **FTA**, **EFW**, **AXT**, **HC**, **ASD**, **ATD**, **AC**, **FL**, **HL**, **UL**, **BN**, **TL**, **FT**, **MSD**, **CRL** and **GS**. The system provides an estimated menstrual age based on estimated fetal weight if the Tokyo or JSUM reference is selected for **EFW1** or **EFW2**.

You can also use the system presets to create up to five user-defined menstrual age tables or formulas for system- and user-defined measurements.

M & R Configuration > Measurement and Report Preset > Item & Reference Selection > EFW/USMA

M & R Configuration > Measurement and Report Preset > User-Defined Menstrual Age

Menstrual Age

Use **Item & Reference Selection** in the system presets to select the method that the system uses to estimate menstrual age for a parameter.

- ***Direct*** estimates a menstrual age from the most recent measurement obtained for a parameter.
- ***Average*** estimates menstrual age by averaging as many as five measurements obtained for a parameter. The worksheet displays the values used to calculate the average.

Composite Menstrual Age

Use the system presets or the worksheet to select the method that the system uses for calculating a composite ultrasound menstrual age (**USMA**). The options are ***average***, one of Hadlock's eleven ***regression equations***, or a ***user-defined formula***.

The basis for an ***average*** is the estimated menstrual ages obtained from any combination of parameters. To obtain an average, the system adds the estimated menstrual ages, then divides the sum by the number of measured parameters.

Hadlock's eleven ***regression equations*** require the measurement of one or more of the following parameters: **BPD**, **HC**, **FL**, or **AC**. The required parameters display below the USMA drop-down list in the **EFW/USMA** tab.

Use **User-Defined Menstrual Age** in the system presets to define a ***user-defined formula*** for composite menstrual age.

M & R Configuration > Measurement and Report Preset > Item & Reference Selection > EFW/USMA

M & R Configuration > Measurement and Report Preset > User-Defined Menstrual Age

Indicating a Single or Multiple Study

Both the Early OB and the Standard OB exams support multiple gestational studies, providing separate measurement information for each fetus.

You can change the type of study when the Measurement function is active.

To indicate a multiple study during measurements:

1. Roll the trackball to highlight **Single** at the top of the Measurement Menu and then press the **SET** key.

   The system displays a confirmation message.

   Note: You cannot change back from a multiple-gestational study to a single-gestational study. To continue imaging on a single fetus, roll the trackball to position the pointer on the **No** button and then press the **SET** key.

2. To change to a multiple-gestational study, roll the trackball to position the pointer on the **Yes** button and then press the **SET** key.

   The system assigns the labeled measurement values already acquired in the current exam to Fetus A in the worksheet and the patient report.

3. Continue imaging for Fetus B or, to resume measurements on Fetus A, roll the trackball to highlight **A** at the top of the Measurement Menu and then press the **SET** key.

Measurement Menu

Note: During a multiple-gestational study, you can assign measured results for up to four fetuses designated as A, B, C, and D at the top of the menu.

The OB exam can display over 30 measurement and parameter labels on different pages of the Measurement Menu. At the bottom of the menu the system displays the number of the current page, such as **Page 1/3**. To access the next page of labels, roll the trackball to highlight the page number and then press the **SET** key.

Note: Measured results for OB, EOB, and Fetal Echo exams display below the measurement label on the Measurement Menu.

The Measurement Menu also provides access to the patient report, worksheet, and OB growth curve graphs. Roll the trackball to highlight the label and then press the **SET** key.

The Measurement Label menu contains system-defined parameter and measurement labels, as well as any user-defined measurement labels.

The ***Clinical menstrual age (MA)*** displays along with the Measured Results. The **Clinical MA** is the menstrual age based on the clinical last menstrual period (LMP) entered in the patient data form or as updated in the worksheet or in the patient report.

For MA parameter labels, a **Calculated MA** displays in the Measured Results next to each label to which a measured result is assigned.

Minimizing the Quantity of Labels Displayed in Measured Results

Display only the labels with measured values in the Measured Results and patient report. Display all the labels (with measured values and without measured values) in the Measured Results and patient report.

Early OB — 2D-Mode Parameter, Measurement, and Calculation Labels

See also: Standard OB — 2D-Mode Parameter, Measurement, and Calculation Labels, p. B3-11

Parameter Labels

The following parameter labels for 2D-mode are used to estimate menstrual age. Parameter labels display in the Measurement Menu, the worksheet, and the patient report. When assigned measured results, parameter labels display an estimated menstrual age (MA) if the measured result is within the range of measurements in the reference table.

MA Parameter Label	Description	Measurement Method
MSD	Mean Gestational Sac Diameter	Distance
CRL	Crown Rump Length	Distance
BPD	Biparietal Diameter	Distance
OFD	Occipital Frontal Diameter. You can measure this individually or obtain it automatically from the HC measurement.	Distance
AC	Abdominal Circumference	Ellipse
HC	Head Circumference	Ellipse
ASD	Abdominal Sagittal Diameter. You can measure this individually or obtain it automatically from the AC measurement.	Distance
ATD	Abdominal Transverse Diameter. You can measure this individually or obtain it automatically from the AC measurement.	Distance
FL	Femur Length	Distance
HL	Humerus Length	Distance
UL	Ulna Length	Distance
BN	Binocular Distance	Distance
TL	Tibia Length	Distance
FT	Foot Length	Distance
GS	Gestational Sac. Maximum Length.	Distance
FTA	Fetal Trunk Area	Ellipse
Facial Angle	Facial Angle	Angle
User-Defined #1-5	You can define up to five measurement labels and select a measurement method for each. The same five labels are available in both Early OB and Standard OB exams.	The 2D-mode measurement method assigned during the definition of the label in the system presets.

Measurement Labels

Measurement labels display on the Measurement Menu, the worksheet, and the patient report, but do not display an estimated menstrual age. User-defined labels and their accompanying measured results display as specified in the **Item & Reference Selection** menu of the system presets.

Measurement Label	Description	Measurement Method
Yolk Sac	Yolk Sac Diameter	Distance
APTD	Anteroposterior Trunk Diameter	Distance
TTD	Transverse Trunk Diameter	Distance
NT	Nuchal Translucency	Distance
NF	Nuchal Fold Thickness	Distance
CTAR	Cardiothoracic Area Ratio: Fetal Heart Area/Fetal Thoracic Cross-Sectional Area	Area Ratio
Facial Angle	Facial Angle	Angle
Ant CV	Anterior Cerebral Ventricle Diameter	Distance
Post CV	Posterior Cerebral Ventricle Diameter	Distance
User-Defined #1-5	You can define up to five measurement labels and select a measurement method for each. The same five labels are available in both Early OB and Standard OB exams.	The 2D-mode measurement method assigned during the definition of the label in the system presets.

Note: The **CTAR** label is available for the OB exams and for the Fetal Echo exam.

Note: Age can be calculated when **APTD** and **TTD** are measured together.

Calculation Labels

The following calculation labels for 2D-mode are available when the Early OB exam is active. Calculation labels do not display in the Measurement Menu. The system performs the calculations once the required measurements are made, displays the calculated values in the Measured Results and then transfers the values to the worksheet and the patient report.

Calculation Label	Description	Required Measurements
Clinical MA	Menstrual Age by last menstrual period	Calculated from the LMP date.
Clinical EDC	Estimated Date of Confinement	Determined by LMP date.
US MA	Composite Menstrual Age by Ultrasound	Determined from all Menstrual Age parameters and calculations.
US EDC	Estimated Date of Confinement by Ultrasound	Determined from all ultrasound parameters and calculations.
EFW1 and **EFW2**	Estimated Fetal Weight	The required measurements vary depending on the selected references (authors).
AXT	Anteroposterior Trunk Diameter multiplied by Transverse Trunk Diameter	APTD TTD

M-Mode Parameter, Measurement, and Calculation Labels

This label displays in the Measurement Menu.

M-mode Calculation Label	Description	Required Measurements
FHR	Fetal Heart Rate, in beats per minute	One to five cardiac cycles in M-mode, depending on the number of cycles selected in the system presets

Doppler Parameter, Measurement, and Calculation Labels

This label displays in the Measurement Menu.

Doppler Calculation Label	Description	Required Measurements
FHR	Fetal Heart Rate, in beats per minute	One to five Doppler cardiac cycles, depending on the number of cycles selected in the system presets

Standard OB — 2D-Mode Parameter, Measurement, and Calculation Labels

The Standard OB exam displays over 30 measurement and parameter labels on different pages of the Measurement Menu. Use the system presets to specify which labels display in the Measurement Menu and the order in which they display.

M & R Configuration > Measurement and Report Preset > Item & Reference Selection

Parameter Labels

The following parameter labels for 2D-mode are used to estimate menstrual age. Parameter labels display in the Measurement Label menu and in the patient report, including the worksheet. When assigned measured results, parameter labels display an estimated menstrual age.

MA Parameter Label	Description	Measurement Method
BPD	Biparietal Diameter. You can measure this individually or obtain it automatically from the HC measurement.	Distance
OFD	Occipital Frontal Diameter. You can measure this individually or obtain it automatically from the HC measurement.	Distance
HC	Head Circumference	Ellipse
ASD	Abdominal Sagittal Diameter. You can measure this individually or obtain it automatically from the AC measurement.	Distance
ATD	Abdominal Transverse Diameter. You can measure this individually or obtain it automatically from the AC measurement.	Distance
AC	Abdominal Circumference	Ellipse
FL	Femur Length	Distance
HL	Humerus Length	Distance
UL	Ulna Length	Distance
BN	Binocular Distance	Distance
TL	Tibia Length	Distance
FT	Foot Length	Distance
FTA	Fetal Trunk Area	Ellipse
User-Defined #1-5	You can define up to five measurement labels and select a measurement method for each. The same five labels are available in both Early OB and Standard OB exams.	The 2D-mode measurement method assigned during the definition of the label in the system presets.

Measurement Labels

Measurement labels display in the Measurement Menu, the worksheet, and the patient report but do not display an estimated menstrual age. User-defined labels and their accompanying measured results also display on the worksheet and the patient report.

Measurement Label	Description	Measurement Method
CL	Clavicle Length	Distance
TC	Thoracic Circumference	Ellipse
Right RL	Renal Length Right	Distance
Left RL	Renal Length Left	Distance
Right RAP	Renal Dimension Anterior-Posterior Right	Distance
Left RAP	Renal Dimension Anterior-Posterior Left	Distance
AFI	Amniotic Fluid Index	Distance
HW	Hemispheric Width	Distance
TCD	Transcerebellar Diameter	Distance
LVW	Lateral Ventricle Width	Distance
Cist Magna	Cisterna Magna (Posterior Fossa)	Distance
Cervix Len	Cervical Length	Distance
NT	Nuchal Translucency	Distance
NF	Nuchal Fold Thickness	Distance
Umb VD	Umbilical Vein Diameter	Distance
APTD	Anteroposterior Trunk Diameter	Distance
TTD	Transverse Trunk Diameter	Distance
CTAR	Cardiothoracic Area Ratio: Fetal Heart Area/Fetal Thoracic Cross-Sectional Area	Area Ratio
Facial Angle	Facial Angle	Angle
Ant CV	Anterior Cerebral Ventricle Diameter	Distance
Post CV	Posterior Cerebral Ventricle Diameter	Distance
User-Defined #1-5	You can define up to five measurement labels and select a measurement method for each. The same five labels are available in both Early OB and Standard OB exams.	The 2D-mode measurement method assigned during the definition of the label in the system presets.

Fetal Heart Measurement Label	Description	Measurement Method
AoD Arch	Aortic Arch Diameter	Distance
Asc AoD	Ascending Aorta Diameter	Distance
Desc AoD	Descending Aorta Diameter	Distance
IVSd	Interventricular Septal dimension at end-diastole	Distance
LVIDd	Left Ventricular Internal Dimension at end-diastole	Distance
LVPWd	Left Ventricular Posterior Wall dimension at end-diastole	Distance
IVSs	Interventricular Septal dimension at end-systole	Distance
LVIDs	Left Ventricular Internal Dimension at end-systole	Distance
LVPWs	Left Ventricular Posterior Wall dimension at end-systole	Distance
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
PA	Pulmonary Artery	Distance
RVDd	Right Ventricular Dimension at end-diastole	Distance
RVOT diam	Right Ventricular Outflow Tract diameter	Distance

Note: Age can be calculated when **APTD** and **TTD** are measured together.

Calculation Labels

The following calculation labels for 2D-mode are available when the OB exam is active. Calculation labels do not display in the Measurement Menu. The system performs the calculations after the required measurements are made, displays the calculated values in the Measured Results and then transfers the values to the worksheet and the patient report. The system displays a range of values for a ratio based on the LMP or IVF date; the calculated value is in range or out of range relative to the **Clinical MA**.

Calculation Label	Description	Required Measurements
TCD/AC	Ratio of Transcerebellar Diameter to Abdominal Circumference	TCD AC
LVW/HW	Ratio of Lateral Ventricular Width to Hemispheric Width	LVW HW
AFI	Amniotic Fluid Index. Sum of four distance measurements made on four different images.	Distance
FL/AC	Ratio of Femur Length to Abdominal Circumference	FL AC
HC/AC	Ratio of Head Circumference to Abdominal Circumference	HC AC
FL/BPD	Ratio of Femur Length to Biparietal Diameter	FL BPD
CI	Cephalic Index Short axis / long axis * 100	BPD OFD
AXT	Anteroposterior Trunk Diameter multiplied by Transverse Trunk Diameter	APTD TTD
Cor BPD	BPD corrected by a formula to adjust the head shape	BPD
EFW1, **EFW2**	Two displays for estimated fetal weight	The required measurements vary depending on the selected reference (author).
Clinical MA	Menstrual Age by last menstrual period	Calculated from the LMP date.
Clinical EDC	Estimated Date of Confinement	Determined by LMP date.
US MA	Composite Menstrual Age by ultrasound	Determined from all Menstrual Age parameters and calculations.
US EDC	Estimated Date of Confinement by ultrasound	Determined from all ultrasound parameters and calculations.

Fetal Heart Calculation Label	Description	Required Measurements
FS%	Percentage of Fractional Shortening FS%=(LVIDd – LVIDs)/LVIDd*100	LVIDd LVIDs

M-Mode Parameter, Measurement, and Calculation Labels

These labels display in the Measurement Menu.

Fetal Heart Measurement Label	Description	Measurement Method
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
Asc AoD	Ascending Aorta Diameter	Distance
AoD Arch	Aortic Arch Diameter	Distance
Desc AoD	Descending Aorta Diameter	Distance
RVOT diam	Right Ventricular Outflow Tract diameter	Distance
PA	Pulmonary Artery	Distance
RVDd	Right Ventricular Dimension at end-diastole	Distance
IVSd	Interventricular Septal dimension at end-diastole	Distance
LVIDd	Left Ventricular Internal Dimension at end-diastole	Distance
LVPWd	Left Ventricular Posterior Wall dimension at end-diastole	Distance
IVSs	Interventricular Septal dimension at end-systole	Distance
LVIDs	Left Ventricular Internal Dimension at end-systole	Distance
LVPWs	Left Ventricular Posterior Wall dimension at end-systole	Distance

M-mode Calculation Label	Description	Required Measurements
FHR	Fetal Heart Rate, in beats per minute	One to five cardiac cycles in M-mode, depending on the number of cycles selected in the system presets

Fetal Heart Calculation Label	Description	Required Measurements
FS%	Percentage of Fractional Shortening FS% = (LVIDd – LVIDs)/LVIDd * 100	LVIDd LVIDs

Doppler Parameter, Measurement, and Calculation Labels

These labels display in the Measurement Menu.

Doppler Measurement Label	Description	Measurement Method
Umb A	Umbilical Artery	PI Auto
MCA	Middle Cerebral Artery	PI Auto
Lt Uterine A	(Maternal) Left Uterine Artery	PI Auto, PI Manual
Rt Uterine A	(Maternal) Right Uterine Artery	PI Auto, PI Manual
User-Defined #1-5	You can define up to five measurement labels and select a measurement method for each label.	The Doppler measurement method assigned to the label in the system presets.

Fetal Heart Measurement Label	Description	Measurement Method
LVOT Vmax	Left Ventricular Outflow Tract Velocity maximum	Velocity
LVET	Left Ventricular Ejection Time	Time
Asc Ao Vmax	Ascending Aorta Velocity maximum	Velocity
Ao Arch Vmax	Aortic Arch Velocity maximum	Velocity
Desc Ao Vmax	Descending Aorta Velocity maximum	Velocity
DA Vmax	Ductus Ateriosus Velocity maximum	Velocity
RVOT Vmax	Right Ventricular Outflow Tract Velocity maximum	Velocity
RVET	Right Ventricular Ejection Time	Time
PA	Pulmonary Artery	Velocity

Doppler Calculation Label	Description	Required Measurements
FHR	Fetal Heart Rate, in beats per minute	One to five cardiac cycles in Doppler, depending on the number of cycles selected in the system presets

Measuring Fetal Heart Rate

Use the system presets to select the number of heart cycles to use with the heart rate tool.

M & R Configuration > Heart Rate Tool

To measure Fetal Heart Rate:

1. During an OB or Early OB exam in M-mode or Doppler, activate the Measurement function.
2. Roll the trackball to select the check box for **FHR** in the on-screen menu and then press the **SET** key.
3. Roll the trackball to position the measurement marker on the M-mode sweep or Doppler spectrum.

   The system updates the **HR** value in the Measured Results.

Determining an Amniotic Fluid Index (AFI)

Use the Amniotic Fluid Index (AFI) measurement method to calculate an index for amniotic fluid volume. This method requires a distance measurement made in each of the four quadrants, using four separate images.

The procedure can be performed in 2D-mode, Dual mode, or 4B-mode. If 2D-mode is used, a new image must be acquired for each measurement. If Dual mode is used, one measurement can be made on each of the first two images and new images must be acquired for the last two measurements.

To measure an Amniotic Fluid Index:

1. During an OB exam, activate the Measurement function.
2. Roll the trackball to select **AFI** in the on-screen menu and then press the **SET** key.
3. Roll the trackball to position the first measurement marker and then press the **SET** key.

   The system anchors the marker and displays the second marker.
4. Roll the trackball to position the second marker and then press the **SET** key.

   The system anchors the marker and displays the distance value in Measured Results.
5. Obtain additional images as required and perform steps 1 through 4 for each image until all four quadrants are measured.

   The system displays the distance value (**Q**) for each quadrant. When the fourth measurement is complete, the system calculates the amniotic fluid index (**AFI**) and displays the value in Measured Results.

To measure AFI quadrants in sequence (Q1 through Q4):

1. During an OB exam, acquire and freeze four 2D-mode images using 4B-mode and then activate the measurement function.
2. Roll the trackball to select **AFI** in the Measurement Menu and then press the **SET** key.

   The system displays the first measurement marker (horizontal line) for the first quadrant (**Q1**).
3. For each quadrant measurement:
   a. Roll the trackball to position the first measurement marker and then press the **SET** key.

      The system anchors the marker and displays the second marker. The second marker contains a vertical line (to facilitate visualization) in addition to the second horizontal line.

   b. Roll the trackball to position the second marker and then press the **SET** key.

      The system anchors the marker, displays the vertical distance value in Measured Results, and updates the calculated amniotic fluid index. The system also displays a marker (horizontal line) for the next quadrant in the sequence.

To measure selected AFI quadrants non-sequentially, complete the following steps for each quadrant:

1. During an OB exam, acquire and freeze a 2D-mode image and then activate the measurement function.

   Note: You can acquire and freeze multiple images using 4B-mode or Dual mode.
2. For each image on the screen (if multiple images were acquired and frozen):
   a. Roll the trackball to select the required AFI quadrant (such as **Q2**) in the Measurement Menu and then press the **SET** key.

      The system displays the first measurement marker (horizontal line) for the selected quadrant.

   b. Roll the trackball to position the first measurement marker and then press the **SET** key.

      The system anchors the marker and displays the second marker.

   c. Roll the trackball to position the second marker and then press the **SET** key.

      The system anchors the marker, displays the vertical distance value in Measured Results, and updates the calculated amniotic fluid index.

Determining a Cardiothoracic Area Ratio (CTAR)

To determine a CTAR:

1. Activate the measurement function.
2. Select **CTAR** in the Measurement Menu and then press the **SET** key on the control panel.

   The system activates the **Area Ratio** measurement method. Area measurements use either the Ellipse or Trace method (selected in the system presets).
3. To determine the area using the ellipse method:
   a. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

      The system anchors the marker and displays an ellipse.

   b. Roll the trackball to rotate the first axis and adjust the size of the ellipse and then press the **SET** key.

      The system updates the measurement data in the Measured Results.

   c. Roll the trackball to adjust the shape of the ellipse along the second axis and then press the **SET** key.

      The system updates the measurement data in the Measured Results.

   d. Roll the trackball to position the ellipse on the image and then press the **SET** key to anchor the ellipse.

   e. Repeat the steps for determining an area measurement using the ellipse method.

      The system displays the traced area for each structure (**A** = smaller area, **B** = larger area) and calculates the ratio of the two areas (**%**).
4. To determine the area using a trace method:
   a. Roll the trackball to position the first measurement marker and then press the **SET** key on the control panel.

      The system anchors the marker and displays a second marker.

   b. Roll the trackball to create a trace of the structure.

      The system updates the measurement data in the Measured Results.

      Note: You can rotate the **SELECT** control on the control panel counterclockwise to delete the trace before completing the circumference.

   c. To complete the trace, press the **SET** key.

      The system displays the area of the traced structure in the Measured Results.

   d. Repeat the steps for determining an area measurement using the trace method.

      The system displays the traced area for each structure (**A**, **B**) and calculates the ratio of the two areas (**%**).

Quik Estimated Fetal Weight

Use the system presets to display the **Quik EFW** soft key selection.

M & R Configuration > Measurement and Report Preset > Customize Keys

To	Do This
Activate Quik EFW to automatically calculate the estimated fetal weight	1. Press **CALIPER** to activate the measurement function. 2. Press the toggle key for **Quik EFW**. The system automatically selects measurement labels and displays the corresponding markers. 3. Press **SET** to anchor the markers. The system automatically calculates and displays the EFW on the measurement screen.

Reassign AC

When **AC** (Abdominal Circumference) is measured, the system assigns **ATD** (Abdominal Transverse Diameter) to the larger measurement value and **ASD** (Abdominal Sagittal Diameter) to the smaller measurement value.

To	Do This
Reassign Abdominal Circumference measurement	1. Press **CALIPER** to activate the measurement function. 2. Select the **AC** measurement label. 3. Measure ATD and ASD. 4. Before confirming the measurement (measurement area dotted green), press the toggle key for **ATD/ASD**. The system toggles the ATD and ASD measurement results. 5. Position the measurement area and then press **SET**. **Note:** Available only when **AC with ATD/ASD Measurement** is selected in the system presets and when the measurement method is **Ellipse**.

Using *syngo* Auto OB

You can use the *syngo* Auto OB measurement method during an OB exam or during review to measure fetal anatomy.

- Biparietal Diameter (BPD)
- Occipital Frontal Diameter (OFD)
- Head Circumference (HC)
- Abdominal Circumference (AC)
- Femur Length (FL)
- Humerus Length (HL)

If a real-time image is displayed during an OB exam or *syngo* Auto OB is unavailable, the associated soft key is disabled.

Use the system presets to enable or disable the Auto OB feature.

M & R Configuration > Measurement and Report Preset > Customize Keys

To	Do This
Activate *syngo* Auto OB	1. Begin an OB exam in 2D-mode and then press **FREEZE**. 2. Press **CALIPER** to activate the measurement function. 3. Press the toggle key for **Auto OB** to select **On**. 4. Select the required Auto OB measurement label. **Note:** The Auto OB labels display in blue. The system displays the value in the Measured Results. 5. Press **SET** to anchor the markers.
Deactivate *syngo* Auto OB	▪ Press the toggle key for **Auto OB** to select **Off**.

Obstetrical Reports

The Obstetrical patient report has the same structure for both the Early OB exam and the Standard OB exam. View and edit the report content using the report tabs:

- The **Data** tab displays information from the patient data form along with labeled measurement and calculation results for all imaging modes.
- The **Standard Description** tab provides drop-down boxes with selections describing structural observations and a comments area for the Standard OB exam.
- The **Biophysical Profile** tab provides selection boxes for entering observed fetal parameters.

The OB report supports multiple gestational reporting and growth analysis graphs. You can generate growth analysis graphs by using data only from the current exam or by linking files to combine current data with data from previous exams. You can annotate the report and edit system-supplied data such as the LMP date. Measurements can be edited in the worksheet.

See also: Growth Analysis Graphs, p. B3-30

See also: Linking Patient Data Files, p. B3-33

Use the system presets to select measurement and parameter labels to be included in an OB Report.

M & R Configuration > Measurement and Report Preset > Item & Reference Selection

M & R Configuration > Measurement and Report Preset > Display Item

Use the system presets to customize the descriptive data fields on the **Standard Description** tab.

M & R Configuration > Measurement and Report Preset > Anatomy Assessments

Multiple Gestational Reporting

When you are performing a multiple-gestation OB exam, the system maintains separate measurement and calculation results for each fetus and displays the results on separate OB report pages.

See also: Indicating a Single or Multiple Study, p. B3-6

To view information for a fetus:

- During the Measurement function, roll the trackball to highlight **A**, **B**, **C**, or **D** at the top of the on-screen menu and then press the **SET** key. Display the patient report.
- While viewing a worksheet, a patient report, or a growth analysis graph, roll the trackball to select **Fetus A**, **B**, **C**, or **D** at the bottom of the page and then press the **SET** key.

Worksheet

In addition to the general report editing capability, the OB report has a worksheet you can use to edit measurement values, menstrual age data, and reference selections.

To access the worksheet:

1. During the Measurement function, roll the trackball to highlight **WorkSheet** in the Measurement Menu and then press the **SET** key.
2. To view different pages of the worksheet, roll the trackball to highlight **Prev** or **Next** at the bottom of the page and then press the **SET** key.
3. To return to the image screen, roll the trackball to highlight **Return** at the bottom of the page and then press the **SET** key.

Editing Worksheets

Use the worksheet for editing estimated menstrual age data, estimated fetal weight data and references. When editing the worksheet, you can:

- Modify the **LMP** (or **IVF**), **Clinical MA**, and **Clinical EDC** fields. These fields can also be modified in the OB Report.
- Select a **reference** (author) other than the default for determining an estimated menstrual age for each parameter and calculation.
- Select a **reference** (author) other than the default for determining an estimated fetal weight (**EFW**).
- Select the variables to be used in the **USMA** and **EFW** calculations, if an author has more than one formula.

  Note: An **EFW** is calculated according to the ranges specified by the author of the equation. Calculated values above or below the valid range display a value of xxx, such as EFW1 xxxg. If all the measurements required by the author have not been made, the system displays blanks next to the EFW label.

- Edit the values used for **averaging** when an averaged method is used for determining an estimated menstrual age.

  Note: Parameters or calculations are determined by either a **direct** measurement method or an **averaged** method. Use the system presets to designate a method:

  Direct uses last measured value to estimate a menstrual age.

  Average calculates a simple average from as many as five measurements for each parameter or calculation.

Modify LMP, Clinical MA or Clinical EDC

When you edit either the **Clinical MA** or the **Clinical EDC**, the system determines the **LMP**.

To modify an LMP (or IVF), Clinical MA, or Clinical EDC:

1. Roll the trackball to position the pointer on the field for the **LMP**, **Clinical MA**, or **Clinical EDC** and then press the **SET** key.
2. Use the keyboard to enter an appropriate date or select a date from the drop-down calendar. The system automatically updates the corresponding fields in the worksheet, the patient report, and the patient data form.

Editing this field:	Causes the system to recalculate:
LMP	Clinical MA and Clinical EDC
Clinical MA	LMP and Clinical EDC
Clinical EDC	LMP and Clinical MA

Select a Reference (Author)

An estimated fetal weight is calculated according to the ranges specified by the author of the equation. Calculated values above or below the valid range display a value of xxx, such as EFW1 xxxg. If all the measurements required by the author have not been made, the system displays blanks next to the EFW label.

The system determines the estimated menstrual age or estimated fetal weight based on the selected author's formulas or tables.

To select a reference:

1. Roll the trackball to position the pointer on the name of the reference for the parameter or calculation label and then press the **SET** key.
2. Roll the trackball to position the pointer on the author's name and then press the **SET** key.

   The system uses the selected author's formulas or tables to recalculate an estimated age or fetal weight and updates the resulting value in the Measured Results, the worksheet, and the patient report.

   For the **Williams EFW%** section, the system calculates the EFW% value.

   Note: EFW% data displays when the estimated fetal age is between 22 and 40 weeks.

Delete Measurements

To delete a measurement used for averaging:

1. Roll the trackball to the value used for averaging and then press the **SET** key.

   The system highlights the value.
2. Use the **Backspace** key on the keyboard to delete the value and then press the **Enter** key.

   The system updates the averaged value based on the remaining measurements.

Early OB Patient Report

The patient report for the Early OB exam has three tabs, each of which may have multiple pages. The report includes data from the patient data form, measured results obtained during an exam that are assigned to a label, and selected descriptive data.

Use the system presets to select specific measurement, parameter, and calculation labels and patient data form entries to include in the Early OB Report.

M & R Configuration > Measurement and Report Preset > Item & Reference Selection

M & R Configuration > Measurement and Report Preset > Display Item

Descriptive Data Fields — Early Description Tab

The Early Description tab of the OB patient report contains descriptive data fields. Options for each field are shown in the following table:

Descriptive Data Fields	Options	Descriptive Data Fields	Options
Viability	(Blank) **Yes** **No** **Not Applicable**	**Fetal Pole**	(Blank) **Seen** **Not Seen** **Multiple**
Uterus	(Blank) **Normal** **Anteflexed** **Retroflexed** **Fibroid(s)** **Abnormal** **Absent**	**Cul-de-sac Fluid**	(Blank) **Sm Amount** **Lg Amount** **None**
Cervix	(Blank) **Normal** **Abnormal** **Incompetent**	**Adnexa**	(Blank) **Seen** **Not Seen** **Mass Rt** **Mass Lt**
Gestational Sac	(Blank) **Intrauterine** **Extrauterine** **Not Seen** **Multiple**	---	---

Standard OB Patient Report

The patient report for the Standard OB exam includes data from the patient data form, measured results obtained during an exam that have been assigned to a label, and selected descriptive data.

Use the system presets to select specific measurement, parameter, and calculation labels and patient data form entries to include in the Standard OB Report.

M & R Configuration > Measurement and Report Preset

Descriptive Data Fields — Standard Description Tab

The Standard Description page of the Standard OB patient report contains descriptive data fields. Each data field has a list of selectable options. You can either select an option for each individual field or apply a predefined set of options to all fields.

Use the system presets to restore the factory-defined set of options to all data fields.

M & R Configuration > Measurement and Report Preset > Anatomy Assessments

To access the standard description tab:

1. During an OB exam, access the patient report.
2. Select the **Standard Description** tab.

   The data fields are blank.

To	Do This
Apply a predefined set of options to all data fields	▪ Press the toggle key for **User Setting**. The system updates the report with a predefined set of options.
Select an option for each individual data field	▪ Click the required option in the list.
Define a set of options to apply to all data fields	1. To remove all displayed options, press the toggle key for **Clear**. 2. Select the required option for each data field. 3. Press the toggle key for **Create Setting**. The system applies the modified options to subsequent exams when you press the toggle key for **User Setting**.
Restores the factory default settings for all data fields	▪ Press the toggle key for **Factory Setting**.
Remove all displayed options in the data fields	▪ Press the toggle key for **Clear**.

Descriptive Data Field	Options	Descriptive Data Field	Options
Fetal Heart Motion	(Blank) **Motion Seen** **No Motion Seen** **Not Applicable**	**4 CH Heart**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Fetal Number	(Blank) **Singleton** **1 of 2** **2 of 2** **Multiple**	**Ao Arch**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Fetal Position	(Blank) **Vertex** **Breech** **Transverse** **Oblique** **Variable**	**4 Extremities**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
3-V Cord	(Blank) **Yes** **No**	**Abdominal Wall**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
AF Volume	(Blank) **Adequate** **Increased** **Decreased**	**Stomach**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Placenta Grade	(Blank) **0** **1** **2** **3**	**Bowel Pattern**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Placenta Location	(Blank) **Anterior** **Posterior** **Fundal** **Right** **Left**	**Bladder**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**

Descriptive Data Field	Options	Descriptive Data Field	Options
Previa	(Blank) **None** **Marginal** **Partial** **Complete**	**Genitalia**	(Blank) **Not Seen** **Male** **Female**
Facial Profile	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**R Kidney**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
L Ankle/Foot	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**L Kidney**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
R Ankle/Foot	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**Lateral Ventricles**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Cardiac Rhythm	(Blank) **Normal** **Abnormal**	**LVOT**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Ductal Arch	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**RVOT**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Placental Cord	**Center** **Marginal** **Velamentous**	**Lips/Palate**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**

Descriptive Data Field	Options	Descriptive Data Field	Options
Choroid	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**Posterior Fossa**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Cerebellum	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**Nuchal Fold**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
C-Spine	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**Sacrum**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
T-Spine	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**Diaphragm**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
L-Spine	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**Lungs**	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**
Cord Insertion	(Blank) **Seen** **Previously Seen** **Not Seen** **Abnormal**	**---**	**---**

Biophysical Profile

The patient report includes the following descriptive fields:

- Fetal Tone
- Fetal Breathing
- Fetal Movements
- Amniotic Fluid

Enter a value of 0, 1, or 2 for each field.

- To increase the number for a field, roll the trackball to position the pointer on the arrow to the left of the number and then press the **SET** key.
- To decrease the number for a field, roll the trackball to position the pointer on the arrow to the right of the number and then press the **SET** key.

When a value is selected for every field, the system totals the four fields to calculate a score for the biophysical profile.

Growth Analysis Graphs

A growth analysis graph displays curves or lines that indicate predicted fetal growth patterns according to the selected reference for a parameter, measurement, or calculation label. The system plots the measured results obtained for measurement, parameter, and calculation labels on the graphs.

A graph can display information acquired in the current exam only, or current information combined with data from earlier exams.

Enter growth data from previous OB examinations in the **OB History** form for use in trend analysis with **Growth Curves**.

Information can be graphed and displayed for up to ten exams. Use the Link Files function to combine data from multiple exams.

See also: Linking Patient Data Files, p. B3-33

Labels — Growth Analysis Graphs

Graph	Description	References
MSD	Mean Gestational Sac Diameter	Rempen
CRL	Crown Rump Length	Hadlock, Robinson, Hansmann, Rempen, ASUM, JSUM, Osaka, Tokyo
BPD	Biparietal Diameter	Hadlock, Merz, Lasser, Hansmann, Rempen, ASUM, Chitty (O-I), Chitty (O-O), JSUM, Osaka, Tokyo, Nicolaides, Verburg
OFD	Occipital Frontal Diameter	Hansmann, ASUM, Chitty, Nicolaides
HC	Head Circumference	Hadlock, Merz, Hansmann, ASUM, Chitty, Nicolaides, Verburg
AC	Abdominal Circumference	Hadlock, Merz, Jeanty, ASUM, Chitty, JSUM, Nicolaides, Verburg
FL	Femur Length	Jeanty, Hadlock, Merz, Hansmann, ASUM, JSUM, Osaka, Tokyo, Nicolaides, Chitty, Verburg
HL	Humerus Length	Jeanty, Merz, Hansmann, ASUM, Osaka, Chitty
UL	Ulna Length	Jeanty, Merz, Hansmann, Chitty
TL	Tibia Length	Jeanty, Merz, Hansmann, Chitty
FT	Foot Length	Mercer, Chitty
TC	Thoracic Circumference	Chitkara
CL	Clavicle Length	Yarkoni
Left RL, **Right RL**	Renal Length, left and right	Bertagnoli, Hansmann
Left RAP, **Right RAP**	Renal Dimension Anterior-Posterior, left and right	Bertagnoli, Hansmann
FTA	Fetal Trunk Area	Osaka
AXT	Anteroposterior Trunk Diameter multiplied by Transverse Trunk Diameter	Tokyo, JSUM
GS	Gestational Sac	Tokyo, Osaka
AFI	Amniotic Fluid Index	Moore
TCD	Transcerebellar Diameter	Nicolaides, Verburg
Cist Magna	Cisterna Magna (Posterior Fossa)	Nicolaides
Ant CV	Anterior Cerebral Ventricle Diameter	Nicolaides
Post CV	Posterior Cerebral Ventricle Diameter	Nicolaides
EFW1, **EFW2**	Estimated Fetal Weight	Hadlock, Hansmann, Jeanty, Yarkoni, Osaka, JSUM, Tokyo, Willliams
HC/AC	A ratio of Head Circumference to Abdominal Circumference	Campbell, Nicolaides
FL/AC	A ratio of Femur Length to Abdominal Circumference	Hadlock
FL/BPD	A ratio of Femur Length to Biparietal Diameter	Hohler
CI	Cephalic Index	Hadlock, Chitty

Graph	Description	References
TCD/AC	A ratio of Transcerebellar Diameter to Abdominal Circumference	Meyer, Nicolaides
Umb a PI	Umbilical Artery Pulsatility Index	JSUM
Umb A RI	Umbilical Artery Resistive Index	JSUM
MCA PI	Middle Cerebral Artery Pulsatility Index	JSUM
MCA RI	Middle Cerebral Artery Resistive Index	JSUM
User-Defined #1-5	A user-defined 2D-mode parameter label	User-defined

To view a Growth Analysis Graph:

1. Access the growth analysis graph using one of the two following methods:
   - During the Measurement function in an Obstetrical exam, roll the trackball to highlight **Graph** in the Measurement Menu and then press the **SET** key.
   - While viewing the worksheet or the patient report, roll the trackball to highlight **Graph** at the bottom of the page and then press the **SET** key.

   The system displays a graph.
2. To view another graph, roll the trackball to position the pointer on the arrow next to the drop-down list of measurement labels and then press the **SET** key.

   The system displays the list of measurement labels.
3. Roll the trackball to highlight the measurement you want to graph and then press the **SET** key.

   The system displays a dot representing the value in the patient report for that measurement. The dot is plotted against measurement values in the vertical axis and Clinical MA in the horizontal axis.
4. To change the reference author, roll the trackball to position the pointer on the arrow next to the drop-down list of references and then press the **SET** key.

   The system displays the list of growth analysis references (authors) for the selected measurement.
5. Roll the trackball and use the scroll bar as necessary to highlight the reference you want to use for the measurement and then press the **SET** key.

   The system displays a line representing the mean values for that measurement over time, and lines representing one standard deviation.
6. To bring the dot representing the measurement value into line with the growth analysis graph, adjust the LMP date.

Displaying Labels next to Growth Analysis Graphs

Use the system presets to enable or disable the display of the labels and values for all measured or calculated parameters next to the Growth Analysis graph (also called Growth Curves). The currently displayed Growth Analysis graph for the selected label and author is not affected by this selection.

If the SD (Standard Deviation) is enabled in system presets, then the system also displays the SD for each parameter.

Quik Graph and Quik Trend

You can display current or previous graphs as quad formats.

Use the system presets to display **Quik Graph** and **Quik Trend** as soft key selections.

To	Do This
Activate Quik Graph	1. Press **CALIPER** to activate the measurement function. 2. Press the toggle key for **Quik Graph**. The system displays the graphs in the current study.
Activate Quik Trend	1. Press **CALIPER** to activate the measurement function. 2. Press the toggle key for **Quik Trend**. The system displays all graphs including the graphs from previous studies.

Linking Patient Data Files

The ***Link Files*** feature combines stored patient information from previous OB exams with current data to produce growth analysis graphs.

All exams used in growth analysis must be imported to the hard disk, and use an identical ***Patient ID***.

If files are stored on a CD, the files containing previous exam data for the current patient must be imported to the hard drive when the request for linking is made.

When a link is requested, the system compares the Patient ID for the current exam to the Patient ID for each report stored on the hard drive. Any or all of the displayed files can be selected for linking.

File linking causes the system to compare the value obtained for a measurement in the current exam to earlier results for the same measurement.

Selecting Files for Linking

To select files for linking:

1. Roll the trackball to highlight the **Link Files** button at the bottom of the page in the worksheet, the patient report, or a growth analysis graph.

   The system displays the **Link Files** screen. The current patient name and ID display in the appropriate fields.
2. Roll the trackball to the **Search** button and press the **SET** key.
3. To include all displayed files in the link, roll the trackball to position the pointer on the **Select All** button and then press the **SET** key.
4. To include selected files in the link, roll the trackball to position the pointer on the box adjacent to the patient name and then press the **SET** key. Repeat for each file to be linked.

   The system displays a check mark (✓) next to each selected file.
5. To remove a selected file from the link, roll the trackball to the check box and then press the **SET** key.

   The system removes the check mark (✓).
6. To search for additional patient files, enter the patient name in the **Patient/File Search** box, roll the trackball to the **Search** button and then press the **SET** key.
7. When you have all the files selected, roll the trackball to highlight the **Link** option and then press the **SET** key.

   The system links measurement information from each selected file after comparing the LMP dates for all of the files. The LMP date must be the same for each exam. If the LMP is different between exams or is missing from a file, the system displays an input screen where you can specify an LMP date.

   Entering or changing the LMP date on the screen only affects the file link process, and does not change the information in the worksheet or the patient report, or stored on disk. This allows the LMP date to be adjusted to include data in the graphs, without changing the exam records.

To view linked file data in growth graphs:

1. Access the growth analysis graph and select a growth parameter and author from the drop-down lists.
2. To view measurement data from previous, linked exam reports, roll the trackball to **Previous** at the bottom of the screen and then press the **SET** key.

   The system displays data from both the current and previous exams on the graphs.
3. To remove previous data from graphs, deselect the **Previous** box.

Entering Growth Data

You can manually enter growth data for GS, CRL, BPD, HC, AC, AXT, FL, HL, and EFW1 parameters. The system incorporates the manually entered growth data into the growth analysis graph (growth curves) on the OB report.

The system retains manually entered growth data until the examination ends.

To manually enter growth data:

Note: The ultrasound system does not check manually entered growth data for reasonability or internal consistency.

1. During an OB exam, press the **Report** key on the keyboard.
2. To display the **Graph** screen, click **Graph** on the report or select **Graph** on the Measurement Menu. Or, press the toggle key for **Graph**.
3. Click **OB History**.
4. Enter data for any or all of the GS, CRL, BPD, HC, AC, AXT, FL, HL, and EFW1 parameters for each fetus, from up to five examinations.
5. Click **OK** to save changes and exit the form.
6. To display the curve of the entered data click **Previous**.
7. To exit the OB report, click **Return**. Or, press the **Report** key on the keyboard or the **ESCAPE** key on the control panel.

B4 Urology Measurements and Calculations

Urology Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for use with the Urology exam. The exam has specific 2D-mode labels and a patient report.

See also: Measurements and Calculations, Chapter B1, Features and Applications Reference

Customizing Urology Measurements and Reports

Use the system presets to customize the Urology exam.

- Specify the shape, size, and default position for the caliper
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Select the measurement methods that display as soft key selections for each mode and the order in which they display
- Customize display and report options and enable operator and referring physician information for the patient report
- Define the Comments Library for the patient report

M & R Configuration > Measurement and Report Preset

2D-Mode Measurement Labels

Measurement Label	Description	Measurement Method Options
U Blad	Urinary bladder	Volume method
Pre V	Pre-Void Volume	Any volume method
Post V	Post-Void Volume	Any volume method
Prostate-V1	Prostate Volume	3 Dist Volume
Length	The system calculates the volume when all three distance measurements have been performed. The volume displays in the patient report and in the Measured Results.	Distance
Width		Distance
Depth		Distance
Prostate-V2	Prostate Volume	3 Dist Volume
Length	The system calculates the volume when all three distance measurements have been performed. The volume displays in the patient report and in the Measured Results.	Distance
Width		Distance
Depth		Distance

2D-Mode Calculation Label

The 2D-mode calculation label for use with the Urology exam, PSAD, does not display in the Measurement Menu. Instead, the system automatically performs a calculation if you enter a PSA value in the Urology patient report and complete a volume measurement of the prostate.

Calculation Label	Description	Required Measurements
PSAD	Prostate Specific Antigen Density Index determined by the PSA value divided by the prostate volume calculation.	A Volume (V) measurement of the Prostate and the PSA value entered using the keyboard in the Urology patient report.
Mic V	Micturated Volume The result of subtracting the post-void volume from the pre-void volume.	Pre-Void Volume Post-Void Volume

Urology Patient Report

The Urology exam has a one-page patient report. The report includes data from the patient data form, measured values obtained during the exam that have been assigned to a label, and descriptive data and text entered by the user.

You can use the Report Drawing function to indicate a specific structure of interest in the patient report.

See also: Report Drawing Function, Measurements and Calculations, Chapter B1, Features and Applications Reference

Descriptive Data

The Urology patient report contains drop-down boxes with descriptive data for the following information:

- Digital Rectal Exam (DRE) Malignancy Suspicion
- Trans Rectal Ultrasound System (TRUS) Prostate
- Trans Rectal Ultrasound System (TRUS) Seminal Vesicles

Selections are shown below.

Report Item	Selections
DRE Malignancy Suspicion	**No** **Yes** **Right** **Left** **No/-Base** **Yes/-Base** **Right/-Base** **Left/-Base** **No/-Apex** **Yes/-Apex** **Right/-Apex** **Left/-Apex** **No/-Mid** **Yes/-Mid** **Right/-Mid** **Left/-Mid**

Report Item	Selections
TRUS Prostate Echogenicity	(Blank)
	Normal
	Hyperechoic
	Isoechoic
	Hypoechoic
	Diffuse
TRUS Prostate Margin	(Blank)
	Intact
	Disrupted
	Intact/-Right
	Disrupted/-Right
	Intact/-Left
	Disrupted/-Left
	Intact/-Apex
	Disrupted/-Apex
	Intact/-Mid
	Disrupted/-Mid
	Intact/-Base
	Disrupted/-Base
TRUS Prostate Size	(Blank)
	Normal
	Enlarged
	Atrophic
	Hypertrophic
TRUS Prostate Symmetry	(Blank)
	Yes
	No
	L>R
	R>L
TRUS Seminal Vesicle Symmetry	(Blank)
	Yes
	No
	L>R
	R>L
TRUS Seminal Vesicle Size	(Blank)
	Normal
	Enlarged
	Atrophic
	Hypertrophic

Prostate References

Prostate Volume

Rifkin, Matthew D., M.D. "Prostate and Seminal Vesicle Measurements." Chapter 16 in *Atlas of Ultrasound Measurements*. B. B. Goldburg and A. B. Kurtz. Chicago: Year Book Medical Publishers. 1990.

Prostate Specific Antigen Density

Benson, M. C., et al. "The Use of Prostate Specific Antigen Density to Enhance the Predictive Value of Intermediate Levels of Serum Prostate Specific Antigen." *Journal of Urology*, 147: 817, 1992.

B5 Vascular Measurements and Calculations

Vascular Measurements and Calculations

All general measurements and calculations in 2D-mode, M-mode, and Doppler are available for the three Vascular exam types:

- Cerebrovascular Imaging
- Peripheral Vascular Imaging
- Venous Imaging

See also: Measurements and Calculations, Chapter B1, Features and Applications Reference

Customizing Vascular Measurements and Reports

Use the system presets to customize a Vascular exam.

- Specify the shape, size, and default position for the caliper
- Specify whether the background for the Measured Results section of the screen has a different color than the image background
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Customize display and report options and enable operator and referring physician information for the patient report
- Define the Comments Library for the patient report
- Define Recommendations for the summary
- Define anatomy assessments for the patient report.
- Select the measurement methods that display as soft key selections for each mode and the order in which they display.
- Specify user-defined measurement labels for use in 2D-mode or Doppler when the Cerebrovascular or Peripheral Vascular exam is active. Measured values can be assigned to the label. The label can also be used in creating user-defined formulas.
- Specify user-defined labels for each mode when the Venous exam is active.

For Peripheral Vascular and Cerebrovascular exams:

- Create or delete up to four ratios or formulas using established parameters. Formula labels display in the patient report. When the required measurements are performed, the calculated result also displays in the report.
- Specify the order of appearance for labels in the Measurement Menu.

M & R Configuration > C-Vascular, P-Vascular, Venous > Measurement and Report Presets

Indicating a Left or Right Study

When a Peripheral Vascular, Cerebrovascular, or Venous exam type is selected, you must indicate which side of the body is being imaged. When the measurement function is active, the system then transfers your measured values into the left study or the right study on the patient report.

To indicate the side of the body you are imaging:

1. During a **C-Vascular**, **P-Vascular**, or **Venous** exam, activate the measurement function.
2. If necessary, press the **CALIPER** key to highlight the Measurement Menu.

   The system displays the Measurement Menu with **Left** or **Right** selected.
3. To toggle the **Left** or **Right** selection on the Measurement Menu, roll the trackball to highlight the **Left** or **Right** label and then press the **SET** key.

Cerebrovascular — 2D-Mode Measurement Labels

These labels display in the Measurement Menu and in the patient report with the measured result, when assigned. The labels are the same for both the **Right** and **Left** imaging selections.

Measurement Label	Description	Measurement Method Option
CCA Prox.	Common Carotid Artery, first sample	A-%Stenosis D-%Stenosis
CCA Mid.	Common Carotid Artery, second sample	A-%Stenosis D-%Stenosis
CCA Dist.	Common Carotid Artery, third sample	A-%Stenosis D-%Stenosis
ICA Prox.	Internal Carotid Artery, first sample	A-%Stenosis D-%Stenosis
ICA Mid.	Internal Carotid Artery, second sample	A-%Stenosis D-%Stenosis
ICA Dist.	Internal Carotid Artery, third sample	A-%Stenosis D-%Stenosis
ECA	External Carotid Artery	A-%Stenosis D-%Stenosis
VA	Vertebral Artery	A-%Stenosis D-%Stenosis
xxxx	You can define measurement labels to correspond to a measurement method. Define these labels in the system presets.	A-%Stenosis D-%Stenosis

Cerebrovascular — Doppler Measurement Labels

These labels display in the Measurement Menu and in the patient report with the measured result, when assigned. The labels are the same for both the **Right** and **Left** imaging selections.

Measurement Label	Description	Measurement Method Option
CCA Prox.	Common Carotid Artery	PI Auto, PI Manual
RI	Common Carotid Artery Resistive Index	RI
Systole	Common Carotid Artery Systole	Velocity
Diastole	Common Carotid Artery Diastole	Velocity
CCA Mid.	Common Carotid Artery	PI Auto, PI Manual
RI	Common Carotid Artery Resistive Index	RI
Systole	Common Carotid Artery Systole	Velocity
Diastole	Common Carotid Artery Diastole	Velocity
CCA Dist.	Common Carotid Artery	PI Auto, PI Manual
RI	Common Carotid Artery Resistive Index	RI
Systole	Common Carotid Artery Systole	Velocity
Diastole	Common Carotid Artery Diastole	Velocity
ICA Prox.	Internal Carotid Artery	PI Auto, PI Manual
RI	Internal Carotid Artery Resistive Index	RI
Systole	Internal Carotid Artery Systole	Velocity
Diastole	Internal Carotid Artery Diastole	Velocity
ICA Mid.	Internal Carotid Artery	PI Auto, PI Manual
RI	Internal Carotid Artery Resistive Index	RI
Systole	Internal Carotid Artery Systole	Velocity
Diastole	Internal Carotid Artery Diastole	Velocity
ICA Dist.	Internal Carotid Artery	PI Auto, PI Manual
RI	Internal Carotid Artery Resistive Index	RI
Systole	Internal Carotid Artery Systole	Velocity
Diastole	Internal Carotid Artery Diastole	Velocity
ECA	External Carotid Artery	PI Auto, PI Manual
RI	External Carotid Artery Resistive Index	RI
Systole	External Carotid Artery Systole	Velocity
Diastole	External Carotid Artery Diastole	Velocity
VA	Vertebral Artery	PI Auto, PI Manual
RI	Vertebral Artery Resistive Index	RI
Systole	Vertebral Artery Systole	Velocity
Diastole	Vertebral Artery Diastole	Velocity
xxxx	You can define measurement labels to correspond to a measurement method. Define these labels in the system presets.	PI Auto, PI Manual RI Velocity Velocity

Peripheral Vascular — 2D-Mode Measurement Labels

These labels display in the Measurement Menu and in the patient report with the measured result, when assigned. The labels are the same for both the **Right** and **Left** imaging selections.

Measurement Label	Description	Measurement Method Option
xxxx	You can define measurement labels to correspond to a measurement method. Define these labels in the system presets.	Distance Area Circumference Volume

Peripheral Vascular — Doppler Measurement Labels

These labels display in the Measurement Menu and in the patient report with the measured result, when assigned. The labels are the same for both the **Right** and **Left** imaging selections.

Measurement Label	Description	Measurement Method Option
CIA	Common Iliac Artery	PI Auto, PI Manual
RI	Common Iliac Artery Resistive Index	RI
Systole	Common Iliac Artery Systole	Velocity
EIA	External Iliac Artery	PI Auto, PI Manual
RI	External Iliac Artery Resistive Index	RI
Systole	External Iliac Artery Systole	Velocity
CFA	Common Femoral Artery	PI Auto, PI Manual
RI	Common Femoral Artery Resistive Index	RI
Systole	Common Femoral Artery Systole	Velocity
PFA	Profunda Femoris Artery	PI Auto, PI Manual
RI	Profunda Femoris Artery Resistive Index	RI
Systole	Profunda Femoris Artery Systole	Velocity
SFA-Prox.	Superior Femoral Artery	PI Auto, PI Manual
RI	Superior Femoral Artery Resistive Index	RI
Systole	Superior Femoral Artery Systole	Velocity
SFA-Mid.	Superior Femoral Artery	PI Auto, PI Manual
RI	Superior Femoral Artery Resistive Index	RI
Systole	Superior Femoral Artery Systole	Velocity
SFA-Dist.	Superior Femoral Artery	PI Auto, PI Manual
RI	Superior Femoral Artery Resistive Index	RI
Systole	Superior Femoral Artery Systole	Velocity
POP A	Popliteal Artery	PI Auto, PI Manual
RI	Popliteal Artery Resistive Index	RI
Systole	Popliteal Artery Systole	Velocity

Measurement Label	Description	Measurement Method Option
TRUNK	Popliteal Trunk	PI Auto, PI Manual
RI	Popliteal Trunk Resistive Index	RI
Systole	Popliteal Trunk Systole	Velocity
ATA	Anterior Tibial Artery	PI Auto, PI Manual
RI	Anterior Tibial Artery Resistive Index	RI
Systole	Anterior Tibial Artery Systole	Velocity
PTA	Posterior Tibial Artery	PI Auto, PI Manual
RI	Posterior Tibial Artery Resistive Index	RI
Systole	Posterior Tibial Artery Systole	Velocity
PER-A	Peroneal Artery	PI Auto, PI Manual
RI	Peroneal Artery Resistive Index	RI
Systole	Peroneal Artery Systole	Velocity
DPA	Dorsalis Pedis Artery	PI Auto, PI Manual
RI	Dorsalis Pedis Artery Resistive Index	RI
Systole	Dorsalis Pedis Artery Systole	Velocity
xxxx	You can define measurement labels to correspond to a measurement method. Define these labels in the system presets.	PI Auto, PI Manual RI Velocity

Vascular Patient Reports

Each Vascular exam type has a patient report. The system transfers labeled measurements and calculations from the Measured Results on the image screen to the patient report. The system also loads information from the patient data form into the report. You can annotate portions of the report.

Use the system presets to select calculation, measurement, and parameter labels to be included in each of the Vascular patient reports. For the Cerebrovascular and Peripheral Vascular exams, you can also indicate which user-defined labels and formulas to display in each report.

M & R Configuration > Measurement and Report Preset

Cerebrovascular Patient Report

The Cerebrovascular patient report includes data from the patient data form, measured values obtained during an exam that have been assigned to a label, calculations determined by the system, and selected data fields.

- A **Data** tab presents an editable **Indication** field, editable measured results that were labeled in 2D-mode and Doppler, specific ratios, and editable blood pressure readings.
- A **Description** tab presents user-selectable descriptive data, a pictogram that you can annotate with drawings, and a comments field.

Use the system presets to select specific measurement, parameter, and calculation labels to include in the Cerebrovascular report.

Use the keyboard for direct entry of **SYS** and **DIAS** values in the **BP** field. You can enter the right and left values using up to three characters.

Note: Systole Ratio **[ICA/CCA(S)]** is calculated by using the highest value between multiple CCA values and the highest value between multiple ICA values.

Note: Diastole Ratio **[ICA/CCA(D)]** is calculated by using the highest value between multiple CCA values and the highest value between multiple ICA values.

Cerebrovascular Report — Description Tab

The Cerebrovascular patient report **Description** tab contains drop-down boxes with descriptive data, a drawing area, and a comments field.

Report Item	Plaque Selections (left and right)	Stenosis Selections (left and right)
ICA	(Blank)	(Blank)
ECA	**None**	**None**
CCA	**Smooth**	**Mild**
	Calcific	**Moderate**
	Irregular	**Severe**
	Complex	**Pre-Occlusive**
		Occluded

Report Item	Plaque Selections (left and right)	Direction Selections (left and right)
VA	(Blank)	(Blank)
	None	**Antegrade**
	Smooth	**Retrograde**
	Calcific	**None Seen**
	Irregular	
	Complex	

Indicating Structures of Interest

The **Description** tab allows you to indicate a structure of interest with a drawing tool on a pictogram.

See also: Report Drawing Function, Measurements and Calculations, Chapter B1, Features and Applications Reference

Peripheral Vascular Patient Report

The Peripheral Vascular exam has a two-page patient report. The report includes data from the patient data form, measured values obtained during an exam that have been assigned to a label, calculations determined by the system and selected descriptive data.

- The first page contains an editable **Indication** field, editable blood pressure readings, and editable measured results that were labeled in Doppler.
- The second page presents user-selectable fields for defining peak systolic ratios, fields for user-defined formulas, and a Comments field.
- The third page contains measured results for the 2D-mode user defined labels.

Use the system presets to select specific measurement, parameter, and calculation labels and patient data form entries to include in the Peripheral Vascular report.

Venous Patient Report

The Venous patient report includes user-defined values and descriptive data.

- The **Data** tab displays an editable **Indication** field and measured results for labels defined in system presets.
- The **Description** tab displays descriptive data fields for all vessels (left and right), editable blood pressure information, and a field for comments.

Venous Report — Descriptive Data Fields

The Venous patient report contains drop-down boxes with descriptive data.

Report Item	Doppler Selections	Description Selections
IVC	(Blank)	(Blank)
	Phasic	**Patent**
	Spontaneous	**Subacute**
	Mild Reflux	**Acute**
	Moderate Reflux	**Chronic**
	Severe Reflux	**Recanalized**
		Resolved Doppler

The drop-down boxes corresponding to each label initially display as blank cells.

Labels	Description Selections for all vessels (right and left)	Doppler Selections for all vessels (right and left)
EIV	(Blank)	(Blank)
CFV	**Patent**	**Phasic**
SFV(P)	**Subacute**	**Spontaneous**
SFV(M)	**Acute**	**Mild Reflux**
SFV(D)	**Chronic**	**Moderate Reflux**
GSV(P)	**Recanalized**	**Severe Reflux**
GSV(M)	**Resolved Doppler**	
GSV(D)		
POP V		
LSV		
PTV		
ATV		
PER V		
DPV		

B6 Cardiac Measurements and Calculations

Cardiac Measurements and Calculations

⚠ **WARNING:** Do not use the cardiac measurements and calculations package unless you are thoroughly trained in echocardiography and thoroughly familiar with the safe operation of the ultrasound system.

Note: You can use the cardiac measurements and calculations with the Ped Echo and TEE exam types.

Imaging the heart necessitates a unique methodology for precision measurements and calculation of equations. 2D-mode, M-mode, and Doppler each have specific measurements and methods for cardiac exams. The system performs calculations when you complete the required measurements and assigns calculation labels to the results. Calculated results display in the Measured Results section of the screen and, along with labeled measurements, are transferred to the worksheet and patient report.

Customizing Cardiac Measurements and Reports

All customization for Cardiac exams is also available for Ped Echo exams. The customized settings for the Ped Echo exam are independent of the Cardiac exam.

Note: When you customize measurements and calculations for use with the Cardiac exam, the customization also applies to the TEE exam.

Use the system presets to customize the cardiac exam type.

M & R Configuration > Measurement and Report Preset

Options for Exam Configuration Default Settings

- Select the system response when you press the **FREEZE** key
- Create or edit the Pictogram List
- Create or edit the Text Annotation List

Exam Configuration > Automatic Freeze Response

Pictogram List

Text Annotation

Options for Measurements and Reports (M & R)

- Specify the shape, size, and default position for the caliper
- Specify whether the background for the Measured Results section of the screen has a different color than the image background
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Select the measurement methods that display as soft key selections for each mode, and the order in which they display
- For left-ventricle guided measurements, select a system-defined pattern of measurement labels to include all the measurements for diastole and systole or to exclude specific labels from the guided measurement
- For non-guided measurements, specify which labels display in the Measurement Menu and the order in which they display
- Customize display options such as measurement titles for each mode, the method used for data averaging, the method for determining Heart Rate, and the performing and referring physician information for the patient report
- Define the Comments Library for the patient report
- Define recommendations for the summary
- Define anatomy assessments for the patient report
- Create user-defined cardiac measurement types and user-defined measurements for each measurement type

Measurement Menu

Use the system presets to customize the list of measurement labels for a non-guided measurement type or to select a pattern of labels for a guided measurement type.

M & R Configuration > Measurement and Report Preset > Display Item > General

You can also use the system presets to create user-defined measurement types, including 2D-mode, M-mode, and Doppler measurement labels.

M & R Configuration > Measurement and Report Preset > Measurement Order

M & R Configuration > Measurement and Report Preset > User-Defined Label

To select a cardiac measurement type:

1. Press the **CALIPER** key on the control panel.
2. Roll the trackball to highlight the name of the measurement type and then press the **SET** key.

   The system displays a list of corresponding measurement labels in the Measurement Menu.

To access the list of cardiac measurement types:

- Roll the trackball to the top of the Measurement Menu to highlight the name of the current measurement type and then press the **SET** key.

  The soft key selections display measurement methods for the active mode.

Averaging Measured Results

You can assign up to five values to each measurement label. The system transfers the values into the worksheet.

Use the system presets to select a method for data averaging, Direct or Average. If you select the Direct method, the last value assigned to a measurement label displays next to the measurement units in the worksheet and in the patient report.

If you select the Average method, the system performs an average of the values as each value is assigned to the label. The last measured value displays in the Measured Results; the calculated average displays next to the measurement units in the worksheet and in the patient report.

M & R Configuration > Measurement and Report Preset > Display Item

Guided Measurements

Guided Measurements are system-defined sequences of individual measurements. A list of the necessary measurements for a guided measurement displays in the Measurement Menu. Once you have started a guided measurement sequence, you must perform the measurements in the specified order.

The Cubed, Teichholz, and Gibson measurement types for 2D-mode and M-mode left ventricular function assessment use guided measurements for systole and diastole. For each measurement type, use the system presets to select a system-defined pattern of measurement labels to include all the measurements for diastole and systole or to exclude specific labels from the guided measurement.

M & R Configuration > Measurement and Report Preset > Measurement Order

2D-Mode Measurement Labels

Measurement Menu Label	Description	Measurement Method
Mitral Valve	***Mitral Valve Function***	---
EPSS	E Point to Septal Separation. The distance between the anterior leaflet and the ventricular septum at early diastole.	Distance
LVOT diam	Left Ventricular Outflow Tract Diameter When you measure LVOT diam for either the Mitral Valve or the Aortic Valve, the system displays the measured results in the worksheet and report for both valves. You can edit the value in the worksheet.	Distance
MVA(Trace)	Mitral Valve Area	Trace
MV diam	Mitral Valve Diameter	Distance
HR	Heart Rate	(user-entered value)
AV/LA	***Aortic Valve/Left Atrium***	---
RV diam	Right Ventricular Diameter	Distance
AOd	Aorta at end-diastole	Distance
AOs	Aorta at end-systole	Distance
ACS	Aortic Cusp Separation	Distance
LAd diam	Left Atrial Diameter at end-diastole	Distance
LAs diam	Left Atrial Diameter at end-systole	Distance
Aortic Valve	***Aortic Valve Function***	---
LVOT diam	Left Ventricular Outflow Tract Diameter	Distance
AV Area	Aortic Valve Area	Trace
Pulmonary Valve	***Pulmonary Valve Function***	---
PV diam	Pulmonary Valve diameter	Distance

Measurement Menu Label	Description	Measurement Method
RV	***Right Ventricle Function***	---
RV diam	Right Ventricle diameter	Distance
PISA(MR)	***Proximal Isovelocity Surface Area (Mitral Regurgitation)***	---
Radius	Radius	Distance
Aliasing Vel	Aliasing Velocity	Automatically determined using the velocity indicated by the color bar. Manually edit in the worksheet.
PISA(MS)	***Proximal Isovelocity Surface Area (Mitral Stenosis)***	---
Radius	Radius	Distance
Aliasing Vel	Aliasing Velocity	Automatically determined using the velocity indicated by the color bar. Manually edit in the worksheet.
Angle	Angle	Angle
Qp/Qs	***Pulmonary Valve / Aortic Valve***	---
Systemic diam	Systemic diameter	Distance
Pulmonic diam	Pulmonic diameter	Distance
LV Dimensions	***Left Ventricular Dimensions***	---
RVAWd	Right Ventricular Anterior Wall at end-diastole	Distance
RVDd	Right Ventricular Dimension at end-diastole	Distance
IVSd	Interventricular Septal Dimension at end-diastole	Distance
LVIDd	Left Ventricular Internal Dimension at end-diastole	Distance
LVPWd	Left Ventricular Posterior Wall Dimension at end-diastole	Distance
IVSs	Interventricular Septal Dimension at end-systole	Distance
LVIDs	Left Ventricular Internal Dimension at end-systole	Distance
LVPWs	Left Ventricular Posterior Wall Dimension at end-systole	Distance
LV Volume-specific	***Left Ventricular Volume***	---
LVAd sax PM, **LVAd sxPM**	Left Ventricular Area at Papillary Muscle level at end-diastole in short axis view	Trace
LVAd sax MV, **LVAd sxMV**	Left Ventricular Area at Mitral Valve level at end-diastole in short axis view	Trace
LVLd apical	Left Ventricular Length at end-diastole in apical view	Distance

Measurement Menu Label	Description	Measurement Method
LVAs sax PM, **LVAs sx PM**	Left Ventricular Area at Papillary Muscle level at end-systole in short axis view	Trace
LVAs sax MV, **LVAs sx MV**	Left Ventricular Area at Mitral Valve level at end-systole in short axis view	Trace
LVLs apical	Left Ventricular Length at end-systole in apical view	Distance
LVAd apical	Left Ventricular Long Axis Area at end-diastole in apical view	Trace
LVAs apical	Left Ventricular Long Axis Area at end-systole in apical view	Trace
LV Mass-specific	***Left Ventricular Mass***	---
A Sax Epi	Area short axis epicardial	Area
A Sax Endo	Area short axis endocardial	Area
a	Semi-major axis from widest minor axis radius to apex	Distance
d	Truncated semi-major axis from widest minor axis radius to mitral annulus plane	Distance
LVL	Left Ventricular Length	Distance
LA Volume-specific	***Left Atrial Volume***	---
A1-A4C	Four-chamber area of left atrium	Area
A2-A2C	Two-chamber or apical long area of left atrium	Area
L	Length	Distance
4CH	Four-chamber volume	Volume (Disc)
2CH	Two-chamber volume	Volume (Disc)
RA Volume-specific	***Right Atrial Volume***	---
A1-A4C	Four-chamber area of right atrium	Area
A2-A2C	Two-chamber or apical long area of right atrium	Area
L	Length	Distance
4CH	Four-chamber volume	Volume (Disc)
2CH	Two-chamber volume	Volume (Disc)
sysBP	Systolic Blood Pressure	Automatically determined using the blood pressure from the patient data page. Manually editable.

2D-Mode Calculation Labels

Calculation Label	Description	Required Measurements	Units
CI	***Cardiac Index*** is the cardiac output per square meter of body surface area (BSA): CI = CO÷BSA. For height in centimeters and weight in kilograms: $BSA=0.007184 \times (Weight^{0.425}) \times (Height^{0.725})$ For height in feet/inches and weight in pounds: $BSA=0.007184 \times (Weight \times 0.454)^{0.425} \times (Height \times 2.54)^{0.725}$	HR and BSA (BSA is determined by height and weight of patient; entered in the patient data form) EDV ESV	$L/min/m^2$
CO	***Cardiac Output*** is the effective volume of blood ejected from the left ventricle of the heart per unit of time: CO = [(EDV – ESV) ÷ 1000](HR).	EDV ESV HR	L/min
EDV and **ESV**	Left Ventricular ***End-Diastolic Volume*** Left Ventricular ***End-Systolic Volume***	Varies with the selected Volume method	
EF	***Ejection Fraction*** is the ratio of the stroke volume to the end-diastolic volume: EF = 100[(EDV-ESV)÷EDV].	EDV ESV	%
FS	***Fractional Shortening*** is the percentage of shortening of the Left Ventricular dimension: FS = 100[(LVIDd - LVIDs) ÷ LVIDd].	LVIDd LVIDs	%
SI	***Stroke Index*** is a measurement of stroke volume normalized to BSA: SI = SV÷BSA.	SV BSA	mL/m^2
SV	***Stroke Volume*** is the volume of blood ejected from a ventricle during one cardiac cycle or phase of ventricular systole: SV = EDV-ESV.	EDV ESV	mL
t	***Thickness of the myocardium*** $t(mm) = SQRT(A\ Sax\ Epi(cm^2) *100/3.14) – SQRT(A\ Sax\ Endo(cm^2)*100/3.14)$	A Sax Epi A Sax Endo	mm
b	***Short axis radius*** $b(mm) = SQRT(A\ Sax\ Endo(cm^2) * 100/3.14)$	A Sax Endo	mm
LV Mass-I	***LV Mass Index*** describes the proportion of left ventricular mass to the body surface area: $LV\ Mass\text{-}I(g/m^2) = LV\ Mass(g) / BSA(m^2)$	LV Mass BSA	g/m^2
LV Mass T-E	***LV Mass T-E*** estimates left ventricular mass using a Truncated Ellipse: $LV\ Mass(g)=1.05*\pi*((b(cm)+t(cm))^2) * (2/3*(a(cm)+t(cm)+d(cm) – (d(cm)^3) / (3*((a(cm)+t(cm))^2))) – (b(cm)^2) * (2/3*a(cm)+d(cm)-d(cm)^3) / (3*(a(cm)^2)))$	a d b t	g

Calculation Label	Description	Required Measurements	Units
LV Mass A-L	***LV Mass A-L*** estimates left ventricular volume using Area and Length: LV Mass(g) = 1.05*(((5/6)* A Sax Epi(cm^2) * (LVL(cm)+t(cm))) – (5/6) * A Sax Endo(cm^2)*LVL(cm))	A Sax Epi A Sax Endo LVL	g
LA Vol-I	***LA Vol-I*** describes the proportion of left atrial volume to the body surface area: LA Vol-I(mL/m^2) = LA Vol(mL) / BSA(m^2)	LA Vol (A-L) or LA Vol (Simp) BSA	mL/m^2
LA Vol (A-L)	***LA Vol (A-L)*** estimates left atrial volume using Area and Length: LA Vol (A-L)(mL) = (8/3/π)*A1-A4C(cm^2) * A2-A2C(cm^2) / L(mm) * 10	A1-A4C A2-A2C L	mL
LA Vol (Simp)	***LA Vol (Simp)*** uses Simpson's formula to estimate left atrial volume using the 4CH and 2CH measurements: LA Vol (Simp)(mL) = (4CH(mL)+2CH(mL)) / 2	4CH 2CH	mL
RA Vol-I	***RA Vol-I*** describes the proportion of right atrial volume to the body surface area: RA Vol-I(mL/m^2) = RA Vol(mL) / BSA(m^2)	RA Vol (A-L) or RA Vol (Simp) BSA	mL/m^2
RA Vol (A-L)	***RA Vol (A-L)*** estimates right atrial volume: using Area and Length RA Vol (A-L)(mL) = (8/3/π)*A1-A4C(cm^2) * A2-A2C(cm^2) / L(mm) * 10	A1-A4C A2-A2C L	mL
RA Vol (Simp)	***RA Vol (Simp)*** uses Simpson's formula to estimate right atrial volume using the 4CH and 2CH measurements: RA Vol (Simp)(mL) = (4CH(mL)+2CH(mL)) / 2	4CH 2CH	mL
AOd/LAs	Aorta Diastole to Left Atrium Systole ratio	LAs AOd	Ratio or Index
LAs/AOd	Left Atrium Systole to Aorta Diastole ratio	LAs AOd	Ratio or Index
mVcfc*	***Mean Velocity of Circumferential Fiber Shortening*** $\frac{(\text{LVIDd(mm)} - \text{LVIDs(mm)})}{\text{LVIDd(mm)} \times \text{LVETc}}$ $\text{LVETc} = \frac{(\text{LVET(ms)}/1000)}{\sqrt{\text{RR}}}$ $\text{RR(sec)} = \frac{60}{\text{HR}}$	LVIDd LVIDs LVET HR	circ/s
ESWS*	***End-Systolic Wall Stress*** 0.334 * sysBP(mmHg) * LVIDs(mm) / (LVPWs(mm) * (1+LVPWs(mm) / LVIDs(mm)))	LVIDs LVPWs sysBP	g/cm^2

* Applies only to Ped Echo exam types.

2D-Mode Measurements

Making a 2D-Mode Distance Measurement

The distance measurement calculates the length of a straight line between two markers.

This procedure uses the CINE playback function so that both diastolic and systolic measurements can be made from one image acquisition.

Use the system presets to customize the system to activate CINE playback when you activate the measurement function.

Exam Configuration > Automatic Freeze Response

To label then measure a distance:

1. During a cardiac exam, acquire and freeze a 2D-mode image.
2. Activate CINE playback.
3. Roll the trackball through Frame Review to view an end systolic or end diastolic frame.
4. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
5. Roll the trackball to select a measurement label in the Measurement Menu that requires the Distance method and then press the **SET** key.

   The system displays the measurement method beside the trackball status icon, activates the measurement method, and places a measurement marker in the image. The system also displays measurement data in the Measured Results.
6. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors a measurement marker and displays another measurement marker.
7. Roll the trackball to position the next measurement marker and then press the **SET** key.

   The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.

To measure then label distance:

1. During a cardiac exam, acquire and freeze a 2D-mode image.
2. Activate CINE playback.
3. Roll the trackball through Frame Review to view an end systolic or end diastolic frame.
4. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
5. If necessary, press the **CALIPER** key or press the toggle key for a measurement method to place a measurement marker in the image.

   The system displays measurement data in the Measured Results.
6. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
7. Roll the trackball to position the next measurement marker and then press the **SET** key.

   The system automatically updates the measurement data in the Measured Results.
8. To assign the measurement data to a label, roll the trackball to select the measurement label in the Measurement Menu and then press the **SET** key.

   The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.

Making a 2D-Mode Trace Measurement

Use the Trace measurement method to outline a structure such as the mitral valve, the aortic valve, or the left ventricular chamber. The system measures the circumference of the structure and then calculates the area.

See also: Determining a Left Ventricular End-Diastolic or End-Systolic Volume, p. B6-16

To make a trace measurement:

1. During a cardiac exam, acquire and freeze a 2D-mode image.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Roll the trackball to select a measurement label in the Measurement Menu that requires the Trace method and then press the **SET** key.

   The system places a measurement marker in the image and displays measurement data for circumference (**C**) and area (**A**) in the Measured Results.
4. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors the marker.
5. Roll the trackball to create a trace of the structure. To delete (undo) a segment of the outline, rotate the **SELECT** control on the control panel counterclockwise.
6. To complete the trace, press the **SET** key.

   The system displays the measurement label and corresponding value in the Measured Results, and assigns the value to the label in the worksheet and the patient report.

Making a 2D-Mode Angle Measurement

To make an angle measurement:

1. During a cardiac exam, acquire and freeze a 2D-mode image.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Press the toggle key for **Angle**.

   The system places a measurement marker in the image.
4. Roll the trackball to position the first marker and then press the **SET** key.

   The system anchors the marker and displays a second marker.
5. To define the reference line, roll the trackball to position the second marker and then press **SET** key.
6. To create the line for the alpha (α) and beta (β) angle:
   a. Roll the trackball to position the first marker and then press the **SET** key.

      The system anchors the marker and displays a second marker.

   b. To draw the angle line, roll the trackball to position the second marker and then press **SET** key.

      The system anchors the angle line, labels the α angle and the β angle, and displays the angle values in the Measured Results.

2D-Mode Left Ventricular Function Assessment

Analysis of the heart involves the assessment of the Left Ventricular (LV) function using 2D-mode measurements.

The system allows you to select from nine different volume formulas to calculate end-diastolic (**EDV**) and end-systolic volumes (**ESV**). The Modified Simpson, Single Plane, Bi-Plane, and Bullet formulas use distance and trace measurements. The Simpson Single Plane and Simpson Bi-Plane measurement types use the Disk volume measurement method. The Cubed, Teichholz, and Gibson formulas use guided measurements for ventricular distances.

See also: 2D-Mode Calculation Labels, p. B6-9

Volume Method	Menu Label	Description	Calculated Results	
Simpson Single Plane	**Simpson SP**	Estimates Volume using the Disk measurement at end-diastole and at end-systole for the apical two-chamber or four-chamber view.	EDV ESV SV CO EF SI CI	mL mL mL L/min % mL/m^2 mL/min/m^2
Simpson Bi-Plane	**Simpson BP**	Estimates Volume using the Disk measurement at end-diastole and at end-systole for the apical four-chamber view: EDV(mL)= π * LVLd(mm) / 20 * $\sum(r_{2i}$(mm)*r_{4i}(mm)) / 1000 ESV(mL)= π * LVLs(mm) / 20 * $\sum(r_{2i}$(mm)*r_{4i}(mm)) / 1000	EDV ESV SV CO EF SI CI	mL mL mL L/min % mL/m^2 mL/min/m^2
Modified Simpson Formula	**Mod. Simpson**	Estimates Volume using the trace measurement in two different views at end-diastole and at end-systole for sax MV and for sax PM. Also requires a distance measurement of the long axis dimension in an apical four-chamber view at end-diastole and at end-systole: EDV (mL) = LVLd apical(mm)/9 * (4*LVAd sax MV(cm^2) + 2*LVAd sax PM(cm^2) + SQRT (LVAd sax MV(cm^2) * LVAd sax PM(cm^2)) /10) ESV (mL) = LVLs apical(mm)/9 * (4*LVAs sax MV(cm^2) + 2*LVAs sax PM(cm^2) + SQRT (LVAs sax MV(cm^2) * LVAs sax PM(cm^2)) /10)	EDV ESV SV CO EF SI CI	mL mL mL L/min % mL/m^2 mL/min/m^2
Single Plane Formula	**Single Plane**	Estimates Volume using the trace measurement in a single plane at end-diastole and at end-systole for apical two- or four-chamber view. Also requires a distance measurement of the long axis dimension in an apical view at end-diastole end-systole: EDV = (8÷(3π)) * (LVAd apical(cm^2))^2 / LVLd apical(mm) * 10 ESV = (8÷(3π)) * (LVAs apical(cm^2))^2 / LVLs apical(mm) * 10	EDV ESV SV CO EF SI CI	mL mL mL L/min % mL/m^2 mL/min/m^2

Volume Method	Menu Label	Description	Calculated Results	
Bi-plane Formula	**Bi-Plane**	Estimates Volume using the trace measurement in two planes at end-diastole and at end-systole for apical and for sax MV. Also requires a distance measurement of the LVIDd and the LVIDs: EDV = (8÷(3π)) * LVAd apical(cm^2) * LVAd sax MV(cm^2) / LVIDd(mm) * 10 ESV = (8÷(3π)) * LVAs apical(cm^2) * LVAs sax MV(cm^2) / LVIDs(mm) * 10	EDV ESV SV CO EF SI CI	mL mL mL L/min % mL/m^2 mL/min/m^2
Bullet Formula	**Bullet**	Estimates Volume using the trace measurement in one view at end-diastole and at end-systole for sax MV. Also requires a distance measurement of the long axis dimension in an apical view at end-diastole end-systole. This formula assumes that the left ventricle is shaped like a bullet; the base being cylindrical and the apex cone-like: EDV = (5÷6) * LVLd apical(mm) * LVAd sax MV(cm^2) / 10 ESV = (5÷6) * LVLs apical(mm) * LVAs sax MV(cm^2) / 10	EDV ESV SV CO EF SI CI	mL mL mL L/min % mL/m^2 mL/min/m^2
Cubed Formula	**Cubed(2D)**	Estimates Volume from the Left Ventricular Internal Diameter (LVID) using the distance measurement: EDV = LVIDd$(mm)^3$ / 1000 ESV = LVIDs$(mm)^3$ / 1000	EDV ESV SV CO EF SI CI	mL mL mL L/min % mL/m^2 mL/min/m^2
Teichholz Formula	**Teichholz(2D)**	Estimates Volume from the Left Ventricular Internal Diameter (LVID) using the distance measurement: EDV(mL) = 7*(LVIDd(mm) * LVIDd(mm) * LVIDd(mm) / 1000) / (2.4 + LVIDd(mm) / 10) ESV(mL) = (7*LVIDs(mm) * LVIDs(mm) * LVIDs(mm) / 1000) / (2.4 + LVIDs(mm) / 10)	EDV ESV SV CO EF SI CI	mL mL mL L/min % mL/m^2 mL/min/m^2
Gibson Formula	**Gibson(2D)**	Estimates Volume from the Left Ventricular Internal Diameter (LVID) using the distance measurement: EDV(mL)= π / 6*(0.98*LVIDd(mm) / 10 + 5.90) * LVIDd(mm) / 10 * LVIDd(mm) / 10 ESV(mL)= π / 6*(1.14*LVIDs(mm) / 10 + 4.18) * LVIDs(mm) / 10 * LVIDs(mm) / 10	EDV ESV SV CO EF SI CI	mL mL mL L/min % mL/m^2 mL/min/m^2

Determining a Left Ventricular End-Diastolic or End-Systolic Volume

When a volume measurement label is selected in the Measurement Menu, the default volume measurement method displays beside the trackball status icon. The Simpson Single Plane and Simpson Bi-Plane measurement types use the Disk volume measurement method.

Note: Use the system presets to have the system automatically derive the heart rate (HR) from a Doppler or M-mode signal or from the ECG trace. In 2D-mode, you can manually edit the heart rate value.

To determine an EDV or ESV:

1. During a cardiac exam, acquire and freeze a 2D-mode image.
2. Activate CINE playback.
3. Roll the trackball through Frame Review to view an end systolic or end diastolic frame.
4. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.

5. Roll the trackball to select a volume measurement label in the Measurement Menu and then press the **SET** key.

   The system displays measurement labels related to the volume measurement label.

6. Roll the trackball to select a measurement label and then press the **SET** key.

   The system places a measurement marker on the image, activates the Disk volume measurement method, and displays the volume (**V**) of the structure in the Measured Results.

7. Roll the trackball to position the measurement marker to begin the volume trace and then press the **SET** key.

   The system anchors the marker.

8. Roll the trackball to create a trace of the structure. To delete (undo) a segment of the outline, rotate the **SELECT** control counterclockwise.
9. To complete the trace, press the **SET** key.

   The system connects the beginning and end points of the trace and displays a line representing the long axis.

10. Roll the trackball to position the endpoint of the long axis and then press the **SET** key.

    The system displays the volume in the Measured Results and assigns the volume value to the measurement label.

2D-Mode Guided Measurements

The system provides guided measurements for the Cubed, Teichholz, and Gibson measurement types for left ventricular function assessment.

Use the system presets to select one of the system-defined guided measurement sequences (patterns) of measurement labels for each measurement type.

M & R Configuration > Measurement and Report Preset > Measurement Order

This procedure describes the complete series of measurements. The measurements can also be performed individually, as non-guided measurements.

To make a guided LV function measurement:

1. During a cardiac exam, acquire and freeze a 2D-mode image.
2. Activate the measurement function.
3. Select the **Cubed(2D)**, **Teichholz(2D)**, or **Gibson(2D)** measurement type from the list in the Measurement Menu.

   The system displays the list of systole and diastole measurement labels in the Measurement Menu.
4. Roll the trackball to highlight **Diastole** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker on the image and displays labels for the required measurements in the Measured Results. The measurement method, **BDistance**, displays beside the trackball status icon.
5. Perform the measurements at end-diastole as follows:
   a. Roll the trackball to position the marker on the posterior right ventricular wall and then press the **SET** key.

      The system anchors the marker and displays the next measurement marker.

   b. Set the plane to complete the measurement string.

      The measurement data for the first distance measurement in the Measured Results updates as you roll the trackball.

   c. Roll the trackball to position the second marker on the anterior interventricular septum and then press the **SET** key.

      The system anchors the marker, sets the plane for the remaining measurements in diastole, and displays the first distance value in the Measured Results. The measurement data for the second distance measurement in the Measured Results updates as you roll the trackball.

   d. Roll the trackball to position the marker on the endocardium of the left ventricular free wall and then press the **SET** key.

      The system anchors the marker and displays the third distance value in the Measured Results. The measurement data for the fourth distance measurement in the Measured Results updates as you roll the trackball.

e. Roll the trackball to position the marker on the posterior left ventricular free wall and then press the **SET** key.

   The system anchors the marker, displays the values for **IVSd**, **LVIDd**, and **LVPWd** in the Measured Results, and assigns the values to the labels in the worksheet and the patient report. The system also displays the calculated value for **EDV** in the Measured Results.

   In the Measurement Menu, the system displays checkmarks next to the completed measurements and highlights **Systole** as the next suggested measurement.

6. To perform systolic measurements, press the **SET** key.

   The system displays a measurement marker on the image and displays four distance (**D**) measurements in the Measured Results.

7. Perform the measurements at end-systole as follows:

   a. Roll the trackball to position the marker on the anterior interventricular septum and then press the **SET** key.

      The system anchors the marker and displays the next measurement marker.

   b. Set the plane to complete the measurement string.

      The measurement data for the first distance measurement in the Measured Results updates as you roll the trackball.

   c. Roll the trackball to position the marker on the posterior interventricular septum and then press the **SET** key.

      The system anchors the marker, sets the plane for the remaining measurements in systole, and displays the first distance value in the Measured Results. The measurement data for the second distance measurement in the Measured Results updates as you roll the trackball.

   d. Roll the trackball to position the marker on the endocardium of the left ventricular free wall and then press the **SET** key.

      The system anchors the marker and displays the second distance value in the Measured Results. The measurement data for the third distance measurement in the Measured Results updates as you roll the trackball.

   e. Roll the trackball to position the marker on the posterior left ventricular free wall and then press the **SET** key.

      The system anchors the marker, displays the values for **IVSs**, **LVIDs**, and **LVPWs** in the Measured Results, and assigns the values to the labels in the worksheet and the patient report. The system also displays the calculated value for **ESV** in the Measured Results.

To make a non-guided LV function measurement:

Note: You can either select a measurement label and then perform the measurement, or perform the measurement and then assign the label to the measured results.

1. During a cardiac exam, acquire and freeze a 2D-mode image.
2. Activate the measurement function.
3. Select the **Cubed(2D)**, **Teichholz(2D)**, or **Gibson(2D)** measurement type from the list in the Measurement Menu.

   The system displays the list of systolic and diastolic measurement labels in the Measurement Menu.
4. Roll the trackball to highlight any measurement label *except* **Diastole** or **Systole** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker on the image and displays a distance (**D**) measurement in the Measured Results. The measurement method, **BDistance**, displays beside the trackball status icon.
5. Roll the trackball to position the measurement marker on the image and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
6. Roll the trackball to position the next measurement marker and then press the **SET** key.

   The system displays the distance value in the Measured Results and assigns the distance to the selected label.

   In the Measurement Menu, the system displays a checkmark next to the completed measurement and next to the **Diastole** or **Systole** series of measurements. The system also highlights the next measurement in the series.
7. Continue making measurements, as required. When all of the required measurements are made, the system calculates the **EDV** or **ESV** and displays the value in the Measured Results.

M-Mode Measurement Labels

Measurement Menu Label	Description	Measurement Method
AV/LA(M)	***Aortic Valve/Left Atrium function***	---
RV diam	Right Ventricular Diameter	Distance
AOd	Aorta at end-diastole	Distance
AOs	Aorta at end-systole	Distance
ACS	Aortic Cusp Separation	Distance
LAd diam	Left Atrial Diameter at end-diastole	Distance
LAs diam	Left Atrial Diameter at end-systole	Distance
LVET	Left Ventricular Ejection Time	Time
LVPEP	Left Ventricular Pre-Ejection Period	Time
Mitral Valve(M)	***Mitral Valve function***	---
CE amp	Amplitude of the E wave	Distance
CA amp	Amplitude of the A wave	Distance
DE excursion	Anterior excursion of the mitral leaflet at early diastole.	Slope
DE amp	Amplitude of the DE wave	Distance
EPSS	E Point to Septal Separation. The distance between the anterior leaflet and the ventricular septum at early diastole.	Distance
EF Slope	Deceleration slope of the mitral leaflet's closure at early diastole	Slope
RV(M)	***Right Ventricle Dimensions***	---
RV diam	Right Ventricle diameter	Distance
LV Dimensions	***Left Ventricle Dimensions***	---
RVDd	Right ventricular dimension at end-diastole	Distance
IVSd	Interventricular septal dimension at end-diastole	Distance
LVIDd	Left ventricular internal dimension at end-diastole	Distance
LVPWd	Left ventricular posterior wall dimension at end-diastole	Distance
IVSs	Interventricular septal dimension at end-systole	Distance
LVIDs	Left ventricular internal dimension at end-systole	Distance
LVPWs	Left ventricular posterior wall dimension at end-systole	Distance
LV Function	***Left Ventricle Function***	---
LVET	Left ventricular ejection time	Time
HR	Heart Rate	(user-entered value)

M-Mode Calculation Labels

Calculation Label	Description	Required Measurements	Units
CI	***Cardiac Index*** is the cardiac output per square meter of body surface area (BSA): CI = CO÷BSA. For height in centimeters and weight in kilograms: $BSA=0.007184 \times (Weight^{0.425}) \times (Height^{0.725})$ For height in feet/inches and weight in pounds: $BSA=0.007184 \times (Weight \times 0.454)^{0.425} \times (Height \times 2.54)^{0.725}$	BSA entry in the patient data form (determined by height and weight of patient)	$L/min/m^2$
CO	***Cardiac Output*** is the effective volume of blood ejected by either ventricle of the heart per unit of time: CO = [(EDV - ESV)÷1000](HR).	EDV ESV HR	L/min
EDV and **ESV**	Left Ventricular End-Systolic Volume and Left Ventricular End-Diastolic Volume estimates volume from the left ventricular internal diameter (LVID) using the distance measurement. Cubed Volume Method: $EDV = LVIDd^3$ $ESV = LVIDs^3$ Teichholz Volume Method: $EDV = 7(LVIDd^3 / 1000) / (2.4+LVIDd/10)$ $ESV = 7(LVIDs^3 / 1000) / (2.4+LVIDs/10)$ Gibson Volume Method: EDV = π / 6*(0.98*LVIDd/10+5.90) * LVIDd/10*LVIDd/10 ESV = π / 6*(1.14*LVIDs/10+4.18) * LVIDs/10*LVIDs/10	LVIDd LVIDs	mL
EF	***Ejection Fraction*** is the ratio of the stroke volume to the end-diastolic volume: EF = 100[(EDV-ESV)÷EDV].	EDV ESV	%
AOd/LAs	Aorta Diastole to Left Atrium Systole ratio	LAs AOd	Ratio or Index
LAs/AOd	Left Atrium Systole to Aorta Diastole ratio	LAs AOd	Ratio or Index
HR	***Heart Rate***: HR = 60÷(R-R interval).	HR a cardiac cycle	bpm
SI	***Stroke Index*** is a measurement of stroke volume normalized to BSA: SI = SV÷BSA.	SV BSA	mL/m^2
SV	***Stroke Volume*** is the volume of blood ejected from a ventricle during one cardiac cycle: SV = EDV-ESV.	EDV ESV	mL
LV Mass	***Left Ventricular Mass*** $LV Mass(g) = 1.04 * ((IVSd(mm)/10 + LVIDd(mm)/10 + LVPWd(mm)/10)^3 – (LVIDd(mm)/10)^3)$	IVSd LVIDd LVPWd	g

Calculation Label	Description	Required Measurements	Units
LV Mass-c	***LV Mass-corrected*** LV Mass-c(g) = 0.8*LV Mass(g) + 0.6	LV Mass	g
LV Mass-i	***LV Mass-Index*** describes the proportion of left ventricular mass to the body surface area LV Mass-I(g/m^2) = LV Mass-c(g) / BSA(m^2)	LV Mass-c BSA	g/m^2
mVcf	***M-mode Velocity of Circumferential Fiber Shortening*** (LVIDd(mm)-LVIDs(mm))/ (LVIDd(mm)*LVET(ms)/1000)	LVIDd LVIDs LVET	circ/s
mVcfc*	***Mean Velocity of Circumferential Fiber Shortening*** $\frac{(\text{LVIDd(mm)} - \text{LVIDs(mm)})}{\text{LVIDd(mm)} \times \text{LVETc}}$ $\text{LVETc} = \frac{(\text{LVET(ms)}/1000)}{\sqrt{\text{RR}}}$ $\text{RR(sec)} = \frac{60}{\text{HR}}$	LVIDd LVIDs LVET HR	circ/s
ESWS*	***End-Systolic Wall Stress*** 0.334 * sysBP(mmHg) * LVIDs(mm) / (LVPWs(mm) * (1+LVPWs(mm) / LVIDs(mm)))	LVIDs LVPWs sysBP	g/cm^2

*Applies only to Ped Echo exam.

M-Mode Measurement Methods

Making an M-Mode Distance Measurement

The distance measurement calculates the length of a straight line between two vertical measurement markers.

To label then measure distance:

1. During a cardiac exam, acquire and freeze an M-mode sweep.
2. Activate the measurement function.

   The soft key selections display M-mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the image and displays measurement data in the Measured Results.
4. Roll the trackball to position the measurement marker and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
5. Roll the trackball to position the next measurement marker and then press the **SET** key to complete the measurement.

   The system displays the distance value in the Measured Results and assigns the distance to the selected label.
6. Continue measurements, as required. The system accommodates up to five measurements for each label in the worksheet.

Making a Heart Rate Measurement

This measurement method determines the heart rate by delineating one heart cycle with measurement markers that display as vertical lines.

To determine a heart rate:

1. During a cardiac exam, acquire and freeze an M-mode sweep.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Roll the trackball to select the **HR** measurement label in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the sweep and displays time (**T**) and heart rate (**HR**) values in the Measured Results.
4. Roll the trackball to position the measurement marker on the sweep at the beginning of the cardiac cycle and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
5. Roll the trackball to position the next measurement marker at the end of the cardiac cycle and then press the **SET** key.

   The system displays the calculated heart rate in the Measured Results and transfers the value to the Worksheet and the patient report.

Making a Time Measurement

The Time method measures the change in time between two points. Time is calculated on the horizontal axis. A measurement marker displays as a vertical line.

To label then measure time:

1. During a cardiac exam, acquire and freeze an M-mode sweep.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Press the toggle key for **Time**.

   The system places a measurement marker on the sweep and displays the time (**T**) value in the Measured Results.
4. Roll the trackball to position the measurement marker on the image and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
5. Roll the trackball to position the next measurement marker and then press the **SET** key.

   The system displays the time value in the Measured Results and assigns the distance to the selected label.

Making a Slope Measurement

The Slope measurement measures the change in distance over time, as determined by two distance measurement markers.

To measure then label a slope:

1. During a cardiac exam, acquire and freeze an M-mode sweep.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Press the toggle key for **Slope**.

   The system places a measurement marker on the sweep and displays the slope (**S**) value in the Measured Results.
4. Roll the trackball to position the measurement marker on the sweep and then press the **SET** key.

   The system anchors the marker and displays the next measurement marker.
5. Roll the trackball to position the second marker then press the **SET** key.

   The system displays the slope value in the Measured Results.
6. To assign the measured results to a label, roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system assigns the measured result to the label.

M-Mode Left Ventricular Function Assessment

The system provides guided measurements for the Cubed, Teichholz, and Gibson measurement types for left ventricular function assessment. Use the system presets to select one of the system-defined guided measurement sequences (patterns) of measurement labels for each measurement type.

M & R Configuration > Measurement and Report Preset > Measurement Order

These measurements can also be performed individually, as non-guided measurements.

To make a guided LV function measurement:

1. During a cardiac exam, acquire and freeze an M-mode sweep.
2. Activate the measurement function.
3. Select the **LV/Cubed(M)**, **LV/Teichholz(M)**, or **LV/Gibson(M)** measurement type from the list in the Measurement Menu.

   The system displays the list of systole and diastole measurement labels in the Measurement Menu.
4. Roll the trackball to highlight **Diastole** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker on the sweep and displays four distance (**D**) measurements in the Measured Results. The measurement method, **MLvDistance**, displays at the bottom of the image screen in the function status.
5. Perform the measurements at end-diastole as follows:
   a. Roll the trackball to position the marker on the posterior right ventricular wall and then press the **SET** key.

      The system anchors the marker and displays the next measurement marker. The measurement data for the first distance measurement in the Measured Results updates as you roll the trackball.

   b. Roll the trackball to position the second marker on the anterior interventricular septum and then press the **SET** key.

      The system anchors the marker and displays the first distance value in the Measured Results. The measurement data for the second distance measurement in the Measured Results updates as you roll the trackball.

   c. Roll the trackball to position the marker on the posterior interventricular septum and then press the **SET** key.

      The system anchors the marker and displays the second distance value in the Measured Results. The measurement data for the third distance measurement in the Measured Results updates as you roll the trackball.

   d. Roll the trackball to position the marker on the endocardium of the left ventricular free wall and then press the **SET** key.

      The system anchors the marker and displays the third distance value in the Measured Results. The measurement data for the fourth distance measurement in the Measured Results updates as you roll the trackball.

   e. Roll the trackball to position the marker on the posterior left ventricular free wall and then press the **SET** key.

      The system anchors the marker, displays the values for **RVDd**, **IVSd**, **LVIDd**, and **LVPWd** in the Measured Results, and assigns the values to the labels in the worksheet and the patient report. The system also displays the calculated value for **EDV** in the Measured Results. In the Measurement Menu, the system displays checkmarks next to the completed measurements and highlights **Systole** as the next suggested measurement.

6. To perform systolic measurements, press the **SET** key.

   The system displays a measurement marker on the sweep and displays four distance (**D**) measurements in the Measured Results.

7. Perform the measurements at end-systole as follows:

   a. Roll the trackball to position the marker on the anterior interventricular septum and then press the **SET** key.

      The system anchors the marker and displays the next measurement marker. The measurement data for the first distance measurement in the Measured Results updates as you roll the trackball.

   b. Roll the trackball to position the marker on the posterior interventricular septum and then press the **SET** key.

      The system anchors the marker and displays the first distance value in the Measured Results. The measurement data for the second distance measurement in the Measured Results updates as you roll the trackball.

   c. Roll the trackball to position the marker on the endocardium of the left ventricular free wall and then press the **SET** key.

      The system anchors the marker and displays the second distance value in the Measured Results. The measurement data for the third distance measurement in the Measured Results updates as you roll the trackball.

   d. Roll the trackball to position the marker on the posterior left ventricular free wall and then press the **SET** key.

      The system anchors the marker, displays the values for **IVSs**, **LVIDs**, and **LVPWs** in the Measured Results, and assigns the values to the labels in the worksheet and the patient report. The system also displays the calculated value for **ESV** in the Measured Results.

8. Roll the trackball to highlight **LVET** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker on the sweep and displays a time (**T**) value in the Measured Results.

9. Roll the trackball to position the measurement marker on the image and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.

10. Roll the trackball to position the next measurement marker and then press the **SET** key.

    The system displays the time value in the Measured Results and assigns the distance to the **LVET** label.

To make a non-guided LV function measurement:

Note: You can either select a measurement label and then perform the measurement, or perform the measurement and then assign the label to the measured results.

1. During a cardiac exam, acquire and freeze an M-mode sweep.
2. Activate the measurement function.
3. Select the **LV/Cubed(M)**, **LV/Teichholz(M)**, or **LV/Gibson(M)** measurement type from the list in the Measurement Menu.

   The system displays the list of systole and diastole measurement labels in the Measurement Menu.
4. Roll the trackball to highlight any measurement label *except* **Diastole** or **Systole** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker on the sweep and displays a distance (**D**) measurement in the Measured Results. The measurement method, **MSimpleDistance**, displays beside the trackball status icon.
5. Roll the trackball to position the measurement marker on the image and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
6. Roll the trackball to position the next measurement marker and then press the **SET** key.

   The system displays the distance value in the Measured Results and assigns the distance to the selected label.

   In the Measurement Menu, the system displays a checkmark next to the completed measurement and the set of measurements (Diastole or Systole) to which it belongs. The system also highlights the next suggested measurement.
7. Continue making measurements, as required. When all of the required measurements are made, the system calculates the **EDV** or **ESV** and displays the value in the Measured Results.

Doppler Measurement Labels

Measurement Menu Label	Description	Measurement Method
Aortic Valve	***Aortic Valve Function***	---
Ao Arch VTI	Aortic Arch Velocity-Time Integral	VTI, PI Manual
AV VTI	Aortic Valve Velocity-Time Integral	VTI, PI Manual
LVOT VTI	Left Ventricular Outflow Tract Velocity-Time Integral	VTI, PI Manual
IVRT	Isovolumic Relaxation Time	Time
AVA(VTI)	***Aortic Valve Area (Velocity-Time Integral)***	---
AV VTI	Aortic Valve Velocity-Time Integral	VTI, PI Manual
LVOT VTI	Left Ventricular Outflow Tract Velocity-Time Integral	VTI, PI Manual
LVOT diam	Left Ventricular Outflow Tract Diameter When you measure LVOT diam for either the Mitral Valve or the Aortic Valve, the system displays the measured results in the worksheet and report for both valves. You can edit the value in the worksheet.	Distance
AVA(Vmax)	***Aortic Valve Area***	---
AV Vmax	Aortic Valve Maximum Velocity	Velocity
LVOT Vmax	Left Ventricular Outflow Tract Maximum Velocity	Velocity
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
AVA(Trace)	***Aortic Valve Area***	---
AV Area	Aortic Valve Area	Trace
VSD	***Ventricular Septal Defect***	---
VSD Vmax	Ventricular Septal Defect Maximum Velocity	Velocity
LVSTI	***Left Ventricular Systolic Time Interval***	---
LVET	Left Ventricular Ejection Time	Time
LVPEP	Left Ventricular Pre-Ejection Period	Time
HR	Heart Rate	HR
Mitral Valve	***Mitral Valve Function***	---
EPSS	E Point to Septal Separation. The distance between the anterior leaflet and the ventricular septum at early diastole.	Distance
E Dur	E-wave Duration	Time
A Dur	A-wave Duration	Time
IVRT	Isovolumic Relaxation Time	Time
MV E pt	Mitral Valve E point	Velocity
MV A pt	Mitral Valve A point	Velocity
MV DT	Mitral Valve Deceleration Time	Acceleration
MV E/A Vel	Mitral Valve E point/A point Velocity	---
MVA(PHT)	***Mitral Valve Area***	---
PHT	Pressure Half-Time	PHT

Measurement Menu Label	Description	Measurement Method
MVA(VTI)	***Mitral Valve Area (Velocity-Time Integral)***	---
MV VTI	Mitral Valve Velocity-Time Integral	VTI, PI Manual
LVOT VTI	Left Ventricular Outflow Tract Velocity-Time Integral	VTI, PI Manual
LVOT diam	Left Ventricular Outflow Tract diameter	Distance
MVA(Trace)	***Mitral Valve Area***	---
MVA(Trace)	Mitral Valve Area	Trace
CO	***Cardiac Output***	---
MV VTI	Mitral Valve Velocity-Time Integral	VTI, PI Manual
MV diam	Mitral Valve diameter	Distance
HR	Heart Rate	HR
Tricuspid Valve	***Tricuspid Valve Function***	---
TV Vmean	Tricuspid Valve Velocity mean	VTI, PI Manual
TV Vmax	Tricuspid Valve Velocity maximum	Velocity
TV E pt	Tricuspid Valve E point	Velocity
TV A pt	Tricuspid Valve A point	Velocity
Pulmonary Valve	***Pulmonary Valve Function***	---
PV Vmax	Pulmonary Valve Velocity maximum	Velocity
RVET	Right Ventricular Ejection Time	Time
RV Act	Right Ventricular Acceleration Time	Time
RVPEP	Right Ventricular Pre-ejection Period	Time
PA Act	Pulmonary Artery Acceleration Time	Time
CO	***Cardiac Output***	---
PV VTI	Pulmonary Valve Velocity-Time Integral	VTI, PI Manual
PV diam	Pulmonary Valve diameter	Distance
HR	Heart Rate	HR
Pulmonary Vein	***Pulmonary Vein Function***	---
PVs1 Vel	Pulmonary Vein systole1 Velocity	Velocity
PVs2 Vel	Pulmonary Vein systole2 Velocity	Velocity
PVd Vel	Pulmonary Vein diastolic Velocity	Velocity
PVa Vel	Pulmonary Vein late diastolic Velocity	Velocity
PVa dur	Pulmonary Vein late diastolic duration	Time
PVs VTI	Pulmonary Vein systolic Velocity-Time Integral	VTI, PI Manual
PVd VTI	Pulmonary Vein diastolic Velocity-Time Integral	VTI, PI Manual
PVd Dect	Pulmonary Vein diastolic Deceleration Time	DcT
AR	***Aortic Regurgitation***	---
Decel Time	Deceleration Time	Time
AI PHT	Aortic Insufficiency Pressure Half-Time	PHT

Measurement Menu Label	Description	Measurement Method
TR	***Tricuspid Regurgitation***	---
TR Vmean	Tricuspid Regurgitation Velocity mean	VTI, PI Manual
TR Vmax	Tricuspid Regurgitation Velocity maximum	Velocity
RAP select	***Right Atrial Pressure selection***	---
0mmHg	Millimeters of mercury	Selection
5mmHg	Millimeters of mercury	Selection
10mmHg	Millimeters of mercury	Selection
15mmHg	Millimeters of mercury	Selection
20mmHg	Millimeters of mercury	Selection
25mmHg	Millimeters of mercury	Selection
PR	***Pulmonary Regurgitation***	---
PR Vmean	Pulmonary Regurgitation Velocity mean	VTI
PR Vmax	Pulmonary Regurgitation Velocity maximum	Velocity
PR Ved	Pulmonary Regurgitation Velocity end diastole	Velocity
MR	***Mitral Regurgitation***	---
MR Vmax	Mitral Regurgitation Velocity maximum	Velocity
dP/dt	Rate of change of pressure over time dP/dt=32 / dt x 1000	dP/dt
PISA(MR)	***Proximal Isovelocity Surface Area (Mitral Regurgitation)***	---
Radius	Radius	Distance
Aliasing Vel	Aliasing Velocity	Automatically determined using the velocity indicated by the color bar. Manually edit in the worksheet.
MR VTI	Mitral Regurgitation Velocity-Time Integral	VTI, PI Manual
PISA(MS)	***Proximal Isovelocity Surface Area (Mitral Stenosis)***	---
Radius	Radius	Distance
Aliasing Vel	Aliasing Velocity	Automatically determined using the velocity indicated by the color bar. Manually edit in the worksheet.
MS VTI	Mitral Stenosis Velocity-Time Integral	VTI, PI Manual
Angle	Angle	Angle
DTI	***Doppler Tissue Imaging***	---
MV medial	***Mitral Valve medial***	---
Ea	Early diastolic motion	Velocity
AR/DR	Rates of Acceleration and Deceleration	AC/DC Rate
Aa	Late diastolic motion	Velocity
Sa	Systolic motion	Velocity

Measurement Menu Label	Description	Measurement Method
MV lateral	***Mitral Valve lateral***	---
Ea	Early diastolic motion	Velocity
AR/DR	Rates of Acceleration and Deceleration	AC/DC Rate
Aa	Late diastolic motion	Velocity
Sa	Systolic motion	Velocity
Qp/Qs	***Pulmonary Valve / Aortic Valve***	---
Systemic VTI	Systemic Velocity-Time Integral	VTI
Systemic diam	Systemic diameter	Distance
Pulmonic VTI	Pulmonic Velocity-Time Integral	VTI
Pulmonic diam	Pulmonic diameter	Distance
HR	Heart Rate	(user-entered value)
Tei index	***Tei Index***	---
LVIMP	***Left Ventricular Index of Myocardial Performance***	---
LVET	Left Ventricular Ejection Time	Time
MV C-O dur	Mitral Valve Close Open duration	Time
RVIMP	***Right Ventricular Index of Myocardial Performance***	---
RVET	Right Ventricular Ejection Time	Time
TV C-Odur	Tricuspid Valve Close-Open duration	Time

Doppler Calculation Labels

Calculation Label	Description	Required Measurements	Units
A/E	Mitral Valve ratio of the A point to the E point A/E=MV A pt(m/s) / MV E pt(m/s)	MV A point (Distance) MV E point (Distance)	n/a
E/A	Mitral Valve ratio of the E point to the A point E/A=MV E pt(m/s) / MV A pt (m/s)	MV E point (Distance) MV A point (Distance)	n/a
CA/CE	Mitral Valve ratio of the CA amplitude to the CE amplitude CA/CE=CA amp (mm) / CE amp (mm)	CA amp (Distance) CE amp (Distance)	n/a
MV PG max	Mitral Valve Pressure Gradient maximum MV PGmax(mmHg)=(MV Vmax(m/s))^2*4	MV Vmax	mmHg
MV PG mean	Mitral Valve Pressure Gradient mean MV PGmean(mmHg)=mean (MV V(m/s)^2*4)	MV Vmean	mmHg
CO	Cardiac Output (Doppler-derived) CO(L/min)=SV(mL) / 1000*HR(bpm)	MV VTI MV diam Heart Rate	L/min
MR PG max	Mitral Regurgitation Maximum Pressure Gradient MR PGmax(mmHg)=(MR Vmax(m/s))^2*4	MR Vmax	mmHg
Ao Arch Vmax	Aortic Arch Velocity maximum	Ao Arch VTI	m/s
Ao Arch Vmean	Aortic Arch Velocity mean	Ao Arch VTI	m/s
Ao Arch PGmax	Aortic Arch Maximum Pressure Gradient Ao Arch PGmax(mmHg)=(Ao Arch Vmax(m/s))^2*4	Ao Arch VTI	mmHg
Ao Arch PGmean	Aortic Arch Pressure Mean Gradient Ao Arch PGmean(mmHg)=mean (Ao Arch V(m/s)^2*4)	Ao Arch VTI	mmHg
AV PG max	Aortic Valve Maximum Pressure Gradient AV PG max(mmHg)=(AV Vmax(m/s))^2*4	AV Vmax	mmHg

Calculation Label	Description	Required Measurements	Units
AV PG mean	Aortic Valve Mean Pressure Gradient AV PG mean(mmHg)=mean (AV V(m/s)^2*4)	AV Vmean	mmHg
PV PG max	Pulmonary Valve Maximum Pressure Gradient PV PGmax(mmHg)=(PV Vmax(m/s))^2*4	PV Vmax	mmHg
PV PG mean	Pulmonary Valve Mean Pressure Gradient PV PGmean(mmHg)=mean (PV V(m/s)^2*4)	PV Vmean	mmHg
PR PG max	Pulmonary Regurgitation Maximum Pressure Gradient PR PGmax(mmHg)=(PR Vmax(m/s))^2*4	PR Vmax	mmHg
PR PG mean	Pulmonary Regurgitation Mean Pressure Gradient PR PGmean(mmHg)=mean (PR V(m/s)^2*4)	PR Vmean	mmHg
PAEDP	Pulmonary Artery End Diastolic Pressure PAEDP(mmHg)=RAP(mmHg) + (PR Ved(m/s))^2*4	RAP PR Ved	mmHg
TR PG max	Tricuspid Regurgitation Pressure Gradient maximum TR PGmax(mmHg)=(TR Vmax(m/s))^2*4	TR Vmax	mmHg
TR PG mean	Tricuspid Regurgitation Pressure Gradient mean TR PGmean(mmHg)=mean (TR V(m/s)^2*4)	TR Vmean	mmHg
RVSP	Right Ventricular Systolic Pressure is determined from the tricuspid regurgitation velocity converted to a pressure gradient: RVSP(mmHg)=(TR Vmax(m/s))^2*4 + RAP(mmHg)	TR Vmax RAP	mmHg
LVOT PG max	Left Ventricular Outflow Tract Maximum Pressure Gradient LVOT PGmax(mmHg)=(LVOT Vmax(m/s))^2*4	LVOT Vmax	mmHg
LVOT PG mean	Left Ventricular Outflow Tract Mean Pressure Gradient LVOT PGmean(mmHg)=mean (LVOT V(m/s)^2*4)	LVOT Vmean	mmHg
VSD PGmax	Ventricular Septal Defect maximum Pressure Gradient VSD PGmax(mmHg)=(VSD Vmax(m/s))^2*4	VSD Vmax	mmHg
TV PGmax	Tricuspid Valve maximum Pressure Gradient TV PGmax(mmHg)=(TV Vmax(m/s))^2*4	TV Vmax	mmHg
TV PGmean	Tricuspid Valve mean Pressure Gradient TV PGmean(mmHg)=mean (TV V(m/s)^2*4)	TV Vmean	mmHg
AR PGmax	Aortic Regurgitation maximum Pressure Gradient AR PGmax(mmHg)=(AR Vmax(m/s))^2*4	AR Vmax	mmHg
MS PGmax	Mitral Stenosis maximum Pressure Gradient MS PGmax(mmHg)=(MS Vmax(m/s))^2*4	MS Vmax	mmHg
LVIMP	Left Ventricular Index of Myocardial Performance LVIMP=(MV C-Odur(ms) – LVET(ms)) / LVET(ms)	MV C-Odur LVET	n/a
RVIMP	Right Ventricular Index of Myocardial Performance RVIMP=(TV C-Odur(ms) – RVET(ms)) / RVET(ms)	TV C-Odur RVET	n/a
HR	Heart Rate: HR = 60/R-R interval.	Measure across one heart cycle	bpm

Calculation Label	Description	Required Measurements	Units
Ea/Aa	Doppler Tissue Imaging ratio of the lateral or medial Ea and Aa measurements Ea/Aa = Ea(m/s) / Aa(m/s)	Ea lateral or medial Aa lateral or medial	n/a
E/Ea	Doppler Tissue Imaging ratio of the lateral or medial E and Ea measurements E/Ea(m) = Mitral Valve E pt(m/s) / Ea(m/s)	Mitral Valve E point Ea lateral or medial	n/a
MVA(VTI)	Mitral Valve Area (Velocity-Time Integral) $MVA(VTI)(cm^2) = \pi*(LVOT\ diam(mm)/2/10)^2 * (LVOT\ VTI(cm) / MV\ VTI(cm))$	LVOT diam LVOT VTI MV VTI	cm^2
AVA(VTI)	Aortic Valve Area (Velocity-Time Integral) $AVA(VTI)(cm^2) = \pi*(LVOT\ diam(mm)/2/10)^2 * (LVOT\ VTI(cm) / AV\ VTI(cm))$	LVOT diam LVOT VTI AV VTI	cm^2
Qp/Qs	Qp/Qs = CO(L/min)(Pulmonary Valve) / CO(L/min)(Aortic Valve)	CO Pulmonary Valve CO Aortic Valve	n/a
SVs	SV(mL)(Aortic Valve)	SV Aortic Valve	mL
COs	CO(L/min)(Aortic Valve)	CO Aortic Valve	L/min
SVp	SV(mL)(Pulmonary Valve)	SV Pulmonary Valve	mL
COp	CO(L/min)(Pulmonary Valve)	CO Pulmonary Valve	L/min
Qp-Qs	Qp-Qs(L/min) = CO(L/min)(Pulmonary Valve) – CO(L/min)(Aortic Valve)	CO Pulmonary Valve CO Aortic Valve	L/min

Doppler Measurements and Measurement Methods

Making a Velocity Measurement

To measure then label velocity:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display Doppler-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Press the toggle key for **Velocity**.

   The system places a measurement marker on the spectrum.
4. Roll the trackball to position the measurement marker on the peak velocity on the spectrum and then press the **SET** key.

   The system anchors the measurement marker and updates velocity (**V**), frequency (**Freq**), and pressure gradient (**PG**) values in the Measured Results.
5. To assign the measured results to a label, roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system assigns the measured result to the label.
6. Continue making measurements, as required. The system accommodates up to five measurements for each label in the worksheet.

Making a Time Measurement

The Time method measures intervals between two measurement markers. The markers display as vertical lines. The system calculates time on the horizontal axis.

To measure then label time:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display Doppler-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Press the toggle key for **Time**.

   The system places a measurement marker on the spectrum.
4. Roll the trackball to position the measurement marker on the spectrum and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
5. Roll the trackball to position the next measurement marker on the spectrum and then press the **SET** key.

   The system anchors a measurement marker and updates time (**T**) in the Measured Results.
6. To assign the measured results to a label, roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system assigns the label to the measured result.
7. Continue measurements, as required. The system accommodates up to five measurements for each label in the worksheet.

Making a Heart Rate Measurement

The Heart Rate measurement requires one cardiac cycle. A measurement marker displays as a vertical line.

To measure heart rate:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Press the toggle key for **HR**.
4. Roll the trackball to select the **HR** measurement label in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the spectrum.
5. Roll the trackball to position the measurement marker on the spectrum at the beginning of the cardiac cycle and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
6. Roll the trackball to position the next measurement marker at the end of the cardiac cycle and then press the **SET** key.

   The system displays the calculated heart rate in the Measured Results and transfers the value to the Worksheet and the patient report.

To manually enter a heart rate:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.
3. Roll the trackball to select **HR (edit)** in the Measurement Menu and then press the **SET** key.
4. Enter the heart rate in the dialog box and select **OK**.

   The system displays a checkmark next to **HR** and displays the heart rate in the Measured Results.

   Note: An asterisk (*) displays next to **HR** in Measured Results when the value has been modified or entered manually.

Making a Trace

Making a trace requires a manual trace of a Doppler waveform. The system determines a maximum velocity and uses the trace to calculate a mean velocity, maximum and mean pressure gradient, and a velocity-time integral.

To measure then label a trace:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Press the toggle key for **PI Manual**.

   The system displays a measurement marker on the spectrum.
4. Roll the trackball to position the marker at the beginning of the waveform and then press the **SET** key.

   The system places another measurement marker on the spectrum and displays measurement data in the Measured Results.
5. Roll the trackball to create a trace of the waveform. To delete (undo) a segment of the outline, rotate the **SELECT** control counterclockwise.
6. To complete the trace, press the **SET** key.

   The system displays the current values in the Measured Results.
7. Roll the trackball to position the marker at the ending of the waveform and press the **SET** key.

   The system displays the final values in the Measured Results.

Making an Acceleration Measurement

Acceleration and deceleration times are derived by measuring the change of velocity over time, using a slope formula.

To measure then label an acceleration/deceleration:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Press the toggle key for **Acceleration**.

   The system places a measurement marker on the spectrum and displays values for acceleration (**Accel**), time (**T**), and velocity (**Vmx**) in the Measured Results.
4. Roll the trackball to position the measurement marker on the velocity in the waveform and then press the **SET** key.

   The system anchors the marker and displays another measurement marker.
5. Roll the trackball to position the marker at the end of the acceleration velocity and then press the **SET** key.

   The system updates the values in the Measured Results.
6. To assign the measured results to a label, roll the trackball to select a measurement label in the Measurement Menu and then press the **SET** key.

   The system assigns the measured results to the labels.

Determining a Pressure Gradient

The system calculates a maximum pressure gradient either from a maximum velocity, using a velocity measurement method or from the tracing of a Doppler waveform, using the trace measurement method.

The system uses a Bernoulli equation to calculate the maximum pressure gradient:

$P_1 - P_2 = 4V^2$.

The mean pressure gradient is calculated from the area of the Doppler spectrum using the trace measurement method.

Measuring a VTI (Continuity Equation)

The system calculates a velocity-time integral, maximum and mean velocities, and maximum and mean pressure gradients from a trace of the Doppler spectrum.

To label then measure a velocity-time integral:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Press the toggle key for **VTI**.

   The system displays the first measurement marker on the spectrum.
4. Roll the trackball to position the measurement marker on the spectrum and then press the **SET** key.
5. Roll the trackball to create a trace of the waveform. To delete (undo) a segment of the trace, rotate the **SELECT** control counterclockwise.
6. To complete the trace, press the **SET** key.

   The system displays both measurement markers and the completed trace in a single color. The system calculates and displays the values for **VTI**, **Vmax**, **PGmax**, **Vmean**, **PGmean**, **AT**, and **ET** in the Measured Results and assigns the values to the labels in the worksheet and patient report.

Determining a Valve Area by Pressure Half Time

The Area Pressure Half Time measurement method requires a peak velocity and a diastolic slope to determine a valve area by measuring the time it takes for the pressure to drop by one half.

To determine a valve area using pressure half-time:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Roll the trackball to select a **PHT** label in the Measurement Menu and then press the **SET** key.

   The system displays a value for pressure half-time (**PHT**).
4. Roll the trackball to position the measurement marker on the spectrum at the peak velocity and then press the **SET** key.

   The system displays another measurement marker on the spectrum.
5. Roll the trackball to position the second marker on the deceleration of the mitral valve and then press the **SET** key.

   The system calculates and displays the values for deceleration time, deceleration slope, pressure half-time, diameter, the calculated area, and the traced area in the Measured Results and assigns the corresponding values to the labels in the worksheet and patient report.

Measuring Valve Regurgitation

The system provides labeled valve regurgitation measurements.

The Doppler dP/dt measurement method measures left ventricular systolic performance. It uses the mitral regurgitation (MR) jet to infer information about the left ventricle, by determining the time required for mitral regurgitation to change from 1 m/s to 3 m/s.

To measure valve regurgitation velocity:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display Doppler-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Roll the trackball to select a velocity label in the Measurement Menu and then press the **SET** key.

   The system places a measurement marker on the spectrum.
4. Roll the trackball to position the measurement marker on the corresponding velocity on the spectrum and then press the **SET** key.

   The system anchors the measurement marker and updates velocity (**V**), frequency (**Freq**), and pressure gradient (**PG**) values in the Measured Results.

To perform the dP/dt measurement for Mitral Regurgitation (MR):

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Roll the trackball to select **dP/dt** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker and two horizontal lines indicating regurgitation velocities of 1 m/s and 3 m/s.

   Note: If the system displays an error message, adjust the velocity to display 1 m/s to 3 m/s on the image screen.
4. Roll the trackball to the point where the MR jet intersects the reference line at a velocity of 1 m/s and then press the **SET** key.

   The system displays another measurement marker on the spectrum.
5. Roll the trackball to the point where the MR jet intersects the reference line at a velocity of 3 m/s and then press the **SET** key.

   The system calculates and displays the value for **dP/dt** in the Measured Results and assigns the value to the label in the worksheet and patient report.

DTI Measurements

You can quantify tissue movement with DTI measurements. The system also generates calculations.

To perform DTI measurements:

1. Press the **FREEZE** key to freeze the image.
2. Activate the measurement function.

   The soft key selections display Doppler-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Select **DTI** from the measurement menu and then select the required DTI label.

   The system activates the required measurement method and displays a measurement marker on the Doppler spectrum.
4. Complete the measurement.

Labels for DTI Measurements and Calculations

All DTI values in the patient report are followed by a letter (**m** or **l**) to indicate the specific mitral valve (medial or lateral, respectively).

Label	Description
MV medial	Mitral valve medial (category)
Ea	Early diastolic velocity of the mitral annulus
AR/DR	Begins the workflow for completing the following measurements: ▪ **ATa** – Acceleration Time of **Ea** ▪ **ARa** – Acceleration Rate of **Ea** ▪ **DTa** – Deceleration Time of **Ea** ▪ **DRa** – Deceleration Rate of **Ea**
Aa	Late diastolic velocity of the mitral annulus
Sa	Systolic velocity of the mitral annulus
MV lateral	Mitral valve lateral (category)
Ea	Early diastolic velocity of the mitral annulus
AR/DR	Begins the workflow for completing the following measurements: ▪ **ATa** – Acceleration Time of **Ea** ▪ **ARa** – Acceleration Rate of **Ea** ▪ **DTa** – Deceleration Time of **Ea** ▪ **DRa** – Deceleration Rate of **Ea**
Aa	Late diastolic velocity of the mitral annulus
Sa	Systolic velocity of the mitral annulus

Note: The system generates the calculation **Ea/Aa** when both **Ea** and **Aa** measurements are completed.

Measuring the Rate and Time for Acceleration and Deceleration

The Doppler Tissue Imaging function provides rate and time measurements for acceleration and deceleration.

To measure the rate and time:

1. During a cardiac exam, acquire and freeze a Doppler spectrum.
2. Activate the measurement function.

   The soft key selections display mode-specific measurements and measurement methods. The Measurement Menu displays measurement labels.
3. Roll the trackball to select **AR/DR** in the Measurement Menu and then press the **SET** key.

   The system displays a measurement marker.
4. Roll the trackball to the starting point for the acceleration measurement and then press the **SET** key.

   The system displays another measurement marker on the spectrum.
5. Roll the trackball to the end point for the acceleration measurement and then press the **SET** key.

   The system determines the acceleration rate (**AR**) and acceleration time (**AT**) and displays another measurement marker on the spectrum.
6. Roll the trackball to the end point for the deceleration measurement and then press the **SET** key.

   The system determines the deceleration rate (**dR**) and deceleration time (**dT**) and assigns the values to the labels in the worksheet and patient report.

Cardiology Patient Worksheets and Reports

The system transfers the labeled measurements and calculations from each cardiac measurement type into the Cardiology Worksheets and the Cardiology Report. Information from the **Patient Data** form displays in the top two lines of the patient report.

Each cardiac measurement type has a separate worksheet. Measurements can be edited only in the worksheet, and edited values are indicated in the worksheet and report with an asterisk (*).

Using the Cardiology Worksheet

The measurements for a measurement type display in the same worksheet even if the measurements are taken in different imaging modes.

You can edit measurements directly in the worksheet. When you edit one of the measurements required for a calculation, the system updates the calculated value.

To access a Cardiology Worksheet:

1. During a cardiac exam, click **Worksheet** in the Measurement Menu.

   The system displays the Cardiology Worksheet.
2. To view a different page of the worksheet, click **Prev** or **Next**.
3. To access the patient report, click **Report**.
4. To return to the image screen, click **Return**.

Editing Worksheets

Edit a worksheet to change the values that display in the patient report and the Measured Results. To change calculated results, edit the measurements that are components of the calculation.

The system displays an asterisk (*) next to an edited value. If an edited value is used in data averaging, an asterisk displays next to the calculated average.

To edit a value in the worksheet:

1. Display the worksheet.
2. Roll the trackball to position the pointer in the cell and then press the **SET** key.
3. Use the keyboard to edit the value.

   The system shifts the value in the cell to the left.
4. Roll the trackball to position the pointer outside of the cell and then press the **SET** key.

   The system displays an asterisk next to the value. If data averaging is used, the system also displays an asterisk next to the new average value.

   Note: If the value just edited is used in a calculation, the system displays an asterisk next to the newly calculated value.

To delete one value for a measurement:

1. Roll the trackball to highlight a value in the worksheet and then press the **SET** key.
2. Click **Delete Cell**.

   The system clears the selected cell in the worksheet. If data averaging is used, the system updates the averaged value based on the remaining measurements.

To delete all values for a measurement:

1. Roll the trackball to highlight a value in the worksheet and then press the **SET** key.
2. Click **Delete Line**.

   The system removes all values for that measurement from the worksheet.

   Note: If the value just deleted is used in a calculation, the system removes the calculated value from the worksheet and the Measured Results.

To delete all values for a measurement type:

1. Click **Delete All**.

   The system displays a verification message.

2. Click **OK**.

   The system removes all values for all measurements from the worksheet, and clears the column in the report for that measurement type. If you do not make any more measurements for that measurement type, the system removes the column from the patient report.

Using the Cardiology Report

The measurements for a measurement type display in the same report column even if the measurements are taken in different imaging modes. An exception is the Mitral Valve measurement type, which has separate lists of measurement labels for 2D/Doppler and for M-mode, and therefore two columns in the patient report.

The system displays only the labels to which values are assigned.

B7 Emergency Medicine Measurements and Calculations

Emergency Medicine Measurements and Calculations

The Emergency Medicine (EM) package includes measurements, calculations, and patient reports for assessing:

- Dimensions of abdominal organs: Gall bladder wall, bile duct, and aorta
- Cardiac function: End-diastolic and end-systolic volumes and the derived ejection fraction
- Fetal Growth: Gestational sac, crown-rump length, and biparietal diameter
- Bladder dimensions for the transverse and sagittal planes

Customizing Emergency Medicine (EM) Measurements and Reports

Use the system presets to customize the EM exam type.

M & R Configuration > Measurement and Report Preset

Options for Exam Configuration Default Settings

- Select the system response when you press the **FREEZE** key
- Create or edit the Pictogram List
- Create or edit the Text Annotation List

Options for Measurements and Reports (M & R)

- Specify the shape, size, and default position for the caliper
- Specify whether the background for the Measured Results section of the screen has a different color than the image background
- Select the default measurement method for each mode
- Select the default method for each type of measurement
- Select the measurement methods that display as soft key selections for each mode, and the order in which they display
- Restrict the display of Measured Results to measured values or display all labels with or without measurement values
- Include or exclude physician identification in the patient report
- Customize the display of tabs on the patient report
- Define the Comments Library for the patient report
- Select the formula for determining a Bladder Volume
- Select the author for use with the menstrual age parameters

Measurement Menu

System-defined measurement labels for the active measurement type display in the Measurement Menu. When a measured result is assigned to a label, the label and value display in the associated section of the patient report.

2D-Mode Measurement Labels

Measurement Menu Label	Description	Measurement Method
GB Wall thk	Gall Bladder Wall Thickness	Distance
CBD	Common Bile Duct	Distance
Aorta	Aorta	Distance
EDV	Left Ventricular End Diastolic Volume	1 Plane Disk
ESV	Left Ventricular End Systolic Volume	1 Plane Disk
GS	Gestational Sac, maximum thickness	Distance
CRL	Crown Rump Length	Distance
BPD	Biparietal Diameter	Distance
Bl Trans D	Bladder, Transverse Depth	Distance
Bl Trans W	Bladder, Transverse Width	Distance
Bl Sag D	Bladder, Sagittal Depth	Distance
Bl Sag L	Bladder, Sagittal Length	Distance

2D-Mode Calculation Labels

The system performs 2D-mode calculations when you complete the required measurements and assigns calculation labels to the results. Calculated results display in the Measured Results section of the screen and are transferred to the associated section of the patient report.

Calculation Label	Description	Required Measurements	Units
EF	***Ejection Fraction*** is the ratio of the stroke volume to the end-diastolic volume: EF = 100[(EDV-ESV) ÷ EDV]	EDV ESV	%
Bladder V	***Bladder Volume*** is calculated from transverse or sagittal bladder measurements, or from measured results in both planes. Transverse 1 Plane Volume: (π x TD x TW x TW) / 6 Sagittal 1 Plane Volume: (π x SD x SL x SL) / 6 Combined 2 Plane Volume: (π x (TD+SD) / 2 x TW x SL) / 6 or (π x TD x TW x SL) / 6 or (π x SD x TW x SL) / 6	Transverse Diameter Transverse Width Sagittal Diameter Sagittal Length	mL

Determining a Left Ventricular End-Diastolic or End-Systolic Volume

The EM exam uses the one-plane disk volume measurement method.

To determine an EDV or ESV:

1. During an EM exam, acquire and freeze a 2D-mode image and activate CINE playback.
2. Roll the trackball to view an end systolic or end diastolic frame.
3. Activate the measurement function.

   The Measurement Menu displays measurement labels.
4. Rotate the **SELECT** control to select **EDV** or **ESV** in the Measurement Menu and then press the **SELECT** control.

   The system places a measurement marker on the image.
5. Roll the trackball to position the measurement marker to begin the volume trace and then press the **SET** key.

   The system anchors the marker.
6. Roll the trackball to create a trace of the structure. To delete (undo) a segment of the outline, rotate the **SELECT** control counterclockwise.
7. To complete the trace, press the **SET** key.

   The system connects the beginning and end points of the trace and displays a line representing the long axis.
8. Roll the trackball to position the endpoint of the long axis and then press the **SET** key.

   The system displays the volume in the Measured Results and assigns the volume value to the measurement label.

M-Mode and Doppler Calculation Labels

The system performs M-mode and Doppler calculations when you complete the required measurements and assigns calculation labels to the results. Calculated results display in the Measured Results section of the screen and are transferred to the associated section of the patient report.

Calculation Label	Description	Required Measurements
FHR	Fetal Heart Rate, in beats per minute	One to five cardiac cycles in M-mode, depending on the number of cycles selected in system presets

Emergency Medicine (EM) Patient Report

The system transfers the labeled measurements and calculations from each measurement or derived calculation into the corresponding section of data, or ***tab***, of the Emergency Medicine (EM) Report. Information from the **Patient Data** form displays in the top two lines of the patient report.

Use the system presets to customize the display of tabs on the patient report.

M & R Configuration > Measurement and Report Preset > Report Tab

EM Report Data (Tabs)

The system displays an asterisk next to the name of each tab that contains report data. Report data includes descriptive fields and the measured and calculated results. Report tabs for the EM exam include:

- FAST (Focused Abdominal Sonography in Trauma)
- Aorta
- Gallbladder
- Renal
- OB (Obstetric)
- Cardiac
- Bladder
- DVT (Deep Vein Thrombosis)

Note: If a measurement has been completed or the description has been edited, the system inserts an asterisk mark (*).

FAST Data

FAST is Focused Abdominal Sonography in Trauma. The data in this section of the report can be used during an ultrasound examination to determine whether fluid has accumulated in the abdominal cavity.

Description of Unique Report Fields

Field	Description	Selections
Morison's pouch	Anterior surface of the hepar and the right kidney	**Negative fluid** **Positive fluid** **Not imaged**
Splenorenal view	Splenorenal	**Negative fluid** **Positive fluid** **Not imaged**
Suprapubic view	Bladder	**Negative fluid** **Positive fluid** **Not imaged**
Cardiac view	Heart	**Subcostal view** **Parasternal view** **Not imaged**
Pericardial effusion	Pericardial effusion	**None** **Physiologic fluid/epicardial fat** **Small effusion** **Moderate effusion** **Large effusion**
Right chest	Right chest	**Pleural fluid** **No pleural fluid** **Not imaged** **Lung sliding/comet tail present** **Lung sliding/comet tail absent**
Left chest	Left chest	**Pleural fluid** **No pleural fluid** **Not imaged** **Lung sliding/comet tail present** **Lung sliding/comet tail absent**

Aorta Data

Description of Unique Report Fields

Field	Description
Imaged transversely	Check box to indicate the orientation of image
Imaged longitudinally	Check box to indicate the orientation of image
Aorta	Measured result

Gallbladder

Description of Unique Report Fields

Field	Description
Imaged transversely	Check box to indicate the orientation of image
Imaged sagitally	Check box to indicate the orientation of image
Gallstones present **Gallstones absent**	Check box to indicate the presence or the absence of gallstones
Wall thickening present **Wall thickening absent**	Check box to indicate the presence or absence of thickening of the gallbladder wall
Wall thickness	Measured result
Sonographic Murphy's present **Sonographic Murphy's absent**	Check box to indicate the presence or absence of tenderness above the gallbladder
Pericholecystic fluid present **Pericholecystic fluid absent**	Check box to indicate the presence or the absence of pericholecystic fluid
Common bile duct measured	Measured result
Common bile duct not imaged	Check box to indicate the bile duct was not imaged

Renal Data

Description of Unique Report Fields

Field	Description	Selections
Right kidney	Check box to indicate the orientation of the image	**Imaged coronally** **Imaged transversely**
Hydronephrosis	Hydronephrosis of right kidney	**None** **Mild** **Moderate** **Severe**
Left kidney	Check box to indicate the orientation of the image	**Imaged coronally** **Imaged transversely**
Hydronephrosis	Hydronephrosis of left kidney	**None** **Mild** **Moderate** **Severe**

Obstetric

Description of Unique Report Fields

Field	Description	Selections
Gravida	Gravida (the number of times of pregnancy)	Transferred from the Patient Data form
Para	Para (the number of times of live birth)	Transferred from the Patient Data form
AB	Abortion (the number of times of abortion)	Transferred from the Patient Data form
Ectopic	Ectopic pregnancy (the number of times of pregnancy)	Transferred from the Patient Data form
LMP	Last Menstrual Period When LMP is calculated from Clinical MA or Clinical EDC, the system inserts the mark ** at the beginning of the indication. In-vitro Fertilization Data (IVF) may be used instead of LMP. IVF = LMP + 14 Days When IVF is calculated from Clinical MA or Clinical EDC, the system inserts the mark ** at the beginning of the indication.	Date transferred from the Patient Data form or selected from the drop-down calendar
Clinical MA	Clinical Menstrual Age Clinical MA = Study Date - LMP	Week + Day
Clinical EDC	Clinical Estimated Data of Confinement Clinical EDC = LMP + 280 Days	Date transferred from the Patient Data form or selected from the drop-down calendar
Measurement	Displays the selected reference author and estimated menstrual age based on measured results for: BPD GS CRL Displays measured results for: FHR	—
Uterus imaged transversely	Check box to indicate the orientation of the image of the uterus	—
Uterus imaged longitudinally	Check box to indicate the orientation of the image of the uterus	—
Intrauterine gestational sac present	Check box to indicate the presence of the intrauterine gestational sac	—
Yolk sac present	Check box to indicate the presence of the yolk sac	—
Fetal pole present	Check box to indicate the presence of the fetal pole	—

Field	Description	Selections
Cardiac flicker present	Check box to indicate the presence of cardiac flicker	—
Fetal motion present	Check box to indicate the presence of fetal motion	—
Interpretation	Interpretation	**Intrauterine pregnancy** **Live intrauterine pregnancy** **No definitive uterine pregnancy**
Fluid in cul-de-sac	Fluid in cul-de-sac	**None** **Physiologic** **Small** **Moderate** **Large**

Cardiac Data

Description of Unique Report Fields

Field	Description	Selections
Subcostal view	Check box to indicate the orientation of the image	—
Parasternal view	Check box to indicate the orientation of the image	—
Apical view	Check box to indicate the orientation of the image	—
Pericardial effusion	Pericardial effusion	**None** **Physiologic fluid/epicardial fat** **Small effusion** **Moderate effusion** **Large effusion**
LV Function	Left Ventricular Function	**Good(EF>50%)** **Moderate(EF 30-50%)** **Poor(EF<30%)**
EF	Ejection Fraction	Calculation results based on EDV and ESV measurements

Bladder

Description of Unique Report Fields

Field	Description	Selections
Imaged transversely	Check box to indicate the orientation of image	—
Depth	Measured results	—
Width	Measured results	—
Imaged sagitally	Check box to indicate the orientation of image	—
Depth	Measured results	—
Length	Measured results	—
Volume	Calculated results based on transverse and/or sagittal plane measurements and the labeled measurements used to calculate the volume	**Trans D** (Transverse Depth) **Trans W** (Transverse Width) **Sag D** (Sagittal Depth) **Sag L** (Sagittal Length)

DVT (Deep Vein Thrombosis)

Description of Unique Report Fields

Field	Description	Selections
Leg imaged	Leg imaged	**Right** **Left**
CFV	Common Femoral Vein	**Compressible** **Non-compressible** **Not imaged**
SFV	Superficial Femoral Veins	**Compressible** **Non-compressible** **Not imaged**
Pop. V	Popliteal Vein	**Compressible** **Non-compressible** **Not visualized**

C1 Patient Data Management

Saving Patient Data

You can save patient data to the system's hard disk.

Saving Patient Registration Data

Use the system presets to automatically store a screen representation of the completed patient data form to the registered patient's study.

General 2 > Patient ID > AutoStore New Patient Form

To save patient registration data:

- Register the patient.

  The system stores the patient data to the system's hard disk when you select the **OK** button at the bottom of the **New Patient Data** form.

Saving Images and Reports

You can save images and reports from the current examination to the system's hard disk.

The system automatically saves patient report data and a representative image of the report each time you save a patient report. The system retains only the most recently saved patient report data for each exam type.

To save an image:

- Press the documentation control (**PRINT/STORE1**, **PRINT/STORE2**, or **CLIP STORE**) that is configured in the system presets for disk storage.

To save a patient report:

1. Press the **Report** key on the keyboard to display the patient report.
2. Press the documentation control (**PRINT/STORE1**, **PRINT/STORE2**, or **CLIP STORE**) that is configured in the system presets for disk storage.

Configuring Clip Options

When you press the documentation control that is configured for clip capture in the system presets, the system captures a set number of image frames and then stores the image frames as a clip.

Customize Keys > Key Function

Note: You can configure multiple documentation controls for clip capture.

The clip contains the image frames acquired either before or after you press the documentation control, according to the acquisition timing option configured in the system presets. The retrospective option captures the image frames acquired before you press the documentation control. The prospective option captures the image frames acquired after you press the documentation control.

Use the system presets to configure clip options such as length and type.

Note: The number of frames in a clip is determined by the duration configured in the system presets and the number of frames to acquire per second.

To configure options for clip capture:

1. Press the **Presets** key on the keyboard and then select **Clip Capture** on the left of the screen to display the **Clip Capture** screen.
2. Change options as required.
3. Select the **Save** button to store the new settings and exit the system presets.

Saving Clips

You can save (capture) a clip during a patient examination. The system saves the clip to the designated storage destination.

The system stores each acoustic frame of the CINE clip rather than the frame rate of the video standard used for storage of a real-time image.

To save (capture) a clip:

- Press the documentation control that is configured in the system presets for clip capture.

Viewing Patient Data

You can view patient data that is stored on the system's hard disk or on inserted storage media, such as a CD/DVD or USB-compatible device.

Hiding Patient Information on the Screen

You can hide patient information on the screen.

Use the system presets to continuously hide or display patient information.

Display > Patient Banner > Hide Patient Information

Accessing the Study Screen and Image Screen

- ***Image screen*** – Displays images for the currently selected study.
- ***Study screen*** – Lists studies that are saved on the selected disk or storage media.

To access the Study screen and Image screen:

1. Press the **REVIEW** key on the control panel or the **Patient Browser** key on the keyboard.

   If a patient is currently registered, then the system displays the Image screen. If there is not a patient currently registered, then the system displays the Study screen.
2. To display the Image screen (from the Study screen), select the **Image Screen** button on the left of the screen.
3. To display the Study screen (from the Image screen), select the **Study Screen** button on the left of the screen.

Logging Out of the Study Screen and Image Screen

You can log out of the Study screen and Image screen. Logging out prevents unauthorized access to patient data.

See also: Configuring User Accounts and Passwords, p. C1-21

To log out of the Study screen and Image screen:

- Use the keyboard shortcut **Ctrl+Q**.

Selecting and Displaying Patient Data

You can select images and studies listed on the Image and Study screens. You can also sort, search for, and hide studies.

Selecting Images and Studies

To select	Do this
An image in the Image screen	Roll the trackball to position the pointer on the image and then press the **SET** key.
A study in the Study screen	Roll the trackball to position the pointer on the study and then press the **SET** key.
Multiple nonconsecutive studies in the Study screen	1. Select a single study. 2. For each additional study, roll the trackball to position the pointer on the study, press and hold the **Ctrl** key on the keyboard, press the **SET** key on the control panel and then release the **Ctrl** key.
Multiple consecutive studies in the Study screen	1. Select a single study (the first study). 2. Roll the trackball to position the pointer on the last study in the series, press and hold the **Shift** key on the keyboard, press the **SET** key on the control panel and then release the **Shift** key.

Sorting Studies

You can sort studies and resize the columns displayed in the Study screen.

To sort the studies displayed in the Study screen:

1. Select a column heading (such as **Patient Name** or **Images**).
   The system sorts the files in ascending order by the selected column header.
2. To sort the files in descending order, select the column heading again.

To resize columns displayed in the Study screen:

1. Roll the trackball over the rightmost vertical line of the column.
2. Press and hold the **SET** key on the control panel and then roll the trackball to the left or right until you achieve the desired column size.

Searching for Studies

You can search for studies stored on the hard disk or on the selected storage media, such as a CD/DVD or USB-compatible device.

To search for a study:

1. Select the applicable option in the **Archive Source** section of the Study screen.
2. Select **Search** in the **Search for Studies** section.

   The system displays the **Search…** dialog box.
3. Use the keyboard to enter partial or complete values for a patient last name or ID, or enter the study date or range of dates and then select **OK**.

   The system removes the **Search…** dialog box from the screen and updates the Study screen, listing only those studies that equal the entered values.
4. To display all stored studies, select **Show All** in the **Search for Studies** section.

   Note: The **Show All** button is available only after a search has been completed.

Hiding Studies

You can limit the display of studies to those newer than the selected age.

Note: This feature is not available for studies stored on a CD/DVD or USB-compatible device.

To limit the display of studies:

1. Select the **Hide Studies** check box at the top of the Study screen.
2. Select the required age from the drop-down list to the right of the check box.

   The system displays studies newer than the selected age and indicates the number of studies displayed (and the total number of studies) on the upper left of the screen.

Reopening Studies

You can reopen a closed study that was created within the last 24 hours to acquire additional images.

Note: You cannot change any patient information when the study is reopened. The reopened study retains the same information as the original study, for example, the number of fetuses.

To reopen a study:

1. Click **Reopen** in the **Study** section of the Study screen.

   The system displays the existing patient registration form.
2. Click **OK**.

   The system activates real-time 2D imaging.

Viewing Images, Clips, and Reports

You can change the display format for images and reports, delete images and reports, and use the slide show capability.

You can also play back clips.

Scrolling Through Images and Reports

You can scroll through the images and reports displayed in the Image screen.

To scroll through the images displayed in the Image screen:

- Rotate the **SELECT** control.

Changing Display Formats

By default, the system optimizes the display format in the Image screen (layout format) to fit the number of images contained in the selected study. For example, if you select a study containing five images, the system displays the images in the **3 x 3** layout format.

In the full-screen display format, the selected image expands to the full size of the screen.

You can change the Image screen display (layout) format to display the selected number of images per page and lock the format for use when you display images from other studies. You can also toggle Image screen display format with full-screen display format.

Lock graphic check box.

To change the layout format for Image screen display of images:

- Select the required layout format from the drop-down list on the upper left of the Image screen.

To lock the selected layout format:

- Select the lock graphic check box on the upper left of the Image screen.

  The system retains the selected layout format until system shutdown.

To toggle Image screen display of an image with full-screen display:

Note: The term "double-click" refers to the action of rolling the trackball to position the trackball pointer on the object and then pressing the **SET** key on the control panel twice in quick succession.

- Either press the **SELECT** control or double-click the image.

  The system displays the image in full-screen display.

Limiting Display to Selected Images

✔

Check mark indicates marked image.

☑

Check box indicates that display is limited to marked images.

You can select (mark) images out of sequence and then limit the display of images to these marked images.

The system indicates each marked image by placing a check mark on the lower right of the image. During simultaneous display of the marked images, the system displays a check box on the upper left of the Image screen.

The system retains the check marks until you exit the Image screen.

To select images for simultaneous display:

1. For each image, select the image and then press the toggle key for **Mark Image** to mark the image for simultaneous display.
2. To cancel selection (marking) of an image, select the image and then press the toggle key for **Unmark Image**.
3. Press the toggle key for **Show Marked** to simultaneously display all the marked images.
4. To remove the markers from all selected images, press the toggle key for **Clear Marked**.
5. To exit simultaneous display of marked images, press the toggle key for **Show All**.

Deleting Images and Reports

You can delete images and reports from studies that are stored on the system's hard disk.

To delete an image or report from a study stored on the system's hard disk:

1. Select **Local Disk** from the **Archive Source** section of the Study screen.
2. Select the required study (or studies) from the Study screen and then select the **Image Screen** button on the left of the screen.

   The system displays the study's images and reports on the Image screen.
3. Select an image or report.

   The system outlines the selected image or report.
4. Select the **Delete** button on the upper left of the screen and then select the **Yes** button in the confirmation message box displayed by the system.

Making Measurements on Stored Images

You can make measurements on images from the current examination. You can also store or print the image with the measurements. When you activate the measurement function for a displayed clip, the system uses the most recently displayed frame from the clip.

Use the system presets to enable the system to save measurements on stored images.

Note: The system can save measurements performed on a stored image from the current study only.

General 2 > Image Store > Image Store Format with Caliper

Use the system presets to specify the default position of the first marker.

Note: During measurements on stored images, the system does not support the **Depth** option in the system presets. If **Depth** is selected, then the system uses the **Center** option instead.

M & R Configuration > General Configuration > Caliper Default Position

To make measurements on a displayed image for the current study:

Note: The term "double-click" refers to the action of rolling the trackball to position the trackball pointer on the object and then pressing the **SET** key on the control panel twice in quick succession.

1. Press the documentation control (**PRINT/STORE1**, **PRINT/STORE2**, or **CLIP STORE**) that is configured in the system presets for disk storage.

   The system saves the image to the system's hard disk and copies the image to the Image screen.
2. Press the **Patient Browser** key on the keyboard.

   The system displays the Image screen.
3. From the Image screen, double-click an image for full-screen display.
4. If the image is a clip, press the **SET** key to stop the playback motion and then either roll the trackball or use the playback controls at the bottom of the Image screen to display the require clip frame.
5. Press the **CALIPER** key to activate the measurement function and then perform the required measurements.

   You can assign measurement labels to images.
6. Press the documentation control (**PRINT/STORE1**, **PRINT/STORE2**, or **CLIP STORE**) configured in the system presets for disk storage or DICOM printing.

   The system saves the image with measurements as a new image on the system's hard disk and displays the image in the Image screen. If the documentation control used is configured for DICOM printing, the system also sends the image to the **printer layout** page.
7. To display the patient report, press the **Report** key.
8. To remove the patient report from the screen, select the **Return** button on the lower right of the patient report or press the **ESCAPE** key on the control panel.
9. To exit the measurement function and display the live image screen, press the **ESCAPE** key on the control panel twice.

   Note: You can store or print the image with measurements to a DICOM device.

Playing Back Clips

You can play back a clip during a patient examination or from completed and saved studies. The playback speed is adjustable. You can also review a clip frame by frame and scroll through images displayed in the Image screen.

The system indicates the location of the currently displayed frame using the bar on the slider control displayed on the lower right of the Image screen.

To play back a clip during a patient examination:

1. Press the **REVIEW** key on the control panel.

   The system displays the image(s) (including any clips) in the Image screen. The system indicates image selection by outlining the selected image with green lines. The last image acquired (the last image on the last page) is automatically selected. If the selected image is a clip, the system automatically plays it back.

   See also: Changing Display Formats, p. C1-8

   See also: Searching for Studies, p. C1-7

2. Select the clip either by using the trackball and **SET** key or by rotating the **SELECT** control.

   The system automatically plays back the selected clip.

3. To stop or start playback motion, use the trackball and **SET** key to select the clip again. (In full-screen display, press the **SET** key.) You can also use the clip control buttons at the bottom of the Image screen.
4. To adjust clip playback speed, use the **Clip Speed** slider control on the lower left of the Image screen.

To play back a clip from a completed study that is saved to the system's hard disk or to a CD/DVD:

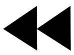
1. Press the **REVIEW** key on the control panel.
2. If the system displays the Image screen, then select the **Study Screen** button to display the Study screen.
3. If the clip is stored on a CD/DVD, then insert the CD/DVD containing the clip into the CD/DVD drive and select the **Load** button in the **Export/Import** section of the Study screen to close the CD/DVD tray.
4. Select the required disk (**Local Disk**, **CD/DVD** or **Removable Disk**) from the **Archive Source** section of the Study screen.
5. Select the study and then select the **Image Screen** button.

   The system displays the image(s) (including any clips) in the Image screen. The system indicates image selection by outlining the selected image with blue lines. The last image acquired (the last image on the last page) is automatically selected. If the selected image is a clip, the system automatically plays it back.
6. Select the clip either by using the trackball and **SET** key or by rotating the **SELECT** control.

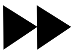
   The system automatically plays back the selected clip.
7. To stop or start playback motion, use the trackball and **SET** key to select the clip again. In full-screen display, press the **SET** key.
8. To adjust clip playback speed, use the **Clip Speed** slider control on the lower left of the image screen.

To review a clip frame by frame:

- In Image screen display format, stop the playback motion and then select the appropriate clip control button at the bottom of the Image screen for display of the desired frame (previous frame or next frame).

  Displays the previous frame.

  Displays the next frame.

- In full-screen display, stop the playback motion and then slowly roll the trackball to the right or left.

To scroll through the images displayed on the Image screen:

- Rotate the **SELECT** control.

Enabling Simultaneous Clip Playback

You can enable simultaneous clip playback of all clips currently displayed in a study using the **Options** dialog box located on the Image screen. Playback is possible for clips in a current patient examination or a completed study.

You can also enable loop-aligned playback. When loop-aligned playback is enabled, all clips begin each playback cycle at the same time. Shorter clips finish playback earlier than longer clips. The system displays these shorter clips as black boxes until the longest clips finish playback and the next playback cycle begins.

To enable simultaneous playback of all clips in the currently displayed study:

1. Select the **Options** button located on the left of the Image screen.
2. Select **Play All Clips** and then click **OK**.

   The system redisplays the Image screen with clips simultaneously in motion.
3. To disable simultaneous playback, reselect the **Options** button, select **Play Only Selected Clip** and then click **OK**.

To enable loop-aligned playback:

1. Select the **Options** button located on the left of the Image screen.

   The system displays the **Options** dialog box.
2. Select **Play All Clips** and then select the **Loop aligned** check box (located below **Play All Clips**).
3. Click **OK** to save changes and close the **Options** dialog box.

Editing a Clip

To edit and create a clip:

1. Select a stored clip and select a **1x1** display layout to enable the **Clip Edit** button.
2. Select **Clip Edit**.
3. Use the controls in the dialog box to locate the starting (first) frame for the new clip.
4. Select **Start Frame**.

   The system displays the frame number on the frame bar.
5. Use the controls in the dialog box to locate the ending (last) frame for the new clip.
6. Select **End Frame**.

   The system displays the frame number on the frame bar and highlights the selected range of frames in blue.
7. Select **Create** to save the selected frames as a new clip.
8. Select **Close** to exit the dialog box.

To delete the settings:

- Select **Clear All** to delete frame selection settings.

Using the Slide Show Capability

You can configure sequential viewing (slide show capability) of clips and images using the **Options** dialog box located on the Image screen. The configuration includes the length of display for images. You can also specify the number of times each clip is played back.

View the slide show using a full-screen display format.

To configure clips and images for sequential viewing in the currently displayed study:

1. Select the **Options** button located on the left of the Image screen.
2. Select the **Slideshow on** check box.
3. To define the length of display for each image, use the keyboard to enter the time (seconds) in the **Image Period (sec)** text box in a "n.nn" format.
4. To specify the number of times each clip is played back, use the keyboard to enter the number in the **Clip Play Loop** text box.
5. Click **OK**.

   The system redisplays the Image screen.
6. Press the toggle key for **Hide Controls** to view the slide show using a full-screen display format.
7. Press the toggle key for **Show Control** to exit full-screen display format.

Creating Teaching Files

Use the teaching file feature to combine images from multiple patient studies into a single teaching file. The system removes all information that could identify a patient from the file.

You cannot store the following as part of a teach file: Images or clips stored from features available when the **Applications** tab is active, images or clips from 3D imaging, report pages, and patient registration forms.

To create a teaching file:

1. Press the **REVIEW** key on the control panel or the **Patient Browser** key on the keyboard.
2. Select the **Image Screen** button to display the Image screen with saved images and clips.
3. For each image required in the teaching file, select the image and then press the toggle key for **Select Image**.
4. Press the toggle key for **Teaching File**.
5. Enter a name for the file in the **New Teaching File Name** section of the teaching file dialog box.

   Note: The system applies a unique identifier to the file name ("**TF**" followed by the date and time of file creation).

6. Select the **New** button.

   The system displays a progress bar and creates a teaching file, and then redisplays the Image screen.

To append an existing teaching file:

1. Press the **REVIEW** key on the control panel.
2. Press the toggle key for **Teaching File**.
3. Select an existing teaching file from the list of displayed studies in the teaching file dialog box.
4. Select the **Append** button to add images to the existing file.

   The system displays a progress bar and updates the teaching file, then redisplays the Image screen.

To view an existing teaching file:

1. Press the **REVIEW** key on the control panel.
2. To display the Study screen with saved files, select the **Study Screen** button.
3. Select an existing teaching file.

   Note: You can sort studies by the unique identifier of the file name ("**TF**" followed by the date and time of file creation) to group all teaching files together.

4. Select the **Image Screen** button to display the Image screen with saved images and clips.

   The images and clips display without any information identifying the patient.

Managing Patient Data

You can transfer studies that are located on the system's hard disk or on inserted storage media such as a CD/DVD or USB-compatible device. You can also delete studies from the system's hard disk.

Transferring Studies to CD/DVD

Using Study screen, you can archive studies onto CD/DVD. You can finalize CD/DVDs to prevent subsequent storage of studies. You can also import (copy) studies from CD/DVD to the system's hard disk.

Note: DICOM-formatted data cannot be imported from CD/DVD to the system's hard disk. If you plan to reimport data that you are archiving onto a CD/DVD, then select the **TIFF** check box to archive TIFF-formatted images.

To archive a study onto a CD/DVD:

1. Press the **Patient Browser** key on the keyboard to display the Study screen.
2. If the system displays the Image screen, then select the **Study Screen** button to display the Study screen.

   The system displays the Study screen.
3. Ensure that **Local Disk** is selected in the **Archive Source** section of the Study screen.
4. Select **CD/DVD** in the **Export/Import** section.
5. Insert the CD/DVD into the CD/DVD drive and then select the **Load** button in the **Export/Import** section of the Study screen to close the CD tray.
6. Select a single study (or multiple studies) and then select **Export** in the **Export/Import** section of the Study screen.

   Note: You can select **Export** up to 20 times per CD/DVD.

   The system copies the selected study or studies to the inserted CD/DVD and updates the study's **Archived** status to **CD/DVD**.
7. To finalize the inserted CD/DVD:

   Note: Finalizing prevents additional storage to the CD/DVD.

   a. Select the **Finalize** button in the **Export/Import** section of the Study screen and then select **OK** to confirm the operation.

      The system displays a message indicating that finalization of the CD/DVD is complete.

   b. Select **OK** to remove the message from the screen.

To copy a study from the inserted CD/DVD to the system's hard disk:

1. Press the **Patient Browser** key on the keyboard to display the Study screen.
2. If the system displays the Image screen, then select the **Study Screen** button to display the Study screen.

   The system displays the Study screen.
3. Insert the media into the CD/DVD drive and then select the **Load** button in the **Export/Import** section of the Study screen to close the CD tray.
4. Ensure that **CD/DVD** is selected in the **Archive Source** section of the Study screen.
5. Select a single study (or multiple studies) and then select **Import** in the **Export/Import** section of the Study screen.

   The system copies the selected study or studies to the system's hard disk. When you select **Local Disk** in the **Archive Source** section to display studies saved on the system's hard disk, the **Archived** status of the imported study is listed as **Import**.

Transferring Studies to a USB-Compatible Storage Device

Using Study screen, you can archive studies onto a USB-compatible storage device. You can also import (copy) studies from a USB-compatible storage device to the system's hard disk.

Note: DICOM-formatted data cannot be imported from a USB-compatible storage device to the system's hard disk. If you plan to reimport data that you are archiving onto a USB-compatible storage device, then select the **TIFF** check box to archive TIFF-formatted images.

To archive a study onto a USB-compatible storage device:

1. Press the **Patient Browser** key on the keyboard to display the Study screen.
2. If the system displays the Image screen, then select the **Study Screen** button to display the Study screen.

   The system displays the Study screen.
3. Ensure that **Local Disk** is selected in the **Archive Source** section of the Study screen.
4. Select **USB** in the **Export/Import** section.
5. Connect the USB-compatible storage device to the USB port.
6. Select a single study (or multiple studies) and then select **Export** in the **Export/Import** section of the Study screen.

   The system copies the selected study or studies to the connected USB-compatible storage device and updates the study's **Archived** status to the **USB**.

To copy a study from the connected USB-compatible storage device to the system's hard disk:

1. Press the **Patient Browser** key on the keyboard to display the Study screen.
2. If the system displays the Image screen, then select the **Study Screen** button to display the Study screen.

   The system displays the Study screen.
3. Connect the USB-compatible storage device to the USB port and then select **Removable Disk** in the **Archive Source** section.
4. Select a single study (or multiple studies) and then select **Import** in the **Export/Import** section of the Study screen.

   The system copies the selected study or studies to the system's hard disk. When you select **Local Disk** in the **Archive Source** section to display studies saved on the system's hard disk, the **Archived** status of the imported study is listed as **Import**.

Saving Frames from Clips

You can display a clip from the currently active study and then save one of the clip frames as a separate image in the study.

Note: Clip frames from previous studies cannot be saved in a currently active study.

To save a clip frame from the currently active study:

1. Press the **REVIEW** key on the control panel.

   The system displays the image(s) (including any clips) in the Image screen. The system indicates image selection by outlining the selected image with blue lines. The last image acquired (the last image on the last page) is automatically selected.
2. Select (click) the clip.
3. Either double-click the clip or press the **SELECT** control.

   The system displays the clip in full-screen format.
4. Stop the playback motion and then display the required frame.
5. Press the documentation control that is configured in the system presets for disk storage.

   The system saves the displayed clip frame as a separate image in the study.

Deleting Studies

You can remove unprotected studies from the system's hard disk.

Note: Studies on a CD/DVD or USB-compatible storage device cannot be deleted using the Study screen. Also, you cannot delete the current study.

To delete a study from the system's hard disk:

1. Select **Local Disk** from the **Archive Source** section of the Study screen.
2. Select a single study (or multiple studies) in the Study screen and then select **Delete**.

   The system removes the study or studies from the system's hard disk.

Protecting Studies

You cannot remove protected studies from the hard drive.

To enable or disable protection for a study on the system's hard disk:

1. Select **Local Disk** from the **Archive source** section of the Study screen.
2. Click the first column for the required study.

   The system displays an icon next to the study when protection is enabled.

System Management of Studies on the Hard Disk

The system displays a message at system start-up when the hard disk reaches 90% capacity. When the hard disk reaches 95% capacity, images or clips cannot be stored and the system displays a message when you try to store images or clips.

Patient Data Protection

You can configure the system to display a password-protected logon screen for the Study screen or Image screen. Passwords restrict access to patient data.

Use the system presets to configure the options available for patient data protection.

Authority

Logging in as an Administrator

You can log in as an administrator to manage user accounts and passwords on the system. The first time you access the **Authorization** screen, the system prompts you to create an administrator account. An administrator can create additional administrator accounts.

To log in as an administrator:

Note: You must have the administrator password for this procedure.

1. Press the **Presets** key on the keyboard and then select **Authorization** on the left of the displayed screen.
2. Select **Password…** on the left of the screen below **Administration**.
3. Use the keyboard to enter the user name and password for the administrator account and then select **OK** to close the dialog box.

   The system displays the options available to the administrator. The administrator account is active until you exit system presets.
4. To save changes and exit the system presets, select the **Save** button at the bottom of the screen.

Configuring User Accounts and Passwords

You can create user accounts and passwords, and implement security restrictions. Levels of access are:

- **Standard**: Provides access to the Study screen or Image screen for viewing and transferring patient data. Users can also change their own passwords.
- **Administrator**: Provides the same access as for standard accounts plus the ability to create and manage accounts.

You must create an administrator account prior to creating user accounts. An administrator can also configure password complexity and expiration parameters.

See also: Logging in as an Administrator, p. C1-20

To create and configure a user account and password:

1. Log in as an administrator.
2. Select **New** on the right of the screen.
3. Use the keyboard to enter the user account name and password in each field as indicated, entering the same password in both **Password** fields and then select **OK** to exit the dialog box.

   The system displays a status message and lists the new account in the **Accounts** list at the top of the screen.
4. To assign administrator privileges to the account, select the account and then select the **Administrator** check box on the right of the screen.
5. To save changes and exit the system presets, select the **Save** button at the bottom of the screen.

To implement security restrictions:

1. Log in as an administrator.
2. To activate password-protection, select the **Login Required** check box in the **Authorization Policy** section of the screen.
3. To configure password complexity and security restrictions, make additional selections in the **Authorization Policy** section.

To	Do this
Restrict the number of login attempts and disable the user account when the limit is reached **Note:** An administrator can enable (unlock) the account. **Note:** The retry limit does not apply to administrator accounts.	1. Select the **Retry Limits Retry Period** check box. 2. Use the keyboard to enter the number of allowed login attempts in the **Attempts** field.
Require a time interval between login attempts	1. Select the **Retry Limits Retry Period** check box. 2. Use the keyboard to enter the number of seconds the user must wait before trying to log in after a failed attempt in the **Seconds** field.
Automatically log out of a user account when there has been no activity for a defined interval	1. Select the **Auto logout** check box. 2. Use the keyboard to enter the time in the **Minutes** field.
Require users to periodically reset their passwords	1. Select the **Password Expire** check box. 2. Use the keyboard to enter the number of days before the system prompts for a password change in the **Days** field.
Configure password complexity	1. Select the **Password Policy** checkbox. 2. To require the password to be a minimum length, use the keyboard to enter the number in the **Minimum Characters** field. 3. To require particular types of characters in the password, use the keyboard to enter the numbers in the following fields: ▪ Lowercase Characters (lowercase alphabetic characters) ▪ Special Characters (non-alpha-numeric characters) ▪ Uppercase Characters (uppercase alphabetic characters) ▪ Numeric Characters (numerals)

4. To save changes and exit the system presets, select the **Save** button at the bottom of the screen.

See also: Logging in as an Administrator, p. C1-20

Changing Passwords

Use the system presets to change the password for an existing user account.

Authorization

Note: The system rejects the password change if the new password does not meet the security restrictions specified by your administrator. Contact your administrator for assistance.

Backing Up and Restoring User Accounts

You can back up user accounts and passwords to disk media, such as a CD/DVD, and restore them by re-loading them on the system. You can also load the user accounts and passwords onto other ultrasound imaging systems to maintain the same user accounts and passwords on multiple systems.

To prevent detection, passwords are encrypted when they are stored to the disk media.

To back up user accounts and passwords:

Note: You must have administrator access to perform this procedure.

1. Log in as an administrator.
2. Insert a disk into the disk drive on the left of the system.
3. Select **Export** on the right of the screen.
4. Select **OK** to close the confirmation dialog box.

   The system displays a progress bar and ejects the media when the export is complete.
5. Remove the disk media from the open drive and then close the drive door.
6. To save changes and exit the system presets, select the **Save** button at the bottom of the screen.

See also: Logging in as an Administrator, p. C1-20

See also: Configuring User Accounts and Passwords, p. C1-21

To restore user accounts:

1. Log in as an administrator.
2. Insert the disk media containing the user accounts and passwords into the disk drive on the left of the system.
3. Select **Import** on the right of the screen.
4. Select **OK** to close the confirmation dialog box.

   The system displays a progress bar during restoration of the user accounts and passwords from the disk. The imported user accounts and passwords overwrite any existing user accounts and passwords.
5. To save changes and exit the system presets, select the **Save** button at the bottom of the screen.

See also: Logging in as an Administrator, p. C1-20

Customizing the Login Screen

Use the system presets to customize the text on the login screen for the Study screen or Image screen.

Note: You must have administrator access to customize the login screen.

Archiving Patient Data

To facilitate location of archive media (such as CDs), mark the media with its electronic label (displayed on the Study screen) when you eject the media after archiving patient data.

Note: The electronic label remains on the screen when you eject the media. The system removes the label from the screen when you close the media drive without inserting labeled media.

When you archive (export) patient data to an unlabeled media disk, the system automatically generates an electronic media label using the DICOM standard format *XXXXXXYYMMDDCCC*, where *XXXXXX* is the system serial number, *YY* is the year, *MM* is the month, *DD* is the day, and *CCC* is an incremental counter that refreshes every day.

Files Saved to External Storage Media

External storage media (for example, CDs, DVDs, and USB-compatible media) may contain the file types listed below.

Patient folders are labeled by the related patient ID. Study folders are labeled with the date and time of the study, using the date format *MM.DD.YYYY*, where *YYYY* is the year, *MM* is the month, and *DD* is the day, and the time format *HH.MM.SS*, where *HH* is the hour, *MM* is the minute, and *SS* is the second. The date format used to name the study folders is unrelated to the date format set in the system presets.

Note: DICOM-formatted files saved to external storage media are stored in the DICOM directory. Patient data for each file is identified when viewed using a DICOM viewing tool.

Extension	File name*	Data Included in File	Location (within the siemens/studies folder)
.CAL	*<ID>_<date><time>_<#>*	Image display parameters for the image file (.TIF) with an identical file name	**images** folder** within the study folder, within the ID-labeled patient folder
.DAT	Archive	Archival status of the related study	study folder within the ID-labeled patient folder
.DAT	Study	Patient data for a specific study that was saved to the CD	study folder within the ID-labeled patient folder
.REP	*<ID><date><exam type>*	Patient report data for a patient report that was saved to the CD	**reports** folder within the study folder, within the ID-labeled patient folder
.SCALE	*<ID>_<date><time>_<#>*	N/A—not used	**images** folder** within the study folder, within the ID-labeled patient folder
.TIF	*<ID>_<date><time>_<#>*	Image that was saved to the CD or image of patient report that was saved to the CD	**images** folder** within the study folder, within the ID-labeled patient folder
.MEAS	*<ID>_<date><time>_<#>*	Presets for Measurements & Reports	**images** folder** within the study folder, within the ID-labeled patient folder
.USER	*<ID>_<date><time>_<#>*	User defined presets	**images** folder** within the study folder, within the ID-labeled patient folder

** Terms in italic type and in carets (<>) indicate information used to name the file. The date format is YYYYMMDD for .REP files and MM.DD.YYYY for all other files, where YYYY is the year, MM is the month, and DD is the day (this date format is unrelated to the date format set in the system presets). The time format for all files is HH.MM.SS, where HH is the hour, MM is the minute, and SS is the second. The number sign (#) is a counter used to facilitate searching for images. The counter increments one unit for each image saved.*

*** Disregard the contents of the folders within the images folder. These contents are used only when viewing images and reports on the ultrasound system.*

Archival History

You can configure the ultrasound system to retain and display archival history for archived studies. You can also view and delete archival history.

Archival history lists archive devices, device identifiers, data format (such as DICOM and TIFF/AVI), and dates of archival.

Note: Device identifiers include electronic labels for external media, AE titles for DICOM devices, IP addresses for network devices, and the ultrasound system's serial number for the system's hard disk.

The system indicates patient data existing on the system's hard disk by listing "HD" in the **Archived** column of the Study screen.

Configuring the System to Retain and Display Archival History

You can configure the ultrasound system to retain and display archival history for archived studies.

To configure the system to retain and display archival history:

Note: To select an item on the screen, roll the trackball to the item and then press the **Enter** key on the control panel.

1. Press the **Presets** key on the keyboard to display the system presets.
2. Select **Archive** on the left of the screen.
3. Select one of the following options (located below **Study Archive History Deletion Policy**) to retain archival history on the ultrasound system's hard disk:
   - **Allow Delete Study Archival History After Study is Deleted** – allows deletion of archival history.
   - **No Delete of Study Archival History** – does not allow deletion of archival history.
   - **Always Delete Study Archive History when Study is Deleted** – allows deletion of archival history and study.
4. Select the **Show Deleted Studies in Study Screen** check box to display archival history.
5. Select **Save** to store the new settings and exit the system presets.

Viewing and Deleting Archival History

You can view and delete archival history.

Prerequisite: Use the system presets to retain and display archival history.

To view archival history:

1. Press the **Patient Browser** key on the control panel.
2. If the Image screen is displayed, then select the **Study Screen** button to display the Study screen.
3. Select the required study.
4. Choose a method to display the **Archival History for …** dialog box:
   – Double-click the study (for studies deleted from the system's hard disk only).
   – Press the toggle key for **Show Archive**.

To delete archival history:

Note: The archival history is available for deletion after the study is deleted from the system's hard disk.

1. Press the **Patient Browser** key on the control panel.
2. If the Image screen is displayed, then select the **Study Screen** button to display the Study screen.
3. Select the required study.
4. Select **Delete** on the right of the screen.

D1 *syngo* Auto Left Heart

Overview

syngo Auto Left Heart is a software program that enables you to analyze 2D-mode data. *syngo* Auto Left Heart automatically traces an outline of the endocardial border of the left ventricle or the left atrium for the end-diastolic and end-systolic images (ED and ES images) on an apical four-chamber (A4C) or apical two-chamber (A2C) view of the heart. *syngo* Auto Left Heart technology also includes methods for manually tracing the border of the left ventricle and/or the left atrium.

⚠ **WARNING:** This application utilizes ultrasound data collected prior to analysis. The quality of the data collected and used as input could have an effect on the output of this application. Variability in ultrasound system performance, operator technique, patient characteristics, and other factors may affect the output. At all times, the clinician is advised to carefully review the output and confirm the information presented with clinical judgment and any other relevant sources of data.

Calculation Data and Measurements

When the border outlines for the ED and ES images are complete, *syngo* Auto Left Heart generates the following calculation data and measurements:

- End-diastolic volume and end-systolic volume measurements
- Ejection Fraction (EF)
- Heart Rate (HR)

Contrast Studies

syngo Auto Left Heart includes a guided method for tracing an outline of the border of the left ventricle for contrast studies.

Note: *syngo* Auto Left Heart supports only non-contrast studies for the left atrium.

Compatible Clips

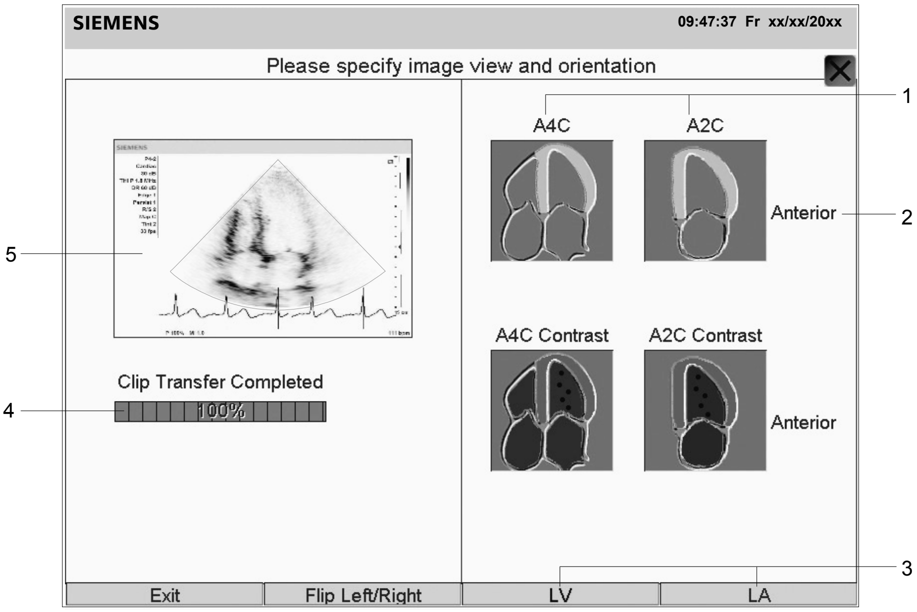
You can activate *syngo* Auto Left Heart for any clip that contains only 2-D mode data. *syngo* Auto Left Heart is recommended for use only on the apical four-chamber (A4C) or apical two-chamber (A2C) view of the adult heart.

Note: Selected clips should not exceed 8 heart cycles or 10 seconds.

Example Screens

Example of View Selection Screen

The program displays the view selection screen when you activate *syngo* Auto Left Heart. The view selection screen prompts you to select a chamber and image view.

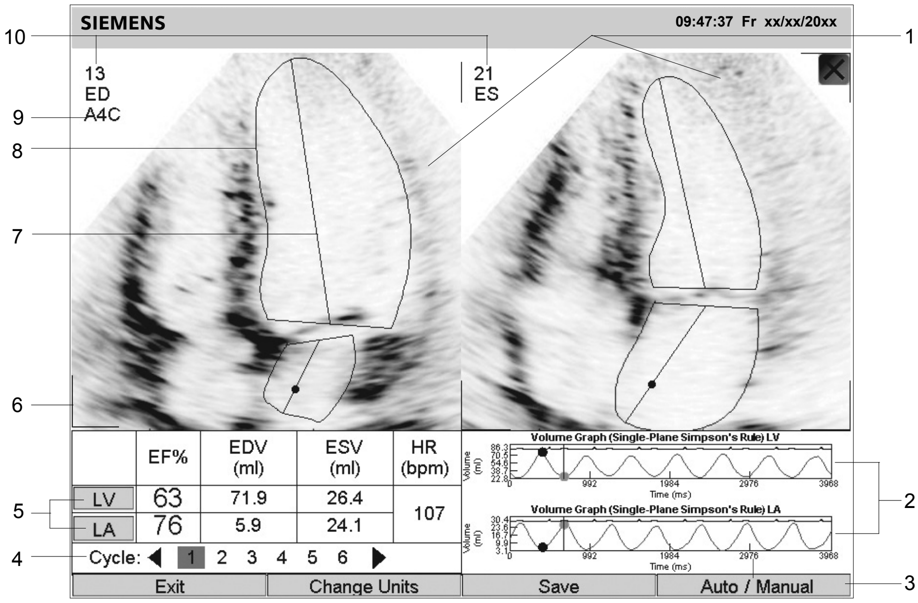


1 A4C and A2C view selections
2 Anterior or inferior left ventricular or left atrial wall indicator for A2C view only
3 LV and LA chamber selections
4 Clip Transfer progress indicator
5 Image from a clip

Note: The contrast view buttons do not display when **LA** is selected.

Example of *syngo* Auto Left Heart Screen

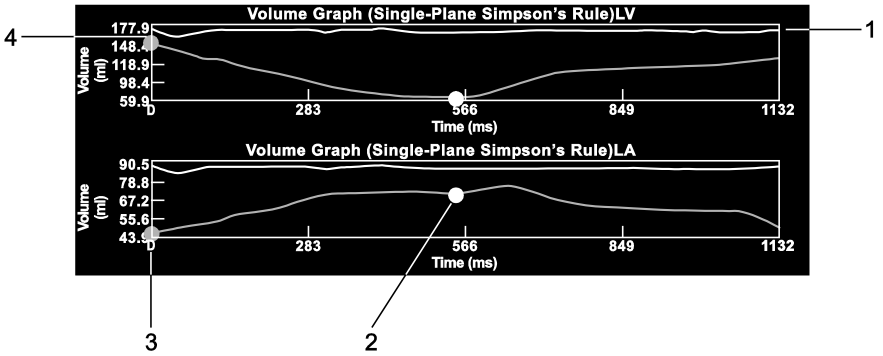
The program displays the *syngo* Auto Left Heart screen when you select the image view.



1 Image display area
2 Volume graphs
3 Location of buttons
4 Heart Cycle indicator
5 Calculation data
6 Frame corner indicating the active image
7 Long axis
8 Outline of the structure
9 Current view and image orientation
10 Frame number

Example of Volume Graph

For non-contrast studies, the program displays a volume graph. The volume graph depicts the values for volume (ml or ml/m^2) over time (ms), using a Single-Plane Simpson's Rule.



1 ECG trace
2 Inactive ED or ES frame (indicated by gray dot)
3 Current frame (indicated by vertical line)
4 Active ED or ES frame (indicated by green dot)

When both the left ventricle and the left atrium are assessed, *syngo* Auto Left Heart displays two volume graphs, one for each chamber.

Activating and Exiting *syngo* Auto Left Heart

When you activate *syngo* Auto Left Heart, the program prompts you to select an image view. If you select a non-contrast image view, then the program automatically selects and displays representative frames for the End Diastole (ED) image and the End Systole (ES) image, outlines the border of the selected chamber (left ventricle is the default), and generates the calculation data and measurements and the volume graph.

Note: The program traces an outline within an image sector (the image display area) only; you can adjust the outline outside the sector, if necessary.

Activating *syngo* Auto Left Heart

To activate *syngo* Auto Left Heart:

1. Select a clip from the review screen.
2. Press the toggle key for **Auto Left Heart**.

   The system displays the *syngo* Auto Left Heart screen.

   Note: Softkey1, Softkey2, Softkey3, and Softkey4 correspond to the selections located at the bottom of the *syngo* Auto Left Heart screen.

3. To view the left atrium, click **LA**.

   Note: *syngo* Auto Left Heart supports only non-contrast clips for **LA**.

4. To flip the image views to match the orientation of the clip, click **Flip Left/Right**.
5. Select an image view and orientation for display on the *syngo* Auto Left Heart screen.

   The program starts the study in the selected module.

   – For non-contrast studies, you can view the automatically generated outline, calculation data and measurement, and the volume graph for either the left ventricle or left atrium.

     Note: The left ventricle is displayed by default. To view the left atrium, click **LA**.

   – For contrast studies, you can use the guided method to create an outline by positioning points along the border of the left ventricle.

   – For contrast and non-contrast studies, you can use the manual method to create an outline of either the left ventricle or the left atrium.

Exiting *syngo* Auto Left Heart

To exit *syngo* Auto Left Heart:

▪ Click the **Exit** button.

  The program exits *syngo* Auto Left Heart and displays the image screen.

Viewing Frames and Heart Cycles

You can view clip frames. You can also select heart cycles from multiple-cycle clips.

Note: The program displays up to eight heart cycles of a multiple-cycle clip.

When you stop playback of the clip, the program automatically displays the End Diastole image (ED image) on the left of the screen and the End Systole image (ES image) on the right of the screen.

The frame number on the upper left of each image indicates the displayed clip frame. The program displays an indicator at the point on the ECG trace that corresponds to the currently displayed heart cycle.

To review the frames in a clip:

1. Position the cursor over the **ED** or **ES** image.
2. Press the right or left arrow key. Or, rotate **SELECT**.

To start and stop playback of a clip:

1. To begin clip playback, press **Arrow** on the keyboard.
2. To stop clip playback, press **Arrow** again. Or, click **Stop**.
3. To view the clip without the outline and the long axis, press **UPDATE**.
4. To display the outline and the long axis on the image, press **UPDATE** again. Or, click **Show Trace**.
5. To toggle between zoom settings, rotate the **DEPTH/ZOOM** control.

   Note: You can activate the zoom function or play the clip back with or without the outline displayed.

   Note: Use the up or down arrow key on the keyboard to adjust the contrast of the image.

To select another heart cycle from a multiple-cycle clip:

- Click a **Cycle** arrow button on the lower left of the screen.

To select another chamber to review:

- Click **LV** or **LA** next to the calculation data and measurement values at the bottom of the screen.

Changing the Representative Frames

You can change the representative frames for the End Diastole image (ED image) and the End Systole image (ES image).

The program displays frame corners around the currently selected image (left or right image). The frame number on the upper left of each image indicates the displayed clip frame.

To change the representative frame for the ED image:

1. Position the cursor over the **ED** image.
2. If the clip is playing, click **Stop**.
3. Press the right or left arrow key or rotate **SELECT** to display the required frame and then click **Set ED**.

To change the representative frame for the ES image:

1. Position the cursor over the **ES** image.
2. If the clip is playing, click **Stop**.
3. Press the right or left arrow key or rotate **SELECT** to display the required frame and then click **Set ES**.

Working with Outlines

You can create outlines of the left ventricle on the ED and ES image frames using a guided method (LV contrast images only) or a manual method (LV or LA non-contrast images).

Using the Guided Method to Create an Outline

You can generate an outline by positioning three points along the border of the left ventricle corresponding to the locations of the apex and the mitral annulus boundaries.

When you complete the positioning of points, the program exits the selected outlining function and displays the outline and its long axis on the image. When you complete generated outlines on both representative frames (ED and ES images), the program generates and displays the calculation data and measurement values at the bottom of the screen.

To generate an outline on a contrast image:

1. Click **Guided/Manual** until **Guided** is highlighted.
2. Specify the landmarks (the apex and the left and right boundaries of the mitral annulus) for each representative frame (ED image and ES image):
   a. Position the cursor over the first landmark and then press **SET** to anchor the marker.
   b. To erase (undo) markers (any landmark), press the toggle key for **Guided/Manual** to highlight **Manual** and then press the toggle key again to highlight **Guided**.

      The program erases any unsaved markers so you can start over.
   c. Position the cursor over the second landmark and then press **SET** to anchor the marker.
   d. Position the cursor over the last landmark and then press the **SET** key to anchor the marker.

      The system connects the three marks and generates an outline.

   Note: The landmarks are adjustable only when the heart cycle is active and calculation data has not been saved.

Using the Manual Method to Create an Outline

You can manually trace an outline of the border of the left ventricle or left atrium using either the draw function or the mark function.

When you complete a traced outline, the program exits the trace function, connects the first and last markers with a straight line, and displays the outline and its long axis on the image. When you complete traced outlines on both representative frames (ED and ES images), the program generates and displays the calculation data and measurement values at the bottom of the screen.

To manually trace an outline:

1. Click **Auto/Manual** or **Guided/Manual** until **Manual** is highlighted.
2. To use the draw function:
   a. Position the cursor over the left or right boundary of the mitral annulus.
      The draw function is active by default.
   b. Press **SET** to activate the trace function and anchor the first marker.
   c. Roll the trackball to trace the border of the chamber.
   d. Position the cursor at the location for the last marker and then press **SET** twice. Or, press the toggle key for **End Trace** to complete the trace.
3. To use the mark function:
   a. Click **Mark** to activate the function.
   b. Position the cursor over the left or right boundary of the mitral annulus and press **SET** to anchor the first marker.
   c. For each point, position the cursor over the required location and then press **SET** to anchor the marker.
   d. To erase (undo) the most recent marker, press the toggle key for **Backup**.
   e. Position the cursor at the location for the last marker and then press **SET** twice to complete the trace.
4. For non-contrast studies, click **Apply** to apply the *syngo* Auto Left Heart algorithm to all frames in the clip.

Adjusting the Outline and Repositioning the Long Axis

You can adjust the outline for the currently selected chamber (LV or LA) and reposition its long axis. The program automatically updates the calculation data and measurements according to your adjustments.

Any outline displayed in green is activated for adjustment and its long axis is activated for repositioning. After the calculation data and measurements are saved, the outline is colored gray on all frames to indicate that it cannot be adjusted.

Note: The outline and long axis for the current heart cycle cannot be changed after you save the calculation data and measurements to a findings record. To create new outlines and save new calculations, exit and then reactivate *syngo* Auto Left Heart.

To adjust the outline of the border:

1. Position the cursor over a segment of the outline.
2. Press and hold **SET** and then roll the trackball to a new location.

   The program updates the calculation data and measurement values at the bottom of the screen. For non-contrast studies, the program also updates the data for the selected frame in the volume graph.
3. For non-contrast studies, click **Apply** to apply the *syngo* Auto Left Heart algorithm to all frames in the clip.

   The program automatically adjusts the outline on all frames in the clip.

To reposition the long axis within the outline:

Note: The base of the long axis is always at the center of the mitral annulus. You can reposition the tip of the long axis.

1. Position the cursor over the dot located on the long axis.

   The program changes the color of the dot to green to indicate that the axis is activated for selection.
2. Press **SET**.

   The program changes the color of the axis to green to indicate that the axis is activated for repositioning.
3. Roll the trackball to reposition the axis and then press **SET**.

   The program anchors the position of the long axis, updates the calculation data and measurement values at the bottom of the screen, and deselects the axis. For non-contrast studies, the program also updates the data for the selected frame in the volume graph.

Working with the Volume Graph and Calculation Data

When an outline is generated, *syngo* Auto Left Heart displays calculation data and measurement values at the bottom of the screen. For non-contrast studies, the program also displays the volume graph.

You can change the units displayed in the calculation data and volume graph for EDV and ESV. You can also adjust the range of values displayed on the Y-axis (volume) of the volume graph.

Changing EDV and ESV units

The units displayed in the results area and reflected in the volume graph are either ml or ml/m^2. Both the table and graph display the same units.

Note: To display units as ml/m^2, *syngo* Auto Left Heart requires the body surface area (BSA) value.

To change the units displayed in the results area and volume graph:

1. Click **Change Units**.

   If the BSA value is not available, *syngo* Auto Left Heart displays the **BSA Calculator.**
2. Enter the height and weight for the patient.
3. Select the units for height and weight.
4. Click the **Save&Close** button. To close the dialog box without saving changes, click **Close**.

Note: To display the **BSA Calculator** manually, roll the trackball to the calculation data at the bottom of the screen and then press **SET** twice.

Changing the Volume Scale

You can change the minimum and maximum range displayed on the Y-axis of a volume graph. You can set different maximum and minimum ranges for the LA and LV volume graphs. The X-axis (time scale) remains the same for both LA and LV volume graphs.

To change the volume scale range:

1. Roll the trackball to the LA or LV volume graph and then press **SET** twice.

   The **Y-Axis Range Selector** for the selected graph displays.
2. Enter the minimum and maximum range to display on the Y-axis.
3. Click the **Save&Close** button. To close the dialog box without saving changes, click **Close**.

Saving Calculation Data and Measurements

You can save *syngo* Auto Left Heart calculation data and measurements to a file on your system's hard drive or export the information to a supported USB device.

Indicators of Saved Heart Cycle Data

Graphics on the *syngo* Auto Left Heart screen indicate when calculation data and measurements for the current heart cycle have been saved.

- Diagonal lines are displayed on the image for the calculated area of the left ventricular or left atrial volume.
- A square-shaped indicator displays above the corresponding heart cycle number on the lower left of the screen.

Note: To recalculate and save new calculations, exit and re-activate *syngo* Auto Left Heart.

Saving *syngo* Auto Left Heart Data

To save *syngo* Auto Left Heart data:

1. Click **Save**.

   Note: The **Save** button is displayed when you have created an outline on both representative images (**ED** and **ES**).

2. Exit *syngo* Auto Left Heart.

Transferring the Measurements to the Patient Report

You can transfer the measurements calculated from the left ventricular volume measurement to the patient report. You must save the patient report to retain a record.

Note: The patient report can accommodate a set of measurements for each view (**A2C** and **A4C**). If you transfer a new set of measurements for the current view, then the system overwrites the previous values for that view. To generate calculations for another view, activate *syngo* Auto Left Heart again (for this or another clip) and select a different view.

To transfer the displayed measurements to the patient report:

Note: The system calculates measurements for the current heart cycle when you create a border on both the ED and ES image of the current heart cycle. Only one set of measurements (calculations and heart rate) per view can be transferred to the patient report.

1. Click **Save**.

   The system shades the portion of the image that represents the left ventricular volume.

2. To display the ED and ES images for another heart cycle, select the required heart cycle button on the lower left of the screen.

   Note: To view or store the patient report for a clip from a previous study (containing the transferred measurements), you must access the patient report during *syngo* Auto Left Heart using the **Report** key on the keyboard.

3. To exit *syngo* Auto Left Heart, click **Exit**. Or, press **APPLICATIONS**.

Calculation Data and Measurements

Measurement	Unit	Description
EF	%	Ejection Fraction calculated for the selected view
HR	bpm	Heart rate detected by the program for the selected view
EDV	ml or ml/m^2	End-diastolic volume calculated for the selected view
ESV	ml or ml/m^2	End-systolic volume calculated for the selected view

Note: Units displayed as ml/m^2 do not display on the report.

Copyright Notice for *syngo* Auto Left Heart

Copyright notice for VXL libraries used in *syngo* Auto Left Heart.

D2 *syngo* Velocity Vector Imaging

Overview

syngo Velocity Vector Imaging (*syngo* VVI) is a clinical software program that enables you to use a personal computer to analyze cardiac clips. The program tracks and estimates tissue velocity and other motion and deformation parameters at selected points on a user-defined outline (trace) of a structure.

syngo VVI illustrates tissue velocity by placing velocity vectors (arrows) on the trace. These velocity vectors (along with the velocity reference point) are the source of the derived quantitative data, such as velocity. You can use *syngo* VVI to analyze rotation, displacement, and radial strain of the left ventricle. You can use *syngo* VVI to evaluate fetal to adult cardiac contraction by analyzing the systolic and diastolic ventricular strain and rotation.

⚠ **WARNING:** This application utilizes ultrasound data collected prior to analysis. The quality of the data collected and used as input could have an effect on the output of this application. Variability in ultrasound system performance, operator technique, patient characteristics, and other factors may affect the output. At all times, the clinician is advised to carefully review the output and confirm the information presented with clinical judgment and any other relevant sources of data.

Compatible Clips

You can activate *syngo* VVI for any clip that contains only 2-D mode data.

Note: Selected clips should not exceed 10 heart cycles or 10 seconds.

Activating and Exiting *syngo* VVI Technology

When *syngo* VVI is active, you can obtain and view velocity vector data based on a traced structure. You can print clips. You can export clips and data to a USB-compatible device.

Activating *syngo* VVI Technology

To activate *syngo* VVI:

1. Press the **REVIEW** key on the control panel and then select a clip from the **Image Screen**.
2. Press the **PAGE** control to select the **Apps**. (Applications) tab.
3. Press the toggle key for **VVI**.

Exiting *syngo* VVI Technology

To exit *syngo* VVI:

- Click the **Exit** button on the *syngo* VVI tools panel. Or, press the **APPLICATIONS** key.

  The program exits *syngo* VVI and displays the live image screen.

Obtaining Velocity Vector Data

You can obtain velocity vector data by processing a trace (contour).

When you process a trace, the program illustrates tissue velocity using velocity vectors (arrows). The program also derives quantitative data from the velocity vectors and from the placement of the velocity reference point.

The velocity vectors indicate the direction and velocity of tissue motion for each clip frame. Vector length illustrates the magnitude of velocity (speed) while the direction of the vector arrowheads illustrates direction.

Quantitative data derived from the velocity vectors include velocity, strain, strain rate, displacement, rotation, rotation rate, ejection fraction (EF), Dmin (diameter of the left ventricle), Dmax (length of the left ventricle), segmental volume, and timing information, such as time-to-peak values. These data are depicted as curves, parametric M-mode graphs, and/or parametric segmental diagrams.

Positioning the Clip Frame

You can position the clip frame within the clip window. Changing the position of the clip frame allows you to view information such as detected heart rate.

To position the clip frame, choose a method:

- Drag the clip frame slider bar.
- Click the right or left arrow button on the clip frame slider.

Basic Clip Review Functions

You can stop or start playback of the clip or review the clip image frame by image frame. You can also select an image frame for display.

To stop or start playback of the clip:

- Click the **Play/Stop** icon.

To review the clip image frame by image frame, choose a method:

- Click the **Prior** or **Next** icon.
- Press the right or left arrow key on the computer keyboard.

To adjust the gamma image setting (to change both brightness and contrast):

- Drag the **Gamma** slider to the right or left.

To restore the original gamma image setting:

- Click the **< >** icon above the **Gamma** slider.

Tracing Structures (Creating Traces)

You can create a trace (contour) to process for velocity vector data.

When the tracing function is active and the cursor is positioned on the clip, the cursor shape changes to a crosshair ("+").

To create a trace:

1. If the clip is playing, click the **Play/Stop** icon; click the **Next** or **Prior** icon to display the desired clip frame.
   - For a single endocardium trace, select **Long Axis**, **Short Axis**, or **Generic Curve**.
   - For simultaneous endocardium/epicardium (endo/epi) traces, select **Long Axis** or **Short Axis**. Select the **Endo+Epi** checkbox.
2. Position the cursor over the desired position on the clip.
3. Press the **SET** key to anchor the first marker.

   Note: For short axis traces, Siemens recommends anchoring the first marker at the top (12 o'clock position).

   Note: For long axis traces, Siemens recommends anchoring the first marker to the left of the target area as follows:

Target area to be measured	Anchor location of first marker
Left ventricle	Base of the interventricular septum and mitral annulus
Left atrium	Mitral annulus near the interatrial septum
Right ventricle	Tricuspid valve annulus near the lateral wall
Right atrium	Tricuspid valve annulus near the lateral wall

4. For each segment of the trace, roll the trackball to outline the structure and then press the **SET** key to anchor the marker and end the segment.

   Note: For long axis traces, Siemens recommends anchoring between 7 and 11 markers. Anchor at least one marker to each wall segment. For short axis traces, Siemens recommends anchoring the final marker at the 11 o'clock position. Do not anchor the final marker at or beyond the position of the first marker (12 o'clock position).

5. To complete the trace, press the **UPDATE** key on the control panel to position the last marker.

To increase or decrease the distance between the endo/epi traces, choose a method:

- Click the small + or - icons to the right of the trace.
- Press the up or down arrows on the keyboard.

To change the distance between the endo/epi traces at selected markers (before processing):

1. Position the cursor over the marker to be moved. The cursor shape changes to a four-pointed arrow.
2. Drag the marker to the new location.
3. To process the trace, click the **Process Images** icon.

Editing and Deleting Traces

You can edit and delete processed traces (contours) on the VVI window.

To edit the currently displayed trace:

1. Click the **Edit Trace** icon to activate the function.
2. Position the cursor over a marker on the trace. The cursor shape changes to a four-pointed arrow.
3. Drag the marker to the new location.
4. To exit the editing function without using the modified trace, click the **Edit Trace** icon.
5. To process the modified trace, click the **Process Images** icon.

To delete a trace, choose a method:

- From the **History** tab on the VVI window, click a trace button and click **Delete**.
- On the VVI window, with the **Edit** function active, position the cursor over a segment of the trace and press the **SET** key. If the cursor shape changes to a four-pointed arrow, you have selected a marker. Move the cursor off the marker and onto a segment before pressing the **SET** key to delete the trace. The program adds a new marker for the start of a new trace.

Processing Traces

You can process traces (contours) to obtain velocity vector data.

When you process a trace, the program generates four equidistant points for every user-defined marker in the trace (except when using the **Generic Trace** processing algorithm) and plays the clip, displaying arrows to indicate the velocity vector data. The size of the velocity vectors is indicated on the lower right.

The program displays a button for each processed trace in the **History** section on the left of the VVI window.

To process a new trace for velocity vector data:

1. Create a trace.
2. Select a trace processing algorithm (such as **Long Axis**).
3. Click the **Process Images** icon.

   The program plays the clip, displaying the velocity vectors (arrows).

To process an existing trace for velocity vector data:

1. Select an existing trace from the **History** section.
2. Select a different trace processing algorithm (such as **Short Axis**).

   The program plays the clip, displaying the velocity vectors (arrows).

Repositioning the Velocity Reference Point

You can reposition the velocity reference point on the clip.

The location of the velocity reference point determines the component of the 2-D velocity vector displayed in the velocity curves and the parametric velocity M-mode graphs for all windows except the Dyssynchrony Analysis window, which references the local direction of the trace (not the velocity reference point). The velocity vectors (arrows) are not affected by the velocity reference point. The strain, strain rate, displacement, rotation, and rotation rate are not affected by the location of the velocity reference point.

To reposition the velocity reference point:

1. If the clip is playing, click the **Play/Stop** icon to display the velocity reference point.
2. Click the velocity reference point.

   When the cursor is over the velocity reference point, the cursor shape changes to a four-pointed arrow.

3. Drag the velocity reference point to a new location.
4. Click the **Play/Stop** icon to hide the velocity reference point and play the clip.

Adding or Removing R-waves

You can add R-waves to clips that have no electrocardiogram (ECG) information. For example, you can add R-waves to fetal heart clips. You can remove R-waves that you determine to be misplaced.

To add or remove an R-wave:

1. Click the **M-mode, R-waves, Crop** icon on the VVI window.

   The program displays the M-Mode, R-waves, Crop window.
2. Choose one of the following:
   - To add an R-wave, position the cursor over a location in the period selector and press the **SET** key to confirm the position.
   - To remove an R-wave, position the cursor over the R-wave you want to remove until the cursor changes to a circle. Press the **SET** key to remove the R-wave.

   The beats per minute count next to the **Bpm** icon changes as you add or remove R-waves.
3. Repeat step two as needed to add or remove R-waves.
4. Click **Close** to exit the M-Mode, R-waves, Crop window and display the previous window.

Cropping the Clip

You can remove frames used in the analysis of the clip to restrict the analysis to a portion of the cardiac cycle.

To crop the clip:

1. Click the **M-mode, R-waves, Crop** icon on the VVI window.

   The program displays M-Mode, R-waves, Crop window.
2. Select and drag the time bars on either end of the **Period Selector** strip.

   Note: You can move the time bars to span a single cardiac cycle. Only frames inside the time bars will be included in the analysis of the cardiac motion.
3. Click **Close** to display the previous window.
4. Click the **Process Images** icon.

   The program plays the clip, displaying the velocity vectors (arrows).

Applying the Average Heart Cycle

When the **Average Heart Cycle** check box is selected, the motion parameters from multiple cardiac cycles are averaged together to compute the motion for the average heart cycle. The program selects the **Average Heart Cycle** check box as the default setting.

To remove the calculated average heart cycle from each heart cycle in the clip:

- Clear the **Average Heart Cycle** check box.

  The program recalculates and updates the display.

To apply the calculated average heart cycle to each heart cycle in the clip:

- Select the **Average Heart Cycle** check box.

  The program recalculates and updates the display.

Viewing Derived Data

You can view data derived from the velocity vector data for the currently displayed trace.

To view data derived from the velocity vector data:

1. Click the icon on the *syngo* VVI desktop that corresponds to the required data.

Derived data	Icon
Velocity	**Strain/Velocity Measurement Window**
Strain	**Strain/Velocity Measurement Window**
Strain rate	**Strain/Velocity Measurement Window**
Radial strain (for endo/epi traces only)	**Strain/Velocity Measurement Window**
Segmental ejection fraction	**Global Measurements Window**
Ejection fraction	**Global Measurements Window**
EDLVM (end diastolic left ventricle mass). Requires endo/epi traces.	**Global Measurements Window**
ESLVM (end systolic left ventricle mass). Requires endo/epi traces.	**Global Measurements Window**
Volume	**Global Measurements Window**
Dmin and Dmax	**Global Measurements Window**
Segmental volume	**Global Measurements Window**
Peak and timing information as related to strain, strain rate, velocity, or displacement	**Dyssynchrony analysis**

2. To display the previous window, click **Close**.

Displaying Derived Data for Other Traces

You can display derived data for previously created traces (contours), including epi traces.

To display derived data for another trace:

- Click a numbered trace button in the **History** section of the *syngo* VVI window.

Defining an M-Mode Background for Curve Plots

You can define an M-mode background for display behind each curve plot. The user-created drawing for the M-mode background can include multiple segments. An M-mode background provides additional timing information.

To define and display an M-mode background:

1. Display an image frame for definition of the freeform M-mode background.
2. Click the **M-mode, R-waves, Crop** icon to display the M-Mode, R-waves, Crop window.
3. Position the cursor over the clip and press the **SET** key to anchor the first marker.
4. For each segment of the M-mode free-form drawing, move the cursor to create the segment and then press the **SET** key to anchor the marker and end the segment.
5. To anchor the last marker and complete the drawing, press the **UPDATE** key.
6. To delete the freeform drawing and restore default settings, click **Reset**.
7. To adjust the gamma image setting (change both brightness and contrast), drag the **Gamma** slider.
8. To restore the original gamma image setting, click the Gamma **< >** icon.
9. To toggle black and white display settings, select the **Reverse Colors** check box.
10. Click **Close** to exit the M-Mode, R-waves, Crop window and display the previous window.
11. From the **Set/Replace the temporary background M-mode with the new M-mode** window, select **OK**.

Changing the Data Display

You can change the velocity vector display, render 3D images of parametric M-mode graphs, and display curves on the curve plots.

Changing the Velocity Vector Display

You can change the display of velocity vectors, such as the length and density. You can display the trajectory of segments of tissue over time. The value for length of the velocity vectors is displayed. For example, "x10" indicates that the velocity vectors are ten times the original length.

To change the velocity vector display:

1. To adjust the length of the velocity vectors (arrows), click the **Shorter Arrows** icon or the **Longer Arrows** icon.

   Note: When comparing multiple sets of data, use the same arrow length for each set.

2. To change the density of points and velocity vectors displayed, click the **Toggle Original Border Points to Equispaced Points x4** icon.
3. To display the trajectory of segments of tissue over time, click the **No Arrows** icon to cycle through the display settings until the trajectory view is visible.
4. To display or hide the velocity vectors, click the **No Arrows** icon to cycle through the display settings.

Rendering 3D Images of Parametric M-mode Graphs

You can render 3D images of the parametric M-mode graphs displayed in the Strain/Velocity Measurement window.

To render 3D images of a parametric M-mode graph:

1. Click the **3D** icon adjacent to the parametric M-mode graph.

   The program displays the 3D rendering in the 3D window.

2. To rotate the 3D image, position the cursor over the image and drag to rotate the rendering.

   Note: Position the cursor at the center of the 3D image for optimal control.

3. To magnify the 3D image, drag the Zoom slider.
4. To restore the original settings for orientation and magnification, click **Reset**.
5. Click **Close** to display the Strain/Velocity Measurement window.

Displaying Curves on the Curve Plots

You can display curves for selected target point(s) on the trace (contour), selected point(s) on the parametric M-mode graph, or specified timing parameters. Available methods depend on the displayed window.

You can also display values for data points on curves, change the time interval or scale of the curve plots, and magnify the curve plots.

The program displays curves on the curve plots in the displayed window. The program assigns a unique color to each point selected on either the parametric M-mode graph or the trace; each curve uses the color of the selected point.

To display a curve for	Do this
A selected target point on the trace (VVI window)	1. If the clip is playing, click the **Play/Stop** icon. 2. Position the cursor over a location on the trace and press the **SET** key to confirm the position.
A selected point on the parametric M-mode graph (VVI window or Strain/Velocity Measurement window)	Position the cursor over a location on the parametric M-mode graph and then press the **SET** key to confirm the position. **Note:** You can select up to 11 uniquely colored points.
All points on the parametric M-mode graph (Strain/Velocity Measurement window)	Click **Row by Row**. **Note:** To remove all curves from the window, click **Delete Stored Points**.
All traces (Global Measurement window)	Select (enable) the **All the Curves** check box.
The current trace only (Global Measurement window)	Clear the **All the Curves** check box.
Specified timing parameters (Dyssynchrony Analysis window)	Select timing parameters. **Note:** To display all curves, select the **All Curves** check box. To display selected curves, clear the **All Curves** check box and select check boxes for the curves. Data on the window includes values for the displayed curves only.

To remove selected points and lines on the parametric velocity M-mode graph (VVI window):

1. Click the line to delete in the parametric velocity M-mode graph.

   The program removes the selected line and adjacent points.
2. Repeat step 1 until all the unnecessary lines and points are removed.
3. Position the cursor outside the parametric velocity M-mode graph.

   The program displays the updated parametric velocity M-mode graph.

Viewing the Curve Details

Curve Detail	Description
var. (variation) +/- <value>	Located at the top of all curve plots. Describes the level of accuracy associated with the curve. The variation value will change based on the screen resolution of the system that captured the image, temporal resolution, and quality of the point selections.
data bubble	Displays when you position the cursor over any location on a curve. The first value is the left y-axis value (for example, volume, velocity, or radial strain rate). The second value is time. The values in the data bubble change as you move the cursor along the curve.
EF=<value>% (Global Measurement window)	Displays ejection fraction as a percentage.
EDLVM[g]=<value> (Global Measurement window)	Requires endo/epi traces. Displays derived mass of the left ventricle at the end of the diastolic cycle. Assumes milliliter to gram conversion rate of 1.05.
ESLVM[g]=<value> (Global Measurement window)	Requires endo/epi traces. Displays derived mass of the left ventricle at the end of the systolic cycle. Assumes milliliter to gram conversion rate of 1.05.

Adjusting Smoothing for Curves

You can enable smoothing for curves on all curve plots (all windows). The program displays a curvy line above each curve plot when smoothing is enabled.

To enable smoothing for curves on the curve plot:

- Click the **Toggle Filtered/Unfiltered Plots** icon.

Changing the Time Interval on the Period Selector

You can change the time interval on the period selector by repositioning the left and/or right frame markers. This is available on the Strain/Velocity Measurement window only.

To define a segment on the Period Selector:

1. Drag the left or right vertical bar of the **Period Selector** graph to a new location.

   When the cursor is over the left or right vertical bar, the cursor shape changes to a horizontal double-arrow to indicate that a vertical bar is available for selection and repositioning.

2. Press the **SET** key to set the new position.

Changing the Scale of the Curve Plots

You can change the scale of curve plots on the Strain/Velocity Measurement and Global Measurements windows.

To change the scale of a curve plot:

1. Position the cursor over the vertical slider bar to the left of the curve plot. The cursor shape changes to a horizontal double-arrow.
2. Drag the selected bar to a new location.
3. Press the **SET** key to set the new position.

Magnifying Curve Plots (Strain/Velocity Measurement Window)

You can magnify the curve plots displayed on the Strain/Velocity Measurement window.

Magnified curve plots display in a full-screen format.

To magnify curve plots:

1. Select the check box for each required curve plot.
2. Click **Zoom**.

   The program magnifies the curve plots in a new window.
3. To export an image of the new window to a storage device or network location, click the **Export** icon.

   The system displays the **Browse for Folder** dialog box.
4. Select a path to export the image and then select **OK**.
5. To display the Strain/Velocity Measurement window, click **Close**.

Magnifying the Thumbnail

To magnify the thumbnail:

1. Position the cursor over the thumbnail.

   The program magnifies the thumbnail.

   Note: The program displays an asterisk in the base left position of any long axis trace on the Dyssynchrony Analysis window. The base left asterisk is useful if the image is rotated or if the image's orientation has changed.
2. Position the cursor away from the magnified image to view the thumbnail.

Exporting, Saving, and Copying Data

You can export, save, and copy data for use outside the program.

Data Type	Selection	Description
window image or clip	**Export** icon	Exports the window image or clip to a storage device or network location.
3D rendering image	**Export** icon	Exports the 3D rendering image.

Exporting Window Images and Clips

You can export *syngo* VVI window images and clips to a storage device or a network location. Exported window image files contain the displayed window without the on-screen selections. Exported clip files contain the clip in motion, as displayed within its clip window.

The export function is available on all windows except the M-mode, R-waves, Crop window.

The program stores exported files in a user-selectable folder, using the following path (where <patient> is the patient name):

<user-selected folder>\VVI\[<patient>]\.

The file name format for exported *syngo* VVI files is (XXXX) MMDDYYYY-HHMMSS, where XXXX is the code indicating the exported window and MMDDYYYY-HHMMSS is the date and time of export; MM is the month, DD is the day, YYYY is the year, HH is the hour, MM is the minute, and SS is the second. The file name extension for image files is JPG; and for clip files, AVI. The file name codes are described below.

- MAIN: VVI window.
- REG: Strain/Velocity Measurement window.
- ZOOM: Full-screen display of magnified curve plot(s).
- 3D: Full-screen display of 3D rendering (parametric M-mode graph).
- GLO: Global Measurement window.
- CRT: Dyssynchrony Analysis window.

To export a window image from *syngo* VVI:

1. If the VVI window is displayed and the clip is playing, click the **Play/Stop** icon.
2. To change the clip frame displayed for the image file, click the **Next Frame** or **Previous Frame** icon.
3. Click the **Export** icon.

   The program displays a dialog box that allows you to select the location for the exported file.
4. Select the location and click **OK**.

   When the export function is complete, the program displays a confirmation message.

To export a clip from *syngo* VVI:

1. If the VVI window is displayed and the clip is not playing, click the **Play/Stop** icon.
2. Click the **Export** icon.
3. Select the location for the exported file, and then click **OK**.
   When the export function is complete, the program displays a confirmation message.

Field Descriptions for Exported Data Files

Field	Processing Algorithm(s)*	Description
*__Note:__ Available processing algorithms include Long Axis, Long Axis for Endo/Epi, Short Axis, Short Axis for Endo/Epi, and Generic.		
Axis	All	Selected processing algorithm, such as Long Axis.
Bpm	All	Heart rate, in beats per minute.
PixelDimension	All	Millimeters per pixel.
ProbeXY (pixel)	All	(x,y) pixel coordinates of the velocity reference point.
ProbeXY (mm)	All	(x,y) coordinates of the velocity reference point, converted to millimeters.
TracedPointsXY (pixel)	All	(x1,y1,x2,y2,x3,y3,…) pixel coordinates of the user-defined points to be tracked.
TracedPointsXY (mm)	All	(x1,y1,x2,y2,x3,y3,…) coordinates of the user-defined points to be tracked, converted to millimeters.
TracedPointsEpiXY (pixel)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	(x1,y1,x2,y2,x3,y3,…) pixel coordinates of the endo and epi user-defined points to be tracked.
TracedPointsEpiXY (mm)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	(x1,y1,x2,y2,x3,y3,…) coordinates of the endo and epi user-defined points to be tracked, converted to millimeters.
EcgPoints	All	Amplitude of the electrocardiogram, sampled every two milliseconds.
FrameTime (msec)	All	Time between adjacent frames.
TimeProgression (msec)	All	Time since the first frame.
Velocity (cm/sec)	All	Velocity towards (positive) or away from (negative) the velocity reference point.
Strain (%)	All	Strain (percentage) for all points along the trace, for every frame.
StrainRate (1/s)	All	Strain rate (per second) for all points along the trace, for every frame.
tX (pixel coord)	All	x-coordinates of the points along the trace, for every frame.
tY (pixel coord)	All	y-coordinates of the points along the trace, for every frame.
tVx (cm/sec)	All	x component of the velocity for every point along the trace, for every frame.
tVy (cm/sec)	All	y component of the velocity for every point along the trace, for every frame.

Field	Processing Algorithm(s)*	Description
EpiVelocity (cm/sec)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	Velocity towards (positive) or away from (negative) the epi velocity reference point.
EpiStrain (%)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	Strain (percentage) for all epi points along the trace, for every frame.
EpiStrainRate (1/s)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	Strain rate (per second) for all epi points along the trace, for every frame.
EpitX (pixel coord)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	x-coordinates of the epi points along the trace, for every frame.
EpitY (pixel coord)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	y-coordinates of the epi points along the trace, for every frame.
EpitVx (cm/sec)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	x component of the velocity for every epi point along the trace, for every frame.
EpitVy (cm/sec)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	y component of the velocity for every epi point along the trace, for every frame.
RadialStrain (%)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	Radial strain (percentage) for all endo and epi points along the trace, for every frame.
RadialStrainRate (1/s)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	Radial strain rate (per second) for all endo and epi points along the trace, for every frame.
Shear (%)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	The difference in the tangential displacement of the endo and epi points (percentage), divided by the endo-epi distance.
ShearRate (1/s)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	The difference in the tangential velocity of the endo and epi points (per second), divided by the endo-epi distance.
Vol (ml)	Long Axis, Long Axis for Endo/Epi	Modified method of disk volume for every frame, converted to milliliters.
Seg. Vol. (ml)	Long Axis, Long Axis for Endo/Epi	Segmental volumes, in milliliters.
Area (cm^2)	Short Axis, Short Axis for Endo/Epi	Short axis area for every frame, in squared centimeters.
Seg. Area (cm^2)	Short Axis, Short Axis for Endo/Epi	Segmental areas, in squared centimeters.
DMin (mm)	Long Axis, Long Axis for Endo/Epi	The maximum distance across the chamber (diameter), parallel to the mitral plane for every frame, in millimeters.
DMax (mm)	Long Axis, Long Axis for Endo/Epi	Distance from the mitral plane to the apex for every frame, in millimeters.
dV/dt (ml/s)	Long Axis, Long Axis for Endo/Epi	The rate of change in the volume.
dA/dt (ml/s)	Short Axis, Short Axis for Endo/Epi	The rate of change in the area.
EndoEpiDistance (mm)	Long Axis for Endo/Epi, Short Axis for Endo/Epi	Distance between corresponding endo and epi points. Not the perpendicular distance between the point and the other trace.

D3 Axius Edge-Assisted Ejection Fraction

About Axius Edge-Assisted Ejection Fraction

Axius Edge-Assisted Ejection Fraction (Axius-EF) can assist you in detecting borders used in automated measurements of the left ventricular volume, ejection fraction, stroke volume, and cardiac output. Axius-EF is an optional feature.

Activating Axius-EF

You must select images to activate Axius-EF. You can select the following types of images for Axius-EF: images from the current study, a clip from the current study, or a clip from a previous study.

When you activate Axius-EF, the system prompts you to select a view (four-chamber or two-chamber) and displays the representative clip frames for the first heart cycle: one for the End Diastole (ED) image and one for the End Systole (ES) image. The selected view is indicated on each Axius-EF measurement and calculation.

On the Axius-EF screen, the End Diastole (ED) image is displayed on the left and the End Systole (ES) image is displayed on the right. The frame number is identified on the upper left of each image. The system indicates the current heart cycle on the lower left of the screen and the detected heart rate (**HR**) and selected view on the lower right of the screen.

Axius-EF allows for five heart cycles. In clips that exceed this maximum, the system omits frames from the beginning of the clip.

To activate Axius-EF:

1. Select images for Axius-EF.

   Note: Store clips for Axius-EF as live images to ensure that the images have the correct heart rate (HR) and cardiac output (CO). Use the system presets to configure clip capture options.

   Clip Capture

To select these images…	Do this:
Images from the current study (real-time imaging)	1. Obtain a series of images for one or more heart cycles. 2. Press the **APPLICATIONS** key on the control panel.
A clip from the current study	1. Press the **REVIEW** key on the control panel to display the DIMAQ Image screen for the current study. 2. Select the clip using the trackball and **SET** key.
A clip from a previous study	1. Complete the current study (examination). 2. Press the **REVIEW** key on the control panel to display the DIMAQ Study screen. 3. If the image is stored on removable media (for example, CD/DVD), insert the media containing the image. 4. Select the required media (**Local Disk** or **CD/DVD**) in the **Archive Source** section of the Study screen. 5. Select the study and then select the **Image Screen** button (or double-click the study). 6. Select the clip using the trackball and **SET** key.

   The system displays **Axius-EF** as a soft key selection.

2. Press the toggle key for **Axius-EF**.

   If you selected images from the current study (real-time imaging), then the system stores a clip of the selected images according to the clip capture options configured in the system presets.

   The system automatically selects two representative clip frames for each heart cycle: one for the End Diastole (ED) image and one for the End Systole (ES) image. The system then displays the **Specify View** dialog box on the screen.

3. Press the toggle key for the view. Alternatively, use the trackball and **SET** key to select the view in the dialog box.
   - **A4C**: Apical four-chamber view of the heart.
   - **A2C**: Apical two-chamber view of the heart.

   The system displays the Axius-EF screen.

4. To exit Axius-EF, press the toggle key for **Exit**. Alternatively, press the **APPLICATIONS** key on the control panel.

Viewing Frames and Heart Cycles

You can play the clip, select a different representative frame for the ED image or the ES image, or select a heart cycle for display.

Reviewing the Clip

You can review the clip (current heart cycle) frame by frame or you can play the clip. When you play the clip, the system displays each frame in sequence, at full playback speed.

To play back the portion of the clip that represents the current heart cycle:

1. Press the **FREEZE** key on the control panel.

   The system automatically plays back the selected clip.

2. To stop playback motion, press the **FREEZE** key again or position the cursor on another view.

   The system stops playback motion and displays the original frame.

To review the current heart cycle of the clip, frame by frame:

- Rotate the **SELECT** control.

  The system displays each frame in sequence on the selected image (ED or ES) according to the speed at which you rotate the **SELECT** control.

  The **Recall ED** (or **Recall ES**) button displays at the bottom of the image.

Selecting Representative Frames

You can change the representative frame for the End Diastole or End Systole image for the current heart cycle displayed on the Axius-EF screen.

To select another representative frame for the ED or ES image (current heart cycle):

1. Roll the trackball to position the measurement marker (+) on the ED or ES image.

   The system outlines the active frame in green.
2. Rotate the **SELECT** control on the control panel until the required frame is displayed.

   Note: Pressing the **SELECT** control deletes any border that is on the selected image.
3. To select the displayed frame as the new representative frame, press the **SELECT** control, and then press the toggle key for **Set ED** (or **Set ES**). Alternatively, select the **Set ED** (or **Set ES**) button at the bottom of the image.
4. To retrieve the current representative frame for display, press the **UPDATE** control, and then press the toggle key for **Recall ED** (or **Recall ES**). Alternatively, select the **Recall ED** (or **Recall ES**) button at the bottom of the image.

Selecting a Heart Cycle

When you select a heart cycle, the system displays the ED and ES images for that heart cycle.

To select a heart cycle:

- Rotate the **M** control on the control panel until the required heart cycle is displayed, or use the trackball and **SET** key to select the required heart cycle button on the lower left of the screen.

Outlining the Border of the Left Ventricle and Generating Calculations

You can visually compare the diastolic (ED) and systolic (ES) volumes of the left ventricle (LV volume) by creating the border of the left ventricle on each image (ED and ES).

You can adjust the border or the long axis (which changes the measurement values). You can also delete an outline (border and long axis), delete a border adjustment in progress, or undo or redo portions of a border or border adjustment in progress.

Outlining the Border of the Left Ventricle

When you create a border, the system automatically detects the apex and mitral annulus, places the long axis at the center of the mitral annulus (ending at the apex), automatically calculates measurement values, and displays the measurement values at the bottom of the screen.

The default method for creating a border is the **Guided** trace method, in which you specify the locations of the apex and the left and right boundaries of the mitral annulus on the image. Other available methods include:

- **Manual trace**: You draw the border.
- **Manual mark**: You mark each change in direction for the border shape.

To create a border using the default Guided trace method:

- Use the trackball and **SET** key to mark the apex and the left and right boundaries of the mitral annulus.

  The system automatically detects the border and draws the outline.

To create a border using the Manual trace method:

1. Roll the trackball to position the measurement marker on the required image (ED or ES) and then press the toggle key for **Manual**.
2. Press the toggle key for **Trace**.
3. Roll the trackball to position the measurement marker at the left or right boundary of the mitral annulus and then press the **SET** key.

   The system anchors the marker.
4. Roll the trackball to trace the left ventricle.
5. When you reach the other boundary of the mitral annulus, anchor the marker as an end point for the border by pressing one of the following: the toggle key for **End**, the **SET** key, or the **UPDATE** key.

   The system connects the left and right boundaries of the mitral annulus with a straight line and displays the border and long axis on the image.

To create a border using the Manual mark method:

1. Roll the trackball to position the measurement marker on the required image (ED or ES) and then press the toggle key for **Manual**.
2. Press the toggle key for **Mark**.
3. For each change of direction in the border shape, roll the trackball to position the measurement marker on the required segment (for example, for the **A2C** view, on the basal inferior segment) and then press the **SET** key.

   The system anchors the marker.
4. To anchor the marker as an end point for the border, press the toggle key for **End** or the **UPDATE** key. Alternatively, double-click the **SET** key.

   The system detects the border using your indicated changes of direction and displays the border and long axis on the image.

Generating Measurement Calculations

To generate calculations for the current heart cycle:

- Create an outline (border and long axis) on each image (ED and ES).

  The system calculates the measurement values according to the left ventricular volume and displays the values at the bottom of the screen.

  See also: Axius-EF Measurements, p. D3-10

Changing the Border or Long Axis

You can adjust the border shape or the long axis position. If the border adjustment affects the position of the apex or mitral annulus, then the system may reposition the long axis.

Note: For the best results when adjusting the border, Siemens recommends placing the new first and last end points near the existing border.

The following methods are available for adjusting the border:

- **Border trace**: The system adjusts the border using your drawn depiction.
- **Border mark**: The system adjusts the border by connecting your marked indications.

To adjust the border shape using the Border trace method:

1. Roll the trackball to position the measurement marker (+) on the required image (ED or ES) and then press the toggle key for **Border**.

   The system highlights the border in green to indicate its activation.

2. Press the toggle key for **Trace**.
3. Roll the trackball to a new end point near the existing border and then press the **SET** key to begin tracing.
4. Roll the trackball to create a new border portion.
5. To anchor the marker as an end point for the new border portion, press one of the following: the toggle key for **End**, the **SET** key, or the **UPDATE** key.

   The system may reposition the long axis. The system updates the calculated values at the bottom of the screen.

To adjust the border shape using the Border mark method:

1. Roll the trackball to position the measurement marker (+) on the required image (ED or ES) and then press the toggle key for **Border**.

   The system highlights the border in green to indicate its activation.

2. Press the toggle key for **Mark**.
3. Roll the trackball to a new end point near the existing border and then press the **SET** key to create the first end point.
4. For each new end point, press the **SET** key. Position the last end point near the existing border.
5. To indicate completion of the new border portion, press the toggle key for **End**, double-click the **SET** key, or press the **UPDATE** key.

   The system may reposition the long axis. The system updates the calculated values at the bottom of the screen.

To reposition the long axis:

Note: The base of the long axis is always at the center of the mitral annulus. You can reposition the long axis by changing the direction from its base.

1. Roll the trackball to position the measurement marker (+) on the required image (ED or ES) and then press the toggle key for **Axis**.

   The system highlights the long axis (center line) in green to indicate its activation.

2. Roll the trackball to position the measurement marker (+) on the new direction of the long axis (from its base) and then press the **SET** key.

   The system updates the measurement values at the bottom of the screen.

Undoing or Redoing Changes

You can undo or redo a change.

To undo a change:

- Either press the toggle key for **Undo** or rotate the **DEPTH/ZOOM** control on the control panel in the counter-clockwise direction.

To redo a change:

- Either press the toggle key for **Redo** or rotate the **DEPTH/ZOOM** control on the control panel in the clockwise direction.

Removing an Outline or Border Adjustment

You can remove an outline or a border adjustment in progress. When you remove an outline, the system removes the border and its corresponding long axis. When you remove a border adjustment in progress, the system retains the original border and long axis.

To remove an outline:

1. Roll the trackball to position the measurement marker (+) on the required image (ED or ES).
2. Press one of the following: the toggle key for **Delete**, the **DEPTH/ZOOM** control, or the **ESCAPE** key.

To remove the border adjustment in progress:

- Press one of the following: the toggle key for **Delete**, the **DEPTH/ZOOM** control, or the **ESCAPE** key.

Transferring the Measurements to the Patient Report

You can transfer the measurements calculated from the left ventricular volume measurement to the patient report. You must save the patient report to retain a record.

Note: The patient report can accommodate a set of measurements for each view (**A2C** and **A4C**). If you transfer a new set of measurements for the current view, then the system overwrites the previous values for that view. To generate calculations for another view, activate Axius-EF again (for this or another clip) and select a different view.

To transfer the displayed measurements to the patient report:

Note: The system calculates measurements for the current heart cycle when you create a border on both the ED and ES image of the current heart cycle. Only one set of measurements (calculations and heart rate) per view can be transferred to the patient report.

1. Press the toggle key for **Enter** or press the **M** control on the control panel.

   The system shades the portion of the image that represents the left ventricular volume and colors the button for the current heart cycle number white to indicate that the displayed measurements are in the patient report.

2. To display the ED and ES images for another heart cycle, select the required heart cycle button on the lower left of the screen.

   Note: To view or store the patient report for a clip from a previous study (containing the transferred measurements), you must access the patient report during Axius-EF using the **Report** key on the keyboard.

3. To exit Axius-EF, press the toggle key for **Exit**. Alternatively, press the **APPLICATIONS** key on the control panel.

Axius-EF Measurements

In the patient report, Axius-EF measurement values are preceded by a superscript Acuson symbol. All Axius-EF values in the patient report are followed by a number (**2** or **4**) to indicate the selected view (**A2C** or **A4C**, respectively). On the Axius-EF screen, the selected view is indicated on the lower right.

Note: The measurement value on the Axius-EF screen and the measurement value in the patient report may differ in the number of decimal places displayed.

See also: Generating Measurement Calculations, p. D3-7

Measurement	Unit	Description
EF	%	Ejection fraction calculated for the selected view
SV	ml	Stroke volume calculated for the selected view
CO	L/min	Cardiac output calculated for the selected view
HR	bpm	Heart rate detected by the system for the selected view
EDV	ml	End diastolic volume calculated for the selected view
ESV	ml	End systolic volume calculated for the selected view

D4 *syngo* Arterial Health Package

Overview

⚠ **Caution:** In the United States of America, federal law restricts this device to sale or use by, or on the order of, a physician.

The *syngo* Arterial Health Package software program (AHP) provides a method of quantifying Carotid Intima-Media Thickness (CIMT). CIMT should be performed by a user who is experienced in CIMT measurement techniques.

Quantification of CIMT is used to provide an estimate of vascular age for use in evaluating the potential risk of cardiovascular events in adults who do not have a history of cardiovascular disease. The AHP program uses semi-automated border detection to determine the maximum and average thickness of the intima-medial layer of the carotid artery.

Indications for Use

The Arterial Health Package (AHP) software provides the physician with the capability to measure Intima Media Thickness and the option to reference normative tables that have been validated and published in peer-reviewed studies. The information is intended to provide the physician with a tool for communicating with patients regarding the state of their cardiovascular system. This feature should be utilized according to the "ASE Consensus Statement; Use of Carotid Ultrasound to Identify Subclinical Vascular Disease and Evaluate Cardiovascular Disease Risk: A Consensus Statement from the American Association of Echocardiography; Carotid Intima-Media Thickness Task Force, Endorsed by the Society for Vascular Medicine".

Compatible Clips and Images

You can activate *syngo* AHP for any clip or image that contains only 2D-mode data and clips or images acquired with a linear transducer.

Acquiring Clips for Use with AHP

Note: Siemens recommends following a description of the exam protocol, including acquisition of clips and images for analysis from the American Society of Echocardiography (ASE) consensus statement.

Acquire clips from at least three angles of each blood vessel segment from both the left and the right sides of the body that are required to complete the selected protocol with an ECG active for adherence to the ASE consensus statement.

Activating and Exiting *syngo* Arterial Health Package

You can activate AHP for a selected compatible clip in an active study or a previously saved study.

Activating *syngo* Arterial Health Package

To activate *syngo* Arterial Health Package:

1. Press **REVIEW**.
2. Select a clip.
3. Press **PAGE** to highlight the **Apps.** (Applications) tab indicator.
4. Press the toggle key for **AHP**.
5. Review and analyze the clip.
6. To select another clip or image, double-click a thumbnail.

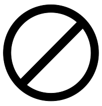
Exiting *syngo* Arterial Health Package

To exit *syngo* Arterial Health Package:

- Click the **Exit** button. Or, press the toggle key for **Exit**.

Excluding Frames from Quantification

You can exclude specific frames from quantification and analysis during review of the clip.



*The **Deleted frame** symbol indicates the frame is unavailable for quantification and analysis.*

To	Do This	Button	Tool Tip
Exclude the current frame from quantification.	**Note:** Excluding a frame does not delete the frame. 1. Click **Exclude Frame** on the image menu. The system excludes the frame from the quantification only. 2. To include the frame in the quantification, select the button again. **Note**: Use the AHP Setup page to view the excluded frames during clip playback.		**Toggle exclude frame**

Analyzing Clips

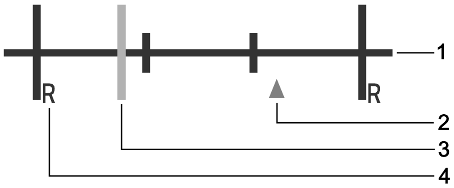
You can analyze any clip that contains only 2D-mode data and clips acquired with a linear transducer.

To analyze the contents of the clip after activating AHP:

1. In the leftmost list, select a population set for use in computation.
2. In the middle list, select a vessel segment.

   Note: The AHP program uses this term to label the segment of the vessel in the report.

3. In the rightmost list, select the angle of acquisition.
4. Click the frame bar to select the reference position corresponding to the start of the R-wave on the ECG trace.

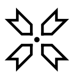


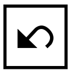
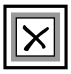
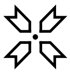
1 Frame bar
2 End systole indicator (green triangle)
3 Reference position indicator (white line)
4 R-wave indicator

Example of displayed frame.

The AHP program outlines the ROI in red and displays a cursor on the left side of the region of interest (ROI).

Note: To magnify the image, click the **Zoom +** button.

To	Do This
Position the CIMT ROI (region of interest)	▪ Click in the vessel near the far wall. The upper edge of the ROI must be within the lumen of the vessel. The AHP program automatically calculates and displays measurement values on the right side of the screen for the active frame.
Lengthen the CIMT ROI	1. Position the cursor on the side of the CIMT ROI. 2. Drag to lengthen the CIMT ROI. Measurement values automatically update after resizing of the CIMT ROI.
Reposition the CIMT ROI without changing the length	**Note:** Use the AHP Setup page to determine the initial size of the CIMT ROI. 1. Hold down the **Ctrl** key and press the left or right arrow on the keyboard. 2. To update the measurement values, position the cursor on the **Save CIMT** button.
Edit the semi-automated trace borders	**Note:** Use the AHP Setup page to determine the ranges of color to apply to the "thickness" between the lumen-intima and media-adventitia or to only display lines to indicate the borders of the lumen-intima and media-adventitia. 1. After positioning the CIMT ROI, select the appropriate far wall tool button for editing borders (**Edit lumen-intima** or **Edit media-adventitia**). 2. Click the intended location of each new point along the boundary. A crossmark indicates the location of each edit point. 3. Double-click the last point to conclude editing.  *Example of the cursor during the edit function.*

To	Do This
Undo an edit point	▪ Click **Undo Edit**.  ***Undo Edit*** *button.*
Clear all of the edit points and the CIMT ROI	▪ Click **Clear Borders**.  ***Clear Borders*** *button.*
Trace a border manually	**Note:** Use the AHP Setup page to determine the ranges of color to apply to the "thickness" between the lumen-intima and media-adventitia or to only display lines to indicate the borders of the lumen-intima and media-adventitia. 1. Select the appropriate far wall tool button for tracing borders (manual trace lumen-intima or manual trace media-adventitia). 2. Click the intended location of each new point along the boundary. A crossmark indicates the location of each point. The AHP program automatically connects the points to draw the line. **Note:** You must trace borders only drawn from left to right. 3. Select the next vessel wall tracing tool. 4. Position each new point along the border of the vessel corresponding to the previous trace. 5. After the lumen-intima and media-adventitia have been traced, double-click the last point.  *Example of the cursor during the manual trace function.*
Save CIMT data to the report	▪ Click **Save CIMT**.

Using Distance Measurements

Note: All distance measurements display in millimeters with three decimal point precision.

The AHP program provides the following measurements of the distances between the lumen-intima boundary and the media-adventitia boundary:

- Maximum CIMT distance for the currently displayed frame
- Mean CIMT distance for the currently displayed frame

Saved measurements display in the report and in the worksheet. You can delete the measurements only on the worksheet.

Using the CIMT Report

The report can display an overall vascular age and an overall risk for potential coronary heart disease. Comparison data within the report is based upon published studies listed in the Clinical References section. Risk analysis is based on information from the *Framingham Heart Study*. The values for risk factor analysis display to the right of the patient data in the report.

The report can contain the following averages for ***each*** segment of the vessel:

- Maximum CIMT
- Mean CIMT
- Mean CIMT percentile (for age, sex and race)

The report can contain the following averages for both the right and left distal CCA segments:

- Mean CIMT
- Mean CIMT percentile
- Vascular age of the segment

The report can contain the following averages across ***all*** segments of the vessel:

- Composite mean CIMT
- Composite mean CIMT percentile
- Average vascular age

  Note: To display the average vascular age and composite mean CIMT percentile values in the report you must measure three angles from each segment of the two segments for CCA ARIC protocols. For ARIC protocols you must measure one angle from each of the six segments.

- Framingham Model CHD Risk (%) (chronological age, blood pressure, cholesterol, diabetes, smoking)

Accessing the CIMT Report

To access the CIMT report:

- Click **Reports**.

To	Do This
Display the report with a scroll bar on the right	▪ Click **Show Report**.
Display the worksheet	▪ Click **Show Worksheet**.
Edit or enter patient data relevant to AHP calculations and Framingham assessment	1. Click **Edit Patient Data**. The AHP program displays the **Framingham CHD Risk Factors** screen. 2. Select the check box for **Perform Framingham Assessment**. 3. Enter the values for systolic and diastolic blood pressure. 4. Enter the values for both the total cholesterol and the HDL cholesterol levels. 5. If applicable, select the check box for **Smoking** and/or **Diabetes**. 6. To save your changes, click **Save**. The data will be available in the report.
Display the worksheet measurements screen	▪ Click **Edit Measurements**.
Delete measurements	**Note:** You can delete measurements from the worksheet only. 1. Click **Show Worksheet**. 2. Click **Edit Measurements**. 3. Select the measurements to delete for a particular vessel, view, and wall. 4. Click **Delete**. 5. To save your changes, click **Save**. 6. To discard your changes, click **Cancel**.
Enter sonographer initials, report prepared by, reporting physician, recommendations, and a summary	1. Click **Edit Summary**. 2. Use the keyboard to enter your comments. 3. To save your comments, click **Save**. 4. To discard your comments, click **Cancel**.
Export measurements or report data	▪ Click **Export**. You can export the report and worksheet in HTML format to a USB device. You can also export the quantification data results, in a comma-separated variables (.csv) format readable by a spreadsheet program (such as Excel), to a USB device.
Preview the report before printing it	▪ Click **Print Preview**.
Print the report	▪ Click **Print**.

Using the AHP Setup Page

You can use the AHP setup page at any time to change the factory (default) settings or to modify application settings. When you select **Save Page** the system retains your selections and definitions.

Accessing the Setup Page

To access the Setup page:

1. Click **Setup**.

   The Setup page displays the **Border**, **Report**, **Units**, **Define Protocol** and **Filter Protocols** tabs.
2. Select a tab for customizing options.

To	Do This
Save changes to the settings	▪ Click **Save Page**.
Restore the factory settings for the displayed setup page	▪ Click **Restore Page Defaults**. The AHP program deletes all user-defined settings and displays only the factory defaults.

Setting Up Options for the CIMT ROI

You can set up options for the display of the CIMT ROI (region of interest) and change the color schemes to apply to the thickness between the lumen-intima boundary and the media-adventitia boundary.

To set up options for the ROI:

1. Select the **Border** tab from the **Setup** page.
2. Select an option and adjust the setting.

To	Do This
Determine the range of color to apply or to only display lines to indicate borders	1. Select **Border lines**, **Solid shading (Mean CIMT)**, **Solid shading (Max CIMT)**, or **Thickness shading** from the **Display of CIMT area** list. The CIMT program applies color to the lines depicting the borders of the vessel boundaries or applies shades of color or a solid color to the "thickness" between the lumen-intima boundary and the media-adventitia boundary. A color bar displays the range of colors and a corresponding scale that indicates the average vessel thickness. 2. Select the name of the current color assigned to **Color_1_Low**, **Color_2_Mid**, **Color_3_Mid_High**, or **Color_4_High**. 3. Click the arrow on the right of the page and then select the **Web**, **Custom**, or **System** tab. 4. Select a color scheme to apply to the selected CIMT area.
Specify the length or width of the CIMT ROI	▪ In the **Search Length** list, select a value in centimeters.
Specify the depth or height of the CIMT ROI for the far wall	▪ In the **Far Wall Search Depth** list, select a value in centimeters.

To	Do This
Visually indicate a segment thickness exceeds the user-defined threshold	▪ Select the **Enable Maximum CIMT Threshold** check box.
Specify the maximum threshold for the CIMT	▪ In the **Maximum CIMT Threshold** list, select a value in millimeters. When reviewing a clip, the AHP program displays a message indicating the CIMT threshold is exceeded and applies yellow highlights to the corresponding segments.
Enable the zoom feature for the ROI	▪ Select the **Zoom to ROI on Detection** check box. **Note:** This feature is not applicable for **Detect All Frames**.
Detect boundaries on all frames	▪ Select the **Detect All Frames** check box. **Note:** Detecting all frames may slow the performance of the AHP program.
Display the CIMT ROI	▪ Select the **Show Search Region** check box.
Omit the excluded frames from clip playback	▪ Select the **Skip Excluded Frames on Playback** check box.

Report Options

To	Do This
Set up a new report	1. Select the **Report** tab. 2. Click **New** in the Reporting Physician section. 3. Enter a name for a physician. 4. Click **New** in the Recommendations section. 5. Enter a title and description.
Remove a report setting	▪ Click **Remove** in the Reporting Physician or the Recommendations section.

Units

To	Do This
Set up default units	1. Select the **Units** tab. 2. Select an option on the **Units** page and adjust the setting.

Protocols

To	Do This
Customize orientation descriptions for a protocol	**Important:** If you define a protocol and subsequently click **Restore Page Defaults** on the **Define Protocol** tab, all user entries are deleted. **Note:** The **Define Protocol** tab lists population sets and data values from the Atherosclerosis Risk in Communities (ARIC) study. 1. Select the **Define Protocol** tab. The AHP program displays a list of population sets. The program also displays the vessel name, segments of the vessel, and possible angles of acquisition. The acquisition angles display as comma-separated variables (CSV). 2. Ensure that the corresponding protocol name for the specified vessel is displayed in the Protocol box. 3. Click **Copy Protocol**. The **Protocol Name** box displays the name of the protocol, which can be modified, and the system gives the existing protocol a new name (for example, it adds a 1 to the end of the name). 4. In the **Protocol Name** box, enter a name for the new protocol. 5. Change the values for **Orientations** if necessary. Enter comma-separated variables (CSV) without any spaces. The customized orientations entered are displayed on the measurements screen for the customized protocol.
Customize the protocol list to include only the required protocol types	1. Select the **Filter Protocols** tab. 2. To display or exclude protocol types from the protocol list, select the appropriate checkbox on the measurements screen.
Customize the default protocol	▪ Select a default protocol from the list of available protocols. The selected protocol is the default protocol that is used each time you activate the AHP program.
Delete an existing protocol	**Note:** The AHP program allows you to delete only user-defined protocols. Factory defaults cannot be deleted. 1. Select the **Define Protocol** tab. 2. Select a population set from the **Protocol** list. 3. Click **Delete Protocol**.

Reference

The reference section provides a glossary of terminology and a list of clinical references.

Glossary

ARIC	Atherosclerosis Risk in Communities study
CCA	Common Carotid Artery
CHD	Coronary Heart Disease
ECA	External Carotid Artery
ICA	Internal Carotid Artery
IMB	Intima-Media boundary
IMT	Intima-Media Thickness
LBUL	Left bulb
LCCA	Left common carotid artery
LI	Lumen-intima
LIB	Lumen-intima boundary
LICA	Left internal carotid artery
MA	Media-adventitia
MAB	Media-adventitia boundary
ROI	Region of Interest
RBUL	Right bulb
RCCA	Right common carotid artery
RICA	Right internal carotid artery

Clinical References

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D5 *syngo four*Sight TEE View

Overview

*syngo four*Sight TEE View (*syngo* TEE) is a software program that enables you to view 3D volume datasets. *syngo* TEE can facilitate evaluation of cardiac diseases such as valvular disease and detection of embolic sources.

Each 3D volume dataset represents a complete heart cycle. A 3D volume dataset is also referred to as a ***phase loop***. A phase loop contains a ***phase***, or volume, for each point in the heart cycle.

⚠ **WARNING:** This application utilizes ultrasound data collected prior to analysis. The quality of the data collected and used as input could have an effect on the output of this application. Variability in ultrasound system performance, operator technique, patient characteristics, and other factors may affect the output. At all times, the clinician is advised to carefully review the output and confirm the information presented with clinical judgment and any other relevant sources of data.

Clip Acquisition Requirements

To view a study with *syngo* TEE, save the volume dataset with the study on the ultrasound system.

Activating and Exiting *syngo* TEE

To	Do This
Activate *syngo* TEE	1. Press **APPLICATIONS**. 2. Press the toggle key for **fourSight TEE**.
Activate *syngo* TEE from a previous study	1. Press **REVIEW**. 2. Press **Image Screen** if the study is active. 3. Select a clip. 4. Press **PAGE** to select the **Apps.** (Applications) tab indicator. 5. Press the toggle key for **fourSight TEE**.
Exit *syngo* TEE	▪ Press the toggle key for **Exit**. Or, press **APPLICATIONS**.

Setting Up for Acquisition

When you activate *four*Sight TEE View, the system displays an acquisition ROI (region of interest) on the live image and displays soft keys for volume acquisition and setup at the bottom of the screen. The system indicates each detected heart beat with a colored vertical marker on the ECG trace. A yellow marker indicates a heart beat inside the acceptable range; a blue marker indicates a heart beat outside the acceptable range.

To	Do This
Set up for 3D acquisition	1. Confirm stability of the ECG leads. 2. Press **APPLICATIONS**. 3. Press the toggle key for **fourSight TEE**.
To change the transducer's step angle	▪ Press the toggle key for **Step Angle** until the system displays the required angle. **Note:** Siemens recommends using the default value of 5 for the step angle.
Confirm and/or change settings for R-wave gating	**Note:** Siemens recommends that you enable R-wave gating for 3D acquisition. 1. Press the toggle key for **R-Gating** to select **On**. The system displays corresponding soft key selections. 2. To automatically set the minimum and maximum acceptable heart rates, press the toggle key for **Auto Set**. 3. To manually set the minimum and maximum acceptable heart rates: – Press the toggle key for **HR Min**. – Press the toggle key for **HR Max**.

Acquiring a 3D Volume Dataset

When you begin acquisition, the system displays a soft key for canceling acquisition and begins advancing the angle indicator. The angle indicator displays the current step angle for the transducer.

When the angle indicator stops advancing, the system displays soft key selections to proceed, postpone, or to delete the acquired data.

During 3D volume acquisition, the system acquires one set of frames per heart cycle that is within the range of acceptable heart rates. After each acquired set of frames, the transducer rotates to the next step angle for acquisition of the next set.

If Color Doppler was active when you activated *four*Sight TEE View, then the system acquires both 2D data and Color Doppler data. Each set of data (2D data and Color Doppler data) is maintained separately, enabling you to view a 3D volume using either or both sets of data.

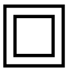
The time required to acquire the dataset depends on the patient’s heart rate, the step angle, and the gating setup. The step angle determines the number of frames acquired. The gating setup determines the range of acceptable heart rates. Each heart cycle outside the range of acceptable heart rates increases acquisition time because acquisition must pause until the next acceptable heart cycle occurs.

To	Do This
Acquire a 3D volume data set	1. Press **SET** or **CLIP STORE** to confirm the ROI (outlined in white). 2. Press **CLIP STORE**. The system acquires the 3D volume data. 3. To view the dataset, press the toggle key for **Reconstruct**. 4. To save the dataset for later use, press the toggle key for **Postpone**. 5. To delete the dataset, press the toggle key for **Delete**.
Cancel acquisition	▪ Press the toggle key for **Cancel**. Or, press **CLIP STORE**.

Viewing the 3D Volume Dataset

You can view a 3D volume dataset.

The program initially displays the volume and its orthogonal planes in a 4:1 display format on the TEE review screen, displays the wireframe on the volume, and plays the phase loop. The program displays the **Single Tiling** display format icon on the upper right of each quadrant.



*The **Single Tiling** display format icon is displayed on each quadrant in the TEE review screen when the 4:1 display format is selected.*

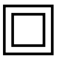
The lower-right quadrant contains the volume (also referred to as the Volume Rendering quadrant or VR quadrant). The other quadrants contain planes of the volume, initially oriented at the center of the volume; each plane is orthogonal to the other two planes. The planes are also referred to as MultiPlanar Reformatting (MPR) quadrants. The program indicates points of intersection between planes by placing uniquely colored axis lines on each plane. For example, the magenta-identified plane contains blue and yellow axis lines.

When you change the orientation of a plane quadrant, the program updates the other plane quadrants to maintain their orthogonal relationships.

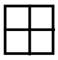
You can display the acquired 2D data and/or Color Doppler data, render the volume, remove data from the volume to help differentiate and clarify anatomical structures, and play the phase loop. You can orient, position, and magnify the volume and planes.

Selecting a Display Format

You can toggle the default 4:1 display format with the full-screen display format on either TEE screen (TEE review screen or TEE volume measurement screen).



*The **Single Tiling** display format icon is displayed on each quadrant in the TEE review screen when the 4:1 display format is selected.*



*The **Quad Tiling** display format icon is displayed on the TEE review screen when the full-screen display format is selected.*

To toggle display formats:

- Click the display format icon on the upper right of the required quadrant.

Displaying the Wireframe on the Volume

The wireframe indicates the boundaries of the displayed volume data. When the wireframe is displayed, each plane within the volume is indicated by a unique color.

To display the wireframe:

- Click the **Show Decorations** button on the toolbar at the top of the TEE review screen.

Displaying the Intersection Lines on the Planes

You can display dashed intersection lines on the planes. The intersection lines on each plane indicate the main axes through the volume.

To display intersection lines on the planes:

1. Click the **Tools** tab on the upper right of the TEE review screen to display the **Tools** selections.
2. Click the **Toggle Lines of Intersection** button.

Selecting a Quadrant

You can select a quadrant for rotation or other manipulation.

To select a quadrant:

- Position the cursor over the required quadrant and click.

Canceling the Previous Operation

You can cancel the most recent operation.

To cancel the most recent operation:

1. Click **Undo** on the toolbar at the top of the TEE review screen (or at the top of the TEE volume measurement screen).
2. To cancel several previous operations, click **Undo** repeatedly.
3. To perform the canceled operation again, click **Redo** on the toolbar.

Restoring Initial Settings

You can restore the initial settings for all quadrants. These settings include:

- Orientation
- Display of the first phase
- Retrieval of any removed data
- Deletion of measurements, annotations, arrows
- Clearing of the memory buffer

To restore initial settings:

- Click the **Reset** button on the toolbar at the top of the TEE review screen (or at the top of the TEE volume measurement screen).

Displaying and Playing Phase Loops

The program lists the current phase number on the lower right of each quadrant.

To display another phase:

- Click either the **Previous Phase** button or the **Next Phase** button on the toolbar at the top of the TEE review screen. Alternatively, click **Previous Phase** or **Next Phase** on the right of the TEE review screen (when **Tools** is selected) or at the top of the TEE volume measurement screen.

To play the phase loop:

- Click the **Play Phase Loop** button on the toolbar at the top of the TEE review screen. Alternatively, click **Play Phase Loop** on the right of the TEE review screen (when **Tools** is selected) or at the top of the TEE volume measurement screen.

To adjust the speed of playback:

1. Click the **Tools** tab on the upper right of the TEE review screen.
2. Position the cursor over the **Set Phase Animation Speed** slider bar.
3. Drag the slider to select the required speed.

Rendering the Volume

You can render the volume by adjusting shading, smoothing, or opacity to change its surface appearance. You can also invert bright and dark values of the 2D data within the volume.

To adjust the shading of the volume:

1. Click the **Render Settings** tab on the upper right of the TEE review screen to display the rendering selections.
2. Choose one or more of the following methods to adjust shading:

To	Do This
Apply a mixture of gradient shading and texture shading to the 2D data within the volume	▪ Click the **Gradient Mode** button.
Apply a mixture of gradient shading and texture shading to both the 2D data and color Doppler data within the volume	▪ Click the **Gradient/Gradient Mode** button.
Mix and adjust gradient shading and texture shading	1. Position the cursor over the **Gradient-Texture Ratio** slider. 2. Drag the slider to adjust the setting.
Adjust the concentration of the texture shading	1. Position the cursor over the **Texture Intensity** slider. 2. Drag the slider to adjust the setting.

To adjust the smoothing of the volume:

1. Click the **Render Settings** tab on the upper right of the TEE review screen to display the rendering selections.
2. Choose one or more of the following methods to adjust smoothing:

To	Click This Button
Increase the structural detail	**No 3D Filter**
Apply a mild, low-pass filter	**Smooth 3D (normal)**
Apply a moderate, low-pass filter	**Smooth 3D (heavy)**
Apply a strong, low-pass filter	**Smooth 3D (massive)**

To adjust the opacity of the volume:

1. Click the **Render Settings** tab on the upper right of the TEE review screen to display the rendering selections.
2. To display only the maximum intensity (highest value) 2D data within the volume, click the **Max IP Mode** button.
3. To display only the maximum intensity (highest value) Color Doppler data within the volume, click the **Max IP Mode** button.
4. To further adjust opacity, position the cursor over a slider and then drag the slider to select the required setting.

Opacity slider	Description
Threshold Tissue	Eliminates darker gray shades, background noise, and "snow" from the 2D data
Transparency Tissue	Adjusts the level of surface transparency for the 2D data
Threshold Color	Applies color to each velocity direction in the Color Doppler data and then eliminate lower amplitude data and background noise
Transparency Color	Adjusts the level of surface transparency for the Color Doppler data

To invert bright and dark voxel values of the 2D data within the volume:

1. Click the **Render Settings** tab on the upper right of the TEE review screen to display the rendering selections.
2. Click the **Invert Tissue** button.

Displaying the Volume Measurement on the Review Screen

You can toggle display of the volume with display of the most recently calculated volume measurement. Volume measurements are calculated on the TEE volume measurement screen.

To toggle display of the volume with display of the most recently calculated volume measurement:

1. Click the **Render Settings** tab on the upper right of the TEE review screen to display the rendering selections.
2. Click the **Show Beutel** button.

Adjusting the Brightness and Contrast

You can adjust the brightness and contrast of the planes.

To adjust brightness:

1. Click the **Tools** tab on the upper right of the TEE review screen to display the **Tools** selections.
2. Position the cursor over the **Brightness** slider bar.
3. Drag the slider to select the required setting.

To adjust contrast:

1. Click the **Tools** tab on the upper right of the TEE review screen to display the **Tools** selections.
2. Position the cursor over **Contrast** slider bar.
3. Drag the slider to select the required setting.

Rotating the Volume

Volume rotation can help you visualize anatomical structures. You can rotate the volume manually or automatically. The volume is always rotated around its center point.

Automatic rotation occurs in a rocking motion for the currently displayed phase at the selected speed and angle of rotation. Manual rotation can be in any direction or can be limited to the clockwise and counterclockwise directions.

To manually rotate the volume (any direction):

1. Click the **Pivot/Orbit** button on the toolbar at the top of the TEE review screen.
2. Drag a portion of the volume quadrant outside the volume in the required direction.

To manually rotate the volume (clockwise or counterclockwise direction):

1. Click the **Rotate** button on the toolbar at the top of the TEE review screen.
2. Drag the volume quadrant in the required direction.

To automatically rotate the volume:

1. Click the **Tools** tab on the upper right of the TEE review screen.
2. To select the angle of rotation:
   a. Position the cursor over the **Set Angle** slider bar.
   b. Drag the slider to select the required angle.
3. If required, click **Set Phase Animation Speed** to adjust the speed.
4. To toggle fast motion with slow motion, click the **Slow Motion** button.
5. Click the **Play Animation** button.

Aligning Orientation of the Volume to a Plane

You can align the orientation of the volume (VR view) to that of the selected plane (MPR view). When you align the volume's orientation, completed measurements are displayed on both the volume and the plane to which the volume is aligned.

To align the volume to the selected plane:

- Click the **Synchronize VR view with active MPR view** button on the toolbar on the TEE review screen.

Panning the Volume

You can pan (shift) the volume to locate the anatomy of interest on the volume surface.

To pan (shift) the volume:

1. Click the **Pan** button on the toolbar at the top of the TEE review screen.
2. Drag the volume in the required direction.

Rotating the Planes

When you rotate a plane, the program rotates all planes to maintain their orthogonal relationships.

To rotate a plane in the clockwise/counterclockwise directions:

1. Click the **Rotate** button on the toolbar at the top of the TEE review screen.
2. Drag the plane in the required direction.

Panning the Planes

You can pan (shift) a plane to locate the anatomy of interest. When you pan the plane, the program automatically updates the other planes to display the corresponding views of the anatomy of interest.

To pan (shift) a plane:

1. Click the **Pan** button on the toolbar at the top of the TEE review screen.
2. Drag the plane in the required direction.

Magnifying a Quadrant

When you magnify a plane, the program also magnifies the other planes using the same magnification factor.

To magnify a quadrant:

1. Click the **Zoom** button on the toolbar at the top of the TEE review screen.
2. Drag the plane in the required direction.

Displaying 2D and Color Doppler Data Within the Volume

You can display acquired 2D and/or Color Doppler data within the volume.

Use buttons on the toolbar at the top of the TEE review screen.

To display this set of data within the volume	Click
2D data only	**Show Tissue**
Color Doppler data only	**Show Color**
2D and Color Doppler data	**Show Color and Tissue**

Removing Data from the Volume

Note: For an optimal view of the volume after removing data, rotate the volume.

Removing data from the volume can help you visualize anatomy that is not located on the surface of the volume and understand its relationship to the volume.

For example, if the anatomy of interest is a small lesion in the center of the volume, then the lesion is not visible on the surface of the volume. You can orient and position the cut plane, adjust the wireframe boundaries, or outline a section of the volume for removal. The amount of volume data remaining indicates the lesion’s location in relation to the volume.

Activating the Cut Plane

You can activate the cut plane for 2D data and/or for Color Doppler data within the volume.

When you activate the cut plane, the program removes the volume data (of the selected types) in front of the cut plane. The cut plane in the volume has the same position and orientation of the most recently selected plane quadrant. If the wireframe is displayed, then the program displays the cut plane in the volume.

To activate the cut plane:

1. To activate the cut plane for 2D data, click the **Clip Tissue** button on the toolbar at the top of the TEE review screen.
2. To activate the cut plane for Color Doppler data, click the **Clip Color** button on the toolbar at the top of the TEE review screen.
3. To de-activate the cut plane, click the relevant button again (**Clip Tissue** or **Clip Color**).

Orienting and Positioning the Cut Plane

You can orient (pivot or tilt) and position ("step through") the cut plane to clarify anatomical structures.

When you orient and position the cut plane, the program updates the orientation and position of the volume quadrant and active plane quadrant and also updates the other plane quadrants to maintain their orthogonal relationships to the active plane quadrant.

To orient the cut plane (after activating the cut plane):

1. Click the **Pivot/Orbit** button on the toolbar at the top of the TEE review screen.
2. Drag the plane in the required direction.

To position the cut plane (after activating the cut plane):

1. Click the **Slice** button on the toolbar at the top of the TEE review screen.
2. Drag the plane in the required direction.

Adjusting the Wireframe Boundaries

You can remove 2D data and/or Color Doppler data from the volume by adjusting the wireframe boundaries. The wireframe does not need to be displayed.

When you adjust a wireframe boundary, the program removes the volume data (of the selected types) in front of the adjusted boundary. This adjustment does not affect the orientation or position of the cut plane or plane quadrants.

To adjust a wireframe boundary:

1. To display the wireframe within the volume quadrant, click the **Show Decorations** button on the toolbar at the top of the TEE review screen.
2. To remove 2D data, click the **Tissue ROI** button on the toolbar at the top of the TEE review screen.
3. To remove Color Doppler data, click the **Color ROI** button on the toolbar at the top of the screen.
4. Drag the wireframe boundary in the required direction.
5. To retrieve the data removed through boundary adjustment, click the relevant button again (**Tissue ROI** and/or **Color ROI**).

Removing an Outlined Section of Data

You can remove 2D data and Color Doppler data within an outlined section of the volume to help clarify anatomical structures.

To remove an outlined section of data from the volume:

1. Click the **Tools** tab on the upper right of the TEE review screen.
2. If the image is playing, click the **Stop Phase Loop** button.
3. Click the **Scalpel Standard** button.

   The cursor changes to a crossmark.
4. Position the crossmark at the starting point on the volume.
5. Drag the crossmark to draw a freeform shape around the data you want removed.

   The outlined section is removed from the volume.
6. To retrieve data removed using **Scalpel Standard**, click the **Remove Erasings** button on the toolbar at the top of the screen.

Navigating the Volume Using a Plane (D↑Art)

You can use a plane (MPR) to navigate the volume by activating the D↑Art function to display only the segment of interest. When this function is active, an arrow indicates the length and direction to use when extracting the segment.

To navigate the volume using a plane:

1. Click the **D↑Art** button on the toolbar at the top of the TEE review screen.
2. Select a plane quadrant and define the region of interest.
   a. Position the cursor at the location for the arrow's base (anchor point) and press **SET**.
   b. Drag the arrowhead in the required direction.

      On the selected plane quadrant, the program displays the region of interest as two parallel dashed lines enclosing an arrow. On the volume quadrant, the program removes volume data outside of the two dashed lines.
3. To shift the region of interest:
   – Drag the arrow's ray (between the ends of the arrow) to reposition the region of interest.
4. To change the anchor point of the arrow:
   – Drag the arrow's base to reposition the anchor point.
5. To expand or contract the region of interest, or to change the arrow's direction:
   – Drag the arrow's tip.
6. To view the volume from other angles, rotate the volume.
7. To exit the D↑Art function, click the **D↑Art** button again.

Making Measurements

Note: To display completed measurements on both the volume and an aligned plane, first align the orientation of the volume to the orientation of the plane.

You can make distance, angle, and area measurements on planes and calculate volume measurements. You can also add annotations and arrows. You can delete measurements, annotations, or arrows.

Volume measurements are available from the TEE volume measurement screen. All other measurement functions are available from the TEE review screen.

The program displays values for completed measurements on the upper left of the plane quadrant.

To Display the Following (after *four*Sight view is activated)	Do This
The TEE review screen	▪ Click **Review**.
The general measurement selections on the TEE review screen	▪ Click the **Measurements** tab from the upper right of the screen.
The TEE volume measurement screen	▪ Click **Volume Measurement**.

Measurement Range and Accuracy

The accuracy of the measurements is based on a reasonable representative dataset. The following table depicts the measurement range and the accuracy for measurements:

	Distance	Area	Angle	Volume
Measurement Range	Measured distance >20% of the image quadrant diagonal	Measured area >20% of the entire image quadrant area	Measured area >20% of the entire image quadrant area	Measured area >20% of the entire image quadrant area and at least four measurement planes
Tolerance	± 5%	± 5%	± 5%	± 5%

Making and Editing Distance, Angle, and Area Measurements

When you select a measurement tool, such as the **Distance** button, the cursor changes to a crossmark.

To make a distance measurement:

1. Click the **Measurements** tab on the upper right of the TEE review screen.
2. Click the **Distance** button.
3. Position the crossmark at the starting point and press **SET**.
4. Drag the crossmark at the required end point.

To make an angle measurement:

1. Click the **Measurements** tab on the upper right of the TEE review screen.
2. Click the **Angle** button.
3. For each point in sequence (the vertex, first vector, and second vector), position the crossmark and then press **SET**.

To make an area measurement:

1. Click the **Measurements** tab on the upper right of the TEE review screen.
2. Click the **Area** button.
3. Press **SET** key for each subsequent point.
4. To add points to the area spline, position the cursor over the line displayed between two points and then press **SET**.
5. To indicate completion of the area measurement, click near the starting point.

   The program automatically closes the shape and displays the measurement value.

To edit a measurement:

1. Position the cursor over a point or end point on the TEE review screen.

   The color of the point or end point changes to indicate that it is selected.
2. Drag the point or end point in the required direction.

Calculating Volume Measurements

You can use 3D volume measurements to draw splines in several planes for calculation of volumes of ventricles, jets, and other anatomical structures. Volume measurements are available from the TEE volume measurement screen.

Note: The orientation and position of the 3D volume and planes cannot be changed within the TEE volume measurement screen. After you calculate a volume, you can rotate the 3D volume and the lower left plane quadrant.

Calculating a Volume

You can calculate a volume for each pair of planes. The program initially displays only one pair of planes for volume calculation.

To calculate a volume for the current pair of planes:

1. On the TEE Review screen, use the navigation buttons to position the structure in the center of the three plane quadrants (MPR windows).
2. Click **Volume Measurement** to display the TEE volume measurement screen.
3. On the upper left quadrant and the upper right quadrant, define a contour (trace):
   a. Press **SET** for each subsequent point.
   b. To add points to the area spline, position the cursor on the line displayed between two points and then press **SET**.
   c. To indicate completion of the area measurement, position the cursor near the starting point and then press **SET**.

      The program automatically closes the shape and depicts the completed contours in green.
4. Click the **Calculate Volume** button to calculate the traced volume.

   The program displays the values for the calculated surface and for the volume of the traced region on the lower right quadrant (3D volume):

   – **Volume** indicates the volume of the whole measurement object.

   – **Color Volume** indicates the blood volume inside the measurement object. (Displayed for Color Doppler data only.)
5. To rotate the 3D volume or the lower left plane quadrant, drag the volume or plane in the required direction.

To increase the correspondence between the defined contours and the anatomy of interest displayed in the lower left quadrant (after calculating a volume):

1. Click the **Double number of planes** button on the right of the TEE volume measurement screen to add plane pair(s).
2. Click the **Next plane pair** button to display the next plane pair.
3. Calculate another volume.

To add plane pair(s):

- Click the **Double number of planes** button on the right of the TEE volume measurement screen.

To reduce plane pair(s):

- Click the **Halve number of planes** button on the right of the TEE volume measurement screen.

To select a plane pair:

- Click the **Next plane pair** button or the **Previous plane pair** button on the right of the TEE volume measurement screen.

Calculating Ejection Fraction from Volumes

You must identify end diastole and end systole to calculate ejection fraction from volumes.

The program displays the volume measurement in milliliters (ml) for each designated frame and the ejection fraction in label text boxes.

To calculate ejection fraction from volumes:

1. Using the **Previous Phase** or **Next Phase** buttons, locate the frame that depicts the end of diastole.
2. Trace a volume on each of the top two frames and click the **Calculate Volume** button.
3. Click the **Set End Diastole** icon in the **Heart Cycle** section.

   The program displays the end diastolic volume measurement in the **Enddiastolic Vol.** text box.
4. Using the **Previous Phase** or **Next Phase** buttons, locate the frame that depicts the end of systole.
5. Trace a volume on each of the top two frames and click the **Calculate Volume** button.
6. Click the **Set End Systole** icon in the **Heart Cycle** section.

   The program displays the end systolic volume measurement in the **Endsystolic Vol.** text box.

   The program calculates ejection fraction and displays the value in the **EF** text box.

   The program displays all three values in the center of the diagnostic area.
7. To rotate the 3D volume or the lower left plane quadrant, drag the volume or plane in the required direction.

Annotating Images

You can add annotations to planes displayed on the TEE review screen. Annotations include text and arrows.

To add an annotation (text) to a plane:

1. Click the **Measurements** tab on the upper right of the TEE review screen.
2. If the image is playing, click the **Stop Phase Loop** button.
3. Click the **Annotation** button.
4. Position the cursor over the required plane and then press **SET**.

   The program displays a text box for entry of the annotation.
5. Use the alphanumeric keyboard to enter the annotation and then press **Enter**.
6. To adjust the position of the annotation, drag the annotation to the required position.

To add an arrow to a plane:

1. Click the **Measurements** tab on the upper right of the TEE review screen.
2. If the image is playing, click the **Stop Phase Loop** button.
3. Click the **Arrow** button.

   The cursor changes to a crossmark.
4. Position the cursor at the point on the required plane on which to place the end of the arrow (ray or line) and then press **SET**.

   The program displays the arrow with its end (opposite the arrowhead) located at the cursor position.
5. Position the cursor at the point on the required plane on which to place the head of the arrow and then press **SET**.

   The program displays the arrow with its arrowhead located at the cursor position.
6. To reposition the arrow:
   a. Position the cursor over the head or tail of the arrow.
   b. Drag the head or tail to the new position.

Deleting Measurements, Annotations, or Arrows

You can delete measurements, annotations, or arrows displayed on the TEE review screen.

To delete a measurement, annotation, or arrow:

1. Click the **Measurements** tab on the upper right of the TEE review screen.
2. Position the cursor over the required measurement or annotation and then press **SET**.
3. Click the **Delete selected annotation or measurement** button.

To delete all measurements, annotations, and arrows:

1. Click the **Measurements** tab on the upper right of the TEE review screen.
2. Ensure that there are not any selected measurements, annotations, or arrows.
3. Click the **Delete selected annotation or measurement** button.

Storing and Exporting

You can store and export clips and images from the TEE review screen to a supported USB device. You can also export clips, images and 3D volume datasets to the system's hard disk.

To	Do This
Export a clip	▪ Start playback of the phase loop and then click **Export AVI/BMP**.
Export an image	1. If the clip is playing, click **Stop Phase Loop**. 2. Click **Export AVI/BMP**.
Store a clip	▪ Start playback of the phase loop and then click **Bookmark**.
Store an image	1. If the clip is playing, click **Stop Phase Loop**. 2. Click **Bookmark**. Or, press the key assigned to the disk store function.

D6 *syngo* Mitral Valve Analysis (MVA)

Overview

Mitral Valve Analysis (MVA) enables you to visualize the complex morphology and dynamics of the 2D and 3D mitral valve in a 3D data set. MVA is a guided workflow for measuring and locating structures such as the MV annulus and the closure line, defining commissures, and generating automatic labeling for anterior and posterior leaflets of the mitral valve.

MVA derives parameters for:

- Quantification of pre- and post-operative valvular function
- Comparison of morphology

You can activate Mitral Valve Analysis for a selected, compatible clip in an active study or a previous study.

⚠ **WARNING:** This application utilizes ultrasound data collected prior to analysis. The quality of the data collected and used as input could have an effect on the output of this application. Variability in ultrasound system performance, operator technique, patient characteristics, and other factors may affect the output. At all times, the clinician is advised to carefully review the output and confirm the information presented with clinical judgment and any other relevant sources of data.

Compatibility

MVA is compatible with volume data sets from the *four*Sight TEE View clinical application package. The selected clip must display a 3D icon to have a data volume available for manipulation.

Activating and exiting *syngo* MVA

Selection	Description
Activate *syngo* MVA	1. Press **REVIEW**. 2. Click **Image Screen** if the study is active. 3. Select a clip. 4. Press **PAGE** to select the **Apps.** (Applications) tab indicator. 5. Press the toggle key for **MVA**.
Exit MVA	▪ Click **Exit**.

Working with MVA

- Workspace: Displays the current study volume and tools you use to review the study.
- Toolspace/Sectional Workflow: Contains analysis tools and displays an ordered workflow for analysis preparation.
- Toolbar: Provides program controls, phase play controls, and navigation tools. When a tool is not available, it is dithered.

The MVA Screens

MVA has three screens: MVA Delineation, MVA Analysis, and MVA Analysis 2D. The Toolbar and Toolspace buttons provide access to all functions, and are available for use with all the analysis screens. During the MVA Delineation workflow and MVA Analysis 2D each screen displays four quadrants:

- Three two-dimensional cut planes
- One three-dimensional reconstruction (4D Data Cube)

MVA Analysis displays the three-dimensional reconstruction of the 4D Data Cube.

Colored corner markers indicate the active image.

Within each quadrant, two colored lines indicate the position of the corresponding orthogonal views. The active image corner colors correspond to the colored axis at each of the other cut plane quadrants.

The spatial arrangement of the cut planes is displayed at the 4D Data Cube to provide a navigational view of a data volume. The 4D Data Cube always displays the cut plane corresponding to the active quadrant.

Changing Presettings

The MVA **Presettings** button on the Toolbar enables you to establish settings for the workflow by opening the **Acquisition** dialog box. This dialog box enables the selection of settings for the workflow. If they are changed within a workflow, all changes are discarded and the workflow must be repeated.

You can change presettings in the **Acquisition** dialog box.

Select	To do this
Fast Workflow Transition	Toggle to change workflow speed by increasing/decreasing the number of selections required to step through the workflow.
Fast Landmark Placement	Toggle to automatically skip/not skip to the next cut plane after all landmarks which belong to the current cut plane have been set.
Number of Closure Line Cut Planes	Toggle to increase/decrease the number of closure line cut planes. The new fragmentation will cause the deletion of any set landmarks.
Number of MV Annulus Delineation Cut Planes	Toggle to increase/decrease the number of MV annulus delineation cut planes. The new fragmentation will cause the deletion of any set landmarks.
Time Delay for Landmark Placement Cine Loop	Stop the loop for the defined amount of time at each **Frame of Interest** by changing the value.

Restoring Initial Settings

You can restore the initial settings for all quadrants. These settings include:

- Orientation
- Display of the first phase
- Retrieval of any removed data
- Deletion of measurements, annotations, arrows
- Clearing of the memory buffer

To restore initial settings:

- Click the **Reset** button on the toolbar at the top of the Workspace.

Using Navigation Tools

You can use these tools to navigate through the volume to clarify anatomical structures.

Select	To do this
Pivot/Orbit	Rotate the selected cut plane around its axis. a. Click the **Pivot/Orbit** button on the toolbar. b. Drag the selected Cut Plane / 3D/4D Data Cube to rotate it around its vertical/horizontal axis.
Rotate	Rotate the selected cut plane around the axis perpendicular to the screen. All planes rotate to maintain their orthogonal relationships. a. Click the **Rotate** button on the toolbar. b. Drag to rotate one of the selected default cut planes.
Pan	Locate the region of interest on the volume surface. a. Click the **Pan** button on the toolbar. b. Drag to relocate one of the selected default cut planes (Front View, Left Side View or Top View) or the 3D/4D Data Cube within a quadrant.
Zoom	Magnify a plane. a. Click the **Zoom** button on the toolbar. b. Drag to zoom the image in and out. All other planes are magnified by the same factor.

MVA Delineation

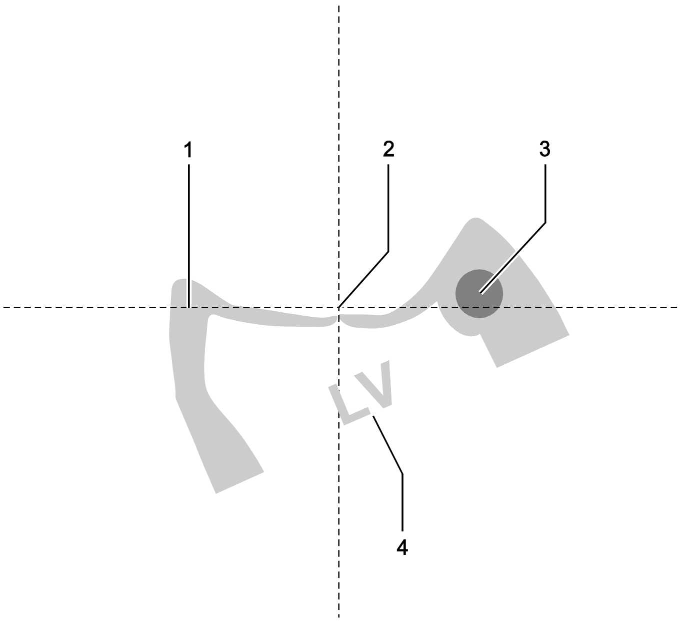
The MVA Delineation screen opens after MVA is started; you can also select it with the **MVA Delineation** button on the toolbar. **MVA Delineation** enables the delineation of the mitral valve annulus and the closure line in 2D cut planes. The screen displays the study volume in four quadrants, showing a three-dimensional reconstruction (4D Data Cube) and three two-dimensional cut planes.

Workstep state labels	Description
Check mark	Indicates a performed step. Selecting a workstep button reactivates the step.
Arrow	Indicates the active step.
Circle	Indicates the next available step.
None (step is dithered)	Indicates step is currently unavailable.

Using Worksteps for Delineation

Select the **Worksteps** tab for a step-by-step workflow of delineation for the preparation of mitral valve reconstruction.

1. On the Worksteps screen, click the **0—Start Workflow** button to start the workflow.
2. Adjust the view by clicking the **1—View Adjustment** button.
   a. Adjust the **Brightness** and **Contrast** sliders to display the dataset with the specific details required for your analysis.
   b. Use the Navigation Tools to align the data to the mid-esophageal LAX view of the left ventricle within the upper left quadrant.
   c. In both upper quadrants, align the annulus ring of the mitral valve to the horizontal line of the crosshairs. The aortic valve must appear on the right side of the upper left quadrant. The heart view shows the LV (left ventricle) beneath the LA (left atrium).
   d. Press the **Context help** button for an example of the required view. The upper left quadrant contains all the criteria in the following picture:



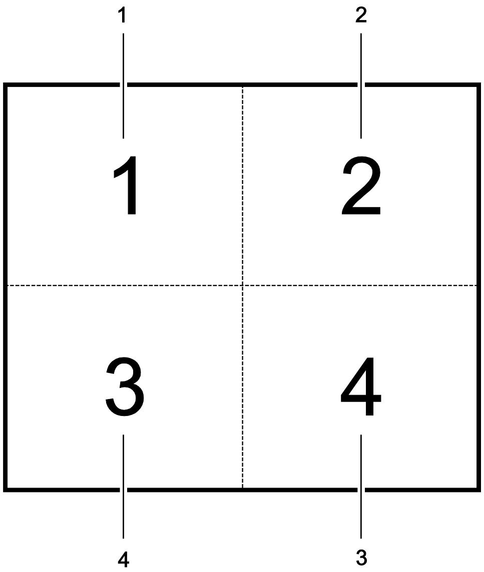
1 Annulus ring on the horizontal line
2 Middle of mitral valve at the crosshairs
3 Aortic valve
4 Left ventricle

Adjusted view (three chamber).

3. Define the frame of interest by clicking the **2—Frame of Interest** button. The frame of interest is the systolic phase, where the mitral valve closes and the closure line is visible.
   a. Use the play/phase tools to further define the frame of interest for analysis.
   b. Confirm your settings by clicking the **Set Frame of Interest** button on the **Work Steps** tab.
4. Set reference points to the annulus of the mitral valve within the frame of interest by clicking the **3—Reference Points** button. These points are used for determining the MV long axis and the rotation axis for the closure line and commissural setting.
   a. Click **Play Phase Loop** before placing reference points. The loop stops for a preset interval at each frame of interest. This feature helps in placing reference points.
   b. Set **Anterior LM** (LM = landmark) and **Posterior LM** at the upper left quadrant.
   c. Set **Anterolateral LM** and **Posteromedial LM** at the upper right quadrant.

   Proper anatomical placement is required for analysis. Before beginning analysis, ensure that your landmarks are positioned correctly.
5. Reduce the region of interest so that no tissue artifacts interfere with your view of the mitral valve by clicking the **4—Free View** button.
6. Delineate the MV annulus by clicking the **5—MV Annulus Delineation** button. Use the cut planes displayed in the upper right quadrant to guide your placement of landmarks.
   – The yellow cut plane is active.
   – Orange cut planes do not have landmarks.
   – Green cut planes have landmarks.
   – The number of cut planes can be changed depending on closure line morphology.
   – Place anterior and posterior landmarks on each cut plane in the upper left quadrant.
   – Drag a landmark to reposition it in the cut plane at the upper left quadrant.

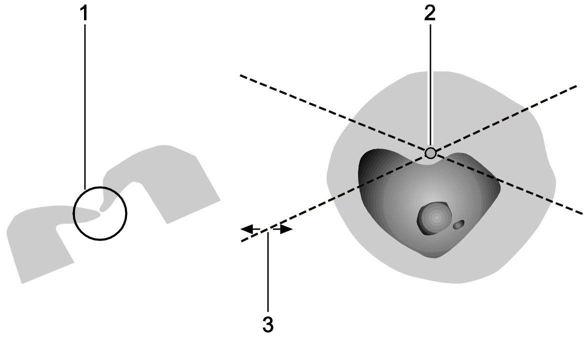
   The lower quadrants display the model of the annulus ring corresponding to the view in the quadrant above.



1 Cut plane view
2 4D Data Cube
3 Reconstructed annulus ring (in ateral view)
4 Reconstructed annulus ring (in top view)

Quadrant relationships.

7. Define Commissures by adjusting each cut plane in the upper right quadrant. Click the **6—Commissures Definition** button and make these adjustments:
   a. Make sure the cut planes touch the ends of the closure line. While doing this, observe the cut plane view in the upper left quadrant. The closure line is just visible. Drag the cut planes to correct their position.
   b. Drag the intersection point to adjust for a closure line that intersects a cut plane more than once, or if the closure line is very deformed.



Performing Commissures Definition.

1 A small aperture should still be visible
2 Intersection point
3 Adjust cut plane

8. Delineate the closure line by placing landmarks in the upper left quadrant. Click the **7—Closure Delineation** button and use the cut planes displayed in the upper right quadrant to guide your placement of landmarks.
   – The yellow cut plane is active.
   – Orange cut planes do not have landmarks.
   – Green cut planes have landmarks.
   – The number of cut planes is changeable depending on closure line morphology.
   – Place a closure line landmark on each cut plane within the frame of interest in the upper left quadrant.

   The lower quadrants display the model of the annulus ring according to the corresponding view above.
9. Finish the preparation for analysis by selecting the **8—Go to Analysis** button.

MVA Analysis

After performing a mitral valve reconstruction, the program displays the **MVA Analysis** screen.

MV-Assessment Analysis displays different presentations of the mitral valve, shows characteristic, automatically calculated MV parameters, and offers additional measuring and labeling functionalities. The Toolbar buttons make switching between 3D and 2D possible during an analysis.

The Toolbar buttons provide access to either 3D or 2D selections during an analysis.

MVA Analysis 3D

MVA Analysis displays one three-dimensional reconstruction (4D Data Cube) of the mitral valve, the reconstructed annulus, and closure line. It also provides information on its morphology.

MVA Analysis 2D

MVA Analysis 2D displays three two-dimensional cut planes (Front View, Left Side View, and Top View) and the three-dimensional reconstruction (4D Data Cube). You can position landmarks on the 2D images to clarify pathologies, which are more easily detected as 2D displays.

You can export the automatically generated measurements or continue using the measurement tools for further analysis. You can also export the data from the analysis. You can save the current analysis if required. Saving an analysis transfers the image data together with the evaluated Closure Line and Mitral Annulus and the automatically calculated values to the Data Management Platform for storage.

MVA Analysis Toolspace

Selecting **MVA** activates MVA for this study and changes the Workspace screen. The upper panel has two tabs, Worksteps and Settings. Worksteps displays by default, with a list of the steps required to complete the review and a Toolspace with sliders for adjusting the brightness and contrast of the image, plus a context help button with details on adjusting the image.

When the workflow reaches the Analysis stage additional general review tools become available, some of which are also available from the main toolbar.

The analysis Toolspace has three tabs with tools for performing analysis.

Analysis

The tools on the **Analysis** tab enable label placement and alternative views of the 4D Data Cube. Additional review tools are described in the **Toolspace** section, and in the **Analysis Settings** section.

To adjust analysis views and labels:

To Adjust	Do This
Loops of Cine data	▪ Select or deselect **Landmark Cine Loop** to toggle continuous animation with interrupted animation of a displayed phase sequence.
Frame of Interest	▪ Click **Go To Frame of Interest** to skip to the phase defined as the frame of interest.
View (available in **Analysis**)	▪ Click **Surgical View** to display the normal surface of the MV annulus ring shown in the 4D Data Cube.
Overlay	a. Click **Show Annulus** to overlay the model of the MV annulus ring within the 4D Data Cube. b. Click **Show Closure Line** to overlay the model of the closure line within the 4D Data Cube.
Landmarks (available in **Analysis 2D**)	a. Click **New** to place a new landmark at a location of interest within an MPR and assign a name to it. If Text in 3D View is selected the label will be displayed within the 3D reconstruction. b. Click **Rename** to edit a selected landmark. c. Click **Delete** to remove a selected landmark.
Label	a. Select **Show Automatic Labels** to display anatomic structure labels for an overview of the mitral valve. b. Click **Add Label** to create an annotation within an MPR and within the 4D Data Cube when done within the MPR, or only within the 4D Data Cube if done there. c. Press **Enter** on the keyboard to confirm the label. d. Click **Delete** to remove a selected annotation.

Settings

The tools on the **Settings** tab enable different representations of the 4D Data Cube, including animation. Controls for changing tissue settings are displayed in a panel on this tab.

To Adjust	Do This
Brightness and Contrast	a. Position the cursor over the **Brightness** slider and drag the slider to the required setting. b. Position the cursor over the **Contrast** slider and drag the slider to the required setting.
Phase control	a. Click the **Play Phase Loop** button to start or pause volume animation. b. Click the **Previous Phase** button to display the previous phase. c. Click the **Next Phase** button to display the next phase. d. Position the cursor over the **Set Phase Animation Speed** slider and drag the slider to the required setting.

To Adjust	Do This
Movie (available in **Analysis**)	a. Click **Play Animation** to start or stop a rocking motion of the 4D Data Cube around its vertical axis. b. Click **Slow Motion** to toggle fast rocking motion with slow rocking motion. c. Position the cursor over the **Set Angle** slider and drag the slider to adjust the rocking motion angle.
Tissue settings	a. Click **Show Tissue** to display only black and white data. b. Click **Show Color** to display only color data. c. Click **Show Color and Tissue** to display color and black and white data. d. Position the cursor over the **Threshold Tissue** slider and drag the slider to adjust thresholds for defining structures of interest. e. Position the cursor over the **Transparency Tissue** slider and drag the slider to adjust the transparency of the object. f. Position the cursor over the **Gradient-Texture Ratio** slider and drag the slider to adjust the gradient and texture shading of the object. g. Position the cursor over the **Texture Intensity** slider and drag the slider to adjust the concentration of texture shading.
Smoothing	a. Click **No 3D Filter** to display the Data Cube with increased structural details. b. Click **Smooth 3D (normal)** to apply a mild low-pass filter to the Data Cube. c. Click **Smooth 3D (heavy)** to apply a moderate low-pass filter to the Data Cube. d. Click **Smooth 3D (massive)** to apply a strong low-pass filter to the Data Cube.
Color Scheme	▪ Select **Tissue Color** to apply a color scheme to the Data Cube.

Measurements

The **Measurements** tab provides access to tools for measurements on an MPR and/or 4D Data Cube.

The measurement functionalities are only available on calibrated datasets. They only function on static images, so you must stop any animation before performing measurements.

Measurement Range and Accuracy

The accuracy of the measurements is based on a reasonable representative dataset. The following table depicts the measurement range and the accuracy for measurements:

	Distance	Area	Angle	Volume
Measurement Range	Measured distance >20% of the image quadrant diagonal	Measured area >20% of the entire image quadrant area	Area spanned by the legs of the measured angle >20% of the entire image quadrant area	Measured area >20% of the entire image quadrant area and at least four measurement planes
Tolerance	± 5%	± 5%	± 5%	± 5%

To make measurements on the image:

- Click the **Measurements** button on the upper right of the MVA Toolspace.

To	Do This
Make a distance measurement	1. Click the **Distance** button. 2. Position the crossmark at the starting point and click to anchor the point. 3. Position the crossmark at the required end point and click to anchor the point. Measurement results display at the upper left of the Workspace.
Make an angle measurement	1. Click the **Angle** button. 2. For each point in sequence (the vertex, first vector, and second vector), position the crossmark and click to anchor the point. Measurement results display at the upper left of the Workspace.
Make an area measurement	1. Click the **Area** button. 2. Position the crossmark at the starting point and click to anchor the point. 3. For each subsequent point, position the crossmark and click to anchor the point. 4. Position the cursor on the end point and press **SET**. Measurement results display at the upper left of the Workspace. 5. To insert points on the area spline, position the cursor between two points and click to anchor the point.
Make a curve length measurement	1. Select the **Curve** button. 2. Position the crossmark at the starting point and click to anchor the point. 3. For each subsequent point, position the crossmark and click to anchor the point. 4. Double-click **SET** to complete the measurement. Measurement results display at the upper left of the Workspace. 5. To insert points on the curve, position the crossmark between two points and click to anchor the point.
Edit a measurement	1. Position the cursor over a point or end point on the measured line. 2. Drag the point or end point in the required direction. 3. To delete the measurement, select it and click **Delete**.
Delete all measurements	▪ Click **Delete**.

Viewing Measurements

- To view the measurement report, press **Report**.

Exporting Measurements

To export measurements:

1. Click the **Export Measurements** button.

   The system displays a dialog box.

2. Enter a file name in the dialog box and then click **OK**.

   The exported file (.csv) contains numerical data automatically calculated by the system. This data describes different spatial objects (closure line, mitral annulus), automatically calculated values, and your original measurements. You can use this data for further numerical and statistical evaluations.